

World Bank Group-LinkedIn Data Insights: Jobs, Skills and Migration Trends

Methodology & Validation Results¹

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Abbreviations

AI	- Artificial Intelligence
BLS	- Bureau of Labor Statistics (USA)
CEDEFOP	- European Center for the Development of Vocational Training
ESCO	- European Skills/Competences, qualifications and Occupations
GNI	- Gross National Income
IDI	- ICT Development Index
ILO	- International Labor Organization
ILOSTAT	- International Labor Organization Statistics
ISIC	- International Standard Industrial Classification
I2D2	- International Income Distribution Data Set
LI	- LinkedIn
LMI	- Labor Market Information
LQ	- Location Quotient
ML	- Machine Learning
NAICS	- North American Industry Classification System
OECD	- Organization for Economic Co-operation and Development
PIAAC	- The Program for the International Assessment of Adult Competencies
WBG	- World Bank Group
ECA	- Europe and Central Asia
EAP	- East Asia and Pacific
LAC	- Latin America and the Caribbean
MENA	- Middle East and North Africa
NA	- North America
O*NET	- Occupational Information Network
SA	- South Asia
SSA	- Sub Saharan Africa
VA	- Value Added

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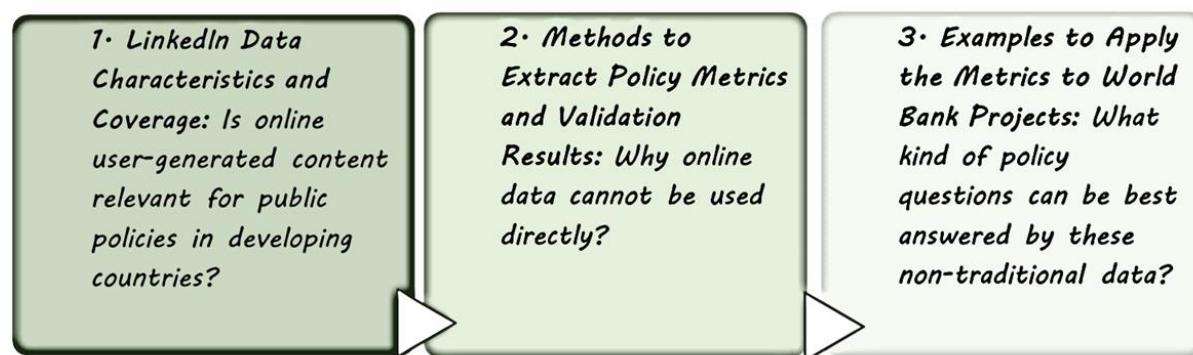
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Executive Summary

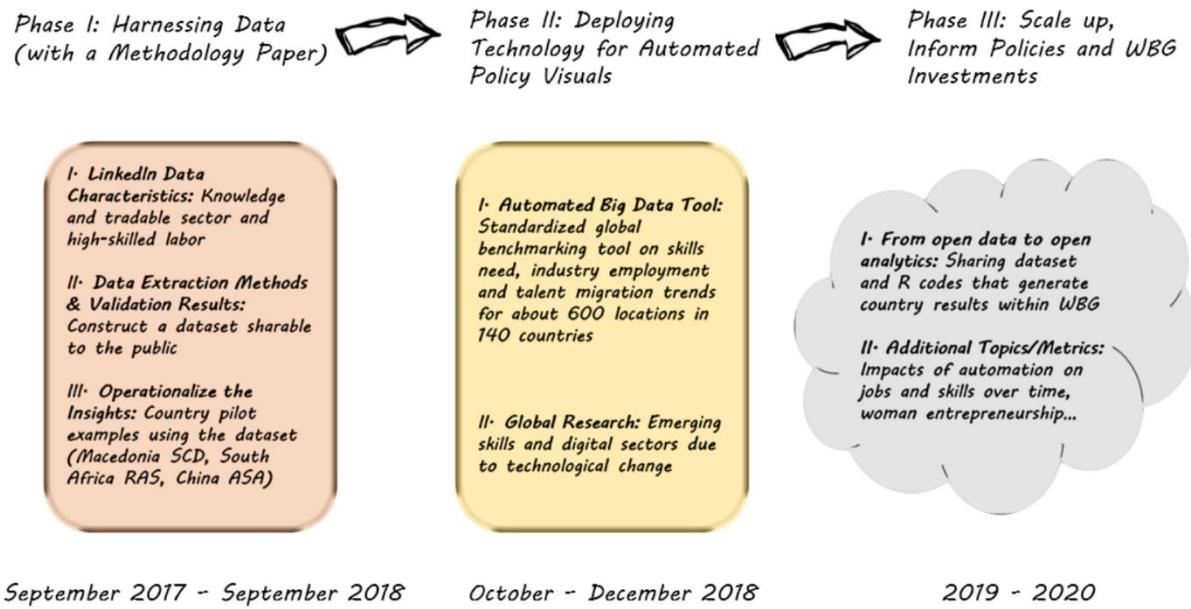
This methodology paper has three objectives: 1) describing LinkedIn data characteristics and representativeness worldwide; 2) outlining the methods used to extract policy metrics from LinkedIn raw data and the validation results of these methods when compared with other data sources; and 3) showcasing some analytical and visualization examples on how these metrics can be used to inform policy-making in areas such as fostering emerging (digital) sectors to create economic growth, upskilling and reskilling the workforce for jobs, talent attraction and retention. These visuals will be automated into a dashboard hosted at a World Bank website. The first phase of the LinkedIn metrics that will be shared with the World Bank Group covers 140 countries and hundreds of cities that have at least 100,000 LinkedIn members, distributed across 148 industries and 35,000 skills categories.

Figure 0-1 Three Objectives of the Methodology Note



This methodology note will be updated as more metrics and validation results become available. As new development opportunities emerge especially in the digital space across the globe, WBG is seeking new data sources that can capture the latest development trends. Often time, traditional government surveys cannot keep up with this demand. Making LinkedIn real time data available for development use, especially in developing countries can be useful for policy-makers. However, since this is the first time that a non-traditional dataset is shared by LinkedIn with a third-party organization as a public good (i.e. strictly non-remunerative), it is important that we make these methodology and validation results available so that researchers and policy-makers can build on this initial effort by the WBG and LinkedIn. Because of the granularity and sheer amount of user-generated data, the industry and skills classifications that LinkedIn taxonomy is using are not standard and cannot be easily conformed to commonly used standards such as ISIC, ESCO and O*NET. Part of the effort of this methodology paper is to match LinkedIn taxonomy to these international standards to allow for easier matching LinkedIn data with external datasets for further analysis (see External vs. LinkedIn Data Matching Methodology Appendix for matching details). This paper is intended to be a living and breathing document and will be updated when new metrics and validation results become available in later phases of the WBG-LinkedIn partnership (road map of the collaboration is shown below, and this paper in its current form falls into phase I).

Figure 0-2 WBG-LinkedIn Collaboration Roadmap

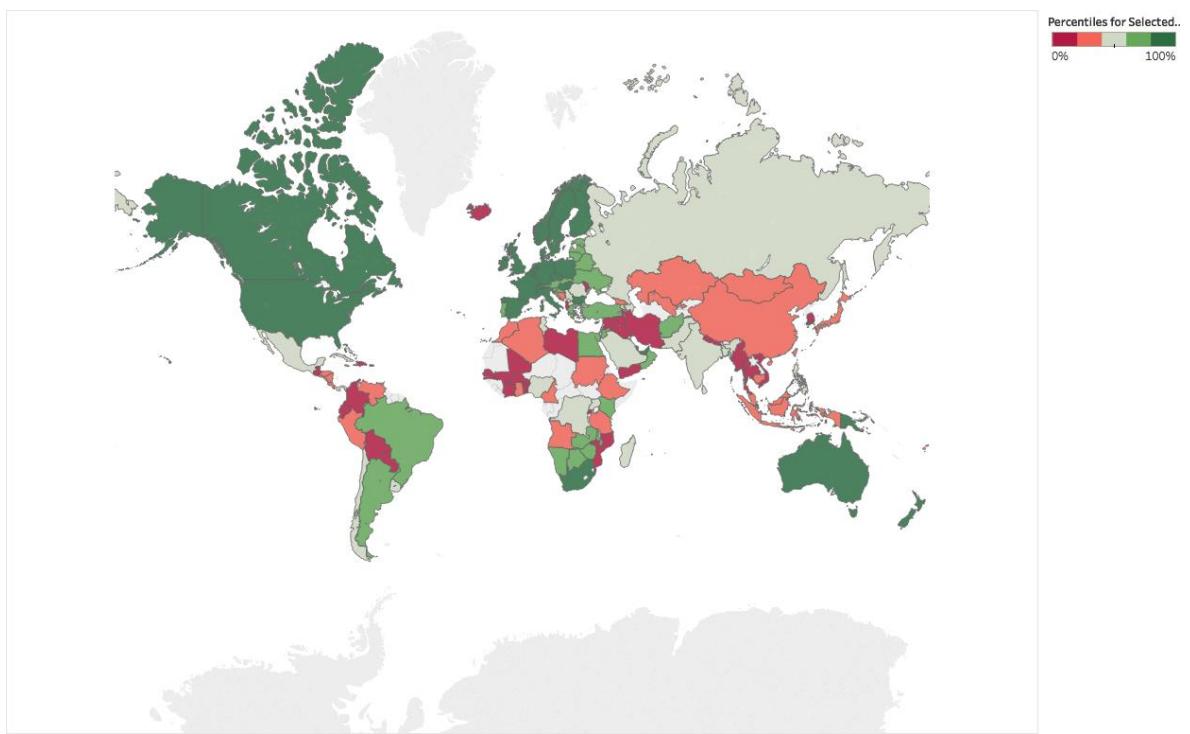


After comparing LinkedIn data with 23 other data sources², LinkedIn data is best at representing skilled labor in the knowledge, digital and tradable sectors, and can shed light on pivotal topics such as the impacts of rising automation and job displacement that are not easily captured in traditional data sources. While one probably suspects that LinkedIn has better membership coverage in developed countries versus developing countries (Figure 0-3), there are certain knowledge and tradable sectors, such as information & communication, professional, scientific & technical activities, financial & business services, arts & entertainment, mining and quarrying³ industries that have good LinkedIn coverage *globally* (Figure 0-4). This allows for benchmarking performance across locations globally in these six sectors. In addition to sectoral skewness, young skilled labor with at least a bachelor's degree are more likely to be on LinkedIn and women disproportionately are more likely to be captured by LinkedIn than national statistics as well. In general, while LinkedIn data is not a representative sample of the entire economy and is self-reported data, it can uniquely capture segments of the economy that are among the most innovative, dynamic, and high-value add. Besides, since this data is updated more frequently than traditional government statistics, it has the unique ability to capture the latest employment and industry skills trends that are often missed by government statistics - especially as related to digital sectors and disruptive technology.

² See Table II-2 & Appendix I (Migration), Table II-3 (Skills), and Table III-1 (Industry Employment) for all the external data sources evaluated by the team.

³ The strong LinkedIn coverage of the mining and quarrying sector is partially due to companies on LinkedIn incorrectly identifying themselves as Oil and Energy companies than Utilities (hence misclassified into ISIC sector B instead of D). An example of this is EDF Energy in the United Kingdom. See section II-C-1 (Industry Coverage Globally).

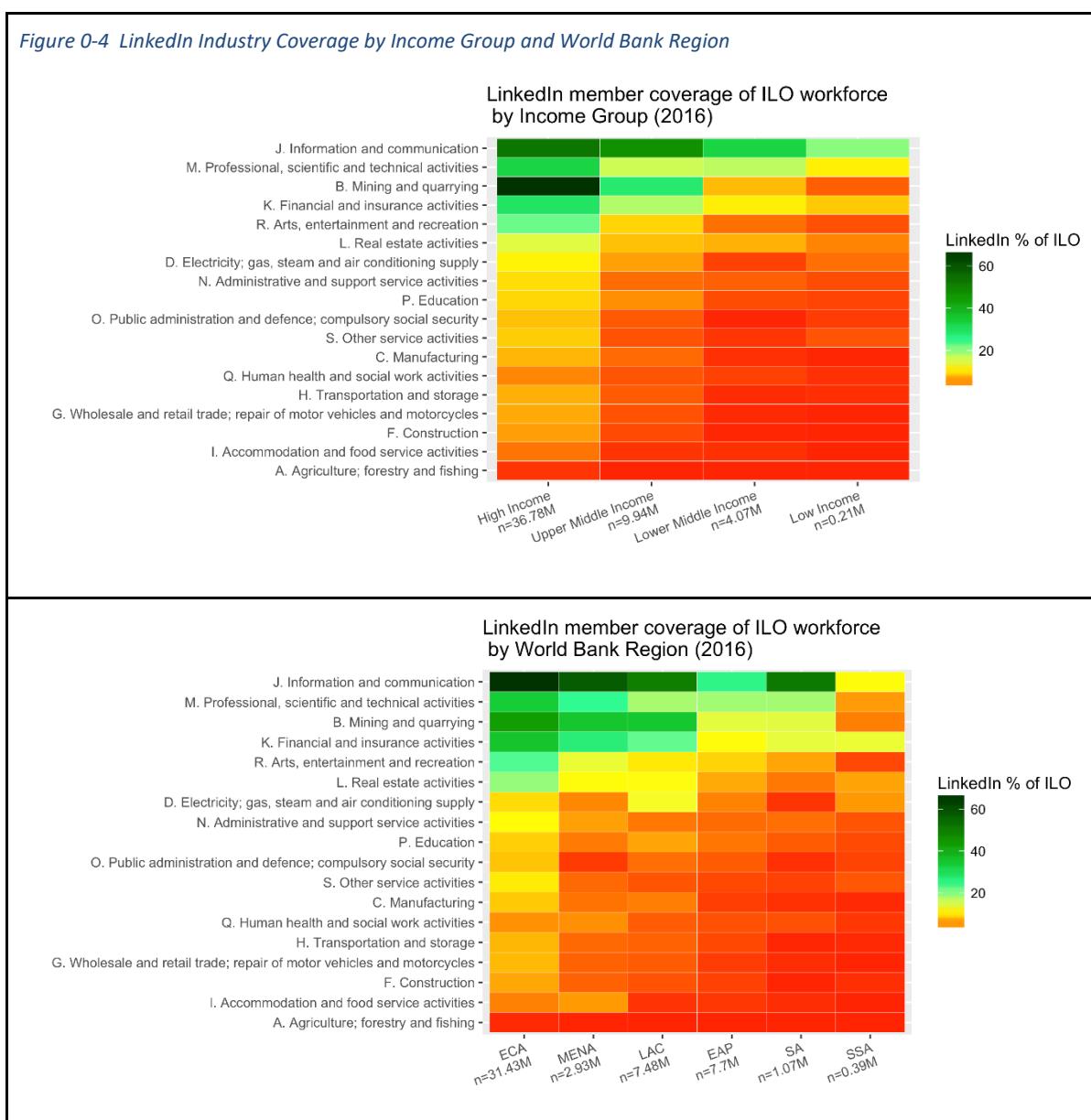
Figure 0-3 LinkedIn Membership Penetration



Note: The penetration rate is calculated by LinkedIn member as a proportion of the total workforce size plus students in that country.

Source: LinkedIn Corporation

Figure 0-4 LinkedIn Industry Coverage by Income Group and World Bank Region



Note: See Section III.C for more information on LinkedIn industry representativeness

Source: WBG using LinkedIn and ILO Data in 92 countries

Three categories of metrics are made available for WBG to access in the first phase of this partnership: Industry employment, skills, and talent migration. The project team experimented different data extraction methods to derive these metrics from LinkedIn member profiles. Since there is heterogeneous user behavior across countries (e.g. user over-reporting work experience; not updating profile of unemployment; LinkedIn membership growing exponentially in developing countries and hence the data might capture LinkedIn business growth instead of industry headcount growth), in addition to conducting validation against other data sources, we use statistical methods to normalize and standardize metrics to ensure they can be compared fairly across countries and industries. For example, we normalize most metrics by LinkedIn membership size in each country so that countries with greater numbers of workers on LinkedIn do not artificially rank higher. Details of metric methodologies and our confidence levels for each are reported in Table 0-1.

Table 0-1 Summary of Metrics: Methodology and Validation Results

Metric Name	Method to Derive the Metrics ⁴	Confidence Level* H, M, L (reasons)
1) Industry Employment		
Industry Employment Location Quotient	<p>For a given country c, industry i, and time t,</p> $\text{Industry } LQ_{c,i,t} = \frac{\text{industry size}_{c,i,t}}{\text{average industry size of all countries in country } c's \text{ income group}_{i,t}}$ <p>where industry size is measured as a relative term:</p> $\text{Industry Size}_{c,i,t} = \frac{\text{member count}_{c,i,t}}{\text{member count}_{c,t}}$	H (good global coverage, good validation results)
Industry Employment Growth ⁵	<p>Growth is given as rate of employment level change (e.g. 2015-2017), for country c, and industry i,</p> $\text{Industry Growth}_{c,i} = \frac{\text{member count}_{c,i,t+1} - \text{member count}_{c,i,t}}{\text{member count}_{c,i,t}} * 100$	M (good global coverage, good validation results but external data source only covers specific countries)
2) Industry Skills Needs		
Industry Skills Needs	<p>For each country, the importance of each skill i in industry j is given by the weight (w_{ij}) as:</p> $w_{ij} = m_{ij} * \ln\left(\frac{N}{n_i}\right)$ <p>where m_{ij} indicates the number of members in industry j having skill i, N is the total number of industries and n_i represents the total number of industries having skill i. The first term gives bigger weight to skills that have high membership penetration while the second term downweight “common” skills that appear in all industries, e.g. Microsoft Office. In this sense, the most important skills for each industry are ones that have high member penetration but also are unique.</p>	M (good global coverage for knowledge and tradable sectors, good validation results but external data source only covers specific countries)
3) Talent Migration		
Inter and Intra-country talent Migration	<p>Given as net migration, where country a is the country of interest, and country b is the source/destination of inflows/outflows, at time t,</p> $\text{Net Migration}_{a,b,t} = \frac{\text{net flows}_{a,b,t}}{\text{member count}_{a,t}} * 10,000$	H (good global coverage for knowledge and tradable sectors, good validation results)

⁴ All metrics at the city level are calculated in the same manner as at the country level, except for Industry LQ, since we do not have city level income for calculation, instead we use country average for the denominator -- how a city compares with its own country average.

⁵ Due to rapid LinkedIn membership growth across the globe, the team constructs a balanced panel data to isolate LinkedIn membership growth from industry employment growth. This effectively means the growth rate captured here is an employment transition rate among experienced hires who hold jobs on LinkedIn across years. For details, see Section IV-A-2).

Migration – Industries Gained/ Loss	<p>Given as net migration, where country a is the country of interest, and country b is the source/destination of inflows/outflows, a talent moving from industry i to industry j (<i>note i and j can be the same</i>), at time t,</p> $\text{Net Industry Migration}_{a,b,i,j,t} = \frac{\text{net flows}_{a,b,i,j,t}}{\text{net migration}_{a,b,t}}$ <p>(This formula is used to calculate the top gaining and losing industries associated with the talent migration flows.)</p>	L (good global migration data for knowledge and tradable sectors, but migration industry movements have no comparable global external data for validation)
Migration – Skills Gained/ Loss	<p>Given as net migration, where country a is the country of interest, and country b is the source/destination of inflows/outflows, both considered for a given skill s, at time t,</p> $\text{Net Skill Migration}_{a_s,b_s,t} = \frac{\text{net skill flows}_{a_s,b_s,t}}{\text{member skill count}_{a_s,t}}$ <p>(This formula is used to calculate the top gaining and losing skills associated with the talent migration flows.)</p>	L (good global migration data for knowledge and tradable sectors, but skills migration has no comparable global external data for validation)

*Note: Confidence level is evaluated against two criteria: 1) global coverage (H: good for global, M: good only for certain sectors, L: limited coverage at the moment but expected to be improved over time as LinkedIn membership continues to grow and diversify and hence it is worthwhile to be included in the dataset and dashboard), 2) validation results against other independent data sources (H: highly positively correlated against various government or international organization data sources, M: highly positively correlated against one other source that has data on a specific region or country only, L: to the best effort by the project team, there is no comparable dataset for validation⁶).

Table 0-2 Sample Policy Questions Using LinkedIn Metrics

Metric Name	Sample Policy Questions
1) Industry employment	
Industry Employment Location Quotient	Which industries are more concentrated in my country/city, compared with an average country in the same income group?
Industry Employment Growth	What are the most recent employment growth trends in my countries/cities, especially in knowledge and tradable sectors?
2) Industry Skills Needs	
Industry Skills Needs	To nurture the industry I am interested in, what are the latest and most important skills in this industry?
3) Talent Migration	
Inter and Intra-Country Talent Migration	Am I (net) losing talent? Which countries do I compete for talent?
Migration – Industries gained/ loss	To which industries these talents are moving to?
Migration – Skills gained/ loss	What skills are gained or lost associated with the talent migration?

⁶ Note that this last point also demonstrates the value of LinkedIn data in that it expands the available information on the topic at hand and can be a complementary to traditional survey or administrative data.

Based on feedbacks from three World Bank pilot projects in South Africa, Macedonia and China, a list of sample policy questions that LinkedIn metrics can answer are listed in Table 0-2. In addition to descriptive trends, another useful application of the LinkedIn metrics is to do cross tabulation analysis across the three categories of metrics. For example, to nurture certain growing industries, one can further explore what are the skills needs or whether there is a risk of talent outflow. Furthermore, to conduct analytical and empirical research, the datasets are structured in ways that can be merged with external data sources easily. For instance, since all the LinkedIn data on industries that are made available through this partnership are at the equivalence of 2 to 3 digit ISIC level, and the project team has mapped these LinkedIn industry classifications against ISIC Rev. 4 standards, merging industry employment and skills in-demand data with economic census, such as wage and productivity data can be extremely helpful to understand private sector growth and the productivity and human capital components in explaining the growth.

To further demonstrate how the above metrics can be used to inform policies in World Bank projects, we provide some sample visualization outputs in this paper. One of them is the top growing and declining sectors globally in 140 countries. Emerging sectors, such as “Renewables and Environment” and “Internet” are registering rapid employment growth in the past three years, while “Newspaper” and “Outsourcing” industries are in the decline across all income groups. This type of insights can be generalized across WB regions or zoom into a particular country as well (see Section VI of this paper: Sample Visualization Outputs).

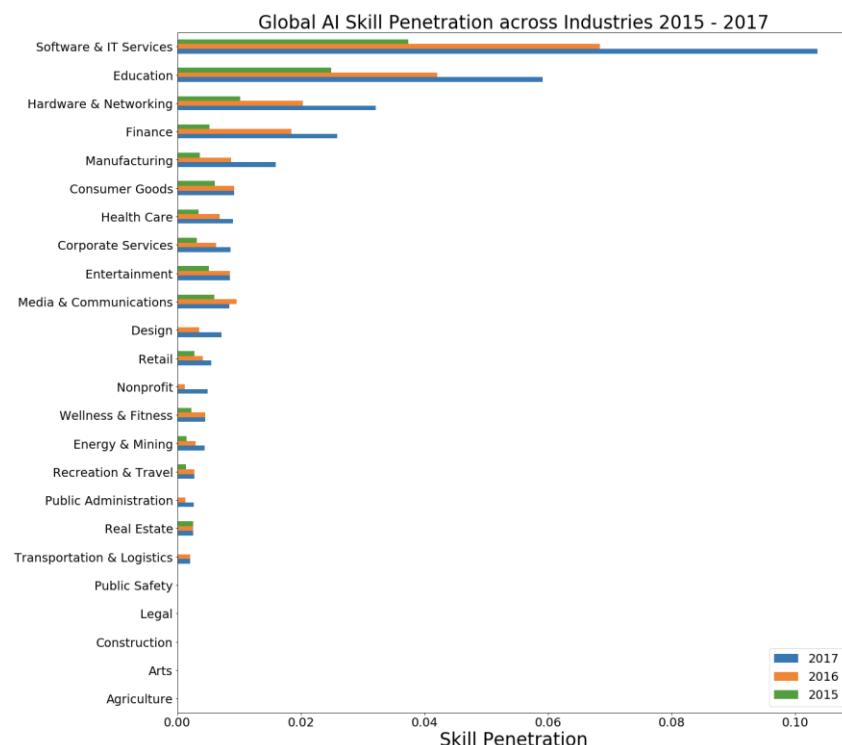
Figure 0-5 Industry Employment Growth, Global Average 2014-2017

Industry Growth, Global Avg Across Countries, Dec 2014-Dec 2017, by Income

Isic Section	Isic Section Name	LinkedIn Industry	High Income	Upper Middle Income	Lower Middle Income	Low Income
B	Mining and quarrying	mining & metals oil & energy	-2.9% -3.6%	0.8% -1.5%	-2.0% -1.5%	0.3% -1.9%
C	Manufacture	renewables and environment aviation and aerospace industrial automation pharmaceuticals plastics automotive glass, ceramics and concrete packaging and containers machinery shipbuilding chemicals paper & forest products textiles food production electrical and electronic manufacturing railroad manufacture printing	4.1% 3.6% 3.1% 3.0% 2.5% 2.4% 2.4% 2.0% 1.5% 0.9% 0.8% 0.6% 0.2% -0.2% -1.1% -1.5% -2.3%	5.1% 3.6% -0.6% 2.6% 2.1% -0.2% 1.6% 3.6% 0.6% 1.0% 3.5% -0.1% 0.0% 1.6% 0.6% -7.6% -3.8%	3.9% 1.2% 0.4% 0.0% 1.9% 0.6% -2.6% 1.5% -0.5% -4.8% 0.4% 3.2% 0.8% 1.6% 0.2% 12.4% -1.6%	-2.8% 2.0% -0.9% -1.1% -0.8% -0.9% -6.9% -1.7% -0.4% 2.0% 0.3%
J	Information and communication	computer and network security internet writing and editing computer software wireless computer games computer networking computer hardware online media information technology and services motion pictures and film semiconductors media production broadcast media telecommunications publishing newspapers	12.9% 10.3% 8.0% 4.2% 3.8% 1.1% 0.6% 0.3% 0.2% -0.3% -0.5% -1.2% -1.7% -2.7% -4.2% -4.3% -8.0%	4.9% 7.9% 8.4% 4.6% -1.2% -0.6% 0.8% -2.1% 3.5% 1.7% 0.2% -1.9% -0.4% -2.1% -2.8% -2.4% -7.7%	0.0% 6.1% 6.7% 1.0% -2.0% -3.2% 0.8% -0.1% 1.0% 1.0% 4.0% -6.6% 0.4% -2.4% -1.8% -2.2% -5.5%	-1.0% 0.6% 2.1% -0.5% -7.1% 0.9% 0.4% 0.1% -1.3% -1.6% -0.1% -0.6%
K	Financial and insurance activities	venture capital and private equity investment management capital markets financial services insurance banking investment banking	15.6% 8.3% 3.5% 2.7% 2.5% 0.4% -2.7%	12.9% 3.8% 6.0% 1.9% 1.1% -1.2% 5.9%	10.7% 3.6% 2.2% 3.6% 2.5% -0.4% 0.3%	-7.7% -0.1% 2.0% 2.5% 0.3% -16.4%
M	Professional, scientific and technical activities	biotechnology alternative dispute resolution executive office veterinary management consulting professional training & coaching design nanotechnology architecture & planning graphic design information services environmental services photography legal services translation and localization marketing and advertising mechanical or industrial engineering law practice public relations and communications events services accounting research market research outsourcing/offshoring	8.1% 6.8% 6.2% 3.1% 2.9% 2.0% 1.8% 1.8% 1.4% 1.4% 1.3% 1.0% 0.9% 0.8% 0.8% 0.1% -0.2% -1.6% -3.0% -3.0% -4.4% -5.1% -7.5% -11.9%	4.9% 6.3% 3.6% 0.6% 3.0% 3.0% -0.4% -2.5% 0.3% 0.3% 0.5% 0.1% 1.0% 0.3% 1.8% -0.1% -0.2% -1.9% -2.1% -0.8% -5.1% -5.2% -2.4%	1.1% 2.7% 1.5% -0.5% 2.3% 1.5% 0.3% 0.9% 1.2% 0.3% 0.6% 0.2% 0.8% 0.6% 3.7% 1.3% -1.1% -1.7% -0.4% -0.1% -4.3% -1.5% -4.5% -5.5%	-1.8% 2.6% 1.6% 1.4% 0.3% -1.4% 0.0% -2.1% -1.4% -2.5% -1.1% -2.4% -0.1% 1.0% -1.1% -2.5% 1.7% -5.8% -2.4% -7.7% -4.6%
R	Arts, entertainment and recreation	gambling & casinos animation health, wellness and fitness fine art arts and crafts entertainment sports music libraries performing arts museums and institutions	8.3% 6.6% 3.9% 1.0% 0.9% 0.0% -0.2% -0.5% -0.5% -1.2% -1.7% -1.7%	1.5% 6.2% 2.9% 0.9% 1.5% -1.7% 1.0% 0.0% 1.1% -1.0% -2.6% -2.6%	10.2% 5.1% 2.0% 0.0% 1.6% 0.1% 0.4% 0.8% -0.3% -2.2% 1.7%	1.5% 2.5% 1.9% 0.4% 2.1%
			0.00%	0.00%	0.00%	0.00%
			Avg. growth	Avg. growth	Avg. growth	Avg. growth

Another key value added of the LinkedIn metrics lie in the “emerging” new skills and industries that cannot be easily picked up by official statistics. LinkedIn’s skill metrics allows the World Bank to measure how new technologies - like Artificial Intelligence - are spreading across industries and changing labor markets around the globe. For example, Artificial Intelligence (AI) skills are among the fastest-growing skills on LinkedIn, and saw a 190% increase from 2015 to 2017 across all industries.

Figure 0-6 Global AI Skill Penetration 2015-2017



This round of technological advancement (aka Industry 4.0) seems more pervasive and is being transmitted to developing countries faster than the previous waves. Across the globe, we can see disruptive technology skills start appearing in many developing countries in the past three years. However, typically “human” skills -- e.g., those related to socio-behavioural characteristics, interpersonal communication and cognitive skills—are also on the rise.

Figure 0-7 Top Rising Skills in Importance Globally 2015-2017

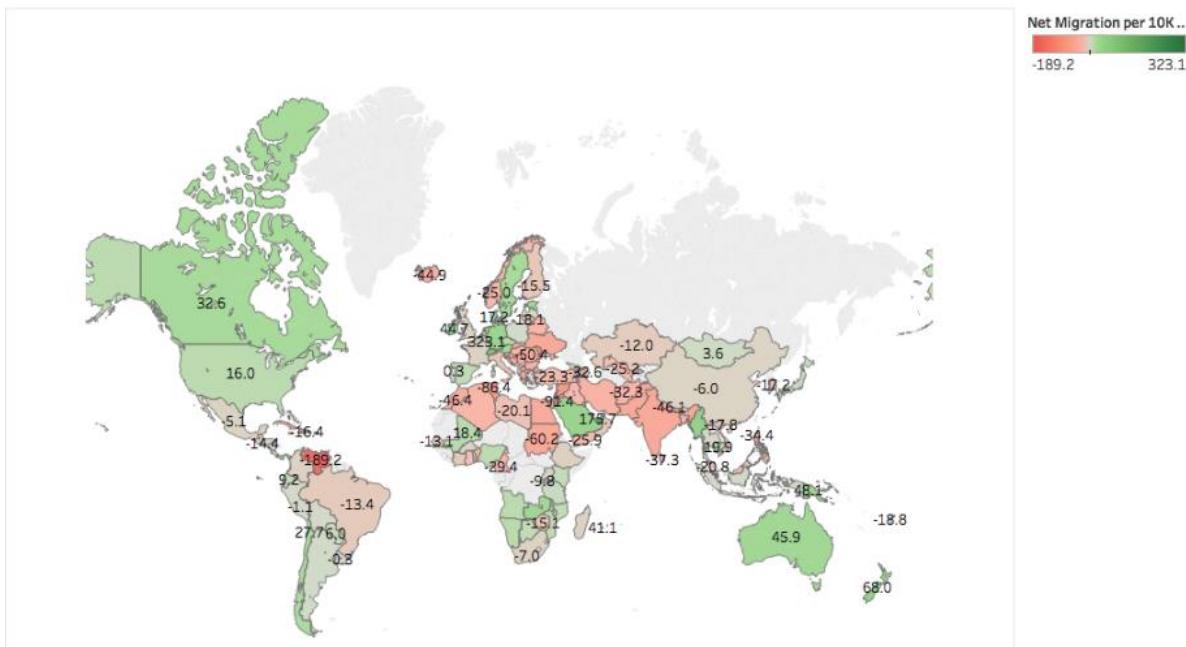
Top Skills Groups Rising in Importance Globally, Across All Industries & Occupations 2015-2017

1	Leadership	6	Web Development
2	Digital Literacy	7	People Management
3	Oral Communication	8	Time Management
4	Business Management	9	Project Management
5	Development Tools	10	Data Science

* Out of 86 skill groups that rose, Artificial Intelligence ranked 34th in terms of having the biggest rise

Near-real-time global talent migration trends can also be captured through LinkedIn data to allow developing country policy-makers assess the health of its country's talent pipeline. As shown in Figure 0-8, MENA, LAC and SAR regions see the biggest talent loss in recent years, while OECD countries, such as Australia, New Zealand, Canada, and the US are still the biggest talent destination countries.

Figure 0-8 Global Talent Migration 2015-2017



All the visuals will be automated and updated regularly⁷ until June 2020 under this 3-year WBG-LinkedIn partnership on: www.worldbank.org/linkedin⁸. The underlying dataset as well as other resources that are helpful for policy-makers around the world will also be updated and made available for free at the same URL as a public good. Subject to demand and user feedbacks, more metrics can be added later.

⁷ There will be a minimum of an annual refresh by LinkedIn. The online visuals can be updated more frequently if there is strong user demand.

⁸ Final URL to be confirmed

I. Introduction

The objectives of this methodology paper is to document: 1) LinkedIn data characteristics worldwide in terms of age, gender, industry and skills distribution; 2) the methodology and assumptions that go into developing the LinkedIn datasets that are shared with the World Bank by LinkedIn Corporation, and our best attempt to compare these LinkedIn metrics against other government administrative and survey data; and 3) Sample analytical and visual examples using these metrics to answer policy questions related to industry growth, skills gap, and talent attraction and retention.

A. Using Big Data for Policy Research

The use of web-based data for economic analysis, has seen considerable research interest in recent years (Antenucci et al 2014; Askitas and Zimmermann 2009, 2015; Chancellor and Counts 2018; Kuhn and Mansour 2014; Guerrero and Lopez, 2017; Tambe 2014). In particular the papers by Tambe (2014) and Antenucci et al (2014) consider labor markets and how big data-driven research may facilitate policy making and correlate with so called “on the ground” indicators. In general, research in this field has been focusing on extracting a limited number of metrics in selected countries to answer specific research questions. This WB-LinkedIn dashboard and the underlying dataset covers hundreds of locations worldwide at scale and allows for benchmarking for policy-makers.

Data projects of this nature are often referred to as Labor Market Information (LMI)-based, and heavily rely on the type and availability of data. A handful of private companies and organizations have pursued an ambitious domestic and limited global dimension of such projects, primarily from US perspectives. Unsurprisingly often relying on web-based data, groups pursuing these projects include Burning Glass, Wanted Analytics, Glassdoor and Career Builder. These organizations primarily aggregate various sources of online data on employment. Glassdoor and Career Builder are online companies with their own proprietary job posting data, that have either acquired external economic research arms or created inhouse research teams to analyze their data. Or in other cases, where private firms share data with international organizations to analyze job postings, such as recent paper on job postings in India by the World Bank (Nomura et al, 2018).

The richness of LinkedIn data, ranging from skills to migration, available on a granular level, arguably exceeds the scope of the above projects. Furthermore, the initiatives mentioned above almost solely rely on job posting data, while LinkedIn takes advantage of detailed member profiles as well as job postings/hires on the platform. In fact, a 2016 publication by RTI International, discusses the above projects and defines general limitations of LMI by 1) Timeliness of data, 2) Accuracy of surveys/questionnaires, 3) Capacity to conduct analysis, 4) Integration of various data sources, 5) Usage by non-government agencies (accessibility to data), and 6) Cost of acquiring data (Johnson, 2016). The LinkedIn data itself as well as the joint World Bank Group - LinkedIn collaboration address each of the previous six points. As will be discussed in detail in this paper, LinkedIn data allows for near-real-time updates for metrics. Furthermore, LinkedIn facilitates comparisons across countries (or cities/regions) through having a single data structure and taxonomy. Finally, the aim of the collaboration is

to offer a public good in the form of a transparent, publicly-accessible dashboard presenting insights as well as the underlying datasets.

The rising interest in utilizing Big Data⁹ for informing far-ranging societal questions in a wide array of disciplines comes with tremendous insights, but also marks a shift in quantitative and qualitative analysis. This shift is described by Tufekci (2014), where the author calls for a close inspection of this “dramatic leap” in analysis and the respective methodologies and interpretations. The 2014 paper primarily addresses concerns over bias found in big data from a single given social network/platform (such as Twitter). Similarly, to the use of LinkedIn data, where one structure and platform is used to derive insights, one must openly address and measure the inherent bias found in the user-base and interaction of users with the platform. Other research on the use of big data questions the use of traditional statistical techniques, where statistical significance (for example) may be inapplicable to data sets on the scale of big data (Gandomi et al, 2015). The authors continue on to address concerns of data heterogeneity, noise accumulation and spurious correlation. LinkedIn metrics as well as validation exercises presented in this paper occur at *aggregate* levels of country-industry-skills pairs. Thus, while concerns on excessively large samples for correlation (i.e. dimensionality) are not a big concern, thought should be given to concerns over heterogeneity arising from many individual members as well as noise accumulation. Another paper on the use of big data for health care warns of identifying patterns where none actually exist due to the complex nature of data connections (European Commission Directorate General for Health and Consumers, 2014).

LinkedIn data fits the big data description above and moves beyond it on a variety of levels. LinkedIn data not only allows for comparison across diverse geographic regions (140 countries, and hundreds of cities) in the form of one unified structure and comparable data points, but is also updated in “real time” by users. The importance of frequently updated data is emphasized in a 2018 paper by authors Aslett and Abott, stating that the “time value of data is a significant driver for Pervasive Intelligence.” In this sense, LinkedIn offers an unconventional source of labor market data in that it describes the latest employment and skills trends as motivated by “on the ground” sentiments in the labor force. More precisely, all data is provided voluntarily and from the perspective of what the labor force views as most relevant. Naturally, as with all data collection methodologies, the paradigm of a double-edged sword emerges. Can user-generated inputs be trusted? Can they be aggregated in a meaningful way? May a relevant and applicable economic message be derived from the “noise”? And although unique, are LinkedIn insights in line with trusted measures of the labor market? These are important questions, vital for identifying where LinkedIn data is most valuable and how it should be positioned to derive the greatest impact

⁹ What is Big Data? The term Big Data has been widely used in recent years, often referring to exceedingly large datasets composed of granular data derived from a variety of sources. Most commonly such sources include social media networks, sensors and measurement instruments, customer databases from private companies (for example purchase and transactional data) and of course survey or government census data. The latter of which is rarely mentioned in Big Data discussions, yet it has been around for many years and more recently readily accessible to nearly any individual. Additionally, the skills and technology to process such data is also more readily available to the majority of the population. As a result, one may wonder what differentiates the popular new terminology of Big Data from previous iterations of relational databases covering topics on demographics and socio-economic factors in the population. Boyde et al (2012), state that Big Data is defined by the analyst’s ability to “search, aggregate, and cross reference” between various sources rather than a reference to a dataset of considerable size.

on policy decisions. It is the purpose of this paper to address these unknowns and to better understand the data strengths and limitations, hence informing the interpretation of results.

B. Quality Control and Limitations of LinkedIn Data

Prior to analyzing bias, we impose a number of basic rules on the data. First, spam and other inactive profiles are removed from the sample to only include active LinkedIn members¹⁰. Second, each data set is filtered to display an aggregated number with at least 50 observations per the most granular observation. For example, for a given skill within a given industry and city to be displayed in the dataset, it must have at least 50 members reporting the skill on their LinkedIn profile. This rule is consistent across all data sets and is imposed to ensure the accuracy and privacy of user data. Such procedures are increasingly important in Big Data, emphasized and referred to as “data forensics” in the 2015 paper on use of big data in economics (Horton et al, 2015). Lastly, in the industry employment related metrics, instead of using a member’s self-reported industry, we use the company that the member works in and which industry the company reports that it belongs to on LinkedIn. This dramatically shrinks the sample size as not every company has a profile on LinkedIn and reports which industry it belongs to. Nonetheless, imposing this filter helps increase the accuracy of industry employment data as members can have different understanding on which industry the company is in, based on their position, experience, and daily work routine.

After these rules are imposed, the remaining sources of bias and limitations of LinkedIn data center on 1) varied LinkedIn usage/uptake among countries, 2) Industry Bias, and 3) Occupation Bias. The first issue of varied LinkedIn usage is generally addressed by normalizing against total country LinkedIn membership or other totals or averages. Nonetheless, varied usage patterns may take other forms, such as different propensities to include skills or sharing work experience between cultures and regions¹¹. The second issue -- industry bias, where certain industries (in particular knowledge and tradable sectors¹²) account for the majority of LinkedIn membership, is addressed through including only these better represented sectors for global benchmarking and cross-country analyses. Rather than blur the data through the use of weights derived from government and official statistics, the approach taken for country-level metrics in this methodology note is to show unmanipulated LinkedIn results with the caveat of using only a truncated dataset to show the better represented sectors only (Figure III-7). Finally, the third bias regarding occupations adds an additional layer to the two previously discussed. Given a defined industry bias, each industry may be biased by the type of occupation most represented on LinkedIn in this industry in a country. In fact, some industry bias is driven by occupational bias on LinkedIn where, for example, an industry such as Financial Services is composed mostly of white collar management and analyst positions - occupations that are well represented on LinkedIn. On the other hand, within the Agriculture sector, management,

¹⁰ Profiles which logged in within the past 12 months, as well as basic section filled out such as: skills, work histories, and education.

¹¹ To decrease the bias due to different usage pattern across countries, especially whether certain culture, race, or gender tend to over-report or under-report their job duties and experience, we include standardized taxonomy on job titles and skills, school and degree names, company-reported industries for this dataset, instead of trying to infer members’ work and education experience from their profiles’ detailed descriptions.

¹² ISIC 4 sections J. Information and communication, M. Professional, scientific, and technical activities, & K. Finance and insurance activities.

analysts and economists make up a lesser degree of the occupational pool - resulting in low LinkedIn representation of this sector (on average) and capturing only a segment of the workforce in the Agriculture sector. Naturally, a strength emerges in that LinkedIn offers strong representation in various industries for given occupations, e.g. IT workers working in various industries, not just in Information and Technology industry¹³.

