Sustainable Economic Growth for Developing Countries through Fintech Ecosystem: A Case Study on Bangladesh

Ph.D. Dissertation

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Sustainable Economic Growth for Developing Countries through Fintech Ecosystem: A Case Study on Bangladesh

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AUTHOR'S DECLARATION

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CERTIFICATE FROM THE SUPERVISORS

This is to certify that the thesis entitled "Sustainable Economic Growth for Developing Countries through Fintech Ecosystem: A Case Study on Bangladesh" is a research work carried out by Khaled Mahmud under our guidance and supervision for the requirement of Doctor of Philosophy (Ph.D.) to be awarded by the University of Dhaka. We also certify that the candidate has committed enough time during his work under our supervision for his research work.

To the best of our knowledge, the thesis satisfies the following:

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b. Duly satisfies the requirements of the degree of Doctor of Philosophy (Ph.D.) from the University of Dhaka
c. Satisfies the desired standard with respect to the quality of the content, depth of language, and format of presentation befitting the current work
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We congratulate the candidate on his research contribution and wish him continued success in his future academic career.

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This study, apart from relying on a host of secondary datasets, conducted the National Citizen Survey (NCS) to collect a total of 1282 datapoints from 16 administrative districts across Bangladesh. I am indebted to the team of surveyors who took an effort and maintained high standards of professionalism, collected each datapoint from individual respondents, and compiled the NCS dataset. Their work immensely allowed the generation of relevant research insights.

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Khaled Mahmud
Dhaka, Bangladesh
2023

Dedicated to

My parents – the constant source
of my strengths and
unconditional support

ABSTRACT

This study undertook a detailed investigation of financial technology (fintech) and its role in promoting sustainable economic growth for developing countries. In doing so, Bangladesh was the focal point. Through methods, both quantitative and qualitative this research aimed to answer four key questions related to fintech ecosystem readiness, customer readiness for fintech, fintech adoption factors, and fintech for sustainable economic development.

The current study investigated the state of the fintech ecosystem in Bangladesh and its readiness with regard to ecosystem players. Narrative analysis, global comparison, and expert panel opinion point to a lack of fintech service and business model diversity in the still-developing fintech ecosystem of Bangladesh. It is found that Bangladesh is in the second stage of a three-step ecosystem development process. With a prudent, time-appropriate, and transparent policy framework, we believe that the fintech ecosystem in Bangladesh can contribute to sustainable development in the long-term.

Apart from secondary datasets, this study conducts the National Citizen Survey (NCS) (N=1282). The nationwide representative sample was constructed through poverty-based stratified random sampling. Data were collected from 16 districts across Bangladesh. The NCS dataset provided the foundation for descriptive analysis and quantitative modeling. It incorporated demographic, economic, financial, technology usage, sentiment, and other variables related to fintech use. To the best of our knowledge, such a representative dataset on overall fintech use in Bangladesh is a first.

This study also proposes the Customer Fintech Readiness (CFR) index to measure overall customer readiness for innovative fintech use. Given the hitherto absence of a measurement scheme for fintech readiness – as opposed to generic technology readiness, the CFR index considers seven key dimensions of customer readiness for fintech use and offers a customer fintech readiness measurement scheme. It has been found that Bangladesh is in the 26th percentile of customer fintech readiness – lagging significantly behind in multiple dimensions e.g., financial conditions, existing fintech usage, etc.

This study also deploys Recursive Feature Elimination (RFE) with multivariate logistic regression to model adoption factors of fintech. Among 133 features in the original model, 55 were preserved. Of these, 26 are found to be significant as determinants of fintech adoption. Importantly, 14 of these are

related to customer concerns with various aspects of fintech use. Thus, customer concerns are major factors of fintech adoption in Bangladesh. Therefore, an effective way to raise adoption in the future is to address concerns and build customer trust.

Finally, this study adopts the Case method, panel data regression, and univariate analyses with quartile-comparison to investigate the relationship between fintech and sustainable economic development. Across these three approaches, fintech's contribution to sustainable economic development was evident. Particularly, our panel data model suggests that fintech channels like Automated Teller Machines (ATM) and debit card usage growth directly contribute to macro-level economic growth. More importantly, results from univariate analyses suggest that countries with higher growth in fintech channels e.g., debit card ownership, mobile money, digital payments, and wage distribution through cards also experienced higher growth in SDG index score, Goal 1, Goal 8, Goal 9, and Goal 11 scores during the period from 2014 to 2021. However, there were important nuances in results across these goals and between the two panels used: (a) all countries and (b) lower middle-income countries (LMIC) only. For LMIC, debit card ownership and digital payment showed the most significant association with progress in selected indicators. Further, univariate results point to a surprising lack of association of fintech with promotion of gender equality – thereby leading to further questions on effective ways to realize fintech's transformative potential for women.

We hope that the recommendations suggested in this report will contribute to the development of a more dynamic and vibrant ecosystem for sustainable economic growth in Bangladesh – and in developing countries across the world.

Table of Contents

1. Introduction 13
1.1. Background 13
1.2. Research Objective and Key Research Questions 20
1.3. Scope of the Research 20
1.4. Motivation for this Research 21
1.5. Significance of the Research 22
1.6. Major Contributions 23
1.7. Organization of this Report 24
2. Literature Review 26
2.1. Fintech Around the Globe 26
2.2. Fintech Ecosystem 34
2.3. Technology Readiness and Fintech Adoption 38
2.4. Adoption Factors of Fintech 44
2.4.1. Security, Perceived Risk, and Trust 44
2.4.2. Literacy and Fintech Use 45
2.4.3. Perceived Usefulness of Fintech 45
2.4.4. Demographic Factors 46
2.4.5. Satisfaction and Usage of Fintech 47
2.4.6. Country-Level Evidence and Heterogeneity 48
2.5. Fintech and Sustainable Economic Development 49
2.5.1. Development and Its Discontents 49
2.5.2. Development and Inequality 52
2.5.3. Development and Sustainability 53
2.5.4. The Role of Technology in Sustainable Development 55
2.5.5. The Role of Fintech in Sustainable Development 57
2.5.6. Fintech and Financial Inclusion 59
3. Conceptual Framework 62
3.1. Methodological Overview 62
3.2. National Citizen Survey (NCS) 65
3.3. NCS Sample Description 66
3.4. Evaluating State of Fintech Ecosystem 67
3.4.1. Global Fintech Markets and Ecosystems 68
3.4.2. Fintech Business Models 69
3.4.3. Key Players in Fintech Ecosystem 69
3.4.4. Process-Model of Fintech Ecosystem Development 70
3.4.5. Way Forward 71
3.5. Measuring Customer Readiness for Fintech 71
3.5.1. Customer readiness dimensions 72
3.5.2. Variable operationalization 74
3.5.2 (a) Demographic 74
3.5.2 (b) Financial Health 75
3.5.2 (c) Financial Literacy 75
3.5.2 (d) E-Readiness 76
3.5.2 (e) Mental Preparedness 77
3.5.2 (f) Current Fintech Usage 77
3.5.2 (g) Overall Sentiment Related to Fintech Use 78

3.5.3. Calculating CFR Index 79
3.5.4. Validating the CFR Index 79
3.6. Finding Adoption Factors of Fintech in Bangladesh 80
3.6.1. Dataset and Train-test Splitting 82
3.6.2. Oversampling with SMOTE 83
3.6.3. Recursive Feature Elimination 83
3.6.4. Estimating Logistic Regression with LIBLINEAR 86
3.7. Establishing Fintech's Relationship with Sustainable Economic Growth 86
3.7.1. Case studies 88
3.7.2. Panel Data Regression 88
3.7.3. Univariate Analysis 90
4. Descriptive Findings from National Citizen Survey (NCS) 93
4.1. Introduction 93
4.2. Banking Behavior and Capacity 95
4.2.1. Overall Bank Account Ownership 95
4.2.2. Bank Account Ownership across Groups 96
4.2.3. Number of Bank Visits per Month 97
4.2.4. Help in Performing Banking Activities 97
4.2.5. Confidence and Awareness Related to Banking Transaction 99
4.3. Computer, Smartphone, and Data Usage 101
4.3.1. Access to Computers 101
4.3.2. Computer Skills 102
4.3.3. Mobile Phone Ownership and Internet Access 104
4.3.4. Smartphone Usage Skills 107
4.3.5. Internet Usage 107
4.4. Concerns Related to Fintech Use and Mental Preparedness 109
4.4.1. Concern for Privacy 109
4.4.2. Concern for Unknown Issues 110
4.4.3. Concern for Limited Control from Government 113
4.4.4. Concern for Financial Scam/Scandal 114
4.4.5. Concern for Cashless Society 117
4.4.6. Concern for Information Security 119
4.4.7. Overall Mental Preparedness 121
4.4.8. Mental Preparedness Across Demographics 122
4.4.9. Mental Preparedness in Different Districts 123
4.5. Mobile Banking Usage 124
4.5.1. Mobile Banking Account Ownership 124
4.5.2. Services from Mobile Banking 126
4.6. Satisfaction with FinTech Services 128
4.6.1. Overall Satisfaction with FinTech 128
4.6.2. FinTech Satisfaction Across Demographics 129
4.6.3. Confidence and FinTech Satisfaction 131
4.6.4. Attitude Regarding Costliness 133
4.6.5. Maximum Preferred Fee 135
4.6.6. Maximum Fee and Mobile Banking Usage 136
4.7. Attitude Regarding Affordability 136
4.8. Summary of Obstacles 139
4.8.1. Consumer Side Obstacles 139
4.8.2. Supplier Side Obstacles 143
4.8.3. Future Service Expectation 144
4.9. Expectations from Fintech Service Providers 147

4.10. Expectations from the Government 151
4.11. Concluding Remarks 156
5. Fintech Ecosystem: Globally and in Bangladesh 157
5.1. Introduction 157
5.2. State of Global Fintech Ecosystem 160
5.2.1. Paytech 162
5.2.2. Challenger Banks 162
5.2.3. Cryptocurrency 162
5.2.4. Infrastructure 162
5.2.5. Insurtech 163
5.2.6. Wealthtech 163
5.2.7. Blockchain 163
5.2.8. Open Banking 163
5.2.9. BNPL 164
5.2.10. SaaS 164
5.2.11. Accounting 164
5.2.12. Regtech 165
5.3. Data and Methods 165
5.4. Overview of Fintech Ecosystem Scenario in Bangladesh 166
5.5. Fintech Business Models 171
5.5.1. Payment and transfers 171
5.5.2. Crowdfunding 173
5.5.3. Peer-to-peer Lending 173
5.5.4. Online Banking 175
5.5.5. Insurance 175
5.5.6. Securities 176
5.5.7. Asset Management 177
5.5.8. Online Accounting 177
5.5.9. Cryptocurrencies and Blockchain 178
5.6. Process Model of Fintech Ecosystem Development 179
5.6.1. Phase 1: Assessment 180
5.6.2. Phase 2: Acceleration 180
5.6.3. Phase 3: Augmentation 181
5.7. Fintech Ecosystem and Bangladesh 181
5.8. Suggestions from Key Informants 184
5.9. Discussion 186
5.10. Concluding Remarks 188
6. Customer Fintech Readiness 190
6.1. Introduction 190
6.2. Customer Fintech in Bangladesh 192
6.3. Constructing the Customer Fintech Readiness (CFR) Index 195
6.3.1. Data Collection 196
6.3.2. Readiness Dimensions 197
6.3.2 (a) Demographic Characteristics 198
6.3.2 (b) Financial Health 198
6.3.2 (c) Financial Literacy 198
6.3.2 (d) E-Readiness 198
6.3.2 (e) Mental Preparedness 200
6.3.2 (f) Fintech Usage 200

6.3.2 (g) Overall Sentiment with Fintech 200
6.3.3. CFR Index 201
6.4. Assessment of CFR's Validity 202
6.5. Customer Fintech Readiness in Bangladesh 206
6.6. Discussion 210
6.7. Concluding Remarks 213
7. Adoption Factors of Fintech 216
7.1. Introduction 216
7.2. Data, Method, and Model 219
7.2.1. Dataset 219
7.2.2. Dataset Train, Test Splitting and Oversampling 219
7.2.3. Recursive Feature Elimination (RFE) 222
7.2.4. Logistic Regression 223
7.2.5. Model Estimation with LIBLINEAR 225
7.3. Summary and Model Results 225
7.3.1. Description of Sample and Fintech Use 225
7.3.2. Logistic Regression Results 229
7.4. Discussion 232
7.4.1. Theoretical Contribution 232
7.4.2. Practical Implication 234
7.5. Concluding Remarks 236
8. Fintech and Sustainable Economic Growth 238
8.1. Introduction 238
8.2. Data and Methods 240
8.2.1. Data 241
8.2.1 (a) Cases 241
8.2.1 (b) Panel Data 241
8.2.1 (c) Univariate Analysis 242
8.2.2. Methods 243
8.2.2 (a) Cases 244
8.2.2 (b) Panel Data Model 244
8.2.2 (c) Univariate Analysis 245
8.3. Selected Cases on Fintech's Impact 247
8.3.1. Country Cases 247
8.3.1 (a) India 247
8.3.1 (b) Indonesia 248
8.3.1 (c) Kenya 250
8.3.2. Fintech Firms 252
8.3.2 (a) Ellevest 252
8.3.2 (b) CreditVidya 253
8.3.2 (c) Riskified 255
8.3.2 (d) Deedster 256
8.4. Panel Data Estimates 257
8.4.1. Baseline Results 257

8.4.2. Addressing Endogeneity 258
8.4.3. Addressing Omitted Variable Bias 260
8.4.4. Addressing Outliers 260
8.5. Results from Univariate Analysis 263
8.5.1. Fintech and SDG Index 263
8.5.2. Fintech and SDG Goal 1 264
8.5.3. Fintech and SDG Goal 5 265
8.5.4. Fintech and SDG Goal 8 266
8.5.5. Fintech and SDG Goal 9 267
8.5.6. Fintech and SDG Goal 11 268
8.6. Bangladesh Perspective 269
8.7. Discussion 271
8.8. Concluding Remarks 276
9. Implications and Policy Recommendations 277
9.1. Introduction 277
9.2. Summary of Findings from NCS 278
9.2.1. Banking Behavior of the Survey Respondents 278
9.2.2. Digital Access 279
9.2.3. Customer Concerns and Mental Preparedness 280
9.2.4. Mobile Banking Usage 281
9.2.5. Internet Banking Usage 281
9.2.6. Fintech Services Satisfaction 282
9.2.7. Obstacles to Use of Fintech 282
9.2.8. Fintech Costliness and Affordability Perception 283
9.3. Summary from Fintech Ecosystem Assessment 284
9.4. Summary from Customer Readiness Assessment 284
9.5. Summary of Findings on Fintech Adoption Factors 285
9.6. Summary Contribution to Sustainable Economic Development 285
9.7. Recommendations 287
9.7.1. Direct Policy Recommendations 287
9.7.1 (a) Fintech Ecosystem Development in Bangladesh 287
9.7.1 (b) Customer Fintech Readiness in Bangladesh 291
9.7.1 (c) Adoption of Fintech in Bangladesh 294
9.7.1 (d) Fintech for Sustainable Economic Development 295
9.7.2. Indirect Recommendations 298
9.7.2 (a) Fintech Service providers/Start-up 298
9.7.2 (b) Government Policy Makers 298
9.7.2 (c) Financial Institutions 298
9.7.2 (d) Consumer 299
9.7.2 (e) Technology Providers 299
9.7.2 (f) Investors 300
9.7.2 (g) Academia 300
10. Conclusion 301
10.1. Concluding Remarks 301
10.2. Future Research 303
11. List of References 306

Appendix A: District Ranking for NCS Sampling 334
Appendix B: NCS Questionnaire 336
Appendix C: List of Countries in Panel Data Regression 345

List of Tables

Table 3.1-1 Summary of study methodology 64
Table 3.3-1 Tabulation of Levels of Education and Gender 66
Table 3.4-1 Anonymized list of expert panel members 71
Table 3.5-1 Seven key dimensions of fintech readiness 73
Table 3.5-2 Value labels for respondent education 74
Table 3.5-3 Value labels for confidence banking alone 75
Table 3.5-4 Value labels for awareness of bank transaction 76
Table 3.5-5 Value labels for computer skills 76
Table 3.5-6 Value labels for smartphone skills 77
Table 3.5-7 Value labels for mental preparedness 77
Table 3.5-8 Value labels for fintech costliness 78
Table 3.5-9 Value labels for fintech satisfaction 78
Table 3.5-10 Value labels for fintech availability 78
Table 3.6-1 List of variables included in the multivariate logistic regression 85
Table 3.7-1 List of variables for panel model estimation 89
Table 3.7-2 List of variables for univariate analysis 91
Table 4.2-1 Bank Account Ownership Across Age Groups 97
Table 4.2-2 Gender Disaggregated Average Bank Visits 97
Table 4.3-1 Computer skill and smartphone skill 103
Table 4.3-2 District-wise Phone Ownership 105
Table 4.3-3 District-wise Phone Ownership Type 106
Table 5.7-1 Question presented to the panel on ecosystem development stage in Bangladesh 182
Table 5.7-2 Likert scale of ecosystem player readiness for expert panel response 183
Table 6.2-1 Comparative Banking and MFS Data between December 2018 and November 2022 194
Table 6.3-1 Descriptive Statistics of Selected Variables from NCS Dataset 197
Table 6.3-2 Factors Affecting Fintech Adoption and Use Distilled in Seven Key Dimensions 199
Table 6.3-3 Weights Assigned to the Seven Dimensions of CFR 202
Table 6.4-1 Validity assessment with regression - number of future fintech services as dependent variable 204
Table 6.4-2 Validity assessment with regression - expectations from fintech service providers as dependent variable 204
Table 6.4-3 Validity assessment with regression - number of expectations from the government as dependent variable 204
Table 6.4-4 Mean CFR Scores by Perception of Fintech's Impact 205
Table 6.4-5 Mean CFR Scores by Perceived Degree of Obstacle in Fintech Use 206
Table 6.5-1 Average Scores Across Seven Dimensions of CFR 207
Table 7.2-1 List of variables included for fintech adoption modelling 221
Table 7.2-2 Dependent and Independent Variables for Multivariate Logistic Regression 225

Table 7.3-1 Descriptive Statistics of Numeric Variables 226
Table 7.3-2 Cross-tab of existing fintech use and mental preparedness to use fintech in daily lives 227
Table 7.3-3 Classification report table for the estimated model 229
Table 7.3-4 Logistic regression model results, feature coefficients, p-values, significance 230
Table 8.2-1 List of variables and data sources for panel data model 242
Table 8.2-2 List variables for univariate analysis 243
Table 8.4-1 Baseline results from panel data estimation (random-effects model) 258
Table 8.4-2 Results from baseline model with instrumented predictor variables (2SLS) 259
Table 8.4-3 Baseline model with additional variables for OVB test - ATM 261
Table 8.4-4 Baseline model with additional variables for OVB test - Debit 261
Table 8.4-5 Model results with Winsorized predictor - ATM 262
Table 8.4-6 Model results with Winsorized predictor - Debit 262
Table 8.5-1 Univariate results for SDG Index 264
Table 8.5-2 Univariate results for Goal 1 265
Table 8.5-3 Univariate results for Goal 5 266
Table 8.5-4 Univariate Results for Goal 8 267
Table 8.5-5 Univariate results for Goal 9 268
Table 8.5-6 Univariate results for Goal 11 269
Table 8.6-1 Comparative fintech data - Bangladesh and peer nations 270
Table 8.6-2 Growth in selected scores in SDG 2030 framework for Bangladesh 271

List of Figures

Figure 2.2-A The five elements of fintech ecosystem 35
Figure 2.2-B: The Seven Elements of the Fintech Ecosystem 38
Figure 3.1-A Overview of methodological flow 63
Figure 3.2-A Choropleth of districts included in NCS sample 65
Figure 3.5-A Customer Fintech Readiness (CFR) index calculation 79
Figure 3.6-A Model estimation process for fintech adoption factors 81
Figure 3.6-B Iterative process of model estimation 84
Figure 3.7-A Methodological overview of investigating fintech and sustainable economic growth 87
Figure 3.7-B Univarite analysis approach with quartile-comparison 91
Figure 4.2-A Overall bank account ownership 96
Figure 4.2-B Gender disaggregated bank account ownership 96
Figure 4.2-C Help needed in banking by gender 98
Figure 4.2-D Help needed in banking across ages 99
Figure 4.2-E-Banking confidence by gender 99
Figure 4.2-F Banking confidence by age 100
Figure 4.2-G Banking activity awareness by age 100
Figure 4.3-A Access to computer by gender 101
Figure 4.3-B Type of computer access 101
Figure 4.3-C Computer access across districts 102
Figure 4.3-D Computer skills by gender 103
Figure 4.3-E Mobile phone ownership by gender 104
Figure 4.3-F Mobile phone ownership by age 104
Figure 4.3-G Type of mobile phone ownership 106
Figure 4.3-H Types of mobile ownership by gender 106
Figure 4.3-I Gender disaggregated smartphone skills 107
Figure 4.3-J Data usage (MB) per month by age 108
Figure 4.3-K Data usage (MB) and expenditure on entertainment per month 108
Figure 4.4-A Concern related to privacy 109
Figure 4.4-B Privacy concern in men and women 110
Figure 4.4-C Unknown issues concern in men and women 112
Figure 4.4-D Unknown issues concern across age groups 112
Figure 4.4-E Concern related to government control limitation 113
Figure 4.4-F Government control limitation concern in men and women 114
Figure 4.4-G Limited government control concern across age groups 114
Figure 4.4-H Concern related to financial scam 115
Figure 4.4-I Financial scam concern in men and women 116
Figure 4.4-J Financial scam concern across age groups 116
Figure 4.4-K Cashless community concern in men and women 118
Figure 4.4-L Cashless community concern across age groups 118
Figure 4.4-M Concern related to information security 120
Figure 4.4-N Information security concern across age groups 121
Figure 4.4-O Mental preparedness for fintech use 122
Figure 4.4-P Mental preparedness in men and women 123

Figure 4.4-Q Mental prepared for fintech use across age groups....123
Figure 4.4-R Mental prepared in different income classes....123
Figure 4.4-S Mental preparedness across districts....124
Figure 4.5-A Gender disaggregated mobile phone ownership....125
Figure 4.5-B Mobile banking account ownerships across levels of annual savings 126
Figure 4.5-C % of respondents using mobile banking for different services....127
Figure 4.6-A Overall customer satisfaction with fintech....128
Figure 4.6-B Most satisfactory fintech: internet banking vs mobile banking....128
Figure 4.6-C Fintech satisfaction across gender....129
Figure 4.6-D Fintech satisfaction across age groups....130
Figure 4.6-E Overall fintech satisfaction across income classes....130
Figure 4.6-F Overall fintech satisfaction across occupations....131
Figure 4.6-G Fintech satisfaction and financial knowledge....132
Figure 4.6-H Fintech satisfaction and confidence banking alone....133
Figure 4.6-I Respondent sentiment on costliness of fintech services....133
Figure 4.6-J Distribution of respondents as per mobile banking usage score....134
Figure 4.6-K Maximum fee for women and men....135
Figure 4.6-L Maximum cash out fee across age groups....135
Figure 4.6-M Distribution of maximum preferred cash-out fee....136
Figure 4.7-A Customer sentiment on fintech affordability....137
Figure 4.7-B Affordability sentiment among men and women....138
Figure 4.7-C Affordability sentiment across age groups....138
Figure 4.7-D Affordability sentiment and mobile banking usage....138
Figure 4.8-A Perceived obstacles in fintech use....140
Figure 4.8-B Economic condition as obstacle to fintech use....140
Figure 4.8-C Geographic location as obstacle to fintech use....140
Figure 4.8-D Miscellaneous other obstacles in fintech use....142
Figure 4.8-E-Government regulation as obstacle to fintech usage....144
Figure 4.8-F Future services expectations....145
Figure 4.8-G Future service - recharge across age....146
Figure 4.8-H Future service - utilities bill across age....146
Figure 4.8-I Future service - money transfer across age....146
Figure 4.9-A Expectation from fintech service providers....148
Figure 4.9-B Expectation of fraud prevention across ages....149
Figure 4.9-C Expectation of fraud prevention across levels of education....149
Figure 4.9-D Higher service quality expectation across max fee categories....150
Figure 4.9-E Faster service expectation across maximum preferred fee categories 150
Figure 4.9-F Faster service expectation across age groups....151
Figure 4.10-A Expectation from government....152
Figure 4.10-B Information secrecy expectation across age....154
Figure 4.10-C Information secrecy expectation and mobile banking usage score 154
Figure 4.10-D Expectations from government across occupations....155
Figure 4.10-E Service quality supervision across age....155

Figure 4.10-F Expectation of more operator competition across age 156
Figure 5.2-A Top 10 Global Fintech Deals in 2021 (in billions of USD) 160
Figure 5.2-B Largest fintech companies by valuation across countries 161
Figure 5.2-C Largest fintech companies by sub-sector 161
Figure 5.4-A: Global Fintech Rankings 2021 and Bangladesh (TBSNews, 2021) . 167
Figure 5.4-B: Month-wise salary disbursement (million BDT) and merchant payment (million BDT) through Mobile Financial Service in 2019 and 2020 (Source: Bangladesh Bank) 169
Figure 5.4-C: Month-wise average daily transactions (million BDT) and number of daily average transactions through Mobile Financial Service in 2019 and 2020 (Chowdhury, 2022) 170
Figure 5.4-D: Point-to-point quarterly growth of Internet banking in 2019 and 2020 170
Figure 5.5-A: bKash facilities and interface 172
Figure 5.5-B: Nagad Interface 172
Figure 5.5-C: iFarmer interface (Tracxn, n.d.) 173
Figure 5.5-D: Summary of facilities of Shadhin 174
Figure 5.5-E: Internet Banking Progression of Bangladesh 2020 - 21 Source: Bangladesh Bank 175
Figure 5.5-F: Nirapod Bima app 176
Figure 5.5-G TallyKhata app interface 178
Figure 5.6-A The process model of Fintech Ecosystem Development (Muthukannan, Tan, Tan, & Leong, 2017) 180
Figure 5.7-A Fintech ecosystem player readiness in Bangladesh 183
Figure 5.7-B Fintech's potential contribution to sustainable economic growth of Bangladesh 184
Figure 6.2-A Monthly Issued Cards and Total Volume of Transaction 195
Figure 6.2-B Monthly Registered MFS Account Numbers and MFS Agents 195
Figure 7.2-A Methodological flow diagram 220
Figure 7.2-B Distribution of fintech users and non-users in the original set after split (left) and distribution after SMOTE. Fintech users are denoted by “0” (in blue) and fintech users are denoted by “1” (in orange). 220
Figure 7.2-C Hypothetical sigmoid function on the coordinate plane. 224
Figure 7.3-A (a) Distribution of respondent ages; (b) Gender-disaggregated box-plot of age; (c) Scatter-plot of age and monthly income; (d) fintech use and bank account ownership; (e) Distribution of monthly income across concern for information security; (f) Scatter-plot of monthly income and data usage. 228
Figure 7.3-B Receiver Operating Characteristic (ROC) curve and Area Under Curve (AUC) score for the estimated model. 229

List of Abbreviations

BB	Bangladesh Bank
BIS	Bank for International Settlements
CFR	Customer Fintech Readiness
CPMI	Committee on Payments and Market Infrastructures
HIC	High Income Countries
LIC	Low Income Countries
LMIC	Lower Middle Income Countries
MFS	Mobile Financial Services
NCS	National Citizen Survey
P2P	Peer-to-peer
PSO	Payment System Operator
PSP	Payment Service Provider
SDGs	Sustainable Development Goals
SDSN	Sustainable Development Solutions Network
UMIC	Upper Middle Income Countries
USP	Unique Selling Point
WB	World Bank
WDI	World Development Indicator

1. Introduction

1.1. Background

If the twentieth century is characterized by foundational leaps in technology, then the beginning of the twenty-first can be termed as an episode of "recombinant innovation" in a "plethora of brilliant" technologies of the fourth industrial revolution offering transformative potential for millions of lives across the world (Brynjolfsson and McAfee 2016; Schwab 2017). Indeed, Sen (2001) noted almost two decades ago the unimaginable opulence human societies experience today compared to any other time in the past. Technology has contributed in multiple ways to raising the quality of life – enabling millions to lead a prosperous life. Perhaps this becomes more evident when one looks at the vast numbers of people lifted out of abject poverty during the preceding decades – among other indications. Undoubtedly, such progress cannot possibly be assigned to a single factor, whereby either technology or policy or innovation or education or healthcare alone can be claimed as the epoch-making driver of collective transformation.

In a surprising but not entirely uncommon juxtaposition, however, there remains an entirely bleak picture. Despite the "opulence" technology has brought to societies across the globe, millions of people are deprived of a decent human life. It seems that for all its mighty progress through several iterations of "industrial revolutions", the difference in the lot of a great many people at the lower ends of the socio-economic spectrum has been anything but revolutionary. Slavery in its literal form is no more. But when millions of people still live in extreme economic uncertainties, hundreds die of preventable diseases, inequal distribution of wealth in communities across the world grows more acute, and technology – rather than being a tool for transformational progress – becomes yet another means of maintaining the status-quo of unfair and unsustainable

economic development, the question of disguised slavery does not totally elude the sensible mind.

Finance has played a pivotal role in the allocation of economic resources. The core function of financial management is to allocate scarce economic resources to the most efficient use – thereby maximizing economic value. In doing so, and attending to other functions of a healthy financial system, finance has been a pioneer in first adopting and then scaling up digital technologies. The first automated teller machines, then referred to as cash dispensing machines, were put to use as early as 1967 (Bátiz-Lazo 2015). Banks were quick to realize the promise computers hold in automating tasks and accelerating operations to serve a larger number of customers. But these were economically well-off segments. Vast numbers of customers were left out of the formal financial channel. They had little to no access to financial services to manage finances, and therefore, no way to achieve a degree of agency and resilience over financial matters. It would almost be another half a century till the emergence of a completely new generation of innovative technologies touching the lives of the "unbanked" or the "underbanked".

Financial technologies, or FinTech or Fintech (interchangeably used in this report), is the combination of financial services and digital technology innovation. Whether, and how, fintech changes individuals and communities for the better is one of the central focal areas of this research. As of writing, the fintech literature is already rich. Multiple directions of research are being conducted to look mainly at fintech technology and business models per se and their relationship with and impact on individuals and human societies. Fintech allows for the "decoupling, decentralizing, and demystifying" of finance in an attempt to take financial services to the very customers who stand to benefit from financial innovation the most – thereby opening a promising path to sustainable development (Alexander et al. 2017; Mahmud, Joarder, and Sakib 2023).

Fintech continues to expand in terms of customer base and funding back-up around the globe. Throughout markets in developing and developed countries, fintech holds the promise of new economic opportunities for customer target segments. Fintech firms provide alternative financial services that seek to change the lives of customers and create value through new business models, products, and services. Business models can be based on a variety of ways to create value for customers. Some may seek to deliver the same value more efficiently and cheaply.

Other fintech service offerings may bring innovative new services to the customers that were simply not possible before through legacy banking firms. Several classification efforts have been found in the literature. Classification of fintech services available in the broader fintech landscape depends on the market being surveyed. For example, ASEAN is a rising and potentially vibrant hub of fintech services due to the macrocosmic and social makeup of countries comprising the southeast-Asia bloc.

Attempts to provide a theoretical framework for analyzing the fintech ecosystem in the literature follow several approaches. For Indonesia, Muthukannan et al., (2017) identified three distinct stages of development fintech firms go through within the fintech ecosystem. However, how countries around the globe fare in terms of their position and gradual evolution through these stages is inadequately understood. Moreover, the role of a dynamic and constantly evolving fintech ecosystem within a country in promoting better financial health for individuals, fintech firms, banks, and other enabling institutions needs further investigation. Across the developing world, in countries like Bangladesh, the impact of a dynamic fintech ecosystem on sustainable development requires a closer look. There remains a paucity of such insights for fintech markets in general. More importantly, the topic is even less understood in the context of Bangladesh where an extensive body of work on the fintech ecosystem, its ability to contribute to sustainable economic development, and viable pathways for further development of this capacity is absent.

While analyzing the emergence and continued rise of fintech across the globe, it is important to consider the role of symbiotic relationships among major players within the fintech ecosystem (I. Lee and Shin 2018). The ecosystem views account for the role of multiple domains of stakeholders that come together to formulate an enabling environment. Lee & Shin (2018) identified five domains in the fintech ecosystem: fintech start-ups, regulators, technology providers, financial customers, and traditional financial services firms. Each of these stakeholders/players in the fintech ecosystem has preliminary roles in how they facilitate the ecosystem. Regardless of the type of business models in focus in markets around the world, fintech has gained significant traction and is expected to continue to attract funding. In addition to opening new doors of possibilities, it also brings new security and economic challenges (An-Chi and Kao 2022).

In an Ernst & Young Global Financial Services Institute survey in 2015, fintech adoption rates among the digitally active population in six markets were 15.5% (Gulamhuseinwala et al. 2015b). Even at that stage, the predominant fintech service among users was the ability to transfer funds. Mobile payment systems accounted for 17.6% of the use cases. Preliminary driving forces of the fintech adoption rates at the macro scale were regulatory incentives, falling technology prices, and consumer demand for alternative fintech services. Increasing investments from venture capital and private equity also accounted for a major driving force in these markets (Gulamhuseinwala et al. 2015b). Even though fintech offers value for the customer across multiple socio-economic classes, primary adopters of early fintech are high-income, high-value customers who are young and are more open to technology (Gulamhuseinwala et al. 2015b).

A host of studies have emerged in the literature focusing on factors affecting fintech adoption. Originally, these studies borrow from the line of investigation into technology adoption in general. After over three decades of scientific literature on the Technology Acceptance Model (TAM), despite several criticisms e.g., measurement biases (F. D. Davis and Venkatesh 1996), continues to be a keystone theoretical foundation. In particular, current and expected future research seeks to delve into areas such as new factors, inter-factor relationships and influence, specific customer segments, and the space between behavioral intention and actual measurable use of technology (Marangunić and Granić 2015). The last of these has gained increasing traction. After all, it is necessary to measure how much behavioral intention actually translates into technology usage.

Another seminal work in the technology adoption domain was the Unified Theory of Acceptance and Use of Technology (UTAUT). Founded on the same strand of psychology literature TAM borrows from, and indeed paying due attention to the structure and theoretical constructs of TAM itself, UTAUT proposes a more systemic perspective on technology acceptance and usage (Venkatesh et al. 2003). Apart from the expected benefits and efforts related to the use of new technologies, UTAUT put forward “social influence” and “external environmental” variables. A line of literature was dedicated to investigating, empirically validating, and critically assessing the model – and expanding where appropriate. Although it has also been argued that initial acceptance of the model by researchers may have, in some cases, limited further work in bringing new perspectives (Venkatesh et al. 2016). A common key element of TAM and UTAUT

relates to their fundamental approach. Because of their basis in the psychology of behavior, they look at the acceptance of technology as primarily a function of customer behavioral constructs. Thereby they focus on psychological factors only, largely avoiding the inclusion of other seemingly disjoint variables, e.g., technological and financial capabilities. Indeed, these overlooked factors may very much make or break acceptance decisions and subsequent intention for usage continuance. Although the literature is rich and continues to develop in understanding factors affecting technology adoption and readiness to use emerging technologies in general, fintech adoption and fintech readiness assessment are two areas where not enough work has been done.

However, that is not to say that the literature does not provide any indications. In fact, with regard to fintech adoption, many factors have been identified. Perceived benefits and perceived risks from fintech use were found to significantly explain fintech adoption rates (Gerlach and Lutz 2021). Across countries, customer trust in the service delivery process and fintech service providers have been found to significantly affect the adoption of fintech services (Amofah and Chai 2022; Cham et al. 2018; Nathan et al. 2022; Salman and Abd. Aziz 2015; Yonghee Jack Kim et al. 2015). Perceived usefulness and enjoyment affected the intention to adopt fintech services (Al-Okaily et al. 2021). Personal variables have a role to play in determining, or at least mediating, the relationship between factors and their effect on adoption intention for fintech. In multiple studies, a resounding theme was differences in adoption rates and adoption intention across gender and age groups. Overall, fintech adoption rates were higher among the young and among males. This trend held for fintech adoption intention too, in multiple samples across markets. In SAARC and ASEAN markets, for instance, males were ahead of females, and younger users were more likely to adopt fintech services compared to their older counterparts (Imam et al. 2022; Loo 2019). Thus, similar studies continue to investigate factors. But such investigation has rarely been performed for Bangladesh specifically, where fintech stands to promote positive socio-economic change.

