ICT Labor Market Analysis Using Online Job Portal Data in Bangladesh

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Abstract: Online job portal data offers opportunities for analyzing real-time labor market demand and supply that were not possible with traditional survey data. This paper uses online job portal data in Bangladesh to analyze high-demand job occupation, title and skills in ICT industry, and finds software engineer and computer programming language such as Java and SQL are high-demand during 2016-2018. Many developing countries place high priorities on development of digital skills and industry, particularly under the COVID-19 pandemic, and real-time online job portal data analysis could close the gap in skills mismatch by informing curriculum revision of educational institutions.

JEL Codes: J23 (Labor Demand), J24 (Human Capital, Skills, Occupational Choice, Labor Productivity)

1. Introduction

Labor market data are systematically collected, through labor force surveys and enterprise surveys, since labor market statistics and analysis are invaluable inputs in policy making. However, traditional labor market data cannot adequately capture rapid technological changes in the economy. New technologies lead to restructuring of an economy it is important to continuously develop, adjust and update skills training programs to maintain relevance to industry needs based on the labor market evidence (World Bank, 2016 and 2019; ADB, 2018). Given the speed of these changes, however, time lags between data collection and publication of typical surveys may be too long. In addition, typical surveys may not well capture emerging and diversifying skill requirements since survey questionnaires are not granular enough.

Data from online job portals can potentially supplement survey data. Online job portal data are available in real time and include granular information that is not collected in traditional data sources. The data also provide the information about both employer's requirement (job descriptions) and job seekers, which enables coherent analysis of both the demand and supply sides. Furthermore, the data capture actual search behavior of employers and job seekers, such as application, viewing, and screening. A growing body of research has demonstrated the potential of online job data (Kureková et al., 2015; Faberman and Kudlyak, 2016; Hershbein and Macaluso, 2018; Matsuda et al., 2019).

This paper explores the potential of online job data in the context of Bangladesh, by demonstrating labor market analysis based on data from a leading online job portal,

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Bdjobs.com. The portal was founded in 2000 and has a total of more than 2.5 million jobseekers and 25 thousand firms registered since then. We focus on analyzing ICT sector, considering that the nature of ICT being rapidly advancing fits our purpose of exploring how useful the real-time and granular features of online job data. In addition, ICT is considered to play a key role in the national economic development policy envisioned as Digital Bangladesh. The data we use include all ICT job ads and all applicants for these ads during 2016 to 2019. We examine how representative the data are of the whole ICT labor market and present new labor market statistics, particularly demands for ICT skills.

It is worth mentioning that government resources to collect official data in Bangladesh and other developing countries are far less sufficient than in developed countries. Thus, low-cost online job data can play a transformative role in Bangladesh. While research and real-world practices that build on online job data are increasing, most of them are in developed countries and may not necessarily apply to the contexts of developing countries. More research from developing countries is necessary.

This paper adds to a growing strand of literature that uses online job data. Nomura et al. (2017) and Matsuda et al. (2019) use online job portal data from India and Pakistan, respectively, and examine how the data can be used in labor market policy. Kuhn and Shen (2013), Helleseter et al. (2018) and Kuhn et al. (2018) examine gender discrimination in Chinese and Mexican online job markets. Using online job ads data from the United States, Deming and Kahn (2018) show that there exists substantial variation in skill demands even within narrowly defined occupations, and Modestino et al. (2016), Hershbein and Kahn (2018), and Burke et al. (2019) find interesting patterns as to how skill requirements change with economic conditions.

2. Context

Bangladesh has achieved strong economic growth over the past decades. Its annual gross domestic product (GDP) growth rate has been above 5% since 2004, and the GDP growth rate in 2018, 7.9%, is the highest among the Asian and Pacific countries. The poverty rate based on the poverty line of PPP $1.90 a day reduced from 34.8% in 2000 to 14.8% in 2016.