An additional dimension of bias centers around skills and how they are extracted from member profiles on LinkedIn. This analysis only uses self-reported skills data. Hence, skills presented on profiles are included out of self-interest for a desired position, or tailored to a desired work location not necessarily the location where the user resides at any given moment. This leads to the matter of when skills are added, as in many cases a user may include skills during the initial completion of their profile and fail to update them as they move to different locations and positions. Finally, a user may have multiple skills, hence measures must be given as relative and a count value of total skills (including skills within a given skill category) may not be interpreted as representative of a given number of individuals.

In sum, LinkedIn is self-reported, and subject to the typical issues with these types of data: non-random sample of users of LinkedIn, i.e. those that are familiar with internet and with basic digital literacy will more likely to use LinkedIn; those that want to network and promote themselves professionally will likely have a LinkedIn profile and keep the profile updated; those that just lost their jobs are unlikely to update their LinkedIn profile saying they are unemployed; there might be some inflation of skills possessed by members, especially this can differ across different cultures and gender (e.g. we find that women tend to have shorter job description which in itself is an interesting finding). We deploy different strategies to address these problems when deriving the methodology for metrics from LinkedIn's raw data, and we do our best efforts to show the pros and cons of each methodology and explain why we choose one over another in the end. It is important that researchers keep in mind these limitations when they interpret results using LinkedIn data.

C. Innovative Applications of LinkedIn Data

In concrete terms, LinkedIn may not only complement the existing labor force data but also serve as a leading force in measuring issues pivotal to today's economic landscape, such as the digital economy, rising automation and job displacement. Due to LinkedIn's unique strength in capturing the latest emerging skills and digital tech-enabled jobs, the platform is well suited to measure emerging trends of changes in most important skills and job composition in specific industries due to automation (and can potentially be scaled to measuring the impact of other disruptive technologies). Some of the analytical visuals in Section V provide examples on this topic.

¹³ One should note that these relationships should be regarded as a hypothesis until a systematic validation on occupations is conducted in future research.

D. Overview of WBG-LinkedIn Partnership and Data Update plan

The WBG-LinkedIn partnership contributes to a wider World Bank Group initiative using digital platform data (private and public) to improve WBG's understanding on market efficiency, social inclusiveness, and environmental sustainability. These objectives are supported through strategic partnerships such as with leaders in digital tourism, use of blockchain technology in global value chains, and digital skills/sector development. The LinkedIn collaboration addresses the latter of the three research objective tiers with a focus on the digital economy and skill trends. By leveraging the World Banks Group's institutional knowledge and expertise, LinkedIn data is harnessed to generate actionable insights for pressing economic challenges in the rapidly changing economic landscape.

This is the first year of a 3-year collaboration MoU signed between the World Bank Group and LinkedIn Corporation. When more derived metrics in other topics of interest become available, they will be added and the validation results will be updated in this paper. Same goes for validation results for the existing metrics. As we have access to more comparable global datasets around topics related to skills, industry employment and migration for validation later on, we will keep improving this note. In sum, we intend to keep this document as a living document that tracks our latest efforts in extracting, cleaning and validating LinkedIn metrics for development use.

The three categories of derived metrics in this first phase of collaboration focus on industry employment, skills-in-demand, and talent migration trends. The selection of these three categories is based on: 1) feedback from World Bank pilot projects in South Africa and Macedonia - which derived metrics are most relevant for policy-makers; 2) feasibility of extracting, cleaning and validating metrics, especially whether a globally harmonized dataset from other sources is readily available to conduct validation; and 3) scalability across locations (e.g. if a specific metric is only good for certain regions or income groups, it receives less priority in the first phase). Sensitivity of the metrics, especially those that might have implications on ethical and privacy issues, is also considered.

All derived metrics are reported at the city or country levels covering hundreds of worldwide locations that have at least 100,000 LinkedIn members (see LinkedIn Country List and City List Appendix)¹⁴. We make use of LinkedIn members' profile information on education, work experience and skills over time to construct this panel dataset. It is envisaged that this dataset will keep improving and updated every 3 months from 2018 to 2020 as a trial collaboration between WB and LinkedIn. Historical data from 2015-2017, from which the validation results here are drawn, will be made available as well.¹⁵

The remainder of the document is structured as follows. Section II reviews the data sources and data merging methods. Section IV offers an analysis of LinkedIn data distribution across age, gender, and industry. Section V presents validation results for the methods used to derive metrics related to industry employment, talent migration, and skills. Finally, section

¹⁴ Based on our pilot experience in South Africa, a sample size of 100,000 is close to the threshold in having reliable derived metrics because for certain metrics, e.g. industry employment growth, the sample size might drop dramatically if there are not enough entries and exits across industries recorded by these 100,000+ members.

¹⁵ Historical LinkedIn data is less reliable and representative globally as it heavily depends on whether members can recall accurately their work history.

VI discusses how these metrics were applied to World Bank country pilot projects, the assumptions behind the visuals and sample analytical visuals.

II. Data Sources

As described, the advantage of this LinkedIn dataset is that it is near real-time, granular with 148 industries and 35,000 detailed skills categories with a global coverage of 140 countries and hundreds of cities, drawing from a user base of 560 million LinkedIn members worldwide. Additionally, professionals are signing up to join LinkedIn at a rate of roughly 2 new members per second and developing countries see membership experiencing exponential growth. More than 46 million students and recent college graduates are on LinkedIn as well. In total, more than 70% of LinkedIn's members are outside the US utilizing the platform in 24 languages, and LinkedIn data science teams are merging and standardizing taxonomies and languages into one coherent dataset.

This World Bank Group – LinkedIn dataset makes heavy use of a member's CV. Each member lists their education and employment history in the "Education" and "Experience" sections of their profile, including both current and previous positions. For example, when a member adds a work experience to their profile, some of the primary inputs include their job title, their employer, and the dates they were employed are captured and standardized. Furthermore, profiles are motivated to include a user's skill set and location. It is through this profile structure that key variables for insights and analysis are extracted¹⁶. The project team then looks for similar metrics collected by other sources, such as government administrative and survey data, or even other non-traditional sources, such as google trends and job posting data - as globally comparable data at such granular scale like LinkedIn is rare - to conduct validation to see whether these metrics contain genuine and strong signals of the markets. The section below describes the data sources used for validation.

A. Age and Gender

LinkedIn data has member count totals by gender, and median and mean age for 142 countries in year 2016. Explicit gender and age information is unavailable on LinkedIn Platform and thus the data are deduced from member profiles (e.g. Male/female names, graduation year of college). Data on these variables therefore do not reflect total LinkedIn membership (as not every member provides complete profile information).

¹⁶ **Job title:** Members are required to include a job title for each position listed on their profile. LinkedIn standardizes this information by mapping these member inputs against a comprehensive taxonomy of over 22,000 job titles that can be further aggregated based on job occupation or function. **Job occupation/function:** Job functions provide much broader groupings of common job roles based on the title the member inputted. The function in which a member works is determined by the classification of the job title in LinkedIn's title taxonomy. **Industry:** Members indicate the name of their employer for each position on their profile, which LinkedIn then maps to a standardized company entity. The industry in which a member works is determined by the classification of the company in LinkedIn's taxonomy of industries. **Skill acquisition:** Members indicate their expertise within the skills section of their profile. LinkedIn clusters the tens of thousands of individual skills that members choose to display on their profile into categories for analysis. **Migration:** We determine a LinkedIn member's location by the location they have indicated in their profile summary. When this location is changed, we measure that change as a migration.

ILO Labor Force Age and Sex data is downloaded¹⁷ from ILOSTAT. Country count varies by reference year. Country selection for matching with LinkedIn data is discussed in the External vs. LinkedIn Data Matching Methodology Appendix (section 1), while countries included in each validation pair (LinkedIn vs. ILO) may be found in country reference tables in the Age ILO-LI Comparison Country List Appendix and Gender ILO-LI Comparison Country List Appendix.

B. Industry Employment Size

LinkedIn industry data has industry member count for 148 industries (roughly mappable to the ISIC two-digit level) for 140 countries. International Labor Organization data on Industry is given by ILO Database of Labor Statistics-Employment by sex and economic¹⁸. Based on definitions from the International Standard Industrial Classification of All Economic Activities (ISIC), Rev.4, ILO is given at the ISIC one-digit level, for 92 countries. Additionally, ILO data from the years 2015, 2016, and 2017 is used in this methodology as not all countries have data updated annually¹⁹. Within this time span, data continuity and harmonization issues are minimized (e.g. due to changes to survey methodology and definitions). The matching framework for these two data sets is given in the in the External vs. LinkedIn Data Matching Methodology Appendix (section 2), with the list of available countries in the Industry Employment ILO-LI Comparison Country List Appendix.

C. Industry Employment Growth

LinkedIn industry growth data is given by a panel of LinkedIn data between 2014-2017. We capture new industry hires/losses by counting active LinkedIn members (who have logged in at least once in the past year) changing jobs from industry A to industry B (i.e. experienced hires). We also use a separate dataset to capture whether recent graduates are entering the market and finding jobs in an industry (i.e. new graduates entering job market), see Table II-1. Due to the characteristics of LinkedIn data, multiple approaches were tried to build an industry employment growth dataset for analysis and “Single Position LinkedIn Panel Data” was adopted in the end. The pros and cons of each approaches are outlined in Table II-1.

¹⁷ ILO Labour Force Age and Sex data downloaded from:

http://www.ilo.org/ilostat/faces/oracle/webcenter/portalapp/pagehierarchy/Page27.jspx?subject=EAP&indicator=EAP_TEAP_SEX_AGE_NB&datasetCode=A&collectionCode=YI&_afrLoop=729967134259350&_afrWindowMode=0&_afrWindowId=jsc0tnev_1#!%40%40%3Findicator%3DEAP_TEAP_SEX_AGE_NB%26_afrWindowId%3Djszc0tnev_1%26subject%3DEAP%26_afrLoop%3D729967134259350%26datasetCode%3DA%26collectionCode%3DYI%26_afrWindowMode%3D0%26_adf.ctrl-state%3Djszc0tnev_45

¹⁸ The ILO Industry Database was downloaded from:

http://www.ilo.org/ilostat/faces/oracle/webcenter/portalapp/pagehierarchy/Page27.jspx?indicator=EMP_TEMP_SEX_ECO_NB&subject=EMP&datasetCode=A&collectionCode=YI&_adf.ctrl-state=42zyhjcu2_45&_afrLoop=210762625104969&_afrWindowMode=0&_afrWindowId=42zyhjcu2_1#

¹⁹ For example, EU countries are required to provide updated LFS data for at least one quarter annually.

Table II-1 LinkedIn Industry Employment Growth Data Extraction Methods

Alternatives for Constructing the Industry Employment Growth Dataset from LinkedIn			
Approach	Pros	Cons	Team Decision on this Approach
Single Position LinkedIn Panel Data	Given as a balanced panel, for a given set of members across time where each member is associated with one position and industry in each year.	Concerns over selecting “main ²⁰ ” position but no significant improvement in result compared with multiple position LinkedIn dataset.	This balanced panel dataset is used for validation and analysis in the end. In US industry employment growth validation, this data set takes the form of monthly observations between 2015 and early 2018, for comparison with the US BLS data. Findings show strong correlations between LinkedIn data and BLS data especially for high penetration rate sectors, detailed findings are discussed in section IV.A.2 of the paper.
Multiple Position LinkedIn Panel Data ²¹	Captures more than one active position by a member.	By capturing multiple positions (for a given member in a single year) the data set takes on the structure of a weakly balanced panel. Meaning, one or more observations per member per year.	The data set does not improve results compared to the single position LinkedIn panel data set. Additionally, due to the inclusion of multiple positions additional noise is likely added.
Recent Graduate LinkedIn Data ²²	Capturing movement of recent graduates, or in other words new additions to the workforce.	Data is given as annual cross sections, giving number of grads moving to work positions in any given industry as well as total number of grads (for a given year).	This dataset provides a glimpse into an important source of industry employment growth: new entrants and recent graduates are treated as a different group for analysis from the single position balanced panel, which are data for experienced hires.
Employment Transitions LinkedIn Data ²³	Data set filters for only industry movements across years.	Membership is not held constant throughout years, meaning bias due to LinkedIn membership growth is not accounted for.	Due to the biases of this dataset compared with single position balanced panel, this is not used.

²⁰ Since a member can list several positions the same time (e.g. volunteer service), “Main” position is defined by highest tenure, or length of time a position has been held. In the case that a multiple position for a given member have the same tenure, the one added first is selected as “main” position.

²¹ In this dataset we find LinkedIn members who had at least one active position in the month of December for the years 2012, 2015, 2016, and 2017. This means that the dataset has information on the same sample of members in the four years considered. At the same time, all members on the platform are considered, including those who listed internship positions, for example. Members can list one or more active positions at each given point in time and, in the multiple -position panel dataset, we allow each LinkedIn members to be associated with one or more positions each year. This makes the dataset a weakly balanced panel, with one or more observations per member per year.

²² The dataset only includes data on recent graduate LinkedIn members. Where each member’s highest level of education is identified as well as the year of graduation. Individuals are counted within the dataset if they have moved to a job (for which an industry can be identified) within 1 year of graduation.

²³ Transitions dataset solely identifies member movements in and out of industries, not holding a constant set of members throughout years (unlike panel sets) and hence can capture LinkedIn membership growth, e.g. when a new member growth is registered in this dataset, we cannot distinguish whether this is a genuine new entry or the member has already worked here, but this is the first time s/he signs up on LinkedIn and hence we register a growth.

Two external data sources are used in the industry employment growth validation. First, ILO data is again given by the same data set described previously in the industry employment size data source section. Second, LinkedIn industry growth is also compared to monthly employment by industry in the US from the Bureau of Labor Statistics (BLS)²⁴, where BLS data is given as non-seasonally adjusted monthly industry employment count between 2015 and April 2018 to match with the LinkedIn dataset constructed by the team. A detailed data matching framework of the two datasets can be found in the External vs. LinkedIn Data Matching Methodology Appendix (section 3),

D. Talent Migration

LinkedIn migration rates are derived from the self-identified locations of LinkedIn members on their profile. For example, when a LinkedIn member updates their location from Nairobi to London, this is counted as a migration. The LinkedIn rates are compared to international migration flows data from the OECD²⁵.

The OECD estimates migrant inflows into OECD countries with population censuses, population registers, and nationally representative surveys. We limit the sample to only those observations that had at least 30 observed migrations from both the OECD and LinkedIn, and where the LinkedIn country has more than 100,000 LinkedIn members. This leaves a total of 1447 country pairs (i.e. country A to country B, C, D, etc.) with 5.46M migrations to OECD countries in OECD data, and a corresponding 1.16M migrations in LinkedIn data. This translates to LinkedIn covering roughly 21.4% of all migration flows in the OECD data set. Coverage is best for migration amongst high income countries. Reference charts can be found in the Migration Data Summary Charts Appendix. Additionally, the detailed dataset matching framework can be found in the External vs. LinkedIn Data Matching Methodology Appendix (section 4).

²⁴ BLS Current Employment Statistics (CES) nationally, downloaded from <https://data.bls.gov/PDQWeb/ce>

²⁵ OECD migration data downloaded from: <http://www.oecd.org/els/mig/keystat.htm>

Table II-2 Summary of Other Major External Migration Datasets Considered

Major Alternative Data Sources Considered for Migration Metrics Validation	Pros	Cons	Team Decision
United Nations Department of Economic and Social Affairs	Shows the number of migrants residing in each country by the country of migrant origin from 1990-2017 (every 5 years, except for 2017)	UN captures migrant stocks, which are different from LinkedIn's migrant flow estimates	Many factors contribute to the changing level of migration stock data - not just talent flow, e.g. the reason for a decreasing number of migrants from Mexico to the US can be attributed to various reasons. We do not think this is a fair comparison dataset for talent migration metric validation.
International Labor Organization	Similar to the above, covering 2003-2015	Same issue as UN data	Same issue as UN data

E. Skills

LinkedIn is able to provide skills data at a very granular level (and for each individual industry in a given country/city). As with all the metrics, a constraint is imposed on extracting data: a cell is only reported with a value if it is not falling below 50 observations for a particular self-reported skill to protect member privacy as well as to ensure the results are not biased due to small sample size²⁷. Members may have more than one associated skill in their profile²⁸.

A variety of sources are used in validating the LinkedIn skills data, even though comparable global skills data at such granular scale as captured by LinkedIn is non-existing. The team hence tried some other non-traditional sources such as Google Trends, Job Posting on LinkedIn, and CEDEFOP Panorama skills data in Europe for validation²⁹. In addition, the derived skill metrics, e.g. most important skills for each industry presented in section IV-B, were validated against proxy indices such as Value

²⁶ The team evaluated 13 alternative sources of data for migration validation and decided to use OECD dataset for migration validation results mainly because this OECD data is the only data source that shows flows of migration (not stock) which is a direct comparison to LinkedIn data. See Migration Validation Other Data Sources Evaluated Appendix for details of the 13 datasets.

²⁷ There are three sources of skills recorded by LinkedIn: 1) self-reported in the skills section of the profile, 2) skills extracted from text in other sections of the LinkedIn profile using a skill-tagger, or 3) inferred from all member data (e.g. their network). We only use self-reported skills from the skills section in our analyses since this is a more foundational source that does not employ additional predictive models, albeit with its own limitations.

²⁸ However, a skill is not necessarily associated with any given industry. This allows for a larger data sample where for whichever reason a member may not be associated with a classifiable industry.

²⁹ Panorama data, given for the year 2016, offers skills data on 28 European countries. Countries vary in the number of observations available however each country offers data on identical skills, facilitating cross-country comparison. The data is based on a survey of employed individuals, either online or via telephone. <http://skillspanorama.cedefop.europa.eu/en>

Add, ICT skill rankings (PIAAC) and ICT development indices³⁰. The dataset matching method can be found in the External vs. LinkedIn Data Matching Methodology Appendix (section 5).

Table II-3 Summary of External Datasets Considered for Skills Metrics Validation Exercises

Summary of Considered Datasets for Skills Metrics Validation			
Dataset	Pros	Cons	Team Decision
World Bank I2D2 (International Income Distribution Data Set) Data ³¹	Allows for comparison of Occupation and Industry distribution across countries. Particularly useful in industry employment and occupation validation.	Limited number of countries available with both Industry and Occupational data (for example, 8 countries in 2015 and 3 in 2016, and 0 in 2017).	I2D2 data is unusable in LinkedIn comparison over desired years due to extremely limited country observations.
World Bank STEP (Skills Measurement Program) Data ³²	Provides skills composition on country level in 17 countries. Derived from both household and employer surveys.	Divergent skill definitions/concepts between STEPS and LinkedIn, and it does not allow for fair comparison.	Data was not pursued further due to poor matching of skills measures/definitions between sources.
Europe Skills Panorama (CEDEFOP) ³⁴	Provides skill data for 28 European countries. Skills are given by 11 categories ³⁵ , ranging from Advanced ICT to Team Work skills. Data is derived from surveys for large working population sample.	Imprecise mapping of LinkedIn skills to Panorama categories. Specifically, LinkedIn have several hundred skills matching to the CEDEFOP "Technical Skills" category, however only a few in "Team Work", which results in low sample size and variation in this category.	Counter intuitive results proved to be driven by skill mapping issues between the two sources. Additionally, limited observations (28 per skill) further led the team to not pursue the data further.
Google Trends Data ³⁶	Allows for the comparison of Skill Flows over time, serving as a good source for matching with the wide variety and specificity of LinkedIn skills and skill categories.	Difficulties comparing across country because of language barriers (LinkedIn has unified conversion to English, not true for google trends).	Difficulties in cross country comparisons due to language barriers as well as the limitation to derive clear skill signal on google search trends limited the scope of the exercise. (e.g. need to capture java the skill, but not java the place, or java coffee)
LinkedIn Job Postings	Premium job postings data on LinkedIn platform are exclusively used, allowing to capture required skills directly from the standardized LinkedIn skills classification. This approach minimizes noise	LinkedIn Job postings can be considered an external data source, driven by company postings rather than member profiles. Nonetheless shared bias towards certain industries/occupations on the	This dataset was used for early skill demand metric development (proxied by hiring rate) in validation exercises.

³⁰ Value Add data are from 3 sources- OECD (<https://data.oecd.org/natincome/value-added-by-activity.htm>), WBG (<http://databank.worldbank.org/data/source/world-development-indicators>), PIAAC ICT skill rankings (<http://www.oecd.org/skills/piaac/>), ICT Development Index (<http://www.itu.int/net4/ITU-D/idi/2017/index.html>)

³¹ I2D2 is a global harmonized household survey database. Providing a basic set of harmonized variables that are comparable across country/time. The dataset is only available selectively within the World Bank.

³² Available at <http://microdata.worldbank.org/index.php/catalog/step>. Survey based data of households and employers in 17 countries.

³³ Skills in STEP given in 3 categories: Cognitive, Behaviour and Personality Types, and Job -Relevant skills.

³⁴ CEDEFOP Skills Panorama provides the most comprehensive landscape of skills and labour data in Europe, also utilizing sources such as OECD and Eurostat. The data is downloaded from <http://skillspanorama.cedefop.europa.eu/bg/datasets>

³⁵ These categories include: Technical skills, Communication skills, Team-working skills, Foreign Language skills, Customer handling skills, Problem solving skills, Learning skills, Planning and organisation skills, Literacy skills, Numeracy skills, and ICT skills.

³⁶ Available at <https://trends.google.com/trends/?geo=US>. Offers data on frequency of a given terms searches relative to total searches for a given period of time. Data is given since 2004 across countries and regions.

	in the data from approaches such as using algorithms to extract skills from text.	platform as a whole may fail to make the validation to be based on a representative sample when using this dataset for validation.	
ICT Development Index ³⁷	Index is available over relatively large time period (2009 to 2017) and for 176 countries. Additionally, it combines 11 indicators into one benchmark measure for correlation exercise.	The individual indicator value and the weights to use to arrive at a single quantitative measure can be subjective.	Used in validating skill metrics with regard to relationship to ICT development level
PIAAC Score ³⁸	Provides measures of proficiency in IT skills of the 'problem-solving in technology-rich environment' section	Only data from 2015 and limited to 35 OECD countries	Used in validating skill metrics with regard to relationship to PIAAC score
Value Added (OECD, WB, ILO)	Metric allows to test theoretical concept of skill similarity between developed countries and developing countries as correlated with value added per worker difference.	Final value added measure derived from multiple sources, with data for 27 countries	Used in validating skill metrics with regard to relationship to value added per worker

III. LinkedIn Data Representativeness

Before we report validation results, it is important to document which segment of the workforce and economic activities that LinkedIn data has better *representativeness*³⁹. We compare LinkedIn data against other representative government data against three dimensions: age, gender and industry.

A. Age

Mean and median age is presented across all cross sections. Global, Income Group, and World Bank Region, including 107 countries in the analysis. Income group analysis classifies those 107 into 4 Income Group categories. Income group is defined by the

³⁷ ITU ICT Development Index (<http://www.itu.int/net4/ITU-D/idi/2017/index.html>)

³⁸ OECD PIAAC Score (<http://www.oecd.org/skills/piaac/>)

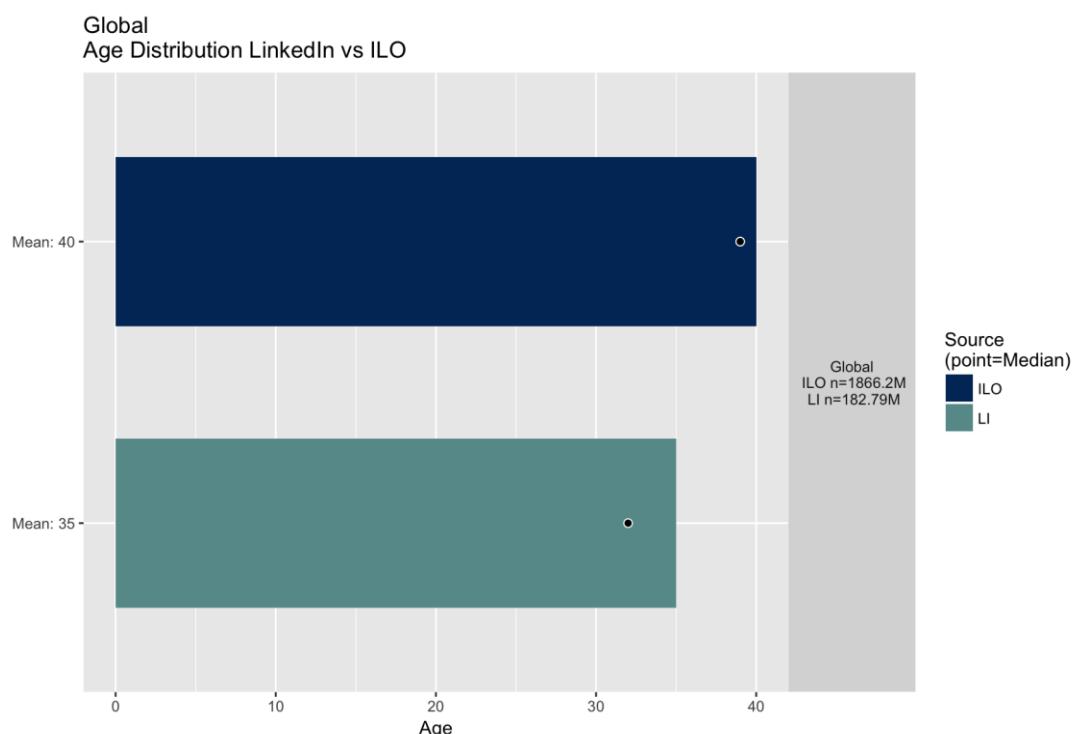
³⁹ We use the term 'representativeness' here loosely as we do not have detailed representative global datasets for comparison with LinkedIn data across not just age, gender and industry dimensions. Ideally, we would like to compare LinkedIn member's education and occupation representation within industries as well to understand true 'representativeness'.

World Bank List of Economies as of June 2017, given by GNI (Gross National Income) per capita⁴⁰.

1) Age Distribution Globally

Mean global age across all 107 countries matched with LinkedIn, has a 5-year difference between ILO and LinkedIn (40 years and 35 years, respectively). Median age is represented in the chart below as the point imposed over the bar, which is 39 and 32 for ILO and LinkedIn respectively. Hence LinkedIn seems to be capturing a younger sample of the workforce. Performing a Welch Two Sample T-Test (unequal variance), age between LinkedIn and ILO is statistically different across all countries globally at p-value < 0.01.

Figure III-1 Global Age Distribution (LinkedIn vs. ILO)



2) Age Distribution by Income Group

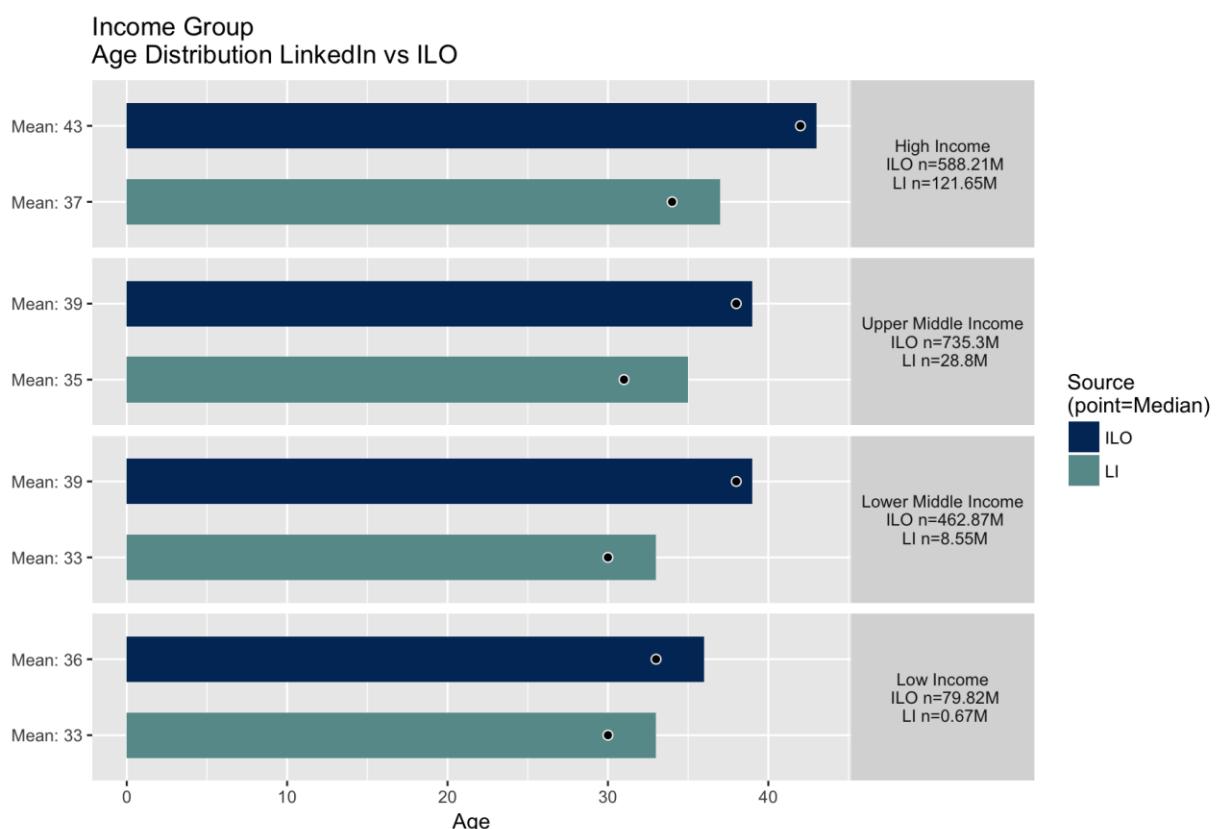
The tendency for a skew towards the younger population amongst LinkedIn data continues at the World Bank income group level. Additionally, the difference

⁴⁰ Low-income economies are defined as those with a GNI per capita, calculated using the [World Bank Atlas method](#), of \$1,005 or less in 2016; lower middle-income economies are those with a GNI per capita between \$1,006 and \$3,955; upper middle-income economies are those with a GNI per capita between \$3,956 and \$12,235; high-income economies are those with a GNI per capita of \$12,236 or more.

between mean age described by ILO and LinkedIn varies between 6 and 3 years of age. High income and lower-middle income countries have the greatest disparity (6 years).

Notably, low income countries have only a 3 year mean difference between ILO and LinkedIn. Median age within this Income Group remains at 3 years (30-LI v. 33-ILO). On the other hand, the largest difference between sources with regard to median is seen in the lower-middle income group (38-ILO v. 30-LI). The superior LinkedIn match amongst low Income countries should be considered with the caveat of lower member sample size at the country level (LI sample size covers <2% of ILO).

Figure III-2 Age Distribution by Income Group (LinkedIn vs. ILO)



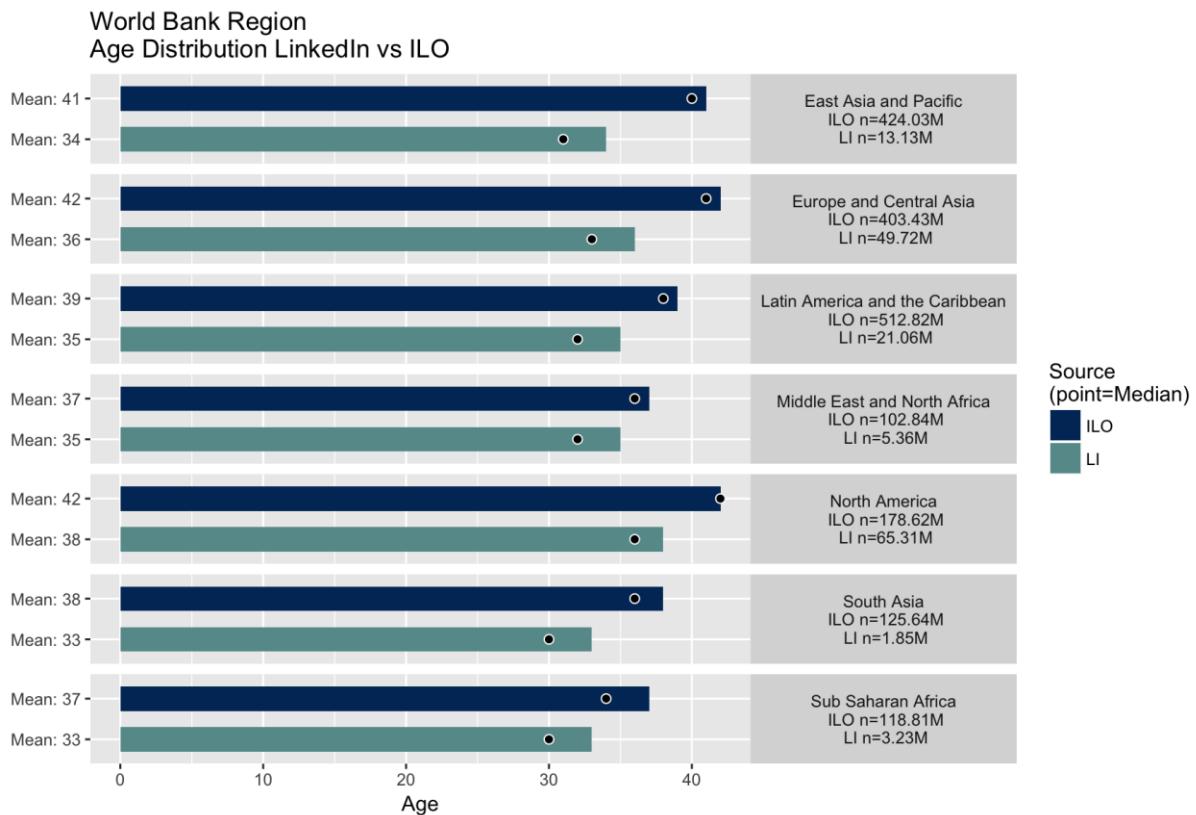
3) Age Distribution by World Bank Region

LinkedIn and ILO identify the highest age in North America and Central Asia⁴¹. The largest age difference between sources is seen in East Asia and the Pacific, with LinkedIn mean age 7 years lower and median age 9 years lower. The greatest

⁴¹ On the lower end, LinkedIn displays the lowest age in Sub-Saharan Africa followed by East Asia, while in ILO the Middle East and North Africa followed by Sub-Saharan Africa are the lowest age groups.

similarity between sources is seen in the Middle East and North Africa with only a 2 year mean age difference (LI: 35 and ILO:37), and 4 years for median age (LI: 32 and ILO: 36).

Figure III-3 Age Distribution by World Bank Region (LinkedIn vs. ILO)

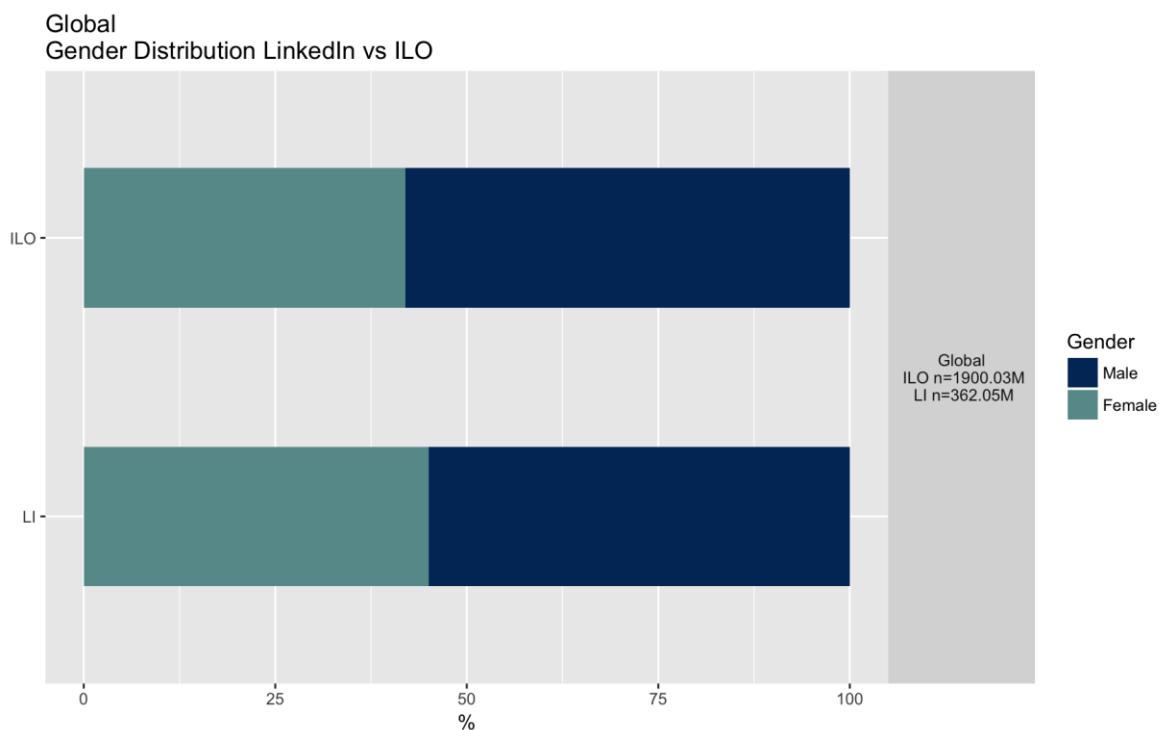


B. Gender

1) Gender Distribution Globally

LinkedIn captures a larger proportion of females in the labor force than the gender breakdown represented by ILO for 63 countries (out of 109). Out of all member profiles on LinkedIn globally where gender could be estimated, 45% are female and 55% are male on LinkedIn. ILO on the other hand, with significantly larger sample size, 42% are female and 58% male. Performing a Welch Two Sample unequal variance T-Test, the female ratio between LinkedIn and ILO is not statistically different across all countries globally with p-value = 0.7163.

Figure III-4 Global Gender Distribution (LinkedIn vs. ILO)



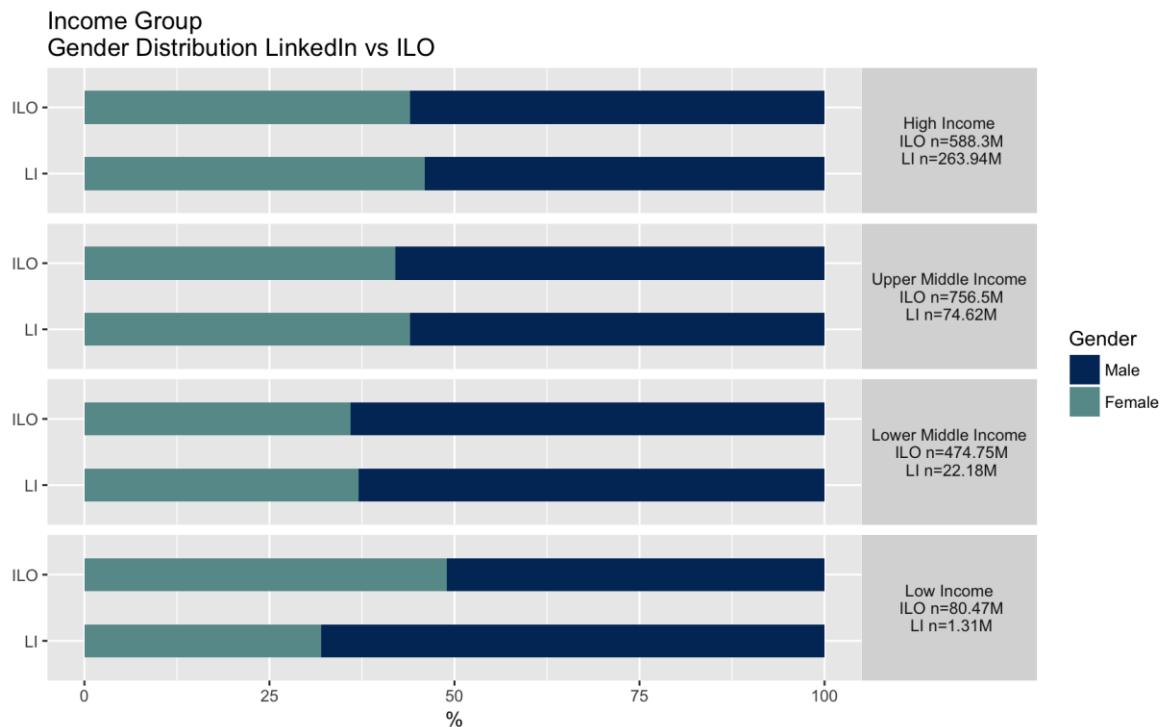
2) Gender Distribution by Income Group

Low income group countries have the lowest proportion of females to males in the labor force (32%), as presented by LinkedIn. ILO on the other hand, has the highest proportion of females to males in low income group countries (49%). This may be explained by male's better access to technology in low income countries required for LinkedIn use, as well as under representativeness of women in industries covered by LinkedIn data (e.g. LinkedIn data has better coverage in IT industry which traditionally is male dominated). LinkedIn has the highest female percentage in high income countries.

Both lower-middle income and high-income groups display only a 1% difference between ILO and LinkedIn gender distribution, where in both cases LinkedIn has a higher representativeness of females⁴².

⁴² LI:37% - ILO:36% and LI: 46% - ILO:45%, for Lower Middle and High Income respectively.

Figure III-5 Gender Distribution by Income Group (LinkedIn vs. ILO)

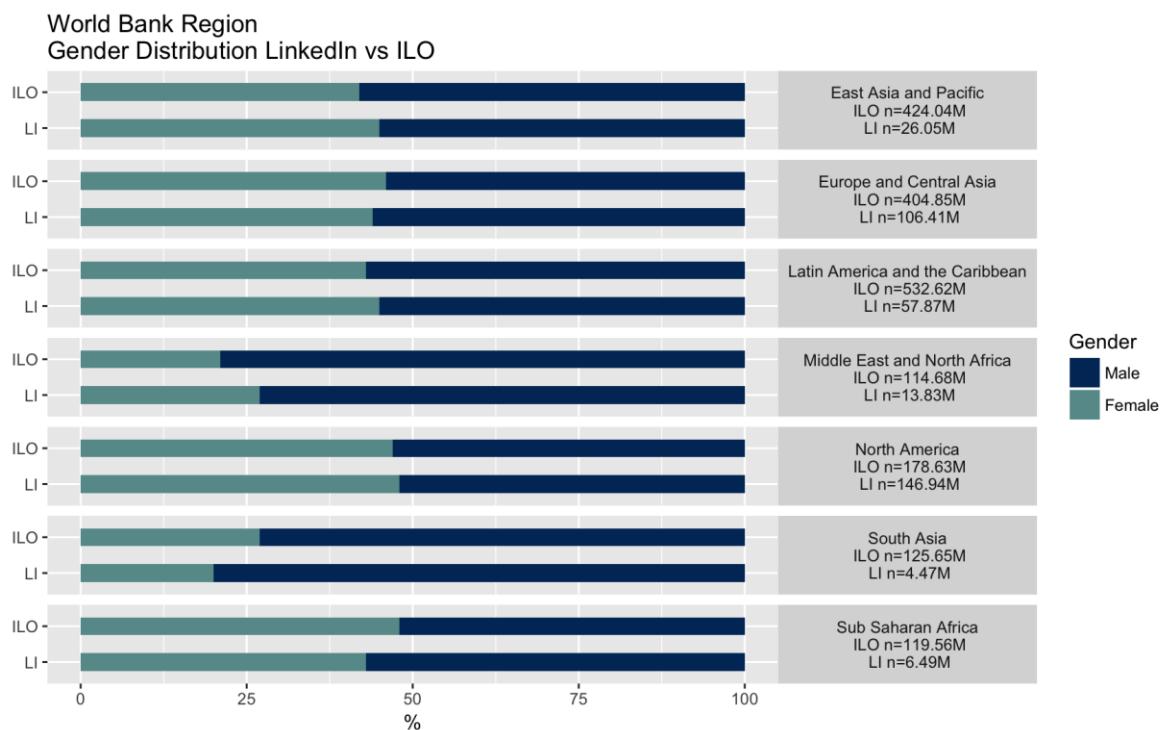


3) Gender Distribution by World Bank Region

Both sources have the highest female percentage of the workforce in North America (LI: 48% and ILO:47%). Both sources find the lowest percentage of females in the workforce in South Asia and in the Middle East and North Africa.