Given finite resources and economic opportunities, the developing parts of the world rationally have fewer incentives to prioritize collective economic, social, and environmental development agenda (Unwin 2009). It is within this very reality that the role of technological innovation comes into play. Information and Communication Technology for Development (ICT4D) as a narrative has

achieved widespread recognition as an answer to the development crisis (Unwin 2009; Vollebergh and Kemfert 2005; Wu et al. 2018). Financial technologies combine the transformative potential of digital technologies with financial services to enable access to innovative financial services – especially by previously overlooked target segments (Douglas W. Arner et al. 2020a). Recent innovations in fintech harness the potential of the fourth industrial revolution technology paradigm where "brilliant technologies" allow instantons, worldwide connectivity, real-time sensing, quick and intelligent decision making, and delivering stat-of-the-art services to a wider market segment at fractions of the cost previously required (Brynjolfsson and McAfee 2016; Schwab 2017). Fintech allows low-income, marginal communities access to financial services (Ahmad et al. 2020). Providing a way to gain financial impudence is important to make progress on the SDG 2030 agenda. In general, human development cannot be sustained with a sizeable portion of the global population deprived of accessing financial services that create, strengthen, and expand the score of economic opportunities for individual and communal growth. While this is crucial for entire communities, it is perhaps even more important for some of the most marginal segments of the world population. Women, the elderly, non-mainstream gender identities, and persons of disabilities are only a few examples of systematically disadvantaged groups who stand to benefit immensely from equality economic opportunities brought forward by the digital-driven fintech services landscape. Fintech also offers greater financial resilience that allow these communities to withstand crises.

Bangladesh is one of the countries in the "developing" world that can immensely benefit from harnessing the transformative potential of fintech for millions of lives. For decades, Bangladesh has maintained remarkable macroeconomic stability despite geopolitical, environmental, and demographic challenges and is now poised to utilize Industry 4.0 technology for the next stage of development (Bhuiyan et al. 2020; Ministry of Planning 2020). This project incorporates a complex and challenging combination of technological innovation, social change, and political forward-thinking. Pertinent to the issue at hand, it requires enabling millions of people throughout the nation to gain financial agency and a level of resilience that allows prosperity for all. For a resource-scarce developing nation situated in the hotbed of geopolitical conflicting priorities and facing the potentially disastrous consequences of climate change, empowering

individual financial freedom through fintech innovation is a crucial policy priority for Bangladesh.

Policy interventions necessary to boost the expansion of fintech service development and its large-scale adoption among the general population require insights on multiple fronts. It is important to understand the current state of the fintech ecosystem with reference to global fintech ecosystem development models. To find out the role of a dynamic fintech ecosystem in aiding sustainable economic development, an investigation is needed on the relationship fintech has with sustainable economic growth. Additionally, it is necessary to also understand, through empirical as well as qualitative means, the specific channels and mechanisms that enable fintech to make such contributions to sustainable development in the first place – so as to find possible areas of obstacles and means of accelerating fintech for sustainable development. Customer adoption of fintech in particular in Bangladesh, a country where advanced digital technologies are still not entirely well understood and commonly used in everyday lives across the population. Important questions remain in terms of what factors primarily decide the adoption of fintech services in Bangladesh. More broadly, however, it is important to understand the overall readiness of the Bangladeshi customer base for fintech use in their daily lives. Such assessment requires the development of an overall readiness measurement scheme, which surprisingly, is not currently available in the literature. This work, by addressing these gaps, seeks to provide a series of insights based on which time-appropriate and empirically validated policy recommendations are provided for the development of fintech in Bangladesh and to derive its attendant sustainable economic benefits.

1.2. Research Objective and Key Research Questions

The overarching objective of this research is to investigate fintech's relationship with sustainable economic growth, with an assessment of the state of the fintech ecosystem and fintech adoption in Bangladesh. To facilitate a systematic investigation along this line, the following four research questions are formulated. In fact, the four major segments of work presented in this report each target one specific research question from the list below.

1. What is the current state of the fintech ecosystem in Bangladesh and globally?
2. To what extent are Bangladeshi users/customers ready for innovative fintech services?
3. What factors primarily determine the adoption of fintech services?
4. Does fintech contribute to sustainable economic growth? What relevant empirical evidence is there?

1.3. Scope of the Research

As the title and central research questions suggest, this study focuses on Bangladesh in investigating fintech, fintech ecosystem, readiness, adoption, and implications for sustainable economic growth. The primary dataset, therefore, is also collected from Bangladesh. However, in trying to gain insight into the aforementioned areas related to fintech and sustainable economic growth for more effective policy and financial prosperity, this study does not limit its investigation solely to Bangladesh. Rather a wider view is adopted. Comparative evaluation is performed, a global benchmark is referred to, worldwide datasets are analyzed, and international cases are consulted. The resultant infusion of domestic and worldwide evidence leads to more robust and universal insights than would otherwise be possible had the study relied on Bangladesh solely. That said, this research nevertheless takes the stance that guiding Bangladeshi policy decisions should be the primary outcome.

The analyses and insights presented by this research will allow Bangladeshi policymakers to have a close look at fintech ecosystem readiness in Bangladesh. Moreover, they will understand what drives the adoption of fintech products and services in the country – thereby allowing space for interventionist policy to boost

fintech expansion for sustainable economic development. For policymakers from developing countries in general, and indeed all across the world, the study established fintech's relationship with sustainable economic development. More importantly, it also identified channels more relevant to this effect. Therefore, the study is also relevant in an international context. Additionally, all data and literature included as part of the study are as recent and relevant to the topic at hand as possible. Broadly, the study considers developments between 2014 and 2021. However, in places where appropriate, this timeline is not allowed to restrict relevant investigation.

1.4. Motivation for This Research

Commensurate with the expansion of fintech in developing countries in other parts of the world, mobile financial services (MFS) in Bangladesh have gained massive traction in the preceding two decades (Kabir et al. 2021). Spearheaded primarily by private sector organizations and supported by progressive government policies, MFS has permeated throughout the domestic market – pulling millions and millions of individual users, and small business owners, into a semi-formal financial system. The case is an example globally. Yet, outside of MFS-led financial services – mainly incorporating mobile money transfer and digital payments, fintech has little footprint. There exist dozens of fintech business models, each with promise for different segments of the market. But there is little presence of these in Bangladesh. In fact, the worldwide fintech market continues to grow each year with record-breaking venture capital funds flowing into innovative fintech startups. New technological innovation and attendant business models emerge. Within this context, allowing for fintech to touch large numbers of customers in Bangladesh with the aforementioned innovations requires a systematic examination of the current state of the fintech ecosystem, patterns of fintech adoption and use, and importantly, fintech's relationship with sustainable development. Such a systematic study is rare in the current literature – especially in the context of Bangladesh. The present work, thus, was motivated to inform a broad spectrum of stakeholders and enable effective fintech policy for sustainable economic development for a developing nation like Bangladesh.

1.5. Significance of the Research

Fintech can be regarded as the domain at the forefront of innovative fourth industrial revolution technologies in everyday life. Armed with increasing computing capability and fast network connectivity across the globe, fintech services providers seek to deliver "intelligent" financial services, facilitate fast and secure payments, cover for financial risk, allow prudent risk management, assist in creating a smarter regulatory framework, and more. At a time when new possibilities are created in the domain, a discourse on fintech's implication for developing countries like Bangladesh is timely.

To enable fintech liberate individuals and communities with intelligent financial services at an affordable price, policy, and commercial prudence are warranted with parallel importance. Across the world, regulators have taken a cautious stance with fintech (Amstad 2019; D. Arner et al. 2017). Indeed, fintech brings new security risks along with economic opportunities. Some authors have argued that fintech, if not properly guided by forward-looking policy, may as well exacerbate existing inequalities and social injustice – thereby proving to be a force for old evils rather than new hope. However, there remains the danger of a policy that is too cautious.

On the other hand, fintech service providers with the industry that facilitate their delivery of innovative financial services, i.e., mobile network operators, legacy banks and financial institutions, and technology enablers need to understand how to reach a larger group of customers who might be in need of fintech for positive change in their lives.

Indeed, fintech can be targeted to drive out "asymmetries" and "market inefficiencies" and lead to a smarter, more representative, and more resilient financial system for all. Since the current research work aims to investigate this very notion, what factors play their part, what obstacles present themselves in this journey, and provide persuasive evidence of fintech's positive transformative potential for sustainable economic development, it can be useful in nudging stakeholders towards the right direction.

1.6. Major Contributions

The current research work investigates fintech, fintech ecosystem, fintech adoption, and fintech's relationship with sustainable economic development. Particular focus is placed on Bangladesh. As such, the study makes a number of contributions to the literature. It also provides time-appropriate guidance to fintech-related policy for the near future and expects to inform fintech services providers and regulators alike in targeting fintech market segments for effective expansion – thereby promote better financial health. A few areas of the contribution this study makes can be highlighted.

First, the current study assesses the stage of fintech ecosystem development in Bangladesh in light of established ecosystem development model. Bangladesh's fintech ecosystem is also comparatively assessed with global and peer-nation benchmarks. In evaluating fintech ecosystem readiness and its contribution to sustainable economic development for Bangladesh, this study utilizes a panel of twenty-one key informants – experts from industry, policy, and academia. Therefore, the study gives a reliable assessment of the state of the fintech ecosystem and future expectations in the context of Bangladesh.

Second, the study conducts a nation-wide representative survey (N=1282), the first of its kind to the best of our knowledge. Termed National Citizen Survey (NCS), the individual survey collected data on a broad range of demographic, economic, financial, digital, and perceptions on fintech use. Data were collected from 16 districts from all across the country and included respondents from varied ages, genders, occupations, and urban/rural origin classes. This representative dataset is then analyzed for descriptive insights. Both for policy decisions and commercial strategy, NCS insights presented by this study can prove to be valuable given the unavailability of a similar dataset. As such, the dataset itself can be regarded as a contribution in this study context.

Third, this study constructs a fintech readiness assessment scheme. The Customer Fintech Readiness (CFR) index is then used to assess the readiness of Bangladeshi customers for innovative fintech use. Calculated from the NCS dataset and constructed with extensive reference to dimensions of fintech readiness in the literature, CFR is then adequately validated by this study. Due to its high validity and easy replicability, the CFR index is expected to provide

researchers in other fintech markets with a significant tool for readiness assessment and attendant investigation.

Fourth, fintech adoption factors are investigated to find out what leads to the adoption of fintech. With all its transformative potential, fintech cannot positively affect the lives of individuals and communities if fintech services are not adopted at scale in the first place. This study utilizes the large number of factors included in the NCS dataset and deploys algorithm-driven feature elimination to select the most relevant factors determining fintech adoption. Therefore, the factors this research identifies as significant determinants of the adoption of fintech are not limited by context-sensitive hypothesis development. Therefore, the study illuminates salient factors in the Bangladesh context and provides very relevant policy guidance for higher fintech adoption. Similarly, commercial strategy can also benefit from this contribution.

Finally, within the clear paucity of empirical evidence of fintech's contribution to sustainable economic development, this study provides a multi-step approach and establishes fintech's contribution to sustainable economic development in a cross-country setting. Indeed, the univariate analyses presented by the study incorporating all countries around the world, as well as lower middle-income countries separately, contribute to the fintech literature with empirical evidence in support of fintech's positive contribution to sustainable economic development – thereby opening a new research direction within the broader fintech literature.

1.7. Organization of this Report

This report is organized as follows. Chapter 2 surveys extant literature on fintech, fintech ecosystem, fintech adoption factors, and fintech and sustainable economic development. A few secondary areas relevant to the current study are also reviewed. Apart from this, reference to extant literature is presented throughout the report wherever appropriate. Chapter 3 provides the conceptual framework of the study. In particular, a detailed description of NCS and the sampling method is available in this chapter. It is important to note that in subsequent chapters where separate analytical work and results are presented in relation to the four major research questions, a section details data and methods for these. As such, these are not repeated in Chapter 3. Descriptive findings from

NCS are presented in Chapter 4 where the reader will find patterns emerging from the data across various sections. These sections deal with, among other things, banking behavior, fintech use, and concerns related to the use of fintech services.

Chapters 5 through 8 constitute the fourth major part of the investigative work in this study. First, Chapter 5 looks at the stage of ecosystem development in Bangladesh's fintech arena with reference to the global state of the fintech ecosystem. It also presents the findings of expert panel opinion on fintech ecosystem readiness in Bangladesh. Chapter 6 presents a scheme for assessing customer readiness for fintech, the CFR Index. It then validates the index. After validity is adequately established, the chapter then uses CFR Index to assess customer fintech readiness in Bangladesh and presents the findings. Chapter 7 focuses on the factors that determine the adoption of fintech services in the context of Bangladesh. Deploying Recursive Feature Elimination (RFE) on NCS data with logistic regression, the chapter then points to the significant features that determine fintech adoption in the country.

Chapter 8 investigates fintech's relationship with sustainable economic development. In dealing with definitional ambiguity and measurement challenges of "development" per se, the chapter takes a two-step approach. In the qualitative part, the chapter presents country-focused and fintech start-up cases and shows how fintech is creating opportunities for different target segments of the market. The quantitative modeling then divides the problem into two parts. First, a panel data regression model establishes fintech's contribution to economic growth. After this is sufficiently established, univariate analysis methods are used to see the relationship between fintech and sustainable development indicators. In doing so, the chapter incorporates all countries across the world. However, considering that the focus of the current work is on fintech for developing countries like Bangladesh, the univariate analyses are also performed for lower and middle-income countries (LMIC) only. This approach provides a range of insights into fintech's impact on sustainable economic development and also on channels of such impact – for developing economies and in general.

2. Literature Review

2.1. Fintech Around the Globe

Fintech firms provide alternative financial services that seek to change the lives of customers and create value through new business models and products and services. Business models can be based on a variety of ways to create value for customers. Some may seek to deliver the same value more efficiently and cheaply. Other fintech service offerings may bring innovative new services to the customers that were simply not possible before through legacy banking firms. Several classification efforts have been found in the literature. Classification of fintech services available in the broader fintech landscape depends on the market being surveyed. For example, ASEAN is a rising and potentially vibrant hub of fintech services due to the macrocosmic and social makeup of countries comprising the southeast Asia bloc. However, countries in ASEAN are uneven in terms of several fintech firms and fintech service offerings available to the customers (M. Soriano et al. 2019). In terms of the number of fintech firms, Singapore and Indonesia lead the block (with 29% and 17% of fintech firms in the region respectively). Other countries in the block are lagging: Cambodia (4%), Vietnam (3%), and Myanmar (1%). Soriano et al., (2019) proposed a taxonomy of fintech business models for a survey of fintech services in the ASEAN region. From a business model perspective, fintech services were divided into sub-categories of 10 different classes. These include digital payments, InsurTech, financial management for businesses, personal management of finance, payments, lending, and crowdfunding. A Survey of the ASEAN fintech landscape reveals that digital lending leads the way in terms of volume of use.

Similar to trends observed in finch landscapes in other parts of the world, digital lending and payments comprise the two biggest categories of business models in ASEAN. Both of these are used to enhance everyday transactions and customers directly benefit from greater access to lending resources and a

smoother way of payments. In ASEAN, apart from these two services, capital crowdfunding, Machine Learning or AI-driven financial services and financial management solutions for businesses are the next biggest business models (M. Soriano et al. 2019). Fintech provides a wide array of enhanced financial services for customers in these categories. In most cases. In most cases, sophisticated, data-driven financial advisory and decision-making are accessible for business and individual customers for fractions of the cost it takes banks and financial institutions to deliver similar products using traditional means.

Within the digital lending market in ASEAN, peer-to-peer business lending is at the top. Fintech removes some of the previously insurmountable barriers to the informal lending market e.g., credit rating based on proxy measures, a platform for the settlement of transactions where enough buyers and sellers credibly participate, etc. Consumer lending in such platforms closely follows and is expected to grow in the coming years in this region. Individual customers comprise the biggest share of fintech users in the ASEAN region. Around 42% of the customers in ASEAN fintech firms are individuals, 28% are corporate players and 22% are SMEs (M. Soriano et al. 2019). The customer profile is significantly determined by the type of service being delivered. For example, 22% of customers in digital lending are corporate entities whereas the share of this customer segment in Machine Learning fintech solutions is 45% (M. Soriano et al. 2019).

Fintech firms have continued to grow in numbers as well as in the scope of fintech solutions delivered to customers. For new fintech startups, findings of a market niche and go-to-market (GTM) strategy have become increasingly important as the fintech landscapes around the world become more and more populated by new entrants. Soriano et al., (2019) identified that fintech firms in ASEAN have been leveraging the ease of access and convenience of use as the GTM strategy for their fintech offerings. Around 83% of firms surveyed followed ease of access as the “high-priority” GTM for their products. Around 80% followed speed, 58% followed the cost of a product, and 58% followed integration as their “high-priority” strategy. Design of an intuitive user interface was a “high priority” GTM for 56% of firms surveyed. Soriano et al., (2019) also found a wide variety of technology fueling fintech innovation in ASEAN. The top three technologies found were predictive analytics, the use of AI and machine learning algorithms, and robotic advisory algorithms.

Financial inclusion is a major area of concern and interest in the ASEAN region for fintech firms due to the high level of unbanked population in the region. Overall, only 51% of people in the region have access to services delivered through a formal banking channel or by financial institutions, as per the World Bank's Global Findex Survey (M. Soriano et al. 2019). A significant variation is observed in terms of the unbanked population in the region. The unbanked population in Singapore, Indonesia, and Malaysia account for around 58%, 37%, and 60% of the population respectively. In Thailand, the figure is 69%. Apart from a huge unbanked population, the ASEAN region also comprises underbanked people. These are customers who own bank accounts but have little to no involvement with the formal banking channels and their products and services. Both the unbanked and underbanked populations in ASEAN pose lucrative opportunities for fintech firms in the region. A sizeable portion of fintech firms in the ASEAN region has proven to be innovative, as measured by the change in their business strategy with a significantly new product or service offering within a particular timeframe.

In facilitating a vibrant fintech ecosystem, regulation plays a key role. Fintech firms do not directly count as financial services providers. Yet fintech firms deal with the funds of their customers. As a result, these firms are subject to the same risk management principles that apply to established banks and financial institutions. Fintech firms are not as heavily regulated as banks. An ideal regulatory framework that defines a universal set of parameters for fintech firms is yet to emerge. For now, regulators seem to control the activities of fintech firms based on the market they operate in and the product they offer to their customers. In ASEAN, Soriano et al., (2019) found that the majority of fintech firms are regulated and are regulated under banking regulations. The highest concentration of unregulated fintech firms was found in Thailand. Overall, fintech firms hold a positive impression regarding the appropriateness and adequacy of these regulations for the time being.

One of the most popular approaches to fintech regulation is the creation and management of regulatory sandboxes that allow fintech companies to develop and test their product offerings with live customers. Apart from providing the firm with real-life simulation opportunities to fine-tune their products and test for potential new features and/or weaknesses, regulatory sandboxes ensure safeguards for customers as well as for other players in the fintech ecosystem.

ASEAN is one of the first regions to institute a "cross-jurisdictional sandbox" that allows fintech firms to approach customers in multiple markets within the bloc (M. Soriano et al. 2019). Another major force shaping the fintech ecosystem in ASEAN is the demand for Shariah-based Islamic financial services. Malaysia is becoming a major hub for the research and development of Islamic financial products and services. This has led to an entirely new sub-category of Islamic fintech products (M. Soriano et al. 2019). Going forward, ASEAN will continue to see a bigger share of the market being taken by products specifically catering to Islamic financial needs. Regulations in these countries also seek to combine the transformative powers of micro-finance and fintech to tackle the universal agenda of greater financial inclusion of the unbanked and underbanked population for sustainable economic development.

While businesses had adopted a customer relationship management (CRM) approach to creating value for decades, the shift towards adopting more focus on the "customer journey or experience is underway" (Buckley and Webster 2016). Compared to CRM, the customer journey focus is a more holistic approach and considers all the events, touchpoints, etc. that shape the customer experience at every stage of the process: before, during, and after the purchase. In developed markets, marketers of fintech products can directly receive feedback from a customer in creating a value-driven customer journey. They can also learn from existing pinpoints of the customer journey in the traditional banking channels, and thereby enhance their product offerings accordingly. In developing markets, however, the customer journey will need to be "evidence-based" (Buckley and Webster 2016).

Ongoing research attempts to shed light on the profile of fintech entrepreneurs and fintech users. There is enough evidence to suggest that the distribution of fintech entrepreneurs and fintech users (at least in terms of early adoption) is heavily skewed towards the higher-income and younger age groups. Even in developing regions like ASEAN, and the broader markets of Asia-Pacific, fintech has emerged and is vibrant in urbanized centers like Singapore, and Hong Kong. Considerable variation exists in the socio-political, economic, and governance makeup of countries in these regions. Perhaps not surprisingly then, the customer journeys of accessing financial services in each of these markets are very different from each other (Buckley and Webster 2016). The nature and limitations of brick-and-mortar banks in and of themselves present a major

barrier to financial service access for a customer in these regions. At the same time, the low quality of institutions adds another layer of challenge to the customer journey. For thousands of rural farmers in countries with an emerging economy, dependence on subsistence farming means the unpredictability of income. Coupled with a lack of access to quality sources of credit, dependence on informal and often economically harmful sources of credit leads to financial ruin for many (Buckley and Webster 2016). The role of microfinance as an alternative source of financial service is underlined in these contexts.

Fintech firms in these economies need to chart new customer journey pathways to bring an innovative transformation of the existing system to drive greater value for customers. With services like digital payments, peer-to-peer lending, and access to low-cost financial advice, fintech firms in these markets have demonstrated the ability to drive financial inclusion. Most importantly fintech firms have done so on top of existing mobile networks and digital infrastructure. In sub-Saharan Africa for example, through platforms like M-Pesa, all a customer needs is the ownership of an SMS-enabled phone that allows them to deposit money and transfer funds (Buckley and Webster 2016).

In an Ernst & Young Global Financial Services Institute survey in 2015, fintech adoption rates among the digitally active population in six markets were 15.5% (Gulamhuseinwala et al. 2015b). Even at that stage, the predominant fintech service among users was the ability to transfer funds. Mobile payment systems accounted for 17.6% of the use cases. Preliminary driving forces of the fintech adoption rates at the macro scale were regulatory incentives, falling technology prices, and consumer demand for alternative fintech services. Increasing investments from venture capital and private equity also accounted for a major driving force in these markets (Gulamhuseinwala et al. 2015b). Even though fintech offered value for the customer across multiple socio-economic classes, primary adopters of early fintech are high-income, high-value customers who are young and are more open to technology (Gulamhuseinwala et al. 2015b). Fintech adoption was also found to be higher in urban areas primarily due to the demographic profile of customers within cities and the effectiveness of offline media reach in these areas (Gulamhuseinwala et al. 2015b). Gulahuseinwala et al., (2015) also found that awareness regarding fintech services available and the value they can generate constituted the main hurdle in fintech adoption. Trust in the technology or service offered was not a big hurdle on the other hand. It was

concluded that as awareness regarding fintech services in these markets rises, adoption rates will also reach higher levels within a relatively short period; and the increase will be led by young and high-income customers. In India, which now boasts at least three promising global fintech hubs, competition with banks in capturing the lucrative share of the market comprising of wealthy customers is tough and is fueling newer innovations; regulatory initiatives like Digital India and the launch of Unified Payment Interface have paved solid foundations for the fintech ecosystem in the country for decades to come (Nathan Associates India 2017). In Bangladesh, the national agenda for greater financial inclusion and phenomenal success for mobile payment services like bKash and Nagad are inspiring new initiatives by banks and financial institutions to bring their fintech innovation to customers (Kabir et al. 2021).

The Global Fintech Index 2020 shows key city centers where fintech innovation has gained traction as well as rising cities in Asia poised to become the fintech hubs of the coming years. The survey for the report covered 230 cities across 65 countries around the globe. The top three cities identified as global fintech hubs included San Francisco, London, and New York. Within the list of 20 global fintech hubs are emerging locations like Mumbai (Rank 10), New Delhi (Rank 16), and Tel Aviv (Rank 18) (Findexable Limited 2019). An intriguing finding from the survey points to cities that are emerging or improving their status as global fintech hubs but are not necessarily top-ranking locations as start-ups. This indicates how fintech startup opportunities are diseases across the globe and fintech clusters are not necessarily fueled by existing startup clusters. Demand side and regulatory side supply factors are at play in determining emerging new fintech startup clusters across the globe.

While analyzing the emergence and continued rise of fintech across the globe, it is important to consider the role of symbiotic relationships among major players within the fintech ecosystem (I. Lee and Shin 2018). The ecosystem views account for the role of multiple domains of stakeholders that come together to formulate an enabling environment. Lee & Shin (2018) identified five domains in the fintech ecosystem: fintech start-ups, regulators, technology providers, financial customers, and traditional financial services firms. Each of these stakeholders/players in the fintech ecosystem has preliminary roles in how they facilitate the ecosystem. Fintech start-ups bring innovative financial services through digital technologies. Regulators provide an enabling environment for

new services to be instituted and expanded sustainably and safely. Technology providers provide the mobile telecommunications and digital technology backbone with services like cloud computing, AI/ML support, mobile networks, and internet access. Financial customers are the sources of revenue for the fintech firms as well as indirectly for other players in the ecosystem. Traditional financial institutions also are important players in the fintech ecosystem. After realizing the disruptive potential of fintech, banks, and financial institutions have started working hand-in-hand with fintech firms. Banks both support fintech firms as financial services providers as well as a partner in delivering their existing products through digital means. The concerted collaboration among these stakeholders makes way for a vibrant fintech ecosystem that is capable of creating value for the customers and other players in the ecosystem (I. Lee and Shin 2018).

The disruption fintech has caused to the banking world is reverberating through all tiers of services. Fintech is redefining the way value can be delivered to customers in ways banks have not thought about for decades. Due to their technological advantage, the scope of services fintech firms can offer to their customers at fractions of the cost is broad and increasing fast. Fintech firms are specifically targeting customer segments that are the most profitable for banks as well (Ghose et al. 2016). Within the banking industry, veteran CEOs have touted how the march of fintech firms is the "beginning of the end" for traditional banking and that "Silicone Valley is coming" with brains and innovative new alternatives to how banking is done in traditional banks (Ghose et al. 2016).

Participation of fintech startups to transform the financial landscape varies in jurisdictions and across market conditions. In Russia, for example, fintech firms still have not been able to hold a firm grasp on the market, and banks play a major role in delivering financial services to customers (Soloviev 2018). Russia is home to the world's largest neo-bank and Russian banks are attempting to experiment with innovative financial technology alternatives like cryptocurrencies. There are some exciting developments in mobile payments and crowdfunding as well. But largely the ecosystem of fintech services is still subdued with most of the players as identified by Lee & Shin (2018) not fully active and collaborating (Soloviev 2018).

Attempts to provide a theoretical framework for analyzing the fintech ecosystem in the literature follow several approaches. For Indonesia, Muthukannan et al., (2017) identified three distinct stages of development fintech

firms go through within the fintech ecosystem. In the “assessment” phase, fintech firms look for unmet demands and opportunities to create value for customers using financial technology platforms. They bring their technological solutions and network resources to scale their solution in the market in the “acceleration” phase. In the “augmentation” phase, relationships with other fintech ecosystem players mature, and complementary features are added to the products/services of fintech firms. The last stage is thus referred to as the “augmentation” phase (Muthukannan et al. 2017). There are complex interactions between ecosystem participants at each stage of development within this process. Fintech service providers, customers, and regulators can benefit from systematically analyzing the stage in which their respective markets are in deciding the best course of action on their behalf.

New fintech services emerge in ecosystems around the globe as companies continue to innovate. It is important to classify these fintech service offerings systematically for better understanding and perhaps for future interaction and regulatory intervention purposes. Based on the cases of 227 fintech firms and their service portfolio three major classes of fintech service offerings were identified: interaction, data, and monetization (Gimpel et al. 2018). In the interaction domain, services mainly center around the interaction between the fintech service provider and the customer to personalize their services and access networks. Data usage, analysis, and access to data are at the core of dimensions identified in data-based fintech service offerings. Monetization-based service offerings revolve around managing and overseeing the customer’s money (Gimpel et al. 2018). However, the fintech landscape is broad enough to demand efforts toward a taxonomy of services offered within each category of the broader fintech landscape. A taxonomy of blockchain-based business models in the fintech landscape identifies “value proposition”, “value creation and delivery”, and “value capture” as the three business models (Weking et al. 2020). As the fintech ecosystem continues to grow further understanding of the classification of each fintech service category and interaction between these domains can be expected to lead to a more stable and universally acceptable classification service in the broader fintech ecosystem.

All five actors of the fintech ecosystem are fully present in Singapore and in terms of financing, venture capital is more prevalent compared to the contributions made by angel investors (Dang Thi Ngoc Anh 2018). In Vietnam, the fintech ecosystem faces the primary challenge of a lack of skilled human resources

at the workplace even though academic records are good in schools and universities. The role of fintech firms in Vietnam is especially important concerning financial inclusion. As per data from 2019, around 69% of Vietnamese did not have bank accounts (Australian Trade and Investment Commission, Commonwealth of Australia 2020). Regulations and policy priorities in Vietnam are aimed toward generating five fintech-focused unicorns by 2019. As of 2019, the country had around 136 fintech start-ups in its fintech ecosystem.

In the European Union, regulators have taken matters related to risk management relatively more seriously. A discussion paper on the European Business Authority's approach to fintech regulation suggested further work in areas including regulatory sandbox authorization, guidelines for prudential risk management for fintech firms and financial institutions related to providing fintech services, consumer protection, and fintech business models ("Discussion Paper on the EBA's Approach to Financial Technology (FinTech)" 2017).

Overall the fintech ecosystem is fueled by demands from individuals, corporate buyers, financial institutions, and regulators or government agencies. Attracting quality talent into the fintech hubs, providing enabling regulations that keep pace with the rapid growth in innovation in the sector, and raising customer awareness to support this growth are key issues players in the fintech ecosystem face today (Mittal 2019).

2.2. Fintech Ecosystem

To comprehend the dynamics of the ever-evolving world of fintech, we must first analyze and understand the fintech ecosystem. A well-constructed fintech ecosystem is crucial to the continued growth of the fintech industry. Five elements were identified (In Lee, 2017) as part of the fintech ecosystem. The five elements are as follows (also exhibited in Figure 2.2-A):

1. Fintech start-ups
2. Technology developers
3. Government (e.g., financial regulators and legislature)
4. Financial customers and
5. Traditional financial institutions

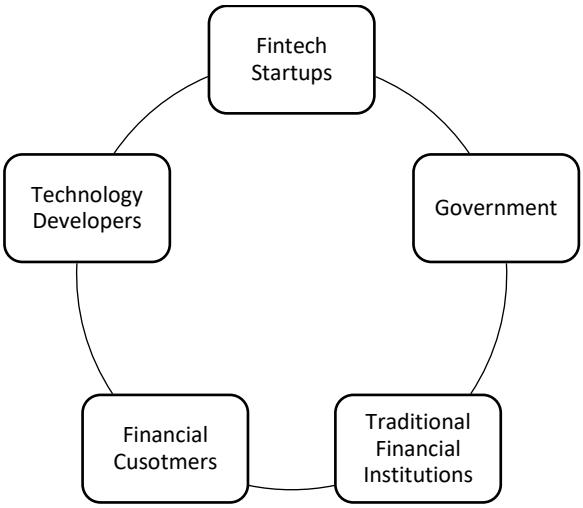


Figure 2.2-A The five elements of fintech ecosystem

These elements work together to foster innovation, boost the economy, encourage cooperation and competitiveness in the financial sector, and ultimately benefit financial industry customers. Figure 5a visualizes the five elements of the fintech ecosystem. By incurring lower operating costs, focusing on more niche markets, and offering more individualized services than traditional financial firms, these primarily entrepreneurial companies have driven significant innovations in the fields of payment, wealth management, lending, crowdfunding, capital markets, and insurance.

One of the key factors influencing growth in the fintech industry is the capacity to unbundle services since traditional financial institutions are at a disadvantage in this scenario. Instead of relying solely on one financial institution for all of their requirements, consumers are starting to pick and choose which fintech businesses' services they want to use. In the case of Bangladesh, a consumer may manage his/her loan via Dana Fintech while using Bkash to manage payments and Nirapod Bima for insurance comparison. For fintech start-ups venture capitalists and private equities are very helpful. The level of investments increased significantly over time (In Lee, 2017).

Digital platforms for social networking, big data analytics, cloud computing, artificial intelligence, smartphones, and mobile services are provided by technology developers. Technology developers provide an atmosphere where finance firms may quickly introduce novel services. Cloud computing may be utilized by cash-strapped fintech firms to provide web-based services at a fraction of the cost of in-house infrastructure development, and big data analytics may be leveraged to offer clients unique customized services. Robo-advisor wealth

management services can employ algorithmic trading tactics as their foundation and charge substantially cheaper costs than conventional wealth management services. The development of communities in the areas of crowdfunding and peer-to-peer lending is facilitated by social media. The advantages of physical distribution are supplanted by the prevalence of mobile devices. Mobile network providers are also offering low-cost infrastructure for the development of services offered by fintech firms, such as mobile banking and payment. These technology developers are then receiving income from the fintech sector.

Governments have been providing a favorable regulatory environment for fintech since the 2008 financial crisis (HollandFintech, 2015). Different governments offer various levels of regulation (e.g., licensing of financial services, relaxation of capital requirements, tax incentives) for fintech startups to encourage fintech innovation and facilitate global financial competitiveness, depending on the national economic development plans and economic policies. For instance, Singapore is altering its online payment laws to be more accommodating of payment service providers and to promote the development of payment technologies. (Reuters, 2016). On the other hand, since 2008, government authorities have imposed stricter regulations, capital requirements, and reporting requirements on conventional financial institutions. Fintech companies can provide customers with more specialized, affordable, and convenient financial services than traditional banks because of the laxer regulatory limitations that are placed on them. Even while certain rules are helpful to fintech firms, they nevertheless need to be aware of how such restrictions could impact the services they offer.

Fintech companies earn revenue from financial customers. Although huge organizations are earning from small and medium-sized businesses and individual consumers. According to a poll, younger, richer clients utilize fintech services the most (HollandFintech, 2015). Early adopters of fintech are often younger, more tech-savvy, urban, and more affluent people. Millennials, or those between the ages of 18 and 34, now make up a large share of fintech consumption in the majority of nations. The tech-savvy millennial generation will make up the majority of the population in the coming decades and will be the main driver of the expansion of fintech services, making the future demography favorable for fintech enterprises.

A significant driving factor in the fintech sector is also represented by traditional financial institutions. Conventional financial institutions have been re-evaluating their current business models and devising plans to embrace fintech innovation as a result of comprehending the disruptive force of fintech and the shrinking window of opportunity to minimize fintech's influence on the market. Traditional financial institutions compete favorably with fintech firms in terms of economies of scale and financial resources. However, traditional financial institutions favor packaged services over unbundled specialized ones, offering users a one-stop shop for all financial goods and services. Although these rapidly expanding fintech businesses were once viewed as threats by traditional financial institutions, they have since turned their attention to working with fintech startups with a variety of funding options. They can benefit from the start-up firms' insights in return for capital, which helps them stay at the cutting edge of technology (Yang, 2015).

The development of fintech may increase the effectiveness and accessibility of each of these channels. The relationship between increased usage of digital financial services and faster economic development was demonstrated in a recent IMF research titled “The Promise of Fintech: Financial Inclusion in the post-Covid era”. A correlation between greater yearly GDP growth rates and nations with higher degrees of digital financial inclusion was found by the study (Sahay, et al., 2020). Additionally, there is some indication that the type of growth was more inclusive, at least in terms of gender. "Digital financial inclusion is shifting from spending to lend," the IMF report's conclusion reads. By adopting the goal of harnessing new technologies to provide access to financing for SMEs as well as other women and youth in 2020, G20 countries intended to accelerate the trend.

In the article “COVID-19, Fintech, and the Recovery of Micro, Small, and Medium-Sized Enterprises: Evidence from Bangladesh”, the authors mentioned another two actors that can be considered critical (Chowdhury, 2022). They are investors and academia. Investors inject money as fuel to the startups and academia is very important in terms of generating ideas and pushing them to the policy makers. (Yazici, 2019) also mentioned these two important key actors of fintech ecosystem while analyzing the fintech ecosystem in Turkey. In the landscape analysis of fintech ecosystem of Pakistan (Termezy & Razi, 2021), it was also mentioned about investors and academia as key players in the fintech ecosystem. In our study, we have considered these two ecosystem players in all of

our questionnaires. Figure 2.2-B visualizes all seven of these elements of the fintech ecosystem.