Despite this impressive economic growth, the country faces significant challenges in worker productivity and employment. Worker productivity in the country, in terms of value added per worker, is about half the South Asian average (Farole and Cho, 2017). The youth unemployment rate increased from 7.8% in 2004 to 12% in 2019, and more than a million new workers join the workforce every year. The quality of jobs is low as, for example, over 80% of the total employment is informal. Large gender gaps persist in the labor market. The labor force participation (LFP) rate of women is only 36% whereas that of men is 81% in 2016-17 (Bangladesh Bureau of Statistics, 2018).

Creating productive formal jobs for both men and women is among the highest priorities for the country. The government has launched the National Skills Development Policy 2011 and has set productive, inclusive job creation as a top national development target in the Seventh Five Year Plan.

To advance skills development and job creation, labor market data are indispensable. The most frequently collected data are Quarterly Labor Force Surveys by the Bangladesh Bureau of Statistics. Another source of labor market data is Household Income and Expenditure Survey, which has an employment module, although it has been conducted approximately only quinquennial. Labor market data on the demand side is particularly limited. The Bangladesh Bureau of Statistics conducts economic census and Survey of Manufacturing Industries but only decennially. The World Bank has periodically conducted Enterprise Surveys, and the ADB recently conducted thematic surveys, an ICT industry employer survey and a tracer survey of computer and software engineering tertiary education graduates (ADB, 2019 and forthcoming). Online job portal data are not systematically collected or used yet by the government.

Our labor market analysis focuses on ICT jobs for three reasons. First, ICT is key to continue the country's strong economic growth. ICT can contribute to increasing worker productivity by making possible adopting new technologies, such as automation in manufacturing, computer-assisted services, and artificial intelligence. ICT is also important in achieving necessary structural transformation of its economy (ADB, 2016). In the Vision 2021 the government aims at creating "Digital Bangladesh", an ICT-based economy. Second, the country lacks ICT-skilled workers. (ADB, 2017 and forthcoming). While the demand for ICT-skilled workers is projected to double in ten year, most college graduates in ICT are not well equipped with industry-relevant skills due to outdated curriculums (Hossain, 2016). Third, since ICT and its skills are rapidly changing and diversifying, interview-based data such as Labor Force Surveys, which necessarily have a substantial time lag between data collection and publication, may not well suit analyzing ICT sector. This challenge can be potentially overcome by real-time online job portal data.

3. Data and Method

We use the data of Bdjobs.com, a leading online job portal in Bangladesh. In the job portal, firms post job ads, and jobseekers create their resumes and apply for job ads. There have been more than 2.5 million registered jobseekers and 25 thousand registered firms since its foundation in 2000, and there are currently 200 thousand visitors per day and 40 million pageviews per month.[3]

The data used in this paper include all ICT job ads in 2016–2018 and all applicants for these ICT job ads. There are 15,637 job ads and 173,214 jobseekers in the data. ICT jobs here mean the jobs which titles and descriptions require ICT skills

[3] The website of Bdjobs.com retrieved on January 26, 2020.

and tasks. Thus, these ICT job ads are not necessarily posted by firms in the ICT sector. The dataset of job ads includes job titles, locations, career level, job descriptions and responsibilities, industries of employers, requirements on age, education, sex, and years of professional experiences. The applicant dataset include gender, nationality, education, skills possessed, present and expected salaries, and last job title.

Some of the data are very straightforward for analysis, but some information such as ICT skills require text mining. The job descriptions include many useful information but they are not readily available for analysis. The text mining using taxonomy of occupation and skills in relatively large real-time data provides opportunity to analyze fast changing ICT skills demand and supply which are not necessarily easy to gauge, particularly when the industry is still nascent development stage.

Summary statistics of the job ads are presented in Table 1. The average number of vacancies is 2.72. Jobs are concentrated in Dhaka city: jobs in Dhaka city account for 55% of all ICT jobs, and those in Dhaka city and locations in the country account for 75%. Almost all jobs are full-time (93%) and mid- to entry-level (53% are mid-level; 40% entry-level). Eighty-five percent of the job ads look for both male and female workers, and 14% look for only men. Thus, most jobs do not have gender preference, but when they do, men are preferred in almost all cases. Since the data includes only ICT jobs, the industries in which employers run their businesses are mostly the ICT sector (64%), and the other sectors are manufacturing (12%), education (4%), and governments (3%).