A dramatic difference in female percentage between sources is seen in South Asia, with LinkedIn displaying 18% Female and ILO displaying 27%. The greatest similarity is seen between North America (1% difference) and Latin America and the Caribbean (2% difference).

Figure III-6 Gender Distribution by World Bank Region (LinkedIn vs. ILO)



C. Industry

In this section the distribution of LinkedIn members across industries is discussed. LinkedIn coverage of the workforce as given by ILO is measured across 92 countries, where results are presented at the global, Income Group, and World Bank Region level.

Table III-1 Summary of Other Considered External Datasets

Alternative Data Sources Considered for Assessing Industry Representativeness	Pros	Cons	Team Decision
ILO ISIC 3 classification	Ability to capture additional countries which use ISIC 3 classification (e.g. the United States)	ISIC Rev. 3 introduces different levels of industry classification compared to ISIC Rev. 4. The alternative classification is problematic on two levels: 1) industries are aggregated in an outdated manner (e.g. lack of standalone ICT industry ⁴³); and 2) ISIC 3 in particular tends to group both well represented and underrepresented LinkedIn industries together and hence making the LI-ILO industry representativeness comparison problematic. The latter point also further dilutes LinkedIn data granularity in an inopportune manner	For the reasons listed, as well as in the interest of preserving consistent mapping, ISIC 3 classification is not included. Furthermore, efforts to re-map ISIC 3 to ISIC 4 did not yield confident results.

⁴³ For example, ISIC 4 includes standalone section J (Information and Communication Technology)

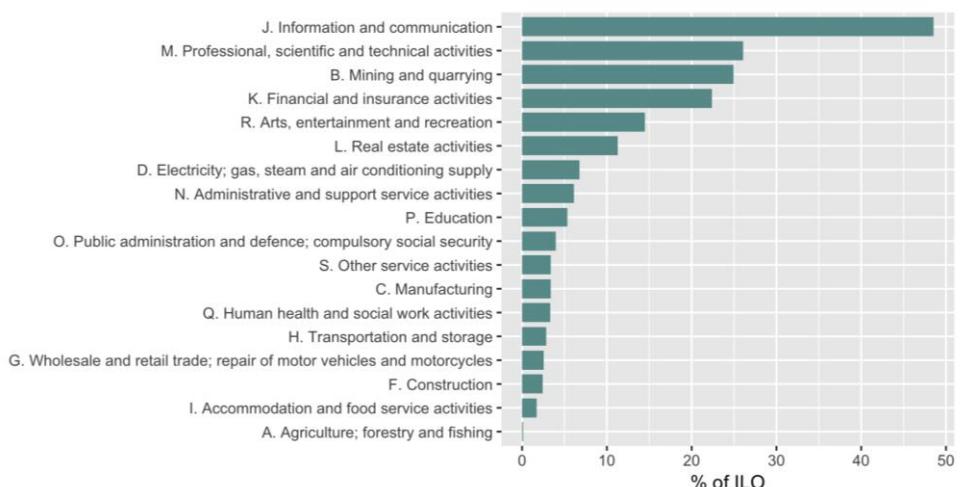
		(e.g. ISIC 3 K. Real Estate, Renting, and Business activities are classified together)	
World Bank I2D2 ⁴⁴ Data	Allows for comparison of Occupation and Industry distribution across countries	Limited number of countries available with both Industry and Occupational data (for example, 8 countries in 2015 and 3 in 2016, and 0 in 2017).	Data not included in the analysis. Key reasons include the limited availability of countries with industry and occupational data in recent years, as well as greater confidence in LinkedIn data quality from 2015 forward only.

1) Industry Coverage Globally

Highest industry coverage by LinkedIn data⁴⁵ is seen primarily in knowledge and tradable sectors, as shown in the figure below. Specifically, these sectors are Information and Communication (~48%), Professional, Scientific and Technical Activities (~26%), Financial and Insurance Activities (~22%), and Arts, Entertainment and Recreation (~14%). Additionally, Mining and Quarrying (~25%)⁴⁶ displays high penetration globally.

On the other hand, Agriculture; Forestry and Fishing (~0.1%), Accommodation and Food Service Activities (~1.7%), Construction (~2%) and Wholesale and Retail (~2%) contain the lowest coverage by LinkedIn members.

Figure III-7 Global LinkedIn Industry Coverage (LinkedIn as % of Total ILO Workforce, 2016)



⁴⁴ International Income Distribution Data Set (I2D2)

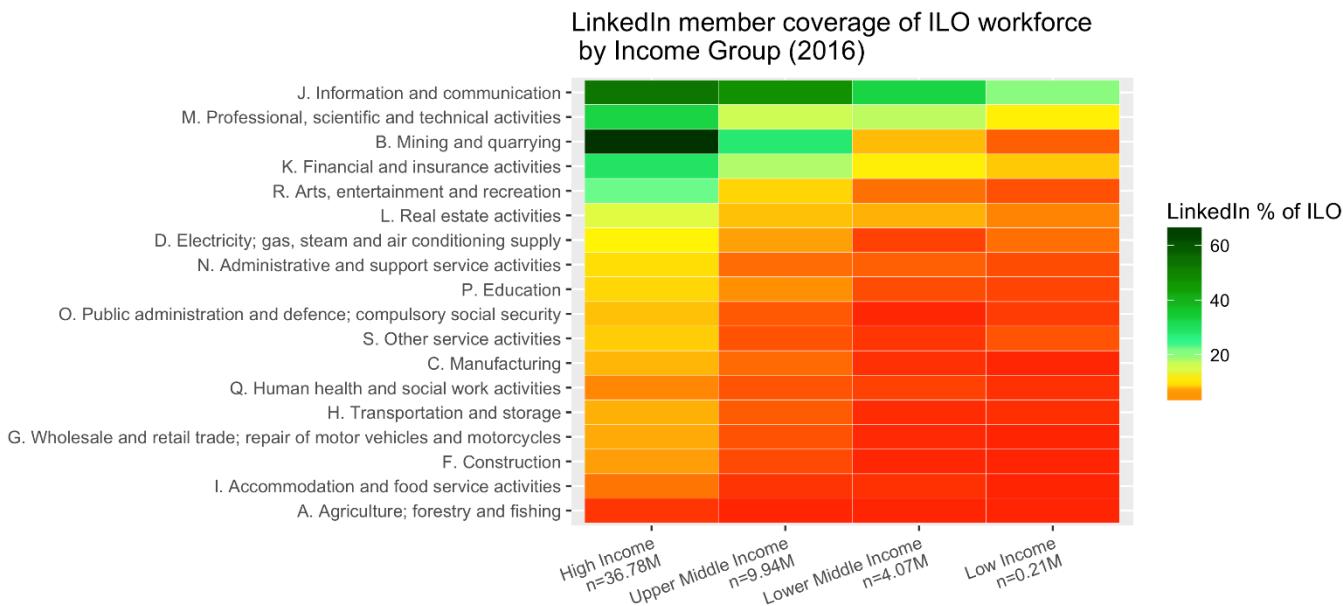
⁴⁵ Measured as percentage of LinkedIn membership in the labour force as defined by ILO in 92 countries.

⁴⁶ The high representativeness of LinkedIn in the mining and quarrying sector is partially due to companies on LinkedIn incorrectly identifying themselves as Oil and Energy companies rather than Utilities (hence being classified into category B rather than D on ISIC). For example, EDF Energy is a major employer in the United Kingdom, categorizes itself under Oil & Energy, yet specializes in electricity and gas sales to homes and business (activities more akin to the Utilities sector).

2) Industry Coverage by Income Group

Across all industries the highest penetration is found in high income group countries, followed by upper-middle income, lower-middle income, and finally low income countries⁴⁷.

Figure III-8 LinkedIn Industry Coverage by Income Group



Note: Industries are ranked by global coverage in ascending order, n= number of member observations that have proper industry classification. Color scale given as red <10%, yellow <20%, and green>20%

Across all groups, highest penetration is seen in J. Information and Communication⁴⁸. Followed by M. Professional, Scientific and Technical Activities, and K. Financial and Insurance Activities. Additionally, F. Construction has considerably higher coverage in high income countries compared to others, as well as R. Arts, Entertainment, and recreation, N. Administrative and support service activities, and O. Public administration and defense.

3) Industry Coverage by World Bank Region

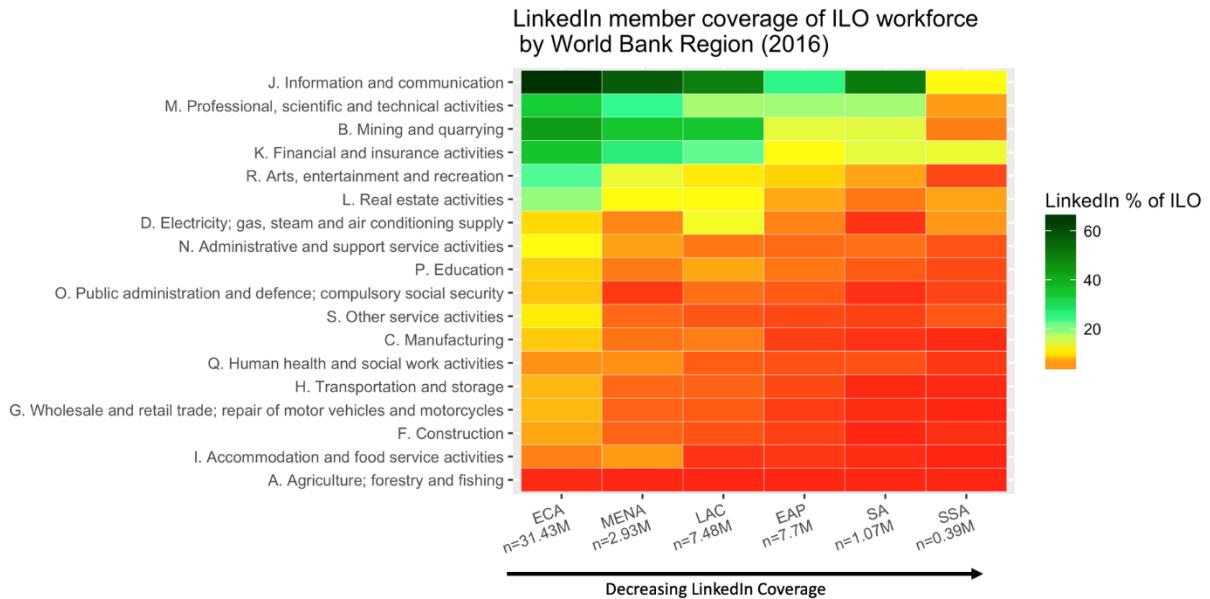
LinkedIn member coverage of the workforce by world bank regions, benchmarked by ILO, is given in the chart below. Again, knowledge and tradable sectors are best represented across world bank regions. Trends across WB regions remain the same as seen across income groups -- higher income regions tend to have better LinkedIn

⁴⁷ Exceptions to this trend occurring between low and lower-middle income countries, where notably O. Public Administration has double the penetration in low income countries than in lower-middle income countries. Low income countries also display higher penetration in D. Electricity, Gas and Utilities as well as H. Transport and Storage.

⁴⁸ with the exception of B. Mining and quarrying for high income countries

coverage. Regions are ordered from left to right by decreasing LinkedIn coverage in the chart below.

Figure III-9 LinkedIn Industry Coverage by World Bank Region



Note: Industries are ranked by global coverage in ascending order, n = number of member observations. Color scale given as red <10%, yellow <20%, and green>20%

On the regional level, J. Information and Communication is the highest penetrated industry across all regions. In second highest penetration is B. Mining and Quarrying for all regions except SSA. Otherwise, M. Professional, Scientific and Technical Activities as well as K. Financial and Insurance Activities are the third and fourth highest coverage industries across all regions⁴⁹.

⁴⁹ Europe and Central Asia has the highest penetration across all industries, with the exception of Middle East and North Africa for I. Accommodation and Food and Service Activities as well as Latin American and the Caribbean for D. Electricity, Gas and Utilities. On the other hand, Sub Saharan Africa has the lowest penetration across industries compared to other regions. However, in a handful of industries SSA surpasses MENA and SA (i.e. "D. Electricity, Gas, Utilities" (EAP, MENA, SA), "L. Real Estate Activities" (MENA, SA), "O. Public Administration and Defence" (MENA, SA), "H. Transport and Storage" (MENA), "S. Other Services and Activities" (MENA, SA), "F. Construction" (SA), "A. Agriculture; Forestry and Fishing" (SA).

IV. LinkedIn Metrics Validation Results

The objective of this section is to understand whether the big data extraction methods that we used to derive LinkedIn metrics contain genuine signals, after validating against other comparable data sources. Three categories of metrics are assessed: 1) industry employment size and growth, 2) talent migration, and 3) skills. Again, results are presented by global, income group, and world bank region⁵⁰ to help readers determine which metrics are more relevant for certain regions or income levels, and which are relevant cross-country comparison globally.

A. Industry Employment Metrics

1) Industry Employment Location Quotient

a) Overview

Understanding which industries hire the most workers in a location and having the ability to benchmark this industry employment concentration (captured by Location Quotient) against peers gives policy-makers a quick summary of the major (tradable) economic activities at a location. However, as mentioned before, LinkedIn data are skewed towards knowledge and tradable sectors. To ensure comparability, we first need to ascertain whether relative industry employment size represented by LinkedIn are at least directionally the same as they are given by ILO, and identify which industries allow for confident cross-country comparisons within the same industry (e.g. Information and Technology sector very likely), and which ones do not (e.g. Agriculture), as sample coverage in the latter under-represented sectors vary considerably across countries.

b) Methodology

With regard to the methodology, two steps are taken. First, industry employment size (distribution of members across industries) is calculated for each country. Given as,

$$\text{Country Industry Size}_{c,i,t} = \frac{\text{member count}_{c,i,t}}{\text{member count}_{c,t}}$$

where industry employment size is given for country c , in industry i for year $t = 2016$ (since ILO data is most complete for 2016).

⁵⁰ Note: Income group and region is defined as an average of all countries in this group rather than aggregating all members in the region as a whole and calculate the average. For example industry size in high income group is given as an average of the relative industry size for all high income countries, treating each country as one unit of (unweighted) observation. Same rationale applies to calculating WB region average.

An Income Group's industry employment size for Income Group I, industry i, for year t is calculated by treating each country in the group as one observation (regardless country size and hence no weighting is applied) and then taking an arithmetic mean across countries in the Income Group:

$$\text{Income Group Average Industry Size}_{I,i,t} = \frac{\sum_{c=1}^n \text{Country Industry Size}_{c,i,t}}{n}$$

where n denotes the number of countries in a given Income Group. Second, we then obtain a country's industry employment location quotient (LQ) by comparing a country's industry size versus Income Group average:

$$\text{Country Industry Size LQ}_{c,i,t} = \frac{\text{Country Industry Size}_{c,i,t}}{\text{Income Group Average Industry Size}_{I,i,t}}$$

Box 1: Which Benchmark to Choose When Calculating Location Quotient?

Due to different LinkedIn coverage rates between developed and developing countries, the team realized that location quotient cannot be calculated by comparing country industry size to global average industry size, as developed countries will systematically under-index because their user base covers a greater number and more diversified industries which "dilute" the industry size (in % of total membership). A variety of benchmarking groups were scrutinized by the team, both from an economics perspective, as well as with a consideration of the validation⁵¹ results. The use of Income Group was chosen in the end due to the fairer comparison of economies in similar stages of development as well as improved validation results. Other benchmarking groups that calculated results by global average, and by World Bank region and its minor continent, were also explored. However, due to varied stages of development across countries within these groups, along with inferior validation results, such benchmarking was not pursued further.

Having identified a suitable benchmark group applicable for all countries in the dataset, another question arises on how best to compare a country to an aggregate of countries (e.g. Income Group). Three options were considered: First, an income group could be treated as a whole, where industry size is defined by absolute member count in industry i over total member count in this income group. Second, a weighted mean of each country's industry size based on each country's workforce size. And third, a simple average of each country's industry size, where as a result each country in the income group is treated as an equal-weight economy regardless the size of the country. The third approach is chosen by the team, as it prevents a much larger LinkedIn member count country (e.g. USA) from overpowering the results.

Finally, while Income Group is selected as the benchmark for defining LQ measures on the country level, this does not prevent comparison of LQ measures across diverse country groupings, depending on the analytical question being asked.

c) Validation Results

The LQ for any given industry of a specific country is compared between LinkedIn and ILO data that is constructed in a similar manner. We first present these correlation results for

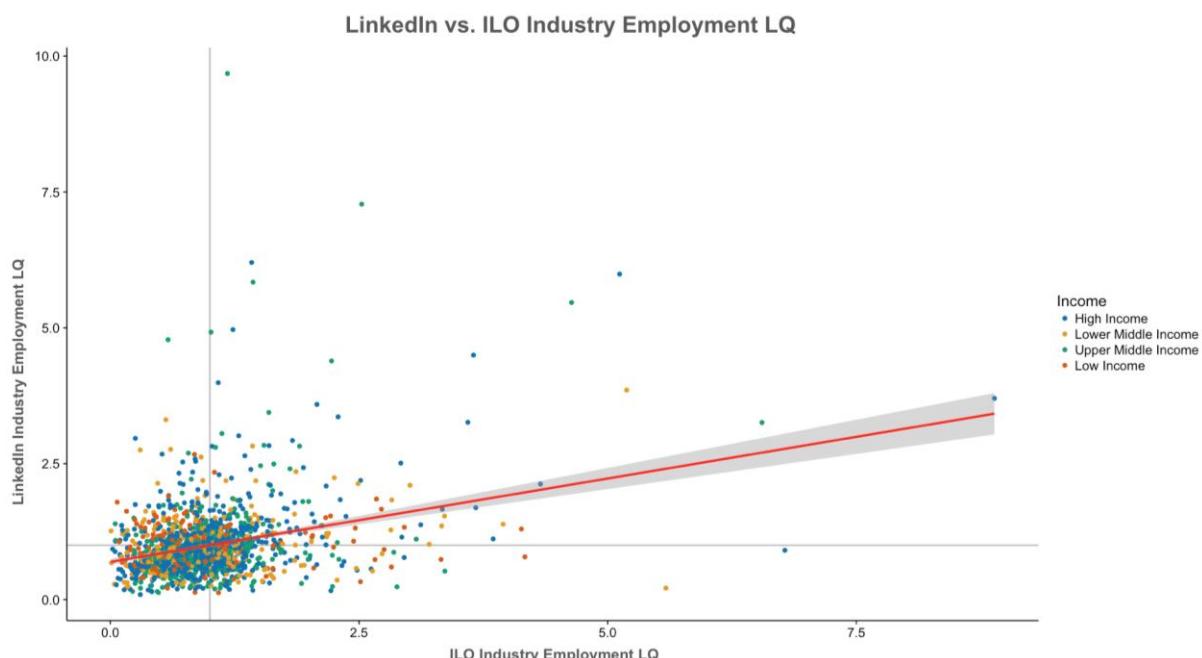
⁵¹ Validating against ILO industry employment measures, for year 2016 data values

all countries and across all industries globally so that readers get a sense of the overall level of confidence -- whether LinkedIn data is able to capture the relative concentration of major industry employment activities or not. We then disaggregate the results by income group, and region, to highlight whether we have a higher confidence level in certain income groups and regions.

(1) Industry Employment Location Quotient Globally

We find that across all countries and all industries (total of 1512 country-industry pairs) there is a positive and statistically significant⁵² correlation of 0.307 between LinkedIn industry LQ and ILO industry LQ, after controlling for income group. This means, the way we constructed the industry LQ metrics in general captures genuine industry employment concentration. This is seen in *Figure IV-1*, giving a positive linear relationship across all LQ country-industry pairs.

Figure IV-1 Country -Industry Pair Location Quotients



Note: Fitted line describes a positive linear relationship given by ILO LQ as a function of LinkedIn LQ. Grey lines, centered at 1 on each axis, represent the position where a country-industry pair has equal industry employment size to its respective Income Group (above/below the line represents greater/smaller industry employment size).

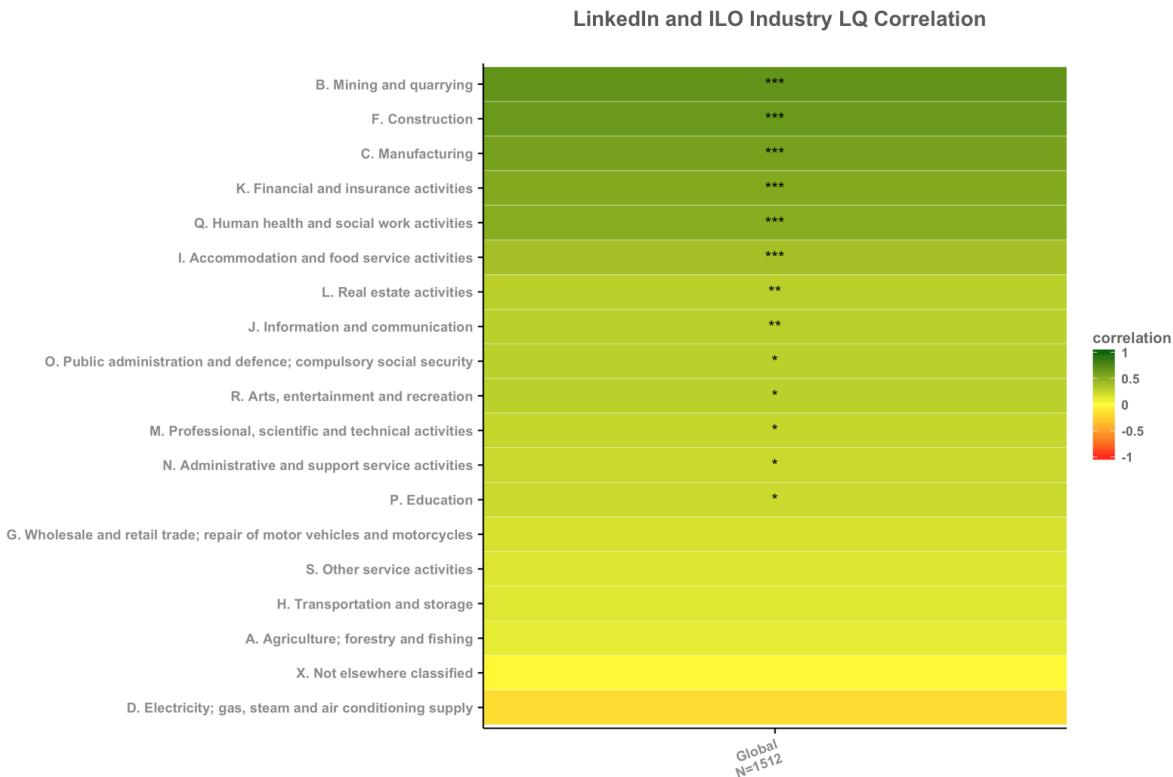
(2) Industry Employment Location Quotient by Industry

The majority of industries display a positive correlation between LinkedIn and ILO data, with over half giving statistically significant correlations. Notably however, Knowledge Sector industries fail to display superior correlation results. For example, while Financial and insurance activities (ISIC section K) has a correlation coefficient of 0.58, Information and Communication (ISIC section J) has a correlation below 0.28. This is likely because section J

⁵² at the 99% confidence interval, given by Pearson Correlation

is the highest penetrated industry on LinkedIn across all countries which leads to section J having a disproportionate over-representation relative to other industries when compared to ILO data. This explains the lower correlation between LI and ILO in this sector.

Figure IV-2 Global Industry LQ Correlation (LinkedIn vs. ILO)

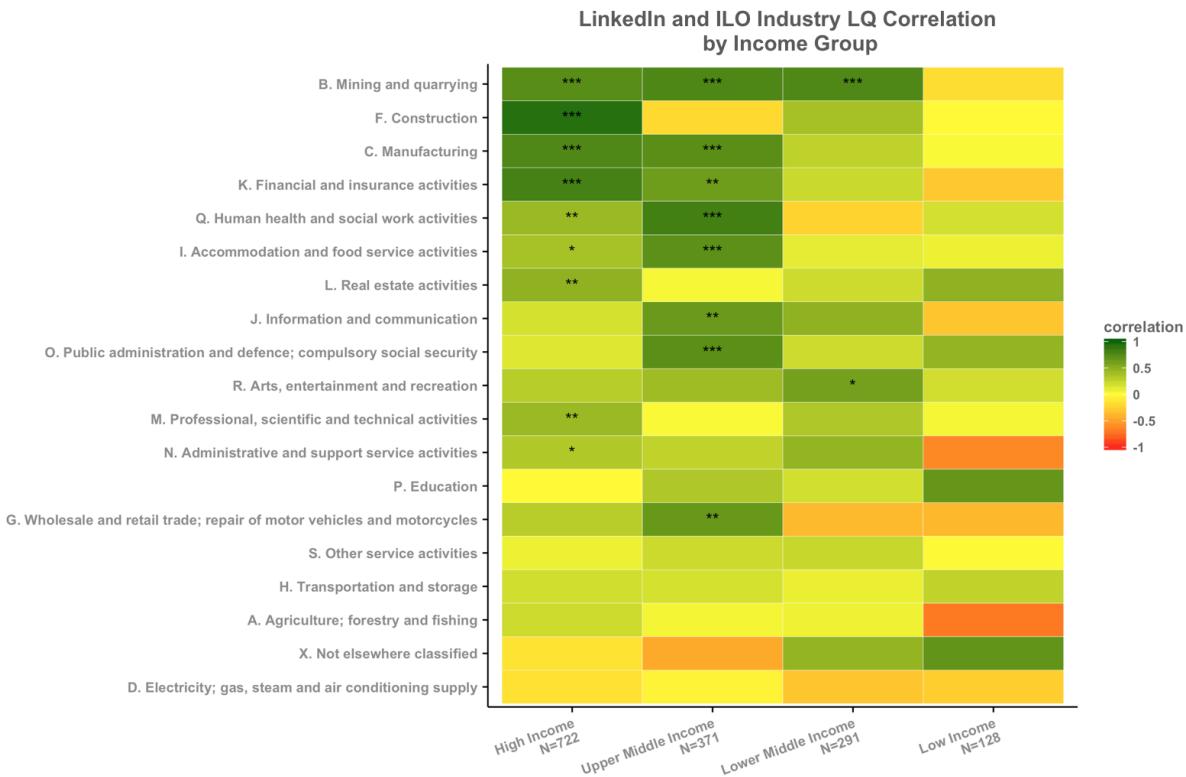


Note: Industries are ranked by global correlation coefficient in ascending order. N = number of country-industry pairs.

(3) Industry Employment Location Quotient by Income Group

Disaggregating the global results by income group, a decreasing trend in both significance and the strength of the correlations is seen as one moves from high income to low income countries (left to right). Knowledge sector correlations in particular are higher as income group level rises probably due to a fairer industry representation in high income countries. It appears that the positive global correlation results presented in the section above are driven by high and upper-middle income countries, with a sharp drop in correlation strength and significance in the lower two income groups. Again, sector J yields poor results even in the high income group for reasons discussed above.

Figure IV-3 Global Industry LQ Correlation by Income Group (LinkedIn vs. ILO)

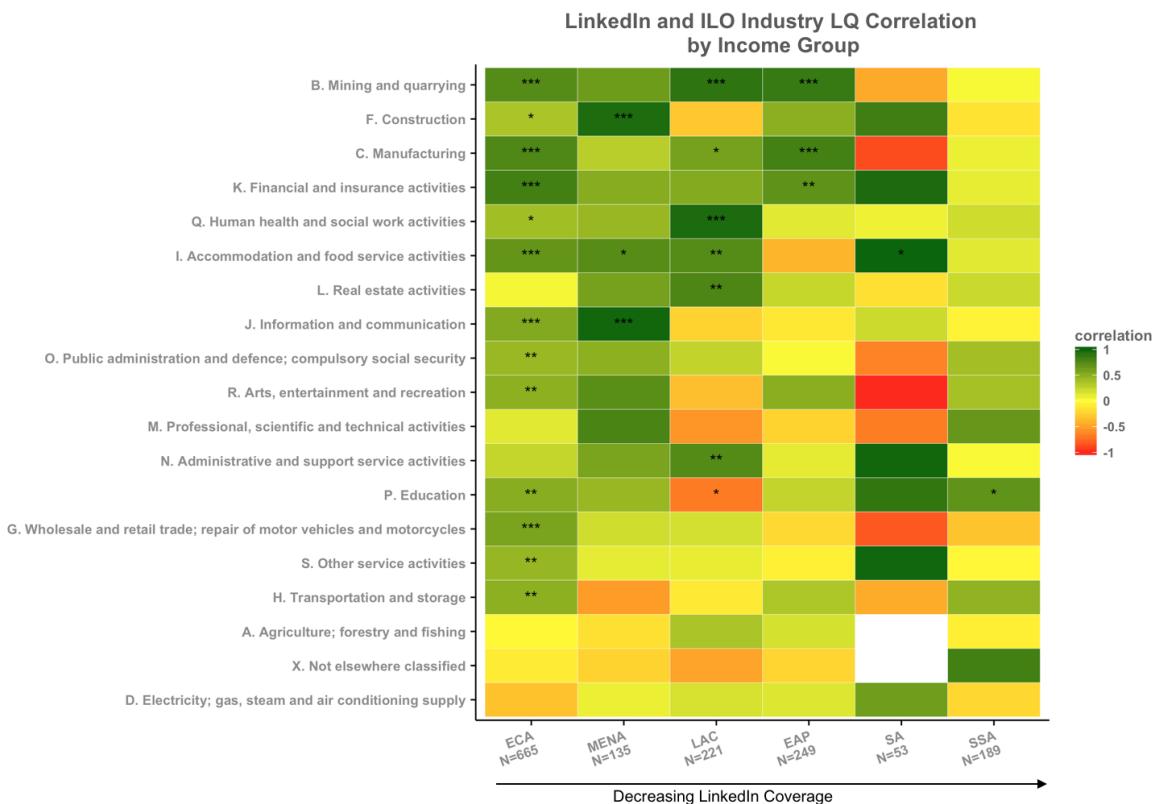


Note: Industries are ranked by global correlation coefficient in ascending order. N = number of country-industry pairs.

(4) Industry Employment Location Quotient by World Bank Region

A similar story is shown when breaking down observations by World Bank regions. Generally, the higher the LinkedIn coverage in a region (i.e. those with at least 20% LinkedIn coverage rate of total workforce), we see stronger correlation between the LQ's. For example, in ECA (Europe and Central Asia), LinkedIn LQ's are closely and positively correlated with ILO across nearly all industries.

Figure IV-4 Global Industry LQ Correlation by World Bank Region (LinkedIn vs. ILO)



Note: Industries are ranked by global correlation coefficient in ascending order. N = number of country-industry pairs.

2) Industry Employment Growth

a) Overview

Capturing industry employment movements across time provides vital information on past and current trends of industry development in a location. We construct a metric based on transitions between industries over time by members on the LinkedIn platform as a proxy for industry employment growth. Note that this metric is derived from a balanced panel of members who have continuously held positions during a three-year period, which does not take into account entrants, exits and members who have employment gaps. This metric likely reflects the transitions between industries among more experienced workers with deeper attachment to the labor market. The purpose of the validation exercise below is to better understand whether the near-real-time LinkedIn employment transitions across industries are able to pick up signals of industry employment growth shown by government data. The exercise shows that despite limitations from a balanced panel, the LinkedIn balanced panel-derived transition rates (hence forth referred to as growth rate) correlates reasonably well with external employment growth rate signals.

Two external time series industry employment data were explored by the team in this validation exercise, 1) ILO and 2) Bureau of Labor Statistics Current Employment Statistics (BLS CES) for the US. As described in the Data Source section and External vs. LinkedIn Data

Matching Methodology Appendix of the paper, ILO offers data across multiple countries, however with considerable limitations on the available length of the time series, as well as varying precision⁵³ of data across countries. These factors move the focus of this section to take a more precise look at the US market where time series industry employment data is more readily available. The US, by far, is also the largest and best-represented market for LinkedIn. Taking this advantage, together with greater access to fine-scale employment statistics is likely to yield a fairer validation result, even though it is not a global-level validation.

Box 2: Why do we construct a balanced panel data from LinkedIn?

LinkedIn membership is observing consistent (if not exponential) growth in since its establishment in 2002. If we look at industry employment growth by simply calculating the differences in industry employment levels over years, this can be problematic as the headcount increase in a particular location might be largely driven by new users signing up for a LinkedIn account. This is especially true in developing countries, where LinkedIn is experiencing exponential growth.

To isolate real industry employment growth from LinkedIn business growth, we freeze membership at any given point in time and construct members' work experience backward. This creates a balanced panel where the members are the same across years and we compare the size of employment in an industry over time as a proxy for the industry employment growth.

However, one of the drawbacks of this approach is that we have to limit the balanced panel to only include members with a job in all years. Because of this, we are essentially capturing industry transition for experienced hires, but no new entrants or exits (note that exit is less likely to be picked up by LinkedIn as members do not have the incentives to voluntarily report on LinkedIn that they have lost a job and are unemployed). Because the panel is balanced, some industries will experience a net gain in employment and some industries will experience a net loss in employment. In other words, we are measuring how well industries are performing in terms of employment relative to each other. For a detailed explanation on the pros and cons of the using the balanced panel data and alternative datasets considered, please see Table II-1.

To capture new entrants, we have to separately construct another repeated cross section dataset for recent graduates looking at their first job after graduation, and their subsequent industry transitions later on should be picked up by the balanced panel dataset mentioned above. This recent graduate dataset is noisier than the balanced panel, in the sense that there is no way to separate LinkedIn business growth among recent graduates from a genuine school cohort size.

By constructing a balanced panel dataset, we can separate to some extent the real industry employment signals from noise created by LinkedIn's business' exponential growth -- an intrinsic feature of social media platforms these days.

b) Methodology

⁵³ Precision is composed of factors such as coverage of industries, survey sample size, as well as variation in surveys across countries and years (i.e. 2014 and 2016).

Given monthly BLS CES data at the national level, a LinkedIn balanced panel data set is constructed for the time period Jan 2015-April 2018 for comparison. Both data sets are given as absolute count of individuals within each industry, from which monthly growth rates are derived as

$$\text{Growth Rate}_{i,m+1,y} = \frac{\text{industry size}_{i,m+1,y} - \text{industry size}_{i,m,y}}{\text{industry size}_{i,m,y}} * 100$$

where, i is BLS industry super-sector⁵⁴, m is month, y is year with a total of 39 monthly growth observations per industry⁵⁵. Subsequently, monthly growth rates are compared between LinkedIn and BLS by running Pearson correlation tests as well as simple linear regression models⁵⁶ across the entire data set as well as industry by industry.

Box 3: Why Correlating Industry Employment Growth between ILO and LinkedIn doesn't yield the expected results?

Considerable effort has been taken by the team in understanding the best way to construct a panel dataset which accurately captures industry employment movements. A key lesson learned is that it is very difficult to find an apples-to-apple comparison for validation. For example, in ILO, industry employment growth (G) is given as $G = X + Y + Z$ (*new entrants, existing employees changing jobs, and exits*), while LinkedIn growth may be mainly given as $G = Y$ (*existing employees changing jobs*). In addition, the global industry growth data over time on ILO requires strong assumptions, extrapolation and harmonization methods across countries and across years, which further adds noise to the ILO industry employment growth data.

Correlating industry growth across all country-industry pairs between LinkedIn and ILO (between 2014 and 2016 as ILO is available for these two years) resulted in a correlation coefficient of 0.138 at the 99% confidence interval. Additionally, low and statistically insignificant correlations were seen for even well represented industries on LinkedIn (i.e. J. Information and Communication), while unexpectedly strong results were seen for the Manufacturing industry (ISIC section C). It is difficult to differentiate whether the unexpected validation results are due to methodological issues or noise from the external data source. Therefore, the team focuses on looking for more comparable and high quality external data (i.e. US BLS monthly data) for this validation exercise.

c) *Validation Results*

⁵⁴ BLS super-sectors are composed of multiple NAICS sectors and roughly equivalent to ISIC 1-digit level, please see the link for more information on BLS super-sector mapping: <https://www.bls.gov/sae/saesuper.htm>

⁵⁵ We multiply this with 11 BLS Super-sectors, yielding a total of 429 observations from each source.

⁵⁶ Simple linear specification of BLS monthly growth as a function of LinkedIn monthly growth.

(1) Industry Employment Growth across all BLS Super-sectors

Taking all 429 industry-month observations across the 11 BLS Super-sectors, for both LinkedIn and BLS data yields a correlation of 0.30 at the 99% confidence interval. The results are promising, considering the inclusion of industries with particularly low LinkedIn penetration and the potential noise due to time lag of LinkedIn members updating their LinkedIn profile to reflect industry transition. Additionally, modelling BLS growth as a function of LinkedIn growth yields a positive coefficient at the 99% confidence interval – reaffirming the directional relationship and correlation between sources.

(2) Industry Employment Growth by each BLS Super-sector

Breaking down the merged dataset by each super-sector, all sectors display positive correlation (where 7 out the total 11 sectors display statistically significant correlation of 0.25 and higher). Among knowledge and tradable sectors where LinkedIn has particularly strong coverage, we find “Trade, Transportation, and Utilities”, “Mining and Logging”, “Education and Health Services”, “Information,” “Professional and Business Services,” and “Financial Activities” are also statistically significant. A summary of correlation and statistical significance by super-sector is shown in *Figure IV-5*.

Figure IV-5 Super-sector Industry Employment Growth Correlation (LinkedIn vs. BLS)

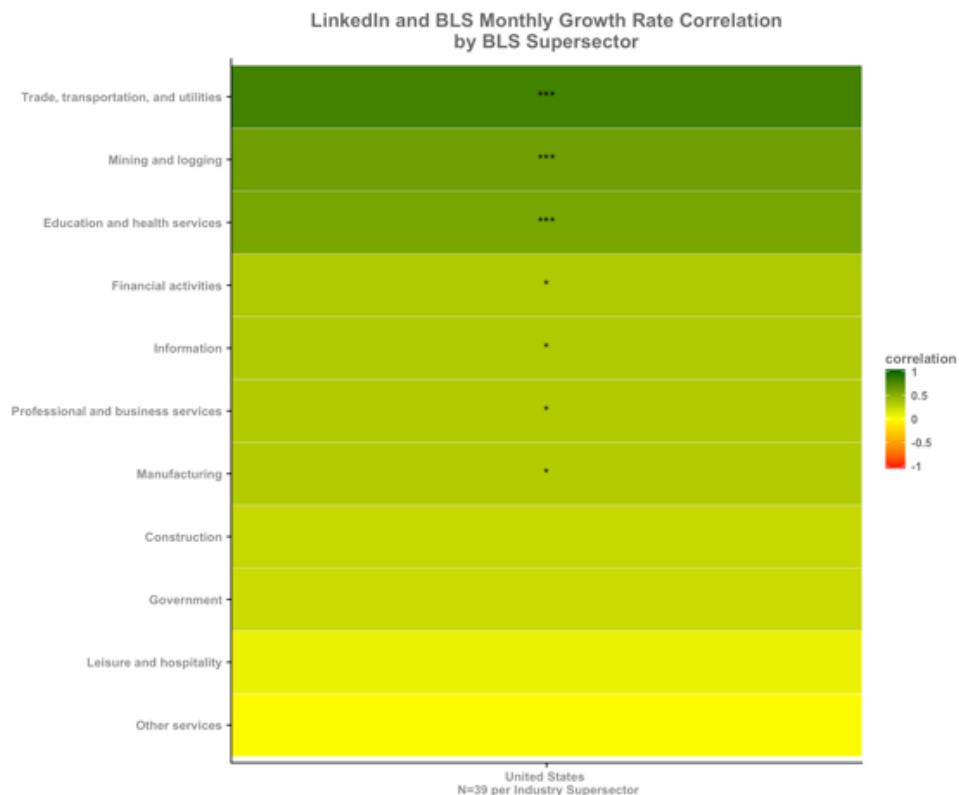


Figure IV-6 and Figure IV-7 show month by month industry movements from both sources. Figure IV-6 is subset by those 7 industries that show positive statistically significant correlation. In general, LinkedIn appears to track BLS closely. Furthermore, LinkedIn displays a “smoothing average” and less dramatic jumps when compared with BLS, likely reflecting the time lag of LinkedIn members updating their profile information when they change industry. This effect is particularly prominent in the “Financial Activities” sector.