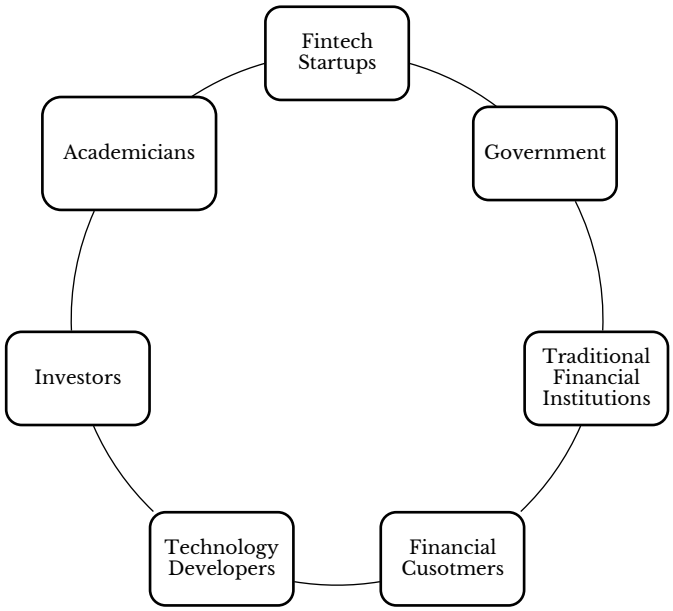


Figure 2.2-B: The Seven Elements of the Fintech Ecosystem

Fintech ecosystems around the world are at different stages of development, therefore requiring differing policy priorities for their healthy management and evolution. A process model of Fintech Ecosystem Development was discussed in a study of the Fintech Ecosystem (FE) in Indonesia and concluded that there are three steps to this process: an Assessment phase, an Acceleration phase, and an Augmentation phase as shown in Figure 17 (Muthukannan, Tan, Tan, & Leong, 2017). Each of the phases requires the participation of different groups of ecosystem entities and is associated with a particular stage of FE maturity (Rizzi, 2016) that leads to several distinct outcomes. A variety of developmental drivers and inhibitors, respectively, both help and hinder the transition between the stages. In the subsections that follow, the phases of the development of the fintech ecosystem are discussed, together with the involved entities, drivers, inhibitors, characteristics, and consequences of each phase.

2.3. Technology Readiness and Fintech Adoption

With rapid development of technology in the last century, a new line of thinking emerged. It was necessary to understand motivations and factors behind

the adoption and usage intention of evolving technological products and services. The Technology Acceptance Model (TAM), proposed over a quarter of a century ago, was one of the earlier efforts to theorize interrelationships among psychological factors leading to new technology acceptance. TAM was built on top of the Theory of Reasoned Action (TRA) from psychology (D 1986). Perceived usefulness of using technology along with perceived convenience of use together contribute to behavioral intention for technology use (D 1986). Since then, TAM has been heavily relied upon and scrutinized for its limitations (Holden and Karsh 2010). A "respectable amount of work" was dedicated to expanding and investigating factors centering around its core theoretical underpinnings (Marangunić and Granić 2015).

After over three decades of scientific literature on TAM investigating new factors and their relationships among and despite a number of criticisms e.g., measurement biases (F. D. Davis and Venkatesh 1996), TAM continues to be a keystone theoretical foundation. In particular, current and expected future research seeks to delve into areas such as new factors, inter-factor relationships and influence, specific customer segments, and the space between behavioral intention and actual measurable use of technology (Marangunić and Granić 2015). The last of these has gained increasing traction. After all, it is necessary to measure how much behavioral intention actually translates into technology usage.

Another seminal work in the technology adoption domain was the Unified Theory of Acceptance and Use of Technology (UTAUT). Founded on the same strand of psychology literature TAM borrows from, and indeed paying due attention to the structure and theoretical constructs of TAM itself, UTAUT proposes a more systemic perspective on technology acceptance and usage (Venkatesh et al. 2003). Apart from the expected benefit and efforts related to the use of new technologies, UTAUT put forward "social influence" and "external environmental" variables. A line of literature was dedicated to investigating, empirically validating, and critically assessing the model – and expanding where appropriate. Although it has also been argued that initial acceptance of the model by researchers may have, in some cases, limited further work in bringing new perspectives (Venkatesh et al. 2016). A common key element of TAM and UTAUT relates to their fundamental approach. Because of their basis in the psychology of behavior, they look at the acceptance of technology as primarily a function of customer behavioral constructs. Thereby they focus on psychological factors only,

largely avoiding the inclusion of other seemingly disjointed variables e.g., technological and financial capabilities. Indeed, these overlooked factors may very much make or break acceptance decisions and subsequent intention for usage continuance. These can be about the user as much as about the environment in which the acceptance and/or usage decision is made.

In a similar line of reasoning, albeit with a markedly different approach, the Technology Readiness Index (TRI) was first proposed almost two decades ago (Parasuraman 2000). TRI gained significant traction in the literature for two main reasons mainly. First, it was one of the first efforts taken to methodically quantify levels of customer readiness to use novel technology. TRI was conceived at the start of a new millennium filled with vibrant technological optimism. The timing was perfect since a plethora of technological products, services, and combinations started to open new doors to customer value.

TRI measured readiness to use technologies. It was based on a large sample of customer attitudes towards four key constructs. Optimism referred to a customer's positive attitude toward the benefits, convenience, and usefulness of new technologies. Individual attitudes also varied in terms of adopting innovative technologies. Both of these were theorized to positively associate with readiness. On the other side, individuals shared their attitude on discomfort from using the technology and the insecurities that stem from potential security fears and issues (Parasuraman 2000). TRI's approach was robust with methodically established reliability and validity measures supporting its appropriateness.

Later on, TRI 2.0 was proposed to reflect changing nature of technologies (Parasuraman and Colby 2015). The multiple-item scale used for the original TRI gained further sophistication in TRI 2.0 while retaining strength of its original approach: a simple yet rigorous method of attitude quantification and a large dataset on a "battery" of questions for analysis (Parasuraman 2000; Parasuraman and Colby 2015). In turn, TRI methodology acts as a major theoretical foundation for this work – particularly for measuring, collecting, and integrating customer attitude data.

Customer participation in service delivery is another strand of the literature relevant to the current work. Empirical evidence supports the hypothesis that customers participating in service generation and delivery make way for overall service delivery effectiveness. Such participation can contribute in several ways. It can facilitate the long-term success of the service provider (Hult et al. 1996; Lukas

et al. 1996), support quality assurance and maintenance (Dong et al. 2015; Mills and Moberg 1982), induce greater customer satisfaction (Currie et al. 2005; Rosenbaum et al. 2005), and effectively harness technology-induced opportunities for cost-saving and value-creation (Marzocchi and Zammit 2006).

Fintech services are, at their core, customer service instances. Propelled by computing advancement, mobile phone technology, and the ubiquity of internet connectivity, fintech aims to disrupt traditional finance (Ghose et al. 2016; Hoang et al. 2022). More importantly, fintech is enabled by emerging technological paradigms including, but by any means not limited to, artificial intelligence, cloud computing, and big data. Fintech brings financial services to customers, as opposed to the traditional model where customers are invited to the service center. Nonetheless, customer participation should prove valuable. This can even be important in allowing fintech to reach a larger customer base with possible winner-take-all effects (Brynjolfsson and McAfee 2016; K. M. Islam and Salma 2016; Kong and Loubere 2021). Fintech's outreach into previously uncharted market segments holds key benefits of financial inclusion (Douglas W. Arner et al. 2020a; Gabor and Brooks 2017a). Not to mention, this would be on top of generating new economic opportunities for service providers and legacy banks (Collevecchio et al. n.d.; Stulz 2019; Thakor 2020).

Extant literature on fintech has thus divulged into several themes. One highlights fintech's impact through new business models, market efficiency implications, favorable unit economics, access to financial services, win-win partnerships, and new value creation opportunities (Douglas W. Arner et al. 2020a; Beck 2020; Siddik 2014). The inclusion of hitherto unaddressed market segments (Coffie et al. 2021; Kong and Loubere 2021) into the financial system is made possible with fintech – two prominent examples being robo-financial advisory and alternative credit rating for marginal customer groups (Philippon 2019). An example of the latter is Applied Data Finance – a New York lender focused on "non-prime" and unbanked individuals in need of unsecured personal loans. Applied Data Finance uses a proprietary method and machine learning to create customer profiles with little to no access to traditional credit history. Across the world, alternative credit rating agencies and their products are crucial to covering millions of "unbanked" or "underbanked" people. This can open a new frontier of loan disbursement and management and unlock potent growth opportunities in some of the lesser-developed pockets of the world economy.

Similarly, wealth management was reserved for the more prosperous segments of the market. Financial advisory services for private wealth management were economically viable only if the client had ample wealth to manage and generate a return from. This would justify the high cost of professional remuneration needed to hire talent for fund management and investment strategy execution. Fintech reduces cost on all relevant fronts i.e., commoditizing financial advisory, decreasing transaction cost, democratizing financial knowledge, and increasing the accuracy of market prediction to name a few (I. Lee and Shin 2018). For example, robo-advisory services like Wealthfront reduce cost (from 1.02% to around 0.25% on funds being managed on investment accounts) and provide a wide array of affordable services. A "bundling" of all these opportunities also results in a significant reduction in cost.

Conversely, the "unbundling" of traditional financial services into "modularized" products tailored for specific customer groups has resulted in increased competition for banks (Basole and Patel 2018; I. Lee and Shin 2018). On the delivery front, services can now be delivered through mobile application interfaces, thereby further expanding the scope for scaling. An important question remains, however: even though fintech allows "invisible primes" to be discovered and served (Di Maggio et al. 2022), how should customers be persuaded to get into the fintech service ecosystem in the first place? After all, solving the technology part of the problem is only half of the work done (Amit et al. 2022; Senan et al. 2022). For instance, institutionalizing alternative credit-rating models that are sensitive to the needs and constraints faced by women in Asia requires building a great deal of trust between the borrower and the financial institutions (Caire and Spohn 2022).

Here, extant literature investigates factors that affect adoption of fintech. A host of such factors has surfaced over the years. Multiple studies have been replicated in varying market and demographic conditions (Sangwan et al. 2019; Soloviev 2018). Some of the proposed factors have repeatedly demonstrated significant relations with fintech adoption. Customer satisfaction (Alkhazaleh and Haddad 2021; Alwi et al. 2019; Barbu et al. 2021), privacy concerns, and concerns over security risk (Ahmed et al. 2020; Gerlach and Lutz 2021; Ryu 2018) trust in the fintech service provider as well as the overall fintech ecosystem (Dishaw and Strong 1999; Hassan et al. 2022; Musyaffi et al. 2021; Nathan et al. 2022; Salman and Abd.Aziz 2015; Solarz and Swacha-Lech 2021) play important roles in

determining fintech adoption. Perhaps not surprisingly, a large number of these studies adopted both TAM and UTAUT to investigate fintech adoption. Perceived variables were found to significantly explain fintech adoption intention and fintech continuance usage intention (T. A. N. Nguyen 2022; Poerjoto et al. 2021; Ryu and Ko 2020; Shiau et al. 2020; Wang et al. 2019). However, scholars have gone beyond customer perception.

The effect of individual-level variables such as demographic characteristics and the literacy rate was investigated and discussed (Carlin et al. 2017; M. Hasan et al. 2022). Higher institutional education has been associated with easier adoption of fintech services (Laidroo and Avarmaa 2020). Financial literacy – the extent to which customers are aware of financial transactions, feel comfortable with managing personal financials, and are confident interacting with financial ecosystem players – mediates adoption of fintech too (M. Hasan et al. 2022). Older customers may find it more difficult to trust fintech services with their money. In multiple investigations, younger segments of the market were more open to adopting fintech services (Imam et al. 2022). In fact, early adopters of fintech services are mainly young ones with a sizeable income to access a wide range of fintech services (R. Hasan et al. 2021; Imam et al. 2022). It was also found that when considered together, the effect of customer concerns with privacy, information security, and risk of using fintech has a greater impact in determining fintech adoption (Mahmud, Joarder, and Muheymin-Us-Sakib 2023).

While the literature identifies a host of such factors and maps these with help from theoretical models such as TAM, UTAUT, and more, an integrated index is absent. Much like TRI for generic technology readiness, readiness for fintech products and services in particular has not been measured systematically. Considering the promise fintech holds for inclusion and new business models, assessment and monitoring of customer fintech readiness will be key. For an emerging nation like Bangladesh, measuring customer readiness for fintech adoption and use can lead to informed policy interventions necessary for sustainable economic development. Such a scheme should ideally incorporate key factors identified so far. Additionally, it should resemble the structure of theoretical constructs proposed by earlier models while keeping easy replication in consideration.

2.4. Adoption Factors of Fintech

This section provides a brief summary of previous works identifying a series of macro and individual factors explaining fintech adoption intention, usage continuation, and attendant economic and social development benefits. Previous work on fintech's implication for financial inclusion is touched upon as well.

2.4.1. Security, Perceived Risk, and Trust

Perceived benefit and perceived risk from fintech use were found to significantly explain fintech adoption rates in a sample of 600 observations by Gelarch and Lutz (2021). Perceived benefit was affected by performance expectancy, economic benefits, and hedonic motivation (Gerlach and Lutz 2021). In Malaysia, the most significant effects came from perceived usefulness, perceived ease of use, competitive advantage, economic gains from the use of fintech, and perceived risk factors (Cham et al. 2018). Similar results were achieved by authors in other countries with varied social, economic, and political makeups (Dishaw and Strong 1999; Hassan et al. 2022; Jibril et al. 2020; Khatun and Tamanna 2020; Mensah and Mwakapesa 2022; Musyaffi et al. 2021; Salman and Abd.Aziz 2015; Solarz and Swacha-Lech 2021). Across jurisdictions, customer experience and trust played a vital role (Amofah and Chai 2022; Cham et al. 2018; Nathan et al. 2022; Salman and Abd. Aziz 2015; Yonghee Jack Kim et al. 2015).

Nguyen et al. (2021) found that perceived security, user satisfaction, and knowledge of services were positively associated with perceived usefulness among fintech customers which influences users' continuance usage intention. Similar relationships were discovered by other authors where perceived variables mediate customer trust in fintech and thereby determine future continuous use (Poerjoto et al. 2021; Ryu and Ko 2020; Shiau et al. 2020; Wang et al. 2019). One strand of studies deals with the factors that lead to greater customer trust. For example, perceived risk and perceived benefit have been found to affect customer trust in fintech services in Islamic fintech services, and this, in turn, determines fintech adoption and usage (Ali et al. 2021). In Germany, too, data security and trust as assessed by customers have a significant influence on customer adoption of fintech services as well as user interaction with the design interface (Stewart and Jürjens 2018).

2.4.2. Literacy and Fintech Use

Laidroo and Avarmaa (2020) found higher levels of tertiary enrollment associated with larger fintech clusters. A longer span of institutional education can reliably explain financial literacy, digital literacy, and awareness of financial alternatives. Users with tertiary education are also capable of navigating the opportunities and challenges posed by fintech firms. Moreover, higher tertiary enrollment means a ready pool of talent for fintech firms. Quality talent plays a crucial role in determining how successful technology-focused start-ups will be in developing and delivering effective solutions to their target customer segments. At the same time, a steady supply of increasingly sophisticated technical talent maintains a competitive edge for fintech startups compared to regional (and global) competitors. From both demand- and supply-side perspectives, the role of higher levels of tertiary-level education can be explained.

2.4.3. Perceived Usefulness of Fintech

In Jordan, perceived usefulness and enjoyment affected the intention to adopt fintech services (Al-Okaily et al. 2021). Personal variables have a role to play in determining, or at least mediating, the relationship between factors and their effect on adoption intention for fintech. And these are not entirely demographic or socio-economic in nature. For example, people with more leisure time exhibited a greater likelihood of experimenting with new fintech solutions and thus had higher levels of adoption intention. This relationship was mediated by the quality of life and the level of financial literacy (Kakinuma 2022). Xie et al. (2021) discussed the factors affecting the adoption of technology by extending the Unified Theory of Acceptance and Use of Technology (UTAUT) model. They found that perceived usefulness and perceived risk along with social factors determined the adoption intention of the user. However, perceived value was another dimension they investigated. Performance expectancy, effort expectancy, and perceived risk in combination affected perceived value of the technology. Together, this had a significant effect in determining adoption intention for the technology. A similar framework can be deployed to understand the effect of these factors on users of fintech services (Xie et al. 2021a).

Perceived benefit was found to have a much more significant effect than perceived risk in a study in Bahrain (Ahmed et al. 2020). Since the demographic and economic profile of customer segments affect adoption and usage intention,

factors' relative importance would also logically vary across countries. In a comparative study, Mu and Lee (2017) investigated the effect of cost and service providers' credibility in determining adoption intention in China and Korea. Significant variation was observed. Cost was a major factor for Chinese customers. For Korean customers, credibility of the provider of fintech service ranked as the more significant determiner of adoption intention (Mu and Lee 2017).

In a sample collected in Hungary on Generation X fintech users, perceived usefulness, perceived ease of use, along with norms and risks related to COVID-19 explained as much as 69% of the variation in intention to use mobile payment systems (Daragmeh et al. 2021). Perceived benefits and social factors significantly affected intention to use fintech services in a survey of 500 potential fintech users during a COVID-19 time study (Nawayseh 2020). Nawayseh (2020) also found a significant mediating effect of trust on the intention to use fintech services. The risks and benefits of using fintech services constitute an important determiner of adoption intention among users. The effect of these two variables depends on the customer group being investigated.

Again, following the TAM model, perceived usefulness, ease of use, costliness, and awareness were found to significantly predict use in Malaysia. Apart from costliness, all other variables positively affected adoption (Jin et al. 2019). Perceived benefit positively affects intention to use fintech services. Whereas perceived risk affects it negatively. However, when measured in terms of risk, i.e., financial risk, legal risk, security risk, and operational risk, effects were stronger for early adopters. Similar results in terms of risk were found by Gelarch and Lutz (2021). For late adopters, other variables were at play. Benefits and risks accounted for a small portion of the variance (Ryu 2018).

2.4.4. Demographic Factors

There seems to be a negative relationship between age and fintech use. Financial literacy helps customers access new fintech services (M. Hasan et al. 2022). Results from Hasan et al. (2022) confirm similar observations from multiple studies in Asia-Pacific (APAC). This underlines the importance of targeted campaigns to promote greater financial inclusion for people from higher age categories. Fintech's role in promoting financial inclusion has been found significant even in the developed market. One example is from British Columbia where fintech has promoted access to new financial services for communities of

underbanked people (Clements 2020). The benefits of fintech can counterbalance limitations of micro-finance facilities. As evidence from Nigeria suggests, microfinance has its own set of limitations and systematic biases (Pedrosa and Do 2011).

In multiple studies, a resounding theme was differences in adoption rates and adoption intention across gender and age groups. Overall, fintech adoption rates were higher among the young and among males. This trend held for fintech adoption intention too, in multiple samples across markets. In SAARC and ASEAN markets, for instance, males were ahead of females, and younger users were more likely to adopt fintech services compared to their older counterparts (Imam et al. 2022; Loo 2019). This calls for attention of fintech service providers and regulators. To equitably distribute expected benefits of fintech, platforms need to be designed for universal appeal. Special measures would be needed to ensure women and the elderly have equal access to fintech services (Imam et al. 2022). Moreover, capturing the complex interaction amid these factors calls for better measurements. In cross-country comparison, complexity of interaction among variables determining differing levels of adoption could be accounted for by better indexes (Huong et al. 2021).

2.4.5.Satisfaction and Usage of Fintech

Using Theory of Dissonance, Assimilation, and Contrast, Alwi et al. (2019) identified factors that affect customer satisfaction in fintech in Malaysia. Based on online survey results of the users of fintech services they concluded security and privacy had a very strong influence (Alwi et al. 2019). Other factors were: information presentation, quality of service, and ease of use. Similar investigations were undertaken by others. Barbu et al. (2021) conducted similar work on fintech satisfaction: testing hypothesis under Partial Least Square and Structured Equation Modeling (SEM). Fintech satisfaction is relevant not only because it determines future levels of adoption and intention to use. Satisfaction also has a spill-over effect within the larger fintech ecosystem—including for banks affiliated with fintech services platforms. In the Jordanian banking sector, for example, fintech satisfaction increases overall satisfaction for the sector (Alkhazaleh and Haddad 2021). In the last few years, fintech firms have entered emerging markets of Asia, ASEAN in particular. New players are competing with older ones. Customer segments for a large number of these firms are the same.

One effective way to retain satisfaction is in a separate niche based on superior value or specialized fintech services.

2.4.6. Country-Level Evidence and Heterogeneity

Important differences across countries remain. The role of macro-level aggregates cannot be denied in determining user intention and levels of adoption at the national level. In determining adoption intention, significant country-level heterogeneity was found, both between and within countries (Kumar et al. 2021). In this case, country-level data from 30 different countries were analyzed. Adoption rates too differ significantly across countries (Ernst & Young 2019a). An intriguing observation emerged from a study in Indonesia. The model showed financial literacy to be the least significant variable in determining customer adoption (Setiawan et al. 2021). The authors also found that user innovativeness had a major role to play. They suggested greater efforts from fintech service providers and enabling regulations from the government.

Due to lower debt levels and a rising middle class, Asia as a continent was largely able to avoid the catastrophic effects of the Global Financial Crisis of 2008 and 2009. Asia's stable macroeconomic conditions have allowed the middle class to rise with increasing purchasing power. This segment now had the intention to access newer modes of services and products. These factors led to a stronger banking network inside Asia with widening coverage. Despite a growing network of banks and financial institutions, a huge population in India and China, for instance, remained outside of the banking network. Fintech has thus found the perfect ground to extend financial services to a sizeable underbanked and unbanked population in two of Asia's largest economic players. Fintech firms here can also find lucrative customer segments for every type of financial service imaginable (Alexander et al. 2017). At the same time, the role of supporting industries and ICT clusters was also identified in promoting fintech clusters in certain locations. Contrary to general expectations, however, the role of financial services clusters was subdued and not as prominent (Laidroo and Avarmaa 2020).

At the country level, fintech has important benefits for female populations. The International Monetary Fund (IMF) used cross-country data from 114 different countries and analyzed the effect of fintech in ensuring financial access for women. After accounting for endogeneity through fixed effects model, findings showed fintech to have significant economic benefits for women (Loko

and Yang 2022). Benefits of greater fintech access were evident in the number of female workers in firms in countries with higher levels of fintech.

Fintech holds enormous potential for the underbanked and unbanked populations across the world (Salampasis and Mention 2018). While regulatory oversight, institutional quality, and overall macroeconomic and technological factors dictate the nature of impact, it was evident that fintech brings greater financial access and more opportunities for financial prosperity. Specific intervention strategies and commercial approaches are determined by careful consideration of these variables. Laos, Vietnam, and Cambodia have been found to hold the highest potential for fintech in the ASEAN region. These countries provide similar geopolitical, technological, political, and socio-economic makeups for fintech firms to consider (Loo 2019).

International development literature has underlined the importance of utilizing the powers of digital technologies e.g., blockchain, mobile networks, and cloud computing in changing the lives of people excluded from the formal banking channel for a while. Fintech has brought ways to realize this for some of the poorest countries in the world. Scholars are still trying to investigate the factors that lead some firms to success in extending financial inclusion for these people. One study found that among the factors, are network effects, customer centricity, the appropriateness of the commercial strategy used by the firm (M. A. Soriano 2017).

2.5. Fintech and Sustainable Economic Development

2.5.1. Development and Its Discontents

Development – as an overarching narrative of both ultimate ends and supporting means thereof – is a dichotomy in itself. On the one hand, the mentioning of it pervades policy literature throughout the world in countries large and small, with as many varieties of language, culture, history, aspirations, and technological stages as can be conceptualized. Yet, the very definition of what constitutes “development” per se is riddled with ambiguity. While universally acknowledged as the end goal for human societies, development is far from being universal in its definition, scope, and measurement.

Throughout the world, macro-level indicators constitute the first line of policy objectives in measuring, evaluating, and steering development toward some common goal. Aggregate measures like annual growth in gross domestic product provide a clear quantifiable picture of total expansion of productive efforts within the country – thereby indicating in too broad of a sense the degree of value generated for the human population residing within its borders. Yet this picture is incomplete at best, and at worst it proves to be severely misguiding (Costantini and Monni 2008). Therefore, for over half a century, economists and social scientists have poured over the right measure of development and what pillars it should constitute for accurate and representative reflection of an improved human condition (Ranis 2004; Sen 2001).

Sen (2001) drew from several hundred years' worth of the history of economic thought and with copious reference to his own work in the preceding decades in providing a direction. In culmination, his idea of "development as freedom" provides an illuminating path whereby human societies can move forward with development as an enabling factor for strengthening individual freedom. As per the "development as freedom" thinking, the ultimate aim of development – and logically, therefore, the cornerstone criteria for measuring its effectiveness – is to increase the freedoms of individuals (Sen 2001). This idea was conceptualized at a time when human civilization has reached a level of "unprecedented opulence". With regards to access to basic services and fulfillments necessary to promote a dignified human life, societies in the high-income, "developed" parts of the world lead a life unimaginable at any other point in known human history. But millions outside this sphere still live in dire circumstances – their life full of "unfreedoms". Although not entirely slaves as the literal meaning of the word would suggest, these people live in a surprising juxtaposition of inhuman living with opulent thriving. Development then, Sen (2001) proposed, is the medium of eradication for unfreedoms to be replaced with freedom of the individual into dignified prosperity.

The literature on development theory is rich, borrowing from several hundred years of economic philosophy among others. There are as many branches of the narrative as arguments within each. What has become apparent, however, is the inadequacy of economic growth as the all-encompassing end game for human societies to journey towards prosperity for their citizens. Development requires careful consideration of the interconnected systems of social interactions,

environmental ecosystems, and political institutions (Henderson et al. 2011; Milenkovic et al. 2014). Indeed, a definite set of measurements for development policy has not been found yet. But any effort towards this goal invariably takes into account the multifaceted interdependencies. For example, Milenkovic et al., (2014) proposed a multivariate approach to assessing socio-economic development. In fact, measuring development per se need not be limited to administrative and economic data as the advent of new technologies and attendant expansion of different measurement avenues allow for alternative and possibly more relevant measures of economic activities given a specific geographic area (Henderson et al. 2011). A case in point is a strand in the literature that relies on "remote sensing" data to measure and evaluate economic growth (Z. Chen et al. 2022; Gu et al. 2022; Keola et al. 2015; Yeh and Li 1997).

Climate change has undoubtedly shifted the narrative of development literature during the past two decades. It is not to say that the role of the physical environment was not deemed important prior to the realization of the sheer scale and severity of the consequences of climate change on human societies across the globe. In fact, the economic literature focused on development theory investigated the dynamics between natural resources and human social progress – the Resources Curse Hypothesis (RCH) and Environmental Kuznets Curve (EKC) are two salient reminders (Milenkovic et al. 2014). However, more careful attention has shifted to the underlying dynamics between humans and their physical environment within the context of social development and progress. Immediately, it has been realized that measurements play a crucial role in not only understanding the role of policy interventions to save the environment for development of human societies – but also in taking corrective actions where needed. Bergh and Botzen (2018) show that replacing GDP with Human Development Index – a widely accepted composite measurement of human development measures – can turn the narrative upside down for developed countries in their efforts to reduce carbon emissions. Conventionally, this requires unpleasant trade-offs of reduced economic growth. With HDI put into the picture, however, not only do countries gain across the pillars of human development, but the collective interest of reduced global temperature suddenly makes more sense. Perhaps not surprisingly then, significant variations are found even among the developed countries in HDI index when GDP per capital is replaced by a more

representative and considerate measure: Index of Economic Well-Being (IEWB) (Osberg and Sharpe 2005).

2.5.2. Development and Inequality

As soon as one takes a break from surveying the narrative variety and lack of resolution on the constituents of development per se, and looks into the question of 'development for whom', a new set of problems present themselves. The immediate discrepancy within this sphere that challenges conventional development narratives is economic inequality (Sen 1997). Since the classic text was first published in 1973 the literature has followed Sen's line of exploration and a rich variety has emerged (Jenkins and Van Kerm 2011). Economic inequality can be looked at and measured from multiple perspectives. Sen (1997) categorized them broadly into positive and normative measures while acknowledging that the line between the two groups is less obvious at times. Yet there remains a clear distinction. The suggestion that reducing equality in all its forms leads to better outcomes in socio-political terms is a naïve one – and it ignores the various underlying complexities of interaction among social and political institutions that make choices (Scruggs 2007).

Inequality in distribution of economic resources may not stay limited within the economic and socio-political system in its impact. In fact, as the interdependent systems narrative would rightly suggest, economic inequality results from and impacts the physical environment as well – the very foundation of economic resources (Drupp et al. 2018; Thorbecke and Charumilind 2002). This has led to the suggestion that policy should consider the environmental inequality aspect as well when trying to address the maldistribution of economic resources i.e., income and wealth inequality (Drupp et al. 2018). However, inequality and challenges in the environment do not have a one-way dynamic whereby economic inequality has some attendant consequences on the physical environment as well which ultimately leads to difficulties in the human condition. The onset of global temperature rise driven by anthropogenic energy use and economic activities points to this feature. Empirical evidence suggests that global warming has direct consequences for societies across the world: societies in warmer regions of the planet exhibit reduced economic expansion on average, and societies in cooler places gain; therefore the ecological imbalance exacerbated by global temperature rise adds to unequal distribution of opportunities among

countries in different parts of the geographic and socio-economic distribution (Diffenbaugh and Burke 2019). As such, inequality is a challenge to development but not in a silo. It is affected by and further drives challenges in nature. The relationship human individuals – and in a scaled-up and vastly more complex form – human social organizations have with the natural world is so intertwined that their theoretical separation in understanding and driving policy for development will prove futile.

Indeed, the complexity inherent in this narrative prevents simplistic attitudes in policy to drive progress. The proposition that a reduction in inequality will drive down environmental degradation is inaccurate (Drupp et al. 2018). Indeed, inequality may or may not be an obstructive factor for preventing environmental degradation after considering the dynamics of other socio-political institutions. At the political organization level too, one can question the conviction behind proposing the welfare state mechanism to preserve environmental integrity in the absence of observations of environmental states in such societies without the welfare state system (Esping-Andersen and Myles 2011). Consequently, inequality is a complex challenge to the idea of development with attendant impact on and from the natural world that further illuminates the need for its due consideration within the development narrative – albeit along with its complexities.

2.5.3. Development and Sustainability

With the backdrop of continuing theoretical and empirical work on development and the role of economic, socio-political, and environmental inequalities, the world as of writing aligns its development efforts towards an integrated framework that incorporates a range of relevant domains and their constituent measurements. The idea of development is shrouded in definitional ambiguities as has been mentioned in the earlier section. Similarly, the idea of sustainable development is fraught with contradiction (Jabareen 2008; Redclift 1992). The Brundtland Commission's work leading to the now milestone report titled "Our Common Future" was informed by a worldwide multi-stakeholder exchange. It took into account opinions, accounts, and suggestions of scientists, environmentalists, economists, social scientists, politicians and policy experts, and members of the general populace from around the world. In some ways, the central contribution of the Brundtland Commission was to put the sustainable

development narrative on center stage and propose the development need not only fulfill the needs of the current generation – it also should be careful about the needs and aspirations of future generations. However, the following decades of work on trying to enrich the field emerged with what has been referred to as the "post-Brundtland quagmire" (Sneddon et al. 2006).

Across the world, communities face enormous challenges in economic, social, and environmental spheres (Flint 2013). Economic inequality is at a record high, and the socio-political institutions once seeming to reach a stage of relative stability have emerged as institutions standing on shaking ground with the advent of technological and social upheaval at the turn of the century (Dixit and Weibull 2007; Orlikowski and Barley 2001; Prior 2013). The need for a development narrative that addresses these underlying issues has been felt more and more. Not only does development need to be representative and sustainable for future generations, but it also needs to account for the manifest complexities underlying social, economic, and political systems. In fact, the inability of frameworks to account for these complexities resulted in, during the earlier phase of the post-Brundtland literature on development and its sustainable form, contradictions in priorities and means of achieving equitable distribution of developmental benefits (Flint 2013; Parris and Kates 2003).

Two important considerations emerge on this backdrop. First, sustainable development framework effectiveness incorporates a pivotal role of "plurality" of epistemological approaches as it does for plurality in conceptualization methods for resource dynamics and collective priorities, preferences, and trade-offs (Sneddon et al. 2006). Without welcoming pluralism of approaches, there is no viable way to resolve the manifold complexities underlying interconnected and interdependent economic, social, and environmental systems. Second, as a means of facilitating plurality and integrating resulting approaches into a framework the role of knowledge systems is important. Empirically, it is suggested that knowledge systems that promote cross-boundary communication, preserve credibility and legitimacy of their mechanism, and facilitate communication are effective in addressing human development challenges (Cash et al. 2003).

International development institutions have evolved considerably in their policy priorities and operational framework during the last three decades in tandem with broader changes in global political order and newer challenges in economic and environmental scenes (Davies 2010). Considering the shift in

narrative within the development and sustainable development literature during the same period, much progress was made on this policy front as well. As of writing, the Sustainable Development Goals 2030 agenda aims at an alignment across countries of the world with respect to shared priorities in development domains. The 17 goals with a total of 169 indicators integrate a series of development domains into a single integrated framework – thereby providing a common guideline for development policy across the globe (Diaz-Sarachaga et al. 2018). In multiple ways, SDG 2030 addressed the two considerations mentioned earlier: the plurality of approaches and facilitating effective knowledge systems. As discussed earlier, for a sustainable development framework to be effective across differing epistemological and preference regimes, an embracing of pluralism with regard to aspirations, goals, and priorities is in order. On the other hand, the facilitation of such collective means exchanging different viewpoints, and a credible and effective knowledge system should allow for cross-boundary translation and mediation of priorities – boundaries being political, epistemological, social, and economic. SDG 2030 agenda, which builds on the foundational progress achieved earlier under the Millennium Development Goals (MDG), provides an array of priorities embodied in its 169 indicators from all relevant domains of human development aspirations for a sustainable future for all (Davies 2010). As such the framework provides constructive guidelines specifically at a time when a common sense of purpose should drive development priorities across the world to save economic, social, and environmental systems from falling apart in the face of unprecedented global and regional challenges.

2.5.4.The Role of Technology in Sustainable Development

Within the development and sustainable development context, the role of technology is an important one to investigate. Indeed, as evidenced by world governments in the Earth Summit 1992 – which took place in a world informed by the Burndtland Commission report – reaching a consensus on development priorities is not easy. Given finite resources and economic opportunities, the developing parts of the world rationally have fewer incentives to prioritize collective economic, social, and environmental development agenda (Unwin 2009). It is within this very reality that the role of technological innovation comes into play. Information and Communication Technology for Development (ICT4D) as a narrative has achieved widespread recognition as an answer to the

development crisis (Unwin 2009; Vollebergh and Kemfert 2005; Wu et al. 2018). Innovation in ICT and its widespread use to deliver services to the population offers new avenues for development priorities to be realized. However, as the world has continued to innovate, newer technological paradigms have emerged. Technological innovation and consequent new possibilities to transform digital and physical systems for better tuning for human development priorities are not limited to information and communication domains only. Rather they belong to virtually all sectors of the economy e.g., enhanced food production and transition into clean energy (Smil 2002, 2010).

Indeed, without the innovative power of these technologies in creating new economic opportunities for people (Vollebergh and Kemfert 2005), for preserving biodiversity and ecological balance (AlQattan et al. 2018), for increasing the efficiency of productive sectors of the economy (Mekhilef et al. 2013), consensus and collective action would provide impossible to achieve in any viable scale (Credé and Mansell 1998). Innovative technological paradigms – both in the digital and physical domains – open previously unexplored and unreachable possibilities within a finite resource system. This characteristic of technological innovation is crucial in the discussion of human development. To support increasingly larger and more populous economic and socio-political systems within a finite resource world with progressive human development priorities that aim at the "freedoms" Sen (2001) proposed, technological innovation makes development possible in a sustainable way (Beder 1994; Wu et al. 2018).

However, technology plays this mediating role of human development promotion within a constrained system not without bringing its own unique set of challenges. Sustainable development presumes the development of current generations without sacrificing the needs and opportunities of future generations. There remains a contradiction, at least in the policy domain, between these two generations of constituencies of sustainable development – one that is mediated by time, among other factors. Members of current generations have a greater say within the power structures that determine policy priority. Although represented at varying levels – notwithstanding the the efficiency with which it is done – younger generations or indeed the generations to yet be born have little to no say in determining such priorities and preferences (Cash et al. 2003; Diaz-Sarachaga et al. 2018). Future generations thus are subject to the policy implications of social, economic, and environmental systems shaped predominantly by their former

generations, but have little access to participate in such crucial decision-making – once again a case in point with regards to an "unfreedom". The fact that technology brings in new possibilities for the human development of current generations does not inherently guarantee the sustainability with which development priorities are pursued. As such, current policy needs to find salient shortfalls in development priorities with regard to the need of future generations for technology-driven human development to be true to its promise of sustainable progress (Diaz-Sarachaga et al. 2018).