Table 1. Summary statistics of job ads

	Mean	St.dev.	N (Job ads)
No of vacancies	2.72	7.48	15,637
Location			
Dhaka city	0.55		15,426
Dhaka city or anywhere in Bangladesh	0.75		15,426
Employment types			
Full-time	0.93		15,636
Part-time	0.00		15,636
Contractor	0.05		15,636
Intern	0.01		15,636
Position levels			
Senior	0.06		15,637
Mid	0.53		15,637
Entry	0.40		15,637
Gender requirement			
Both male and famale	0.85		15,637
Male only	0.14		15,637
Female only	0.01		15,637
Industries of employers			
ICT	0.64		15,404
Manufacturing	0.12		15,404
Construction	0.01		15,404
Wholesale, retail	0.01		15,404
Finance, real estates	0.03		15,404
Governments	0.03		15,404
Education	0.04		15,404
Airts, entertainment	0.02		15,404
Others	0.11		15,404

Source: Authors calculation based on Bdjobs.com data

Figure 1 and 2 show word clouds of, respectively, job titles in job ads and applicant skills listed in their resumes. The most frequent job titles are software engineer, web developer, IT officer, IT executive, and software developer. As only ICT job ads are included in the data, these job titles visualized in the word cloud are ICT-related. According to Figure 2, the most commonly listed skills of applicants are Excel, PowerPoint, OneNote, Marketing, Word, Computer skill, MySQL, Adobe Photoshop, JavaScript. While this word clouding is not intended for rigorous analysis, it is useful in visually capturing characteristics of the datasets.

Figure 1. Job titles in job ads

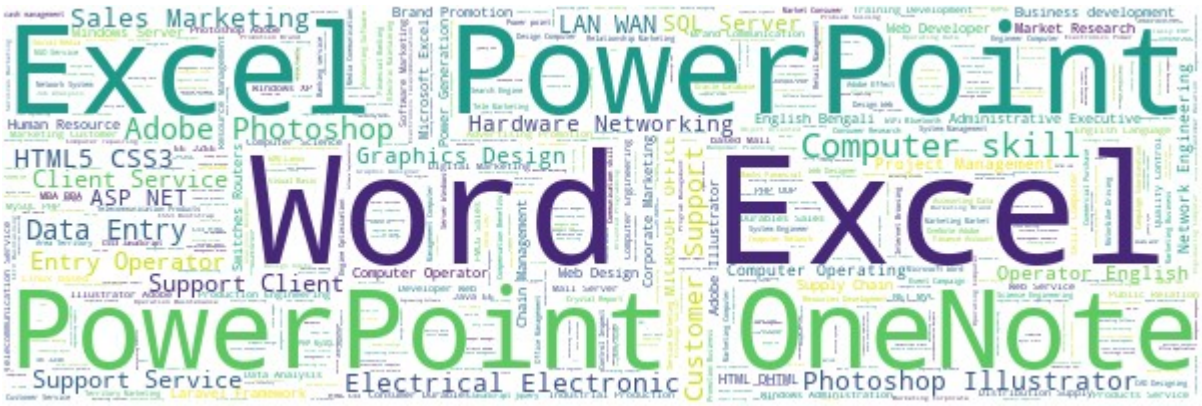

Figure 2: Skills listed in jobseekers' resumes

A caveat in using online job portal data in general is that the data may not represent an entire population of interest. In our case, the data of Bdjobs.com may not represent the entire ICT job market in Bangladesh. It is important to be aware how the population that an online job portal dataset represents may differ from an entire population in a job and labor market.

To examine the representativeness of our data, we compare our data with an employer survey data collected by the Asian Development Bank (ADB) in 2019. The employer survey data is a sample survey of the firms in the ICT related industry associations in Dhaka city. The data include information about job vacancies filled by the firms. Since these job vacancies are a representative pool of job ads in the ICT sector, we use this information about job vacancies to examine the representativeness of the data of Bdjobs.com.