Figure IV-6 Monthly Growth of Super-sectors with sig. cor. (LinkedIn vs. BLS, Jan 2015 – Apr 2018)

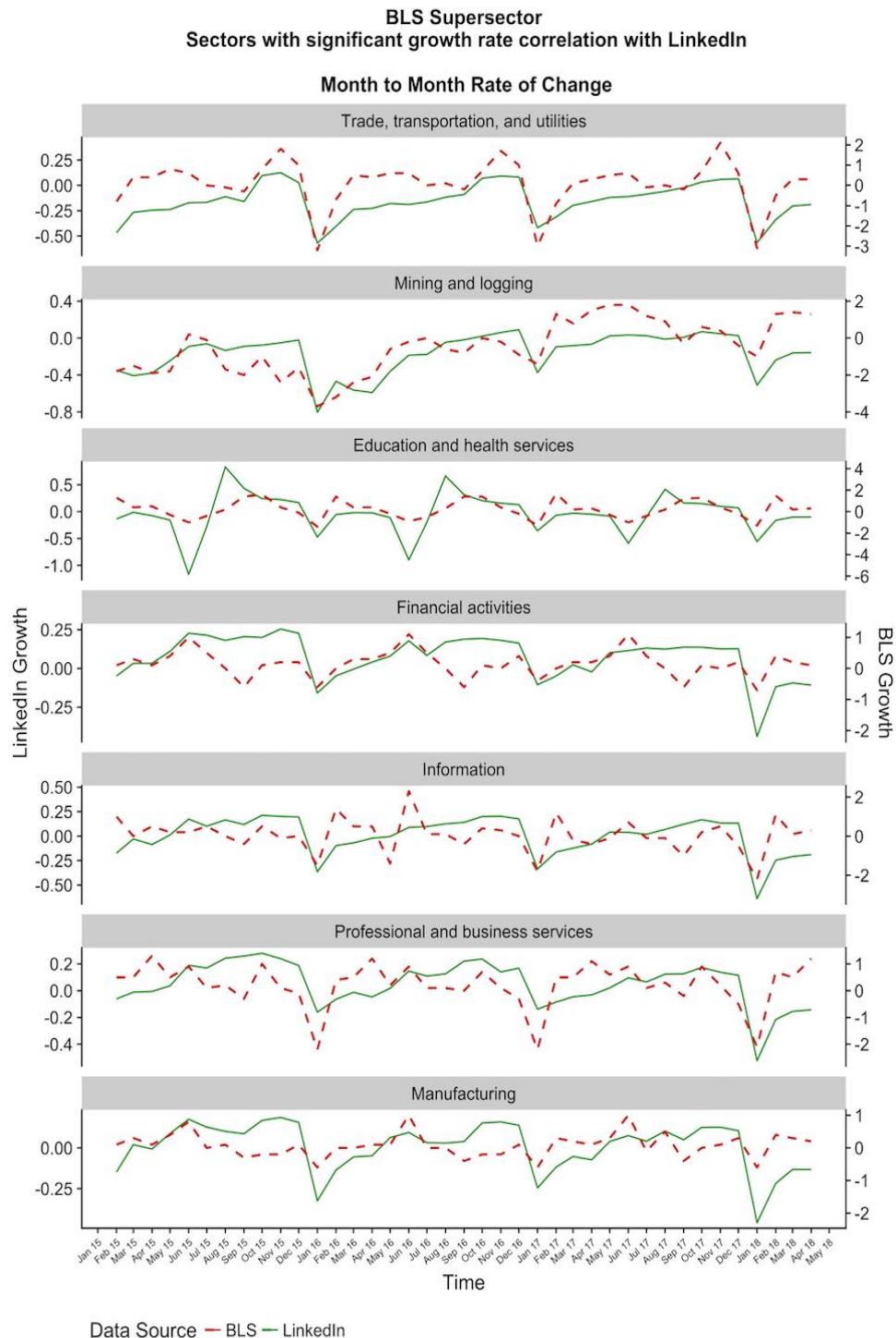
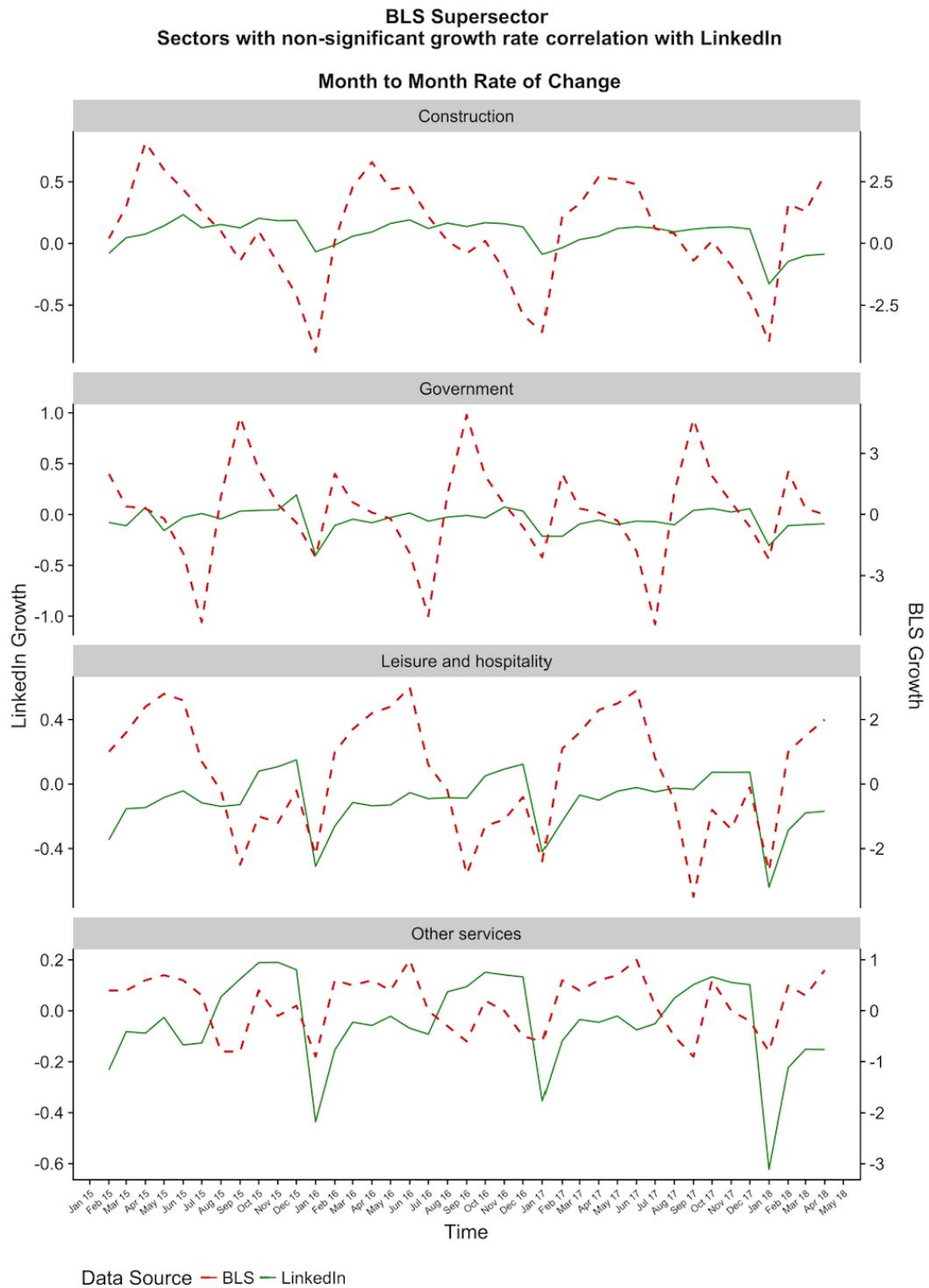


Figure IV-7 Monthly Growth of Super-sectors with non-sig. cor. (LinkedIn vs. BLS, Jan 2015 – Apr 2018)



B. Industry Skills Needs

a) Overview

Measuring industry skills needs, is central to identifying opportunities that are needed for effective skill development policies to promote a competitive labor force that in turn fosters private sector growth and job creation. This section discusses how to derive skills needs in each industry and their validation results.

In order to compare skills needs across different industries, taking into account different occupation composition within the same industry across countries, as well as the different timing and frequency a member would update his/her skill profile (e.g. after creating a LinkedIn profile vs. after changing to a new job), this requires careful treatment how to extract reliable skills metrics that describes genuine industry skills needs.

Two skill metrics were derived: 1) top most represented skills in an industry [given by the top ranked skills] and 2) skill penetration rates [given as a number] in an industry. Top most represented skills in an industry showcase a list of most distinctive and represented skills possessed by members working in the industry. Skill penetration rates measure the time trend of different skills that show up among the top most represented skills across different occupations in an industry.

Both metrics aim to provide a picture of the skills needs of an industry globally and over time, but they approach the industry skill profiles from different angles. Top most represented skills paint a general picture of skills reported by members working in the industry. In contrast, skills penetration rates look at how skills are associated with different jobs across industries and shows the time trend of the change. In other words, it measures how the representativeness of skills change for the occupations in an industry over time.

b) Methodology

(1) Top Most Represented Skills

i. Identifying the most represented skills

In order to identify the most represented skills for an industry in a given country, we map the industry into a vector space in which each skill is a dimension. The most represented skills are the ones that have the highest weights (w):

$$[(skill_1, w_1), (skill_2, w_2), \dots, (skill_n, w_n)]$$

where n is the total number of skills in any industry and any country.⁵⁷ Taking the internet industry in the US as an example, we illustrate how we calculate the weights below.

To illustrate, to compute weights for each skill in an industry, we first select all members who work in this industry. We then count the number of times each skill appears in the LinkedIn

⁵⁷ A skill vector includes all the skills that are relevant to any industry in any country. This ensures that all skill vectors have the same length so that skill vectors for different industries and different countries can be compared. If a particular skill is not relevant to an industry in a country, the weight would be 0.

profile under the “skills” section among these members. For example, if we are interested in identifying the most represented skills of the internet industry in the US, we first find all members working in the internet industry, extract skills from their profiles and compute the weight for each skill as the count of members having that skill. This initial approach results in the following skill vector (showing the top 10 skills with the highest weights):

microsoft excel	microsoft office	data analysis	sql	microsoft powerpoint	microsoft word	python	research	leadership	r
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The problem with the member count approach, as evident from the above example, is that a set of generic, cross functional skills such as microsoft excel and microsoft office occupy the top spots in the skills vector. These skills hardly are representative of the group of people under consideration. In fact, we find this is often the case for all the industries. We address this issue in two ways.

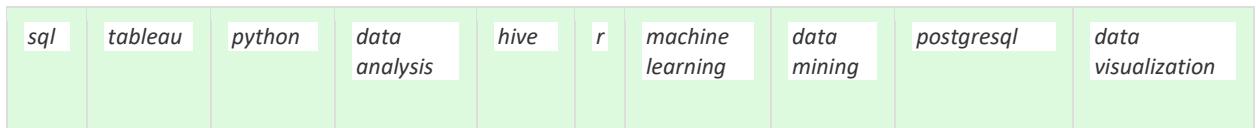
First, we match positions with skills added during the period that a position is held. This is because we find that members are likely to include generic and cross functional skills to their profile even if these skills are not representative of the industry they work in. Such skills are often not added as they are acquired or as a result of experience on the job. We call the approach to associate skills only with positions during which the skills are added a “skills flow” approach. This is compared to a “skills stock” approach where we associate all the skills on a member’s profile added prior to and during a given job title/position. In addition, career trajectory is often “non-linear”. When members switch occupations or industries, skills acquired in previous jobs are not necessarily associated with future jobs. Lastly, the “skills flow” approach is also more likely to discern changes in skills composition over time than the “skills stock” because emerging skills are less likely to be buried in the large amount of historical skills that members have from long time ago. In the illustrative case above, matching positions with skills added on the job results in the following skill vector:

data analysis	sql	python	tableau	microsoft excel	microsoft office	r	microsoft powerpoint	microsoft word	hive
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Second, we further adjust the weight to downweigh skills that are common across many industries. For each skill i in industry-country pair j , the weight is computed as:

$$w_{ij} = m_{ij} * \ln\left(\frac{N}{n_i}\right)$$

where m_{ij} indicates the number of members in industry-country pair j having skill i , N is the total number of industry-country pairs and n_i represents the total number of industry-country pairs having skill i . The second logarithmic term downweights skills that are common across many industries. For example, if a skill appears in every industry and country, then N equals n_i . The second term and the final weight would be both close to zero. In other words, the skill is hardly representative of any particular industry in any country. This weighting scheme is one form of the TF-IDF technique that is commonly used in text mining. After applying the TF-IDF technique, we have the new weighted skill vector:



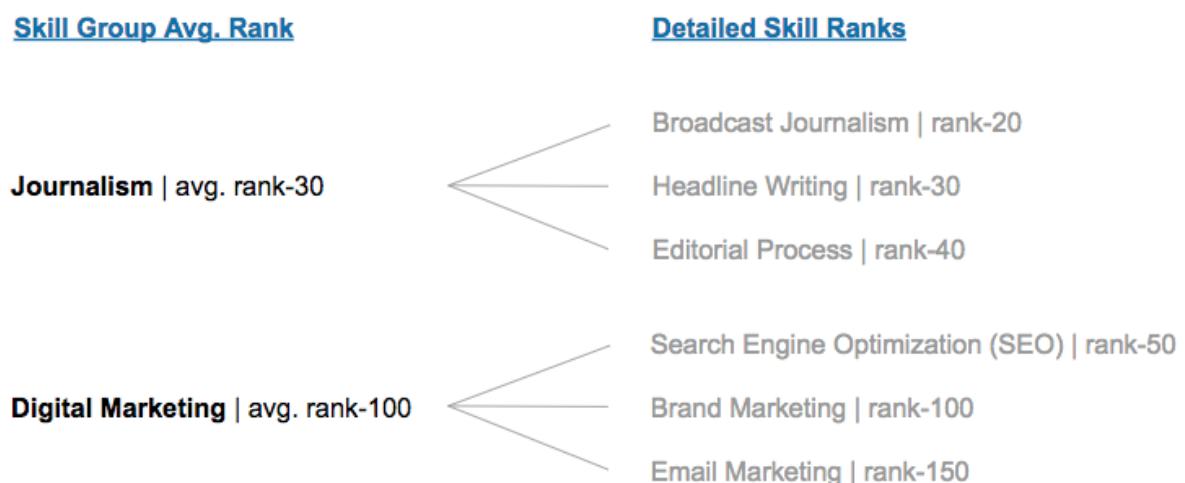
We use skills added in 2015, 2016 and 2017 separately to compute the most represented skills for each year. This provides a time series to discern changes in skills needs of an industry over time. For each industry-country pair, we rank the most represented skills by the descending order of their weight to derive the most represented skills for each industry and for each country.

ii. Aggregating skills to groups of skills

LinkedIn has an enormous library of individual skills. For the ease of analysing meaningful general trends of skills, we further group individual skills into broader categories. For example, python and C++ are grouped into ‘development tool’ skill group, online marketing and search advertising are grouped into ‘digital marketing’ skill group. To construct the skill groups, skills are clustered based on the likelihood of co-occurrence of skills on LinkedIn profiles. A detailed list of skills and their corresponding skill groups can be found in the Skill Group Classification Appendix.

For an industry-country pair, based on the list of most represented skills, we average the ranking of all the skills in a given skill group to arrive at the average ranking of the skill group – see Figure IV-8 for an illustrative example. We perform this exercise for each skill group. As a dummy example, for the *Online Media* industry in a given country, we would compute the skill group average rank for two skill groups “Journalism” and “Digital Marketing” as the following.

Figure IV-8 Example of Aggregating Detailed Skills to Skill Groups



In order to identify the most represented skill groups for each industry globally, for each skill group-industry pair we take an average of the ranking of the skill group across all the countries. Then for each industry, we rank the skill groups by its average ranking.

(2) Skill Penetration Rate

To measure the penetration rate of a skill group for a given industry, there are four steps in computing the penetration rate. First, we use the framework developed above to identify the most represented skills for each occupation in an industry.⁵⁸

Second, we measure how prevalent is a skill group for a given industry-occupation pair. We limit each skill vector to the top 30 most represented skills.⁵⁹ Among the top 30 skills that belong to different skill groups, we count the number of skills for each of the skill group. Among the top 30 skills, the more skills showing up for a skill group, the more important this skill group is for a given industry-occupation pair. We limit to the top 30 skills in order to make sure that we focus on the part of skill vectors that are of better quality and have less noise.

Third, we calculate the skill group penetration rate on the occupation level by dividing the number of skills that show up in the skill vector and belong to the same skill group by the total length of the vector. Since the skill vector is cut off at top 30 skills, the denominator is 30 for all industry-occupation pairs.

Lastly, we take an average of the skill group penetration rate across occupations within each industry to generate the industry-level skill group penetration rate.⁶⁰ We do this for different time periods to generate the time trends of industry skills penetration.

Box 4: An example to calculate ‘digital marketing’ skill group’s penetration rate in ‘Information Technology & Services’ industry

We illustrate the calculation of skill group penetration by using the ‘digital marketing’ skill group and the Information Technology & Services industry as an example. The digital marketing skill group includes 77 skills such as online marketing and search engine optimization. The global Information Technology & Services industry includes over 1300 occupations such as software engineer and digital marketing specialist in 2015.

Among the top 30 most represented skills of digital marketing specialist in the Information Technology & Services industry, 13 skills belong to the ‘digital marketing’ skill group. As a result, the ‘digital marketing’ skill group has a (13/30) 43% penetration rate among digital marketing specialist in the Information Technology & Services industry. By the same means, we can calculate

⁵⁸ We do not create skill profiles at the occupation-industry-country level because we do not have sufficient skills data to do so. Instead we create skill profiles at the occupation-industry level.

⁵⁹ We restrict the dataset to industry-occupation pairs that have more than 30 most represented skills in order to maintain sufficient skill data to compute skill penetration rates.

⁶⁰ For example, ‘accounting’ skills group can appear in many occupations within the finance industry and hence need to average across occupations within the finance industry to calculate accounting skill penetration rate.

the ‘digital marketing’ skill group penetration rate for software engineers, which, not surprisingly, turns out to be 0%.

Lastly, we perform the same ‘digital marketing’ skill group penetration calculation for all the other occupations in the Information Technology & Services industry and then average penetration rates across these occupations to arrive at 1.4% skills penetration rate for the ‘digital marketing’ skill group in the Information Technology & Services industry in 2015.

2) Validation Results

Since there is no direct measure of skills penetration rate by industry for each country globally, we conduct validation by comparing skills similarity between country A versus the US, and country A’s development outcomes versus the US – this requires the assumption that if a country has similar skills composition as the US in the same industry, it should generate similar development outcomes as the US, such as value added per worker. To limit this validation exercise within a workable scope, we focus on the *ISIC Section J - Information and Communication*.

First, having skills vectors for two industry-country pairs (G_1 and G_2), we can compute skill similarity between the two countries by computing cosine similarity between the two vectors:

$$\text{Skill Similarity} = \frac{G1 \cdot G2}{|G1| * |G2|}$$

where for each industry j and a total of n skills, each G is $[w_{1j}, w_{2j} \dots w_{nj}]$. Note that cosine similarity is invariant to country size thus not biased by country size or LinkedIn membership size.⁶¹

Then, we collect three development outcomes, value added by worker, PIAAC problem-solving skills score, and ICT development index and correlate these outcomes with skills similarity index for each country. A description of each of the three development outcomes are as follows:

(1) Value added per worker by industry

We developed a mapping between LinkedIn’s industries and the ISIC industries so we can follow the same framework and derive the skill needs for the ISIC industries. we are able to use OECD, ILO and WBG data to collect value added (VA) data by industry and correlate VA with the skills similarity index.

Value added by industry as a share of total value added for each country was obtained from OECD data. This data was then combined with WB WDI gross value added country data at constant 2010 USD, in order to get the absolute level of value added for a specific industry. As a last step, we divided our levels of value added by total employment in a given country

⁶¹ For example, if a country doubles in size, as long as the number of skills members have proportionately increases, the cosine similarity would remain the same.

and industry division as reported by the ILO to derive value added per worker. We compare the difference in VA per worker between countries as a measure of the productivity gap and correlate this gap with skills similarity between countries and see whether the latter term can explain the productivity gap. In particular we use the USA as the benchmark or “frontier” country.

(2) PIAAC IT skills score of ‘Problem solving in technology-rich environments’

We correlate skill similarity index within *Information and Communication Industry* with the performance difference between countries in IT Skills in ‘problem solving in technology-rich environments’ section of PIAAC 2016. The Programme for the International Assessment of Adult Competencies (PIAAC) is an international assessment of adult skills managed by the OECD with data available for 34 countries from 2015. It focuses in three kind of skills literacy, numeracy, and ‘problem solving in technology-rich environments’ (PS-TRE).⁶²

The scale of PS-TRE is divided into four levels of proficiency (Levels 1 through 3 plus below Level 1). The features of the tasks at these levels are described in detail in Table 2.3, in an OECD skills study⁶³. We used two indicators for the validation exercise: PSL11 which is the proportion of 16-65 year-olds scoring at level 2 and 3 in PS-TRE, and the mean score of the level 3 performers (IT Level 3). To test the correlation of these indicators with our skill similarity measure, we used the US as the benchmark country.

(3) ICT Development Index Data

The ICT Development Index (IDI)⁶⁴, is available from 2009 to 2017 for 176 countries. It combines 11 indicators into one benchmark measure⁶⁵. It is used to monitor and compare developments in information and communication technology (ICT) between countries and

⁶² In PIAAC, PS-TRE is defined as using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks. PS-TRE assesses the cognitive processes of problem solving—goal setting, planning, selecting, evaluating, organizing, and communicating results. The core aspects of the PIAAC PS-TRE assessment requires to master of foundational computer (ICT) skills, including (a) skills associated with manipulating input and output devices (e.g., the mouse, keyboard, and digital displays), (b) awareness of concepts and knowledge of how the environment is structured (e.g., files, folders, scrollbars, hyperlinks, different menus or buttons), and (c) the ability to interact effectively with digital information (e.g., commands such as save, delete, open, close, send). It involves familiarity with electronic texts, images, graphics and numerical data, the ability to locate, evaluate, and critically judge the validity, accuracy, and appropriateness of accessed information.

⁶³ https://www.oecd-ilibrary.org/education/skills-matter_9789264258051-en.

⁶⁴ <http://www.itu.int/net4/ITU-D/idi/2017/index.html>

⁶⁵ The ICT development process, and a country’s evolution towards becoming an information society, can be depicted through three-stages: readiness, intensity and impact. Based on this conceptual framework, the IDI is divided into the following three sub-indices, and a total of 11 indicators: **Access sub-index:** captures ICT readiness, includes five infrastructure and access indicators (fixed-telephone subscriptions, mobile-cellular telephone subscriptions, international Internet bandwidth per Internet user, households with a computer, and households with Internet access). **Use sub-index:** captures ICT intensity, includes three intensity and usage indicators (individuals using the Internet, fixed broadband subscriptions, and mobile-broadband subscriptions). **Skills sub-index:** capture capabilities or skills which are important for ICTs. It includes three proxy indicators (mean years of schooling, gross secondary enrolment, and gross tertiary enrolment). As these are proxy indicators of ICT-related skills, is given half weight than the other two sub-index.

over time, and the extent to which countries can make use of them to enhance growth and development in the context of available capabilities and skills. To test the correlation of these indicators with our skill similarity measure, we used the US as the benchmark.

(4) Correlation results

We find evidence that skill differences could explain differences in industry-specific value added per worker and ICT-related development measures across countries for members working in the Information and Communication industry. We correlated a skill similarity measure to indicators of value added per workers (relative to the US), PIACC Skills Score in technology-rich environment, and ICT development (relative to the US). This contributes to the economics of education literature that investigates the role of human capital to the economic performance, which typically references education and standardized test rankings.

For each sub-industry within ISIC Section J (Information and Communication), we found positive but insignificant correlation between skills similarity index and value added per work difference. We found a positive correlation of the skills similarity index with o IT skills scores in the ‘problem solving in technology-rich environments’ section of PIAAC. For skills difference and the ICT development difference, the correlation was significant for four sub-industries within Information and Communication sector ranging from .41 to .64, with sub-industries like Programming and Information Services scoring highest.

Table IV-1 Correlations between skills and development outcomes (US as the benchmark)

Variable	VApctUS	Obs	ITLevel3	Obs	PSL11	Obs	ICT-DI	Obs
<i>Section J</i>								
Programming	0.282	27	0.504**	21	0.406*	21	0.638***	53
Information services	0.140	27	0.407*	21	0.319	21	0.480***	53
Communication	0.088	27	0.105	21	0.026	21	0.449***	52
Telecommunications	0.078	27	0.218	21	0.087	21	0.412***	53
Broadcasting	0.028	27	0.354	21	0.253	21	0.211	52
Publishing	-0.053	27	0.138	21	0.144	21	0.115	53

Once we control for a specific occupation within the information and communication sector, our correlation results improve. Looking at the skill vector of Software Engineers in the entire information and communication sector, we found that our measure of skill similarity to the US is positively correlated with the proportion of 16-65 year-olds scoring at level 2 and 3 in PS-TRE (PLS11), and the mean score of the level 3 performers (IT Level 3), both correlations are statistically significant with p-value below 0.05.

Table IV-2 Correlations with Software Engineer in Section J skills vector (US as the benchmark)

Variable	VApctUS	Obs	ITLevel3	Obs	PSL11	Obs	ICT-DI	Obs
<i>Section J</i>								
Software Engineer	0.233	26	0.612	22	0.608	22	0.518	53
T-stat	1.173		3.460		3.428		4.329	
P-value	0.252		0.002		0.003		0.000	

C. Talent Migration Metrics

a) Overview

Monitoring international flows of migrants is key to designing effective talent attraction and retention policies. However, migration data tend to be coarse, inconsistent across countries, expensive to gather, and available only with a considerable delay. This section presents LinkedIn profile data as an alternate source for measuring migration and how this data compares to OECD migration flows data. A natural derivation from the talent migration metric is to look at the skills gained and loss, as well as the industries associated with these talent movements. Since there is no equivalent dataset for validation of these latter two derived metrics, their formulas are not detailed here but can be found in the Executive Summary Section.

b) Methodology

We compare migration outflows in the entire year of 2015, normalized by LinkedIn country member counts at the end of 2015 (for calculating migration rate using LinkedIn data) and by the OECD population figures for 2015 from the country of origin (for calculating migration rate using OECD data), which is denoted as country A below, interpreted as flows from Country a to Country b normalized by country membership per 10,000 members.

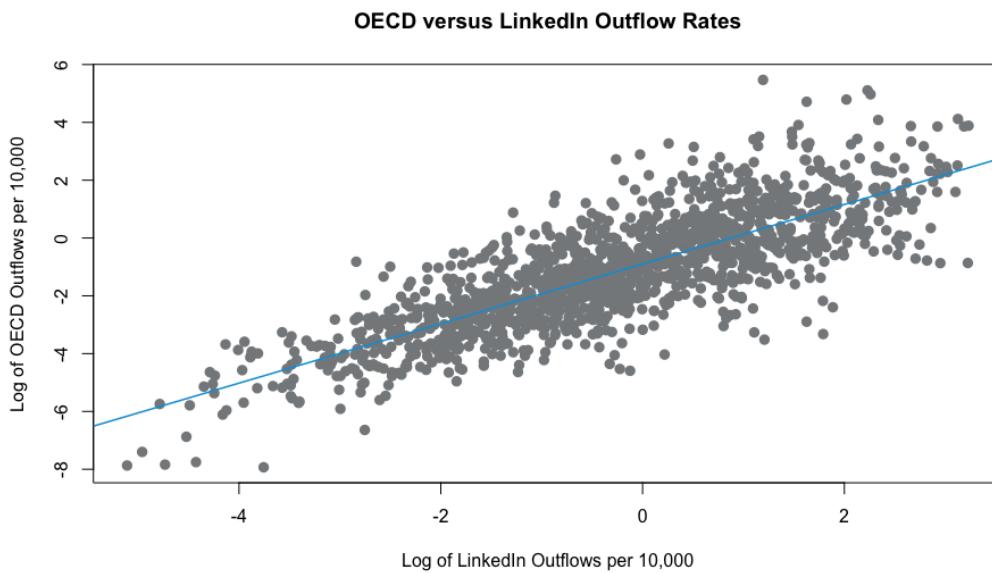
$$\text{Normalized Migration Outflows}_{a,b} = \frac{\text{total outflows}_{a,b}}{\text{member count}_{a,2015}} * 10,000$$

c) Validation Results

(1) Talent Migration Globally

The correlation of all 1447 country pairs (Figures IV 8-IV 9), without removing outliers, is 0.304 at a significance level of 0.001. These results, however, include outliers – many of which correspond to inflows to Germany from countries such as Syria and middle income countries in Eastern Europe; and Middle Income countries in Latin America and the Caribbean to the United States (see Migration Validation Country List and Coverage Appendix *for complete list*). Removing these improves the correlation (Pearson's product-moment=0.439; sig. level 0.001). In addition, we address these outliers and differences in scale by log transforming both outflow rates. These log transformed rates are highly correlated (Pearson's product-moment correlation 0.804; at a significance level of 0.001).

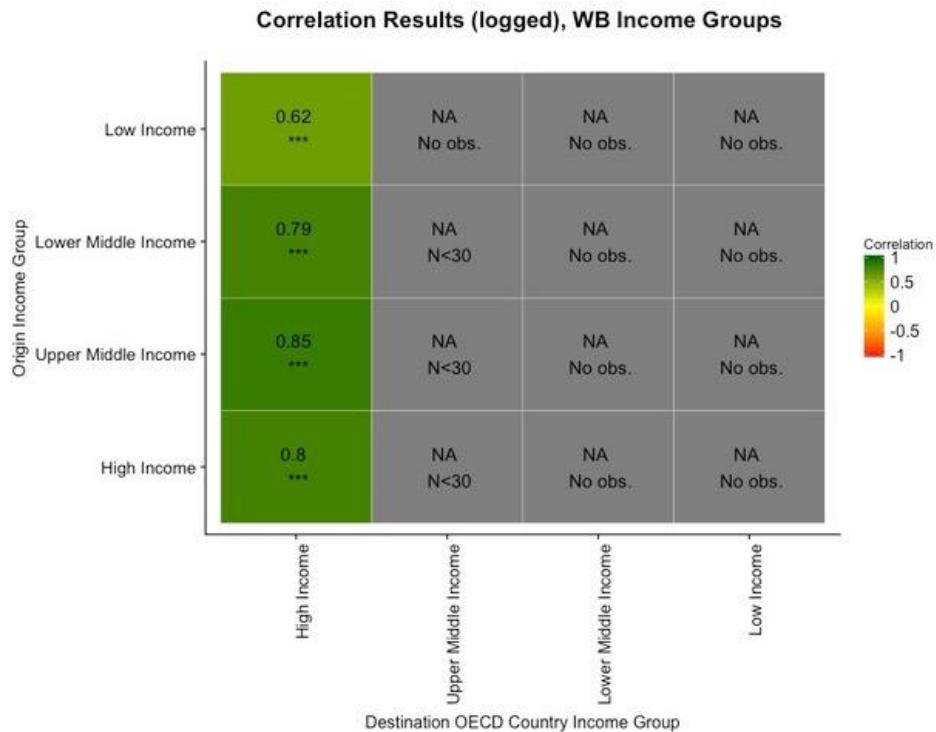
Figure IV-9 Log Transformed Outflow Migration Rate OECD Data vs. LinkedIn



(2) Talent Migration by Income Group

Sub-setting to income groups leaves four out of 16 subsets with at least 30 country pairs to correlate (Figure IV-10). The data limitations are due to OECD data availability, since the OECD only offers inflow data for OECD countries. Within this available data, LinkedIn best tracks migrations amongst higher income countries. This is likely due to skilled economic migration (a group more likely to be captured by LinkedIn) making up a larger share of the migration amongst those countries compared to low income countries where more migration is likely forced.

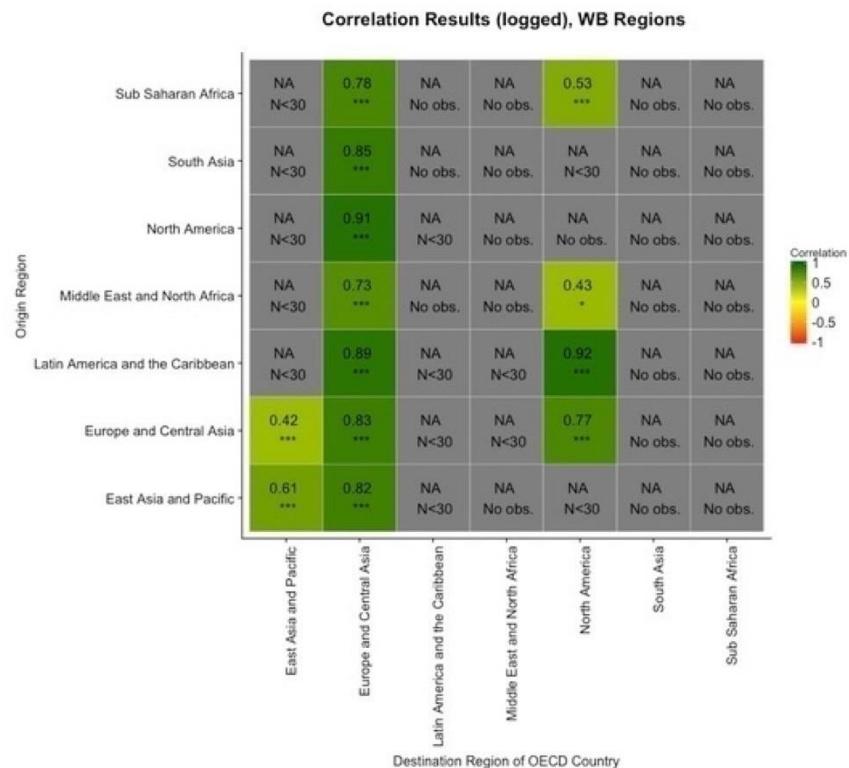
Figure IV-10 Migration Correlation Results by Income Group (Log transformed)



(3) Talent Migration by World Bank Region

Sub-setting to World Bank regions leaves 13 out of 49 possible subsets with at least 30 country pairs to correlate (Figure IV-11). Migration rates correlate best in markets where LinkedIn is most widely adopted in both the origin and destination regions. For example, correlations of migration rates of North Americans moving to Europe and Central Asia (0.91), or Latin Americans moving to North America (0.92), are amongst the strongest. Conversely, correlations of migration rates from countries in the Middle East and North Africa (0.43), where LinkedIn is less prevalent, to North America, are comparatively weaker.

Figure IV-11 Migration Correlation Results by World Bank Region (Log transformed)



V. Sample Visualization Outputs Using LinkedIn Metrics and Country Applications

Now that we understand LinkedIn data's main characteristics as well as the derived metrics that are made available under this World Bank Group-LinkedIn partnership, in this section we provide some examples on how we transform these metrics into benchmarking visuals and apply them to World Bank projects. All these visuals together with the underlying dataset are made available at: www.worldbank.org/linkedin.

The full range of metrics are made available at both the country and city level. Country level examples are shown in this paper, with similar methodologies applied to city-level insights. Furthermore, given the intended audience, use and LinkedIn data characteristics and global workforce coverage rate, all visuals are limited to 6 *Tradable Sectors*⁶⁶ to ensure global benchmark results are based on a decent sample size with relatively fair sample representativeness across countries. Finally, to control for noise and make the skills metrics more actionable, skills are reported at skills group level. This maintains some level of detail but at the same time ensures enough sample size to conduct skills analysis (e.g. we report the 'robotics' skill group instead of 'mechatronics' skill which is one of the detailed skills within robotics). The LinkedIn data currently has about 250 skill groups that includes the top ~10,000 most reported detailed skills on LinkedIn. As new skills start emerging on the LinkedIn platform, the skills taxonomy will be updated to reflect the latest skills trends.

The sample visualization outputs are presented in the following sections. Section A. Industry Employment Dynamics, provides insight on the comparative advantage of a country in industry employment concentration as well as the latest industry employment growth trends. Section B. talks about the latest industry skills needs to inform workforce planning and training policies. Section C. talks about talent migration trends and the associated skills and industries that are gained and loss. Last but not least, to ensure fair and ethical use of LinkedIn member profile data, each metric in the visualization outputs are based on aggregated measures -- the most detailed level of observation in the dataset has to reach at least 50 observations to report an aggregated value.

A. Industry Employment Dynamics

Sample visualization outputs begin with an overview of sectoral employment concentration in a country, given by a summary of sectoral employment location quotient. This allows policy-makers to gain a quick understanding of a country's employment composition as well as comparative advantage with regard to industry employment concentration within the 6 tradable sectors that are captured by this LinkedIn dataset.

Sample standout industry outputs within the Finance & Insurance sector (ISIC classification Section K) are shown for four pilot countries (Figure V-1). This overview of industry employment location quotient serves as a quick sector scan, likely informing subsequent

⁶⁶ These six knowledge and tradable sectors using ISIC Rev. 4 classification are: B-Mining & Quarrying; C-Manufacturing; J-Information & Communication; K-Financial & Insurance Activities; M-Professional, Scientific, & Technical Activities; and R-Arts, Entertainment & Recreation

industry deep dives. The visual shows both those industries that fall below or above the Income Group average employment size (=1.0), as well as the magnitude to which they fall behind or surpass their income group peers. For example, in China, the relative employment size of venture capital and private equity industry is substantially higher than the average of all upper-middle income countries. Only sub-industries that have at least 50 observations⁶⁷ are included (hence explaining why Macedonia has less sub-industries within Finance and Insurance Sector).

Figure V-1 Industry Employment Size LQ within Finance & Insurance Sector for China, Macedonia, Mexico and South Africa

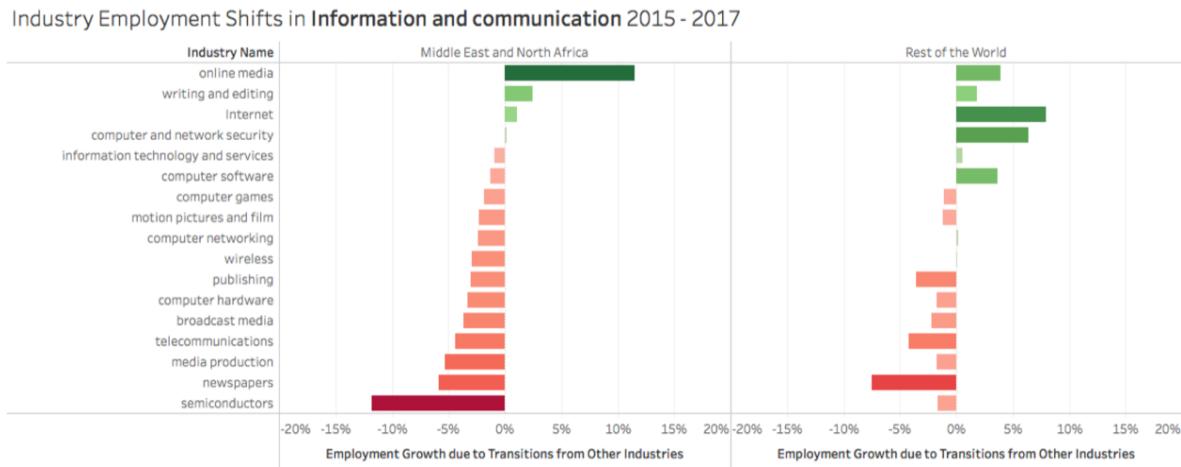
Finance & Insurance Sector Industry LQ (2015-2017 Moving Average)



After looking at static comparative advantage in industries, one key value add of the LinkedIn data is that it can record and reflect intra- and inter-industry headcount change almost near real time, and we translate this dynamic into Industry Employment Growth visual. This visual can be particularly useful for policy-makers who need to decide on and track the performance of strategic industries in a country, region or globally. For example, one can compare information and communication sector growth in the MENA region to global growth trends, as seen in Figure V-2. The results show that MENA largely tracks global employment trends in this sector (e.g. the Online Media industry in MENA is growing at a ~10% vs. ~5% globally, but still lags in some key emerging sectors, such as internet and computer network & security).

⁶⁷ To ensure data quality, the more stringent industry categorization method was applied for this visual, i.e. instead of the self-reported industry that a member says s/he belongs to in their profile, we look at the company this person works in and which industry this company belongs to – this dramatically decreases the sample size as many companies cannot be easily mapped to an industry.

Figure V-2 Industry Employment Shifts in the Information and Communication Sector, 2015-2017



Box 5: Should We Weight the LinkedIn Data to Obtain a Representative Sample when Conducting Global Benchmarking?

As described in the LinkedIn data description and validation sections of this paper, LinkedIn data should not be treated as a random sample of a country's workforce. Indeed, with regard to industry employment, the LinkedIn user base presents a definable bias in industry distribution and varied levels of market coverage across countries/regions (please refer to LinkedIn Data Representativeness section).

To address varying sample size and skewed industry distribution, the use of weights, given by a country population, and industry employment count (from local government or international statistics) to re-weight LinkedIn data was explored. That would allow LinkedIn member base to be re-scaled to a representative sample. One of the key obstacles to this approach, however, is the lack of sufficient government data on industry employment distribution for the wide range of countries available in the LinkedIn dataset. Furthermore, in order to impose weights on LinkedIn data, the LinkedIn classification of industries (2-to-3 digit of ISIC equivalent) would require re-structuring and matching with external sources and their varied definitions of industry activities by country. Finally, such an approach would be unlikely to address the full complexity of skewness (e.g. Occupation Skewness: management, technical and sales occupations in the manufacturing sector are more likely to be on LinkedIn than factory floor workers).

In the interest of avoiding excessive manipulation of the data, LinkedIn data is not re-weighted. Instead all industry employment metrics are reported as *relative* measures based on a country's membership size (i.e. as % of total LinkedIn members in a country).