2.5.5. The Role of Fintech in Sustainable Development

Financial technologies combine the transformative potential of digital technologies with financial services to enable access to innovative financial services – especially by previously overlooked target segments (Douglas W. Arner et al. 2020a). Recent innovations in fintech harness the potential of the fourth industrial revolution technology paradigm where "brilliant technologies" allow instantons, worldwide connectivity, real-time sensing, quick and intelligent decision making, and delivering state-of-the-art services to a wider market segment at fractions of the cost previously required (Brynjolfsson and McAfee 2016; Schwab 2017). Fintech allows low-income, marginal communities access to financial services (Ahmad et al. 2020). Women can take greater control over their financial agency – promoting women's empowerment through financial independence and resilience (Mohamed et al. 2021). Even though formal bank branch networks across the globe have pushed further and further into the periphery, bringing a greater number of customers in semi-urban, rural, and remote areas into the formal banking channel, penetrating large populations away from the urban centers has been proven difficult from a purely economic perspective (Amit et al. 2023; Imam et al. 2022). Fintech on the other hand has brought financial services to marginal communities through ICT and improved algorithms. As a result, the large swaths of "unbanked" or "underbanked" populations on the planet aspire to gain agency over their financial lot as a result of opportunities offered by fintech and attendant innovative business models.

Providing a way to gain financial impudence is important to make progress on the SDG 2030 agenda. In general, human development cannot be sustained with a sizeable portion of the global population deprived of accessing financial services that create, strengthen, and expand the score of economic opportunities

for individual and communal growth. While this is crucial for entire communities, it is perhaps even more important for some of the most marginal segments of the world population. Women, the elderly, non-mainstream gender identities, and persons of disabilities are only a few examples of systematically disadvantaged groups who stand to benefit immensely from equality economic opportunities brought forward by the digital-driven fintech services landscape. Fintech also offers greater financial resilience that allows these communities to withstand crises of various scores – the most recent case being that of COVID-19 lockdowns and the attendant dramatic narrowing of economic opportunities around the world (Farahani et al. 2022). Post-Covid-19, fintech continues to be a driving factor of new and existing economic opportunities across the developing world (Sahay et al. 2020).

Indeed, the avenues of fintech boosting human development possibilities across sectors are wide (Zhang et al. 2021). To get an overview of these, one must carefully consider the multifaceted, pluralistic view needed to appropriately conceptualize human development priorities, and how fintech aids in the achievement of such priorities. To that end, as discussed earlier, the SDG 2030 agenda with its 17 goals and 169 indicators can provide a practical guiding framework. This definitely allows for better measurement and assessment of the direction and degree of support offered by these innovative fintech services and business models. However, a critical evaluation of fintech's contribution to sustainable development should not be strongly limited to quantitative forms of investigations. Indeed, it might not be entirely possible to duly measure and evaluate crucial human development aspects through quantitative models due to the multifarious complexities attached to normative human priorities. In fact, such an assessment should neither be limited from the perspective of a single conceptual framework. That being suggested, the SDG 2030 framework provides an adequate starting point – one that properly reflects the human development priorities of the time.

Fintech has been found to increase the efficiency of legacy banking institutions (C.-C. Lee et al. 2021). Empirical evidence from China suggests that the use of fintech within the banking business model enhances banking performance in four major ways: a) by allowing for better disbursement of credit and more effective raising capital, b) by making payments and clearing systems faster and more secure, c) by allowing for more prudent investment for

management efficacy, and d) by providing support services that track, assess, and utilize market opportunities. With regards to cashless payments i.e., automated teller machines, credit cards, debit cards, and electronic money, Wong et al., (2020) find evidence of fintech services positively driving macro-level growth in a panel of 15 OECD countries. Donovan (2012) pointed out, however, that the advent of mobile money services i.e., M-PESA in sub-Saharan Africa brought both new opportunities for the local communities and new security challenges. Fintech, thus, offers economic opportunities for human development in marginalized communities. However, it is not as straightforward in promoting economic equality as might be expected. In fact, there are certain ways fintech can exacerbate existing inequalities.

Evidence of fintech's positive contribution to a separate constituent part of the broader human development agenda or directly to the SDG agenda 2030 has been found in other parts of the world. Hudaefi (2020) investigated Islamic fintech's impact on SDGs, Piliyanti (2019) analyzed the sustainability implications of crowd-funding platforms in promoting better capital accumulation and disbursement, Zhang et al., (2021) demonstrated fintech's ability to promote afforestation programs in China – thereby illuminating fintech's ability to contribute to domains outside of the strictly economic. In all these cases, fintech's contribution to supporting sustainable development priorities was positive and significant. Similar evidence has emerged from other studies as well (see Appiah-Otoo & Song, 2021; Arner et al., 2022; Banna et al., 2022; Blakstad & Allen, 2018; Chikalipah, 2020; Hinson et al., 2019; Hoang et al., 2022; Jiang, 2023; Khaki et al., 2022; Rizwan & Mustafa, 2022; Zetzsche et al., 2019). But technology is not accompanied by any particular normative agenda and the kind of impact fintech has on the larger human development efforts across many parts of the world is also open to the ways its paradigms and models are put to use. More precisely, a large part of the challenge of harnessing fintech for financial inclusion (Ashenafi and Yan n.d.; Demir et al. 2022; Panos and Wilson 2020; Sahay et al. 2020; Salampasis and Mention 2018) and for alleviating the human condition (Hodula 2023; Luo et al. 2022) depends on appropriate policy and regulations (Xu 2019).

2.5.6.Fintech and Financial Inclusion

Extant literature is growing steadily in investigating fintech's implication on financial inclusion. Fintech allows for transaction disintermediation, information

asymmetry reduction, new business model viability, favorable unit economics, more accessible products, and services, "unbundled" service experience, the breaking of geographical and socio-economic barriers previously insurmountable, and much more (Beck 2020; Gabor and Brooks 2017a; Siddik 2014). Technology-enabled platforms and business models that democratize financial services, traditionally unavailable for low-income individuals/households, should have a positive impact. However, a systematic investigation of exactly how fintech achieves this, and indeed whether this expectation holds ground for users of all backgrounds and across markets is in order. Philippon (2019) illustrated the point with two cases: robo-advisory and alternative credit rating. With the former, it was clear that fintech enables lower-income households to access wealth management services historically reserved only for wealthy households. The latter addresses existing inefficiencies in credit scoring. It reduces "non-statistical" biases inherent in traditional processes (Philippon 2019). Alternative credit scoring used by fintech platforms allows non-traditional customers to access credit at a lower cost. This is especially the case for "invisible primes": people with low credit scores and almost no credit histories (Di Maggio et al. 2022). Present in both aforementioned cases are transaction disintermediation and cost-efficiency contributions of fintech.

The use of alternative datasets allows relatively "risky" customers to be eligible for credit, customers who might otherwise have been labeled as "subprime" (Jagtiani and Lemieux 2019). Indeed, prospects of fintech in association with state and interstate development apparatus cannot be overlooked. Fintech's predictive power for example allows the incorporation of behavioral financial factors, thereby allowing service providers to better know their "irrational customers" (Gabor and Brooks 2017a). However, to what extent fintech facilitates financial inclusion at the systemic level is open to question still. The ability of fintech service providers to venture into markets banks have to get out of and/or find no longer profitable, is an advantage. It is beneficial for customers who are enabled by their services. Yet entry into ever riskier segments, adjusted for the technological superiority and attendant predictive power, may have contradictory effects on specific market segments and the overall financial system. In fact, an Asian Development Bank working paper raised important questions. While presenting a series of new opportunities fintech presents for customers and regulators, the paper also notes unique new challenges. Where should the trade-

off be between an open, transparent, more “unbundled” financial services ecosystem on the one hand and a regulatory framework that is invariably required to keep the ecosystem healthy for all participants on the other (Beck 2020)? This is one of the questions that need to be addressed.

3. Conceptual Framework

3.1. Methodological Overview

The current research work deploys a variety of methods – quantitative as well as qualitative. In building an understanding of fintech and its implications for and contribution to sustainable economic development for developing nations like Bangladesh, these methods therefore also utilize relevant data from primary and secondary sources. This chapter provides the reader with an overview of methods deployed for the four major segments of the current research work. Figure 3.1-A depicts the methodological flow of the current work and Table 3.1-1 presents objectives, methods, and primary data sources for each of the four major segments of the work. In fact, the subsequent sections discuss primary data sources and data and methods deployed for these segments separately. It is to be noted that in rendering chapters as standalone units for the reader to look into the respective research question and attendant investigations independently, each chapter dealing with the four primary segments of research work in this chapter also contains a data and methods section. This chapter nonetheless provides a one-stop source of data and methods utilized for the study.

After a review of the relevant literature concerning the key research question, data were collected. The primary dataset for this research comes from National Citizen Survey (NCS), detailed later. However, several key secondary datasets were relied on to investigate fintech and its implications on sustainable development. The four major segments of work, although not dependent on each other per se, nonetheless followed a sequential pattern. First, fintech ecosystems were studied – in Bangladesh with reference to global benchmark.

Using the process model of ecosystem development, a panel of experts provided their insights on the stage of development currently occurring in Bangladesh's fintech landscape. In this part of the research, qualitative opinions were also collected on fintech's impact on sustainable economic development and

possible future pathways. Second, after the ecosystem view was clear, the readiness of customers was investigated. This study used the Customer Fintech Readiness (CFR) Index, developed by the author, to assess customer readiness for innovative fintech use in Bangladesh. Before evaluating customer readiness from the NCS dataset, however, CFR's validity is established. The resultant insights on overall customer readiness and areas of gaps have important policy implications. Third, after overall readiness, factors behind individual customer adoption of fintech are investigated. The study reveals significant features that drive customers to adopt fintech. Finally, the research then focuses on the impact of fintech on sustainable economic development. This is established through case studies, panel data models, and univariate analyses.

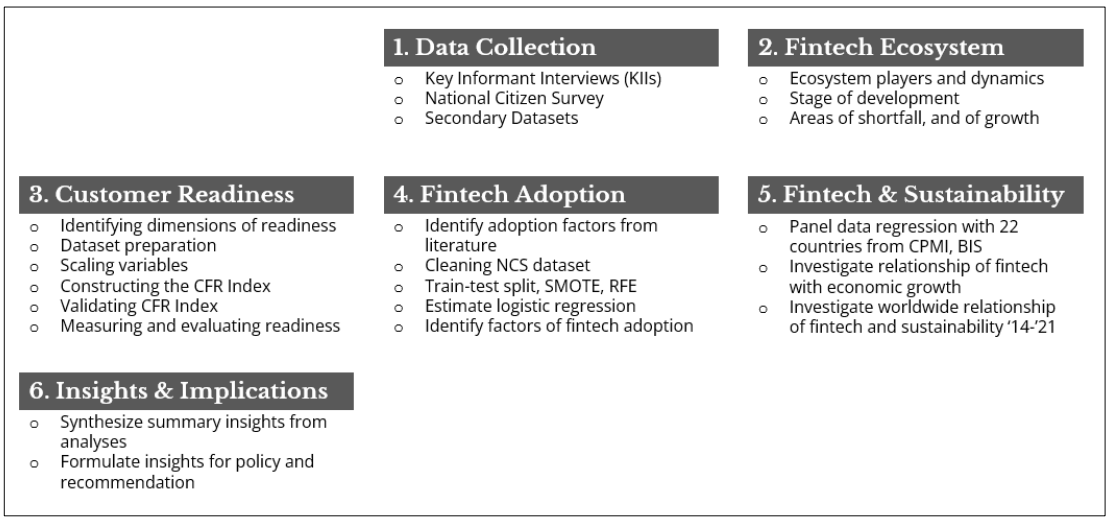


Figure 3.1-A Overview of methodological flow

Table 3.1-1 Summary of study methodology

Sl. No.	Research Question	Segment	Objective(s)	Method	Data
RQ1	What is the current state of the fintech ecosystem in Bangladesh and globally?	Fintech Ecosystem	Evaluate the state of the fintech ecosystem and business models across the globe Identify fintech ecosystem readiness assessment framework Identify ecosystem players Assess fintech ecosystem readiness in Bangladesh	Ecosystem readiness framework, Key Informant Interviews	KIIs and various secondary sources
RQ2	To what extent are Bangladeshi users/customers ready for innovative fintech services?	Customer readiness	Develop a customer readiness evaluation scheme Establish the validity of the scheme Evaluate customer readiness for fintech in Bangladesh Identify gaps and recommend policy interventions	Dimension identification, index construction, index validation, readiness measurement	NCS dataset
RQ3	What factors primarily determine the adoption of fintech services?	Adoption factors of fintech	Determine factors that influence adoption of fintech in Bangladesh Identify the major class features that determine fintech adoption	Logistic regression with SMOTE and Recursive Feature Elimination (RFE)	NCS dataset
RQ4	Does fintech contribute to sustainable economic growth? What relevant empirical evidence is there?	Fintech and sustainable economic growth	Adopt a mixed-method approach to establish fintech's contribution to sustainable economic development Find empirical evidence for fintech's impact on economic growth Find empirical evidence for fintech's contribution to sustainable development	Case studies, panel data model, univariate analyses	WDI, CPMI, Findex, SDR

3.2. National Citizen Survey (NCS)

Out of the 64 districts in Bangladesh divided into 8 divisions, we took 16 districts for sampling citizens in the National Citizen Survey (NCS). From each division, 2 districts were selected. District selection was based on poverty levels. For appropriate representation of citizens on both sides of the socio-economic spectrum, districts in each division were ranked on the weighted average poverty score as per the Bangladesh Bureau Statistics (BBS) method. The districts with the lowest and highest weighted scores were selected. District rankings are provided in Appendix A. In case more than one ranked the same in either of the slots, a random selection of one of them was followed.

After selecting a district, geographic variation was preserved by selecting the main administrative unit and the one farthest from that. This was done in three iterations in total until the smallest unit was accounted for. At this point, systematic sampling was followed to select 10 data points from 2 wards within a unit (the hierarchy was: district [16], sub-district or Upazila [32], Union [64], and Ward [128] respectively). The entire population of a Ward was divided by 10. Data collection started from a randomly selected house, afterwards every nth (n=population of the ward/10) house was approached. A total of 20 samples were collected from each Union, 10 from each Ward, resulting in a total of 1282 instances. Figure 3.2-A shows the choropleth of selected districts in the NCS.

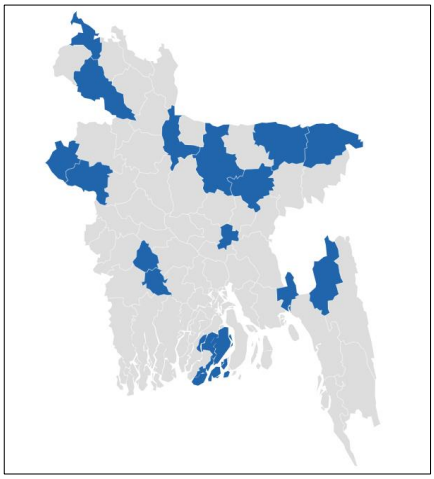


Figure 3.2-A Choropleth of districts included in NCS sample

3.3. NCS Sample Description

This section presents a few selected descriptive data on the sample collected from NCS. For insights gathered from NCS dataset, the reader is referred to Chapter 4. Out of a total of 1282 responses, 86% were collected from male respondents. The rest 14% were female respondents. Fintech is equally beneficial and relevant for male and female users. The transformative potential for fintech services and products holds unique value for female users in terms of greater financial freedom and better financial decision-making for the long-term prosperity of themselves and their households. However, the gender-imbalanced sample from NCS is a direct result of the poverty-based stratified random sampling technique used – as described in the previous section. Because in each iteration, two opposite extreme sides of the socioeconomic spectrum were picked, gender could not be controlled for. In fact, no other demographic or socio-economic variables were controlled for other than poverty.

Table 3.3-1 shows distribution of respondents' educational backgrounds. Twenty-one percent of the survey respondents had primary education as their highest level of institutional educational training. 24% reported their highest level of education to be secondary. From higher secondary, the survey found around 17% of respondents. Only 11% and 6% of respondents had graduate-level and post-graduate level education. Within each gender, most of the female respondents were from primary and secondary levels. While the majority of male respondents were from primary, secondary, and higher secondary levels. We note that in each gender, all levels of education were represented.

Table 3.3-1 Tabulation of Levels of Education and Gender

Level of Education	**Female**	**Male**	**Grand Total**
Post-graduate	5%	7%	6%
Graduate	5%	12%	11%
Higher Secondary	10%	20%	18%
Secondary	29%	27%	28%
Madrasa (kawmi)	0%	1%	1%
Primary	28%	19%	21%
Other	0%	0%	0%
None	22%	14%	15%
Grand Total	**100%**	**100%**	**100%**

The average household size in our survey was 5 members strong. Throughout our dataset, the minimum household size was 1 and the maximum was 12 members strong. Average, minimum, and maximum household sizes

according to the 16 districts in given in the following table. We note that single-member families, small families as well as extended families were represented in the sample for this report. This is important because banking and financial behavior as well as attitude, access, and opinion towards technology are likely mediated by household size, type, and lifecycle stage.

Eighty-four percent of respondents in this survey were married and the rest 16% were single. Single-member households are on the rise in other parts of Asia. Going forward, due to systemic economic and social factors, we expect single-member households to also start rising in urban developed areas in Bangladesh. For more details, a cross-tabulation of marital status and gender is also provided.

Our survey also incorporated a wide range of occupations. Most notable among these were government job holders, non-government job holders, businessmen, and students. Non-residents also accounted for a sizeable portion of this survey. Non-residents are important stakeholders of the fintech user base due to remittance flows. Fintech platforms like mobile banking wallets provide an easy and cost-effective way to remit money to families at home.

The average monthly income in this survey was found at BDT 22,220 and the average monthly expenditure was BDT 18,250. There was considerable variation in both average income and average expenditure across districts. This is expected since districts were chosen from different sides of the socio-economic and poverty spectrum. The following two tables provide district-wise data on average monthly income and expenditure.

3.4. Evaluating State of Fintech Ecosystem

A fintech ecosystem is comprised of key players, enabling factors, and interdependencies. Ecosystem of fintech service providers and other players in the market allows for superior customer value – provided the ecosystem is a dynamic one with prudent and progressive policies. In fact, as fintech services become more commonplace across the globe, regulators try to find the best mix of policies and supporting roles to foster a dynamic fintech ecosystem that is secure and agile at the same time. Governments have been providing a favorable regulatory environment for fintech since the 2008 financial crisis (HollandFintech, 2015). Different governments offer various levels of regulation (e.g., licensing of financial services, relaxation of capital requirements, tax

incentives) for fintech startups to encourage fintech innovation and facilitate global financial competitiveness, depending on the national economic development plans and economic policies. For instance, Singapore is altering its online payment laws to be more accommodating of payment service providers and to promote the development of payment technologies. (Reuters, 2016). On the other hand, since 2008, government authorities have imposed stricter regulations, capital requirements, and reporting requirements on conventional financial institutions. Fintech companies can provide customers with more specialized, affordable, and convenient financial services.

The role of a healthy ecosystem in fostering innovation and diffusion of fintech services is key. Fintech services rely on a host of enabling services e.g., mobile networks, access to financial and customer-level data, backward- and forward-linkage logistical supports, a cluster of fintech firms for innovation, and access to capital for further development of products and market expansion. This segment of the study, therefore, looks at the state of fintech ecosystem in Bangladesh. Specifically, it looks at the key players, business models, and evolution of the fintech ecosystem in light of fintech ecosystem development model.

3.4.1. Global Fintech Markets and Ecosystems

The invention of the internet in the 1980s and the subsequent internet revolution in the 1990s ushered in a new era for the world which opened new horizons for all types of businesses. But it was the financial crisis of 2008 after which Fintech was catapulted into the limelight. Systematic risk in the system, created by the reckless bankers needed to be eliminated to bring back objectivity in the financial markets and ensure such an economic collapse never occurred. Thus, Fintech came of age. These values include venture capital, private equity, and mergers and acquisitions each year. We can see a general upward trend in the investments, which peaked at $ 213.8 billion in 2019, just before the Covid-19 pandemic. In 2020, global investments in Fintech lost steam but got back on track again in 2021 to reach $210.1 billion. Using secondary data, this segment looks at the state of fintech innovation and ecosystem in markets around the globe. In turn, this allows for benchmarking. A comparative picture then emerges.

3.4.2. Fintech Business Models

New business models continue to emerge around the world in fintech arena. Novel technologies undoubtedly create space for new business models. However, that is not always a requirement. In fact, the ability to find an optimal way to reach unexplored target customer segments – especially across the developing world – accounts for significant market opportunities for existing and emergent fintech services. A section is, therefore, dedicated to assessing the state of mainstream fintech business models across the world. Moreover, their current state in Bangladesh is analyzed, narratively, with support from publicly available data where appropriate. The following fintech business models are included:

1. Payments and transfer
2. Crowdfunding
3. Peer-to-peer lending (P2P)
4. Online banking
5. Insurance
6. Securities trading
7. Asset management
8. Online accounting management
9. Cryptocurrencies and blockchain

3.4.3. Key Players in Fintech Ecosystem

Ecosystem players each have their respective roles and agendas within the fintech ecosystem. A taxonomy of major players in fintech ecosystem allows for critical analyses of roles and responsibilities – therefore leading to insights on optimal strategies for a healthy and dynamic fintech ecosystem. Using theoretical models in the literature, these ecosystem players are identified and discussed within the context of Bangladesh. The following major ecosystem players are included in this segment:

1. Fintech startups
2. Government
3. Traditional financial institutions
4. Customers
5. Technology enablers
6. Investors
7. Academicians

3.4.4. Process-Model of Fintech Ecosystem Development

In evaluating the current development stage of fintech ecosystem in Bangladesh, the process model of fintech ecosystem development is used. A process model of Fintech Ecosystem Development was discussed in a study of the Fintech Ecosystem (FE) in Indonesia and concluded that there are three steps to this process: an Assessment phase, an Acceleration phase, and an Augmentation phase (Muthukannan, Tan, Tan, & Leong, 2017). Each of the phases requires the participation of different groups of ecosystem entities and is associated with a particular stage of maturity. In the Assessment phase, development of core capabilities is directed at filling existing market gaps. As a result of enhanced connectivity among ecosystem players, "positive network externalities" are generated in the Acceleration phase. In the Augmentation phase, increased variety of fintech innovation allows for operational and innovation synergies – leading to superior value creation for customers as well as other ecosystem players as a whole.

To assess Bangladesh's ecosystem development within this framework, a panel of 21 key informants was consulted. The panel included experts from the industry, academia, policy, regulation, and finance. An anonymized list of panel members, organizations, respective fields, and number of years of experience is given in Table 3.4-1. The panel provided their opinion on which of the three stages of development in the process model Bangladesh currently is in. The median value of their rating was taken as the prevailing development stage for fintech in Bangladesh.

Apart from the overall development stage, the panel also provided their opinion on the state of readiness for each of the seven fintech ecosystem players. The rating was collected on a five-point Likert scale with 1 being a "very low" level of readiness and 5 being a "very high" level of readiness. From this, an overall understanding of the state of readiness of each of these seven key ecosystem players.

Table 3.4-1 Anonymized list of expert panel members

Company	Years of experience	Years with company	Role as fintech ecosystem player
bKash	17	3	Financial institution, startup
Eastern Bank limited	14	11	Financial Institution
Dana Fintech	20	2	Technology Provider, Startup
Shurjomukhi Ltd.	34	12	Startup
Civil Audit Directorate	22	22	Government
University of Dhaka	22	20	Academia
Datasoft	32	20	Technology Provider
Novotel Limited	25	15	Technology Provider
AUST	6	3	Consumer, Academia
Dana Fintech	18	1.5	Startup
Eastern Bank limited	12	3	Financial Institution
BRAC Bank Limited	25	6	Financial Institution
BASIS	25	0.5	Technology Provider
Mastercard	27	10	Financial Institution, Technology Provider
Bangladesh Bank	29	29	Government
Nagad Ltd.	25	3	Financial Institution
University of Dhaka	15	12	Academia
BASIS standing committee on Fintech & Digital	24	4	Technology Provider, Startup, Investor
Eastern Bank limited	18	10	Financial Institution
British financial Institution	23	3	Financial Institution
MyAsiaVC	30	4	Investor

3.4.5.Way Forward

Additionally, the expert panel provided suggestions on pathways for the development of a more dynamic and vibrant fintech ecosystem in Bangladesh. These suggestions were later synthesized with insights generated from the rest of the three segments of the current research work. Overall synthesis then provided a solid base for policy recommendations.

3.5. Measuring Customer Readiness for Fintech

Fintech holds enormous potential to offer financial agency and financial resilience to customers. Combined with the digital innovation of fourth industrial revolution technology, fintech-led financial services aspire to bring innovative financial products to marginalized communities of underbanked or unbanked populations. This requires adoption of fintech by the broader customer base. While the previous section – dealing with the state and overall readiness of fintech ecosystem – discussed macro-level readiness, this section investigates readiness

on the part of customers who will use fintech in their daily lives to derive the aforementioned socio-economic benefits in the first place.

Unfortunately, despite the rise in number and variety of fintech literature, little effort has been taken to find a fintech readiness scale that measures customer readiness for fintech. Established frameworks look at adoption of technology in general. Technology Adoption Model (TAM), Unified Theory of Adoption and Use of Technology (UTAUT), Technology Readiness Index (TRI), and subsequently TRI 2.0 look at levels of preparedness to adopt technological products in customers. However, these are not readily usable in measuring customer preparedness for fintech products and services for developing nation users in particular. There are two reasons. First, the adoption and use of fintech, a class of technology-enabled financial services quite novel to the vast majority of the population across the developing world, is influenced by factors not readily considered under established models. As an example, the importance that perceived security risk has in determining customers' adoption of fintech products is considerably higher for fintech than everyday technologies that have been adopted by the broader market for decades e.g., refrigerators, mobile telecommunications, etc (Ali et al. 2021; Kin Leong Tang et al. 2020; Stewart and Jürjens 2018). Second, established frameworks in the literature rely mostly on samples from developed nations. This study, on the other hand, focuses on fintech in the context of developing nations like Bangladesh. As such, measuring customer readiness specifically in Bangladesh would entail the construction of datasets with instances from the country itself (NCS dataset), and the development of a customer readiness index that incorporates all major dimensions of fintech readiness currently under investigation in extant literature.

3.5.1. Customer readiness dimensions

The assessment of customer fintech readiness in Bangladesh under the current study starts with identification of dimensions of factors. These factors are under investigation in extant literature for their theorized and empirically validated impact on fintech adoption. This study identified a total of seven key dimensions of customer fintech readiness factors. Table 3.5-1 below provides the list. It is noted that all in all these seven dimensions provide a wide and holistic view of individual customer readiness for the adoption and usage of innovative fintech services. Once these dimensions are identified, variables are then selected

under each to represent its measurement in the composite customer fintech readiness index.

Table 3.5-1 Seven key dimensions of fintech readiness

Dimension	Factors	Related Work
Demography	Demographic characteristics of the customer/user e.g., age, gender	Alice Huong et al. 2021 Clements 2020 Chen et al. 2021 Gulamhuseinwala et al. 2015 M. Hasan et al. 2022 Imam et al. 2022 Pedrosa and Do 2011 Sioson and Kim 2019
Financial Health	Financial and economic characteristics of the customer/user e.g., current income, savings, consumption pattern	Amit et al. 2023 Hau et al. 2019 Mohamed et al. 2021 Rizvi et al. 2018 Senan et al. 2022 Solarz and Swacha-Lech 2021
Literacy	Institutional as well as non-institutional literacy e.g., level of education, financial literacy	Agarwalla et al. 2015 M. Hasan et al. 2022 Laidroo and Avarmaa 2020 Niu et al. 2020
E-Readiness	The extent to which customers/users are ready to adopt digital technologies e.g., connectivity, digital literacy	Azad 2016 Gerlach and Lutz 2019 Jünger and Mietzner 2020 Nathan et al. 2022 Parasuraman 2000 Salman and Abd.Aziz 2015 Setiawan et al. 2021
Mental Preparedness	Factors affecting customer/user mental preparedness to adopt and continue use of fintech services in daily lives e.g., customer reported level of acceptance	Dishaw and Strong 1999 R. Hasan et al. 2021 Jin et al. 2019 Kong and Loubere 2021 Kusumawati et al. 2020 Le 2021 Salman and Abd.Aziz 2015 Setiawan et al. 2021 Stewart and Jürjens 2018
Fintech Use	Degree of existing use of fintech services e.g., mobile banking, internet banking, ATMs	Amit et al. 2022 Azad 2016 Carlin et al. 2017 Gabor and Brooks 2017 Gerlach and Lutz 2019 R. Hasan et al. 2021 Hwang and Kim 2018 Shareef et al. 2018 Urumsah et al. 2022
Sentiment	Perceived variables that affect customer/user sentiment towards fintech services and/or platforms e.g., security risk, privacy concerns, usefulness	Ali et al. 2021 R. Hasan et al. 2021 Hwang and Kim 2018 Kin Leong Tang et al. 2020 Le 2021 Mu and Lee 2017 Poerjoto et al. 2021 Xie et al. 2021

3.5.2.Variable operationalization

Selected variables under each dimension are transformed before calculating the composite customer fintech readiness index. All variables were transformed on a scale from 0 to 100, dimension scores were also calculated on a scale from 0 to 100. The calculation method of the composite index is given in the next section.

3.5.2 (a) Demographic

For demographic measurements, we considered two variables. Age of respondents and their level of education. Following findings from previous sections, higher age was deemed to hurt overall fintech readiness. This was primarily due to concern factors and technical readiness. Higher levels of institutional education were deemed to have a positive impact on fintech readiness. This was also found in several sections of this report. Age was scaled from 0 to 100 and subtracted from 100 as follows:

$$Age_s = 100 - \left\{ \frac{age_i - \min(age)}{\max(age) - \min(age)} * 100 \right\}$$

In this case, Age_s is the standardized age. At first, the minimum age in the survey is deducted from age_i of the respondent and is then divided by the range of age values found in the survey. This is multiplied by 100 to scale. Finally, we subtract it from 100 to incorporate the negative relationship.

Levels of institutional education of the respondents were also converted into numeric values on a scale of 1 to 100 using the following value-labeling:

Table 3.5-2 Value labels for respondent education

Response	Value
None	0
Primary	20
Madrasa (kawmi)	20
Secondary	40
Higher Secondary	60
Graduate	80
Post-graduate	100
Other	100

On average, we assumed a 20-step increment in fintech readiness with each additional level of institutional education. Higher levels of institutional education equip a person for wider fintech use and address some of the concerns related to security, financial fraud, and privacy.

3.5.2 (b) Financial Health

As part of our survey, we collected data on several financial and economic variables. However, in our analyses, only a handful were particularly relevant in explaining dependent variables in previous sections. To construct the financial health dimension of our score, we used two variables related to financial health: the monthly income and annual savings of the respondents. As with other variables, both monthly income and annual savings were scaled from 1 to 100 and averaged for dimension score.

3.5.2 (c) Financial Literacy

The financial literacy dimension in our scale consists of three variables which look into the number of times the respondent visits the bank per month, their assessment of how confident they are performing activities, and their overall awareness of bank transactions. The number of times the respondent visited a bank in a given month was scaled from 0 to 100. To label respondents' assessment of their confidence in performing banking activities, the following value label was used:

Table 3.5-3 Value labels for confidence banking alone

Response	Value
Not confident at all	20
Low confident	40
Slightly confident	60
Confident	80
Very confident	100

In transforming respondents' assessment of awareness of bank transactions, we used the following value labels:

Table 3.5-4 Value labels for awareness of bank transaction

Response	Value
No knowledge at all	20
Very low knowledge (only deposit and withdrawal)	40
Some knowledge (deposit scheme and loan scheme)	60
Above average knowledge (LC, stock market, financial report, ratios, etc.)	80
Expert (certified financial analyst)	100

In both of these cases, an equal interval step increment was used for increasing levels of confidence and awareness of fintech readiness.

3.5.2 (d) E-Readiness

We incorporated 4 measures to assess respondents' e-readiness for fintech use. Access to mobile technology is a must for fintech use at the highest level. Especially in terms of mobile financial services, the minimum technology the user needs is access to a phone (preferably a smartphone) and access to high-speed internet. Better phones and access to high-speed internet become increasingly important for a wider scope of services. For Internet banking, however, access to a personal computer becomes important. Respondents who had access to a computer were assigned 100 and those who did not were assigned a 0. We used the following value labeling to transform respondents' assessment of their computer skills:

Table 3.5-5 Value labels for computer skills

Response	Value
Not skilled at all	20
Very low skills	40
Some skills	60
Skilled	80
Very skilled	100

To transform respondents' assessment of their smartphone-use skills, the following value labeling was used:

Table 3.5-6 Value labels for smartphone skills

Response	Value
Not skilled at all	20
Very low skills	40
Some skills	60
Skilled	80
Very skilled	100

We also considered respondents' data usage per month. Existing data usage is an effective proxy for future openness to use wider and more sophisticated fintech services. The next generation of fintech services will likely demand higher levels of internet use. Data usage per month was measured in megabytes and was scaled from 0 to 100.

3.5.2 (e) Mental Preparedness

Respondents were asked to also evaluate their assessment of mental preparedness for fintech use on a day-to-day basis. To transform their assessment, the following value labeling was used:

Table 3.5-7 Value labels for mental preparedness

Response	Value
Not prepared at all	20
Low prepared	40
Average preparedness	60
Prepared	80
Adequately prepared	100

Higher levels of perceived mental preparedness should constitute an important aspect of the overall fintech readiness assessment. For this reason, this single variable constituted an entire dimension for our overall scale.

3.5.2 (f) Current Fintech Usage

Current fintech usage, perhaps obviously, is another important predictor of the future readiness of newer fintech services. Our survey incorporated several types of measures looking into mobile banking usage, internet banking usage, frequency of mobile and internet banking services used, and the average volume of money transacted on these platforms. Very few respondents were found to actively use Internet banking services. We had to prevent the scale from becoming

artificially inflated by including Internet banking variables. Thus, current fintech usage only considered the frequency of mobile banking use and the average volume of mobile banking use. Both of these variables were scaled from 0 to 100. The average of these scaled variables was taken for the dimension score.

3.5.2 (g) Overall Sentiment Related to Fintech Use

User sentiment related to fintech can be from different angles. Indeed, our survey incorporated multiple lines of sentiment assessment questions to get an overall view of user sentiment. For this scale, we incorporated the three most salient sentiment aspects: respondents' assessment of fintech costliness, assessment of satisfaction with fintech use, and assessment of fintech service availability. To transform respondents' assessment of fintech costliness, satisfaction, and availability, we used the following value labeling:

Table 3.5-8 Value labels for fintech costliness

Response	Value
I don't use fintech	0
Very costly	20
Costly	40
Neutral	60
Cheap	80
Very cheap	100

Table 3.5-9 Value labels for fintech satisfaction

Response	Value
I don't use fintech	0
Highly dissatisfied	20
Dissatisfied	40
Neutral	60
Satisfied	80
Highly satisfied	100

Table 3.5-10 Value labels for fintech availability

Response	Value
I don't know	0
Not available at all	20
Not available	40
Neutral	60
Available	80
Highly available	100

3.5.3. Calculating CFR Index

Figure 3.5-A below depicts the step-by-step calculation of individual CFR scores and overall CFR score for the sample. First, variables under a dimension are averaged to calculate the average score of the dimension. As an example, a respondent's age score and education score are averaged to find out their Demographic dimension score out of 100. Similarly, all six other dimension scores are calculated. The Customer Fintech Readiness (CFR) index follows an average-of-average method to measure overall fintech readiness. This allows for avoiding methods like Principal Component Analysis for easy replicability in any other sample in a similar developing nation context. After scores on all seven dimensions are obtained, a weighted average method is used. Weights were assigned by the panel of 21 key informants with relevant expertise in fintech in Bangladesh. In fact, Chapter 6 of this report provides detailed CFR construction methodology. We find out the average CFR scores of respondents to find the composite average CFR score of the overall market.

