

# IT Freelancing and Remittance Earnings in Bangladesh: Opportunities and Challenges

Sabina Yasmin<sup>1\*</sup>, K. M. Mahiuddin<sup>2</sup>, Mohammed Nazmul Huq<sup>1</sup>, Md Riadul Islam Sakib<sup>2</sup>

<sup>1</sup>Department of Statistics and Data Science, Jahangirnagar University

<sup>2</sup>Department of Government & Politics, Jahangirnagar University

## Abstract

In Bangladesh, IT freelancing is becoming a cornerstone of economic progress, creating jobs for a large and enthusiastic young and tech-savvy populations while also increasing foreign earnings through remittances. This study examines how IT freelancing enhances employability and contributes to economic development and foreign currency inflows. Using both primary and secondary data collected from a diverse set of stakeholders, including individual freelancers, IT training centers, etc., the study identifies rapid sector growth, with annual earnings of over \$1 billion. Yet, challenges persist, such as a gender disparity with women making up only 9% of freelancers, regional wage differences, and skill shortages in areas like AI, cybersecurity, and web development. Further challenges stem from inadequate rural infrastructure and unreliable payment systems. The study recommends investments in digital infrastructure, specialized training programs, and policies promoting gender inclusivity and freelancing as a career. These measures could boost Bangladesh's global competitiveness and the economic potential of its IT freelancing sector.

**Keywords:** Employability, IT freelancing, Remittances, Skill gap, Wage discrepancies.

## Introduction

In today's rapidly evolving digital economy, Information Technology (IT) freelancing has emerged as a significant contributor to economic development, particularly in developing countries like Bangladesh. This employment framework aligns with the United Nations' Sustainable Development Goal (SDG) 8 representing the *Decent Work and Economic Growth*, which emphasizes the promotion of sustained, inclusive, and sustainable economic growth, full

and productive employment, and decent work for all [1]. IT freelancing presents a unique opportunity for individuals to engage in remote, flexible work while tapping into international markets. This employment strategy has proven to be a gateway to higher employability for many specifically providing higher opportunities for youth, fostering skill development, economic empowerment, and socio-economic mobility, all these contributing to countries' socio-economic development [2].

Globally, the freelance market is expanding rapidly. As of 2024, there are an estimated 1.57 billion freelancers worldwide, accounting for 47% of the global workforce [3]. The global freelance market was valued at \$3.39 billion in 2021 and is expected to grow to \$9.19 billion by 2027, with significant contributions from IT and digital services [4]. The Asia-Pacific region plays a significant role in this growth, contributing approximately 29% to the global freelance workforce, with countries like India, Pakistan, and the Philippines leading in freelancer earnings

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\*Author for Correspondance e-mail: [sabina.stat@juniv.edu](mailto:sabina.stat@juniv.edu)

[5]. Bangladesh, as a part of this dynamic market, ranks as the 2nd largest supplier of freelancers globally, with an estimated 650,000 freelancers actively engaged in the IT sector [6]. The country holds a 16% share of the global online labor market, with freelancers earning a collective \$500 million annually [7].

In recent days, freelancing has become an increasingly important part of the economy, offering an alternative to traditional employment sectors [8-10]. Moreover, IT freelancing has the potential to increase remittances, which form a crucial part of Bangladesh's economy. As freelancers earn in foreign currencies, they inject much-needed foreign exchange into the local economy, bolstering economic resilience and improving the overall standard of living for many people. The flexibility of freelancing allows individuals to work remotely from Bangladesh while contributing to global projects, thus opening new avenues for increasing both personal and national income [11] [12].

IT freelancing holds particular significance for Bangladesh, given the country's young demographic and its swift embrace of digital technologies [13]. With over 60% of the population under the age of 35, the country has a vast talent pool that is increasingly tech-savvy and eager to engage in the global digital economy [14]. This young workforce is drawn to freelancing due to flexibility, the potential for higher earnings, and the opportunity to overcome traditional employment obstacles, such as geographic constraints and the limited availability of local job opportunities.

Despite the promising opportunities, challenges remain. Bangladesh's freelancers face significant hurdles, including inadequate digital infrastructure to ensure uninterrupted and high-speed internet, particularly in rural areas, and issues related to payment security and international transactions [15]. In 2024, only 9% of freelancers in Bangladesh are women [16]. This gender disparity highlights barriers such as limited access to digital skills and societal norms. These barriers need to be addressed to unlock the full potential of freelancing as a sustainable economic force [17-19]. Nonetheless, with the continued growth of the global freelance market and increasing efforts to upskill the youth, IT freelancing in Bangladesh is poised to make a lasting impact on both individual livelihoods and the broader national economy.

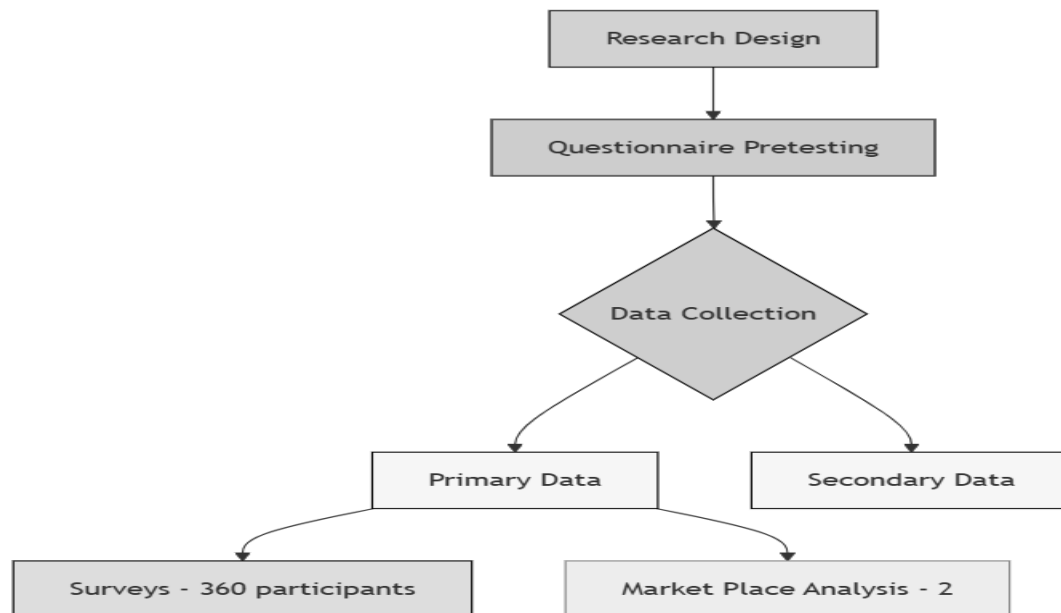
With these backdrops, this research evaluates the IT freelancing sector's role in elevating Bangladesh's economy, particularly through increased job opportunities and higher remittances. It also explores how IT freelancing can advance economic growth by leveraging the capabilities of the country's young, technologically adept population and by boosting foreign currency earnings. Furthermore, the study assesses the current conditions and potential growth of the IT freelancing market in Bangladesh, identifies critical skills shortages, and recommends actionable strategies that meet global standards aiming to overcome the existing disparities and infrastructure challenges to maximize the sector's contribution to national development.