Figure V-3 Growing and Declining Industries Worldwide in 140 Countries (Moving Average of 2015-2017)



Figure V-4 Growing and Declining Industries by World Bank Region (Moving Average of 2015-2017)

Industry Growth, Global Avg Across Countries, Dec 2014-Dec 2017, by Region

Figure V-5 Growing and Declining Industries by Income Group (Moving Average of 2015-2017)

Industry Growth, Global Avg Across Countries, Dec 2014-Dec 2017, by Income

Isic Section	Isic Section Name	LinkedIn Industry	High Income	Upper Middle Income	Lower Middle Income	Low Income
B	Mining and quarrying	mining & metals	-2.9%	0.8%	-2.0%	0.3%
		oil & energy	-3.6%	-1.5%	-1.5%	-1.9%
C	Manufacture	renewables and environment	4.1%	5.1%	3.9%	6.4%
		aviation and aerospace	3.6%	3.6%	1.2%	-2.8%
		industrial automation	3.1%	-0.6%	0.4%	
		pharmaceuticals	3.0%	2.6%	0.0%	-0.9%
		plastics	2.5%	2.1%	1.9%	
		automotive	2.4%	-0.2%	0.6%	-1.1%
		glass, ceramics and concrete	2.4%	1.6%	-2.6%	
		packaging and containers	2.0%	3.6%	1.5%	
		machinery	1.5%	-0.2%	-0.5%	-0.8%
		shipbuilding	0.9%	1.0%	-4.8%	
		chemicals	0.8%	3.5%	0.4%	-0.9%
		paper & forest products	0.6%	-0.1%	3.2%	-6.9%
		textiles	0.2%	0.0%	0.8%	-1.7%
		food production	-0.2%	1.6%	1.6%	-0.4%
		electrical and electronic manufacturing	-1.1%	0.6%	0.2%	2.0%
		railroad manufacture	-1.5%	-7.6%	12.4%	
		printing	-2.3%	-3.8%	-1.6%	0.3%
J	Information and communication	computer and network security	12.9%	4.9%	0.0%	-1.0%
		internet	10.3%	7.9%	6.1%	0.6%
		writing and editing	8.0%	8.4%	6.7%	2.1%
		computer software	4.2%	4.6%	1.0%	-0.5%
		wireless	3.8%	-1.2%	-2.0%	
		computer games	1.1%	-0.6%	-3.2%	-7.1%
		computer networking	0.5%	0.8%	0.8%	0.9%
		computer hardware	0.3%	-2.1%	-0.1%	0.4%
		online media	0.2%	3.5%	1.0%	
		information technology and services	-0.3%	1.7%	1.0%	0.1%
		motion pictures and film	-0.5%	0.2%	4.0%	
		semiconductors	-1.2%	-1.9%	-6.6%	
		media production	-1.7%	-0.4%	0.4%	
		broadcast media	-2.7%	-2.1%	-2.4%	-1.3%
		telecommunications	-4.2%	-2.8%	-1.8%	-1.6%
		publishing	-4.3%	-2.4%	-2.2%	-0.1%
		newspapers	-8.0%	-7.7%	-5.5%	-0.6%
K	Financial and insurance activities	venture capital and private equity	15.6%	12.9%	10.7%	-7.7%
		investment management	8.3%	3.8%	3.6%	-0.1%
		capital markets	3.5%	6.0%	2.2%	2.0%
		financial services	2.7%	1.9%	3.6%	2.5%
		insurance	2.5%	1.1%	2.5%	0.3%
		banking	0.4%	-1.2%	-0.4%	0.3%
		investment banking	-2.7%	5.9%	0.3%	-16.4%
M	Professional, scientific and technical activities	biotechnology	8.1%	4.9%	1.1%	-1.8%
		alternative dispute resolution	6.8%	6.3%	2.7%	
		executive office	6.2%	3.6%	1.5%	2.6%
		veterinary	3.1%	0.6%	-0.5%	
		management consulting	2.9%	3.0%	2.3%	1.6%
		professional training & coaching	2.0%	3.0%	1.5%	1.4%
		design	1.8%	-0.4%	0.3%	0.3%
		nanotechnology	1.8%	-2.5%	0.9%	
		architecture & planning	1.4%	0.3%	1.2%	-1.4%
		graphic design	1.4%	0.3%	0.3%	0.0%
		information services	1.3%	0.5%	0.6%	-3.8%
		environmental services	1.0%	0.1%	0.2%	-2.1%
		photography	0.9%	1.0%	0.8%	
		legal services	0.8%	0.3%	0.6%	-0.1%
		translation and localization	0.8%	1.8%	3.7%	
		marketing and advertising	0.1%	-0.1%	1.3%	1.0%
		mechanical or industrial engineering	-0.2%	-0.2%	-1.1%	-1.1%
		law practice	-1.6%	-1.9%	-1.7%	-2.5%
		public relations and communications	-3.0%	-2.1%	-0.4%	1.7%
		events services	-3.0%	-0.8%	-0.1%	-1.1%
		accounting	-4.4%	-5.1%	-4.3%	-5.8%
		research	-5.1%	-0.2%	-1.5%	-2.4%
		market research	-7.5%	-5.2%	-4.5%	-7.7%
		outsourcing/offshoring	-11.9%	-2.4%	-5.5%	-4.6%
R	Arts, entertainment and recreation	gambling & casinos	8.3%	1.5%	10.2%	
		animation	6.6%	6.2%	5.1%	1.5%
		health, wellness and fitness	3.9%	2.9%	2.0%	2.5%
		fine art	1.0%	0.9%	0.0%	
		arts and crafts	0.9%	1.5%	1.6%	
		entertainment	0.0%	-1.7%	0.1%	1.9%
		sports	-0.2%	1.0%	0.4%	0.4%
		music	-0.5%	0.0%	0.8%	2.1%
		libraries	-0.5%	1.1%	-0.3%	
		performing arts	-1.2%	-1.0%	-2.2%	
		museums and institutions	-1.7%	-2.6%	1.7%	
			0.00%	0.00%	0.00%	0.00%
			Avg. growth	Avg. growth	Avg. growth	Avg. growth

B. Industry Skills Needs

After examining the latest industry employment dynamics, this section explores the latest skills needs by industry. All visuals are reported at skills group that covers the most commonly seen 10,000 detailed skills on LinkedIn. For example, the output below shows the top 10 most represented skill groups in the Online Media industry Globally.⁶⁸

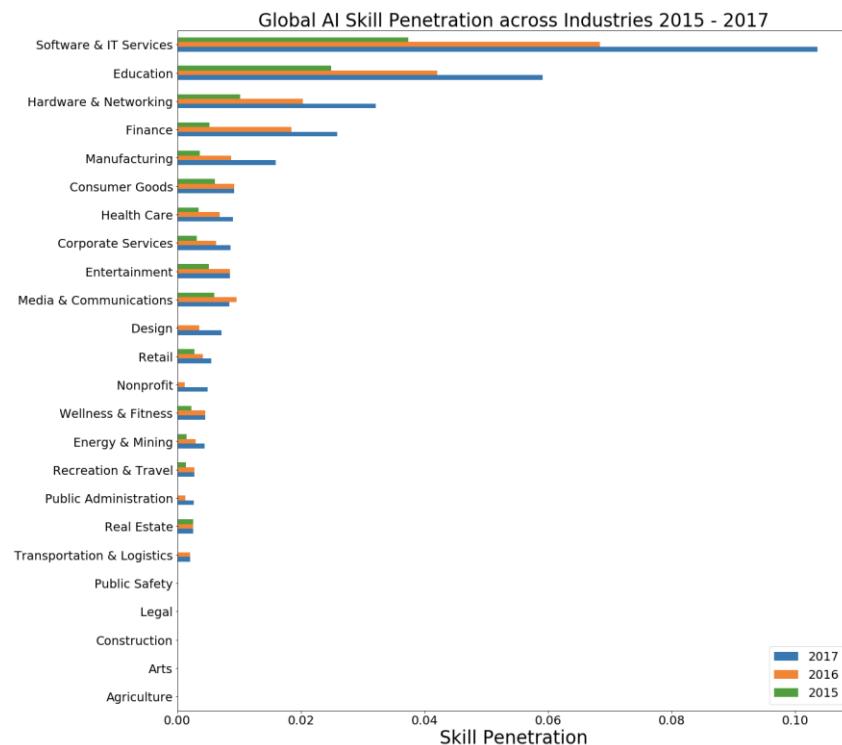
Figure V-6 Most Representative Skill Groups for the Online Media Industry Globally

1	Social Media	6	Advertising
2	Journalism	7	Graphic Design
3	Editing	8	Photography
4	Writing	9	Oral Communication
5	Digital Marketing	10	Digital Literacy

In addition, readers will be able to choose a skills group and see which industries are currently applying these skills across developed and developing countries. One key advantage of LinkedIn skills data is its ability to capture the latest emerging skills, for example, disruptive tech skills are widely reported across developing countries – almost all 140 countries in the LinkedIn dataset possess some types of disruptive tech skills, albeit these skills are more concentrated in a small number of industries in developing than developed countries. The example below shows the top industries with highest AI skill penetration globally.

⁶⁸ A detailed classification of individual skills into categories and groups can be found in the Skill Group Classification Appendix.

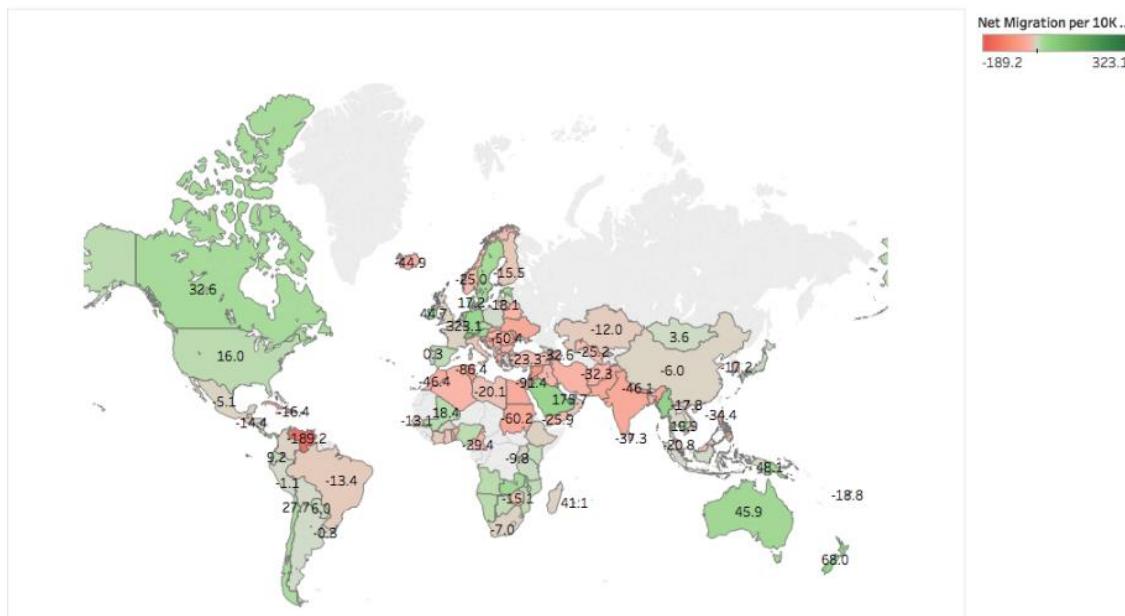
Figure V-7 Top Industries Applying AI Skill, Globally 2015-2017



C. Talent Migration

The use of LinkedIn data to monitor international flows of talent migration allows policy makers to shape their talent attraction and retention programs and assess the health of a country's talent pipeline. A key value added of LinkedIn data is the ability to track talent movements in near real time as well as the type of industries and skills that are gained or loss associated with these movements. For example, the figure below shows that while OECD on average are net gaining talents, some developing countries in MENA, LAC, and SAR see the most net talent loss. . Figure V-11 takes an in-depth regional look at MENA migration rates to/from other countries. Additionally, policy makers in MENA may want to see if countries in their region are retaining the talent needed to support the growing industries or not. Such policy questions can be informed by looking at the greatest net gained and loss of skills and industries that are associated with these talent movements, as seen in Figure V-12.

Figure V-8 International Talent Net Migration (per 10,000 LinkedIn Members in the Country of Interest, Annual Moving Average 2015-2017)



Box 6: How to Compare Migration Flows Across Countries Fairly?

LinkedIn membership varies considerably between countries, posing a challenge in understanding how to interpret absolute movements of members from one country to another. For example, comparing an absolute count of inflow from country X of 1,000 LinkedIn members to Mexico as opposed to an inflow from country Y of 100,000 LinkedIn members to Mexico is not fair. Given various levels of LinkedIn membership, the appropriate question is: how to compare migration flows across countries fairly using some sorts of normalization method.

The first strategy considered by the team is weighting LinkedIn membership in each country by the population/workforce as given by official statistics. As discussed previously, this opens the Pandora's Box of the need to address the various sources of bias (industry bias, occupation bias) which official statistics are not sufficient to tackle. An alternative is to construct migration flows normalized by country of interest e.g. if Mexico is the country of interest, all absolute net flows in and out of Mexico, regardless origin and destination countries are normalized by LinkedIn membership in Mexico (and multiplied by 10,000). Hence, this metric gives readers the relative scale of talent migration impacts on Mexico across countries e.g. likely the net outflows from Mexico to the US is larger than any other country in the world, as this is normalized by Mexico LinkedIn membership not USA LinkedIn membership.

Figure V-9 MENA Net Migration Rate per 10,000 LinkedIn Members, 2015-2017

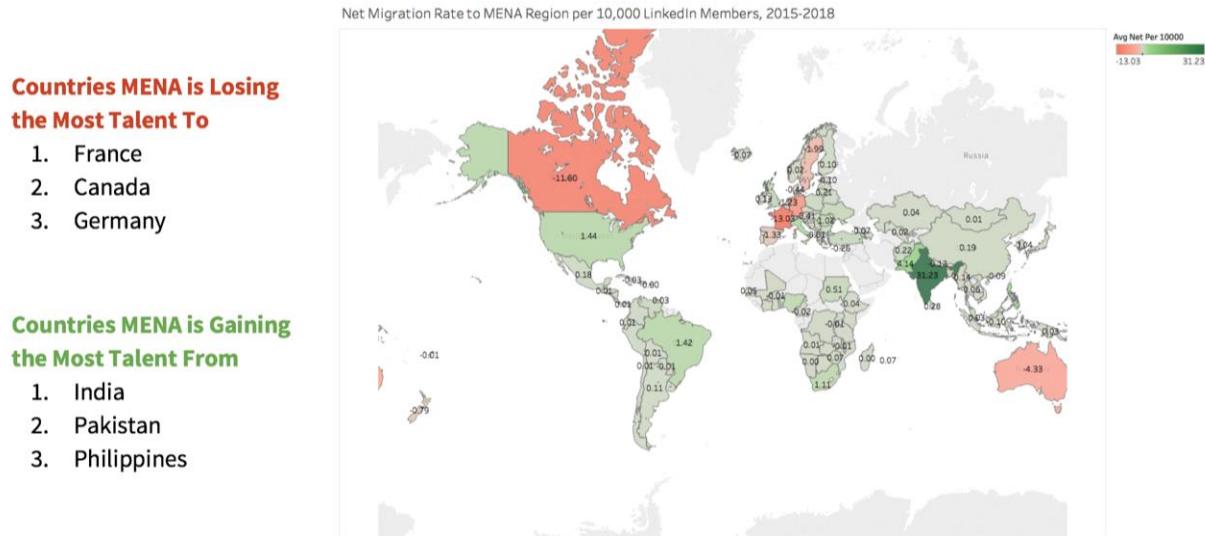


Figure V-10 MENA Largest Skills/Industries Loss associated with Talent Movements, 2015 -2017



VI. Conclusions

This methodology and validation report is the first attempt to harness the dynamic and fast-growing LinkedIn dataset to support the analytical, advisory and operational work of the World Bank Group. While it's promising, it also has limitations due to the lower penetration of LinkedIn membership in many developing countries, especially in non-tradable, non-tech, and non-digital sectors. Thus, the data seems to be more relevant to study knowledge and tradable sectors whereby the LinkedIn penetration rate is high across countries. In this manner, it may from the outset serve as a complementary dataset to other government statistics. With the growing usage of LinkedIn, this data can become more and more relevant for developing countries across the globe.

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VIII. Appendix

A. LinkedIn Data Country List (100,000+ members) n=140

Country (A-K)	WB Income Group	WB Region	Country (L-Z)	WB Income Group	WB Region
Afghanistan	Low Income	South Asia	Latvia	High Income	Europe and Central Asia
Albania	Upper Middle Income	Europe and Central Asia	Lebanon	Upper Middle Income	Middle East and North Africa
Algeria	Upper Middle Income	Middle East and North Africa	Libyan Arab Jamahiriya	Upper Middle Income	Middle East and North Africa
Angola	Lower Middle Income	Sub Saharan Africa	Lithuania	High Income	Europe and Central Asia
Argentina	Upper Middle Income	Latin America and the Caribbean	Luxembourg	High Income	Europe and Central Asia
Armenia	Lower Middle Income	Europe and Central Asia	Macedonia, FYR	Upper Middle Income	Europe and Central Asia
Australia	High Income	East Asia and Pacific	Madagascar	Low Income	Sub Saharan Africa
Austria	High Income	Europe and Central Asia	Malawi	Low Income	Sub Saharan Africa
Azerbaijan	Upper Middle Income	Europe and Central Asia	Malaysia	Upper Middle Income	East Asia and Pacific
Bahamas	High Income	Latin America and the Caribbean	Mali	Low Income	Sub Saharan Africa
Bahrain	High Income	Middle East and North Africa	Malta	High Income	Middle East and North Africa
Bangladesh	Lower Middle Income	South Asia	Mauritius	Upper Middle Income	Sub Saharan Africa
Belarus	Upper Middle Income	Europe and Central Asia	Mexico	Upper Middle Income	Latin America and the Caribbean
Belgium	High Income	Europe and Central Asia	Moldova, Republic of	Lower Middle Income	Europe and Central Asia
Benin	Low Income	Sub Saharan Africa	Mongolia	Lower Middle Income	East Asia and Pacific
Bolivia	Lower Middle Income	Latin America and the Caribbean	Morocco	Lower Middle Income	Middle East and North Africa
Bosnia and Herzegovina	Upper Middle Income	Europe and Central Asia	Mozambique	Low Income	Sub Saharan Africa
Botswana	Upper Middle Income	Sub Saharan Africa	Myanmar	Lower Middle Income	East Asia and Pacific
Brazil	Upper Middle Income	Latin America and the Caribbean	Namibia	Upper Middle Income	Sub Saharan Africa
Bulgaria	Upper Middle Income	Europe and Central Asia	Nepal	Low Income	South Asia
Burkina Faso	Low Income	Sub Saharan Africa	Netherlands	High Income	Europe and Central Asia
Cambodia	Lower Middle Income	East Asia and Pacific	New Zealand	High Income	East Asia and Pacific
Cameroon	Lower Middle Income	Sub Saharan Africa	Nicaragua	Lower Middle Income	Latin America and the Caribbean
Canada	High Income	North America	Nigeria	Lower Middle Income	Sub Saharan Africa
Chile	High Income	Latin America and the Caribbean	Norway	High Income	Europe and Central Asia
China	Upper Middle Income	East Asia and Pacific	Oman	High Income	Middle East and North Africa
Colombia	Upper Middle Income	Latin America and the Caribbean	Pakistan	Lower Middle Income	South Asia
Congo, the Democratic Republic of the	Low Income	Sub Saharan Africa	Palestinian Territory, Occupied	NA	Middle East and North Africa
Costa Rica	Upper Middle Income	Latin America and the Caribbean	Panama	Upper Middle Income	Latin America and the Caribbean
Côte d'Ivoire	Lower Middle Income	Sub Saharan Africa	Papua New Guinea	Lower Middle Income	East Asia and Pacific

Croatia	Upper Middle Income	Europe and Central Asia	Paraguay	Upper Middle Income	Latin America and the Caribbean
Cuba	Upper Middle Income	Latin America and the Caribbean	Peru	Upper Middle Income	Latin America and the Caribbean
Cyprus	High Income	Europe and Central Asia	Philippines	Lower Middle Income	East Asia and Pacific
Czech Republic	High Income	Europe and Central Asia	Poland	High Income	Europe and Central Asia
Denmark	High Income	Europe and Central Asia	Portugal	High Income	Europe and Central Asia
Dominican Republic	Upper Middle Income	Latin America and the Caribbean	Puerto Rico	High Income	Latin America and the Caribbean
Ecuador	Upper Middle Income	Latin America and the Caribbean	Qatar	High Income	Middle East and North Africa
Egypt	Lower Middle Income	Middle East and North Africa	Reunion	High Income (France)	Sub Saharan Africa
El Salvador	Lower Middle Income	Latin America and the Caribbean	Romania	Upper Middle Income	Europe and Central Asia
Estonia	High Income	Europe and Central Asia	Rwanda	Low Income	Sub Saharan Africa
Ethiopia	Low Income	Sub Saharan Africa	Saudi Arabia	High Income	Middle East and North Africa
Fiji	Upper Middle Income	East Asia and Pacific	Senegal	Low Income	Sub Saharan Africa
Finland	High Income	Europe and Central Asia	Serbia	Upper Middle Income	Europe and Central Asia
France	High Income	Europe and Central Asia	Singapore	High Income	East Asia and Pacific
Georgia	Lower Middle Income	Europe and Central Asia	Slovakia	High Income	Europe and Central Asia
Germany	High Income	Europe and Central Asia	Slovenia	High Income	Europe and Central Asia
Ghana	Lower Middle Income	Sub Saharan Africa	South Africa	Upper Middle Income	Sub Saharan Africa
Greece	High Income	Europe and Central Asia	Spain	High Income	Europe and Central Asia
Guatemala	Lower Middle Income	Latin America and the Caribbean	Sri Lanka	Lower Middle Income	South Asia
Haiti	Low Income	Latin America and the Caribbean	Sudan	Lower Middle Income	Sub Saharan Africa
Honduras	Lower Middle Income	Latin America and the Caribbean	Sweden	High Income	Europe and Central Asia
Hong Kong	High Income	East Asia and Pacific	Switzerland	High Income	Europe and Central Asia
Hungary	High Income	Europe and Central Asia	Syrian Arab Republic	Lower Middle Income	Middle East and North Africa
Iceland	High Income	Europe and Central Asia	Taiwan, Province of China	High Income	East Asia and Pacific
India	Lower Middle Income	South Asia	Tanzania, United Republic of	Low Income	Sub Saharan Africa
Indonesia	Lower Middle Income	East Asia and Pacific	Thailand	Upper Middle Income	East Asia and Pacific
Iran, Islamic Republic of	Upper Middle Income	Middle East and North Africa	Togo	Low Income	Sub Saharan Africa
Iraq	Upper Middle Income	Middle East and North Africa	Trinidad and Tobago	High Income	Latin America and the Caribbean
Ireland	High Income	Europe and Central Asia	Tunisia	Lower Middle Income	Middle East and North Africa
Israel	High Income	Middle East and North Africa	Turkey	Upper Middle Income	Europe and Central Asia
Italy	High Income	Europe and Central Asia	Uganda	Low Income	Sub Saharan Africa
Jamaica	Upper Middle Income	Latin America and the Caribbean	Ukraine	Lower Middle Income	Europe and Central Asia
Japan	High Income	East Asia and Pacific	United Arab Emirates	High Income	Middle East and North Africa

Jordan	Lower Middle Income	Middle East and North Africa	United Kingdom	High Income	Europe and Central Asia
Kazakhstan	Upper Middle Income	Europe and Central Asia	United States	High Income	North America
Kenya	Lower Middle Income	Sub Saharan Africa	Uruguay	High Income	Latin America and the Caribbean
Korea, Republic of	High Income	East Asia and Pacific	Uzbekistan	Lower Middle Income	Europe and Central Asia
Kuwait	High Income	Middle East and North Africa	Venezuela	Upper Middle Income	Latin America and the Caribbean
			Viet Nam	Lower Middle Income	East Asia and Pacific
			Yemen	Lower Middle Income	Middle East and North Africa
			Zambia	Lower Middle Income	Sub Saharan Africa
			Zimbabwe	Low Income	Sub Saharan Africa

B. LinkedIn Data City List n=600

Country	City
Australia	Adelaide, Australia; Brisbane, Australia; Canberra, Australia; Melbourne, Australia; New South Wales, Australia; Newcastle, Australia; Perth, Australia; Queensland, Australia; Sydney, Australia; Victoria, Australia
Belgium	Antwerp Area, Belgium; Bruges Area, Belgium; Brussels Area, Belgium; Charleroi Area, Belgium; Gent Area, Belgium; Liège Area, Belgium; Namur Area, Belgium
Brazil	Alta Floresta Area, Brazil; Belém Area, Brazil; Belo Horizonte Area, Brazil; Blumenau Area, Brazil; Brasília Area, Brazil; Campinas Area, Brazil; Campo Grande Area, Brazil; Caxias do Sul Area, Brazil; Cuiabá Area, Brazil; Curitiba Area, Brazil; Florianópolis Area, Brazil; Fortaleza Area, Brazil; Goiânia Area, Brazil; João Pessoa Area, Brazil; Joinville Area, Brazil; Londrina Area, Brazil; Maceió Area, Brazil; Manaus Area, Brazil; Natal Area, Brazil; Porto Alegre Area, Brazil; Recife Area, Brazil; Ribeirão Preto Area, Brazil; Rio de Janeiro Area, Brazil; Salvador Area, Brazil; São José dos Campos Area, Brazil; São Luís Area, Brazil; São Paulo Area, Brazil; Sorocaba Area, Brazil; Uberlândia Area, Brazil; Vila Velha Area, Brazil
Canada	Alberta, Canada; British Columbia, Canada; Calgary, Canada Area; Edmonton, Canada Area; Halifax, Canada Area; Kitchener, Canada Area; London, Canada Area; Montreal, Canada Area; New Brunswick, Canada; Ontario, Canada; Ottawa, Canada Area; Quebec, Canada; Saskatchewan, Canada; Toronto, Canada Area; Vancouver, Canada Area; Winnipeg, Canada Area
Chile	Santiago Province, Chile
China	Beijing City, China; Beijing Suburb, China; Changchun, Jilin, China; Changsha, Hunan, China; Changzhou, Jiangsu, China; Chengdu, Sichuan, China; Chongqing City, China; Chongqing Suburb, China; Dalian, Liaoning, China; Dongguan, Guangdong, China; Foshan, Guangdong, China; Fuzhou, Fujian, China; Guangzhou, Guangdong, China; Guiyang, Guizhou, China; Haerbin, Heilongjiang, China; Haikou, Hainan, China; Hangzhou, Zhejiang, China; Hefei, Anhui, China; Huhehaote, Inner Mongolia, China; Huizhou, Guangdong, China; Jiaxing, Zhejiang, China; Jinan, Shandong, China; Jinhu, Zhejiang, China; Kunming, Yunnan, China; Lanzhou, Gansu, China; Linyi, Shandong, China; Nanchang, Jiangxi, China; Nanjing, Jiangsu, China; Nanning, Guangxi, China; Nantong, Jiangsu, China; Ningbo, Zhejiang, China; Qingdao, Shandong, China; Quanzhou, Fujian, China; Rest of Anhui, China; Rest of Fujian, China; Rest of Gansu, China; Rest of Guangdong, China; Rest of Guangxi, China; Rest of Guizhou, China; Rest of Hebei, China; Rest of Henan, China; Rest of Hubei, China; Rest of Hunan, China; Rest of Inner Mongolia, China; Rest of Jiangsu, China; Rest of Jiangxi, China; Rest of Liaoning, China; Rest of Shandong, China; Rest of Shanxi, China; Rest of Sichuan, China; Rest of Yunnan, China; Rest of Zhejiang, China; Shanghai City, China; Shanghai Suburb, China; Shenyang, Liaoning, China; Shenzhen, Guangdong, China; Shijiazhuang, Hebei, China; Suzhou, Jiangsu, China; Taiyuan, Shanxi, China; Taizhou, Zhejiang, China; Tianjin City, China; Urumqi, Xinjiang, China; Weifang, Shandong, China; Wenzhou, Zhejiang, China; Wuhan, Hubei, China; Wuxi, Jiangsu, China; Xi'an, Shaanxi, China; Xiamen, Fujian, China; Xuzhou, Jiangsu, China; Yantai, Shandong, China; Yinchuan, Ningxia, China; Zhengzhou, Henan, China; Zhuhai, Guangdong, China
Colombia	Bogotá D.C. Area, Colombia
Czech Republic	Prague, The Capital, Czech Republic
Denmark	Central Region, Denmark; Copenhagen Area, Capital Region, Denmark; Copenhagen Area, Denmark; Northern Region, Denmark; Sealand Region, Denmark; Southern Region, South Jutland, Denmark
Finland	Helsinki Area, Finland
France	Angers Area, France; Bordeaux Area, France; Chambéry Area, France; Clermont-Ferrand Area, France; Dijon Area, France; Grenoble Area, France; La Rochelle Area, France; Le Havre Area, France; Lille Area, France; Lyon Area, France; Marseille Area, France; Metz Area, France; Montpellier Area, France; Mulhouse Area, France; Nantes Area, France; Nice Area, France; Orléans Area, France; Paris Area, France; Pau Area, France; Reims Area, France; Rennes Area, France; Rouen Area, France; Strasbourg Area, France; Toulouse Area, France; Tours Area, France
Germany	Berlin Area, Germany; Bielefeld Area, Germany; Bremen Area, Germany; Cologne Area, Germany; Frankfurt Am Main Area, Germany; Hamburg Area, Germany; Hannover Area, Germany; Kassel Area, Germany; Leipzig Area, Germany; Mannheim Area, Germany; Munich Area, Germany; Nürnberg Area, Germany; Stuttgart Area, Germany
India	Agra Area, India; Ahmedabad Area, India; Allahabad Area, India; Bengaluru Area, India; Bhopal Area, India; Bhubaneshwar Area, India; Calicut Area, India; Chandigarh Area, India; Chennai Area, India; Chhindwara Area, India; Cochin Area, India; Coimbatore Area, India; Dehra Dun Area, India; Digras Area, India; Gurgaon, India; Guwahati Area, India; Hyderabad Area, India; Indore Area, India; Jaipur Area, India; Jalandhar Area, India; Kalyan Area, India; Kanpur Area, India; Kolkata Area, India; Lucknow Area, India; Ludhiana Area, India; Madurai Area, India; Mumbai Area, India; Mysuru Area, India; Nagpur Area, India; Nasik Area, India; New Delhi Area, India; Noida Area, India; Patna Area, India; Pune Area, India; Quilon Area, India; Rajkot Area, India; Salem Area, India; Surat Area, India; Thiruvananthapuram Area, India; Tiruchirappalli Area, India; Trichur Area, India; Vadodara Area, India; Varanasi Area, India; Vijayawada Area, India; Vishakhapatnam Area, India
Indonesia	Bandung Area, West Java, Indonesia; Banten Province, Indonesia; Central Java Province, Indonesia; East Java Province, Indonesia; Greater Jakarta Area, Indonesia; Surabaya Area, East Java, Indonesia; West Java Province, Indonesia

Italy	Bari Area, Italy; Bergamo Area, Italy; Bologna Area, Italy; Brescia Area, Italy; Catania Area, Italy; Florence Area, Italy; Genoa Area, Italy; Milan Area, Italy; Modena Area, Italy; Monza and Brianza Area, Italy; Naples Area, Italy; Padova Area, Italy; Palermo Area, Italy; Perugia Area, Italy; Rome Area, Italy; Salerno Area, Italy; Treviso Area, Italy; Turin Area, Italy; Varese Area, Italy; Venice Area, Italy; Verona Area, Italy; Vicenza Area, Italy
Japan	Within 23 wards, Tokyo, Japan
Malaysia	Johor, Malaysia; Kuala Lumpur, Malaysia; Penang, Malaysia; Perak, Malaysia; Sarawak, Malaysia; Selangor, Malaysia
Mexico	Aguascalientes Area, Mexico; Chihuahua Area, Mexico; Ciudad López Mateos Area, Mexico; Ciudad Nezahualcóyotl Area, Mexico; Ecatepec Area, Mexico; Guadalajara Area, Mexico; Guadalupe Area, Mexico; Hermosillo Area, Mexico; León Area, Mexico; Mérida Area, Mexico; Mexico City Area, Mexico; Monterrey Area, Mexico; Morelia Area, Mexico; Naucalpan de Juárez Area, Mexico; Puebla de Zaragoza Area, Mexico; Querétaro Area, Mexico; San Luis Potosí Area, Mexico; San Nicolás de los Garzas Area, Mexico; Tampico Area, Mexico; Tijuana Area, Mexico; Tlalnepantla Area, Mexico; Toluca Area, Mexico; Tuxtla Gutiérrez Area, Mexico; Veracruz Area, Mexico; Villahermosa Area, Mexico; Zapopan Area, Mexico
Netherlands	Almere Stad Area, Netherlands; Amsterdam Area, Netherlands; Apeldoorn Area, Netherlands; Breda Area, Netherlands; Eindhoven Area, Netherlands; Enschede Area, Netherlands; Groningen Area, Netherlands; Maastricht Area, Netherlands; Nijmegen Area, Netherlands; Rotterdam Area, Netherlands; The Hague Area, Netherlands; Tilburg Area, Netherlands; Utrecht Area, Netherlands; Zwolle Area, Netherlands
New Zealand	Auckland, New Zealand; Canterbury & West Coast, New Zealand; Wellington & Wairarapa, New Zealand
Norway	Bergen Area, Norway; Oslo Area, Norway; Stavanger Area, Norway
Pakistan	Lahore, Pakistan
Peru	San Miguel Province, Peru
Philippines	NCR - National Capital Region, Philippines; Region III - Central Luzon, Philippines; Region IVA - Calabarzon, Philippines; Region VII - Central Visayas, Philippines
Poland	Cracow, Lesser Poland District, Poland; Warsaw, Masovian District, Poland; Wrocław, Lower Silesian District, Poland
Portugal	Lisbon Area, Portugal; Porto Area, Portugal
Romania	Bucharest, Romania
Russian Federation	Moscow Region, Russian Federation; Moscow, Russian Federation; Saint Petersburg, Russian Federation
South Africa	Cape Town Area, South Africa; Durban Area, South Africa; Johannesburg Area, South Africa; Port Elizabeth Area, South Africa
Spain	A Coruña Area, Spain; Barcelona Area, Spain; Bilbao Area, Spain; Gijón Area, Spain; Granada Area, Spain; Madrid Area, Spain; Málaga Area, Spain; Murcia Area, Spain; Palma Area, Spain; Pamplona Area, Spain; Santa Cruz De Tenerife Area, Spain; Sevilla Area, Spain; Valencia Area, Spain; Vigo Area, Spain; Zaragoza Area, Spain
Sweden	Gothenburg, Sweden; Stockholm County, Sweden; Stockholm, Sweden
Switzerland	Basel Area, Switzerland; Bern Area, Switzerland; Geneva Area, Switzerland; Zürich Area, Switzerland
Taiwan, Province of China	Taipei City, Taiwan
Thailand	Bangkok Metropolitan Area, Thailand
Turkey	Ankara, Turkey; Bursa, Turkey; Istanbul, Turkey; Izmir, Turkey

United Kingdom	Aberdeen, United Kingdom; Bath, United Kingdom; Belfast, United Kingdom; Birmingham, United Kingdom; Bournemouth, United Kingdom; Bradford, United Kingdom; Brighton, United Kingdom; Bristol, United Kingdom; Cambridge, United Kingdom; Canterbury, United Kingdom; Cardiff, United Kingdom; Chelmsford, United Kingdom; Chester, United Kingdom; Cleveland, United Kingdom; Coventry, United Kingdom; Croydon, United Kingdom; Dartford, United Kingdom; Derby, United Kingdom; Doncaster, United Kingdom; Edinburgh, United Kingdom; Exeter, United Kingdom; Glasgow, United Kingdom; Gloucester, United Kingdom; Guildford, United Kingdom; Harrow, United Kingdom; Hemel Hempstead, United Kingdom; Ipswich, United Kingdom; Kingston upon Thames, United Kingdom; Leeds, United Kingdom; Leicester, United Kingdom; Liverpool, United Kingdom; London, United Kingdom; Manchester, United Kingdom; Milton Keynes, United Kingdom; Newcastle upon Tyne, United Kingdom; Northampton, United Kingdom; Norwich, United Kingdom; Nottingham, United Kingdom; Oxford, United Kingdom; Peterborough, United Kingdom; Plymouth, United Kingdom; Portsmouth, United Kingdom; Preston, United Kingdom; Reading, United Kingdom; Redhill, United Kingdom; Rochester, United Kingdom; Romford, United Kingdom; Sheffield, United Kingdom; Slough, United Kingdom; Southall, United Kingdom; Southampton, United Kingdom; Southend on Sea, United Kingdom; Stevenage, United Kingdom; Stockport, United Kingdom; Stoke-on-Trent, United Kingdom; Swansea, United Kingdom; Swindon, United Kingdom; Tonbridge, United Kingdom; Twickenham, United Kingdom; Warrington, United Kingdom; York, United Kingdom
United States	Albany, New York Area; Albuquerque, New Mexico Area; Allentown, Pennsylvania Area; Amarillo, Texas Area; Anchorage, Alaska Area; Asheville, North Carolina Area; Athens, Georgia Area; Augusta, Georgia Area; Austin, Texas Area; Bakersfield, California Area; Baltimore, Maryland Area; Bangor, Maine Area; Baton Rouge, Louisiana Area; Beaumont/Port Arthur, Texas Area; Biloxi, Mississippi Area; Birmingham, Alabama Area; Boise, Idaho Area; Bryan/College Station, Texas Area; Buffalo/Niagara, New York Area; Burlington, Vermont Area; Canton, Ohio Area; Charleston, South Carolina Area; Charleston, West Virginia Area; Charlotte, North Carolina Area; Charlottesville, Virginia Area; Chattanooga, Tennessee Area; Cincinnati Area, KY; Clarksville, Tennessee Area; Cleveland/Akron, Ohio Area; Colorado Springs, Colorado Area; Columbia, Missouri Area; Columbia, South Carolina Area; Columbus, Georgia Area; Columbus, Ohio Area; Corpus Christi, Texas Area; Dallas/Fort Worth Area; Davenport, Iowa Area; Dayton, Ohio Area; Daytona Beach, Florida Area; Des Moines, Iowa Area; Dover, Delaware Area; Duluth, Minnesota Area; El Paso, Texas Area; Eugene, Oregon Area; Evansville, Indiana Area; Fargo, North Dakota Area; Fayetteville, Arkansas Area; Fayetteville, North Carolina Area; Flagstaff, Arizona Area; Fort Collins, Colorado Area; Fort Myers, Florida Area; Fort Pierce, Florida Area; Fort Wayne, Indiana Area; Fresno, California Area; Gainesville, Florida Area; Grand Junction, Colorado Area; Great Falls, Montana Area; Greater Atlanta Area; Greater Boston Area; Greater Chicago Area; Greater Denver Area; Greater Detroit Area; Greater Grand Rapids, Michigan Area; Greater Los Angeles Area; Greater Memphis Area; Greater Milwaukee Area; Greater Minneapolis-St. Paul Area; Greater Nashville Area, TN; Greater New Orleans Area; Greater New York City Area; Greater Omaha Area; Greater Philadelphia Area; Greater Pittsburgh Area; Greater Salt Lake City Area; Greater San Diego Area; Greater Seattle Area; Greater St. Louis Area; Green Bay, Wisconsin Area; Greensboro/Winston-Salem, North Carolina Area; Greenville, North Carolina Area; Greenville, South Carolina Area; Harrisburg, Pennsylvania Area; Hartford, Connecticut Area; Hawaiian Islands; Hickory/Lenoir, North Carolina Area; Houston, Texas Area; Huntington, West Virginia Area; Huntsville, Alabama Area; Indianapolis, Indiana Area; Ithaca, New York Area; Jackson, Mississippi Area; Jacksonville, Florida Area; Johnson City, Tennessee Area; Kalamazoo, Michigan Area; Kansas City, Missouri Area; Killeen/Temple, Texas Area; Knoxville, Tennessee Area; Lafayette, Indiana Area; Lafayette, Louisiana Area; Lakeland, Florida Area; Lancaster, Pennsylvania Area; Lansing, Michigan Area; Las Vegas, Nevada Area; Lewiston/Auburn, Maine Area; Lexington, Kentucky Area; Lincoln, Nebraska Area; Little Rock, Arkansas Area; Louisville, Kentucky Area; Lubbock, Texas Area; Macon, Georgia Area; Madison, Wisconsin Area; McAllen, Texas Area; Medford, Oregon Area; Melbourne, Florida Area; Miami/Fort Lauderdale Area; Missoula, Montana Area; Mobile, Alabama Area; Modesto, California Area; Montgomery, Alabama Area; Myrtle Beach, South Carolina Area; Naples, Florida Area; New London/Norwich, Connecticut Area; Norfolk, Virginia Area; Ocala, Florida Area; Odessa/Midland, Texas Area; Oklahoma City, Oklahoma Area; Orange County, California Area; Orlando, Florida Area; Oshkosh, Wisconsin Area; Pensacola, Florida Area; Peoria, Illinois Area; Phoenix, Arizona Area; Pocatello, Idaho Area; Portland, Maine Area; Portland, Oregon Area; Providence, Rhode Island Area; Provo, Utah Area; Raleigh-Durham, North Carolina Area; Reading, Pennsylvania Area; Redding, California Area; Reno, Nevada Area; Richland/Kennewick/Pasco, Washington Area; Richmond, Virginia Area; Roanoke, Virginia Area; Rochester, New York Area; Rockford, Illinois Area; Sacramento, California Area; Saginaw, Michigan Area; Salinas, California Area; San Antonio, Texas Area; San Francisco Bay Area; San Luis Obispo, California Area; Santa Barbara, California Area; Sarasota, Florida Area; Savannah, Georgia Area; Scranton, Pennsylvania Area; Shreveport, Louisiana Area; Sioux Falls, South Dakota Area; South Bend, Indiana Area; Spokane, Washington Area; Springfield, Massachusetts Area; Springfield, Missouri Area; St. Cloud, Minnesota Area; Stockton, California Area; Syracuse, New York Area; Tallahassee, Florida Area; Tampa/St. Petersburg, Florida Area; Toledo, Ohio Area; Topeka, Kansas Area; Tucson, Arizona Area; Tulsa, Oklahoma Area; Tuscaloosa, Alabama Area; Tyler, Texas Area; Urbana-Champaign, Illinois Area; Washington D.C. Metro Area; Wausau, Wisconsin Area; West Palm Beach, Florida Area; Wichita, Kansas Area; Wilmington, North Carolina Area; York, Pennsylvania Area; Youngstown, Ohio Area

C. External vs. LinkedIn Data Matching Methodology Appendix

Comparing LinkedIn data to external data sources requires careful and structured matching of different taxonomies. The approach is outlined for each validation exercise. Particular attention was given to industry and age comparison, where matching between sources involves explicit assumptions and references to LinkedIn data storage structure.

1) Age and Gender

LinkedIn age data is given as median and mean months of experience by a member. Transforming into annual experience, 1 year of experience translates to an age of 23, with an assumption grounded in that majority of full time employment (excluding internships and apprenticeships) begins after the completion of undergraduate tertiary studies, as 80% of LinkedIn members possess at least a college or equivalent degree. Selecting age 23 as a starting point facilitates capturing variation in length of undergraduate studies (ex. 4 years in the US v. 3 years in majority of Europe). Following this approach, 2 years of experience translate to 24 years of age, 3 to 25 and so forth.

ILO age data is selected in a 10-year age band⁶⁹ categorization. The first “<15 years old” category is removed due to low count and comparability to LinkedIn data. Subsequently, the “65+” age band is renamed to “65-75”, to facilitate calculation of mean and median values. Finally mean and median are calculated for matching to LinkedIn data. Mean and median age values are matched by country for the year 2016 as this is the latest and complete year of ILO age sample⁷⁰.

Gender data is similarly structured in LinkedIn and ILO data. Offering 3 categories, “Female”, “Male”, “Total/Unknown” (excluding missing data). In both data sets “Total/Unknown” category is removed per country. LinkedIn derives gender from names of individual profiles, run through an algorithm identifying which gender a given individuals name is most likely associated with. LinkedIn and ILO gender data are matched by country for the year 2016⁷¹.

2) Industry Employment Size

LinkedIn data is categorized by 148 industries (roughly ISIC 2 to 3-digit equivalent), which are further classified into 22 higher-level industry groups (roughly ISIC 1-digit equivalent). The 148 industries which are mapped to ISIC Rev. 4 can be found in *Table III-1*. The detailed LinkedIn-ISIC industry matching, including how LinkedIn

⁶⁹ 10-year age bands: <15, 15-24, 25-34, 35-44, 45-54, 55-64, and 65+

⁷⁰ 10 additional countries included from year 2015, and 10 additional countries included from year 2014 for ILO data to maximize coverage. These are noted with * and **, for years 2015 and 2014 respectively in appendix country reference tables.

⁷¹ 12 additional countries included from year 2015, and 10 additional countries included from year 2014 for ILO data to maximize coverage. These are noted with * and **, for years 2015 and 2014 respectively in appendix country reference tables.

industry is mapped to ISIC 2 digits, could be found in the detailed LinkedIn to ISIC Rev. 4 Industry Mapping Appendix.

Three LinkedIn Industries that are not mapped to any of the ISIC categories were labelled as X, “Not elsewhere classified”; ISIC Section E “Water supply; sewerage waste management and remediation activities” has no correspondent industry in the LinkedIn data, thus was excluded from the mapping.

Year 2016 data were applied for the mapping exercise, in the case where countries have no 2016 data within the ILO Labor Statistics, 2014/2015 data were supplemented whichever is the latest available. Yielding a final country count of 92 for the industry employment size representativeness exercise.