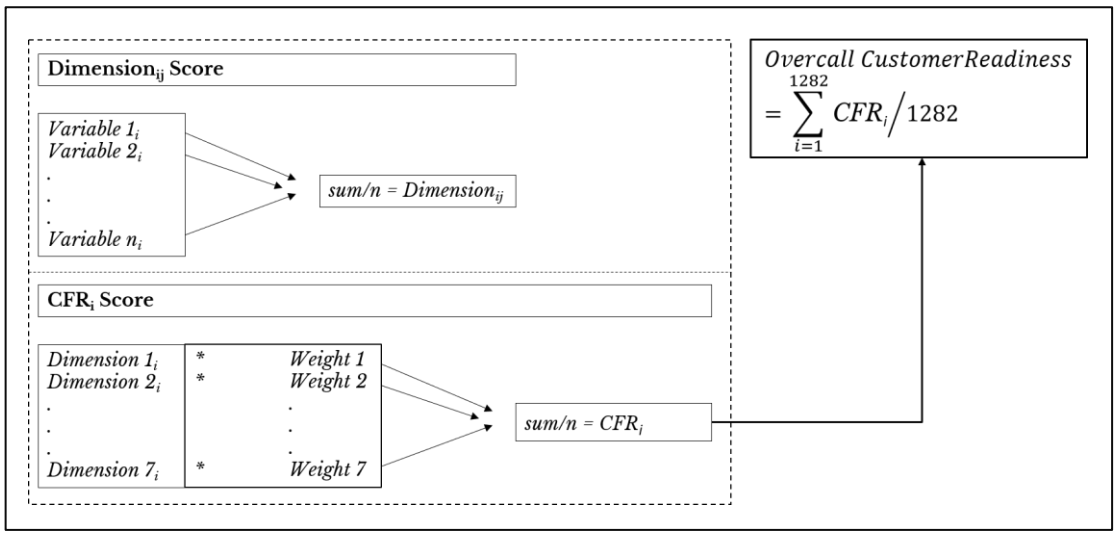


Figure 3.5-A Customer Fintech Readiness (CFR) index calculation

3.5.4. Validating the CFR Index

In order to establish the validity of the CFR index in measuring customer fintech readiness, several different methods were followed. Chapter 6 presents validity assessment process and results in detail. Assessment of CFR's validity is done in two main ways. First, the CFR score is used as a predictor, along with control variables, in a multiple regression model with the number of customer expectations as the dependent variable. Three alternative models were estimated

with three alternative dependent variables: a) the number of future fintech services customers report using in the future, b) the number of expectations they have from fintech service providers, and c) the number of expectations they have from government. The underlying argument is that if CFR is indeed a valid measurement of customer readiness for fintech, then CFR score should be a significant predictor of these expectations since readier customers are more likely to use fintech services in the future and their expectations from other ecosystem players also should be higher.

Second, one-way ANOVA is performed to evaluate differences in CFR scores across groups of customers and to assess if expected patterns hold. One-way ANOVA is performed on based two alternative grouping methods. The first one is based on customer-reported levels of agreeableness on fintech's impact on society, the economy, and the environment – the argument being that CFR scores should be higher in higher reported levels of agreeableness. The second one is based on customer-reported levels of obstacles in using fintech services – the argument here being that in lower reported levels of obstacles faced, CFR scores should be higher. These results are also available in detail in Chapter 6. Overall, the CFR is established as a valid measure of customer readiness for fintech use. Combined with its easy replicability, this enabled the CFR to be an important tool for readiness assessment and further investigation into fintech use for researchers.

3.6. Finding Adoption Factors of Fintech in Bangladesh

A separate line in the fintech literature investigates factors, at the individual level, that determine the adoption of fintech services. Individual-level demographic, economic, technological skills, etc. have been identified. Customer perceived variables e.g., perceived risk, perceived usefulness, perceived utilities, and benefits from using fintech products have also been found to have a significant impact. However, different samples studied by different researchers have either focused on one particular domain of factors, or their theoretical models have excluded the consideration of the rest. Another challenge with using established theoretical models of understanding adoption of fintech services – which by themselves are not properly developed since they draw heavily from generic frameworks more appropriate for generic technology adoption – is that

they make implicit assumptions about the relative importance of a class of factors e.g., customer perception over others.

Bangladesh in recent decades has observed a remarkable increase in adoption of mobile financial services (MFS). The primary service used by customers across the country through MFS platforms is mobile money transfer and digital payments. Excluding these, the vast majority of fintech services emerging across the world in recent times have negligible footprints in the Bangladesh market. Moreover, mobile money accounts do not necessarily require the opening of an account with a bank – thereby not contributing much per se to systemic financial inclusion for most mobile money account holders. If the benefits of emergent fintech services are to be realized, it is important to understand what factors play their parts in determining fintech adoption. More specifically, it is important to find what factors are important for customer fintech adoption in Bangladesh. Figure 3.6-A below depicts the methodological flow chart of modeling fintech adoption among Bangladeshi customers in this segment of the current study.

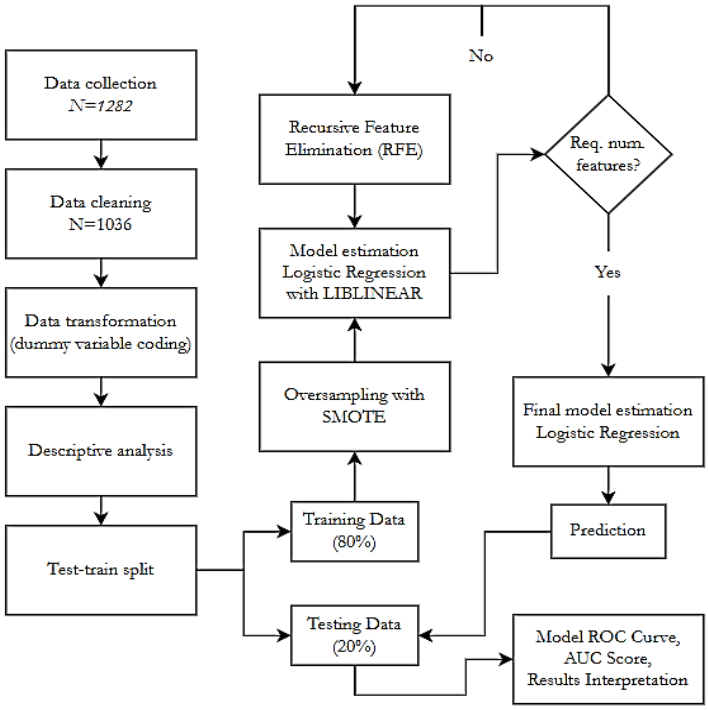


Figure 3.6-A Model estimation process for fintech adoption factors

The following sections provide a description of the four major steps in the estimation process. Overall, the flow is as follows. The NCS dataset was used for

modeling fintech adoption factors. Due to model sensitivity to extreme outliers, the dataset was cleaned and extreme outliers were excluded. After this, the number of instances was *N*=1036. Since there was a large number of categorical variables – Likert scale questions where respondents reported their responses on a five-point (sometimes six) scale – the variables were dummy-transformed. The dataset was then split into a training set and a test set. Multivariate logistic regression models were estimated where the dependent variable was binary-logistic: fintech use or non-use. Features were excluded through Recursive Feature Elimination (RFE) to reach a selection of the most optimal mix of features significantly predicting fintech adoption. Moreover, the Library for Large Linear Classification (LIBLINEAR) was used as an estimation algorithm for the logistic regression models. Finally, the model was evaluated through a number of parameters including Receiver Operating Characteristics (ROC), and Area Under Curve (AUC) scores.

3.6.1. Dataset and Train-test Splitting

The NCS dataset was used to model fintech adoption to find significant predictors of adoption. After data wrangling and cleaning, our sample size stood at N = 1036. To gain a comprehensive view of fintech usage and related factors, the questionnaire covered a wide number of demographic, economic, behavioral, technological, and perceptual/opinion-related questions.

A list of variables included in the NCS dataset for this modeling purpose is given in Table 3.6-1. Where categorical variables are used, the labels are provided in column 2. Since multi-variate logistic regression is used to model fintech adoption among customers, all categorical variables are dummy-transformed into separate features. For example, mental preparedness for fintech use had five alternative options to choose from:

I. Very low
II. Low
III. Neutral
IV. High
V. Very high

Consequently, the variable was dummy-transformed resulting in five different features as follows:

I. Mental preparedness very low
II. Mental preparedness low
III. Mental preparedness neutral
IV. Mental preparedness high
V. Mental preparedness very high

After all categorical variables were dummy transformed, our dataset constituted a total of 133 different features to be used for modeling fintech adoption. Before modeling, however, the dataset was split into a training set and a test set. The first was to be used to estimate the optimal model with the second being used for assessing the accuracy of the model estimated. The dataset used for modeling (N=1036) was train-test split into an 80-20 ratio.

3.6.2. Oversampling with SMOTE

Model results based on asymmetric classes may lead to inaccurate predictions with potentially serious results depending on the use of the model. As an example, false negatives due to model inaccuracy that can be traced to sampling asymmetry may lead to serious health hazards (Chawla et al. 2002). To address the issue, a number of techniques have been deployed in the literature. SMOTE oversamples the minority class to bring symmetry. The method has widely been used in computer science, software development, biological classification, and more (Amirruddin et al. 2022; Ijaz et al. 2018; Pears et al. 2014).

SMOTE is widely used in multiple disciplines due to its ease of use and effectiveness in a wide range of scenarios. The algorithm works by choosing a required number of "k-nearest neighbors" for each instance in the minority class and applying linear interpolation to randomly generate instances until the class imbalance is addressed. The synthetic instances are added and a new dataset is then constructed. After deploying SMOTE, our training dataset was balanced in terms of fintech users and non-users.

3.6.3. Recursive Feature Elimination

Out of the 133 features included, *55* of the most significant features were preserved in the final model. The method with which this selection was performed is referred to as Recursive Feature Elimination (RFE). One common

misconception among researchers is the use of Principal Component Analysis (PCA) in situations like this. However, PCA is a dimensionality-reduction method – not a feature elimination method. Both the use of RFE and using LIBLINEAR (described in the next section) to estimate the regression models for this segment of the study were performed with Python's *scikit-learn* package. This is a machine learning library for Python programming language featuring, among other capabilities, "various classification, regression and clustering algorithms including support-vector machines, random forests, gradient boosting, k-means and DBSCAN, and is designed to interoperate with the Python numerical and scientific libraries NumPy and SciPy" (Wikipedia 2023).

RFE works in an iterative way. In the context of this segment, the first iteration is estimating logistic regression with all 133 features included. Once the algorithm estimates the model, features are ranked in terms of their significance in predicting the dependent variable. The bottom-ranked feature is then excluded and the model re-estimated. On each iteration, the model is estimated with $n - 1$ features, where n = number of features included in the previous iteration. The iterative process, depicted simply in Figure 3.6-B, is continued till the algorithm reaches the specified number of optimal features to preserve.

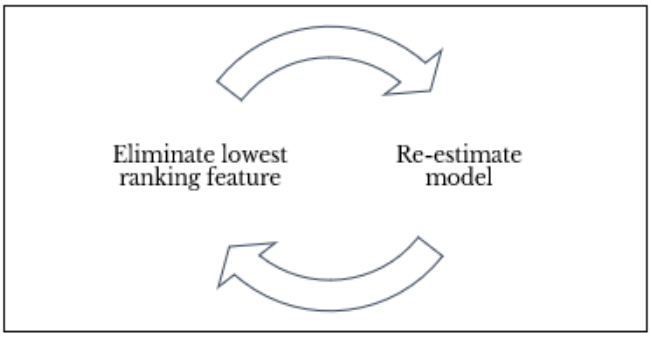


Figure 3.6-B Iterative process of model estimation

Table 3.6-1 List of variables included in the multivariate logistic regression

Variable	Labels
Gender	Male, Female
Age	-
Education	Primary, Secondary, None, Higher secondary, Graduate, Post-graduate, Madrasa_(kawmi)
Marriage	Married, Single
Occupation	Business, Day Laborer, Homemaker, Non-government Job, Retired, Student, Unemployed, Driver (Rickshaw/Van/Engine Vehicle), Farmer/Fisherman/Boatman, Government Job, Government Allowance, Non-resident. Others
Household	-
Expenses	-
ExpRent	-
ExpFood	-
ExpUtilities	-
ExpEducation	-
ExpHealthcare	-
ExpEntertainment	-
ExpClothing	-
ExpHouseHelp	-
ExpMisc	-
Income	-
AnnualSaving	-
House	Traditional House, Cemented House
BankAccount	No, Yes
BankVisit	-
BankAwareness	Very low knowledge (only deposited and withdrawal), Some knowledge (deposited scheme and loan scheme), No knowledge at all, Above average knowledge (LC, stock market, financial report, ratios etc.), Expert (certified financial analyst)
Computer	No, Yes
Mobile	No, Yes
SmartphoneSkill	Not skilled at all, Very low skills, Some skills, Skilled, Very skilled
Internet	No, Yes
Data_usage	-
Concern_Information_Secrecy	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Unknown_Issues	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Limited_GovControl	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Financial_Scandal	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Cashless_Community	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Information_Security	I don't Know, Very Low, Low, More or less, High, Very High
MentalPreparedness	Low prepared, Not prepared at all, Average preparedness, Prepared, Adequately prepared
Fintech_satisfaction	I don't use fintech, Satisfied, Neutral, Dissatisfied, Highly dissatisfied, Highly satisfied
Max_fee_per_1000	-
Obstacle_economic_condition	Very low, Low, Neutral, High, Very high
Obstacle_geographic_location	Very low, Low, Neutral, High, Very high
Obstacle_confidence_in_technology	Very low, Low, Neutral, High, Very high
Obstacle_service_intuitiveness	Very low, Low, Neutral, High, Very high
Fintech_service_affordability	Very low, Low, Neutral, High, Very high
Fintech_costliness	I don't know, Not affordable at all, Not affordable, Neutral, Affordable, Highly affordable

3.6.4. Estimating Logistic Regression with LIBLINEAR

Logistic regression as an econometric tool is used widely for classification and predictive modeling. In binary logistic regression, the dependent variable assumes either 0 (e.g., failure, absence, negative, etc.) or 1 (e.g., success, presence, positive). In this study, the dependent variable is binary, where 0 indicates no use of fintech and 1 indicates use of fintech services. Fintech use and non-use in the context of this modeling purpose is defined as follows: 1 is the frequency of monthly fintech service use of any kind included in the questionnaire is 2 or above; 0 otherwise. The independent variables in the multivariate logistic regression models are all the features included in the model, excluded in each iteration as per their rank by the RFE algorithm. Chapter 7 provides further details on model specification and a list of dependent and independent variables.

For both RFE and final model estimation, we used LIBLINEAR. Among open-source, classification packages, the Library for Large Linear Classification (LIBLINEAR) is preferred in this case for two reasons. LIBLINEAR has been found to perform better among competing models and it is computationally less intensive (Fan et al. 2008).

3.7. Establishing Fintech's Relationship with Sustainable Economic Growth

Across the world, communities face enormous challenges in economic, social, and environmental spheres (Flint 2013). Economic inequality is at a record high, and the socio-political institutions once seeming to reach a stage of relative stability has emerged as institutions standing on shaking ground with the advent of technological and social upheaval at the turn of the century (Dixit and Weibull 2007; Orlikowski and Barley 2001; Prior 2013). Financial technologies combine the transformative potential of digital technologies with financial services to enable access to innovative financial services – especially by previously overlooked target segments (Douglas W. Arner et al. 2020a). Indeed, the avenues of fintech boosting human development possibilities across sectors are wide (Zhang et al. 2021). To get an overview of these, one must carefully consider the multifaceted, pluralistic view needed to appropriately conceptualize human development priorities, and how fintech aids in the achievement of such

priorities. However, although the literature is rich with disjointed narratives of fintech contributing to sustainable economic development with innovative products and business models, there is a clear lack of cross-country empirical evidence of fintech's relationship with and contribution towards sustainable economic development.

In this segment of the current study, effort is taken to fill this void by establishing fintech's relationship with sustainable economic growth. First, fintech's contribution to macro-level economic growth, proxied by annual growth in gross domestic product, is investigated with cross-country panel data. This allows for establishing fintech's contribution to growth as it is. Second, this study adopts quartile comparison as a method to analyze fintech's relationship with progress in sustainable development. More accurately, the study finds out if growth in fintech is also associated with higher levels of progress achieved in selected sustainable development indicators – thereby providing empirical evidence of fintech's contribution to sustainable development. The two, combined, can reliably indicate fintech's impact on sustainable economic growth. Figure 3.7-A below provides a bird's-eye-view of the methodology. Details on data and methods for each are given in Chapter 8.

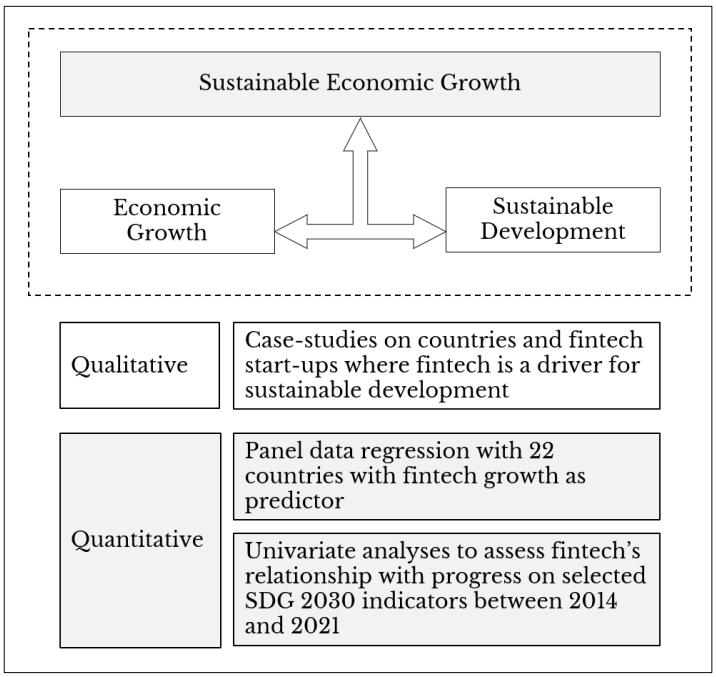


Figure 3.7-A Methodological overview of investigating fintech and sustainable economic growth

3.7.1. Case studies

The case studies under this segment are constructed from publicly available data on fintech companies and ways they are changing the socio-economic status of target market segments and target communities across the world. For country cases, three particular economies were considered: 1) India, 2) Indonesia, and 3) Kenya. In constructing cases on fintech companies with an impact, the four cases included in this chapter provide a diverse perspective on a range of fintech's impact on targeted segments e.g., on women's financial independence, access to credit for small business owners, transaction risk management for e-commerce businesses, and fintech solution for sustainable consumption and climate action. These are: 1) Ellevest, 2) CreditVidya, 3) Riskified, 4) Deedster. As mentioned before, there are difficulties in quantifying and empirically establishing the entirety of fintech's contribution to sustainable economic development. Importantly, qualitative analysis allows for a clearer view of the channels with which fintech makes such contributions. Exactly how fintech allows for specific target segments of the market to benefit from technology-enabled financial services is, therefore, reflected in these cases.

3.7.2. Panel Data Regression

In the quantitative part of the investigation – which constitutes the principal focus on trying to establish empirical evidence in support of fintech's relationship with sustainable economic development in this segment – the first approach is investigating fintech's contribution to aggregate-level economic growth. In this part, a panel of 22 countries – all members of the Committee on Payments and Market Infrastructures (CPMI) of the Bank for International Settlements (BIS) – is constructed with annual data from 2013 to 2021. The dependent variable for the panel data regression was country-level annual GDP growth. The predictor variable included three alternative proxy measures of fintech growth: growth in ATM cash withdrawals, growth in transactions performed through debit cards, and growth in transactions performed through credit cards. Four variables were included as control variables. Additionally, four variables with possible impact on the dependent variable were included to test for omitted variable bias. Table 3.7-1 provides a list of variables and data sources. Chapter 8 discusses model specification and estimation methods in further detail.

Table 3.7-1 List of variables for panel model estimation

Variables	Description	Unit Measurement	Data Source
GDP	Gross domestic product growth rate	Annual % growth	WDI
Fintech variables			
ATM	Growth in cash withdrawals from Automated Teller Machines	Annual % growth	CPMI, BIS
Debit	Growth in transactions performed through cards with debit function	Annual % growth	CPMI, BIS
Credit	Growth in transactions performed through cards with credit function	Annual % growth	CPMI, BIS
Control variables			
Inflation	Consumer Price Inflation (CPI) Index inflation	Annual %	WDI
Life	Growth in average gender aggregated total life expectancy	Annual % growth	WDI
Education	Growth in allocation for education as a percentage of GDP	Annual % growth	WDI
Export	Growth in Export volume index is derived from UNCTAD's volume index series	Annual % growth	WDI
Import	Growth in Import volume index is derived from UNCTAD's volume index series	Annual % growth	WDI
Additional variables for Omitted variables bias test			
GCF	Growth in gross capital formation	Annual % growth	WDI
FDI	Growth in foreign direct investment	Annual % growth	WDI
RD	Growth in expenditures on research and development (R&D) as a percent of GDP	Annual % growth	WDI
Branch	Growth in the number of bank branches within the jurisdiction	Annual % growth	WDI

The following steps summarize the panel data regression estimation in this part:

1. Three baseline models are first estimated with three alternative proxy measures of fintech growth as predictors. Initially, both fixed-effects and random-effects models are estimated. Subsequently, as per the Hausman test statistic, it was deemed that the random-effects models were more appropriate. So random-effects models were used for baseline results – as well as all subsequent estimations.
2. To address possible endogeneity problem, two-stage-least-square (2SLS) regression with instrumented variables is estimated. This was done for all three baseline models.

3. Furthermore, four additional variables are used to test for possible omitted variable bias. This is done individually as well as parallelly with all four variables added to the baseline model at once.
4. The effect of extreme outliers was addressed with winsorization of the predictor variable and subsequent re-estimation of the model.

After following these steps, the empirical relationship found between fintech growth and aggregate level economic growth for the 22 countries in the panel is deemed robust. In fact, the relationship holds not just for developed nations, but for developing nations as well. The panel used for the regression included countries from different stages of development (although high-income countries were a majority). Therefore, the empirical relationship can be regarded as largely universal.

3.7.3. Univariate Analysis

To assess fintech's contribution to sustainable development, a quartile-comparison method allowed for no assumption of linearity between the relationship. This was a major advantage. Figure 3.7-B below provides a graphical representation of the univariate analysis method. To investigate fintech's impact with regard to sustainability, a series of univariate analyses were performed. These aim at assessing differing levels of growth in selected sustainable development indicators from the SDG 2030 framework across ranked as per growth in fintech variables.

Two broad classes of variables were used: a) country-level fintech data for ranking, and b) country-level sustainability indicators. Country-level fintech data were collected from the Global Findex Dataset from the World Bank. On the other hand, the Sustainable Development Report (formerly SDG Index and Dashboards) dataset from the Sustainable Development Solutions Network of the United Nations provided country-level data on national progress on the SDG 2030 index, goals, and indicators. Table 3.7-2 has the list of variables used for both.

Table 3.7-2 List of variables for univariate analysis

Variable Name	Description	Measurement
Ranking Variables		
DCRD	Debit card ownership, % of population aged 15+	Growth between 2014 and 2021
CCRD	CeBIT card ownership, % of population aged 15+	Growth between 2014 and 2021
MMNY	Mobile money account ownership, % of the population aged 15+	Growth between 2014 and 2021
DGPM	Percentage of the population made or received digital payments	Growth between 2014 and 2021
WAGC	Percentage of wage recipients received wages to card	Growth between 2014 and 2021
Development Indicators		
SDGI	SDG Index score	Growth between 2014 and 2021
Goal 1	Score on Goal 1	Growth between 2014 and 2021
Goal 5	Score on Goal 5	Growth between 2014 and 2021
Goal 8	Score on Goal 8	Growth between 2014 and 2021
Goal 9	Score on Goal 9	Growth between 2014 and 2021
Goal 11	Score on Goal 11	Growth between 2014 and 2021

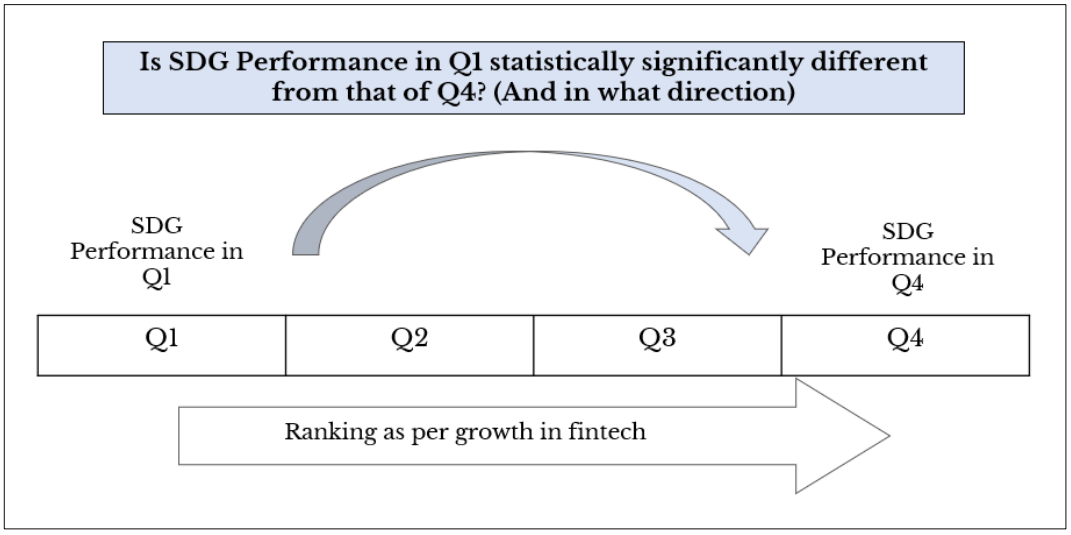


Figure 3.7-B Univariate analysis approach with quartile-comparison

Once countries were ranked based on a selected fintech variable, average growth in selected SDG goals was assessed, and T-test and Z-test were performed for differences in mean growth rates in the top and bottom quartiles of countries. Additionally, the F-statistic for one-way ANOVA was also calculated for differences across the four quartiles. These methods and results are available in detail in Chapter 9 which deals with fintech's impact on sustainable economic development. In general, all univariate analyses were performed in two stages: a) for all countries across the world, and b) for lower-middle-income countries (LMIC) only. Results from the first panel allow for the investigation of fintech's contribution to sustainable economic development in general across the world – regardless of development stage and socioeconomic, political, and other heterogeneities. On the other, results for the panel consisting of LMICs only provide insights for developing nations in Bangladesh – therefore providing more relevant insights for policy recommendations.

4. Descriptive Findings from National Citizen Survey (NCS)

4.1. Introduction

Fintech firms provide alternative financial services that seek to change the lives of customers and create value through new business models, products, and services. Business models can be based on a variety of ways to create value for customers. Some may seek to deliver the same value more efficiently and cheaply. Other fintech service offerings may bring innovative new services to the customers that were simply not possible before through legacy banking firms. Several classification efforts have been found in the literature. Classification of fintech services available in the broader fintech landscape depends on the market being surveyed. For example, ASEAN is a rising and potentially vibrant hub of fintech services due to the macrocosmic and social makeup of countries comprising the Southeast Asia bloc. However, countries in ASEAN are uneven in terms of several fintech firms and fintech service offerings available to the customers (M. Soriano et al. 2019). In terms of the number of fintech firms, Singapore and Indonesia lead the block (with 29% and 17% of fintech firms in the region respectively). Other countries in the block are lagging: Cambodia (4%), Vietnam (3%), and Myanmar (1%). Soriano et al., (2019) proposed a taxonomy of fintech business models for a survey of fintech services in the ASEAN region. From a business model perspective, fintech services were divided into sub-categories of 10 different classes. These include digital payments, InsurTech, financial management for businesses, personal management of finance, payments, lending, and crowdfunding. A Survey of the ASEAN fintech landscape reveals that digital lending leads the way in terms of volume of use.

Similar to trends observed in finch landscapes in other parts of the world, digital lending and payments comprise the two biggest categories of business models in ASEAN. Both of these are used to enhance everyday transactions and

customers directly benefit from greater access to lending resources and a smoother way of payments. In ASEAN, apart from these two services, capital crowdfunding, Machine Learning or AI-driven financial services and financial management solutions for businesses are the next biggest business models (M. Soriano et al. 2019). Fintech provides a wide array of enhanced financial services for customers in these categories. In most cases. In most cases, sophisticated, data-driven financial advisory and decision-making are accessible for business and individual customers for fractions of the cost it takes banks and financial institutions to deliver similar products using traditional means.

Within the digital lending market in ASEAN, peer-to-peer business lending is at the top. Fintech removes some of the previously insurmountable barriers to the informal lending market e.g., credit rating based on proxy measures, a platform for the settlement of transactions where enough buyers and sellers credibly participate, etc. Consumer lending in such platforms closely follows and is expected to grow in the coming years in this region. Individual customers comprise the biggest share of fintech users in the ASEAN region. Around 42% of the customers in ASEAN fintech firms are individuals, 28% are corporate players and 22% are SMEs (M. Soriano et al. 2019). The customer profile is significantly determined by the type of service being delivered. For example, 22% of customers in digital lending are corporate entities whereas the share of this customer segment in Machine Learning based fintech solutions is 45% (M. Soriano et al. 2019).

Fintech firms have continued to grow in numbers as well as in the scope of fintech solutions delivered to customers. For new fintech startups, findings of a market niche and go-to-market (GTM) strategy have become increasingly important as the fintech landscapes around the world become more and more populated by new entrants. Soriano et al., (2019) identified that fintech firms in ASEAN have been leveraging the ease of access and convenience of use as the GTM strategy for their fintech offerings. Around 83% of firms surveyed followed ease of access as the “high-priority” GTM for their products. Around 80% followed speed, 58% followed the cost of a product, and 58% followed integration as their “high-priority” strategy. Design of an intuitive user interface was a “high priority” GTM for 56% of firms surveyed. Soriano et al., (2019) also found a wide variety of technology fueling fintech innovation in ASEAN. The top three technologies

found were predictive analytics, the use of AI and machine learning algorithms, and robotic advisory algorithms.

Similarly, fintech has gained significant traction in Bangladesh. The large-scale adoption of Mobile Financial Services (MFS) by customers across a wide spectrum of socio-economic categories bears testimony to the underlying potential of fintech to enable transformative economic and social change in the country. However, the paucity of national-level data on patterns and trends of customer usage of fintech acts as a major obstacle to harnessing policy-relevant insight for timely decision-making. Indeed, investigation of possible factors enabling or obstructing the adoption and subsequent usage of fintech products/services among customers in Bangladesh has proven to be particularly necessary in the context of fintech research in the country.

To assess customer readiness for fintech, usage or mental preparedness to use fintech services, and concerns and/or expectations related to fintech in Bangladesh, the National Citizen Survey (NCS) (methodological detail outlined in chapter 3) collected a large number of data points from individuals across the nation. Subsequently, the NCS dataset was used to model customer readiness, investigate adoption factors of fintech, and perform additional analyses for the current study. This chapter, however, presents descriptive insights received from NCS dataset. As such, the trends and patterns present in the findings in this chapter can enable key policy decisions both for regulators and commercial fintech services providers in Bangladesh.

4.2. Banking Behavior and Capacity

4.2.1. Overall Bank Account Ownership

Despite what we would expect after over a decade of efforts to bring a larger share of the population into the formal banking channel, the share of respondents reported to have no bank account according to our survey was significantly high. Around 62% of the respondents in our survey said they do not have a bank account. Around 38% of the respondents said they have at least one bank account in a formal banking channel. Important to note here, that the proportion of mobile banking wallet users in our survey was higher than this as reported in a later section dedicated to mobile banking usage. The fact that almost 6 out of 10 individuals in

a nationally representative sample of people from various walks of life do not own a formal bank account is important to consider for current and future fintech service design and delivery.

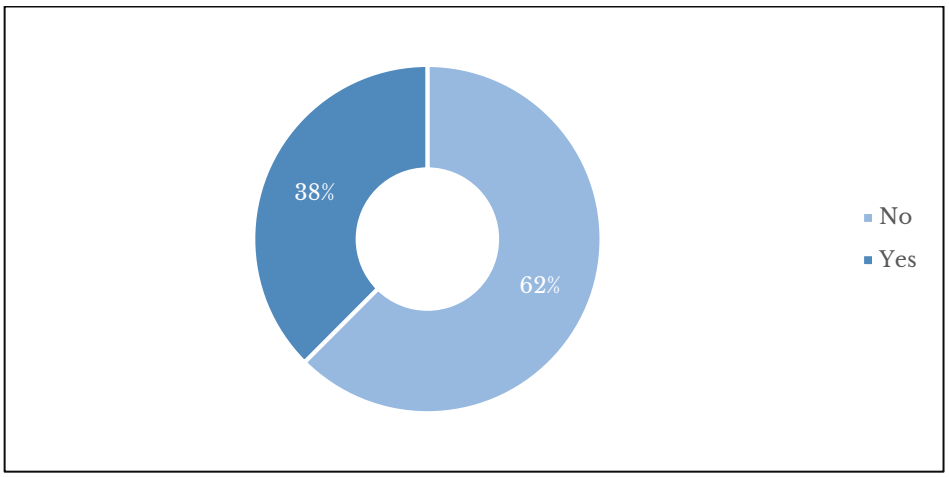


Figure 4.2-A Overall bank account ownership

4.2.2. Bank Account Ownership across Groups

Bank account ownership varies considerably across different groups. We looked at bank account ownership across gender, age, income classes, and levels of annual savings among respondents. As expected, women lagged behind men in terms of bank account ownership. Around 30% of female respondents reported having a bank account and around 39% of male respondents said they have a bank account. Fintech services specifically designed for female users need to consider the lack of experience interacting with formal banking channels for female customers and make the overall service design more intuitive and easily

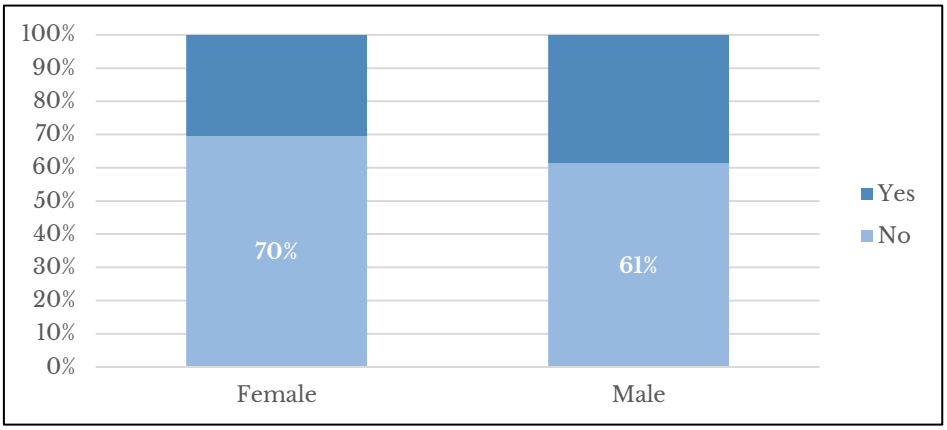


Figure 4.2-B Gender disaggregated bank account ownership

understandable regardless of previous levels of experience. However, this applies to all classes of users and fintech service design.

Account ownership was different for different ages of respondents. Overall, bank account ownership was higher in younger respondents. Account ownership among respondents aged between 15 and 25 was 25%. With respondents aged 25-34, it was 42% and with respondents aged 35-44, it was 45%. Only 17% of individuals aged between 65-74 had a bank account.

Table 4.2-1 Bank Account Ownership Across Age Groups

Age Group	No	Yes	Grand Total
15-24	75%	25%	9%
25-34	58%	42%	34%
35-44	55%	45%	25%
45-54	66%	34%	17%
55-64	65%	35%	8%
65-74	83%	17%	5%
75-84	73%	27%	1%
85-94	100%	0%	0%
Grand Total	**62%**	**38%**	**100%**

4.2.3. Number of Bank Visits per Month

One proxy measure we take for the level of involvement with formal banking channels is the number of visits to the bank each month. The average number for the entire survey was 2.16 times in a given month. For female respondents, this was slightly higher at 2.19 times. However, looking at the minimum and the maximum number of visits to a bank, we find the maximum number of bank visits per month for male respondents was higher at 25 times while 10 times for female respondents.

Table 4.2-2 Gender Disaggregated Average Bank Visits

Row Labels	Average visit	Min Visit	Max Visit
Female	2.19	0.05	10.00
	26 per annum	*1 per annum*	*120 per annum.*
Male	2.16	0.01	25.00
	26 per annum	*0 per annum.*	*300 per annum*

4.2.4. Help in Performing Banking Activities

It is also important to mark how confident respondents, in general, are performing regular banking operations. This provides a proxy measure for the state of readiness of the customer base for more sophisticated banking products

and services provided through fintech platforms. According to our survey data, 82% of respondents said they can perform their banking activities on their own. Only 16% said they take help from someone and around 2% reported taking someone with them to the bank to help them. For the female customer, the ratio of independent banking operations was lower at 62%, while 34% said they take help from someone in performing their banking operations while 4% reported taking someone with them to the bank to help them with their banking activities.