## **Methodology**

### **Study Design and Data Sources**

This study employed a cross-sectional mixed-methods research design, combining both primary and secondary data to explore the current landscape, challenges, and opportunities within the IT freelancing sector in Bangladesh. The aim was to develop a comprehensive

understanding of the ecosystem by engaging directly with stakeholders and supplementing field data with a rigorous review of existing literature and market intelligence. Primary data were collected using a purposive and snowball sampling strategy, allowing the inclusion of a diverse group of participants across freelancing domains, training institutions, and geographic regions. The study commenced with an extensive planning phase, followed by a multi-stage data collection and analysis process, as outlined in the following flowchart (see figure 1).



*Figure 1: Conceptual framework for Study Design*

### **Primary Data Sources**

Primary data for this study were collected from four key stakeholder groups through structured surveys, interviews, and field visits. Individual freelancers, the core participants, provided firsthand insights into their experiences, challenges, motivations, skill development, and earnings. Key informant interviews (KIIs) with heads of IT training centers and freelancing agencies offered employer-side perspectives on skill expectations, curriculum relevance, and performance gaps. Representatives from freelancing associations, such as the Bangladesh Freelancers Development Society (BFDS), contributed policy-level views on industry challenges and capacity-building needs. Additionally, freelancing platforms like Freelancer.com, Upwork, and Payoneer were analyzed to capture data on skill demand, wage patterns, and project types using structured observation and data scraping. Field visits to major IT hubs and co-working spaces in Dhaka and other regions allowed for direct observation and informal conversations, adding contextual depth and enhancing the validity of the structured data collected.

### **Secondary Data Sources**

A comprehensive literature review was conducted to inform the research framework, guide primary data collection, and validate the findings. Secondary data sources included peer-reviewed journal articles on the gig economy, digital labor markets, and freelancing models

in developing countries; industry reports and market intelligence from platforms such as Payoneer and Freelancer.com; government publications such as the LEDP Impact Assessment by the ICT Division and census data from the Bangladesh Bureau of Statistics; as well as reports from national dailies and policy briefs addressing gender disparities, policy gaps, and regional trends in Bangladesh's freelancing landscape. The literature review served multiple purposes: it helped identify global and regional trends in IT freelancing, benchmark best practices and scalable models from comparable economies, and pinpoint research gaps specific to the Bangladeshi context.

### **Survey Instrument and Sampling Bias**

Quantitative data were collected using structured questionnaires distributed electronically via email and social media to reach digitally active IT freelancers across Bangladesh. The survey included multiple-choice, Likert-scale, and open-ended items covering demographics, and professional background. The questionnaire also explored the challenges and opportunities faced by freelancers, including perceived skill gaps and the impact on remittances. To ensure validity, the instrument was pre-tested with 10 freelancers and reviewed by IT industry and academic experts. Trained enumerators ensured clarity and consistency in data collection. However, the purposive and snowball sampling methods may have biased the sample toward urban, internet-connected freelancers. These limitations are acknowledged within the cross-sectional design.

### **Sample Size**

The sample size for freelancers' survey was calculated to ensure that the study results are statistically significant and reflective of the population. Given these considerations, the sample size was calculated using the formula for a proportion in a population:

$$n = \frac{z^2 \times p \times (1 - p)}{d^2} \times D$$

Where,  $z$ =statistical certainty chosen;  $p$  =estimated proportion;  $d$  = precision desired;  $D$ = design effect, and  $n$  = desired sample size. The sample proportion was assumed as 0.5 since this value provides the maximum sample size. Considering 5% level of significance and 5% acceptable margin of error, the required sample size of the proposed evaluation study was 384. However, the final sample size consisted of 360 participants after accounting for incomplete responses.

Despite using non-probability sampling methods (purposive and snowball), efforts were made to ensure representation across key demographic and professional characteristics, including region, gender, freelancing platform, and skill domain. Participants were selected from a wide range of geographic locations, IT training centers, and freelancing communities, enhancing the diversity and contextual validity of the sample. As a result, the final sample provides a reasonably representative snapshot of the active freelancing population in Bangladesh.