Table 2 compares the data of Bdjobs.com and the employer survey data with respect to job positions and gender composition. In both data, the percentage of senior- and management-level jobs is the same, 5% (columns 1 and 3). There are noticeable differences in the percentages of entry- and mid-level jobs between the two data. In Bdjobs.com data, entry- and mid-level jobs constitute 48% and 45%, respectively (column 1). In the employer survey data, entry-level jobs are only 7%, and mid-level and

professional jobs are 40% and 47%, respectively (column 3). If professional jobs are categorized as mid-level jobs, albeit some professional jobs being possibly at the senior level, mid-level jobs account for 87% in the employer survey. Thus, Bdjobs.com data seem to overrepresent entry-level jobs and underrepresent mid-level and/or professional jobs but this may not be a serious issue if mid-level and/or professional jobs are offered through promotion within a company.

Comparison of the gender composition between the two data is not straightforward since Bdjobs.com data include gender requirements of job ads (i.e., male only, female only, and both male and female) while the employer survey data includes the genders of actual hires. If we assume that 25% of the job ads that do not have gender requirements (i.e., jobs for both male and female), Bdjobs.com data indicates that female hires account for approximately 22%,[4] which is the same in the employer survey. Thus, Bdjobs.com data may not be gender-skewed.

Column 2 in Table 2 restricts the sample to the job ads in Dhaka city, and column 4 restricts to the employers who often use online job advertisements. These restrictions take into account the fact that the employer survey represents employers in Dhaka city only and that some employers outside Dhaka do not use online job advertisements.[5] The differences between the two data based on columns 2 and 4 are found to be similar to those in columns 1 and 3.

In sum, the ICT job ads data from Bdjobs.com seem to be not representative of the entire ICT job market. In comparison to the employer survey, which is a representative sample of the firms which belong to ICT related industry associations in Dhaka, Bdjobs.com data have similar gender composition but different composition in terms of job levels. Bdjobs.com data has a larger proportion of entry-level jobs and a smaller proportion of mid-level jobs although the data has the same percentage of senior-level jobs as the employer survey. This un-representativeness of the online job data may not be surprising since all ICT jobs are not necessarily advertised online. In fact, only 13% of the firms in the employer survey often use online job advertisement. However, as the use of online job advertisements is increasingly expanding, online job ads data may be more representative of a whole job market in the future. What is important in using online job ads data is to be aware that the representativeness of online job ads data is not guaranteed and to examine how different the data is, as exercised above in this section.

[4] According to column 1 in Table 2, job ads for only females constitutes 1%, and job ads with no gender requirements are 82%. Under the assumption that 25% of the job ads with no gender requirements were filled by women, the total of female hires is 21.5 (= 1 + 82 x 0.25).

[5] Only 63 employers of 477 employers often use online job advertisements.

Table 2. Comparison of Bdjobs.com and the employer survey

Data:	Bdjobs.com		Data:	Employer Survey	
Sample:	Whole sample	Jobs in Dhaka city	Sample:	Whole sample	Employers who use online job advertisements
	Mean	Mean		Mean	Mean
	(1)	(2)		(3)	(4)
Position level			Position level		
Senior	0.05	0.05	Management	0.05	0.03
Mid	0.45	0.47	Professional	0.47	0.71
Entry	0.48	0.47	Mid	0.40	0.22
			Entry	0.07	0.04
Gender requirement			Gender		
Male only	0.17	0.11	Male hires	0.77	0.77
Female only	0.01	0.01	Female hires	0.22	0.23
Both male and female	0.82	0.88			
Obs.: Job ads	11,987	6,496	Obs.: Vacancies	5,966	492
			Obs.: Employers	477	63

Note. Columns 1 and 2 show sample means weighted by the number of vacancies. Columns 3 and 4 show summary statistics of the vacancies filled during the last 12 months prior to the employer survey.
Source: Authors calculation based on Bdjobs.com data

4. Analysis: Skill Demands and Supply

This section provides a few examples in which online job ads can produce useful labor market analysis that may not be possible with conventional data such as labor force surveys and enterprise surveys.