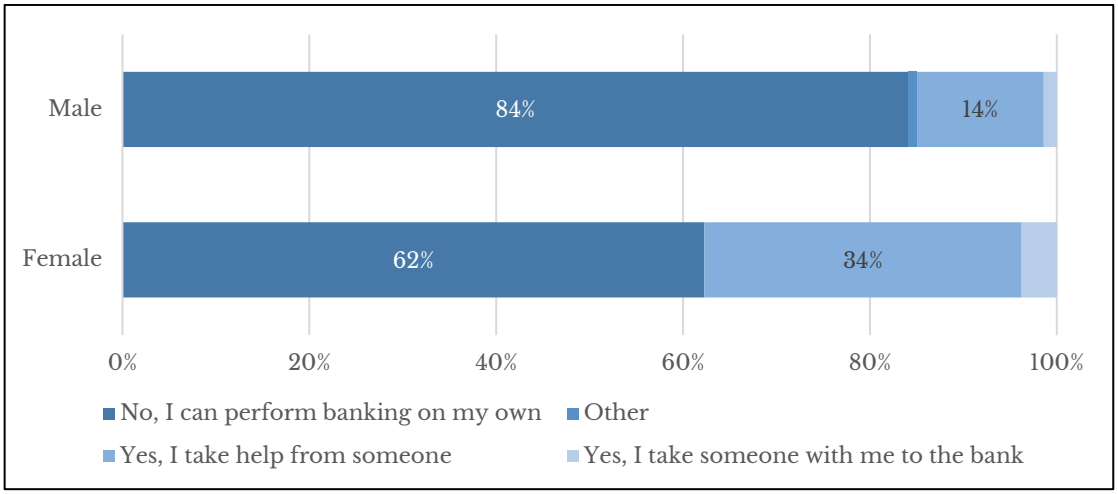


Figure 4.2-C Help needed in banking by gender

Female financial freedom is crucial for sustainable economic development. Without having the capacity and environment in which female customers can perform their banking and financial activities alone and in full freedom, we cannot expect them to truly have financial independence. We note that such financial freedom in banking operations is mediated by a host of financial and cultural factors. Nonetheless, in designing banking products and services, fintech service providers have an opportunity a gap created in the formal banking channel. Additionally, technological solutions can intervene in ways that supersede cultural barriers at times which is not possible through legacy systems like a physical bank.

The ratio of respondents who reported performing their banking activities on their own is higher in younger segments. But again, we note that respondents aged between 15-24 showed a slightly lower average. 77% of respondents in this category reported being able to perform their banking on their own, which was lower than the proportion in the subsequent two age groups. Also, the ratio of taking help from someone in older age groups was higher.

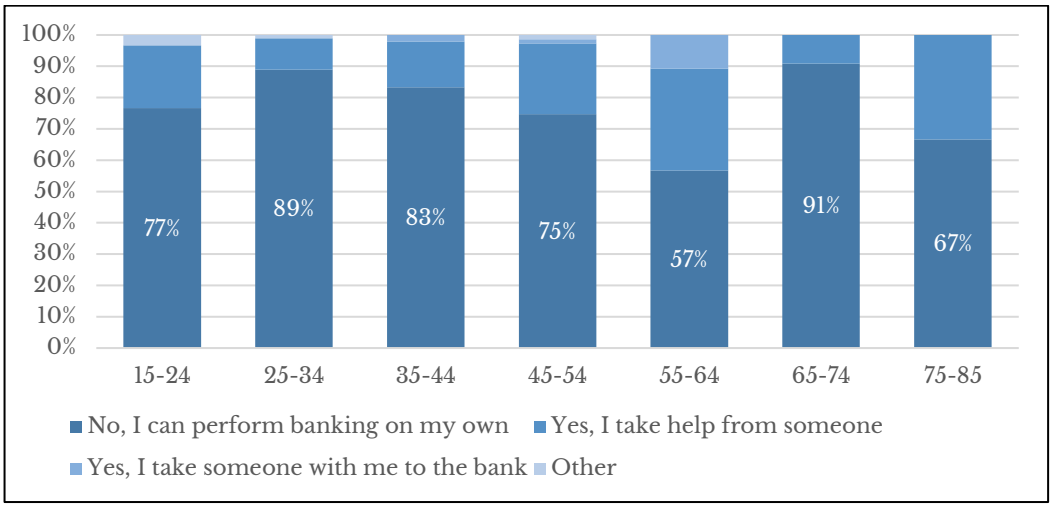


Figure 4.2-D Help needed in banking across ages

4.2.5.Confidence and Awareness Related to Banking Transaction

Although female respondents were more likely to seek help from someone in performing banking activity, according to our data they reported to be more confident in performing banking operations compared to male respondents. Around 39% of female respondents reported being "confident" and another 15% reported being "very confident" in banking activities. Among male respondents, 25% reported being "confident" and 4% reported being "very confident" in performing banking activities on a day-to-day basis.

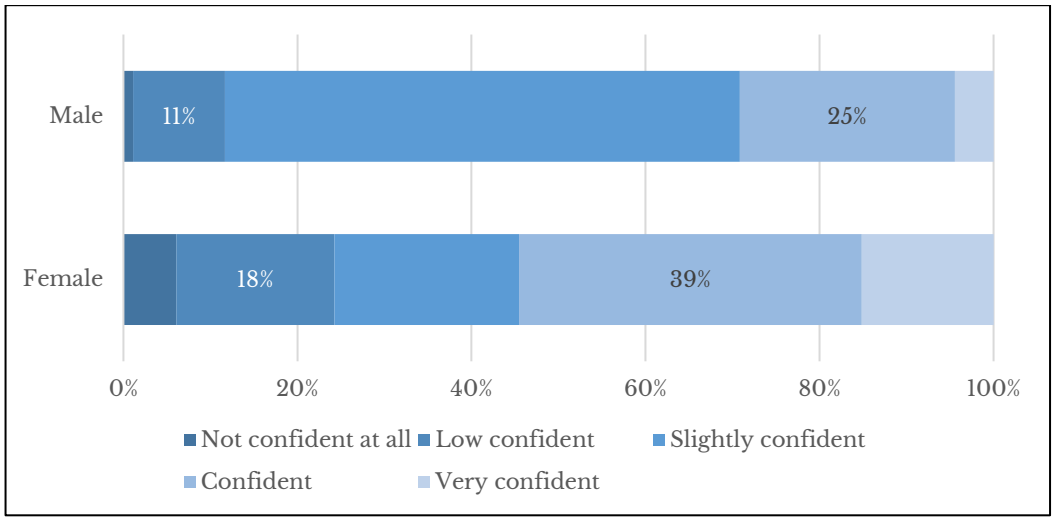


Figure 4.2-E-Banking confidence by gender

We note that confidence increased with age. Older respondents had higher proportions of confidence in performing day-to-day banking operations.

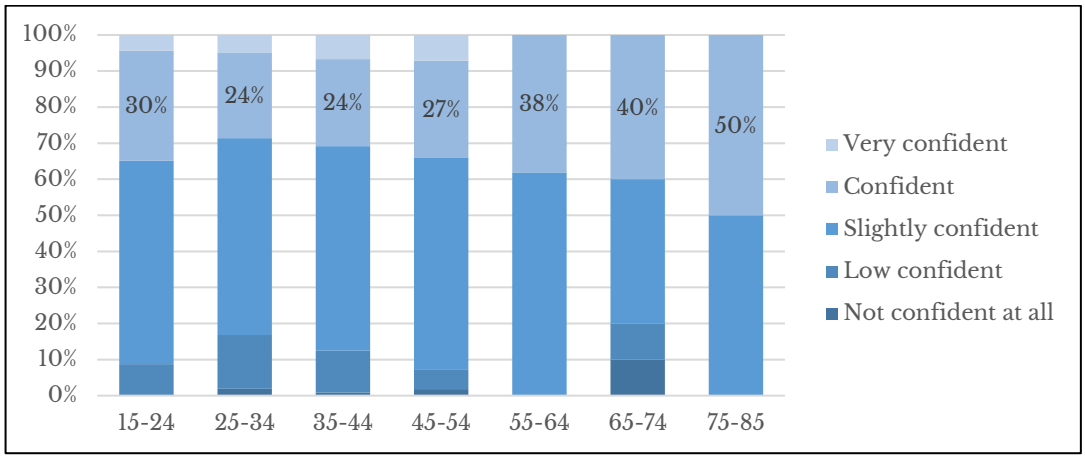


Figure 4.2-F Banking confidence by age

Another factor that impacts the confidence and future fintech readiness is respondents' current level of awareness of knowledge regarding banking activities. According to our survey, 37% of respondents said they have "no knowledge at all". Another 39% reported having "very little knowledge". Female respondents reporting "no knowledge at all" was 55% of total female respondents.

If we take the three pieces together, then female respondents take more help from someone for day-to-day banking activities, they have higher levels of reported confidence, and they report having little awareness about banking transactions. Better service design and awareness-raising interventions are needed to address this situation indicating a large gap in confidence and understanding of banking activities among female customers. Similarly, awareness is lower in higher age classes. In designing future fintech services, service providers should pay particular attention to female and senior customers to appeal to their needs.

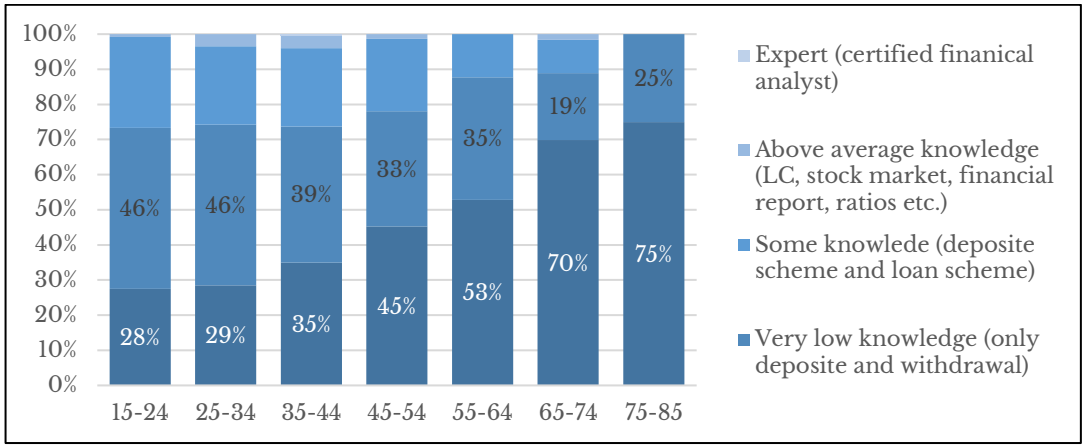


Figure 4.2-G Banking activity awareness by age

4.3. Computer, Smartphone, and Data Usage

4.3.1. Access to Computers

Access to computers remains limited across genders and districts in Bangladesh, as suggested by our survey data. The overall computer access rate according to our data is 18%. The rest 82% of respondents reported not having access to a computer in any way. This is an indication of inadequate computer access for a large part of the population. But this should be considered in conjunction with access to smartphones. Access to a computer is heavily skewed when disaggregated for gender. Around 20% of male respondents have access to a computer in one way or the other while the proportion is a mere 7% among female respondents. Of respondents with access to a computer, the majority have a personal computer at their home. Around 64% of the respondents reported having a personal computer at home. Another 14% reported they had access to someone else having a personal computer in their household. Around 20% reported using a computer from a friend or relative or colleague and only 2% reported using a cybercafé.

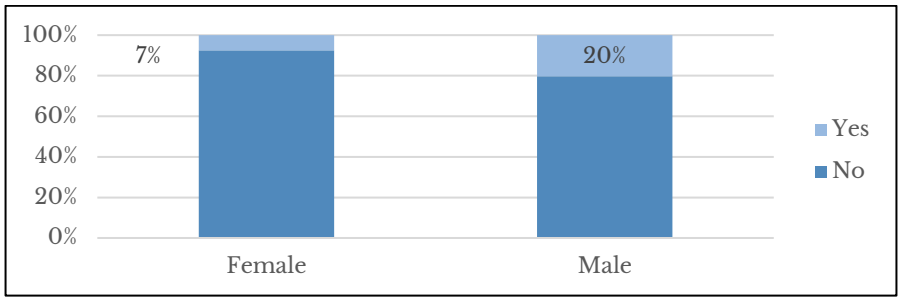


Figure 4.3-A Access to computer by gender

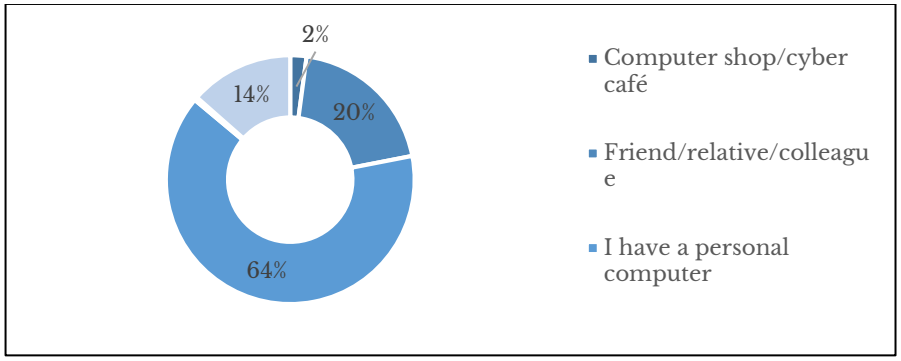


Figure 4.3-B Type of computer access

We observed considerable variation in terms of computer access across districts in our survey. The top three districts with the highest levels of computer

access were Rajshahi (44%) Kishoreganj (39%), and Chapai Nawabganj (32%). The lowest-ranking three districts were Mymensing (0%), Jamalpur (1%), and Bhola (8%).

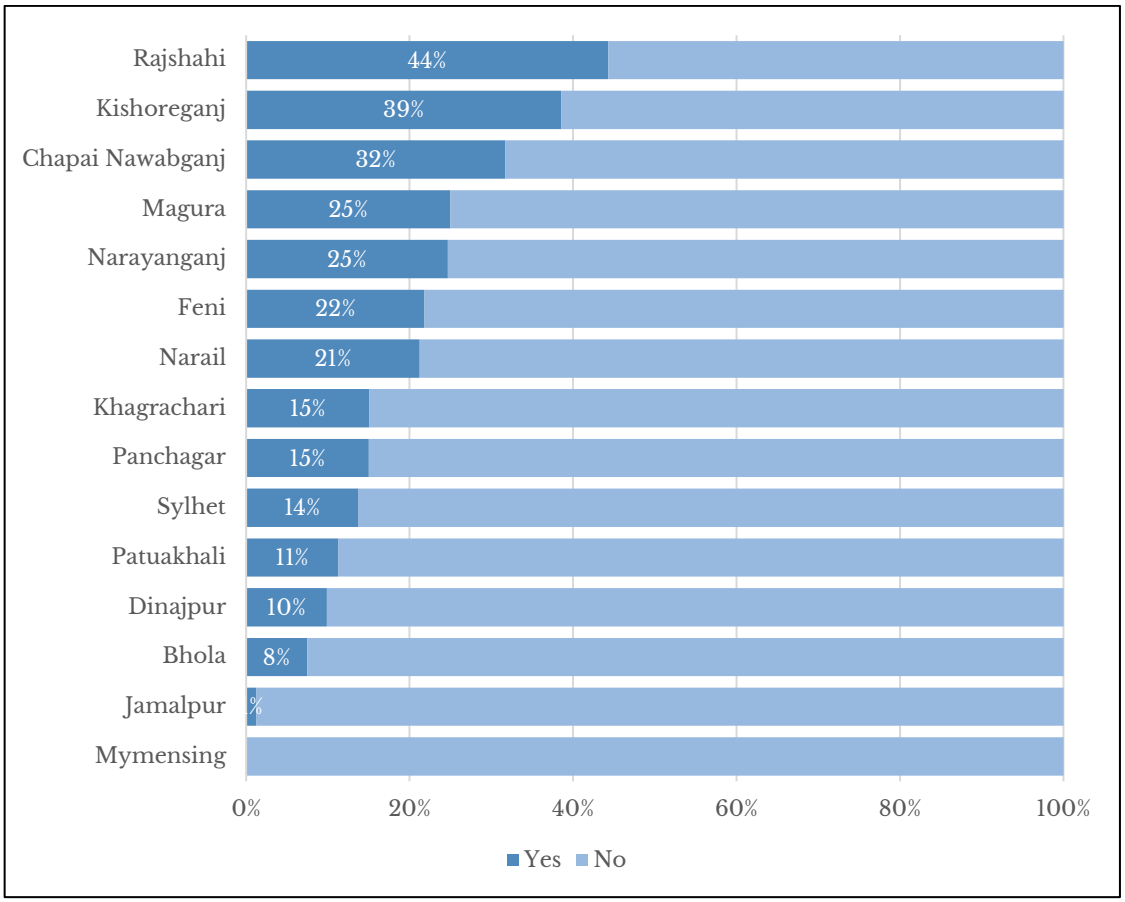


Figure 4.3-C Computer access across districts

4.3.2. Computer Skills

According to respondents' assessment of their computer skills, the majority of individuals had low or moderate levels of skills in using computers. Around 56% of respondents reported having "some skills" in using a computer. Only 14% reported being "skilled" and 11% reported being "very skilled" in operating a computer on their own. 16% of respondents reported having "very low skills". Male respondents reported higher levels of skills compared to female respondents on average.

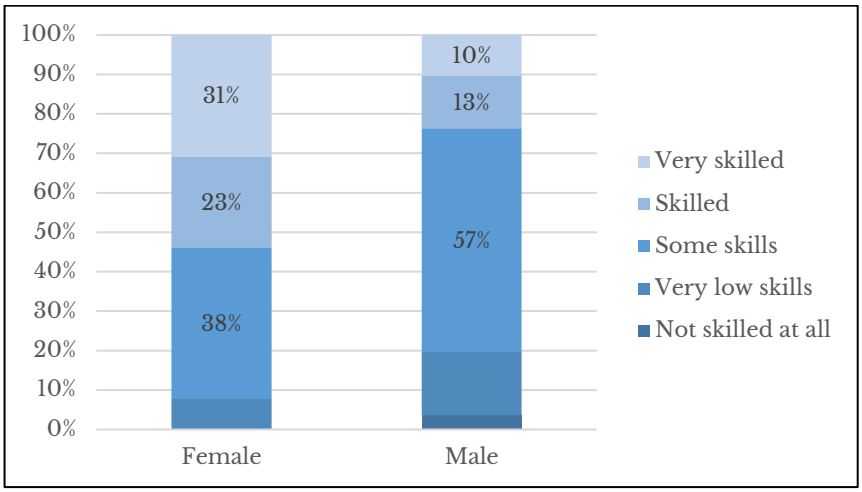


Figure 4.3-D Computer skills by gender

Reported skills in operating a computer were higher among younger respondents and lower among older respondents. This is expected due to the lower technology orientation of older generations of users. Markedly, the proportion of respondents "very skilled" in operating a computer was higher in older generations of users. This may be due to experience or due to an incorrect assessment of skills to the demands of new skill sets in the market. However, delving into the actual cause of this was beyond the scope of this report.

Similar to computer access, considerable differences were found in reported levels of skills in operating a computer among different districts across the country. The results were similar to the pattern observed in the previous chart.

An intriguing observation emerges from looking at reported skills for computers vs. smartphones. Even though respondents reported having low or no skills at all operating a computer, they reported having average skills operating smartphones. However, respondents did not report their smartphone skills to be very high across the survey.

Table 4.3-1 Computer skill and smartphone skill

Computer Skill	**Smartphone Skill**			
	Not skilled at all	**Very low skills**	**Skilled**	**Some skills**
Not skilled at all	1%	0%	0%	3%
Very low skills	1%	2%	4%	12%
Some skills	0%	2%	19%	42%
Skilled	0%	0%	9%	3%
Very skilled	1%	0%	2%	1%

4.3.3. Mobile Phone Ownership and Internet Access

The majority of respondents in our survey reported owning mobile phones of any type (smartphone or dumbphone). Contrary to the dearth of access to computers, most respondents had access to their mobile phones. According to our data, mobile phone ownership on average was 90% for the entire survey. Female phone ownership was slightly below average at 83%.

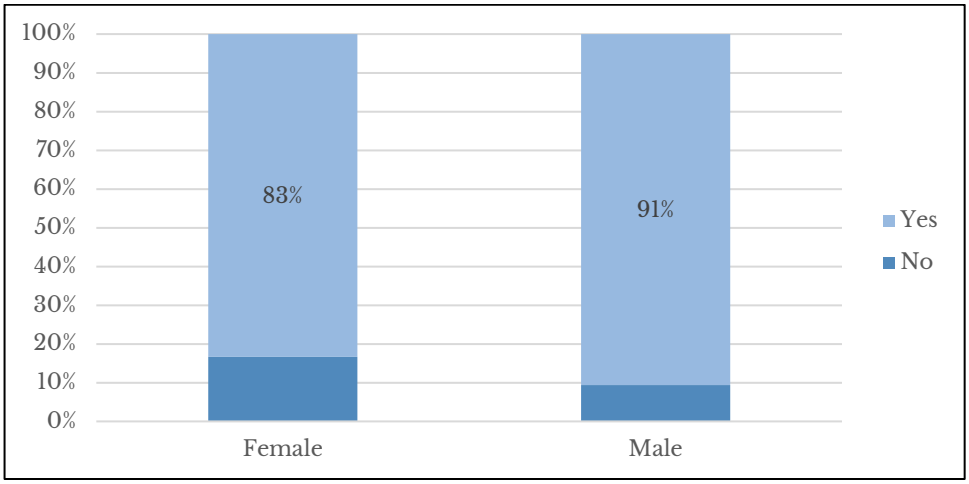


Figure 4.3-E Mobile phone ownership by gender

Phone ownership was consistently higher in younger age groups. For people aged between 15-24 phone ownership was a whopping 97%. This steadily declined to around 60% for people aged between 65-74.

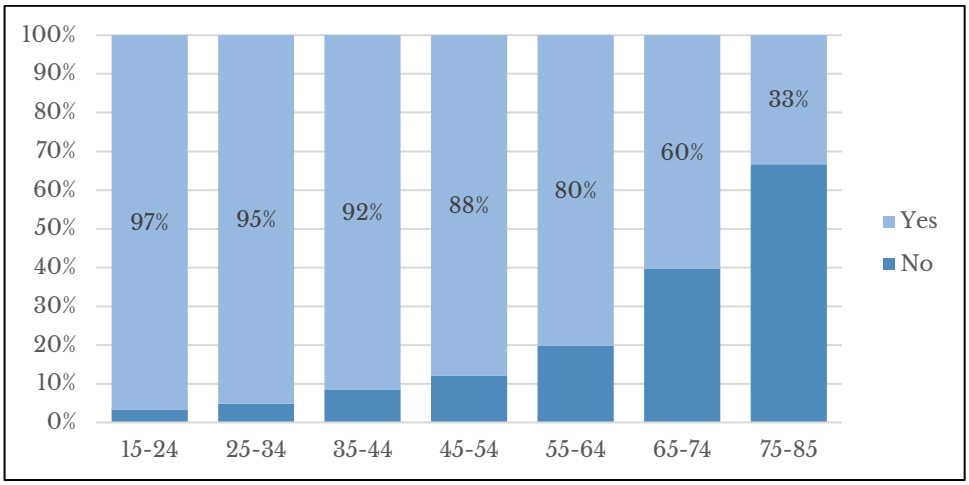


Figure 4.3-F Mobile phone ownership by age

There is some overlap between top and bottom-ranking districts in terms of access to mobile phones and access to computers. The top-ranking districts in terms of phone access according to our survey were Rajshahi (100%), Narayanganj (100%), and Feni (99%). The bottom-ranking districts were Patuakhali (73%), Bhola

(75%), and Panchagar (81%). We note that even in bottom-ranking districts, mobile phone ownership was considerably high. In terms of phone ownership, our survey data suggests that the general population is adequately prepared for the fintech services of the future.

Table 4.3-2 District-wise Phone Ownership

District	No	Yes	Grand Total
Patuakhali	28%	73%	100%
Bhola	25%	75%	100%
Panchagar	19%	81%	100%
Dinajpur	16%	84%	100%
Jamalpur	14%	86%	100%
Narail	14%	86%	100%
Sylhet	14%	86%	100%
Chapai Nawabganj	9%	91%	100%
Magura	8%	93%	100%
Khagrachari	3%	97%	100%
Mymensing	3%	98%	100%
Kishoreganj	1%	99%	100%
Feni	1%	99%	100%
Narayanganj	0%	100%	100%
Rajshahi	0%	100%	100%

This is even more so due to the increasing penetration of smartphone users. According to our survey data, 54% of phone users owned a smartphone and 46% owned a dumbphone. Fintech services are possible through dumbphones. But the range and speed of service delivery to customers owning a dumbphone are limited. Future fintech services are likely to incorporate a wider set of data and will likely require faster internet connectivity. These new fintech services will require users to use smartphones. Already we see the general population with a high level of phone ownership and a majority of those phone owners use smartphones. Going forward, smartphone ownership will increase as vendors can reduce prices further and extend physical stores closer to every semi-urban and rural center. One thing that vendors need to keep in mind is the slightly lower smartphone ownership rate for female respondents compared to male phone owners.

Apart from taking a district-wise look at phone ownership rates, we also wanted to see the level of smartphone and dumbphone ownership across districts included in our survey. The highest concentration of smartphone ownership was found in Kishroeganj (85%), followed by Narayanganj (79%), Feni (79%), Khagrachari (72%), and Rajshahi (70%).

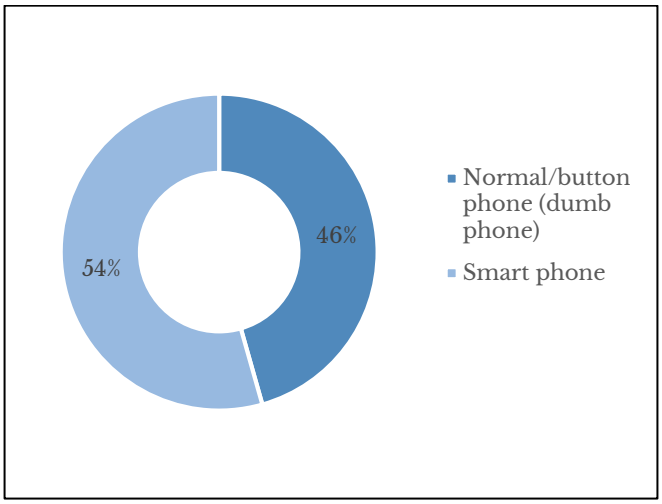


Figure 4.3-G Type of mobile phone ownership

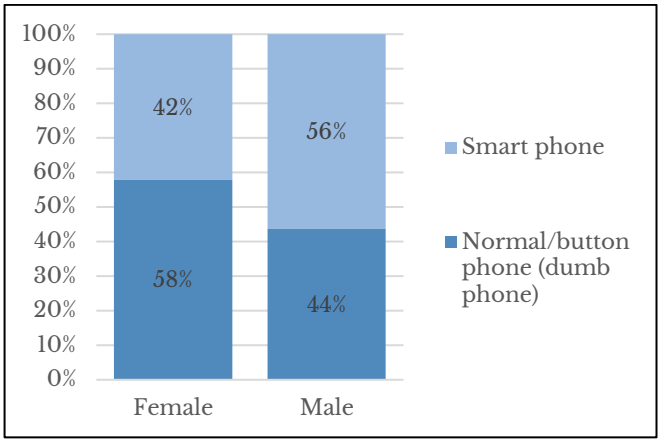


Figure 4.3-H Types of mobile ownership by gender

Table 4.3-3 District-wise Phone Ownership Type

District	Normal/button phone (dumb phone)	Smartphone
Jamalpur	84%	16%
Sunamganj	76%	24%
Dinajpur	72%	28%
Mymensing	69%	31%
Sylhet	62%	38%
Panchagar	62%	38%
Bhola	50%	50%
Magura	47%	53%
Chapai Nawabganj	40%	60%
Patuakhali	38%	62%
Narail	30%	70%
Rajshahi	30%	70%
Khagrachari	28%	72%
Feni	21%	79%
Narayanganj	21%	79%
Kishoreganj	15%	85%

4.3.4. Smartphone Usage Skills

Slightly higher than in computer skills, 14% of respondents in our survey indicated they were "skilled" in operating a smartphone. Another 39% of respondents said they had "some skills" in using their smartphones. Around 24% of individuals indicated they had next to no skills in operating a smartphone at all. The implication for fintech service providers is the need to design their service interfaces accordingly. Smartphone ownership rates, as we just mentioned in high. It is likely to go higher. But mere ownership of a smartphone cannot be taken as a proxy for skills in using smartphones, as this is also no guarantee that fintech service users are adequately prepared to take on more and more sophisticated fintech services that require a higher level of smartphone skills and greater involvement from the user.

Similar to female skills reported elsewhere in the report, the proportion of female respondents reporting to be "not skilled at all" in operating a smartphone is even higher. 40% of female respondents reported they have no skills at all in operating a smartphone. Coupled with the fact that senior respondents had even lower levels of orientation with smartphones, fintech service providers need to consider this carefully before rolling out a new service and designing their interfaces accordingly.

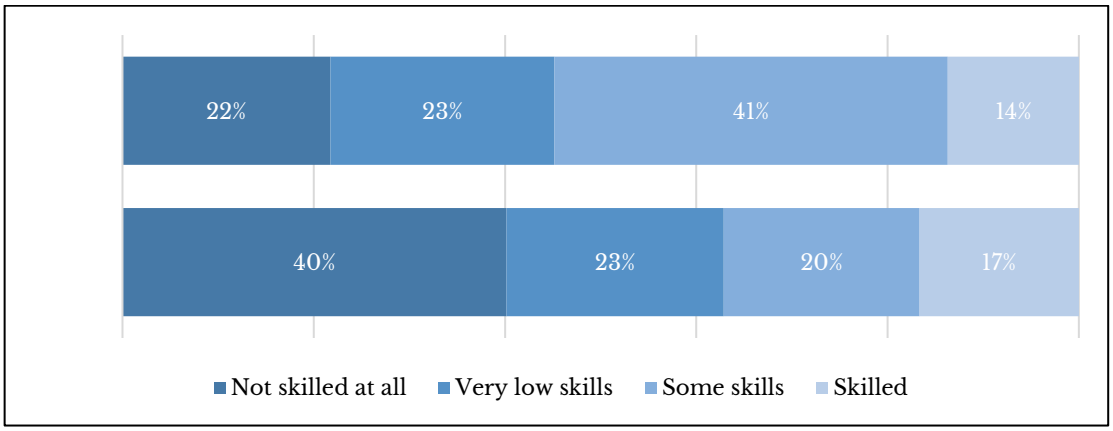


Figure 4.3-I Gender disaggregated smartphone skills

4.3.5.Internet Usage

Additionally, disaggregated monthly expenditure in different sectors could provide further insights into the relationship between the consumption of data and consumer spending in other areas of life. For example, we saw that with increased expenditure on entertainment, data consumption slightly increases.

This can be due to two factors. Increased spending signifies more disposable income, which makes it more affordable for users to consume more data. And entertainment itself can be purchased over the internet in the form of audio, video, and streaming services. This again indicates higher data consumption. District-wise data consumption shows considerable variation. Jamalpur ranked the lowest in terms of monthly average data consumption (3,553 megabytes) and Magura ranked the highest (26,932 megabytes).

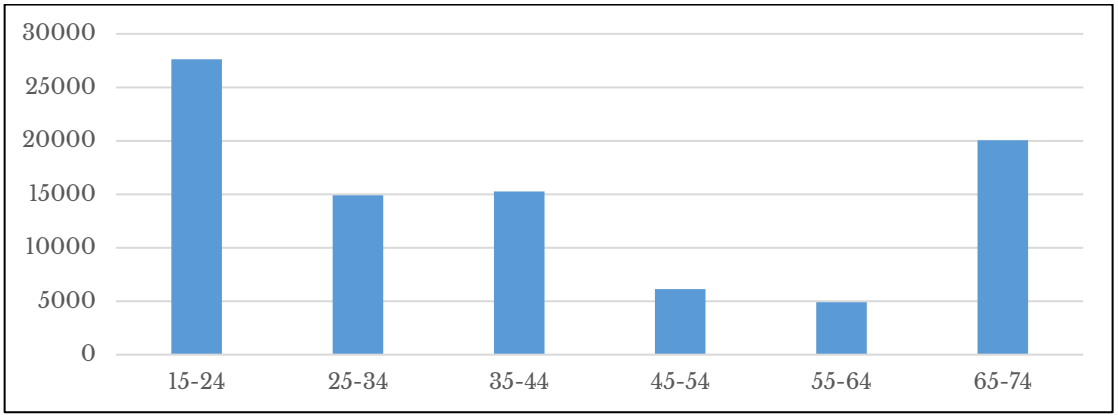


Figure 4.3-J Data usage (MB) per month by age

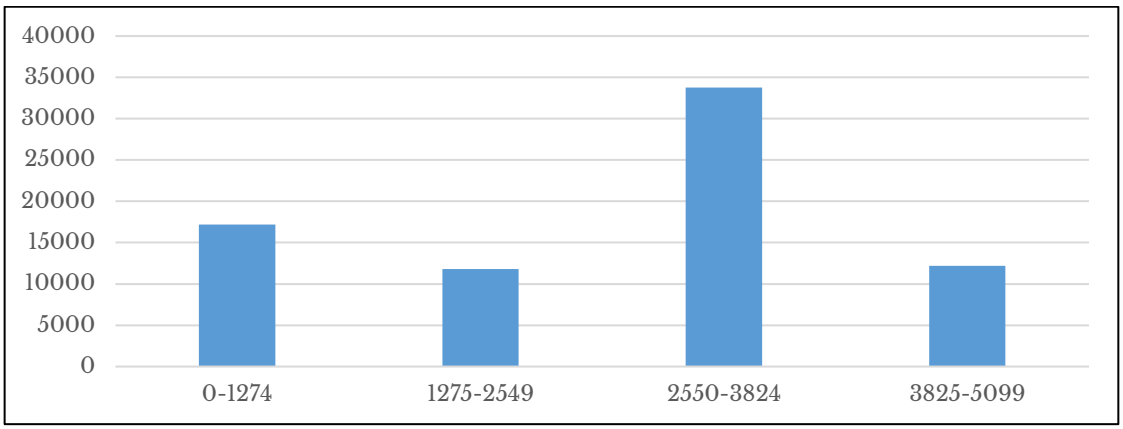


Figure 4.3-K Data usage (MB) and expenditure on entertainment per month

4.4. Concerns Related to Fintech Use and Mental Preparedness

4.4.1. Concern for Privacy

Fintech services require the collection and sharing of sensitive financial information. In the wrong hands, information such as these can be exploited for financial for the attacker and ruin it for the pertinent user. Privacy and protection of personal financial information is the first concern that users have the deal with the first time they venture into a new fintech service. Our data suggest that overall, 31% of respondents considered privacy as 'high' or a 'very high' concern for them. Around 27% of respondents were 'more or less concerned about privacy in fintech platforms. Only 4% of respondents considered privacy a very low concern for them. At the same time, we noted a significant portion of respondents (17%) reported having not known the concern regarding privacy in our survey. Fintech service providers in Bangladesh need to invest more in customer education.

Customer education needs to focus on two issues. Fintech service providers need to bring down the portion of respondents who still don't know the privacy concerns. It becomes a great deal of responsibility for the platform to empower users with the necessary knowledge tools to form awareness. Next, service providers need to take adequate measures to protect customer privacy.

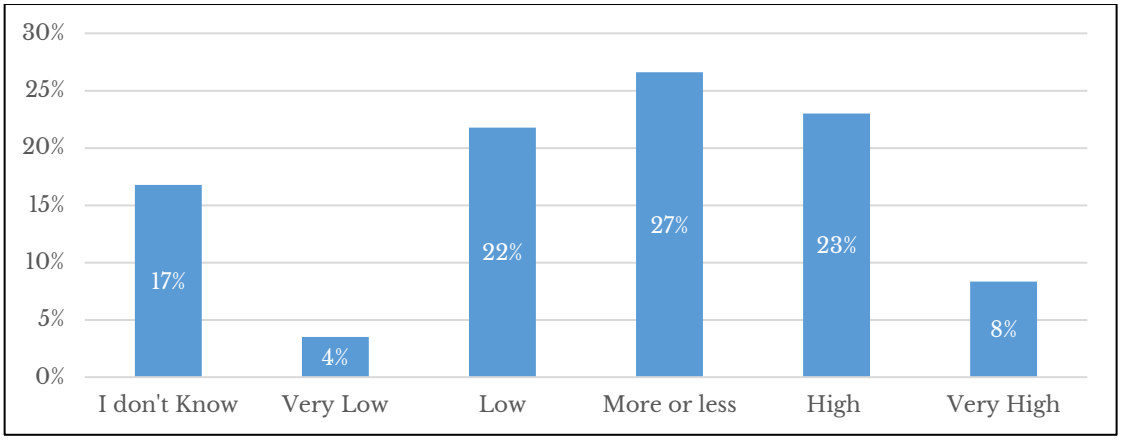


Figure 4.4-A Concern related to privacy

Security of sensitive financial information has to be ensured. This will have to be done by safeguarding both old and new users of the platform from external malicious attacks. However, when it comes to protecting customer privacy, fintech service providers need to understand how internal digital infrastructure plays a big role. Robustness of the internal digital infrastructure in place in the face of

attacks should continue to be of strategic business importance and a primary target for regulatory scrutiny.