## Data Analysis

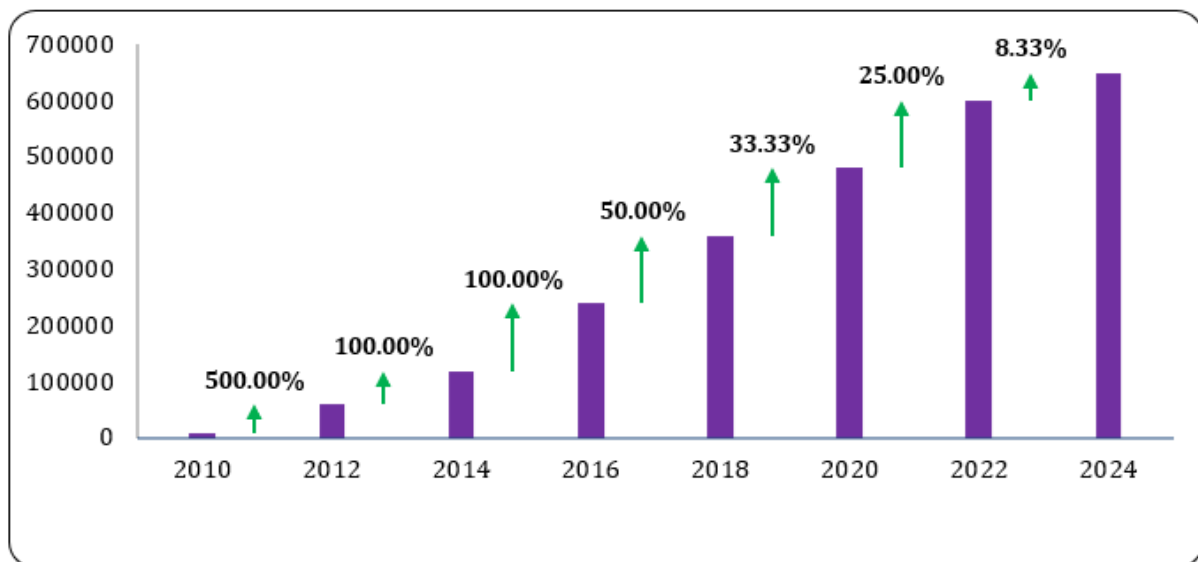
Data analysis was conducted using Stata version 15.0 to identify key patterns and relationships among primary indicators. Various statistical methods were applied to ensure robust analysis, and results were visualized through charts and graphs to provide a clear interpretation of findings. In Python, GeoPandas was used to process and manipulate geographical data, integrating spatial information such as average hourly rates across different regions.

## Results

### Current state of IT freelancing in Bangladesh

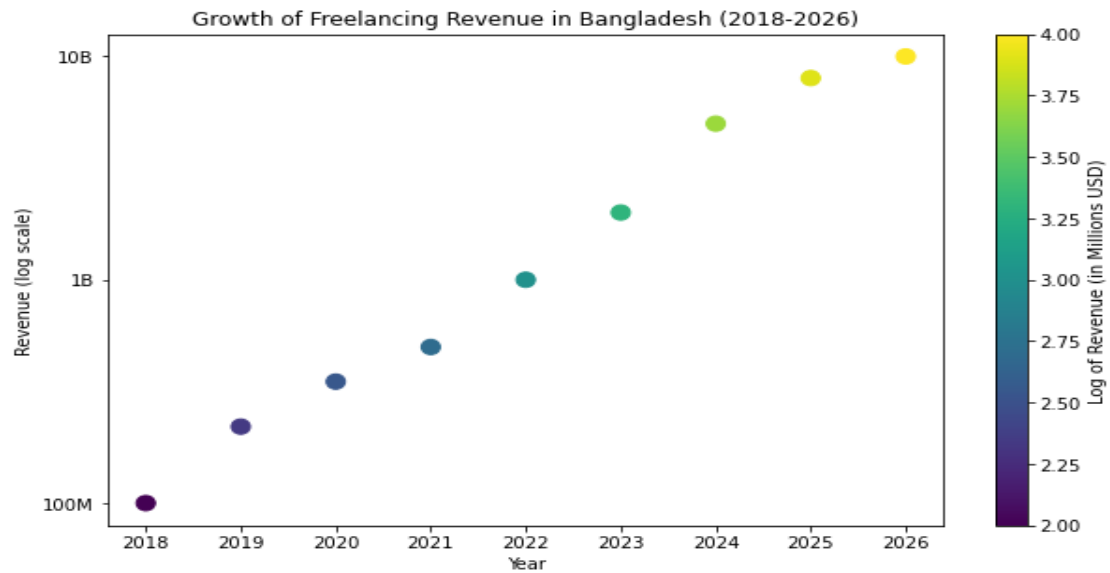
**Trends of IT freelancers in Bangladesh:** Figure 2 shows the consistent growth of IT freelancers in Bangladesh from 2010 to 2024. Starting from a small base in 2010, the number of freelancers grew exponentially, with the most significant percentage increase occurring between 2010 and 2012 (a 500% increase). The growth rate doubled between 2012 and 2014 (a 100% increase) and remained strong through 2016, when the number of freelancers doubled again. From 2016 to 2024, growth rates gradually declined, but the overall number of freelancers continued to rise, reaching over 650,000 by 2024. Notably, the growth rate in recent years slowed to 8.33% from 2022 to 2024, signaling a more mature market.

Figure 2: Growth in the number of IT freelancers in Bangladesh from 2010 to 2024 [Data Source: Impact Assessment LEDP, ICT Division, 2023] [11]