ISIC Sector (1 Digit)⁷²	LinkedIn 148 Industry (Roughly 2 Digit Equivalent)⁷³
A. Agriculture; forestry and fishing	farming; ranching; dairy; fishery
B. Mining and quarrying	mining & metals; oil & energy
C. Manufacturing	defense and space; pharmaceuticals; food production; aviation and aerospace; automotive; chemicals; machinery; shipbuilding; textiles; paper & forest products; railroad manufacture; printing; electrical and electronic manufacturing; plastics; renewables and environment; glass, ceramics and concrete; packaging and containers; industrial automation
D. Electricity; gas, steam and air conditioning supply	utilities
F. Construction	construction; building materials; civil engineering
G. Wholesale and retail trade; repair of motor vehicles and motorcycles	cosmetics; apparel and fashion; sporting goods; tobacco; supermarkets; consumer electronics; consumer goods; furniture; retail; food & beverages; consumer services; wholesale; wine and spirits; luxury goods and jewelry
H. Transportation and storage	package/freight delivery; transportation/trucking/railroad; warehousing; airlines/aviation; maritime; logistics and supply chain; import and export
I. Accommodation and food service activities	hospitality; restaurants
J. Information and communication	computer hardware; computer software; computer networking; Internet; semiconductors; telecommunications; motion pictures and film; broadcast media; newspapers; publishing; information technology and services; writing and editing; computer games; online media; computer and network security; wireless; media production
K. Financial and insurance activities	banking; insurance; financial services; investment banking; investment management; venture capital and private equity; capital markets
L. Real estate activities	Real estate; commercial real estate
M. Professional, scientific and technical activities	law practice; legal services; management consulting; biotechnology; veterinary; accounting; architecture & planning; research; executive office; marketing and advertising; information services; environmental services; market research; public relations and communications; design; professional training & coaching; translation and localization; events services; nanotechnology; alternative dispute resolution; outsourcing/offshoring; mechanical or industrial engineering; photography; graphic design
N. Administrative and support service activities	leisure, travel & tourism; recreational facilities and services; fundraising; staffing and recruiting; security and investigations; facilities services; human resources; business supplies and equipment
O. Public administration and defense; compulsory social security	military; legislative office; judiciary; international affairs; government administration; law enforcement; public safety; public policy; political organization; government relations

⁷² ISIC section “E. Water supply; sewerage waste management and remediation activities” removed due to no corresponding LinkedIn industries.

⁷³ LinkedIn industries “program development”, “think tanks”, and “philanthropy” (sk: 102, 130, 131 respectively) fail to match ISIC section definitions and hence are mapped to ISIC section “X. Not elsewhere classified”

P. Education	primary/secondary education; higher education; education management; e-learning
Q. Human health and social work activities	medical practice; hospital & health care; medical device; alternative medicine; mental health care
R. Arts, entertainment and recreation	entertainment; gambling & casinos; sports; museums and institutions; fine art; performing arts; libraries; arts and crafts; music; health, wellness and fitness; animation
S. Other service activities	individual and family services; religious institutions; civic & social organization; non-profit organization management; international trade and development
X. Not elsewhere classified	Unknown; program development; think tanks; philanthropy

3) Industry Employment Growth

Since ILO provides very limited time series observations for calculating industry employment growth, LinkedIn industry employment data is mapped to US BLS data by using the North American Industry Classification System (NAICS). LinkedIn industry mapping to each of the 11 super-sectors of NAICS is summarized in the table below.

BLS Super-sector (NAICS aggregate)	LinkedIn 148 Industry ⁷⁴
Construction	construction; building materials
Education and health services	biotechnology; medical practice; hospital & health care; pharmaceuticals; veterinary; medical device, primary/secondary education; higher education; education management; alternative medicine; e-learning; mental health care
Financial activities	banking; insurance; financial services; real estate; investment banking; investment management; venture capital and private equity; commercial real estate; capital markets; international trade and development
Government	military; legislative office; judiciary; international affairs; government administration; executive office, law enforcement; public safety; public policy
Information	computer software; telecommunications; motion pictures and film; broadcast media; marketing and advertising; newspapers; publishing; printing; information services; public relations and communications; translation and localization; computer games; online media; wireless; media production; animation
Leisure and hospitality	entertainment; gambling & casinos; leisure; travel & tourism; hospitality; restaurants; sports; museums and institutions; fine art; performing arts; recreational facilities and services; music; health; wellness and fitness
Manufacturing	defense & space; computer hardware; semiconductors; cosmetics; apparel and fashion; sporting goods; tobacco; food production; consumer electronics; consumer goods; furniture; food & beverages; aviation and aerospace; automotive; chemicals; machinery; shipbuilding; textiles; paper & forest products; railroad manufacture; electrical and electronic manufacturing; plastics; mechanical or industrial engineering; wine and spirits; luxury goods and jewelry; renewables and environment; glass; ceramics and concrete; packaging and containers; industrial automation
Mining and logging	mining & metals; oil & energy
Other services	libraries; individual and family services; religious institutions; civic & social organization; consumer services; non-profit organization management; fundraising; program development; political organization; events services; outsourcing/offshoring; philanthropy

⁷⁴ Four LinkedIn industries are not able to be mapped to NAICS, namely “farming”, “ranching”, “dairy”, and “fishery”. In summary, the BLS super-sector does not include the agriculture sector, and it is not a well-represented industry within the LinkedIn user base anyways.

Professional and business services	computer networking; internet; law practice; legal services; management consulting; accounting; architecture & planning; civil engineering; research; environmental services; information technology and services; market research; design; writing and editing; staffing and recruiting; professional training & coaching; nanotechnology; computer and network security; alternative dispute resolution; security and investigations; facilities services; think tanks; photography; human resources; graphic design; government relations
Trade, transportation, and utilities	supermarkets; retail; utilities; package/freight delivery; transportation/trucking/railroad; warehousing; airlines/aviation; maritime; arts and crafts; logistics and supply chain; wholesale; import and export; business supplies and equipment

4) Talent Migration

LinkedIn migration data is matched to OECD migration data at the country level, by country name. Subsequently the data set is filtered prior to correlation analysis for a minimum sample of 30 or more observations in each country pair.

5) Skill Need by Industry

Similarities between skill composition are measured on the industry level, where both LinkedIn and external data sources use the ISIC 4 industry classification in order to facilitate comparison. The *skill similarity index* derived by the team, is compared to Value Added (OECD, ILO, WB), IT skills proficiency (PIAAC) and ICT development level (ICT Development Index) at both the industry and occupation level.

D. LinkedIn to ISIC Rev. 4 Industry Mapping Appendix

isic_section	isic_section_name	isic_division	isic_division_name	LinkedIn industry_sk	LinkedIn industry_name	LinkedIn industry_group_sk	LinkedIn industry_group_name
A	Agriculture; forestry and fishing	1	Crop and animal production, hunting and related service activities	63	Farming	1	Agriculture
A	A. Agriculture, forestry and fishing	1	Crop and animal production, hunting and related service activities	64	Ranching	1	Agriculture
A	A. Agriculture, forestry and fishing	1	Crop and animal production, hunting and related service activities	65	dairy	1	Agriculture
A	A. Agriculture; forestry and fishing	3	Fishing and aquaculture	66	fishery	1	Agriculture
B	B. Mining and quarrying	5	Mining of coal and lignite	56	mining & metals	16	Energy and Mining
B	B. Mining and quarrying	6	Extraction of crude petroleum and natural gas	57	oil & energy	16	Energy and Mining
C	C. Manufacturing	25	Manufacture of fabricated metal products, except machinery and equip	2	defense and space	10	Manufacturing
C	C. Manufacturing	25	Manufacture of plastic, rubber, chemically, medicinal chemical and botanical products	3	chemicals	10	Manufacturing
C	C. Manufacturing	10	Manufacture of food products	23	Food production	10	Manufacturing
C	C. Manufacturing	30	Manufacture of other transport equipment	52	aviation and aerospace	10	Manufacturing
C	C. Manufacturing	29	Manufacture of motor vehicles, trailers and semi-trailers	53	automotive	10	Manufacturing
C	C. Manufacturing	20	Manufacture of chemicals and chemical products	54	chemicals	10	Manufacturing
C	C. Manufacturing	28	Manufacture of machinery and equipment n.e.c.	55	machinery	10	Manufacturing
C	C. Manufacturing	30	Manufacture of other transport equipment	58	shipbuilding	10	Manufacturing
C	C. Manufacturing	33	Manufacture of electrical equipment	60	electronics	10	Manufacturing
C	C. Manufacturing	17	Manufacture of paper and paper products	61	paper & forest products	10	Manufacturing
C	C. Manufacturing	30	Manufacture of other transport equipment	62	railroad manufacture	10	Manufacturing
C	C. Manufacturing	18	Printing and reproduction of recorded media	83	printing	11	Media & Communications
C	C. Manufacturing	26	Manufacture of computer, electronic and optical products	112	electrical and electronic manufacturing	10	Manufacturing
C	C. Manufacturing	22	Manufacture of rubber and plastics products	117	plastics	10	Manufacturing
C	C. Manufacturing	32	Manufacture of textile, except apparel	144	textiles and environment	10	Manufacturing
C	C. Manufacturing	32	Other manufacturing	145	glass, ceramics and concrete	10	Manufacturing
C	C. Manufacturing	32	Other manufacturing	146	packaging and containers	10	Manufacturing
C	C. Manufacturing	32	Other manufacturing	147	industrial automation	10	Manufacturing
D	D. Electricity; gas, steam and air conditioning supply	35	electricity; gas, steam and air conditioning supply	59	utilities	16	Energy and Mining
F	F. Construction	41	Construction of buildings	48	construction	3	Construction
F	F. Construction	43	Construction of roads	49	industrial materials	3	Construction
F	F. Construction	43	Civil engineering	51	civil engineering	3	Construction
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	18	cosmetics	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	19	apparel and fashion	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	20	sporting goods	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	21	tobacco	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	22	supermarkets	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	24	consumer electronics	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	25	consumer goods	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	26	furniture	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	27	retail	24	Retail
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	34	food & beverages	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	35	personal care	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	48	Wholesale trade, except of motor vehicles and motorcycles	93	computer services	24	Retail
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	48	Wholesale trade, except of motor vehicles and motorcycles	133	wholesale	24	Retail
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	142	wine and spirits	4	Consumer goods
G	G. Wholesale and retail trade; repair of motor vehicles and motorcycles	47	Retail trade, except of motor vehicles and motorcycles	143	luxury goods and jewelry	4	Consumer goods
H	H. Transportation and storage	53	Postal and courier activities	87	package/freight delivery	15	Transportation & Logistics
H	H. Transportation and storage	49	Land transport and transport via pipeline	92	transportation/trucking/railroad	15	Transportation & Logistics
H	H. Transportation and storage	52	Railway, road and support activities for transportation	93	warehousing	15	Transportation & Logistics
H	H. Transportation and storage	51	Air transport	94	aerodrome/aviation	15	Transportation & Logistics
H	H. Transportation and storage	50	Water transport	95	maritime	15	Transportation & Logistics
H	H. Transportation and storage	52	Warehousing and support activities for transportation	116	logistics and supply chain	15	Transportation & Logistics
H	H. Transportation and storage	52	Warehousing and support activities for transportation	134	import and export	15	Transportation & Logistics
I	I. Accommodation and food service activities	55	Accommodation	131	hospitality	14	Recreation and Travel
I	I. Accommodation and food service activities	56	Food and services activities	32	restaurants	14	Recreation and Travel
J	J. Information and communication	62	Information and communication	33	computer hardware	8	Software & IT Services
J	J. Information and communication	62	Computer programming, consultancy and related activities	4	computer software	8	Software & IT Services
J	J. Information and communication	62	Computer programming, consultancy and related activities	5	computer networking	19	Hardware & Networking
J	J. Information and communication	61	Telecommunications	6	Internet	8	Software & IT Services
J	J. Information and communication	62	Computer programming, consultancy and related activities	7	semiconductors	19	Hardware & Networking
J	J. Information and communication	61	Telecommunications	8	telecommunications	19	Hardware & Networking
J	J. Information and communication	59	Production of video and television programme production, sound recording	9	motion pictures and film	18	Entertainment
J	J. Information and communication	58	Programming and broadcasting activities	36	broadcast media	11	Media & Communications
J	J. Information and communication	58	Publishing activities	81	newspapers	11	Media & Communications
J	J. Information and communication	58	Publishing activities	82	publishing	11	Media & Communications
J	J. Information and communication	63	Information service activities	96	information technology and services	8	Software & IT Services
J	J. Information and communication	58	Publishing activities	103	writing and editing	11	Media & Communications
J	J. Information and communication	100	Information and communication	104	computer games	18	Media & Communications
J	J. Information and communication	63	Information service activities	113	online media	8	Media & Communications
J	J. Information and communication	62	Computer programming, consultancy and related activities	118	computer and network security	19	Hardware & Networking
J	J. Information and communication	62	Computer programming, consultancy and related activities	119	wireless	19	Hardware & Networking
J	J. Information and communication	61	Telecommunications	120	telecommunications	11	Media & Communications
J	J. Information and communication	59	Activities of head offices; management consultancy activities	111	management consulting	5	Corporate Services
K	K. Financial and insurance activities	64	Financial service activities, except insurance and pension funding	125	biotechnology	12	Healthcare
K	K. Financial and insurance activities	65	Insurance, reinsurance and pension funding, except compulsory social	41	banking	7	Finance
K	K. Financial and insurance activities	66	Financial service activities, except insurance and pension funding	42	insurance	7	Finance
K	K. Financial and insurance activities	66	Financial service activities, except insurance and pension funding	43	investment services	7	Finance
K	K. Financial and insurance activities	64	Financial service activities, except insurance and pension funding	45	investment banking	7	Finance
K	K. Financial and insurance activities	66	Financial service activities, except insurance and pension funding	46	investment management	7	Finance
K	K. Financial and insurance activities	64	Financial service activities, except insurance and pension funding	106	venture capital and private equity	7	Finance
L	L. Real estate activities	66	Activities auxiliary to financial service and insurance activities	129	capital markets	7	Finance
L	L. Real estate activities	68	Real estate activities	44	Real estate	22	Real estate
M	M. Professional, scientific and technical activities	69	Research and development	102	commercial real estate	22	Real estate
M	M. Professional, scientific and technical activities	69	Legal and accounting activities	9	law practice	9	Legal
M	M. Professional, scientific and technical activities	69	Legal and accounting activities	10	legal services	9	Legal
M	M. Professional, scientific and technical activities	70	Activities of head offices; management consultancy activities	11	management consulting	5	Corporate Services
M	M. Professional, scientific and technical activities	72	Scientific research and development	12	biotechnology	12	Healthcare
M	M. Professional, scientific and technical activities	75	Veterinary activities	16	veterinary	12	Healthcare
M	M. Professional, scientific and technical activities	71	Architectural and engineering activities; technical testing and analysis	105	engineering	17	Design
M	M. Professional, scientific and technical activities	72	Scientific research and development	50	architectural & planning	17	Design
M	M. Professional, scientific and technical activities	70	Activities of head offices; management consultancy activities	70	research	6	Education
M	M. Professional, scientific and technical activities	73	Advertising and market research	76	executive office	5	Corporate Services
M	M. Professional, scientific and technical activities	70	Activities of head offices; management consultancy activities	80	marketing and advertising	11	Media & Communications
M	M. Professional, scientific and technical activities	70	Activities of head offices; management consultancy activities	84	information services	5	Corporate Services
M	M. Professional, scientific and technical activities	74	Other professional, scientific and technical activities	86	informational services	5	Corporate Services
M	M. Professional, scientific and technical activities	74	Other professional, scientific and technical activities	77	market research	11	Media & Communications
M	M. Professional, scientific and technical activities	73	Scientific research and development	120	alternative dispute resolution	9	Legal
M	M. Professional, scientific and technical activities	70	Activities of head offices; management consultancy activities	123	outsourcing/dfshoring	5	Corporate Services
M	M. Professional, scientific and technical activities	74	Other professional, scientific and technical activities	135	mechanical or industrial engineering	10	Manufacturing
M	M. Professional, scientific and technical activities	74	Other professional, scientific and technical activities	136	photography	2	Art
M	M. Professional, scientific and technical activities	74	Other professional, scientific and technical activities	140	graphic design	17	Design
N	N. Administrative and support service activities	79	Activities of tour operator, reservation service and related activities	20	travel & tourism	14	Recreation and Travel
N	N. Administrative and support service activities	81	Services to buildings and landscape activities	40	renting facilities and services	14	Recreation and Travel
N	N. Administrative and support service activities	82	Office administrative, office support and other business support activities	103	fundraising	13	Nonprofit
N	N. Administrative and support service activities	78	Employment activities	104	staffing and recruiting	5	Corporate Services
N	N. Administrative and support service activities	80	Security and investigation activities	121	security and investigations	5	Corporate Services
N	N. Administrative and support service activities	81	Services to buildings and landscape activities	122	facilities services	5	Corporate Services
N	N. Administrative and support service activities	78	Emergency activities	123	human resources	5	Corporate Services
N	N. Administrative and support service activities	82	Other business support activities	138	business supplies and equipment	5	Corporate Services
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	71	military	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	72	legislative office	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	74	international affairs	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	75	government administration	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	77	law enforcement	21	Public Safety
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	78	public safety	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	79	public policy	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	107	political organization	20	Public Administration
O	O. Public administration and defence; compulsory social security	84	Public administration and defence; compulsory social security	148	government relations	20	Public Administration
P	P. Education	67	Education	67	primary/secondary education	6	Education
P	P. Education	85	Education	68	postsecondary education	6	Education
P	P. Education	85	Education	69	education management	6	Education
P	P. Education	85	Education	132	e-learning	6	Education
Q	Q. Human health and social work activities	86	Human health activities	13	medical practice	12	Healthcare
Q	Q. Human health and social work activities	86	Human health activities	14	hospital & health care	12	Healthcare
Q	Q. Human health and social work activities	86	Human health activities	17	medical device	12	Healthcare
Q	Q. Human health and social work activities	86	Human health activities	125	alternative medicine	23	Wellness and Fitness
Q	Q. Human health and social work activities	86	Human health activities	139	public health care	23	Wellness and Fitness
R	R. Arts, entertainment and recreation	90	Creative, arts and entertainment activities	20	entertainment	18	Entertainment
R	R. Arts, entertainment and recreation	92	Gambling and betting activities	29	gambling & casinos	14	Recreation and Travel
R	R. Arts, entertainment and recreation	93	Sports activities and amusement and recreation activities	33	sports	14	Recreation and Travel
R	R. Arts, entertainment and recreation	91	Libraries, archives, museums and other cultural activities	37	museums and institutions	13	Nonprofit
R	R. Arts, entertainment and recreation	90	Creative, arts and entertainment activities	38	fine art	2	Art
R	R. Arts, entertainment and recreation	90	Creative, arts and entertainment activities	39	performing arts	2	Art
R	R. Arts, entertainment and recreation	91	Activities of libraries, archives and other cultural activities	85	library	2	Nonprofit
R	R. Arts, entertainment and recreation	90	Creative, arts and entertainment activities	111	arts and crafts	2	Art
R	R. Arts, entertainment and recreation	90	Creative, arts and entertainment activities	115	music	18	Entertainment
R	R. Arts, entertainment and recreation	93	Sports activities and amusement and recreation activities	124	health, wellness and fitness	23	Wellness & Fitness
R	R. Arts, entertainment and recreation	90	Creative, arts and entertainment activities	127	animation	18	Entertainment
S	S. Other service activities	96	Other personal, cultural and recreational services	130	individual and family services	13	Nonprofit
S	S. Other service activities	94	Activities of professional membership organizations	89	religious institutions	13	Nonprofit
S	S. Other service activities	94	Activities of professional membership organizations	90	civic and social organization	13	Nonprofit
S	S. Other service activities	94	Activities of professional membership organizations	100	non-profit organization management	13	Nonprofit
S	S. Other service activities	94	Activities of professional membership organizations	141	international trade and development	13	Nonprofit
X	X. Not elsewhere classified	-9	Not_mapped	-9	Unknown	-9	ERR
X	X. Not elsewhere classified	-9	Not_mapped	102	program development	13	Nonprofit
X	X. Not elsewhere classified	-9	Not_mapped	130	think tanks	13	Nonprofit
X	X. Not elsewhere classified	-9	Not_mapped	131	philanthropy	13	Nonprofit

E. Age ILO-LI Comparison Country List in 2016 (*2015, **2014) n=107

Country	Income Group	World Bank Region	LI Mean Age	LI Median Age	ILO Mean Age	ILO Median Age	LI Obs	ILO Obs
Algeria**	Upper Middle Income	Middle East and North Africa	34	31	36	34	331,637	11,452,000
Argentina**	Upper Middle Income	Latin America and the Caribbean	36	34	39	38	1,955,851	11,911,000
Armenia	Lower Middle Income	Europe and Central Asia	33	31	43	43	45,233	1,217,000
Australia	High Income	East Asia and Pacific	37	34	40	39	4,105,425	12,709,000
Austria	High Income	Europe and Central Asia	37	35	40	41	376,724	4,487,000
Azerbaijan	Upper Middle Income	Europe and Central Asia	33	31	39	38	84,877	5,010,000
Bahrain*	High Income	Middle East and North Africa	35	32	37	35	84,647	773,000
Bangladesh	Lower Middle Income	South Asia	31	29	38	37	491,476	59,526,000
Belarus	Upper Middle Income	Europe and Central Asia	32	30	40	40	145,724	5,160,000
Belgium	High Income	Europe and Central Asia	38	36	41	41	1,342,608	4,974,000
Bolivia*	Lower Middle Income	Latin America and the Caribbean	33	31	40	38	109,347	5,050,000
Bosnia and Herzegovina	Upper Middle Income	Europe and Central Asia	34	32	41	41	50,943	1,049,000
Brazil	Upper Middle Income	Latin America and the Caribbean	35	32	38	38	9,879,037	101,258,000
Bulgaria	Upper Middle Income	Europe and Central Asia	34	33	43	42	223,216	3,261,000
Burkina Faso**	Low Income	Sub Saharan Africa	33	30	36	33	35,416	5,789,000
Cameroon**	Lower Middle Income	Sub Saharan Africa	32	30	38	36	123,227	7,112,000
Canada	High Income	North America	38	35	41	41	6,383,239	19,438,000
Chile	High Income	Latin America and the Caribbean	34	31	43	43	1,353,825	8,698,000
Colombia	Upper Middle Income	Latin America and the Caribbean	33	30	39	38	1,542,792	288,507,000
Costa Rica	Upper Middle Income	Latin America and the Caribbean	34	32	39	37	231,924	2,190,000
Cote D'Ivoire	Lower Middle Income	Sub Saharan Africa	32	30	36	34	139,180	8,708,000
Croatia	Upper Middle Income	Europe and Central Asia	35	33	41	40	183,335	1,826,000
Cyprus	High Income	Europe and Central Asia	36	33	41	40	85,579	414,000
Czech Republic	High Income	Europe and Central Asia	35	33	42	42	571,725	5,346,000
Denmark	High Income	Europe and Central Asia	39	37	41	41	1,200,566	3,024,000
Dominican Republic	Upper Middle Income	Latin America and the Caribbean	34	31	39	38	196,648	4,594,000

Ecuador	Upper Middle Income	Latin America and the Caribbean	34	31	39	38	436,519	7,840,000
Egypt	Lower Middle Income	Middle East and North Africa	33	30	36	33	872,391	28,961,000
El Salvador	Lower Middle Income	Latin America and the Caribbean	34	32	39	38	98,469	2,849,000
Estonia	High Income	Europe and Central Asia	35	33	43	42	67,523	687,000
Ethiopia	Low Income	Sub Saharan Africa	32	30	33	31	92,315	8,743,000
Fiji	Upper Middle Income	East Asia and Pacific	34	31	38	37	29,479	340,000
Finland	High Income	Europe and Central Asia	38	36	42	42	521,182	2,682,000
France	High Income	Europe and Central Asia	36	33	41	41	6,027,239	29,553,000
Georgia	Lower Middle Income	Europe and Central Asia	33	31	46	47	65,702	1,996,000
Germany	High Income	Europe and Central Asia	37	35	43	44	2,809,482	43,038,000
Greece	High Income	Europe and Central Asia	37	35	42	41	474,751	4,801,000
Guatemala	Lower Middle Income	Latin America and the Caribbean	34	32	36	33	164,991	6,659,000
Honduras	Lower Middle Income	Latin America and the Caribbean	34	31	37	34	82,028	3,684,000
Hong Kong	High Income	East Asia and Pacific	35	33	42	42	516,153	3,918,000
Hungary	High Income	Europe and Central Asia	35	33	42	41	311,939	4,582,000
Iceland	High Income	Europe and Central Asia	37	34	41	41	41,066	192,000
Indonesia	Lower Middle Income	East Asia and Pacific	32	30	39	38	2,266,537	124,665,000
Iran, Islamic Republic of	Upper Middle Income	Middle East and North Africa	34	31	38	37	578,160	25,721,000
Ireland	High Income	Europe and Central Asia	36	34	41	41	766,281	2,189,000
Israel	High Income	Middle East and North Africa	36	34	40	39	518,229	3,922,000
Italy	High Income	Europe and Central Asia	38	35	43	43	4,276,564	25,768,000
Jamaica	Upper Middle Income	Latin America and the Caribbean	35	32	39	38	95,950	1,350,000
Japan	High Income	East Asia and Pacific	37	34	45	46	569,397	66,490,000
Kazakhstan*	Upper Middle Income	Europe and Central Asia	33	31	38	37	175,926	9,073,000
Korea, Republic of	High Income	East Asia and Pacific	34	32	45	45	472,795	27,246,000
Kuwait	High Income	Middle East and North Africa	35	33	38	37	153,089	2,702,000
Latvia	High Income	Europe and Central Asia	34	33	42	42	93,846	986,000
Lithuania	High Income	Europe and Central Asia	33	32	43	43	126,082	1,474,000
Luxembourg	High Income	Europe and Central Asia	38	36	40	40	101,665	275,000
Macedonia	Upper Middle	Europe and Central	34	32	40	40	55,724	

	Income	Asia						945,000
Madagascar*	Low Income	Sub Saharan Africa	33	31	36	34	39,307	11,249,000
Malaysia	Upper Middle Income	East Asia and Pacific	33	31	36	33	921,921	14,665,000
Mali	Low Income	Sub Saharan Africa	33	31	36	34	32,695	6,043,000
Malta	High Income	Middle East and North Africa	36	33	39	38	57,654	198,000
Mauritius	Upper Middle Income	Sub Saharan Africa	34	32	40	40	64,500	578,000
Mexico	Upper Middle Income	Latin America and the Caribbean	34	32	39	38	3,101,642	53,663,000
Moldova, Republic of	Lower Middle Income	Europe and Central Asia	34	31	42	41	42,150	1,269,000
Mongolia	Lower Middle Income	East Asia and Pacific	33	30	38	38	29,215	1,234,000
Mozambique	Low Income	Sub Saharan Africa	33	30	36	33	64,327	10,176,000
Myanmar	Lower Middle Income	East Asia and Pacific	31	29	36	36	74,439	21,956,000
Namibia	Upper Middle Income	Sub Saharan Africa	33	31	36	33	51,866	861,000
Netherlands	High Income	Europe and Central Asia	40	38	41	41	3,947,816	8,962,000
New Zealand	High Income	East Asia and Pacific	37	34	42	41	713,944	2,596,000
Nicaragua**	Lower Middle Income	Latin America and the Caribbean	34	31	36	33	74,838	2,792,000
Norway	High Income	Europe and Central Asia	39	36	41	41	785,072	2,765,000
Oman	High Income	Middle East and North Africa	34	32	35	33	119,582	2,265,000
Pakistan*	Lower Middle Income	South Asia	33	30	36	33	1,128,883	57,318,000
Panama	Upper Middle Income	Latin America and the Caribbean	35	32	40	39	153,156	1,870,000
Paraguay	Upper Middle Income	Latin America and the Caribbean	34	31	38	36	76,412	1,193,000
Peru	Upper Middle Income	Latin America and the Caribbean	33	30	36	35	1,044,742	5,160,000
Philippines	Lower Middle Income	East Asia and Pacific	32	30	38	37	1,411,630	41,971,000
Poland	High Income	Europe and Central Asia	33	32	41	40	1,105,274	17,258,000
Portugal	High Income	Europe and Central Asia	37	34	43	42	939,840	5,175,000
Puerto Rico*	High Income	Latin America and the Caribbean	37	35	40	40	181,704	1,130,000
Qatar	High Income	Middle East and North Africa	34	32	36	34	250,140	2,049,000
Romania	Upper Middle Income	Europe and Central Asia	35	33	42	41	704,513	8,976,000
Russian Federation	Upper Middle Income	Europe and Central Asia	34	31	40	40	2,009,746	76,634,000
Rwanda**	Low Income	Sub Saharan Africa	31	29	36	32	34,160	5,549,000
Saudi Arabia	High Income	Middle East and North Africa	34	32	38	38	877,117	12,381,000

Senegal*	Low Income	Sub Saharan Africa	33	30	37	36	102,142	3,589,000
Singapore	High Income	East Asia and Pacific	35	33	43	43	872,013	2,256,000
Slovakia	High Income	Europe and Central Asia	34	33	41	40	179,121	2,755,000
Slovenia	High Income	Europe and Central Asia	36	34	41	41	101,339	991,000
South Africa	Upper Middle Income	Sub Saharan Africa	35	32	37	36	2,183,443	21,737,000
Spain	High Income	Europe and Central Asia	37	35	42	42	4,046,783	22,820,000
Sri Lanka	Lower Middle Income	South Asia	33	30	42	41	230,235	8,801,000
Sweden	High Income	Europe and Central Asia	38	36	42	41	1,505,767	5,276,000
Switzerland	High Income	Europe and Central Asia	38	36	42	41	1,077,657	4,838,000
Taiwan, Province of China	High Income	East Asia and Pacific	33	31	41	40	424,704	11,724,000
Tanzania, United Republic of	Low Income	Sub Saharan Africa	32	30	36	33	137,192	21,617,000
Thailand	Upper Middle Income	East Asia and Pacific	35	32	42	42	356,806	37,951,000
Trinidad and Tobago*	High Income	Latin America and the Caribbean	36	33	39	38	85,855	642,000
Turkey	Upper Middle Income	Europe and Central Asia	34	31	38	37	1,937,038	30,521,000
Ukraine	Lower Middle Income	Europe and Central Asia	33	31	40	40	694,073	17,953,000
United Arab Emirates	High Income	Middle East and North Africa	33	32	36	34	1,488,390	7,570,000
United Kingdom	High Income	Europe and Central Asia	37	34	41	41	10,419,250	33,223,000
United States	High Income	North America	38	36	42	41	58,929,394	159,187,000
Uruguay	High Income	Latin America and the Caribbean	37	33	40	40	193,891	1,782,000
Viet Nam	Lower Middle Income	East Asia and Pacific	32	30	40	39	369,790	54,305,000
Yemen**	Lower Middle Income	Middle East and North Africa	36	32	35	32	31,184	4,846,000
Zimbabwe**	Low Income	Sub Saharan Africa	33	31	35	32	133,624	7,062,000

F. Gender ILO-LI Comparison Country List in 2016 (*2015, **2014) n=109

Country	Gender	World Bank Region	Income Group	LI % by Gender	ILO % by Gender	LI Obs	ILO Obs
Albania*	Female	Europe and Central Asia	Upper Middle Income	49.57%	42.90%	58,519	562,000
	Male	Europe and Central Asia	Upper Middle Income	50.43%	57.10%	59,544	748,000
Algeria	Female	Middle East and North Africa	Upper Middle Income	29.73%	18.14%	288,155	2,078,000
	Male	Middle East and North Africa	Upper Middle Income	70.27%	81.86%	680,975	9,376,000
Argentina**	Female	Latin America and the Caribbean	Upper Middle Income	48.46%	41.82%	2,576,655	7,050,000
	Male	Latin America and the Caribbean	Upper Middle Income	51.54%	58.18%	2,740,941	9,807,000
Armenia	Female	Europe and Central Asia	Lower Middle Income	54.52%	47.42%	38,345	579,000
	Male	Europe and Central Asia	Lower Middle Income	45.48%	52.58%	31,986	642,000
Australia	Female	East Asia and Pacific	High Income	45.07%	46.55%	3,810,888	5,917,000
	Male	East Asia and Pacific	High Income	54.93%	53.45%	4,644,801	6,793,000
Austria	Female	Europe and Central Asia	High Income	40.10%	46.83%	394,399	2,102,000
	Male	Europe and Central Asia	High Income	59.90%	53.17%	589,082	2,387,000
Azerbaijan	Female	Europe and Central Asia	Upper Middle Income	34.37%	48.66%	40,980	2,439,000
	Male	Europe and Central Asia	Upper Middle Income	65.63%	51.34%	78,238	2,573,000
Bahrain*	Female	Middle East and North Africa	High Income	28.21%	21.52%	54,766	167,000
	Male	Middle East and North Africa	High Income	71.79%	78.48%	139,386	609,000
Bangladesh	Female	South Asia	Lower Middle Income	23.63%	29.85%	195,994	17,768,000
	Male	South Asia	Lower Middle Income	76.37%	70.15%	633,401	41,760,000
Belarus	Female	Europe and Central Asia	Upper Middle Income	47.64%	49.78%	174,086	2,570,000
	Male	Europe and Central Asia	Upper Middle Income	52.36%	50.22%	191,318	2,593,000
Belgium	Female	Europe and Central Asia	High Income	41.42%	46.11%	1,222,293	2,294,000
	Male	Europe and Central Asia	High Income	58.58%	53.89%	1,728,786	2,681,000
Bolivia*	Female	Latin America and the Caribbean	Lower Middle Income	37.36%	41.92%	184,561	2,118,000
	Male	Latin America and the Caribbean	Lower Middle Income	62.64%	58.08%	309,392	2,935,000
Bosnia and Herzegovina	Female	Europe and Central Asia	Upper Middle Income	44.80%	38.30%	46,730	411,000
	Male	Europe and Central Asia	Upper Middle Income	55.20%	61.70%	57,584	662,000
Brazil	Female	Latin America and the Caribbean	Upper Middle Income	46.53%	43.70%	11,359,512	44,249,000
	Male	Latin America and the Caribbean	Upper Middle Income	53.47%	56.30%	13,056,358	57,010,000
Bulgaria	Female	Europe and Central Asia	Upper Middle Income	51.35%	46.40%	185,781	1,514,000
	Male	Europe and Central Asia	Upper Middle Income	48.65%	53.60%	176,001	1,749,000
Burkina Faso**	Female	Sub Saharan Africa	Low Income	30.42%	48.18%	22,529	

						2,790,000	
	Male	Sub Saharan Africa	Low Income	69.58%	51.82%	51,534 3,001,000	
Cameroon**	Female	Sub Saharan Africa	Lower Middle Income	34.73%	45.13%	90,886 3,247,000	
	Male	Sub Saharan Africa	Lower Middle Income	65.27%	54.87%	170,783 3,947,000	
Canada	Female	North America	High Income	46.62%	47.32%	6,126,056 9,198,000	
	Male	North America	High Income	53.38%	52.68%	7,014,458 10,241,000	
Chile	Female	Latin America and the Caribbean	High Income	43.49%	41.04%	1,652,805 3,571,000	
	Male	Latin America and the Caribbean	High Income	56.51%	58.96%	2,147,529 5,130,000	
Colombia	Female	Latin America and the Caribbean	Upper Middle Income	46.99%	43.15%	2,313,729 124,505,000	
	Male	Latin America and the Caribbean	Upper Middle Income	53.01%	56.85%	2,609,842 164,004,000	
Costa Rica	Female	Latin America and the Caribbean	Upper Middle Income	43.35%	37.73%	283,474 827,000	
	Male	Latin America and the Caribbean	Upper Middle Income	56.65%	62.27%	370,406 1,365,000	
Cote D'Ivoire	Female	Sub Saharan Africa	Lower Middle Income	36.96%	40.67%	95,300 3,542,000	
	Male	Sub Saharan Africa	Lower Middle Income	63.04%	59.33%	162,580 5,167,000	
Croatia	Female	Europe and Central Asia	Upper Middle Income	49.08%	46.25%	169,091 846,000	
	Male	Europe and Central Asia	Upper Middle Income	50.92%	53.75%	175,409 983,000	
Cyprus	Female	Europe and Central Asia	High Income	45.91%	48.32%	74,036 201,000	
	Male	Europe and Central Asia	High Income	54.09%	51.68%	87,211 215,000	
Czech Republic	Female	Europe and Central Asia	High Income	47.12%	44.34%	442,586 2,372,000	
	Male	Europe and Central Asia	High Income	52.88%	55.66%	496,657 2,977,000	
Denmark	Female	Europe and Central Asia	High Income	45.96%	47.29%	831,322 1,431,000	
	Male	Europe and Central Asia	High Income	54.04%	52.71%	977,294 1,595,000	
Dominican Republic	Female	Latin America and the Caribbean	Upper Middle Income	44.79%	40.49%	231,017 1,861,000	
	Male	Latin America and the Caribbean	Upper Middle Income	55.21%	59.51%	284,710 2,735,000	
Ecuador	Female	Latin America and the Caribbean	Upper Middle Income	43.97%	42.39%	640,698 3,324,000	
	Male	Latin America and the Caribbean	Upper Middle Income	56.03%	57.61%	816,394 4,517,000	
Egypt	Female	Middle East and North Africa	Lower Middle Income	25.78%	24.22%	629,241 7,016,000	
	Male	Middle East and North Africa	Lower Middle Income	74.22%	75.78%	1,811,200 21,948,000	
El Salvador	Female	Latin America and the Caribbean	Lower Middle Income	41.00%	41.83%	129,327 1,193,000	
	Male	Latin America and the Caribbean	Lower Middle Income	59.00%	58.17%	186,118 1,659,000	
Estonia	Female	Europe and Central Asia	High Income	52.56%	48.55%	52,835 335,000	
	Male	Europe and Central Asia	High Income	47.44%	51.45%	47,679 355,000	
Ethiopia	Female	Sub Saharan Africa	Low Income	24.24%	48.86%	20,599 4,367,000	
	Male	Sub Saharan Africa	Low Income	75.76%	51.14%	64,386 4,571,000	
Fiji	Female	East Asia and Pacific	Upper Middle Income	47.97%	33.72%	28,252	

						115,000
	Male	East Asia and Pacific	Upper Middle Income	52.03%	66.28%	30,639 226,000
Finland	Female	Europe and Central Asia	High Income	52.52%	48.14%	318,032 1,292,000
	Male	Europe and Central Asia	High Income	47.48%	51.86%	287,533 1,392,000
France	Female	Europe and Central Asia	High Income	45.98%	48.13%	6,116,984 14,224,000
	Male	Europe and Central Asia	High Income	54.02%	51.87%	7,186,985 15,332,000
Georgia	Female	Europe and Central Asia	Lower Middle Income	58.32%	45.77%	67,645 914,000
	Male	Europe and Central Asia	Lower Middle Income	41.68%	54.23%	48,344 1,083,000
Germany	Female	Europe and Central Asia	High Income	36.28%	46.35%	2,461,490 19,948,000
	Male	Europe and Central Asia	High Income	63.72%	53.65%	4,323,323 23,092,000
Greece	Female	Europe and Central Asia	High Income	43.72%	44.70%	347,785 2,147,000
	Male	Europe and Central Asia	High Income	56.28%	55.30%	447,654 2,656,000
Guatemala	Female	Latin America and the Caribbean	Lower Middle Income	40.94%	35.00%	216,872 2,332,000
	Male	Latin America and the Caribbean	Lower Middle Income	59.06%	65.00%	312,827 4,330,000
Honduras	Female	Latin America and the Caribbean	Lower Middle Income	44.72%	39.33%	106,073 1,449,000
	Male	Latin America and the Caribbean	Lower Middle Income	55.28%	60.67%	131,108 2,235,000
Hong Kong	Female	East Asia and Pacific	High Income	46.52%	49.09%	489,671 1,924,000
	Male	East Asia and Pacific	High Income	53.48%	50.91%	563,011 1,995,000
Hungary	Female	Europe and Central Asia	High Income	48.93%	45.70%	182,596 2,096,000
	Male	Europe and Central Asia	High Income	51.07%	54.30%	190,571 2,490,000
Iceland	Female	Europe and Central Asia	High Income	34.20%	46.94%	30,670 92,000
	Male	Europe and Central Asia	High Income	65.80%	53.06%	59,005 104,000
Indonesia	Female	East Asia and Pacific	Lower Middle Income	40.13%	38.48%	2,005,588 47,973,000
	Male	East Asia and Pacific	Lower Middle Income	59.87%	61.52%	2,991,848 76,693,000
Iran, Islamic Republic of	Female	Middle East and North Africa	Upper Middle Income	32.09%	18.97%	671,476 4,892,000
	Male	Middle East and North Africa	Upper Middle Income	67.91%	81.03%	1,420,988 20,898,000
Ireland	Female	Europe and Central Asia	High Income	45.29%	45.07%	742,531 988,000
	Male	Europe and Central Asia	High Income	54.71%	54.93%	896,974 1,204,000
Israel	Female	Middle East and North Africa	High Income	36.74%	47.30%	348,170 1,856,000
	Male	Middle East and North Africa	High Income	63.26%	52.70%	599,525 2,068,000
Italy	Female	Europe and Central Asia	High Income	46.53%	42.37%	4,901,693 10,919,000
	Male	Europe and Central Asia	High Income	53.47%	57.63%	5,632,186 14,850,000
Jamaica	Female	Latin America and the Caribbean	Upper Middle Income	51.99%	46.08%	134,828 623,000
	Male	Latin America and the Caribbean	Upper Middle Income	48.01%	53.92%	124,504 729,000
Japan	Female	East Asia and Pacific	High Income	49.24%	43.37%	269,727