Table 3 demonstrates how useful analyzing time trends in high-demand jobs by using online job portal data. Software engineer is the largest number of vacancies in 2016 and 2017 and the third in 2018. Java Software Engineer is the second in 2016, the third in 2017, and the seventh in 2018. Web developer is the third in 2016, the second in 2017, and the sixth in 2018. iOS developer is the fourth and fifth in 2016 and 2017, respectively, but drops to 13th in 2018. This time series of demand at the job title level is useful in informing workers and policy makers and education and training institutes as to what jobs are on a rise and what skills to develop.

Table 3. Jobs in high demand by years

Year:	2016	2017	2018
Job titles	Ranks by frequency		
Software Engineer	1	1	3
Java Software Engineer	2	3	7
Web Developer	3	2	6
iOS Developer	4	5	13
IT Executive	5	7	9
Senior Software Engineer	6	6	4
Java Developer	7	20	15
PHP Website Developer	8	12	10
Programmer	9	16	14
.NET Programmer	10	29	41
.NET Developer	11	21	31
Bioinformatics Developer	12	8	20

Note. This table shows the ranks of job titles based on how many vacancies are advertised with the respective job titles.
Source: Authors calculation based on Bdjobs.com data

Table 4 shows the number of applications per vacancy. This information indicates which job has excess supply of workers and which lack workers. The three high-demand jobs (Software Engineer, Java Software Engineer, and Web Developer) receive about 50 to 100 applications per vacancy. iOS Developer jobs receive a relatively fewer number (27 to 39) of applications. IT Executives jobs are very competitive as they receive over 500 applications per vacancy. There seems to be not much time trends in the number of applications.

Table 4. Labor supply to high-demand jobs

Year:	2016	2017	2018
Job titles	Mean # of applications per vacancy		
Software Engineer	93	83	103
Java Software Engineer	55	47	55
Web Developer	97	78	88
iOS Developer	27	29	39
IT Executive	509	570	508
Senior Software Engineer	44	58	58
Java Developer	31	52	42
PHP Website Developer	84	101	73
Programmer	75	92	62
.NET Programmer	46	57	38
.NET Developer	50	56	89
Bioinformatics Developer	53	51	65

Source: Authors calculation based on Bdjobs.com data

Table 5 shows required skills in jobs. Across years, design skills are required in 23%-25% vacancies. Web applications skills and Development skills are in high demand but

may be in a decline since these skills are less frequently required in 2018 than in 2016 and 2017. Analysis of required skills, as presented here as an example, can be informative to jobseekers, policy makers, and educators in identifying which skills to develop.

Table 5. Skills in high demand by years

Year:	2016		2017		2018	
	Ranks	% vacancies	Ranks	% vacancies	Ranks	% vacancies
Required skills	(1)	(2)	(3)	(4)	(5)	(6)
Web Applications	1	27%	2	23%	6	16%
Design	2	25%	1	23%	1	23%
Development	3	24%	8	19%	10	15%
SQL	4	23%	10	19%	11	15%
Product Knowledge	5	22%	4	20%	12	15%
Java	6	21%	3	22%	5	17%
PHP Frameworks	7	20%	11	18%	20	12%
PHP	8	19%	15	16%	25	11%
Knowledge Sharing	9	19%	6	20%	15	14%
Knowledge Management	10	19%	9	19%	14	14%

Note. Columns 1, 3 and 5 show the ranks of skills based on the number of vacancies that require the respective skills. Columns 2, 4 and 6 show the percentage of the vacancies that require the skills.
Source: JobKred calculation based on Bdjobs.com data

In Table 6, analysis of required skills is further broken down into high-demand jobs, i.e., Software Engineer, Java Software Engineer, and Web Developer. The three most frequently required skills in Software Engineer jobs are Software development, Design, and Development. These skills are required in about 30% of Software Engineer vacancies. In other words, these skills are nearly indispensable to be hired for Software Engineer jobs. In Java Software jobs, skills of Web Applications, Development, and Web Application Designs are required in about 30% vacancies. In Web Developer jobs, 50% vacancies require Java skills; 48% require Script skills; 41% require Product Knowledge skills. This job title-level analysis of required skills can help policy makers and educators precisely identify skills to develop for particular jobs.