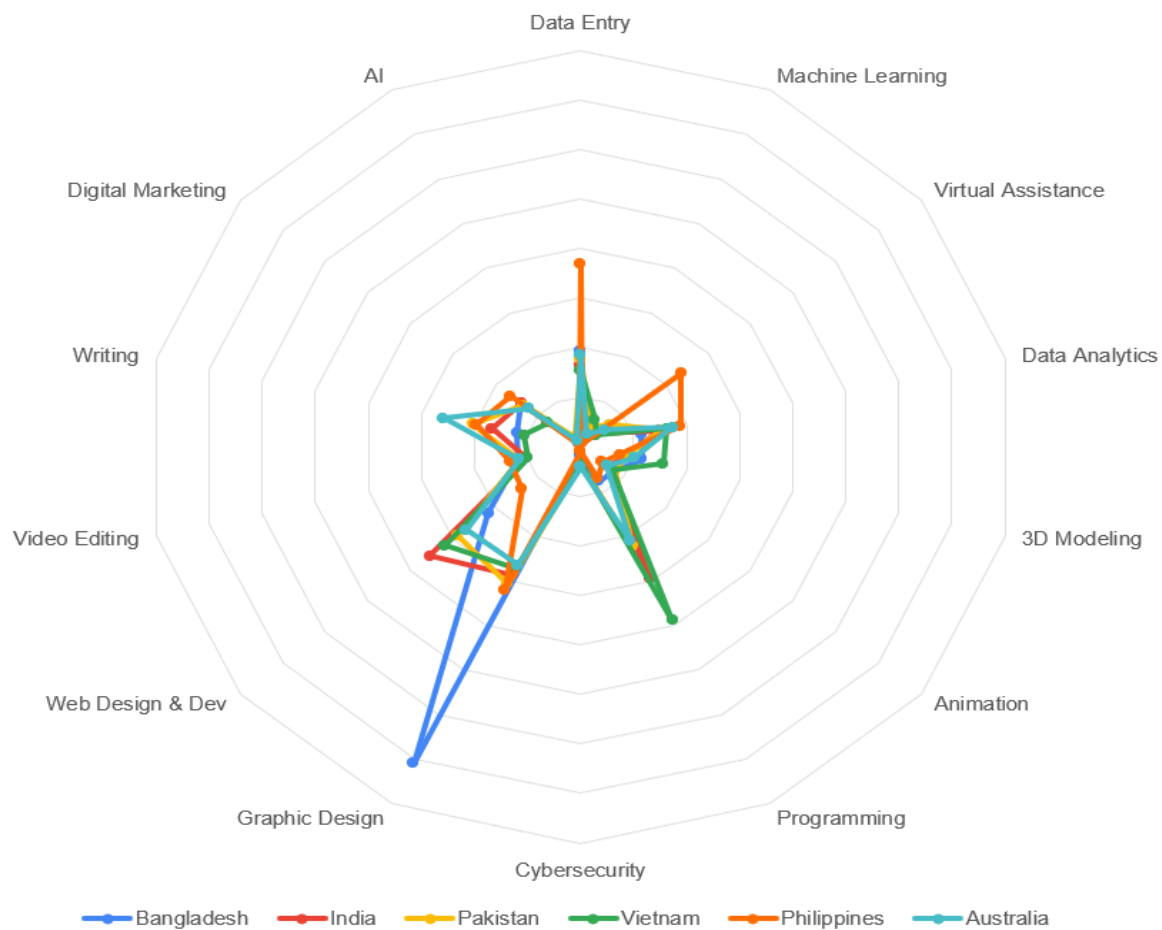
The growth of freelancing revenue in Bangladesh between 2018 and 2026, showing an exponential increase over the period. Beginning at USD100 million in 2018, the revenue demonstrates consistent year-on-year growth, surpassing USD1 billion by 2022 and is projected to reach over \$10 billion USD by 2026. (see figure 3)

Figure 3: Total revenue earning of freelancing in Bangladesh (2018-2026). [Data Source: Impact Assessment LEDP, ICT Division, 2023] [11]



**Freelancing skillsets in Bangladesh- A comparison with selected countries:** While assessing how different countries specialize in various freelancing skills on Freelancer.com marketplace, Bangladesh is especially strong in Graphic Design, far outpacing other countries. India leads in Programming and Cybersecurity, showcasing its robust IT industry. The Philippines stands out in Virtual Assistance and Data Entry, which matches its well-known role in the business process outsourcing industry. Vietnam is particularly good at programming, indicating a specific area of expertise. Web Design and Development are also popular, with India being the top performer. Skills like Digital Marketing, Machine Learning, and AI are less prominent but are gradually gaining attention. (see figure 4)

Figure 4: Comparative distribution of freelancing skill specialization across selected Asia-Pacific countries. (Source: Freelance.com marketplace, Accessed on 8 June-22 June 2024)



**Demographic and social overview of freelancers:** The survey with the selected freelancers reveals that an overwhelming majority (80.0%) of the respondents were male and the remaining 20.0% were female. This suggests that males are more engaged in the IT freelancing sector, or at least more likely to participate in this survey. The IT freelancers were relatively young, well educated, and majority lived in urban areas. Web and Software Development is the most common skill among the study respondents, with 73.1% of participants engaged in this area, followed by Graphic Design (53.3%) and Digital Marketing (40%). Data Entry (15.8%) and Content Writing (7.8%) are less represented.

Regarding years of experience in freelancing, 66% of respondents have 0-3 years of experience, indicating that many freelancers are relatively new to the field. The primary motivation for entering freelancing is flexible work hours (88.1%), followed by higher pay (37.8%) and wider job options (37.2%). Interestingly, only 21.9% cited earning security as a major reason, indicating that while freelancers value income, flexibility and job variety are stronger motivators. Detailed information including table can be found in the supplementary material (table 1).

In supplementary material, figure 1 highlights the perceived importance of various skills needed to win high-value freelance bids. Web Development, AI, Software Development,

Digital Marketing and Graphic Design are highly valued skills as most of them more than 50 percent consider them as demanding skills to get high valued bid projects.

### Challenges persist in boosting freelancing careers in Bangladesh

Despite the growing popularity of freelancing as a viable career option in Bangladesh, several challenges continue to impede the progress of freelancers in the country. These challenges range from global pay disparities and gender inequality, skill gaps and individual-level hurdles like reliable internet technology, payment issues, Lack of professional networks and mentorship, etc. Below is a deeper exploration of the key obstacles confronting freelancers in Bangladesh:

**Wage differences – Bangladesh vs. global payment structure:** Table 2 compares the freelancing earnings in Bangladesh across various skill fields with the global benchmark rates, highlighting the differences in pay. It reveals significant gaps between the local and global hourly rates for most skill categories. For instance, Web and Software Development, a priority skill for the freelancers in Bangladesh, earns USD20/hr compared to a global rate of USD50/hr, resulting in a USD30/hr deficit. Similarly, Graphic Design and Digital Marketing show a USD20/hr gap in Bangladesh as compared to global rates. Lower-paying fields like Data Entry and Content Writing also exhibit smaller but notable deficits, with differences of USD5/hr and USD10/hr, respectively. In contrast, high-paying jobs such as Finance and Marketing reveal even larger gaps, with Bangladesh freelancers earning around USD20/hr compared to global rates of USD41/hr and USD34/hr, respectively.