Across gender, our data show no significant difference between male and female respondents. Both were almost equally distributed across different levels of privacy concern. Around 33% of women had high levels of concern for privacy which was 31% among men. A distinct pattern emerges in concern levels across respondents from different age groups. Firstly, very high levels of concern were relatively lower in the youngest age group in our survey. Around 19% of people aged between 15 and 24 had high levels of privacy concerns. This jumped to 30% for respondents aged 25-34, and 26% for respondents aged between 35-44. Beyond this age group, high levels of privacy concerns again start to decline. But the proportion of respondents with no knowledge regarding privacy concerns increases.

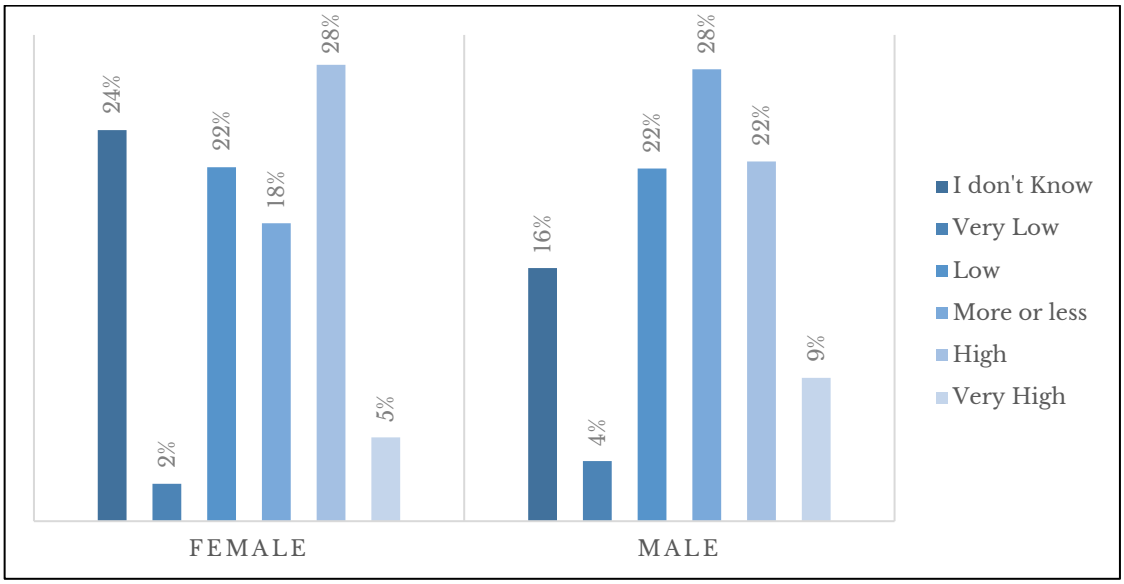


Figure 4.4-B Privacy concern in men and women

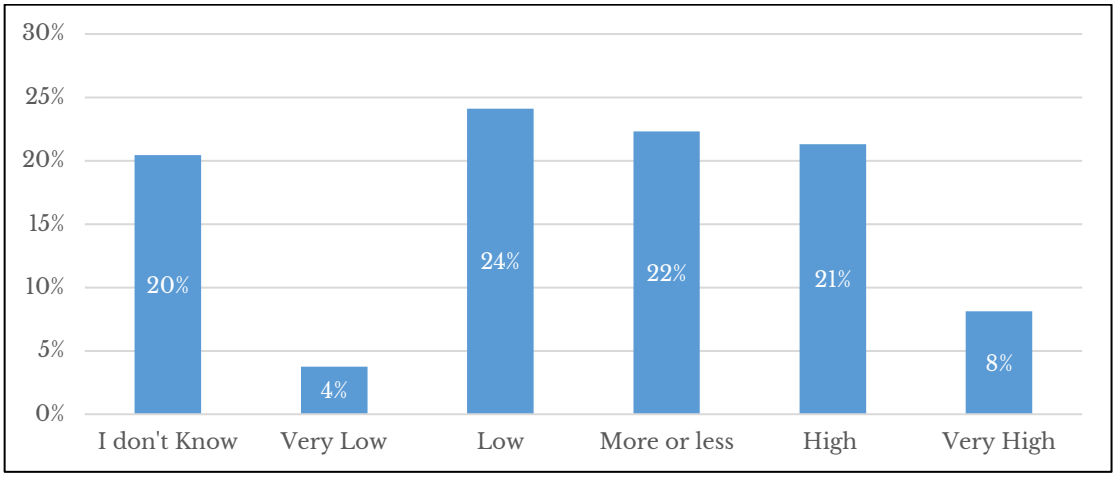
Around 23% of respondents aged 45-54 did not know about privacy concerns. For people aged 55-64, 40% did not know about privacy concerns. Lack of knowledge of privacy concerns in fintech use was highest for people aged 75-85 (our highest age category). 67% of people in this group lacked knowledge regarding issues of concern related to privacy in fintech services usage.

4.4.2. Concern for Unknown Issues

A new technology incites unknown fear among common users. Some of these fears have a rational basis, such as the potential for a hacker attack on the

Internet banking system. Others are purely in the realm of paranoia. This is not just the case with fintech. For example, when the first electricity connections were being established in the US, people were concerned about what would happen when excess electricity overflowed from sockets and filled up the entire floor, completely invisible but ready to kill anyone who stepped on it. In our survey, we asked respondents to assess their concern for unknown but potentially harmful issues in the use of fintech services. Around 22% of respondents said they had more or less some concerns regarding these issues. Around 29% expressed very high levels of concern for unknown issues in the use of fintech services.

Customer education is key in this area as well. We note that mobile banking operators in Bangladesh have done a great deal in providing educational content through different marketing media. These were aimed at addressing the fear of the use of a new financial service built on top of technology. The widespread use of mobile banking wallets today is testimony to the success of these awareness campaigns. Nonetheless, we see a sizeable portion of respondents fearful of unknown issues. This should be addressed by more innovative channels of awareness. We expect the overall use of fintech service to go up once these concerns are properly addressed.



Fintech service providers in particular will have to focus on educating women regarding unknown issues. Our data suggest a larger portion of women are concerned about unknown issues in fintech usage compared to men. Around 35% of women surveyed expressed high levels of concern with unknown issues which was 31% among men. 24% of women said they didn't know about unknown issues in fintech which was also lower in men (16%). Only 2% of women said they had very low concern for unknown issues in fintech use. This was 4% among men.

Across age groups, unknown issues were a greater concern for ages groups. For people aged 25-34 (28%), 34-44 (34%), 45-54 (38%), unknown issues was a high concern. The lack of knowledge regarding unknown issues was higher in older age groups. For example, 46% of people aged 65-74 said they didn't know about unknown issues in fintech usage.

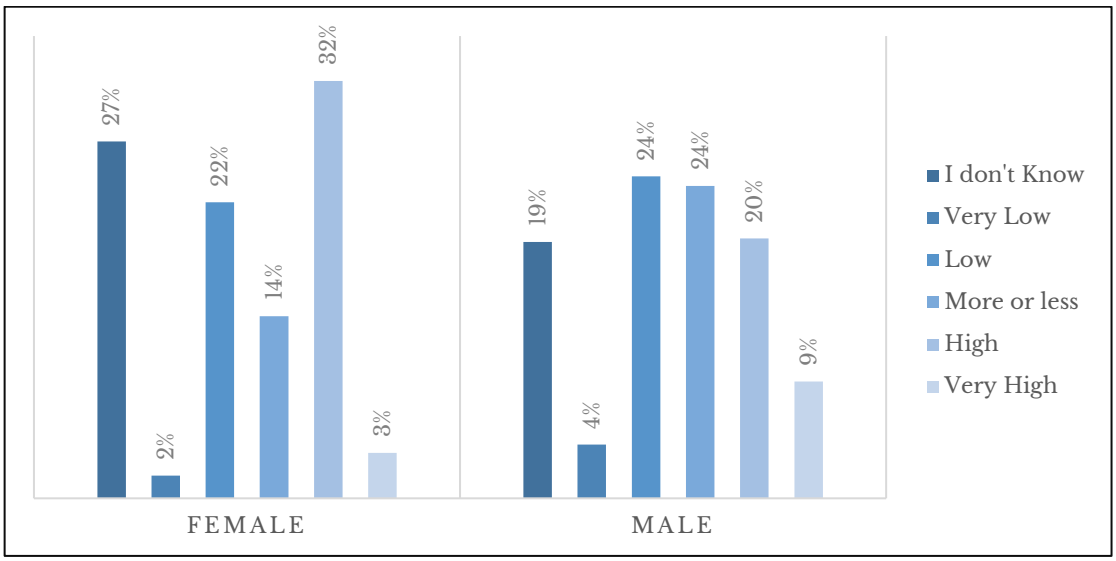


Figure 4.4-C Unknown issues concern in men and women

Respondents from higher levels of monthly income were less likely to be concerned about unknown issues in fintech use. In our survey, respondents were mostly from lower-income groups across the country.

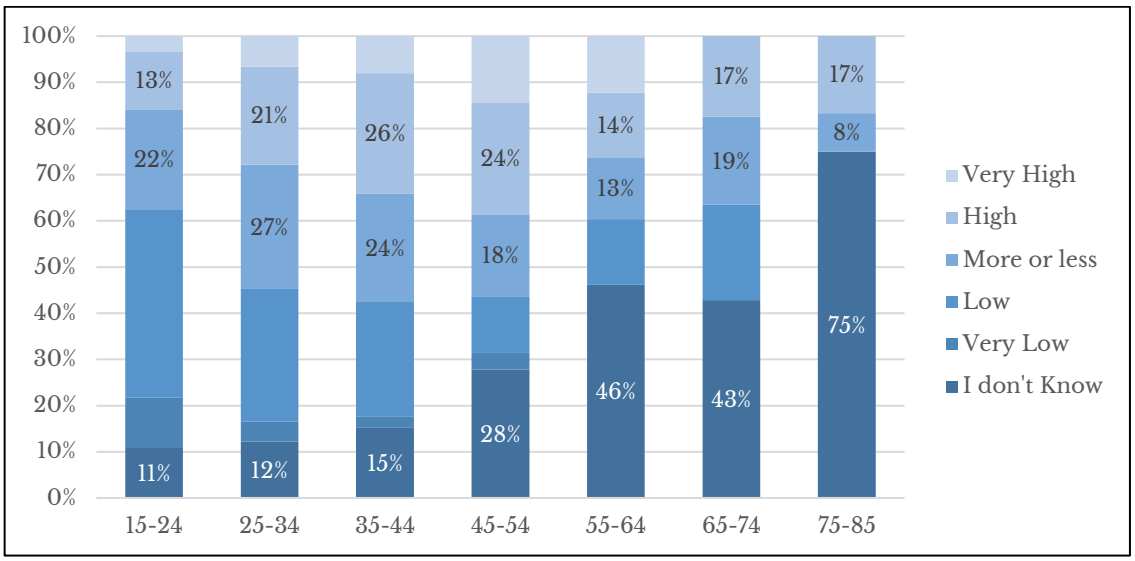


Figure 4.4-D Unknown issues concern across age groups

4.4.3. Concern for Limited Control from Government

Fintech platforms are relatively new to the financial services landscape. This is not just the case for Bangladesh. Throughout the world, regulators are thinking hard to find out a way to bring fintech platforms under control for the greater benefit of every participant in the fintech ecosystem. This concerns customers above all others. According to Bangladesh Bank's (BB) guideline for mobile financial services, mobile banking services need to be somehow affiliated and under the majority control of scheduled commercial banks; thus, falling under BB supervision. Going forward, we will need a more direct approach to fintech regulation. To make space for non-affiliated start-ups to bring their innovative prowess into the fintech ecosystem and incite competition, regulators will need a more thorough framework of fintech service regulation and risk management. We asked respondents to report the extent of their concern about limitations of government control over existing and emerging fintech services as part of our survey.

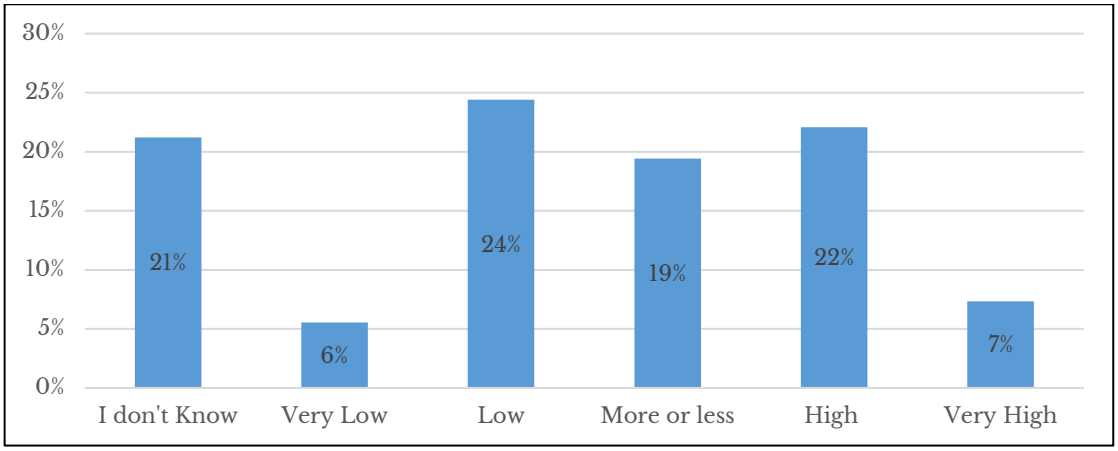


Figure 4.4-E Concern related to government control limitation

Respondents in our survey were more or less equally divided in terms of concern for limited government control. Around 29% had high levels of concern for this. While 30% of respondents reported having low levels of concern. 21% of the people surveyed did not have adequate knowledge regarding this issue. Similarly, there were no significant differences across genders with concerns about limitations of government control.

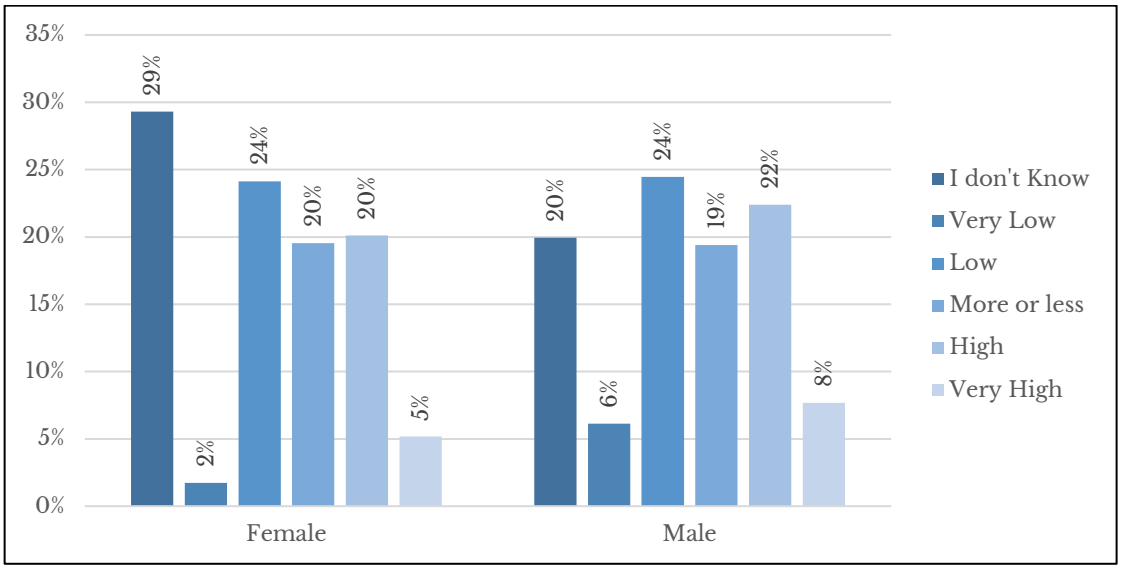


Figure 4.4-F Government control limitation concern in men and women

Across age groups, concern for government control limitations was highest among people aged between 45-54 of whom 36% expressed high levels of concern. Concern was also high among people aged between 35-44. For younger and older respondents, we found relatively low levels of concern. And similar to other areas of concern reported in this section, older generations exhibited significantly high proportions of users lacking adequate knowledge regarding this issue.

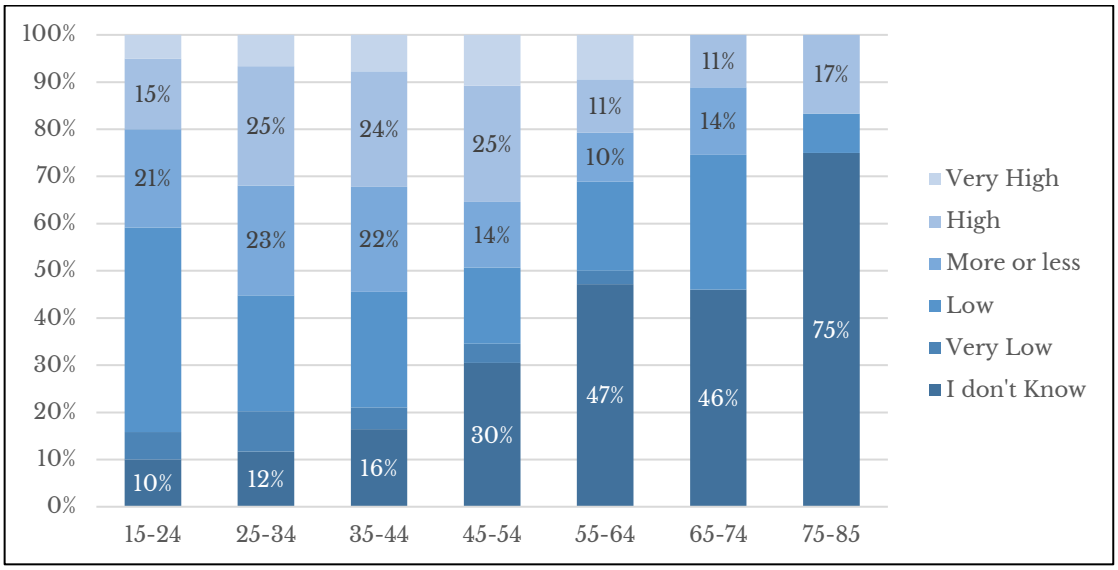


Figure 4.4-G Limited government control concern across age groups

4.4.4. Concern for Financial Scam/Scandal

The financial scam is the biggest fear factor in fintech service usage. For understandable reasons, customers are weary of the constant possibility of scams.

A series of possible financial scams can render fintech users devastated. In traditional digital banking services such as the use of credit cards to make an online payment, the risk of credit card fraud and information theft was high. The range of fintech services is wider and keeps expanding. It is difficult for the common user to fathom all the possible ways their money can be scammed by malicious entities. It comes down to fintech service providers to make their systems more robust. We see customers regularly being scammed over mobile banking wallets like bKash and Rocket despite repeated and costly investments for services providers to target users with educational content. This demonstrates a salient feature of the challenge in fintech security. A wide range of users with little to no institutional education or training in financial decision-making benefit from fintech use. It is difficult to bring them all on par with the security challenges of fintech use and take necessary precautionary measures. In most cases, the measure in question is as simple as not sharing security codes with unknown entities. Yet, consumers get scammed in innovative new ways almost every month.

However, our data suggest that despite a collective failure to make everyone aware of security breaches, respondents are well informed of the degree to which financial scamming is a concern in fintech usage. In fact, among all the concern areas respondents were asked to evaluate, financial scam ranks first. Around 44% of respondents in our survey reserved high levels of concern for financial scams or scandals in fintech usage. Equally alarming was the fact that despite these repeated attacks on individual mobile banking accounts around 22% of respondents said they do not know about concern factors related to a financial scam. Also, only 2% of respondents reported financial scams as a very low concern in fintech usage.

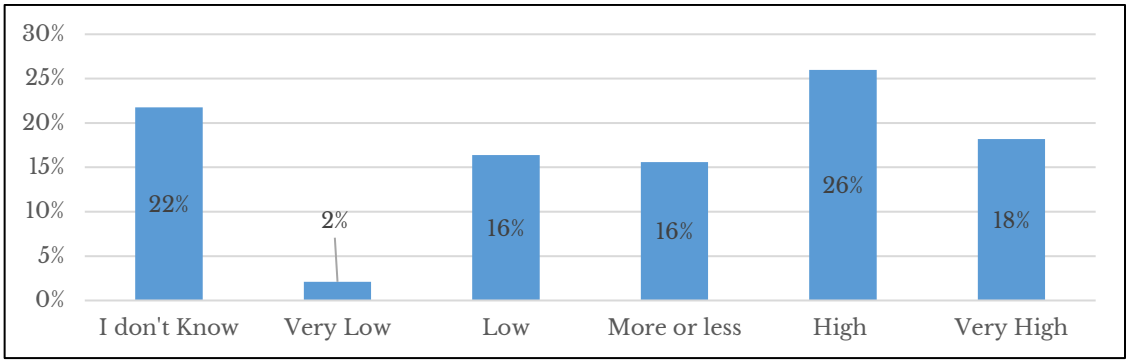


Figure 4.4-H Concern related to financial scam

The pattern of high concern for financial scams in using fintech services was largely gendered agnostic. We did not find any significant differences across

genders for levels of concern in this issue. Age however revealed a clear pattern. In the youngest age group, concern for the financial scam was the lowest (27% with high concerns). If we look at levels above some concern ('More or less'), 69% of people aged 25-34, 66% of people aged between 35-44, 56% of people aged 45-54, and 45% of people aged between 55-64 were concerned. 31% of people between 45-54 and 45% of people aged between 55-64 did not know about the financial scam concern of fintech usage.

For respondents with higher monthly income, concern for the financial scam was relatively higher. This is expected. Individuals with higher levels of income tend to do greater volumes of transactions with fintech. For example, we would expect high-income users of a mobile banking wallet to reserve a higher balance for cashless transactions. Similarly, they can be expected to use Internet banking more often and for larger transactions. A potential attack on these accounts can cause greater harm by forfeiting a larger monetary value.

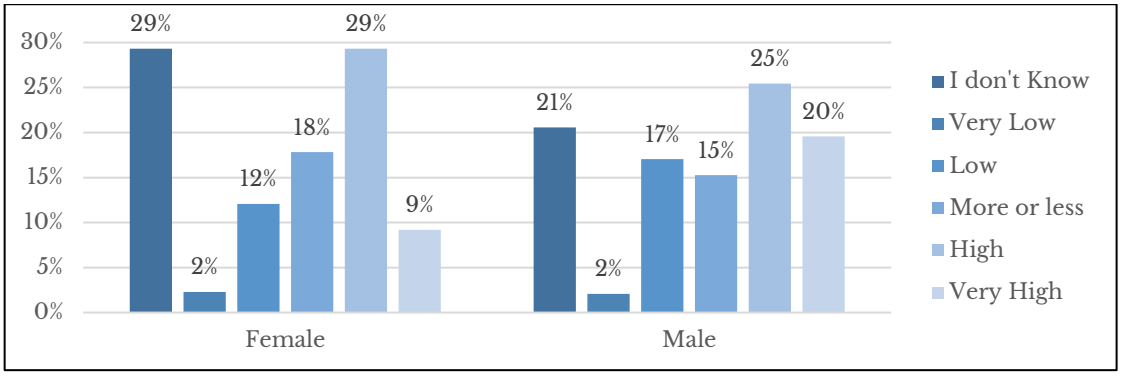


Figure 4.4-I Financial scam concern in men and women

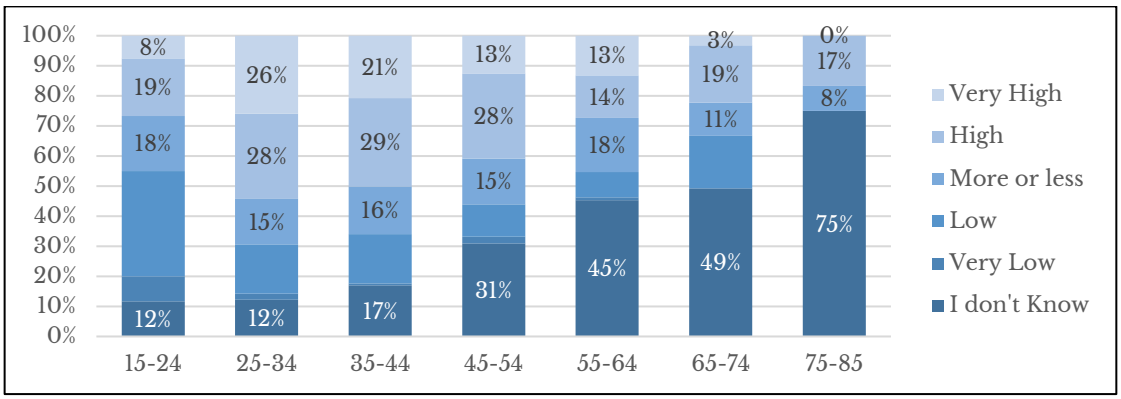
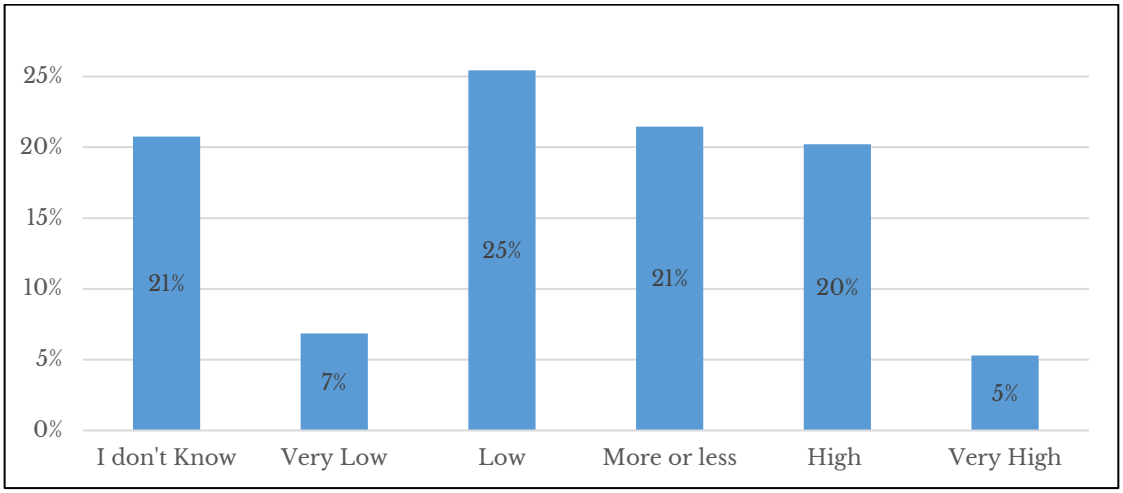


Figure 4.4-J Financial scam concern across age groups

4.4.5. Concern for Cashless Society

For centuries, cash has been the standard mode of transaction. Cash transactions offer individuals with speed and cost-efficiency. Fintech today offers alternatives to cash and offers to address age-old problems that came with the storing and usage of cash currencies. For one, cash is problematic for large volumes of transactions. Costs associated with the transportation, verification, and security of cash grows exponentially with larger and larger volumes of transaction. Cash also is relatively less durable compared to previous metal currencies and new fintech alternatives. At the same time, cash is difficult to manage across accounts and institutions. Fintech offers solutions to all these. Mobile wallets, cryptocurrencies, and Internet banking accounts allow users to do large quantities and volumes of transactions at light speed without incurring significant costs. However, the leap from centuries-old cash to a new form of transaction takes time on the consumer's end. After all, currencies are all about trust.



For the success of mobile banking wallets and other forms of currencies which can be expected in used in Bangladesh very soon, trust in a cashless community is required from the majority of the users. For our survey, we looked at the level of concerns customers have related to a future cashless society. We found around 25% of respondents reported high levels of concern, but 32% reported low or very low levels of concern. At the same time, 21% reported not knowing about the issue. Going forward, we believe concern for a cashless society should be brought down by the proper development of cashless payments infrastructure. Cost is the major source of concern for a cashless community. In peer countries like India, the use of Uniform Payments Interface (UPI) enables

massive numbers of cashless transactions to take place at fractions of the cost consumers have to carry here in Bangladesh for their mobile banking wallets. A regulatory framework conducive to payment systems architecture with drastically reduced transaction cost will be key in garnering support for people to complete the shift to cashless modes.

This is gender ubiquitous. Women (men) were not more likely to be concerned about the onset of a cashless community than men (women). This implies again that concern for cashless is universal. Although there was a declining trend among respondents of high and higher age groups in terms of concern or cashless community. This however was less pronounced compared to concern for other issues covered in this section; again, this implies cashless community is a largely common concern among respondents.

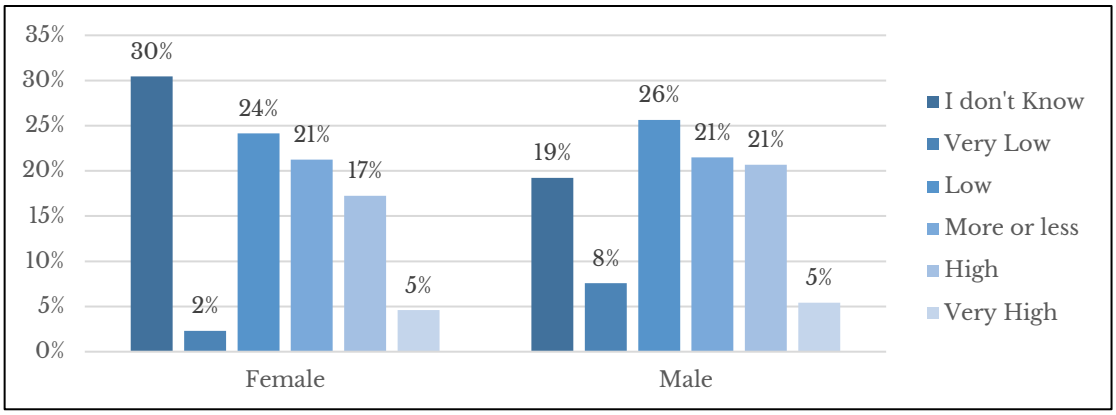


Figure 4.4-K Cashless community concern in men and women

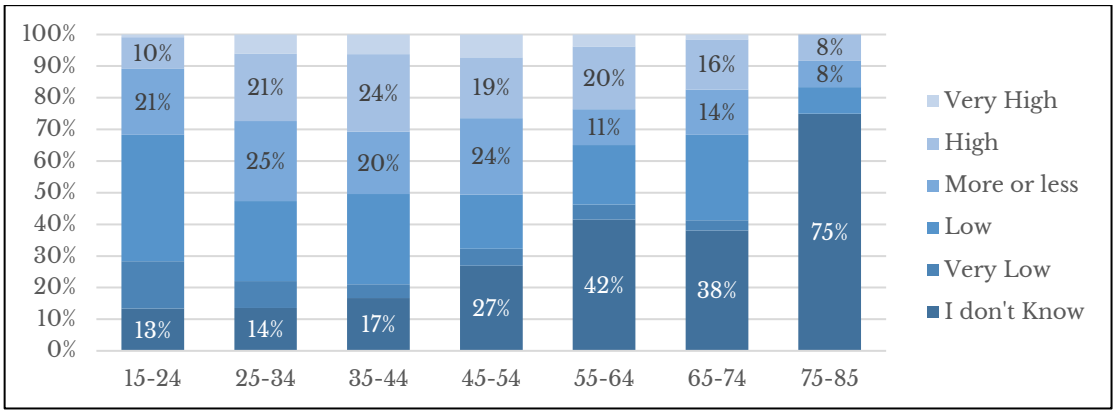


Figure 4.4-L Cashless community concern across age groups

Cashless community concerns prevail among respondents in all income classes leading to further confirmation of the issue being universal for our survey sample.

4.4.6. Concern for Information Security

Information security is a pervasive concern for digital technology services of all kinds. The wave of the fourth industrial revolution (4IR) services that combine transformative powers of technology with services required by people has this in common. In InsureTech (Insurance technology), RegTech (Regulatory Technology), PropTech (Property technology), and fintech, the chance of a data breach is high and always imminent. Digital infrastructures need to cope with constantly evolving forms of threats and hope to stay ahead of the curve. In fintech, the concern is more sensitive due to the service being directly linked with money. As explained in previous concern areas, people's hard-earned savings and investments are put to the test by using fintech services. Naturally, concern for the security of information resting in the hands of fintech service providers and mediators is high. A two-step approach seems effective for service providers. The first was related to the strengthening of digital infrastructures. The second is about creating customer awareness.

While a healthy degree of concern for information security is needed on the customer end, unusually high levels of fear of information security threats are detrimental to the large-scale implementation of fintech services for greater societal benefits. We would expect customers to stay on alert. But we should be critical of a high level of fear. Such fear needs addressing by fintech product developers, service providers, channel managers, mobile network operators, banks, and certainly the government agencies responsible for the safety and resilience of these systems. Part of our survey was dedicated to assessing customer concerns for information security in fintech use. We found a significant portion of respondents expressing a high or very high level of concern regarding the security of the information they provide to fintech services (38%). However, this should not only revolve around the information provided by the customer. The information generated in fintech systems as a result of customer interaction is also valuable and requires protective measures. These include transaction history, account balance information, financial planning, and budget, savings and loan information, patterns of purchase through payment systems, etc.

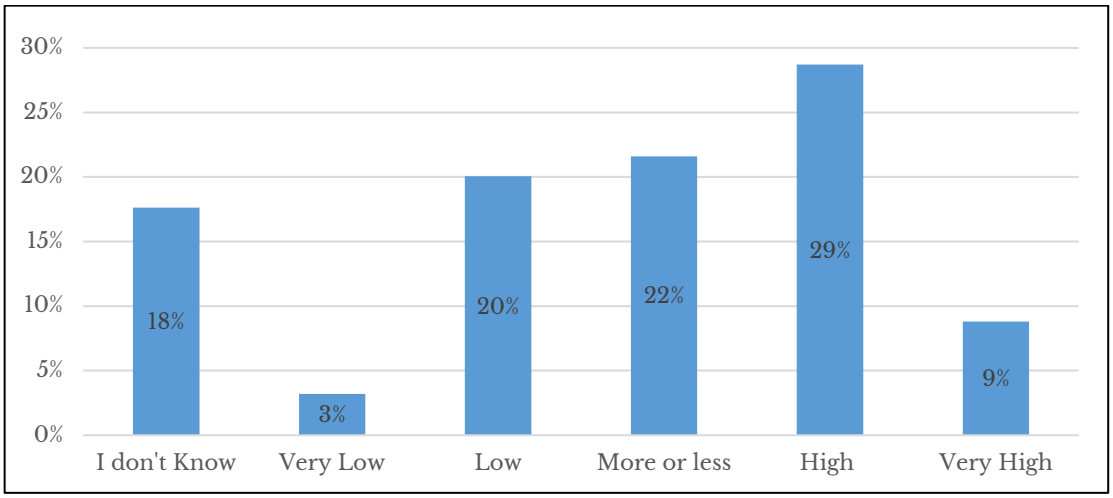


Figure 4.4-M Concern related to information security

We propose that this is a healthy indication of customer awareness regarding very real security risks related to financial information within the fintech ecosystem. Luckily, we find only 3% of survey respondents with very low levels of concern on the matter. Concern for information security was high across most of the age groups considered in our survey. 31% of people aged between 25-34 and 33% of people aged between 35-44 expressed high concerns for information security in fintech use. Three were people with very levels of concern in this age group as well. We note the slightly lower level of concern among people aged 15-24 with a high or very high level of concern on the matter (28%). Younger users tend to have smaller savings and a smaller number of transactions on fintech platforms. The potential for large losses in the event of a data breach is high for these individuals nonetheless. Since data-related purchase history, credit card information, subscriptions, etc. are sensitive and can be used to inflict considerable damage on the user.

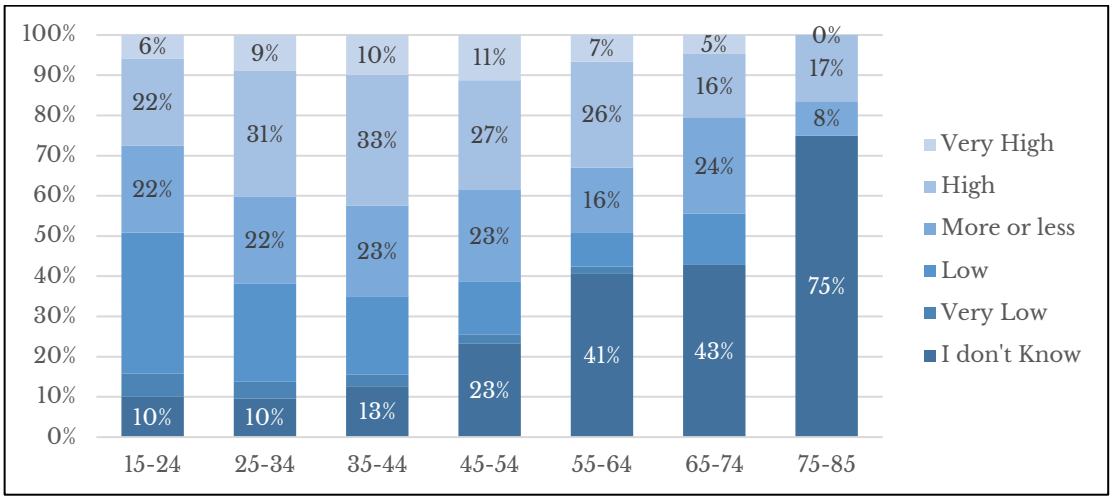


Figure 4.4-N Information security concern across age groups

We expect fintech service providers in Bangladesh to adopt the two-step approach and continue to invest in their internal security structures. At the same time, service providers by law should be required to deliver effective awareness content to existing and new users for their safeguard. These would have to be targeted to all genders since our data shows no pattern in levels of concern regarding information security in men vs. women.