						28,830,000	
	Male	East Asia and Pacific	High Income	50.76%	56.63%	278,106	37,650,000
Kazakhstan*	Female	Europe and Central Asia	Upper Middle Income	53.42%	48.82%	141,302	4,430,000
	Male	Europe and Central Asia	Upper Middle Income	46.58%	51.18%	123,223	4,644,000
Korea, Republic of	Female	East Asia and Pacific	High Income	46.82%	42.31%	175,299	11,529,000
	Male	East Asia and Pacific	High Income	53.18%	57.69%	199,078	15,717,000
Kuwait	Female	Middle East and North Africa	High Income	23.75%	25.94%	87,238	702,000
	Male	Middle East and North Africa	High Income	76.25%	74.06%	280,102	2,004,000
Latvia	Female	Europe and Central Asia	High Income	68.32%	50.25%	86,719	496,000
	Male	Europe and Central Asia	High Income	31.68%	49.75%	40,210	491,000
Lithuania	Female	Europe and Central Asia	High Income	68.69%	50.64%	103,975	748,000
	Male	Europe and Central Asia	High Income	31.31%	49.36%	47,400	729,000
Luxembourg	Female	Europe and Central Asia	High Income	40.34%	45.29%	71,033	125,000
	Male	Europe and Central Asia	High Income	59.66%	54.71%	105,058	151,000
Macedonia	Female	Europe and Central Asia	Upper Middle Income	52.99%	38.71%	59,021	367,000
	Male	Europe and Central Asia	Upper Middle Income	47.01%	61.29%	52,364	581,000
Madagascar*	Female	Sub Saharan Africa	Low Income	42.58%	48.68%	21,647	5,477,000
	Male	Sub Saharan Africa	Low Income	57.42%	51.32%	29,191	5,775,000
Malaysia	Female	East Asia and Pacific	Upper Middle Income	38.80%	38.56%	779,521	5,655,000
	Male	East Asia and Pacific	Upper Middle Income	61.20%	61.44%	1,229,430	9,012,000
Mali	Female	Sub Saharan Africa	Low Income	25.94%	43.60%	16,182	2,830,000
	Male	Sub Saharan Africa	Low Income	74.06%	56.40%	46,212	3,661,000
Malta	Female	Middle East and North Africa	High Income	43.00%	39.00%	60,724	78,000
	Male	Middle East and North Africa	High Income	57.00%	61.00%	80,482	122,000
Mauritius	Female	Sub Saharan Africa	Upper Middle Income	43.00%	39.14%	53,079	227,000
	Male	Sub Saharan Africa	Upper Middle Income	57.00%	60.86%	70,364	353,000
Mexico	Female	Latin America and the Caribbean	Upper Middle Income	42.18%	38.19%	4,036,175	20,496,000
	Male	Latin America and the Caribbean	Upper Middle Income	57.82%	61.81%	5,533,853	33,169,000
Moldova, Republic of	Female	Europe and Central Asia	Lower Middle Income	55.31%	49.69%	70,136	632,000
	Male	Europe and Central Asia	Lower Middle Income	44.69%	50.31%	56,659	640,000
Mongolia	Female	East Asia and Pacific	Lower Middle Income	41.23%	46.73%	4,103	578,000
	Male	East Asia and Pacific	Lower Middle Income	58.77%	53.27%	5,848	659,000
Morocco	Female	Middle East and North Africa	Lower Middle Income	34.08%	26.30%	443,933	3,089,000
	Male	Middle East and North Africa	Lower Middle Income	65.92%	73.70%	858,559	8,657,000
Mozambique*	Female	Sub Saharan Africa	Low Income	29.05%	52.74%	44,455	

						5,368,000
	Male	Sub Saharan Africa	Low Income	70.95%	47.26%	108,566 4,811,000
Myanmar*	Female	East Asia and Pacific	Lower Middle Income	56.55%	43.19%	57,078 9,485,000
	Male	East Asia and Pacific	Lower Middle Income	43.45%	56.81%	43,856 12,474,000
	Female	Sub Saharan Africa	Upper Middle Income	45.92%	49.13%	50,633 424,000
Namibia	Male	Sub Saharan Africa	Upper Middle Income	54.08%	50.87%	59,639 439,000
	Female	Europe and Central Asia	High Income	41.40%	46.41%	2,793,754 4,161,000
Netherlands	Male	Europe and Central Asia	High Income	58.60%	53.59%	3,953,805 4,804,000
	Female	East Asia and Pacific	High Income	46.48%	47.40%	726,686 1,231,000
New Zealand	Male	East Asia and Pacific	High Income	53.52%	52.60%	836,786 1,366,000
	Female	Latin America and the Caribbean	Lower Middle Income	39.57%	38.51%	81,341 1,076,000
Nicaragua**	Male	Latin America and the Caribbean	Lower Middle Income	60.43%	61.49%	124,232 1,718,000
	Female	Europe and Central Asia	High Income	40.74%	47.02%	480,015 1,301,000
Norway	Male	Europe and Central Asia	High Income	59.26%	52.98%	698,151 1,466,000
	Female	Middle East and North Africa	High Income	21.49%	15.09%	58,952 342,000
Oman	Male	Middle East and North Africa	High Income	78.51%	84.91%	215,413 1,925,000
Pakistan	Female	South Asia	Lower Middle Income	16.34%	23.24%	540,138 13,319,000
	Male	South Asia	Lower Middle Income	83.66%	76.76%	2,764,827 44,002,000
Panama	Female	Latin America and the Caribbean	Upper Middle Income	43.06%	40.92%	170,168 766,000
	Male	Latin America and the Caribbean	Upper Middle Income	56.94%	59.08%	225,006 1,106,000
Paraguay	Female	Latin America and the Caribbean	Upper Middle Income	45.34%	40.64%	115,959 1,339,000
	Male	Latin America and the Caribbean	Upper Middle Income	54.66%	59.36%	139,774 1,956,000
Peru	Female	Latin America and the Caribbean	Upper Middle Income	40.67%	46.88%	1,312,977 8,378,000
	Male	Latin America and the Caribbean	Upper Middle Income	59.33%	53.12%	1,915,332 9,495,000
Philippines	Female	East Asia and Pacific	Lower Middle Income	51.28%	39.00%	1,827,697 16,370,000
	Male	East Asia and Pacific	Lower Middle Income	48.72%	61.00%	1,736,335 25,604,000
Poland	Female	Europe and Central Asia	High Income	48.77%	44.88%	1,062,201 7,746,000
	Male	Europe and Central Asia	High Income	51.23%	55.12%	1,115,785 9,514,000
Portugal	Female	Europe and Central Asia	High Income	47.01%	48.77%	1,099,740 2,525,000
	Male	Europe and Central Asia	High Income	52.99%	51.23%	1,239,403 2,652,000
Puerto Rico*	Female	Latin America and the Caribbean	High Income	50.50%	42.26%	246,557 478,000
	Male	Latin America and the Caribbean	High Income	49.50%	57.74%	241,682 653,000
Qatar	Female	Middle East and North Africa	High Income	22.69%	13.16%	104,511 270,000
	Male	Middle East and North Africa	High Income	77.31%	86.84%	356,023 1,781,000
Romania	Female	Europe and Central Asia	Upper Middle Income	53.37%	42.69%	744,618

						3,833,000
	Male	Europe and Central Asia	Upper Middle Income	46.63%	57.31%	650,712 5,145,000
Russian Federation	Female	Europe and Central Asia	Upper Middle Income	50.37%	48.50%	2,735,510 37,166,000
	Male	Europe and Central Asia	Upper Middle Income	49.63%	51.50%	2,695,013 39,469,000
Rwanda**	Female	Sub Saharan Africa	Low Income	32.50%	53.48%	21,929 2,968,000
	Male	Sub Saharan Africa	Low Income	67.50%	46.52%	45,538 2,582,000
Saudi Arabia	Female	Middle East and North Africa	High Income	16.45%	16.86%	330,032 2,088,000
	Male	Middle East and North Africa	High Income	83.55%	83.14%	1,676,529 10,297,000
Senegal*	Female	Sub Saharan Africa	Low Income	32.23%	40.18%	67,919 1,443,000
	Male	Sub Saharan Africa	Low Income	67.77%	59.82%	142,813 2,148,000
Singapore	Female	East Asia and Pacific	High Income	44.12%	45.77%	630,939 1,033,000
	Male	East Asia and Pacific	High Income	55.88%	54.23%	799,208 1,224,000
Slovakia	Female	Europe and Central Asia	High Income	47.99%	45.25%	164,821 1,248,000
	Male	Europe and Central Asia	High Income	52.01%	54.75%	178,594 1,510,000
Slovenia	Female	Europe and Central Asia	High Income	53.08%	46.63%	86,052 463,000
	Male	Europe and Central Asia	High Income	46.92%	53.37%	76,055 530,000
South Africa	Female	Sub Saharan Africa	Upper Middle Income	46.96%	45.00%	2,079,667 9,782,000
	Male	Sub Saharan Africa	Upper Middle Income	53.04%	55.00%	2,349,083 11,957,000
Spain	Female	Europe and Central Asia	High Income	44.76%	46.48%	4,107,055 10,608,000
	Male	Europe and Central Asia	High Income	55.24%	53.52%	5,068,548 12,213,000
Sri Lanka	Female	South Asia	Lower Middle Income	41.40%	34.94%	137,485 3,076,000
	Male	South Asia	Lower Middle Income	58.60%	65.06%	194,620 5,728,000
Sweden	Female	Europe and Central Asia	High Income	45.11%	47.61%	1,143,330 2,513,000
	Male	Europe and Central Asia	High Income	54.89%	52.39%	1,391,171 2,765,000
Switzerland	Female	Europe and Central Asia	High Income	40.74%	46.60%	852,383 2,256,000
	Male	Europe and Central Asia	High Income	59.26%	53.40%	1,239,869 2,585,000
Taiwan, Province of China	Female	East Asia and Pacific	High Income	45.51%	44.22%	319,210 5,185,000
	Male	East Asia and Pacific	High Income	54.49%	55.78%	382,162 6,541,000
Tanzania, United Republic of**	Female	Sub Saharan Africa	Low Income	30.38%	49.63%	106,321 10,730,000
	Male	Sub Saharan Africa	Low Income	69.62%	50.37%	243,644 10,889,000
Thailand	Female	East Asia and Pacific	Upper Middle Income	39.25%	45.57%	134,934 17,293,000
	Male	East Asia and Pacific	Upper Middle Income	60.75%	54.43%	208,810 20,659,000
Trinidad and Tobago*	Female	Latin America and the Caribbean	High Income	51.80%	41.40%	126,923 267,000
	Male	Latin America and the Caribbean	High Income	48.20%	58.60%	118,120 378,000
Turkey	Female	Europe and Central Asia	Upper Middle Income	32.07%	31.55%	1,565,295

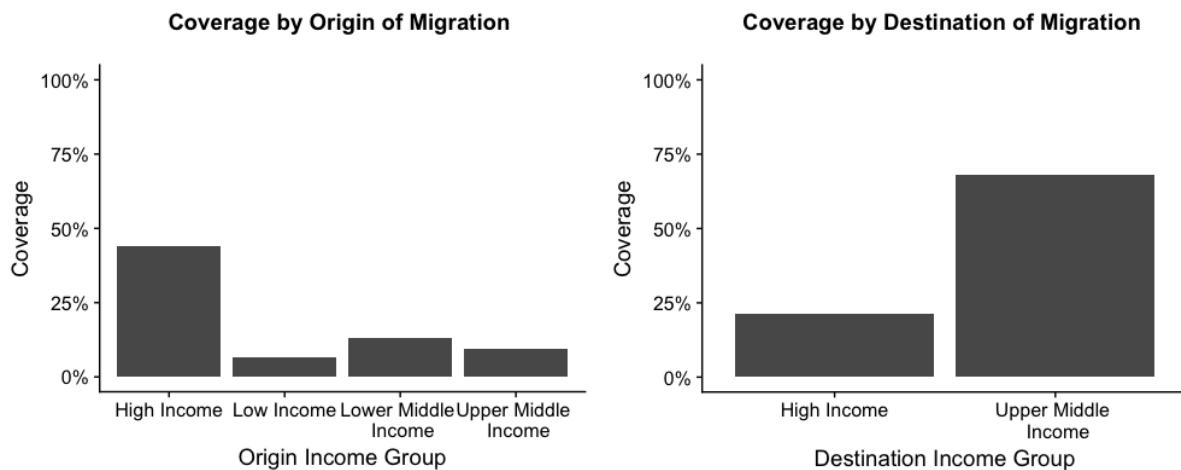
						9,630,000
	Male	Europe and Central Asia	Upper Middle Income	67.93%	68.45%	3,314,937 20,893,000
Ukraine	Female	Europe and Central Asia	Lower Middle Income	46.69%	47.23%	814,368 8,479,000
	Male	Europe and Central Asia	Lower Middle Income	53.31%	52.77%	929,735 9,475,000
United Arab Emirates	Female	Middle East and North Africa	High Income	28.13%	19.14%	712,447 1,449,000
	Male	Middle East and North Africa	High Income	71.87%	80.86%	1,820,305 6,123,000
United Kingdom	Female	Europe and Central Asia	High Income	43.12%	46.69%	9,736,096 15,512,000
	Male	Europe and Central Asia	High Income	56.88%	53.31%	12,843,154 17,714,000
United States	Female	North America	High Income	47.96%	46.76%	64,168,893 74,432,000
	Male	North America	High Income	52.04%	53.24%	69,630,394 84,755,000
Uruguay	Female	Latin America and the Caribbean	High Income	50.86%	45.63%	287,167 814,000
	Male	Latin America and the Caribbean	High Income	49.14%	54.37%	277,442 970,000
Viet Nam	Female	East Asia and Pacific	Lower Middle Income	58.44%	48.44%	489,359 26,307,000
	Male	East Asia and Pacific	Lower Middle Income	41.56%	51.56%	348,061 28,000
Yemen**	Female	Middle East and North Africa	Lower Middle Income	10.94%	8.17%	11,082 396
	Male	Middle East and North Africa	Lower Middle Income	89.06%	91.83%	90,212 4,453
Zimbabwe**	Female	Sub Saharan Africa	Low Income	39.59%	52.79%	100,304 3,729
	Male	Sub Saharan Africa	Low Income	60.41%	47.21%	153,054 3,335

G. Industry Employment ILO-LI Comparison Country List (*2015, **2014) n=92

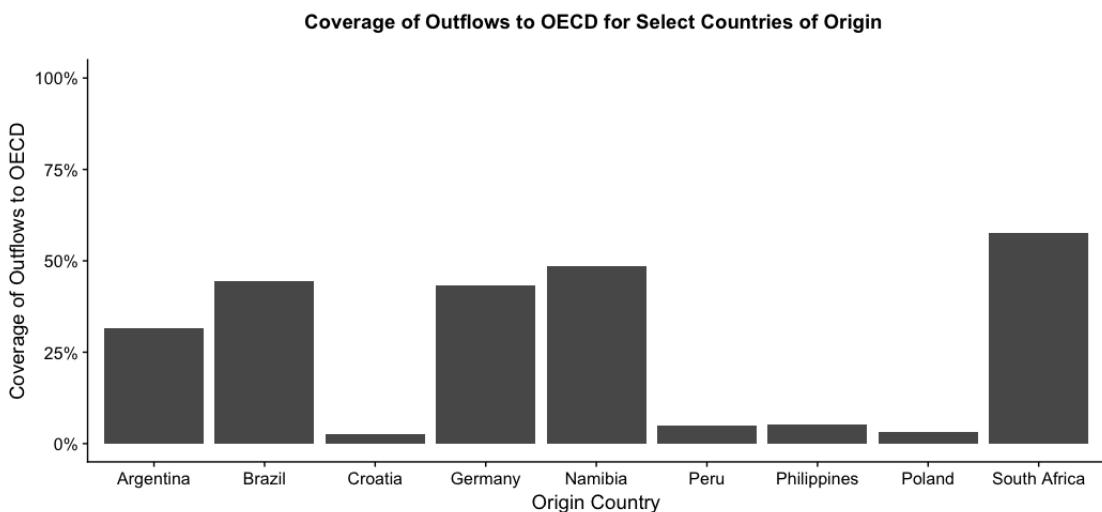
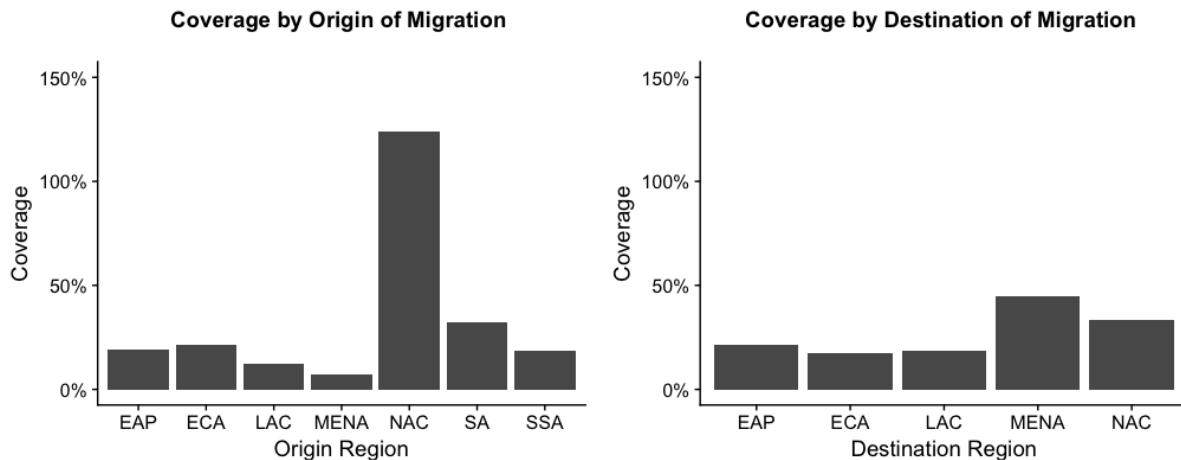
Country	WB Income Group	WB Region	LI 2016 Obs	ILO 2016 Obs	LI as % of ILO
Argentina**	Upper Middle Income	Latin America and the Caribbean	876,824	14,196,000	6.18
Armenia	Lower Middle Income	Europe and Central Asia	14,656	624,000	2.35
Australia	High Income	East Asia and Pacific	3,129,614	11,875,000	26.35
Austria	High Income	Europe and Central Asia	207,295	4,178,000	4.96
Azerbaijan	Upper Middle Income	Europe and Central Asia	42,391	4,722,000	0.9
Bahrain	High Income	Middle East and North Africa	37,468	656,000	5.71
Bangladesh	Lower Middle Income	South Asia	270,286	58,390,000	0.46
Belarus	Upper Middle Income	Europe and Central Asia	17,495	4,606,000	0.38
Belgium	High Income	Europe and Central Asia	971,532	4,490,000	21.64
Bolivia	Lower Middle Income	Latin America and the Caribbean	29,539	4,795,000	0.62
Bosnia and Herzegovina*	Upper Middle Income	Europe and Central Asia	6,908	424,000	1.63
Brazil	Upper Middle Income	Latin America and the Caribbean	4,294,662	82,712,000	5.19
Bulgaria	Upper Middle Income	Europe and Central Asia	130,727	2,968,000	4.4
Cote D'Ivoire	Lower Middle Income	Sub Saharan Africa	33,912	8,471,000	0.4
Croatia	Upper Middle Income	Europe and Central Asia	94,558	1,553,000	6.09
Cuba**	Upper Middle Income	Latin America and the Caribbean	1,828	4,867,000	0.04
Cyprus	High Income	Europe and Central Asia	42,739	337,000	12.68
Czech Republic	High Income	Europe and Central Asia	339,438	5,042,000	6.73
Denmark	High Income	Europe and Central Asia	868,355	2,813,000	30.87
Dominican Republic	Upper Middle Income	Latin America and the Caribbean	65,947	3,958,000	1.67
Ecuador	Upper Middle Income	Latin America and the Caribbean	106,126	7,257,000	1.46
Egypt	Lower Middle Income	Middle East and North Africa	539,470	24,718,000	2.18
El Salvador	Lower Middle Income	Latin America and the Caribbean	19,043	2,564,000	0.74
Estonia	High Income	Europe and Central Asia	37,664	632,000	5.96
Ethiopia***	Low Income	Sub Saharan Africa	33,780	6,096,000	0.55
Fiji	Upper Middle Income	East Asia and Pacific	12,664	266,000	4.76
Finland	High Income	Europe and Central Asia	399,114	2,418,000	16.51
France	High Income	Europe and Central Asia	3,616,495	26,061,000	13.88
Germany	High Income	Europe and Central Asia	1,817,700	40,781,000	4.46
Ghana*	Lower Middle Income	Sub Saharan Africa	104,057	8,736,000	1.19
Greece	High Income	Europe and Central Asia	236,700	3,599,000	6.58
Guatemala	Lower Middle Income	Latin America and the Caribbean	56,713	6,202,000	0.91
Honduras	Lower Middle Income	Latin America and the Caribbean	20,760	3,383,000	0.61
Hong Kong*	High Income	East Asia and Pacific	356,490	3,773,000	9.45
Hungary	High Income	Europe and Central Asia	192,207	4,275,000	4.5
Iceland	High Income	Europe and Central Asia	19,408	181,000	10.72
Indonesia*	Lower Middle Income	East Asia and Pacific	931,157	114,799,000	0.81
Iran, Islamic Republic of	Upper Middle Income	Middle East and North Africa	260,282	22,428,000	1.16
Ireland	High Income	Europe and Central Asia	555,765	1,994,000	27.87
Israel*	High Income	Middle East and North Africa	352,207	3,550,000	9.92
Italy	High Income	Europe and Central Asia	2,312,745	21,736,000	10.64
Japan	High Income	East Asia and Pacific	284,786	64,390,000	0.44
Kazakhstan*	Upper Middle Income	Europe and Central Asia	44,471	8,534,000	0.52
Korea, Republic of	High Income	East Asia and Pacific	174,724	26,044,000	0.67
Latvia	High Income	Europe and Central Asia	51,419	872,000	5.9
Lithuania	High Income	Europe and Central Asia	68,315	1,337,000	5.11

Luxembourg	High Income	Europe and Central Asia	53,231	233,000	22.85
Macedonia	Upper Middle Income	Europe and Central Asia	26,612	700,000	3.8
Madagascar*	Low Income	Sub Saharan Africa	8,501	10,840,000	0.08
Malaysia	Upper Middle Income	East Asia and Pacific	497,461	13,951,000	3.57
Mali	Low Income	Sub Saharan Africa	9,325	5,657,000	0.16
Malta	High Income	Middle East and North Africa	29,862	180,000	16.59
Mauritius	Upper Middle Income	Sub Saharan Africa	18,813	460,000	4.09
Mexico	Upper Middle Income	Latin America and the Caribbean	1,389,334	48,975,000	2.84
Moldova, Republic of	Lower Middle Income	Europe and Central Asia	12,470	1,184,000	1.05
Mongolia	Lower Middle Income	East Asia and Pacific	10,668	767,000	1.39
Mozambique*	Low Income	Sub Saharan Africa	25,989	9,621,000	0.27
Myanmar*	Lower Middle Income	East Asia and Pacific	29,128	21,687,000	0.13
Namibia	Upper Middle Income	Sub Saharan Africa	23,323	589,000	3.96
Netherlands	High Income	Europe and Central Asia	3,121,335	8,379,000	37.25
New Zealand*	High Income	East Asia and Pacific	502,775	2,338,000	21.5
Norway	High Income	Europe and Central Asia	575,148	2,612,000	22.02
Pakistan	Lower Middle Income	South Asia	695,391	58,263,000	1.19
Panama	Upper Middle Income	Latin America and the Caribbean	66,742	1,679,000	3.98
Peru	Upper Middle Income	Latin America and the Caribbean	407,107	4,618,000	8.82
Philippines	Lower Middle Income	East Asia and Pacific	743,015	40,755,000	1.82
Poland	High Income	Europe and Central Asia	731,086	15,987,000	4.57
Portugal	High Income	Europe and Central Asia	469,563	4,450,000	10.55
Puerto Rico*	High Income	Latin America and the Caribbean	65,144	896,000	7.27
Qatar	High Income	Middle East and North Africa	153,460	1,853,000	8.28
Romania	Upper Middle Income	Europe and Central Asia	368,829	8,285,000	4.45
Rwanda**	Low Income	Sub Saharan Africa	11,475	5,268,000	0.22
Saudi Arabia	High Income	Middle East and North Africa	546,573	10,141,000	5.39
Senegal*	Low Income	Sub Saharan Africa	30,909	3,068,000	1.01
Serbia	Upper Middle Income	Europe and Central Asia	120,162	2,534,000	4.74
Singapore*	High Income	East Asia and Pacific	553,893	2,142,000	25.86
Slovakia	High Income	Europe and Central Asia	105,578	2,451,000	4.31
Slovenia	High Income	Europe and Central Asia	46,696	895,000	5.22
Spain	High Income	Europe and Central Asia	1,975,973	17,580,000	11.24
Sri Lanka**	Lower Middle Income	South Asia	137,082	8,175,000	1.68
Sweden	High Income	Europe and Central Asia	1,085,655	4,879,000	22.25
Switzerland	High Income	Europe and Central Asia	725,025	4,522,000	16.03
Taiwan, Province of China	High Income	East Asia and Pacific	178,339	10,810,000	1.65
Tanzania, United Republic of	Low Income	Sub Saharan Africa	37,267	20,900,000	0.18
Thailand	Upper Middle Income	East Asia and Pacific	173,139	37,276,000	0.46
Turkey	Upper Middle Income	Europe and Central Asia	903,490	26,893,000	3.36
Ukraine	Lower Middle Income	Europe and Central Asia	262,317	16,016,000	1.64
United Arab Emirates	High Income	Middle East and North Africa	1,012,938	6,513,000	15.55
United Kingdom	High Income	Europe and Central Asia	8,784,306	31,278,000	28.08
Uruguay	High Income	Latin America and the Caribbean	91,016	1,510,000	6.03
Viet Nam	Lower Middle Income	East Asia and Pacific	195,703	52,946,000	0.37
Zimbabwe*	Low Income	Sub Saharan Africa	56,969	6,085,000	0.94

H. Migration Data Summary Charts Appendix



**Note that all OECD countries are High Income except for Mexico (this is driving the high coverage of Upper Middle Income in the Coverage by Destination of Migration chart).



I. Migration Validation Other Data Sources Evaluated Appendix

Source	Link	Geography Level	Years	Data Structure	Notes
United Nations Department of Economic and Social Affairs	International migrant stock 2015	Major Area Region Country	1990 1995 2000 2005 2010 2015 2017	XLS file	Shows number of migrants from specific country to major area, region and country of destination by totals and by gender
Organisation for Economic Co-operation and Development	International migration database	Country	1975-2015	Self-service chart that can be exported as XLS or CSV file	Presents data showcasing flows and stocks of the total immigrant population and immigrant labor force, together with data on acquisition of nationality List of databases found here
International Labor Organization	Migrants by country of origin (Thousands)	Country	2003-2015	Table that can be exported as XLS file	Sources: Labor force survey, Official estimate, Other administrative records and related sources, Other household survey, Other official source, Population census
United States Department of Homeland Security	Table 3. Persons Obtaining Lawful Permanent Resident Status By Region And Country Of Birth: Fiscal Years 2013 To 2015	Country Region	2013-2015	Table online that can be converted into an XLS file	Shows number of immigrants who are: granted green card, admitted as temporary nonimmigrants, granted asylum/refugee status, naturalized
*Migration Policy Institute	Immigrant and Emigrant Populations by Country of Origin and Destination	Country	Mid-2015	Tableau map (can be configured into text file – source found here)	Source: UN Department of Economic and Social Affairs – “Trends in International Migrant Stock: Migrants by Destination and Origin” (see above)
*International Organization for Migration	World Migration	Country	2015	Interactive map	Source: UN Department of Economic and Social Affairs – “Trends in International Migrant Stock: Migrants by Destination and Origin” (see above) Migration Data Portal aims to serve as access point for timely and comprehensive migration statistics (coming December 2017)

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Wittgenstein Centre for Demography and Global Human Capital	Global Flow of People	Country Region	1990- 1995 1995- 2000 2000- 2005 2005- 2010	XLS file	Bilateral migration flows at region and country levels for 5-year periods (mid-year to mid-year) Estimates reflect migration transitions and thus cannot be compared to annual movements flow data published by UN or Eurostat (because of differences in definition, measurements and data collection procedures)
United Nations Economic Commission for Europe	UNECE Statistical Database – Migration	Country (former USSR)	2001- 2014	Self-service dashboard that can be exported as XLS file	Focuses on former USSR countries Data based on population censuses provided by national statistical offices
*Pew Research Center	Origins and destinations of European Union migrants within the EU	Country (European Union)	2015	Interactive map	Figures refer to total number (cumulative “stocks”) of migrants born or living in European Union countries
The Migration Observatory at the University of Oxford	Home Office Control of Immigration Statistics	Inner UK data	2011	XLS file	Home Office publishes data collected in process of managing entries into the UK and other changes of legal status of persons subject to immigration control Data collected through UK Border Agency Main types of entry data: entry clearance visas issued, passenger entries recorded
Eurostat	Migration and migrant population statistics	Country (European Union)	2016	XLS file	Table 6: Main countries of citizenship and birth of the foreign/foreign-born population, 1 January 2016
United States Department of State	Report of the Visa Office 2017	Country (Immigrant visas to United States) City (Visa issuing office)	2013- 2017	Statistical Tables in PDF files	Table III. Immigrant Visas Issued (by Foreign State of Chargeability or Place of Birth): Fiscal Year 2017 Table IV. Summary of Visas Issued by Issuing Office: Fiscal Year 2017

* indicates that data is from UN Department of Economic and Social Affairs

J. Migration Validation Country List and Coverage Appendix

Coverage by OECD Destination Country					
Income Group	Region	OECD Destination Country	LinkedIn data: Total Inflows	OECD data: Total Inflows	Coverage
High Income	ECA	Ireland	5113	5000	102%
High Income	ECA	Slovak Republic	1988	2811	71%
Upper Middle Income	LAC	Mexico	21775	32013	68%
High Income	ECA	Iceland	755	1255	60%
High Income	ECA	Luxembourg	8263	17913	46%
High Income	MENA	Israel	5451	12177	45%
High Income	ECA	Finland	5574	12833	43%
High Income	ECA	United Kingdom	180788	457000	40%
High Income	EAP	Australia	76637	201041	38%
High Income	ECA	Denmark	14500	39114	37%
High Income	ECA	France	69168	193175	36%
High Income	NAC	Canada	83525	243806	34%
High Income	ECA	Portugal	8298	25060	33%
High Income	NAC	United States	306963	929156	33%
High Income	ECA	Latvia	929	2873	32%
High Income	ECA	Czech Republic	7288	24106	30%
High Income	ECA	Switzerland	39254	130211	30%
High Income	ECA	Hungary	5359	18890	28%
High Income	ECA	Netherlands	37037	138577	27%
High Income	ECA	Norway	10006	40668	25%
High Income	EAP	New Zealand	20146	82039	25%
High Income	ECA	Estonia	1276	5336	24%
High Income	ECA	Sweden	19352	81819	24%
High Income	ECA	Belgium	23202	102340	23%
High Income	ECA	Spain	53754	270027	20%
High Income	ECA	Slovenia	741	4093	18%
High Income	ECA	Italy	32732	189547	17%
High Income	ECA	Poland	10720	68762	16%
High Income	ECA	Austria	10857	112804	10%
High Income	LAC	Chile	12725	152926	8%
High Income	EAP	Japan	15289	243153	6%
High Income	ECA	Germany	80095	1617639	5%

Coverage by Origin Country					
Income Group	Region	Origin Country	LinkedIn data: Flows to OECD	OECD data: Flows to OECD	Coverage
High Income	MENA	United Arab Emirates	11574	4419	262%
High Income	EAP	Singapore	13949	6364	219%
High Income	MENA	Qatar	957	536	179%
High Income	ECA	Switzerland	16515	12544	132%
High Income	MENA	Malta	424	329	129%
High Income	NAC	United States	148428	118103	126%
High Income	NAC	Canada	44020	37418	118%
High Income	EAP	Australia	39870	37139	107%
High Income	ECA	United Kingdom	112112	121743	92%
Upper Middle Income	LAC	Panama	1379	1723	80%
High Income	ECA	Belgium	18210	23430	78%
Lower Middle Income	EAP	Papua New Guinea	342	445	77%
Upper Middle Income	SSA	Botswana	112	157	71%
High Income	ECA	Sweden	11757	19025	62%
High Income	ECA	France	71041	115381	62%
High Income	ECA	Denmark	9080	14842	61%
High Income	ECA	Netherlands	25589	42319	60%
High Income	MENA	Bahrain	689	1178	58%
Upper Middle Income	SSA	South Africa	10683	18495	58%
Low Income	SSA	Mozambique	241	425	57%
Low Income	SSA	Malawi	90	160	56%
High Income	ECA	Norway	6670	12236	55%
High Income	LAC	Chile	4346	8062	54%
High Income	ECA	Ireland	9564	18251	52%
High Income	MENA	Israel	5580	11245	50%
Upper Middle Income	SSA	Namibia	98	202	49%
Lower Middle Income	SA	India	125633	265734	47%
High Income	MENA	Oman	624	1334	47%

High Income	ECA	Spain	43503	96776	45%
High Income	ECA	Cyprus	406	904	45%
Upper Middle Income	LAC	Brazil	30126	67926	44%
Upper Middle Income	LAC	Costa Rica	1512	3433	44%
High Income	ECA	Germany	47137	108816	43%
High Income	ECA	Austria	7631	18192	42%
High Income	MENA	Saudi Arabia	5112	12395	41%
High Income	ECA	Luxembourg	1342	3306	41%
High Income	EAP	New Zealand	11864	32100	37%
Lower Middle Income	SSA	Angola	1125	3267	34%
Low Income	SSA	Benin	480	1439	33%
Upper Middle Income	LAC	Venezuela	11186	33820	33%
High Income	ECA	Finland	4335	13384	32%
Upper Middle Income	EAP	Malaysia	6417	20166	32%
Upper Middle Income	LAC	Argentina	7005	22193	32%
High Income	EAP	Japan	9483	30428	31%
Lower Middle Income	SSA	Zambia	183	637	29%
High Income	MENA	Kuwait	1114	4190	27%
High Income	ECA	Czech Republic	5723	23603	24%
High Income	ECA	Italy	37059	170576	22%
Lower Middle Income	EAP	Indonesia	5498	25852	21%
Upper Middle Income	ECA	Turkey	11300	54044	21%
Lower Middle Income	EAP	Mongolia	129	644	20%
High Income	LAC	Uruguay	678	3460	20%
Lower Middle Income	EAP	Cambodia	598	3227	19%
Lower Middle Income	MENA	Jordan	1511	8370	18%
Lower Middle Income	SSA	Kenya	1901	10610	18%
Low Income	SSA	Rwanda	187	1094	17%
Upper Middle Income	ECA	Russia	12574	74222	17%
Upper Middle Income	SSA	Mauritius	574	3427	17%
High Income	ECA	Iceland	515	3220	16%
Upper Middle Income	MENA	Lebanon	2201	14073	16%
Low Income	SSA	Zimbabwe	438	2823	16%
Upper Middle Income	ECA	Kazakhstan	807	5227	15%
Low Income	SSA	Madagascar	322	2116	15%
Low Income	SSA	Burkina Faso	187	1268	15%
Lower Middle Income	SSA	Nigeria	7083	48508	15%
High Income	ECA	Portugal	9325	64119	15%
Lower Middle Income	SSA	Ghana	2061	14428	14%
Upper Middle Income	EAP	Thailand	5998	42536	14%
Low Income	SSA	Senegal	839	6090	14%
High Income	ECA	Greece	6965	52066	13%
Upper Middle Income	MENA	Iran	7722	58484	13%
High Income	LAC	Trinidad and Tobago	443	3560	12%
Lower Middle Income	MENA	Tunisia	2633	22881	12%
Lower Middle Income	MENA	Egypt	4234	37032	11%
Upper Middle Income	EAP	China	41637	365316	11%
Upper Middle Income	EAP	Fiji	360	3278	11%
Upper Middle Income	LAC	Colombia	7875	74360	11%
Lower Middle Income	SA	Sri Lanka	1854	18028	10%
Low Income	SSA	Togo	247	2436	10%
High Income	ECA	Estonia	612	6037	10%
Lower Middle Income	SA	Bangladesh	3185	31899	10%
Upper Middle Income	ECA	Belarus	820	8598	10%
Upper Middle Income	LAC	Mexico	16185	180610	9%
Upper Middle Income	LAC	Ecuador	1848	22905	8%
Lower Middle Income	SA	Pakistan	7469	94109	8%
High Income	ECA	Slovak Republic	2774	35922	8%
High Income	ECA	Slovenia	721	9688	7%
Lower Middle Income	SSA	Cameroon	1036	15095	7%
High Income	ECA	Latvia	885	13348	7%
Lower Middle Income	ECA	Ukraine	6764	108210	6%
Upper Middle Income	LAC	Jamaica	1429	23068	6%
High Income	ECA	Lithuania	1638	27015	6%
Lower Middle Income	MENA	Morocco	4875	81424	6%
High Income	ECA	Hungary	5874	98301	6%
Low Income	SA	Nepal	1350	23104	6%
Lower Middle Income	ECA	Georgia	571	9773	6%
Lower Middle Income	LAC	Nicaragua	371	6552	6%
Lower Middle Income	LAC	Guatemala	827	14655	6%
Upper Middle Income	MENA	Algeria	2446	43397	6%
Lower Middle Income	EAP	Philippines	9104	169926	5%

Lower Middle Income	ECA	Armenia	469	9104	5%
Upper Middle Income	LAC	Peru	3314	68344	5%
Lower Middle Income	ECA	Moldova	431	10086	4%
Low Income	SSA	Ethiopia	604	16909	4%
High Income	ECA	Poland	9968	304214	3%
Lower Middle Income	SSA	Sudan	115	3580	3%
Upper Middle Income	LAC	Dominican Republic	1901	62437	3%
Upper Middle Income	ECA	Bulgaria	3491	122384	3%
Upper Middle Income	LAC	Paraguay	143	5047	3%
Lower Middle Income	ECA	Uzbekistan	112	3977	3%
Upper Middle Income	ECA	Croatia	1934	75679	3%
Lower Middle Income	LAC	Honduras	486	19185	3%
Lower Middle Income	LAC	El Salvador	517	22596	2%
Upper Middle Income	ECA	Romania	9579	422839	2%
Low Income	SSA	Mali	74	3539	2%
Low Income	LAC	Haiti	451	22867	2%
Lower Middle Income	MENA	Yemen	53	3194	2%
Lower Middle Income	EAP	Myanmar	208	15342	1%
Upper Middle Income	MENA	Iraq	1269	96776	1%
Lower Middle Income	LAC	Bolivia	381	34337	1%
Upper Middle Income	ECA	Albania	859	88747	1%
Upper Middle Income	LAC	Cuba	605	63717	1%
Lower Middle Income	MENA	Syria	796	372039	0%

Outliers - Cook's D of $\text{OECD_rate_per_10K} = B_0 + B_1(\text{li_rate_per_10K})$ Regression						
Destination Country	Origin Country	OECD rate per 10K	Li rate per 10K	Log OECD rate	Log li rate	Cook's D (mean=0.0016)
Germany	Syria	165.305	9.297	5.108	2.230	0.4566
Germany	Croatia	143.957	9.576	4.970	2.259	0.3610
United States	Jamaica	61.428	22.778	4.118	3.126	0.2091
Germany	Albania	237.297	3.300	5.469	1.194	0.2064
Germany	Bulgaria	120.209	7.542	4.789	2.021	0.1541
Australia	New Zealand	48.607	25.298	3.884	3.231	0.0990
United States	Japan	0.422	25.127	-0.864	3.224	0.0985
United States	Cuba	47.462	24.198	3.860	3.186	0.0889
Germany	Luxembourg	47.266	18.603	3.856	2.923	0.0729
Germany	Romania	111.388	5.085	4.713	1.626	0.0676
Germany	Hungary	59.379	10.335	4.084	2.336	0.0569
United States	Dominican Republic	48.072	14.283	3.873	2.659	0.0555
Belgium	Luxembourg	4.921	22.222	1.593	3.101	0.0362
Australia	Papua New Guinea	0.419	19.126	-0.869	2.951	0.0307
United States	Singapore	1.411	17.399	0.344	2.856	0.0181
Portugal	Angola	0.458	16.761	-0.780	2.819	0.0174
United States	Israel	4.916	18.544	1.593	2.920	0.0150
Czech Republic	Slovak Republic	12.285	22.670	2.508	3.121	0.0130
France	Madagascar	0.796	15.556	-0.228	2.744	0.0121
United Kingdom	Greece	9.806	20.560	2.283	3.023	0.0114
Germany	Poland	49.872	4.685	3.909	1.544	0.0109
United States	India	0.490	14.964	-0.714	2.706	0.0107
United Kingdom	Romania	28.173	14.327	3.338	2.662	0.0096
United Kingdom	Bulgaria	6.967	17.818	1.941	2.880	0.0086
United Kingdom	Hungary	9.199	19.076	2.219	2.948	0.0082
United States	El Salvador	30.873	8.397	3.430	2.128	0.0077
Germany	Austria	11.731	20.259	2.462	3.009	0.0068
United States	Bahrain	1.057	13.675	0.055	2.616	0.0067
France	Tunisia	9.321	18.532	2.232	2.920	0.0066
United States	Kuwait	2.680	14.487	0.986	2.673	0.0066
United States	Georgia	3.568	14.922	1.272	2.703	0.0065
United States	Canada	3.525	14.894	1.260	2.701	0.0065

K. Skill Group Classification Appendix

Skill Group	Detailed Skill (Top 10 as Example)
Editing	Editing, Copy Editing, Proofreading, Text Editing, English Grammar, Fact-checking, Web Editing, Punctuation, Formatting Documents, Spelling
Business Management	Management, Strategic Planning, Business Process Improvement, Change Management, Strategy, Team Management, Business Planning, Vendor Management, Business Process, Small Business
Music	Music, Music Production, Singing, Music Industry, Sound, Audio Recording, Music Composition, Songwriting, Music Education, Musical Theatre
Physics	Optics, Thermodynamics, Nuclear Magnetic Resonance (NMR), Heat Transfer, NMR Spectroscopy, Dynamics, Photonics, Biophysics, Astronomy, Experimental Physics
Public Safety	Risk Assessment, Emergency Management, Safety Management Systems, Occupational Health, Law Enforcement, Investigation, Crisis Management, Public Safety, Criminal Justice, Private Investigations
Signal Processing	Signal Processing, Image Processing, Digital Signal Processing, Audio Processing, Encoding, Video Processing, Speech Processing, Multiplexing, Analog Signal Processing, Speech Signal Processing
Instrumentation	Instrumentation, Calibration, Industrial Control, Data Acquisition, Measurements, Meters, Electronic Instrumentation, Instrument Control
Physical Security	Physical Security, Security Management, Surveillance, Security Operations, Closed-Circuit Television (CCTV), Industrial Safety, Workplace Safety, Firefighting, Executive Protection, Corporate Security
Bookkeeping	Accounts Receivable, QuickBooks, General Ledger, Bookkeeping, Peachtree, Accounts Payable & Receivable, MYOB, Expense Reports, Petty Cash, Record Keeping
Digital Marketing	Digital Marketing, Online Marketing, E-commerce, Search Engine Optimization (SEO), Email Marketing, Digital Strategy, Direct Marketing, Google Analytics, Search Engine Marketing (SEM), Google Adwords
Retail Packaging	Packaging Design, Retail Packaging, Packaging Engineering, Packaging Artwork, Pharmaceutical Packaging, Packaging Machinery
Nursing	Nursing, Basic Life Support (BLS), Inpatient Care, Critical Care Nursing, Advanced Cardiac Life Support (ACLS), Patient Education, Acute Care, Working with Physicians, Patient Advocacy, Vital Signs
Enterprise Software	SAP Products, Enterprise Software, SAP ERP, SAP Implementation, High Availability, SAP Netweaver, Microsoft Dynamics CRM, Cognos, Magento, Microsoft Dynamics NAV
Compensation & Benefits	Relocation, Benefits Administration, Deferred Compensation, PeopleSoft, Benefits Negotiation, Compensation & Benefits, SAP HR, Incentives, Compensation, Benchmarking
Delivery Operations	Freight, International Logistics, Third-Party Logistics (3PL), Freight Forwarding, Air Freight, Forwarding, Freight Transportation, Direct Store Delivery, Freight Brokerage, Lean Logistics
Pathology	Flow Cytometry, Laboratory Medicine, Toxicology, Pathology, Biomarkers, Biomarker Discovery, Anatomic Pathology, Medical Microbiology, Cancer Biology, Veterinary Pathology
Competitive Strategies	Competitive Intelligence, Global Delivery, Thought Leadership, Market Intelligence, Positioning, Pricing Analysis, SWOT analysis, Future Trends, Global Strategy, Strategy Execution
Travel Management	Tourism, Travel Management, Leisure Industry, Business Travel, Leisure Travel, Travel Planning, Travel, Online Travel, Tour Operators, Sabre
Recruiting	Recruiting, Interviewing, Sourcing, Employee Benefits Design, Technical Recruiting, Hiring, Onboarding, Executive Search, Applicant Tracking Systems, Screening
Persuasion	Persuasion, Pitching Ideas, Influence Others, Convincing People, Make Things Happen, Persuader
Commercial Photography	Commercial Photography, Fashion Photography, Studio Photography, Studio Lighting, Headshots, Architectural Photography, Still Life, Product Photography, On Location, Food Photography
Sports Coaching	Sports Coaching, Strength Training, Sports Nutrition, Fitness Instruction, Endurance, Golf Instruction, Sports Development, Performance Enhancement, College Football, Coaching Baseball
Mining	Minerals, Gold, Coal, Mineral Processing, Iron Ore, Base Metals, Mining Engineering, Underground Mining, Copper, Coal Mining