Table 4. High-demand skills in high-demand jobs

Job title:	Software Engineer		Job title:	Java Software		Job title:	Web Developer	
	Ranks	% vacancies		Ranks	% vacancies		Ranks	% vacancie
Required skills	(1)	(2)	Required skills	(3)	(4)	Required skills	(5)	(6)
Software Development	1	30%	Web Applications	1	32%	Java	1	50%
Design	2	29%	Development	2	29%	Script	2	48%
Development	3	28%	Web Application Design	3	25%	Product Knowledge	3	41%
Applications Software Development	4	26%	Java	4	24%	CSS JavaScript	4	39%
Software Development Methodologies	5	25%	SQL	5	23%	PHP	5	38%
Web Applications	6	24%	Knowledge Management	6	23%	HTML + CSS	6	35%
Software	7	22%	PHP Frameworks	7	23%	Always Willing to learn	7	33%
Knowledge Management	7	22%	Knowledge Sharing	8	22%	jQuery UI	8	33%
Lean Software Development	9	20%	Design	9	22%	PHP Frameworks	9	31%
Code Review	10	18%	Applications	10	21%	Responsive Web Design	10	31%
Requirement Specifications	11	18%	Product Knowledge	11	21%	HTML Scripting	11	30%
Design Specifications	11	18%	Design Development	12	21%	SQL	12	30%
SQL	13	18%	Java Software Development	13	21%	Knowledge Representation	13	29%
SQL Server	14	18%	Web Technologies	14	20%	CSS	14	29%
Java Software Development	15	17%	SQL Server	15	19%	Able to Work under Pressure	15	28%

Note. This table show the demand for skills within each of the job titles indicated in the column header. Columns 1, 3 and 5 show the ranks of skills based on the number of vacancies that require the respective skills. Columns 2, 4 and 6 show the percentage of the vacancies that require the skills.
Source: JobKred calculation based on Bdjobs.com data

5. Conclusions

Online job portal data offer new and exciting avenues for policy analysis that were not possible with traditional survey data. This paper uses time-series data during 2016 – 2018 from the largest online job portal at Bdjobs.com in Bangladesh to analyze high-demand job occupation, title and skills in ICT industry. The online job postings not only include job occupation and title but also skills requirement in the job descriptions which can be extracted through text mining. The limitation of data, however, is the representativeness of sample as well as the availability of sufficient number of data by sector. ICT industry has relatively large online job posting, but compared with employer survey conducted in ICT industry in 2018, the online job portal data includes more entry-level jobs. This may not be a problem since there is a career progression within a company, and employer needs to recruit more entry-level jobs. In addition, this relatively large data can be available for analysis in real-time basis, providing opportunity to assess fast changing skills demand in ICT industry.

This study finds that Software Engineer is the high-demand job title for recruitment and other job titles such as Java Software Engineer, Web Developer, iOS Developer are also important for employers in recent years. The popular job titles from the applicants is IT Executives with large competition, and relatively smaller number of applications is observed for iOS Developer compared with Software Engineer or Web Developer. The IT skills in web application, design and software development are high-demand, and computer language such as Java, SQL and PHP are also frequently included in the job descriptions in online job portal in ICT industry. These are all key information to inform curriculum revision and design for effective IT trainings.

Many developing countries place high priorities on development of digital skills and industry. For example, under the vision of Digital Bangladesh, the government expands skills training program. The COVID-19 pandemic forced all educational institutions closed from March but ICT industry is recovering fast compared with other industries, and real-time online job portal data analysis could identify the most relevant skills. This will help existing training institutions to prepare for reopening, but the courses related to ICT are also readily available through massive open online courses, and skills mismatch can be addressed through taking appropriate online education courses.

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