*Table 2: Comparison of average hourly earnings in Bangladesh across major freelance skill categories and corresponding global benchmark rates (Source: Survey data, Upwork, Freelance.com and Payoneer Blog) [20]*

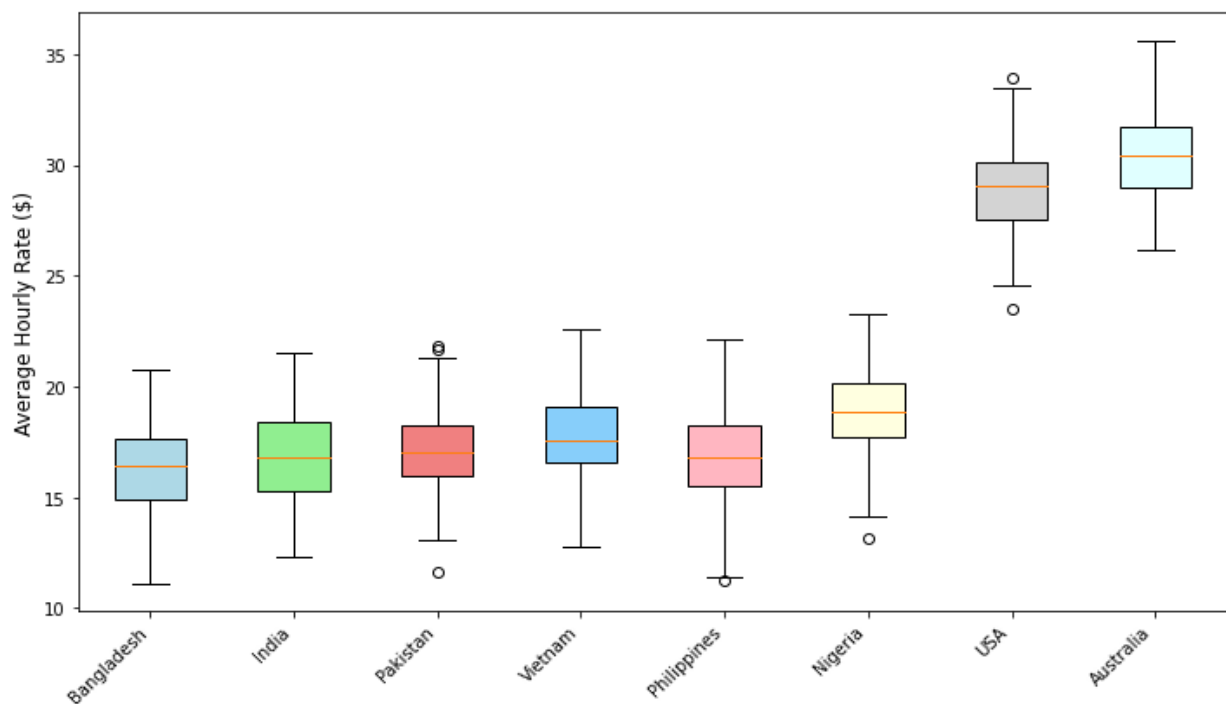
| Skill Field                              | Earnings in Bangladesh (USD/hr) | Global Benchmark Rate (USD/hr) | Differences in rate (USD/hr) |
|------------------------------------------|---------------------------------|--------------------------------|------------------------------|
| <b>Priority skills among respondents</b> |                                 |                                |                              |
| Web and Software Development             | 20                              | 50                             | -30                          |
| Graphic Design                           | 10                              | 30                             | -20                          |
| Digital Marketing                        | 20                              | 40                             | -20                          |
| Data Entry                               | 10                              | 15                             | -5                           |
| Content Writing, Drafting                | 15                              | 25                             | -10                          |
| <b>High Paying Job (Online source)</b>   |                                 |                                |                              |
| Finance                                  | 20                              | 41                             | -21                          |
| Marketing                                | 10                              | 34                             | -24                          |



|                       |    |    |     |
|-----------------------|----|----|-----|
| Multimedia Production | 15 | 33 | -18 |
| IT                    | 20 | 29 | -9  |
| Project Management    | 10 | 28 | -18 |