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Higher Education	Higher Education, Curriculum Development, Program Development, Program Evaluation, Adult Education, Lecturing, English as a Second Language (ESL), Intercultural Communication, Online Research, International Education
Product Marketing	Marketing Strategy, Market Research, Product Marketing, Marketing Management, Competitive Analysis, Brand Development, Integrated Marketing, Market Planning, Customer Insight, Go-to-market Strategy
Constitutional Law	Constitutional Law, Discrimination Law, Election Law, First Amendment, Supreme Court
Financial Accounting	Financial Analysis, Financial Reporting, Financial Accounting, Corporate Finance, Financial Statements, International Financial Reporting Standards (IFRS), Financial Audits, Generally Accepted Accounting Principles (GAAP), U.S. Generally Accepted Accounting Principles (GAAP), Financial Forecasting
Cardiology	Cardiology, Vascular, Interventional Cardiology, Hypertension, Catheters, Echocardiography, Cardiovascular Disease, Vascular Surgery, Cardiac Surgery, Pacemakers
Volunteer Management	Volunteer Management, Volunteering, Youth Mentoring, Volunteer Recruiting, Volunteer Training, Community Service
Automotive	Automotive, Automotive Aftermarket, Automotive Engineering, Automotive Sales, Dealer Management, Powertrain, Motors, Motorsports, Automotive Electronics, Aftersales
Data Storage Technologies	SQL, Microsoft SQL Server, MySQL, Databases, Cloud Computing, Oracle Database, Oracle HR, Data Center, Virtualization, PL/SQL
Software Testing	Test Automation, User Acceptance Testing, Manual Testing, Test Planning, HP Quality Center, Regression Testing, Debugging, System Testing, Software Quality Assurance, Test Cases
Anthropology	Archaeology, Cultural Anthropology, Cultural Resource Management, European Studies, Cultural Studies, Historical Archaeology, Social Anthropology, Latin American Studies
Nuclear Engineering	Nuclear, Radiography, Reactor, Nuclear Safety, UV, Digital X-ray, Dosimetry, Nuclear Energy, Radiation Monitoring, Radiochemistry
Psychiatry	Psychiatry, Dual Diagnosis, Mental Health Treatment, Child Psychiatry, Behavioral Disorders, Forensic Psychiatry, Geriatric Psychiatry, Addiction Psychiatry, Deconstruction, Psychiatrists
Kinesiology	Exercise Physiology, Kinesiology, Biomechanics, Low Back Pain, Musculoskeletal Physiotherapy, Corrective Exercise, Bodybuilding, Gait Analysis, Musculoskeletal Injuries, Group Exercise
Psychology	Psychotherapy, Working with Adolescents, Stress Management, Counseling Psychology, Family Therapy, Cognitive Behavioral Therapy (CBT), Psychological Assessment, Interventions, Mindfulness, Elder Care
Affiliate Marketing	Trade Marketing, Relationship Marketing, Affiliate Marketing, Network Marketing, Local Marketing, Destination Marketing, Influencer Marketing, Consumer Marketing, Web Marketing Strategy, Marketing Operations
Ocean Transportation	Maritime, Maritime Operations, International Shipping, Container Shipping, Ocean Transportation, Ports, Navigation, ISM Code, Sailing, Boat
Law	Legal Research, Litigation, Legal Writing, Corporate Law, Legal Advice, Commercial Litigation, Corporate Governance, Legal Assistance, Regulatory Affairs, Appeals
Neurology	Neurology, Neuroscience, Neurosurgery, Stroke Rehabilitation, Central Nervous System, Spinal Cord Injury, Neurological Disorders, Brain Injury, CNS disorders, Movement Disorders
Sociology	Cultural Diversity, Ethnography, Social Psychology, Social Research, Qualitative Data, Demography, Quantitative Data, Institutional Change
Oceanography	Scuba Diving, Marine Biology, Meteorology, Oceanography, Climate, Underwater, Marine Survey, Marine Conservation, Physical Oceanography
Translation	Translation, Technical Translation, Localization, Language Services, Bilingual Communications, Legal Translation, Trados, Spanish Translation, Website Localization, Internationalization
Data Science	Data Analysis, Forecasting, Statistics, Analytics, SPSS, R, Trend Analysis, Data Mining, SAS, Modeling
Interior Design	Interior Design, Space Planning, Furniture, Interior Architecture, Building Materials, Flooring, Refurbishments, Furnishings, Lighting Design, Retail Design

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Dance	Dance, Choreography, Contemporary Dance, Ballet, Dance Education, Modern Dance, Classical Ballet, Zumba, Dance Instruction, Tap Dance
Leadership	Leadership, Team Leadership, Team Building, Cross-functional Team Leadership, Organizational Leadership, Strategic Thinking, Strategic Leadership, Technical Leadership, Situational Leadership, Business Innovation
Inside Sales	Account Management, Direct Sales, Sales Process, Solution Selling, International Sales, Cold Calling, Sales Effectiveness, Consultative Selling, Telemarketing, Territory Management
International Law	International Business, International Trade, International Law, Export, Human Rights, European Union, Cross-border Transactions, Immigration Law, European Law, International Arbitration
Physical Medicine and Rehabilitation	Rehabilitation, Fitness Training, Physical Therapy, Sports Medicine, Injury Prevention, Weight Training, Manual Therapy, Strength & Conditioning, Functional Training, Exercise Prescription
Lodging	Hospitality Industry, Hotel Management, Front Office, Rooms Division, Hotel Booking, Property Management Systems, Guest Service Management, Opening Hotels, Reservations, Housekeeping
Data-driven Decision Making	Decision Support, Decision Analysis, Business Decision Making, Ethical Decision Making, Decisiveness, Data-driven Decision Making
Flexible Approach	Easily Adaptable, Diplomacy, Adaptation, Flexible Schedule, Flexible Approach, Agility, Can Do Approach, Constructive Feedback, Open-mindedness, Lateral Thinking
Property Management	Investment Properties, Property Management, Working with Tenants, Apartments, Dispositions, Lease Negotiations, Social Housing, Affordable Housing, Shopping Centers, Yardi
Ground Transportation	Shipping, Road, Forklift Operation, Rail Transport, Trucking, Fleet Management, LTL Shipping, Truckload Shipping, Dispatching, Shipping & Receiving
Writing	Writing, Creative Writing, Proposal Writing, Publishing, Report Writing, Web Content Writing, Storytelling, News Writing, Publications, Resume Writing
Electronics	Electronics, Electrical Wiring, Embedded Systems, Semiconductors, Arduino, Integrated Circuits (IC), Consumer Electronics, Sensors, Semiconductor Industry, Soldering
Oral Communication	Public Speaking, Communication, Presentations, Presentation Skills, Interpersonal Communication, Presenter, Technical Presentations, Presentation Development, Professional Communication, Oral Communication
Social Perceptiveness	Emotional Intelligence, Self-confidence, Interpersonal Relationships, Cross-cultural Communication Skills, Cultural Awareness, Social Justice, Intercultural Skills, Social Enterprise, Cross-cultural Teams, Social Innovation
Professional Cleaning	Carpet Cleaning, Professional Cleaning, Data Cleaning, Floor Cleaning, Window Cleaning, Commercial Cleaning, Industrial Cleaning, Upholstery Cleaning, Home Cleaning, Green Cleaning
Time Management	Time Management, Organization Skills, Multitasking, Skilled Multi-tasker, Self-management, Tenacious Work Ethic, Prioritize Workload, High degree of initiative, Deadline Oriented, Time-efficient
Zoology	Animal Work, Zoology, Entomology, Parasitology, Birds, Ornithology, Exotic Animals, Laboratory Animal Medicine, Reptiles, Aquariums
Real Estate	Residential Homes, Real Estate Transactions, Commercial Real Estate, Sellers, Mortgage Lending, Working with First-Time Home Buyers, Real Estate Development, Renovation, Short Sales, Buyer Representation
Criminal Law	Criminal Law, Anti Money Laundering, Criminal Defense, Business Litigation, Wrongful Death Claims, Expert Witness, Forensic Accounting, Automobile Accidents, Crime Scene Investigations, Conveyancing
Intellectual Property	Intellectual Property, Licensing, Patent Law, Trademarks, Copyright Law, Trade Secrets, Patent Litigation, Patent Prosecution, Trademark Infringement, Patentability
Nanotechnology	Nanotechnology, Nanomaterials, Molecular Modeling, Carbon Nanotubes, Nanostructures, Nanomedicine, Mechanical Properties, Nanoelectronics
Software Development Life Cycle (SDLC)	Integration, Requirements Analysis, Agile Methodologies, Software Development Life Cycle (SDLC), Scrum, Solution Architecture, Requirements Gathering, Systems Engineering, Unified Modeling Language (UML), Software Design
Politics	International Relations, Politics, International Development, Political Campaigns, Foreign Policy, Public Affairs, Humanitarian, Political Consulting, Foreign Affairs, State Politics
Public Health	Public Health, Health Education, Health Promotion, Epidemiology, Prevention, Health Policy, Global Health, Community Health, Medical Affairs, Health Economics
Project Management	Project Management, Project Planning, Program Management, Microsoft Project, Software Project Management, Project Estimation, Stakeholder Management, Project Coordination, Facilitation, Project Delivery

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Central Banks	Interest Rates, Monetary Policy, Inflation
Advertising	Advertising, Online Advertising, Copywriting, Brand Management, Web Analytics, Creative Strategy, Sponsorship, Media Planning, Sports Marketing, Direct Mail
Organic Chemistry	Biochemistry, High-Performance Liquid Chromatography (HPLC), Analytical Chemistry, Good Laboratory Practice (GLP), Organic Chemistry, ELISA, Chromatography, Protein Purification, UV/Vis Spectroscopy, Protein Chemistry
Biomedical Engineering	Medical Devices, Biomedical Engineering, Electronic Data Capture (EDC), Biomaterials, Medical Technology, Medical Equipment, Bioanalysis, Medical Device R&D, Biomedical Devices
Operational Efficiency	Operational Planning, Supply Chain Optimization, Operational Excellence, Key Performance Indicators, Demand Planning, KPI Reports, Operational Efficiency, Inventory Planning, Operational Strategy, Cost Effective
Architecture	AutoCAD, Computer-Aided Design (CAD), SketchUp, Enterprise Architecture, Architectural Design, Revit, Sustainable Design, Design Research, AutoCAD Architecture, Green Building
Personal Coaching	Coaching, Personal Development, Mentoring, Career Counseling, Personal Training, Motivational Speaking, Life Coaching, Business Coaching, Job Coaching, Lifestyle Coaching
Human Resources	Performance Management, Employee Relations, Talent Management, HR Consulting, HR Policies, Human Resources Information Systems (HRIS), Succession Planning, New Hire Orientations, Workforce Planning, Labor Relations
Construction Engineering	Construction Management, Contractors, Concrete, EPC, Value Engineering, Construction Safety, HVAC, Submittals, Primavera P6, Construction Drawings
Gastroenterology	Gastroenterology, Digestive Disorders, Hepatology, Gastrointestinal Disorders, Gastrointestinal Surgery
National Security	National Security, Homeland Security, Counterinsurgency, Government Relations, Coalitions, Interagency Coordination, Government Liaison, Federal Government Relations, NSA
Religious Studies	Preaching, Theology, Pastoral Care, Discipleship, Religion, Biblical Studies, Youth Ministry, Pastoral Counseling, Church Events, Missions
Airlines	Airlines, Commercial Aviation, Airports, Flight Safety, Civil Aviation, Piloting, Flight Planning, Air Charter, Aviation Security, IATA
Retail Sales	Sales Management, Retail, Merchandising, Pricing Strategy, Visual Merchandising, Retail Sales, Store Management, Fast-Moving Consumer Goods (FMCG), Trade Shows, Loss Prevention
Telecommunications	Telecommunications, Mobile Devices, Wireless Technologies, Internet Protocol (IP), GSM, Unified Communications, 3G, LTE, Radio Frequency (RF), Mobile Communications
Chemical Industry	Chemical Engineering, Polymers, Coatings, Formulation, Aspen HYSYS, Fragrance, Adhesives, Paper Industry, Resin, Chemical Industry
Wellness	Wellness, Fitness, Holistic Health, Wellness Coaching, Nutritional Counseling, Healing, Therapeutic Massage, Yoga, Meditation, Nutrition Education
Product Testing	Testing, Quality Control, Validation, Quality Auditing, Corrective and Preventive Action (CAPA), Nondestructive Testing (NDT), Verification and Validation (V&V), Welding Inspection, Ultrasonic Testing, QA Engineering
General Surgery	Surgery, Operating Room, Working with Surgeons, General Surgery, Surgical Instruments, Disposables, Aseptic Technique, Laparoscopic Surgery, Endoscopy, Reconstructive Surgery
Customer Service Systems	Customer Service Management, IVR, CRM Integration, Call Routing, Service Processes, Queue Management, Customer Service Systems, Service Automation, Call Flow Design, Customer Portal
People Management	Teamwork, Supervisory Skills, Personnel Management, People Management, Team Motivation, Conflict Management, Distributed Team Management, Workforce Management, Organizational Structure, Staff Training
Air Force	Aerospace, Military Operations, Defense, Weapons Handling, Force Protection, Intelligence Analysis, Intelligence, Air Force, Radar, Electronic Warfare
Air Traffic Control	Airport Management, Air Traffic Control, International Flight Operations, Airspace Management, ADS-B
Utilities	Energy, Energy Industry, Pumps, SCADA, Energy Management, Electricity, Building Services, Boilers, Gas Turbines, Pneumatics
Shipbuilding	Marine Engineering, Shipbuilding, Yachting, Naval Architecture, Vessels, Maritime Safety, Marine Industry, Shipyards, Boat Building, Marine Systems
Aircraft Management	Aircraft Maintenance, Aircraft Systems, Business Aviation, B737, A320, Helicopter Operations, Aircraft Leasing, Aircraft Management, Flight Management Systems, Cockpit
Cosmetology	Styling, Cosmetics, Beauty Industry, Skin Care, Makeup Artistry, Hair Cutting, Spa, Hair Care, Cosmetology, Waxing

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Product Development	Product Development, Product Launch, Product Design, Innovation Management, Product Lifecycle Management, Product Innovation, Commercialization, Innovation Development, Mechanical Product Design, Product Engineering
Revenue Analysis	Revenue Analysis, Yield Management, Revenue Cycle, Revenue Cycle Management, Revenue Forecasting, Revenue Modeling, Revenue Streams, Revenue Share
Animation	DES, After Effects, 3D Studio Max, Animation, 3D Modeling, 3D, Rendering, Maya, Motion Graphics, Storyboarding
Industrial Design	Sketching, Concept Development, Concept Art, Design Thinking, User-centered Design, Model Making, Rapid Prototyping, Design Strategy, Ergonomics, Design Engineering
Problem Solving	Problem Solving, Creative Problem Solving, Decision-Making, Collaborative Problem Solving, Ethics, Problem Analysis, Solution Focused, Analytic Problem Solving, Root Cause Problem Solving, Team Problem Solving
Forestry	Forestry, Trees, Forest Management, Forest, Renewable Resources, Sustainable Forest Management, Forest Products, Urban Forestry, Forest Carbon
Scientific Computing	Matlab, Finite Element Analysis, Mathematical Modeling, Simulink, Bioinformatics, SASS, Scala, High Performance Computing (HPC), Scientific Computing, Maple
Payroll Services	Payroll, ADP Payroll, Payroll Taxes, Payroll Processing, Payroll Administration, Time & Attendance, Kronos, Payroll Services, Kronos Timekeeping, Payroll Analysis
Nuclear Physics	Radiation Safety, Nuclear Power Plants, Radiation, Nuclear Physics, Nuclear Proliferation, Radioactive Materials, Reactor Physics, Radiation Effects, Radioactivity, Linear Accelerators
Administrative Assistance	Data Entry, Office Administration, Administration, Process Scheduler, Phone Etiquette, Typing, Scheduling, Filing, Receptionist Duties, Clerical Skills
Family Medicine	Medical Education, Home Care, Internal Medicine, Diabetes, Pain Management, Medical-Surgical, Immunology, Infectious Diseases, Wound Care, IV Therapy
Anesthesiology	Anesthesiology, Mechanical Ventilation, Regional Anesthesia, Sedation, Intubation, Conscious Sedation, General Anesthesia, U.S. Federal Communications Commission (FCC), Intraoperative Monitoring
Printing	Digital Printing, Pre-press, Offset Printing, Print Management, Wide Format Printing, Screen Printing, 3D Printing, Color Management, Variable Data Printing, Managed Print Services
Graphic Design	Adobe Photoshop, Adobe Illustrator, InDesign, Web Design, Adobe Creative Suite, Art Direction, Logo Design, Drawing, Illustration, Graphics
Pharmaceutics	Clinical Research, Clinical Trials, Pharmaceutical Sales, Pharmacy, Pharmaceutics, Pharmacology, Market Access, Pharmacovigilance, Biopharmaceuticals, U.S. Title 21 CFR Part 11 Regulation
Partner Development	Partner Management, Business Alliances, Partnerships, Strategic Alliances, Partner Development, Partnership-building, Partner Programs, Channel Programs, Partner Support
Art History	Contemporary Art, Museums, Art Education, Curating, Gallery Administration, Cultural Heritage, Museum Collections, Museum Education, Historical Research, World History
Accounts Payable	Accounts Payable, Invoicing, Cash Collection, JD Edwards, Purchase Orders, Invoice Processing, Expenses, Billing Systems, Billing Process, Client Billing
Growth Strategies	Mergers & Acquisitions, Restructuring, Customer Acquisition, Financial Structuring, Corporate Development, Acquisitions, Acquisition Integration, International Business Development, LBO, Market Entry
Apparel	Fashion, Apparel, Textiles, Fashion Design, Sewing, Fashion Illustration, Footwear, Fashion Shows, Sportswear, Wovens
Evolutionary Biology	Evolutionary Biology, Natural History, Paleontology, Synthetic Biology, Species Identification, Flora & Fauna
Environmental Engineering	Environmental Engineering, Waste Management, Stormwater Management, Hazardous Waste Management, Waste, Erosion Control, Municipalities, Traffic Management, Redevelopment, Green Technology
Professional Sports	Sports Management, Athletics, Football, Athletic Training, Soccer, Golf, Swimming, Basketball, Martial Arts, Tennis
Analytical Reasoning	Critical Thinking, Technical Analysis, Independent Thinking, Analytical, Analytical Reasoning, Logical Approach, Systems Thinking, Information Analysis, Reasoning Skills, Scientific Analysis
Dermatology	Dermatology, Skin Care Products, Plastic Surgery, Microdermabrasion, Chemical Peels, Acne, Laser Hair Removal, Botox Cosmetic, Hair Removal, Juvederm

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Electronic Control Systems	Programmable Logic Controller (PLC), Control Systems Design, Distributed Control System (DCS), Building Automation, Allen-Bradley, Building Management Systems, Variable Frequency Drives, Lighting Control, Control Logic, WinCC
History	American History, European History, Oral History, Critical Reading, Ancient History, Social Change, Film History, Local History, Public Records, Cultural History
Entrepreneurship	Entrepreneurship, Start-ups, Social Entrepreneurship, Lean Startup, Angel Investing, Start-up Ventures, Entrepreneurship Development, Small Business Development, Early-stage Startups, Growth Hacking
Foreign Languages	English, Spanish, French, Dutch, Portuguese, German, Foreign Languages, Italian, Multilingual, Chinese
Veterinary Medicine	Microbiology, Veterinary Medicine, Animal Welfare, Animal Behavior, Pet Care, Dogs, Veterinary Surgery, Veterinary Technology, Veterinary Nursing, IACUC
Computer Graphics	Computer Graphics, AutoCAD Mechanical, OpenGL, Qt, GIMP, Digital Image Processing, Engineering Drawings, Adobe Freehand, 2D graphics, MEL
Inventory Management	Inventory Management, Enterprise Resource Planning (ERP), Inventory Control, Warehouse Operations, Materials Management, Warehouse Management Systems, Distribution Center Operations, SAP Sales & Distribution, Stock Management, Order Management
Urology	Urology, Dialysis, Kidney Transplant, Pediatric Urology
Social Services	Mental Health, Social Services, Case Management, Crisis Intervention, Group Therapy, Mental Health Counseling, Behavioral Health, Youth Development, Motivational Interviewing, Clinical Supervision
Obstetrics	Obstetrics and Gynecology, Pregnancy, Women's Health, Obstetrics, Gynecology, Fertility, Prenatal Care, Infertility, Midwifery, Maternity
Sales Operations	Customer Relationship Management (CRM), Sales Operations, Business-to-Business (B2B), Salesforce.com, Strategic Partnerships, Pre-sales, Business Relationship Management, Sales Presentations, Channel Partners, Key Account Development
Artificial Intelligence	Machine Learning, Data Structures, Artificial Intelligence, Computer Vision, Apache Spark, Deep Learning, Pattern Recognition, OpenCV, Artificial Neural Networks, Neural Networks
Earth Science	Renewable Energy, Geographic Information Systems (GIS), ArcGIS, Geology, Global Positioning System (GPS), Geological Mapping, Mineral Exploration, Remote Sensing, Geophysics, Logging
Oral Comprehension	Learning Disabilities, Educational Assessment, Listen, Assistive Listening Devices, Oral Comprehension
Reading Comprehension	Reading Comprehension, Reading Intervention, Guided Reading
Computer Hardware	Computer Hardware, Servers, Microcontrollers, Printed Circuit Board (PCB) Design, VHDL, Verilog, Field-Programmable Gate Arrays (FPGA), PLC Programming, Application-Specific Integrated Circuits (ASIC), IBM iSeries
Inorganic Chemistry	Inorganic Chemistry, Catalysis, Physical Chemistry, Surface Chemistry, Precious Metals, Organometallic Chemistry, Heterogeneous Catalysis, Inorganic Synthesis, Silicones, Adsorption
Family Law	Family Law, Juvenile Law, Elder Law, Prenuptial Agreements, Divorce Law, Family Mediation, Paternity, Preparation of Wills, Legal Separation, Juvenile Delinquency
Contract Law	Civil Litigation, Dispute Resolution, Arbitration, Joint Ventures, Contract Law, Contractual Agreements, Construction Law, Company Law, Software Licensing, Breach Of Contract
Insurance	Risk Management, Insurance, Health Insurance, Underwriting, General Insurance, Property & Casualty Insurance, Commercial Insurance, Life Insurance, Claims Management, Liability
Creativity Skills	Creativity Skills, Creative Arts, Creative Work, Creative Merchandising, Creative Visualization, Creative Conception, Creative Content Production, Creative Campaign Development, Creative Content Creation, Creative Industries
Mathematics	Numerical Analysis, Mathematica, Fortran, Operations Research, Applied Mathematics, Calculus, Numerical Simulation, Monte Carlo Simulation, Algebra, Mathematical Analysis
Research	Research, Qualitative Research, Research and Development (R&D), Quantitative Research, Research Design, Focus Groups, Primary Research, Secondary Research, Qualitative & Quantitative Research Methodologies, Financial Research
Sales Leads	Lead Generation, Demand Generation, Inbound Marketing, Lead Management, Sales Leads, Inbound Lead Generation, Client Prospecting, Social Selling, Channel Partner Development, Building New Business
Army	U.S. Department of Defense, Army, Counterterrorism, Military Training, Tactics, Military Logistics, Afghanistan, Veterans, Special Operations, Combat

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Maintenance & Repair	Maintenance, Maintenance Management, Maintenance & Repair, Preventive Maintenance, Computer Repair, Hydraulics, Heavy Equipment, Computer Maintenance, Plant Maintenance, Mechanics
Library Science	Library Services, Cataloging, Information Literacy, Archives, Collection Development, Library Management, Library Instruction, Library Research, Digital Libraries, Metadata
K-12 Education	Tutoring, Lesson Planning, Teacher Training, Classroom Management, Elementary Education, Special Education, Differentiated Instruction, Literacy, K-12 Education, Secondary Education
Robotics	Automation, Robotics, Control Theory, Process Automation, Machine Design, Electrical Controls, Mechatronics, Electro-mechanical, Motion Control, Machine Vision
Literature	Literature, Poetry, English Literature, Short Stories, Novels, Book Reviews, Literary Criticism, Memoir, Essays, Narrative
Investment Banking	Investments, Financial Services, Financial Planning, Asset Management, Investment Banking, Private Equity, Wealth Management, Mutual Funds, Retirement Planning, Hedge Funds
Collaborative Style	Collaborative Leadership, Collaboration Solutions, Cross-functional Collaborations, Build Strong Relationships, Collaborative Environment, Collaboration Tools, Collaborative Work, Cross-Organization Collaboration, Team Environments, Collaborative Style
Human Computer Interaction	User Experience, User Interface Design, Bootstrap, Interaction Design, User Experience Design, Usability, Usability Testing, Human Factors, Wireframing, Experience Design
Urban Planning	Urban Design, Urban Planning, Comprehensive Planning, Land Development, Transportation Planning, Land Use Planning, Zoning, Historic Preservation, Urbanism, Urban
Active Learning	E-Learning, Distance Learning, Moodle, Needs Analysis, Self Learning, Passionate about work, Professional Learning Communities, Active Learning, Quick Study, Learn New Software Quickly
Management Accounting	Budgeting, Account Reconciliation, Managerial Finance, P&L Management, Cash Flow, Cash Management, Cost Accounting, Variance Analysis, Bank Reconciliation, Management Accounting
Management Consulting	Business Analysis, Management Consulting, Business Intelligence, Market Analysis, Strategic Consulting, Business Process Mapping, Business Case, Business Modeling, Process Consulting, Client Presentation
Investor Relations	U.S. SEC Filings, Investor Relations, Capital Raising, U.S. Securities and Exchange Commission (SEC), SEC Financial Reporting, XBRL, Public Companies, Securities Offerings, Board of Directors Reporting, Stock Compensation
Social Media	Social Media, Social Media Marketing, Digital Media, Blogging, Facebook, Twitter, Social Marketing, YouTube, Instagram, Social Media Optimization (SMO)
Bartending	Wine, Bartending, Wine Tasting, Alcoholic Beverages, Beer, Beverage Industry, Wine & Spirits Industry, Cocktails, Craft Beer, Champagne
Event Planning	Event Planning, Event Management, Corporate Events, Live Events, Festivals, Meeting Planning, Weddings, Party Planning, Event Production, Wedding Planning
Composites	Composites, Carbon, Composite Structures, Prestressed Concrete, Fibre, Polymer Composites, Aircraft Structures, Fiberglass, Carbon Fiber, Mould Design
Tax Accounting	Tax, Income Tax, Tax Preparation, Corporate Tax, Tax Accounting, Tax Advisory, Value-Added Tax (VAT), International Tax, Sales Tax, Tax Research
Agricultural Production	Agribusiness, Farms, Sustainable Agriculture, Animal Husbandry, Animal Nutrition, U.S. Department of Agriculture (USDA), Irrigation, Horses, Crop Protection, Organic Farming
Teaching	Teaching, University Teaching, Language Teaching, Teaching English as a Second Language, English Teaching, Teaching English as a Foreign Language, Teaching Writing, Sales Trainings, Instructors, Assistant Teaching
Genetic Engineering	Molecular Biology, Polymerase Chain Reaction (PCR), Genetics, Real-Time Polymerase Chain Reaction (qPCR), Genomics, Molecular Cloning, Gel Electrophoresis, DNA, Protein Expression, DNA Extraction
Corporate Communications	Media Relations, Strategic Communications, Press Releases, Corporate Communications, Newsletters, Internal Communications, Corporate Identity, Corporate Branding, Corporate Social Responsibility, Crisis Communications
Development Tools	Java, C++, C, Linux, C#, Python, Unix, .NET Framework, ASP.NET, Git
Linguistics	Grammar, Applied Linguistics, Computational Linguistics, Phonetics, Discourse Analysis, Phonology, Syntax, Pragmatics, Language Testing, Psycholinguistics
Pharmaceutical Manufacturing	Pharmaceutical Industry, Biotechnology, GMP, Laboratory Skills, Standard Operating Procedure (SOP), U.S. Food and Drug Administration (FDA), Clinical Development, Good Clinical Practice (GCP), Technology Transfer, CRO Management
Computer Networking	Networking, Windows Server, Active Directory, Software as a Service (SaaS), Network Administration, Voice over IP (VoIP), Cisco Systems Products, Internet Protocol Suite (TCP/IP), Network Design, Switches

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Emergency Medicine	Cardiopulmonary Resuscitation (CPR), First Aid, Emergency Medicine, Emergency Services, Life Support, EMT, Paramedic, Emergency Nursing, Ambulance, First Aid Training
Carpentry	Carpentry, Woodworking, Cabinetry, Roofers, Wood, Millwork, Joinery, Kitchen Cabinets, Finish Carpentry, Engineered Wood Products
Game Development	Video Games, Game Development, Unity3D, Game Design, Online Gaming, Mobile Games, Gaming Industry, Gaming, Perforce, Unity
Communication Disorders	Speech, Speech Therapy, Traumatic Brain Injury, Language Disorders, Aphasia, Audiology, Assistive Technology, Apraxia, Augmentative and Alternative Communication (AAC), Hearing Aids
Web Development	HTML, JavaScript, Cascading Style Sheets (CSS), PHP, Web Development, XML, jQuery, HTML5, WordPress, Web Services
Dentistry	Dentistry, Cosmetic Dentistry, Restorative Dentistry, Oral Surgery, Teeth Whitening, Periodontics, Prosthodontics, Endodontics, Dental Care, Veneers
Painting	Painting, Visual Arts, Oil Painting, Art Exhibitions, Restoration, Watercolor, Acrylic, Paint, Acrylic Painting, Murals
Geotechnical Engineering	Highways, Geotechnical Engineering, Earthworks, Foundation Design, Excavation, Tunnels, Seismic Design, Pavement Engineering, Slope Stability, Rock Mechanics
Fluid Dynamics	Computational Fluid Dynamics (CFD), Fluid Mechanics, Aerodynamics, Fluid Dynamics, Fluids, Dynamic Simulation, Turbulence Modeling
Tax Law	Tax Law, Revenue Recognition, Asset-Backed Security (ABS), Securities Lending, Commercial Mortgage-Backed Security (CMBS), Mortgage-Backed Security (MBS), Distressed Debt, FIN 48, Unsecured Loans, Use Tax
Debt Collection	Debt Collection, Debt Restructuring, Debt Management, Credit Control, Debt Settlement, Debt Consolidation, Debtors, Debtor/Creditor, Vendor Finance
Sculpture	Sculpture, Clay, Stoneware, Statues
Oncology	Oncology, Cancer, Cancer Research, Chemotherapy, Oncology Clinical Research, Breast Cancer, Cancer Screening, Cancer Treatment, Molecular Oncology, Gynecologic Oncology
Hosting Services	Web Hosting, Internet Services, Managed Hosting, Email Hosting, Hosting Services
Radiology	Medical Imaging, Radiology, Digital Imaging, Picture Archiving and Communication System (PACS), Medical Ultrasound, X-ray, MRI, Medical Diagnostics, DICOM, Computed Tomography
Landscape Architecture	Landscaping, Landscape Design, Horticulture, Landscape Architecture, Landscape Maintenance, Garden Design, Garden, Tree Planting, Lawn Care, Plant Identification
Cloud Computing	Microsoft Azure
Physiology	Cell Culture, Cell Biology, Western Blotting, Microscopy, Assay Development, Confocal Microscopy, In Vitro, Animal Models, Tissue Culture, In Vivo
Information Management	SharePoint, Content Management, Content Management Systems (CMS), Document Management, Knowledge Management, Records Management, Laboratory Information Management System (LIMS), Symfony, Enterprise Content Management, SharePoint Designer
Food Service Operations	Restaurant Management, Catering, Nutrition, Menu Development, Pre-opening, Banquet Operations, MICROS, Fine Dining, Recipe Development, Sanitation
Navy	Command, Navy, Maritime Security, Marine Operations, Ship Management, Diving, Seamanship, Vessel Operations, Docking, Submarines
Economics	Financial Modeling, Valuation, Stata, Econometrics, Quantitative Analytics, Macroeconomics, EViews, Energy Markets, Economic Research, International Economics
Employee Learning & Development	Training, Leadership Development, Organizational Development, Employee Training, Employee Engagement, Instructional Design, Training Delivery, Executive Coaching, Organizational Effectiveness, Training & Development
Aerospace Engineering	CATIA, ANSYS, Avionics, Aeronautics, Airworthiness, Helicopters, Aerospace Engineering, Abaqus, CAE, Flight Test
Customer Experience	Customer Satisfaction, Customer Retention, Contact Centers, Customer Experience, Customer Support, Customer Engagement, Service-Level Agreements (SLA), Client Services, Consumer Insight, Complaint Management

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Healthcare Management	Hospitals, Healthcare Management, Healthcare Information Technology (HIT), Electronic Medical Record (EMR), Patient Safety, U.S. Health Insurance Portability and Accountability Act (HIPAA), Medical Terminology, Managed Care, Medicare, Healthcare Consulting
Theatre	Theatre, Acting, Stage Management, Drama, Improvisation, Comedy, Theatrical Production, Stage Lighting, Set Design, Shakespeare
Ophthalmology	Ophthalmology, Contact Lenses, Optometry, Eyewear, Glaucoma, Eye Exams, Ocular Disease, Dry Eye, Lenses, LASIK
Surveying	Surveying, Cadastral, Leveling
Television	Television, Broadcasting, Commercials, Broadcast Television, Camera, Avid Media Composer, TV Production, Streaming Media, Reality Television, Sony Vegas
Procurement	Contract Negotiation, Logistics Management, Contract Management, Procurement, Subcontracting, Strategic Sourcing, Transportation Management, Supply Management, Global Sourcing, Import
Nonprofit Management	Nonprofit Organizations, Community Outreach, Fundraising, Grant Writing, Community Development, Capacity Building, Non-Governmental Organizations (NGOs), Community Engagement, Economic Development, Accountability
Digital Literacy	Microsoft Office, Microsoft Excel, Microsoft Word, Microsoft PowerPoint, Microsoft Outlook, Microsoft Access, Visio, Mac, Computer Literacy, Microsoft Products
Auditing	Auditing, Internal Controls, Internal Audit, Sarbanes-Oxley Act, External Audit, Assurance, Consolidation, Accountants, Preparation, Statutory Audit
Mobile Application Development	Android, Mobile Applications, Android Development, iPhone, Android Studio, Android SDK, Mobile Internet, Blackberry, Mobile Application Development, Windows Phone
Educational Research	Educational Technology, Educational Research, Assessment, ADDIE, Action Learning, Evidence-Based Practice (EBP), Cognitive Science, Transcripts
Capital Markets	Portfolio Management, Due Diligence, Financial Risk, Equities, Capital Markets, Trading, Derivatives, Financial Markets, Fixed Income, Bloomberg
Cyber-security	Security, Network Security, Firewalls, Information Security, Computer Security, Information Assurance, Information Security Management, IT Audit, Security Audits, Vulnerability Assessment
Recreation	Outdoor Recreation, Casino Gaming, Camping, Mountaineering, Theme Parks, Therapeutic Recreation, Golf Clubs, Camp, National Parks
Photography	Photography, Digital Photography, Image Editing, Portrait Photography, Lightroom, Event Photography, Fine Art Photography, Photojournalism, Wedding Photography, Travel Photography
Water Engineering	Water Resource Management, Water Treatment, Water Supply, Pump Stations, Water Engineering, Industrial Water Treatment, Drainage Systems, Activated Sludge
Employment Law	Employment Law, U.S. Family and Medical Leave Act (FMLA), Employment Contracts, Equal Employment Opportunity (EEO), I-9 Compliance, Union Avoidance, Employment Law Compliance, Employment Litigation, U.S. Equal Employment Opportunity Commission (EEOC), Union Agreements
Plastics	Plastics, Injection Molding, Extrusion, Thermoplastics, Blow Molding, Mold, Plastic Extrusion, Thermoforming, Plastics Engineering, Plastics Industry
Manufacturing Operations	Operations Management, Continuous Improvement, Lean Manufacturing, Six Sigma, Project Engineering, 5S, Inspection, Commissioning, Process Engineering, Quality Management
Structural Engineering	Structural Engineering, MathCAD, Reinforced Concrete, Retaining Walls, Earthquake Engineering, Autodesk Robot Structural Analysis, Concrete Materials, Marinas, Pile Foundations, Aluminum Alloys
Botany	Gardening, Botany, Habitat Restoration, Plant Physiology, Native Plants, Plant Ecology, Plant Genetics, Ethnobotany
Oil & Gas	Petroleum, Oil & Gas, Gas, Onshore Operations, Petrochemical, Piping, Oil & Gas Industry, Refinery Operations, Natural Gas, Piping and Instrumentation Drawing (P&ID)
Radio Production	Radio, Audio Editing, Radio Broadcasting, Adobe Audition, Audio Post Production, Radio Production, Audio Mixing, Radio Host, Radio Advertising, Radio Promotions
Machining	SolidWorks, Welding, Metal Fabrication, Autodesk Inventor, Machining, Geometric Dimensioning & Tolerancing, Machine Tools, Machinery, Computer Numerical Control (CNC), CAD/CAM
Conceptual Art	Mixed Media, Conceptual Art, Artistic Vision, Installation Design, New Media Art, Interactive Art
Agronomy	Agronomy, Soil Sampling, Plant Breeding, Soil Science, Plant Pathology, Soil Fertility, Seed Production, Hydrologic Modeling, Plant Propagation, Soil Management

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Property Law	Property Law, Property Damage, Estate Law, Ownership, Low-Income Housing Tax Credit (LIHTC), Evictions, Land Use Law, Personal Property, Trust Deeds, Property Rights
Technical Support	Windows, Troubleshooting, ITIL, Technical Support, Operating Systems, System Administration, IT Service Management, IT Strategy, IT Management, Disaster Recovery
Food Manufacturing	Food Safety, Food Industry, Hazard Analysis and Critical Control Points (HACCP), Food Processing, Food Science, Food Technology, Food Manufacturing, Food Microbiology, Food Packaging, Food Chemistry
Video	Video Production, Video Editing, Video, Film, Final Cut Pro, Film Production, Adobe Premiere Pro, Video Post-Production, Documentaries, Short Films
Natural Language Processing	Information Retrieval, Natural Language Processing, Text Mining, Speech Recognition, Text Analytics, Semantic Technologies, Sentiment Analysis, NLTK, Parsing, Natural Language Understanding
Orthopedic Surgery	Orthopedic Surgery, Sports Injuries, Musculoskeletal System, Chronic Pain, Spine, Neuromuscular Therapy, Knee, Outpatient Orthopedics, Orthotics, Podiatry
Environmental Consulting	Sustainability, Environmental Compliance, Environmental Consulting, Hazardous Materials, Remediation, Incident Investigation, OHSAS 18001, Environmental Permitting, Environmental Auditing, HAZWOPER
Journalism	Journalism, Magazines, Newspapers, Online Journalism, Broadcast Journalism, AP Stylebook, Digital Publishing, Breaking News, Reporting, Sports Writing
Materials Science	Materials, Materials Science, Design of Experiments, Characterization, Spectroscopy, Metallurgy, Thin Films, Scanning Electron Microscopy, Raw Materials, Metrology
Documentation	Software Documentation, Technical Writing, Documentation, Technical Documentation, Confluence, Manuals, Document Imaging, Technical Communication, FrameMaker, Snagit
Negotiation	Negotiation, Mediation, Conflict Resolution, Strategic Negotiations, Cooperation, Conflict, Priority Management, Union Relations, Collaborative Law, Adjudication
Childcare	Child Development, Early Childhood Education, Working With Children, Childcare, Early Intervention, Early Childhood Development, Babysitting, Early Childhood Literacy, Preschool, Safeguarding Children
Legislation	Legislative Relations, Legislation, Regulations, Legislative Research, State Government, Policy Development, Legislative Affairs, Citizenship, Legislative Policy, Government Administration
Fishing	Fishing, Fly Fishing, Ecotourism, Commercial Fishing
Public Policy	Public Policy, Government, Policy Analysis, Public Sector, Local Government, Government Contracting, Grassroots Organizing, Private Sector, Federal Government, Public Transport
Environmental Science	Life Sciences, Environmental Awareness, Sustainable Development, Environmental Management Systems, Environmental Science, Environmental Impact Assessment, ISO 14001, Environmental Policy, Ecology, Climate Change
Paediatrics	Paediatrics, Neonatal Intensive Care, Neonatal Nursing, Neonatology, Adolescent Health, Pediatric Surgery, Child Health
Cooking	Cooking, Culinary Skills, Food Preparation, Baking, Dairy Products, Pastry, Bakery, Seafood, Cake Decorating, Flavors
Power Systems	Power Generation, Energy Efficiency, Power Plants, Solar Energy, Power Distribution, Power Systems, Photovoltaics, Wind Energy, Power Electronics, Energy Audits
Wholesale	Wholesale, Order Picking, Wholesale Operations, Invoice Discounting, Wal-Mart, Gross Margin, Rebates, Pick & Pack, Cross Merchandising, Discount
Structural Analysis	Structural Analysis, Engineering Design, Bridge, Calculations, Stress Analysis, Specifications, FEM analysis, Slabs, Structural Modeling, Structural Integrity
Crafts	Printmaking, Jewelry Design, Embroidery, Floral Design, Weaving, Crochet, Knitting, Pottery, Yarn, Quilting
Drilling Engineering	Pipelines, Offshore Drilling, Upstream, Drilling, Oilfield, Completion, HAZOP Study, Front End Engineering Design (FEED), Subsea Engineering, Offshore Operations
Educational Administration	Staff Development, Educational Leadership, Student Affairs, Student Development, Academic Advising, Admissions, Technology Integration, Student Engagement, Technology Needs Analysis, Educational Consulting