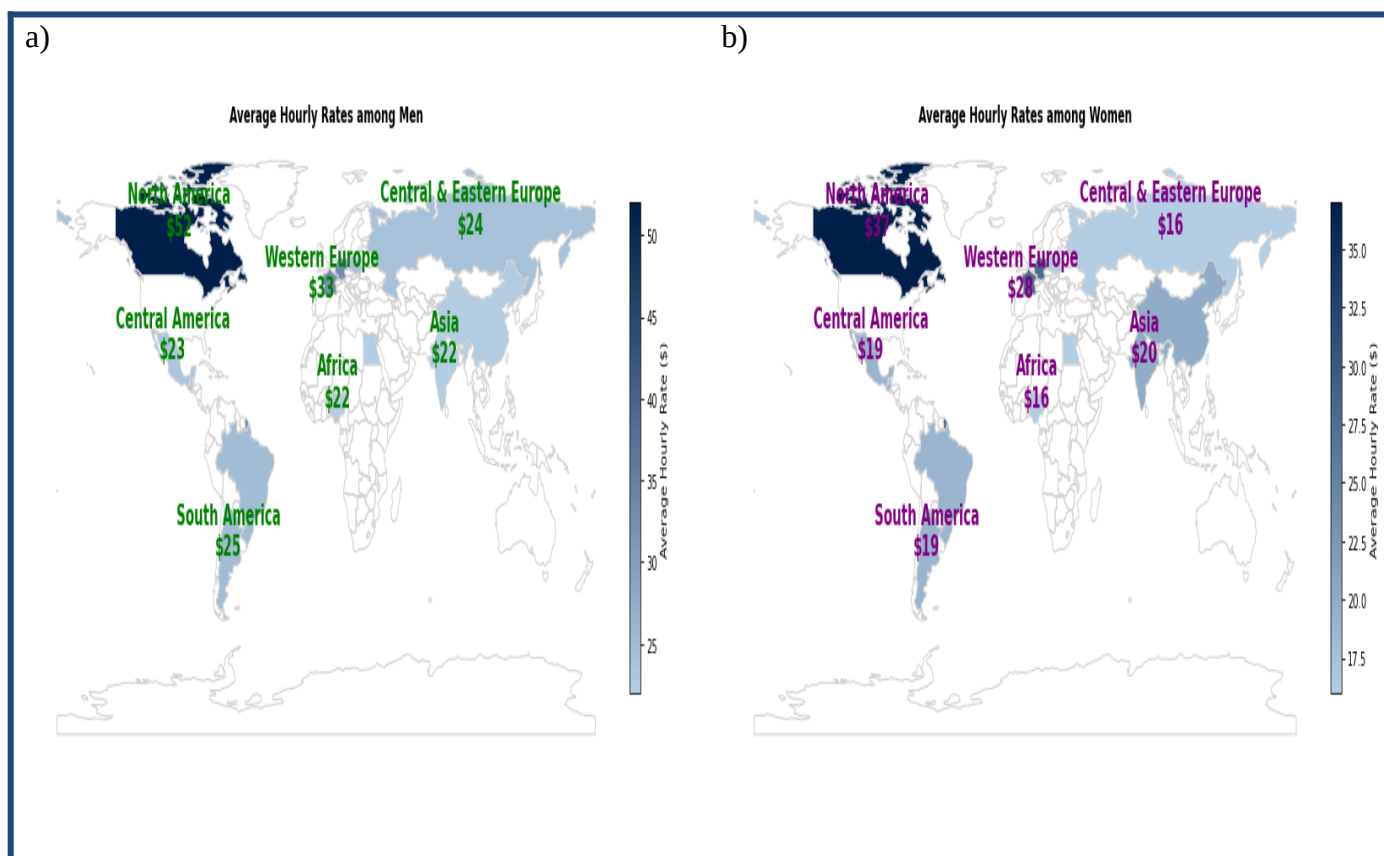
**Hourly freelancing rate in Bangladesh and other selected countries:** The distribution of freelance earnings per hour on Freelancer.com across various countries, segmented by different income ranges illustrates that in countries like Bangladesh and India, a substantial majority of freelancers earn between USD10-USD20, with each country also having a significant portion earning below USD10. This suggests a prevalence of lower to mid-range paying gigs in these regions. Similarly, Pakistan and Vietnam show a concentration in the USD10-USD20 range, indicating mid-range freelance opportunities are most common. The Philippines presents a distinct pattern, with the highest percentage of freelancers earning below USD10. In contrast, the USA and Australia display a more diverse earning spectrum, with a greater proportion of freelancers earning above USD30 and USD40, pointing towards higher economic opportunities in these developed markets. The distribution of hourly rates for freelancers across different countries shows that USA and Australia have the highest and most variable rates, with medians around USD30 and wider ranges of hourly earnings. In contrast, Bangladesh, India, and Philippines have lower and more consistent rates, with medians below USD17. Countries like Pakistan and Vietnam fall in the mid-range, while outliers in USA and Pakistan suggest some freelancers charge significantly higher rates than others (Figure 5).

*Figure 5: Distribution of average hourly freelancing rates across selected countries; cross-national income disparities among freelancers. [Source: Freelancer.com platform analytics, accessed June 8–22, 2024]*



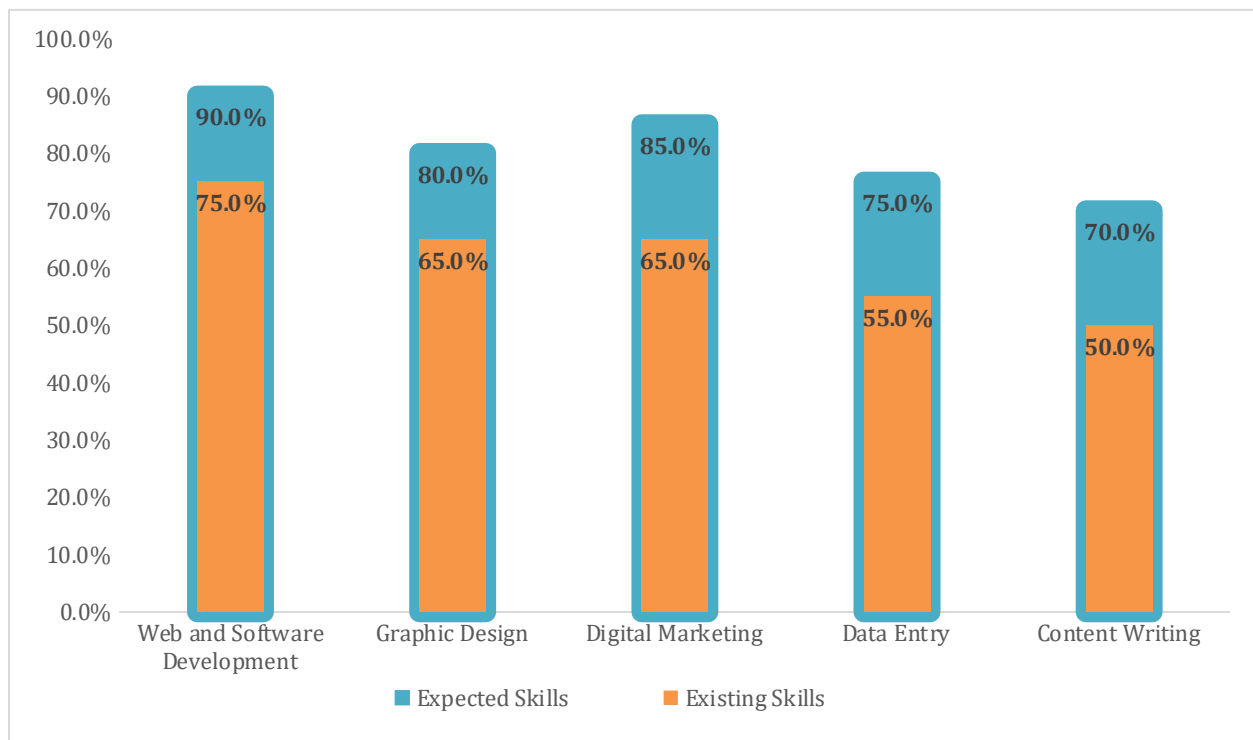
**Gender pay gap in freelancing rates:** The average hourly rates by region highlighting economic disparities across the globe. North America leads with the highest rate at USD41, followed by Western Europe at USD31. Europe, Central America, South America, Asia, and Africa all have similar rates at USD22, reflecting comparable economic conditions that contrast sharply with the more affluent regions. (see supplementary file) There persistent gender pay gap in freelancing across all regions, with men consistently earning more than women. In North America, men earn 16.9% more than women, with rates of USD52/hr for men compared to USD37/hr for women. Similarly, in Central & Eastern Europe and Africa, the gap is particularly wide, with men earning 20% and 15.8% more than women, respectively. Even in Western Europe and South America, the gender pays gap remains notable at 8.2% and 13.6%. In Asia, the gap is smaller, with men earning 4.8% more than women, but the discrepancy still exists [20]. (see figure 6(a,b)).

Figure 6: Average hourly freelancing rates by region, disaggregated by gender. (Source: Payoneer Global Freelancer Income Report (2022). Accessed: June 2024) [20]



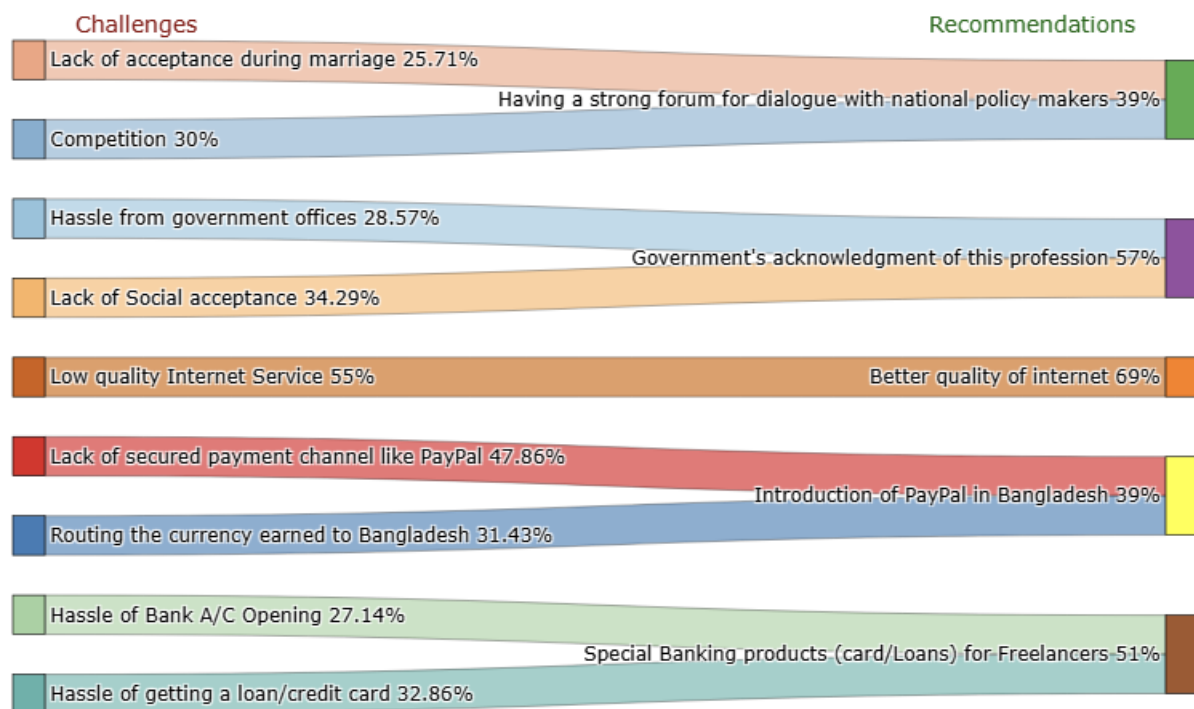
**Skill gap analysis:** The skill gap analysis, derived from the survey conducted with freelancers, highlights a comparison between the expected and the existing skills across various freelancing sectors. For Web and Software Development, the largest gap is visible, where existing skills are significantly below the expected level. Similarly, in Graphic Design, Digital Marketing, Data Entry, and Content Writing, the existing skills fall short of the required skills, although the gap is less pronounced compared to Web and Software Development (see figure 7).

Figure 7: Comparison of expected versus existing skills among freelancers in key service areas in Bangladesh. [Source: Survey (n=360)]



**Key obstacle and possible way out for freelancers:** The Sankey plot highlights the main challenges facing the freelancers in Bangladesh, with poor internet quality affecting 63.6% of respondents and lack of secure payment options impacting 59.4%. Social acceptance issues, including difficulties in gaining societal acceptance (35.3%) and challenges in personal relationships like marriage (24.7%), add to their struggles, alongside competition and bureaucratic hurdles that affect roughly 28% to 33% of freelancers. These challenges are linked to targeted recommendations, such as improving internet quality (69%), introducing PayPal (39%), creating freelancer-specific banking products (51%), establishing a forum for policy dialogue (39%), and achieving government recognition of freelancing as a legitimate profession (57%). (Figure 8).

Figure 8: Mapping Key Challenges and Recommendations for Freelancers [Source: Survey (n=360)]



## Discussion

In the context of Bangladesh's growing digital economy, IT freelancing has emerged as a key driver of economic empowerment, offering flexible employment opportunities and contributing to the country's global competitiveness [21]. The study aimed to explore the role of IT freelancing in enhancing employability and increasing remittances in Bangladesh. It employed a multi-stage data collection approach, gathering insights from individual freelancers, IT training centers, freelancing agencies, and marketplace analysis. The findings reveal several key trends and challenges in the sector, which have important implications for policy, education, and workforce development.

The results indicate a substantial increase in the number of IT freelancers in Bangladesh from 2010 to 2024, with nearly 650,000 freelancers currently active in the sector [22] [11]; Freelancers Union, 2023). This significant growth aligns with global trends, particularly in the Asia and the Pacific region, where countries like India and the Philippines also see thriving freelancing markets [20][7].

However, the data also reveal a concerning gender imbalance, with only 9% of freelancers being women [6]. This disparity reflects deeper structural, cultural, and technological barriers that limit women's entry and progression in the freelancing sector. Traditional gender roles, especially in rural and conservative households, often impose disproportionate domestic responsibilities on women, restricting their ability to engage in full-time freelancing or work flexible hours required by global clients. Additionally, limited access to digital literacy training, gendered digital divides, and lower confidence in ICT use further reduce women's

participation [23] [24]. Addressing this gender gap is crucial for ensuring inclusive economic growth, as outlined in the Sustainable Development Goal (SDG) 8 on decent work and economic growth [25]. Without deliberate action to reduce these disparities, the economic potential of the freelancing sector will remain unequally distributed.

The study also highlights disparities between local and global freelancing earnings, particularly in high-demand areas such as web and software development, graphic design, and digital marketing [11]. Freelancers in Bangladesh earn significantly less than their global counterparts, with hourly rates for web development averaging USD20 per hour, compared to a global benchmark of USD50 per hour [20] [11]. These wage differences reflect a skill gap between the current capabilities of Bangladeshi freelancers and the expectations of international clients [26] [27]. The skill gap analysis reinforces this point, with the largest gap observed in web and software development, followed by graphic design and digital marketing. Although these are priority skill areas among Bangladeshi freelancers, existing training programs may not be sufficient to bridge the gap to global standards, limiting freelancers' ability to compete for higher-paying jobs [28]. This suggests a need for targeted interventions to upgrade the skill levels of freelancers. Programs that focus on advanced technical skills like AI, cybersecurity, and machine learning, which are increasingly in demand in global markets, could help freelancers command higher rates and access more lucrative projects [29]. Additionally, the findings point to the importance of continuous skill development through certifications, online courses, and mentorship programs [30] [10].

The challenges faced by freelancers in Bangladesh need to be addressed, which impede their ability to fully capitalize on the opportunities in the global freelancing market. The most prominent issue identified is poor internet connectivity, particularly in rural areas, which affects the ability of freelancers to deliver high-quality work on time. Secure payment channels also pose a significant barrier, with nearly 60% of respondents highlighting difficulties in receiving payments from international clients [31] [20]. These challenges not only affect freelancers' financial security but also discourage more individuals from entering the freelancing market.

Moreover, the findings reveal social and cultural barriers to freelancing. Many freelancers report a lack of social acceptance, with freelancing perceived as an unstable or less prestigious career choice [32] [33]. This perception is particularly evident in personal relationships, where freelancers experience difficulties in gaining social acceptance, including challenges related to marriage and family expectations [34]. Addressing these socio-cultural issues requires broader awareness campaigns and efforts to legitimize freelancing as a viable and respected career path [35] [36].

Despite these challenges, the study underscores the positive contributions of freelancing to Bangladesh's economy. The growing number of freelancers and the increasing revenue generated by the sector highlight the potential of freelancing to drive economic growth and support remittances, which are a crucial source of income for many Bangladeshi households [33]. The projected revenue increase from USD1 billion in 2022 to over USD10 billion by 2026 reflects the rising global demand for digital services, positioning Bangladesh as a key player in the global freelancing market [37].

However, to fully realize this potential, a phased and multi-stakeholder approach is essential. Short-term priorities should include expanding access to affordable, high-speed internet, particularly in rural regions, and ensuring timely access to secure international payment

gateways. In the medium term, vocational and ICT training programs must be updated to reflect global market demand, with a focus on advanced skills such as AI, cybersecurity, and digital marketing. These programs should be implemented through collaboration between the ICT Division, training centers, and private-sector platforms. Long-term efforts should focus on building an inclusive digital ecosystem through gender-sensitive policies, mentorship programs, and social campaigns to legitimize freelancing as a viable career. To ensure accountability, a national freelancing roadmap led by the Ministry of ICT, in partnership with industry and academia, could be developed to define milestones, responsibilities, and implementation timelines for supporting sustainable growth in the sector, especially for women and rural freelancers [38][39].

This study offers valuable insights into Bangladesh's IT freelancing sector, but several limitations must be acknowledged. First, the use of purposive and snowball sampling may affect generalizability, despite efforts to ensure diversity across region, gender, and platforms. Second, reliance on self-reported data introduces potential biases; triangulation with secondary sources was used to improve reliability. The absence of qualitative data, such as interviews or case studies, limits interpretive depth, particularly on gender norms, platform dynamics, and client bias. Wage disparity analysis is constrained by the lack of data on algorithmic and client-side factors, which are noted as areas for future research. While visual data presentation and referencing have been improved, the study's cross-sectional design limits causal inferences and implementation analysis. Lastly, though some thematic overlap with existing literature exists, this study contributes by contextualizing freelancing within Bangladesh's remittance and digital labor landscape.

## **Conclusion**

This study highlights the significant role of IT freelancing in boosting employability and remittance flows in Bangladesh, with substantial growth providing new opportunities for the young, tech-savvy workforce. However, challenges such as the gender gap, wage disparities, and limited digital infrastructure, especially in rural areas, persist. Freelancers also face issues with secure payment systems and societal acceptance, which limit their potential contributions to economic development. To maximize IT freelancing's impact, it is important to enhance the digital infrastructure and improve internet access and secure payment systems. Further, upskilling initiatives should target high-demand fields like web development, AI, and cybersecurity, ensuring freelancers can compete globally. Addressing the gender imbalance through policies that support women in acquiring digital skills is also critical. Finally, promoting freelancing as a legitimate and stable career will help reduce social stigma. By tackling these challenges, Bangladesh can solidify its position as a key player in the global freelancing market, supporting both individual and national economic growth.

## **Acknowledgement**

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## **Conflict of Interest Statement**

The authors affirm that there are no conflicts of interest associated with this publication. This study was executed independently and has not been influenced by any external funding bodies.

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The data supporting the findings of this study are available from the corresponding author upon reasonable request.

### **Authors contribution**

Sabina Yasmin: Conceptualization, Methodology, Visualization, Formal analysis, Writing—original draft

K. M. Mahiuddin: Conceptualization, Supervision, Writing—original draft, Writing—review and editing

Mohammed Nazmul Huq: Conceptualization, Supervision, Writing—original draft, Writing—review and editing

Md Riadul Islam Sakib: Data Curation, Writing—original draft

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