Service providers can target more content toward lower-income users. Our data suggest concern levels are already high among users with higher levels of monthly income. However, information security threats affect individuals of all income classes. They can face potentially lifelong security issues from a single breach. Since the fintech ecosystem is moving towards integrated apps containing all financial and non-financial solutions under a single app, we can expect similar trends in emerging economies. As Bangladesh moves more and more towards a unified digital architecture for a wider range of fintech solutions, information breaches can have spillover effects due to integrated datasets. Fintech platforms cannot afford a single weak link in the chain.

4.4.7. Overall Mental Preparedness

Mental preparedness among customers for fintech use is low across the country. Our survey data reveals that 16% of respondents report being 'not prepared at all for fintech service usage. 29% of respondents report being 'low prepared' while another 34% report 'average preparedness'. Unfortunately, only 5% of respondents in our survey throughout the country were found to be 'adequately prepared' for fintech services – both existing and future ones.

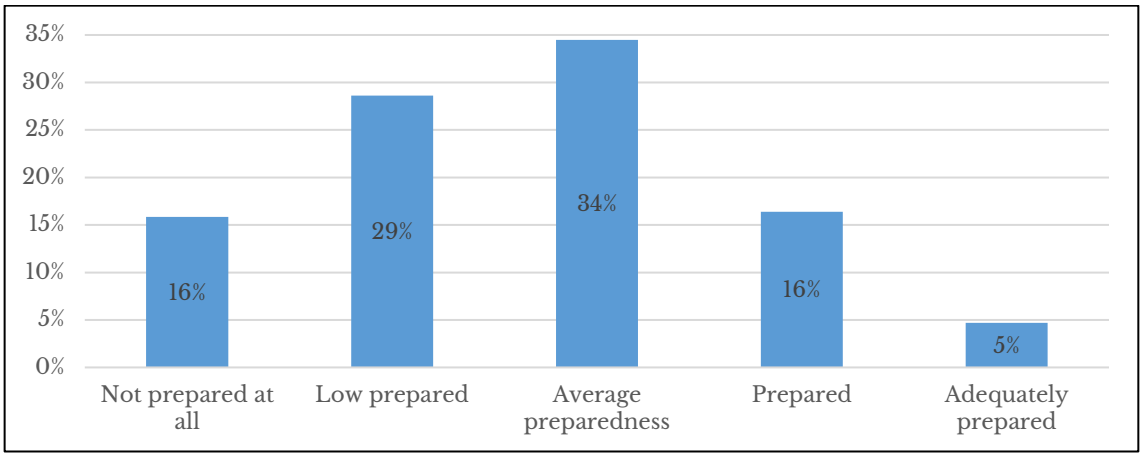


Figure 4.4-O Mental preparedness for fintech use

4.4.8. Mental Preparedness Across Demographics

It is important to look into the demographic details of being mentally prepared for fintech service usage. Our data suggest women are even less prepared than men. Around 24% of respondents report being 'not prepared at all' (compared to 15% of men). Women respondents rank lower in being 'prepared' to use fintech as well (11% of women compared to 17% of men). Investment aimed at addressing preparedness for future fintech services should prioritize women. Since women's financial independence and security are linked to a larger set of socio-economic welfare at the household and community levels, preparing female customers for more value-adding fintech ensures equitable distribution of benefits promised by fintech services and platforms.

Older users will also need some sort of prioritization. This is based on our observation that there is a steady rise in reporting being 'not prepared at all' to use fintech for customers in older age groups and a steady fall in confidence being 'prepared' or 'adequately prepared'. The two levels of preparedness constitute 44% of people aged 15-24. This then reduced to 24% for people aged 25-34, 20% for people aged 35-44, and 17% for people aged 45-54. In the 45-54 age group, 24% of people reported 'not being prepared at all'. 34% of people aged 55-64 and 40% of people aged 65-74 were not at all prepared to use fintech. Mental preparedness to use fintech increased with monthly income. We also found a slight upward tendency of mental preparedness to use fintech services as the respondents' data usage increased.

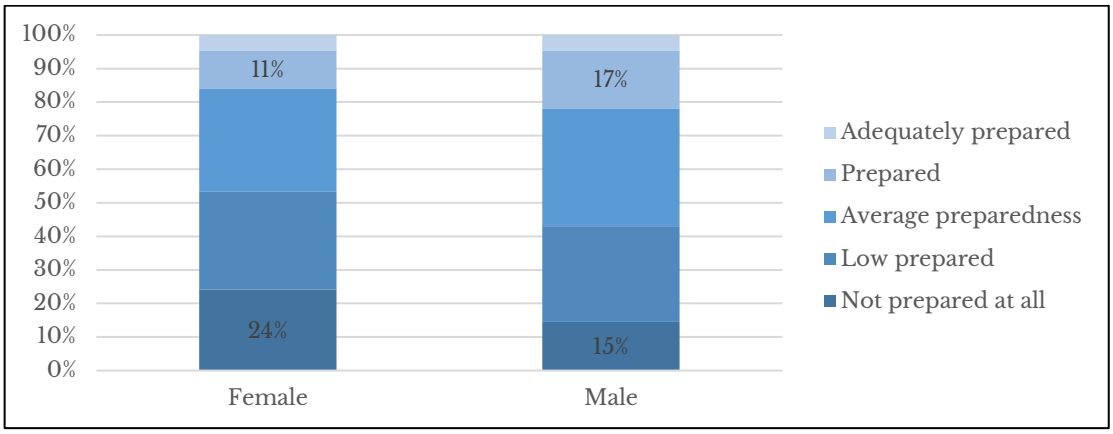


Figure 4.4-P Mental preparedness in men and women

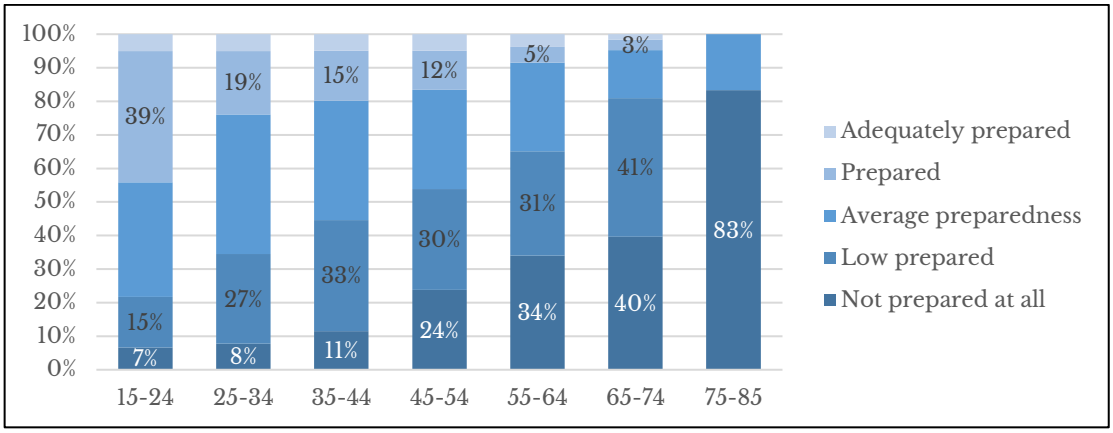


Figure 4.4-Q Mental prepared for fintech use across age groups

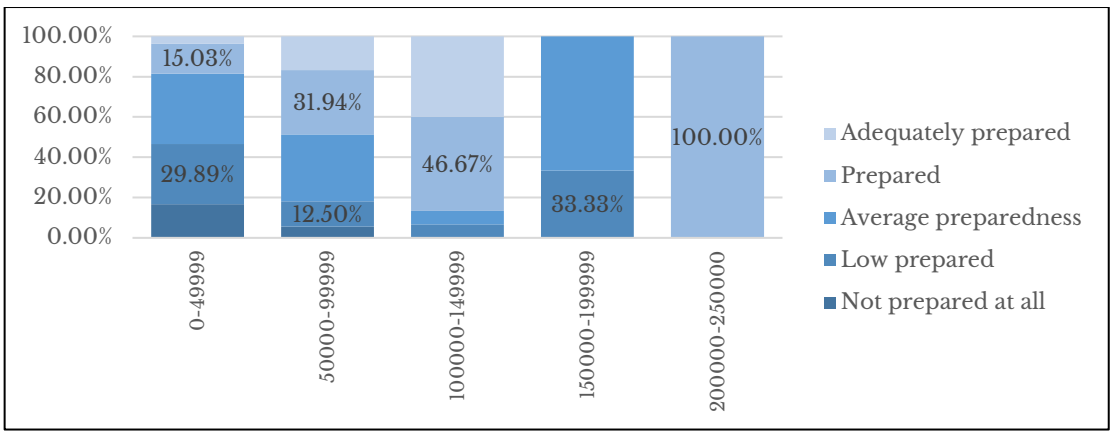


Figure 4.4-R Mental prepared in different income classes

4.4.9. Mental Preparedness in Different Districts

Mental preparedness to use fintech services was markedly lower in northern districts including Panchagar, Dinajpur, Chapai Nawabganj, and Rajshahi. People reporting to be not prepared at all for fintech use in these districts constitute around 56%, 23%, 20%, and 15% of total district respondents surveyed respectively.

The highest concentration of adequately prepared respondents was found in Feni. Sunamganj, Sylhet, Mymensing, and Narayanganj reported relatively high levels of mental preparedness.

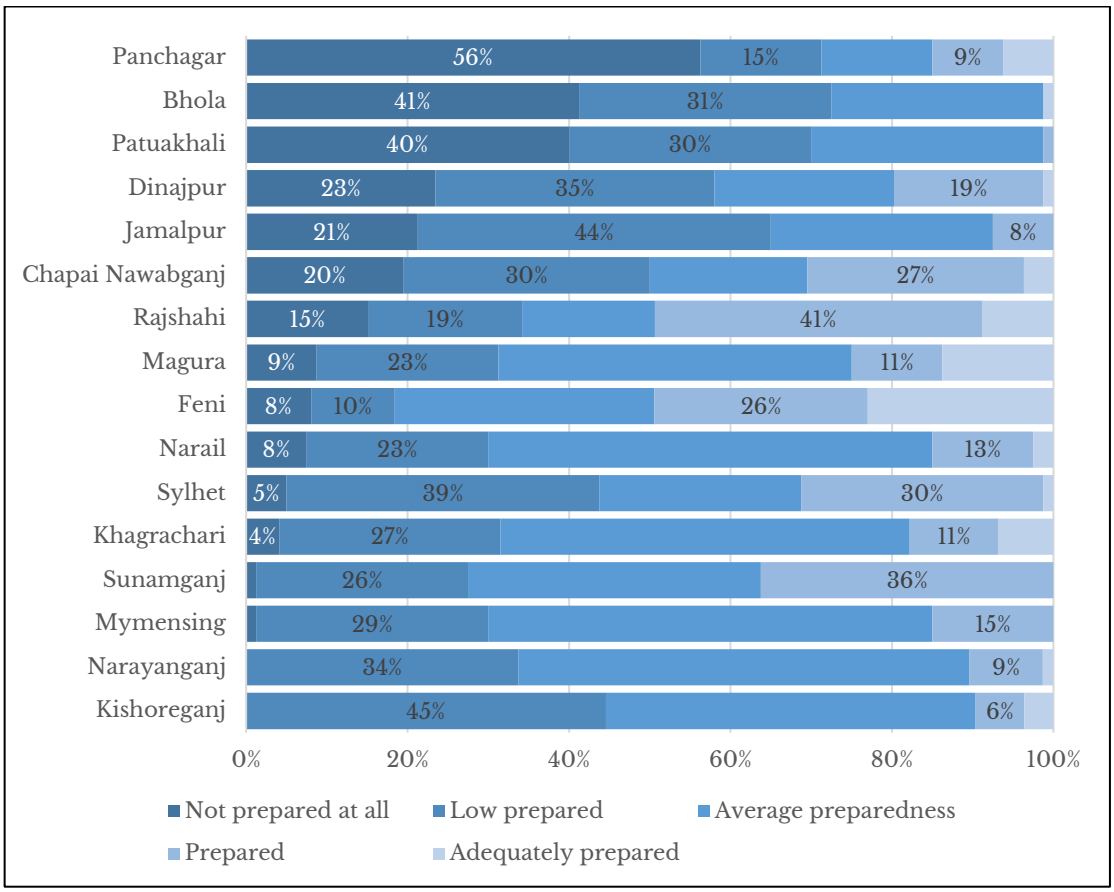


Figure 4.4-S Mental preparedness across districts

4.5. Mobile Banking Usage

4.5.1. Mobile Banking Account Ownership

A majority of respondents owned a mobile banking account at least with one of the available mobile wallet service providers. In our survey, 72.85% of respondents said they had a mobile banking account. Account ownership was slightly higher among male respondents. We also found a gradual decline in account ownership in higher age groups. This could be due to access to smartphones or a lack of necessary digital skills to utilize mobile banking services. However, elsewhere in our survey, we saw older respondents were more likely to rely on either family members or friends to access digital financial services. This

could also be the reason for decreased account ownership status in older age groups in our survey.

We looked at mobile banking account ownership to economic variables. No particular relationship between monthly income and expenditure was found. This is interesting given how we expected higher income classes to have higher levels of mobile banking account ownership. However, this can be explained by the relatively low transaction cost of mobile banking services. Due to the convenience of opening a mobile banking account and decreasing transaction costs, all income classes have access to at least a baseline level of mobile banking facilities. However, account ownership was found to be higher as respondents' annual savings increased.

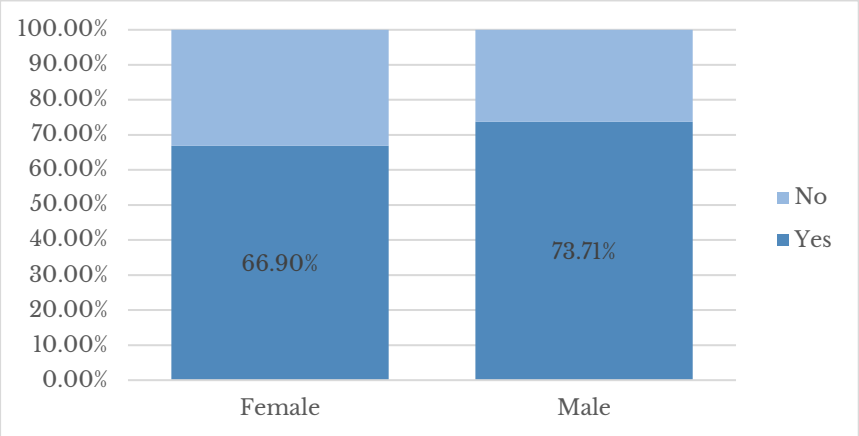
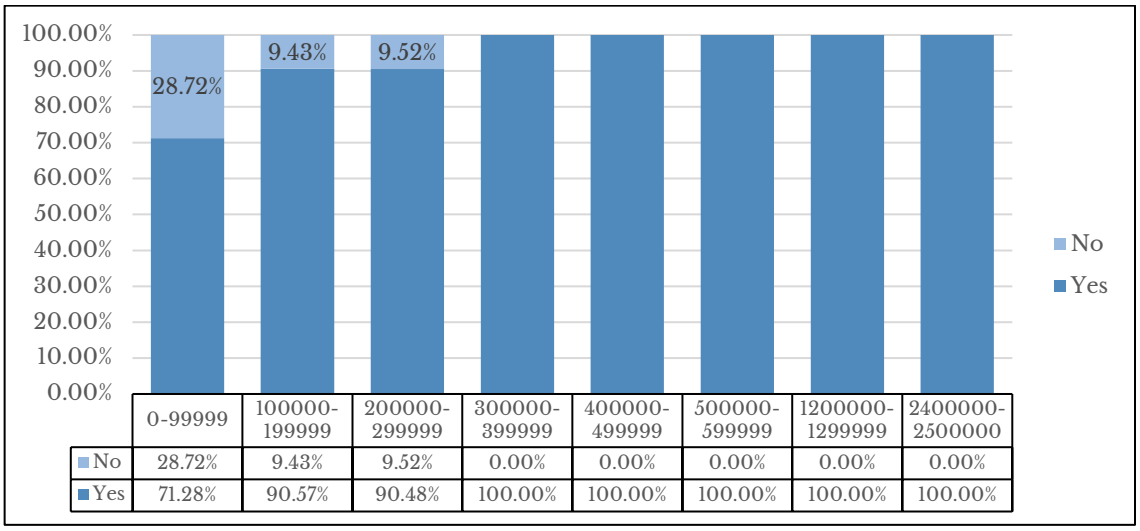


Figure 4.5-A Gender disaggregated mobile phone ownership

We found 100% account ownership status for all respondents with annual savings of BDT 300,000 or above. Since high savings individuals are more likely to already take traditional banking services higher levels of mobile banking accounts in these savings groups are expected. Current and future fintech service providers can benefit from prioritizing low-net-worth individuals through newer and more cost-competitive services since the high-end market is already saturated.



	0-99999	100000-199999	200000-299999	300000-399999	400000-499999	500000-599999	1200000-1299999	2400000-2500000
No	28.72%	9.43%	9.52%	0.00%	0.00%	0.00%	0.00%	0.00%
Yes	71.28%	90.57%	90.48%	100.00%	100.00%	100.00%	100.00%	100.00%

Figure 4.5-B Mobile banking account ownerships across levels of annual savings

4.5.2.Services from Mobile Banking

A host of services are offered in mobile banking apps. The number and scope of these services are increasing to make financial transactions across platforms more convenient for customers. In our survey, we asked respondents about the type of services they received using their mobile banking accounts. The type of services includes, among others, money transfers, mobile recharges, loan transactions, credit card bill payments, utility bill payments, and shopping bill payments. The most common service received by customers in our survey was money transfer. Of the respondents, 56% responded yes. This was followed by mobile recharge, utility bill payment, and shopping bill payments.

Understandably, almost none of the respondents used their mobile banking accounts for loan transactions, bank deposits, investments, and insurance bill payments. Financial technology platforms like mobile banking apps have had significant contributions to financial inclusion. These platforms bring people from remote areas and marginal social classes into the formal financial system and provide them with an array of affordable and convenient financial services. However, mobile banking apps will also have to act as the connective tissue between the legacy banking ecosystem and the end users. To derive the full range of benefits, customers should effectively interact with the formal channels of banking and financial services. This means loan and deposit payments and receipts, subscriptions to insurance products, and paying bills for specific financial products. Our data suggests there is room for improvement in these categories.

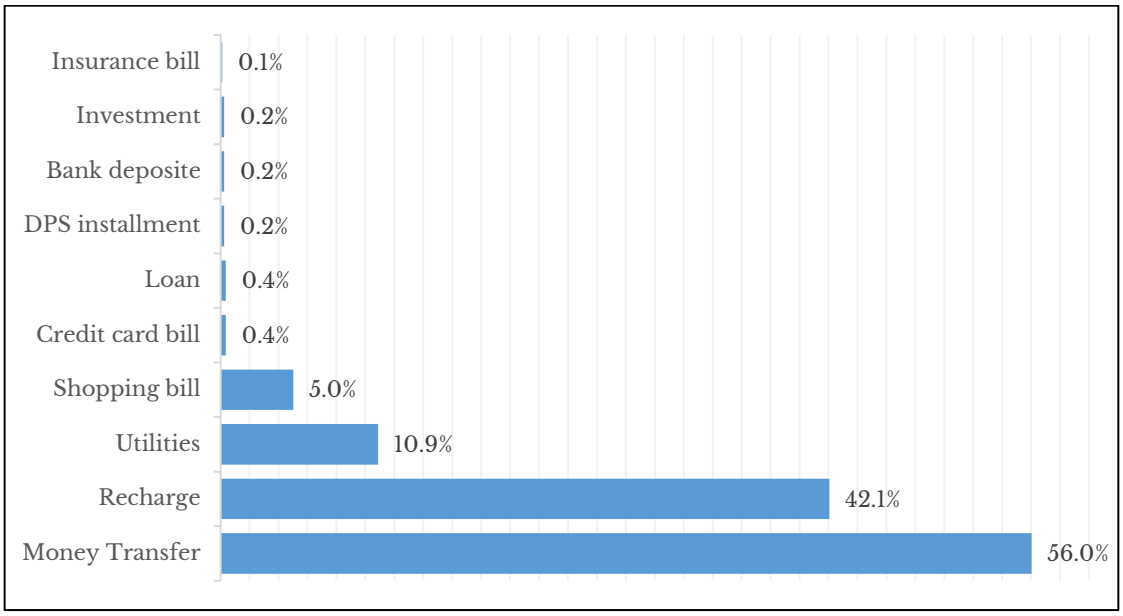


Figure 4.5-C % of respondents using mobile banking for different services

Leading mobile banking platforms in Bangladesh have expanded their range of services in recent years. Led by bKash, mobile financial services providers are now offering investment, loan disbursement, credit card bill payment, internet bill payment, and investment products (for example, Figure 1 shows services available in the bKash app). However, both banks and MFS providers need to expand these to areas other than Dhaka to allow people across the country to access these services fully. MFS providers will have to focus on convenience and affordability. Banks and financial institutions also need to build processes that allow for seamless service delivery on the customer end. Going forward, the industry has significant growth potential in these pockets of the market.

In terms of mobile banking account ownership, both female and male respondents were at par with each other – as stated previously. Female respondents lagged in virtually all mobile banking services compared to males. The only exception was shopping bill payments (female 5.15% and male 1.49%). This is important since account ownership in itself does not bring the benefits of mobile financial services. The informational, financial, affordability, and technical obstacles leading to this discrepancy require thorough assessment. Mobile financial services providers will have to approach customers – female users in particular – to help them use these services more frequently.

4.6. Satisfaction with FinTech Services

4.6.1. Overall Satisfaction with FinTech

Overall, 37.05% of respondents surveyed reported they were either satisfied or highly satisfied with fintech services. Only .11% of respondents reported high dissatisfaction with fintech services being used at present.

Notwithstanding Internet banking users being a minority in our survey, we looked at a comparative picture of satisfaction with mobile banking vs. Internet banking. A majority portion (93.27%) of respondents chose mobile banking over internet banking as their most satisfactory choice for fintech services. This is expected since our survey found only a handful of active Internet banking users. However, this is yet another piece of evidence that mobile banking, in terms of functionality and perceived customer satisfaction, is miles ahead of Internet banking. Banks and financial institutions that are currently offering Internet banking services – either parallelly with mobile banking services or solely through a web interface – need to improve Internet banking services delivery.

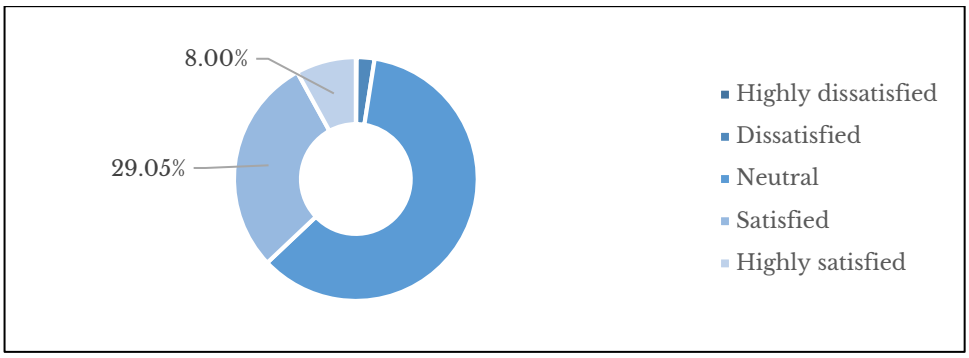


Figure 4.6-A Overall customer satisfaction with fintech

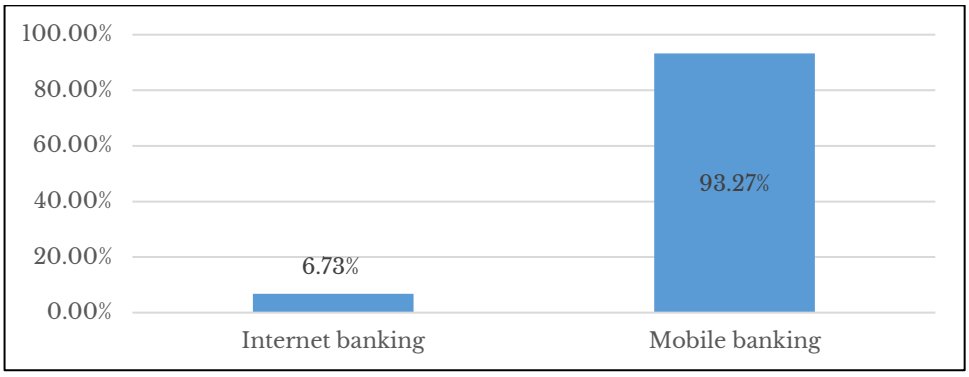


Figure 4.6-B Most satisfactory fintech: internet banking vs mobile banking

A possible way forward is to undertake a careful study of the things being done right in mobile banking. Connectivity, convenience, and cost-effectiveness

are some of the dimensions we find Internet banking service providers can focus on.

4.6.2. FinTech Satisfaction Across Demographics

Satisfaction regarding overall fintech services was slightly higher among women compared to men. 29.81% of women reported they were 'satisfied' with fintech services (compared to 28.95% of men) and 14.42% of women reported being 'highly satisfied' (compared to 7.14% of men). Hence, there were twice as many women who were very satisfied with available fintech services compared to men.

Across age groups, we see younger respondents reporting to be more satisfied or highly satisfied than their older counterparts. This portion was the highest in our youngest age category where almost 60% of survey respondents aged between 15-24 reported satisfaction regarding fintech services. Interestingly, all of the respondents in our survey sample aged between 75-85 were satisfied with fintech services. Fintech service providers should focus on improving the overall service experience for their customers aged between 35 and 74. Specific demographic and psychographic makeup unique to these age groups needs to be incorporated in service experience design in the available fintech platforms.

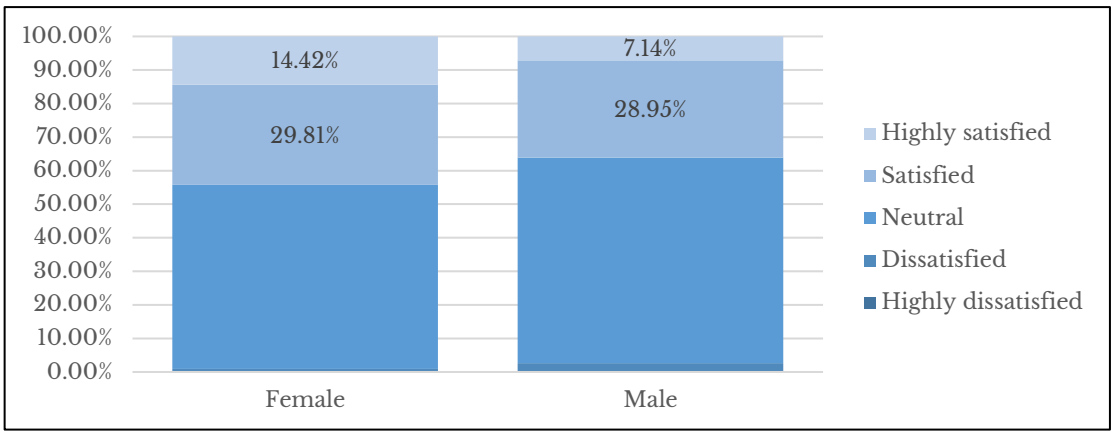


Figure 4.6-C Fintech satisfaction across gender

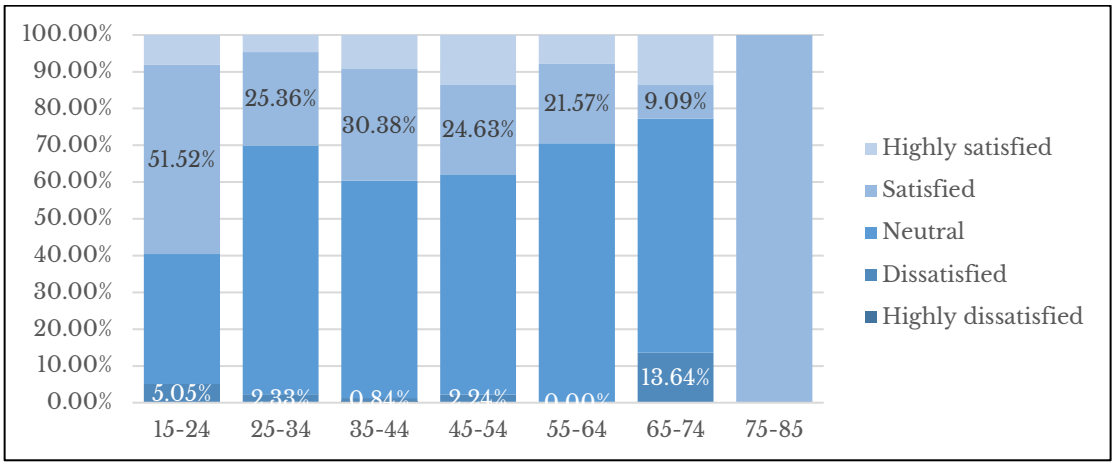


Figure 4.6-D Fintech satisfaction across age groups

There was a definite trend in satisfaction levels across monthly income classes. Respondents with higher monthly incomes were more likely to be satisfied with fintech services. This finding has significance because it implies the importance of costliness as a determiner of overall fintech satisfaction. Providers of fintech services may look into possible ways to make higher-order services more affordable for lower-income classes or create customized versions of these services that are more cost effective for the intended target audience.

This applies to not just transaction charges. We understand that higher-income users are more likely to use mobile banking or Internet banking services in their day-to-day financial activities. The scope for the use of fintech for individuals with lower income (and hence lower frequency and volume of financial activities) is limited. One area of innovation for fintech service providers is to identify and create financial services these individuals are likely to use daily cost-effectively.

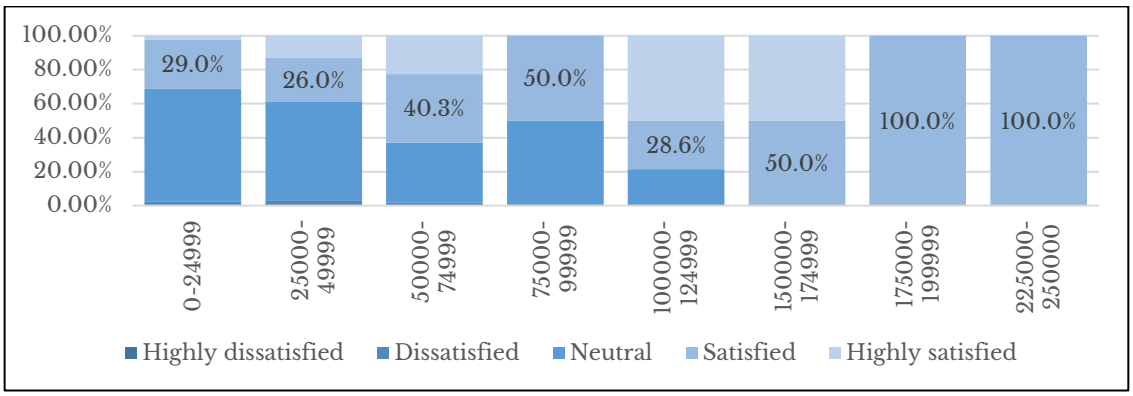


Figure 4.6-E Overall fintech satisfaction across income classes

Across occupations, fintech satisfaction was reported to be higher among government job holders (64%). Following findings across other sections in this

report, government job holders are ahead in terms of adoption, use, and their perception of fintech services and benefits. Students (54%) were found to have higher levels of fintech satisfaction.

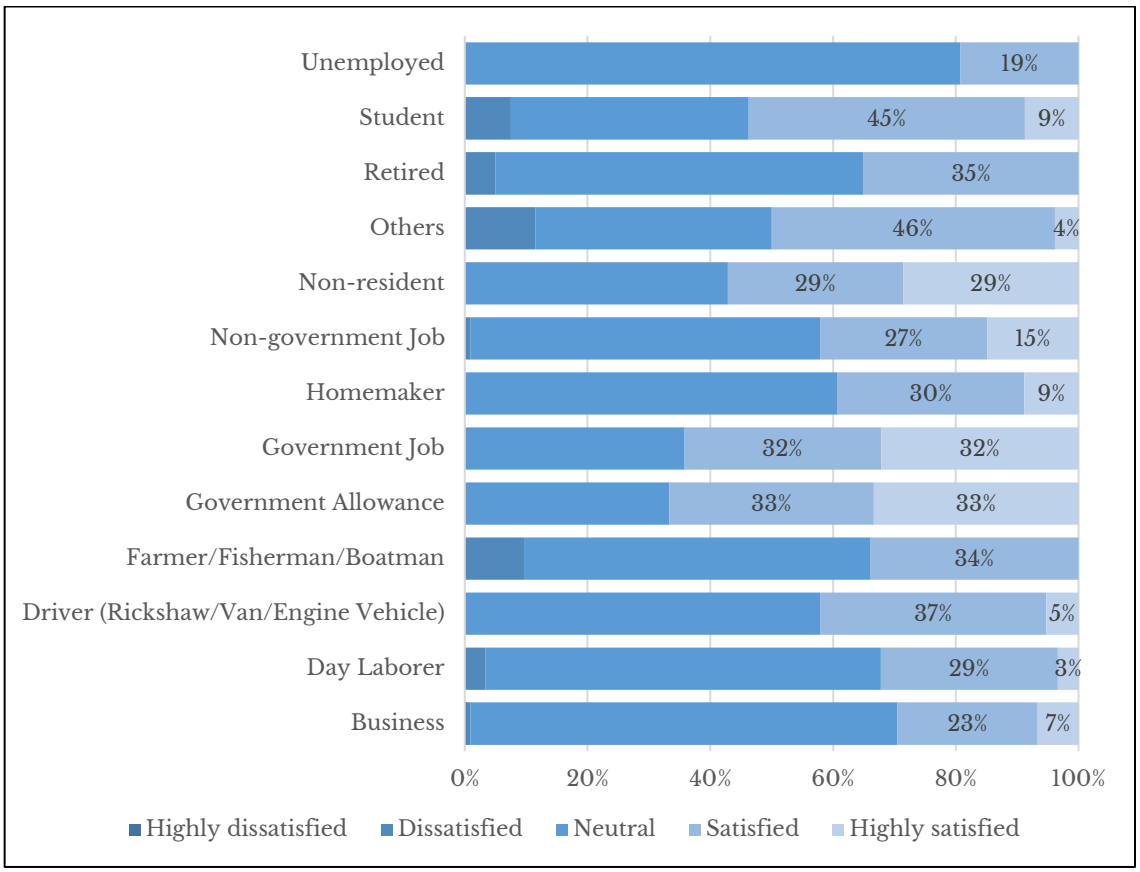


Figure 4.6-F Overall fintech satisfaction across occupations

4.6.3. Confidence and FinTech Satisfaction

Fintech services are designed to appeal to a wide range of customers. Financial knowledge is not a direct requirement to effectively benefit from the services offered in fintech platforms. The entire point of fintech service platforms is to make financial transactions and decision-making easier for the customer. Widespread financial inclusion brought by the spread of fintech services across different parts of the globe is precise to the non-requirement of previous financial knowledge or acumen. Our data nonetheless suggest a high likelihood of satisfaction with fintech services when the respondent has high levels of financial knowledge. We measured financial knowledge by asking respondents to evaluate their awareness of bank transactions.

Our data showed the portions of highly satisfied customers in the above average and 'some knowledge' segments to be 17% and 21% respectively. This was lower in the 'no knowledge at all' (4.89%), and 'very low knowledge' (1.25%) segments. Dissatisfaction was also relatively higher in respondents with more than average knowledge of bank transactions. This is perhaps due to having a higher expectation and the ability to scrutinize limitations of existing fintech services among clients who already understand the process and obstacles of legacy banking institutions. We should mention here that our survey respondents were given specific examples to compare their bank transaction awareness levels and evaluate their respective levels of awareness accordingly.

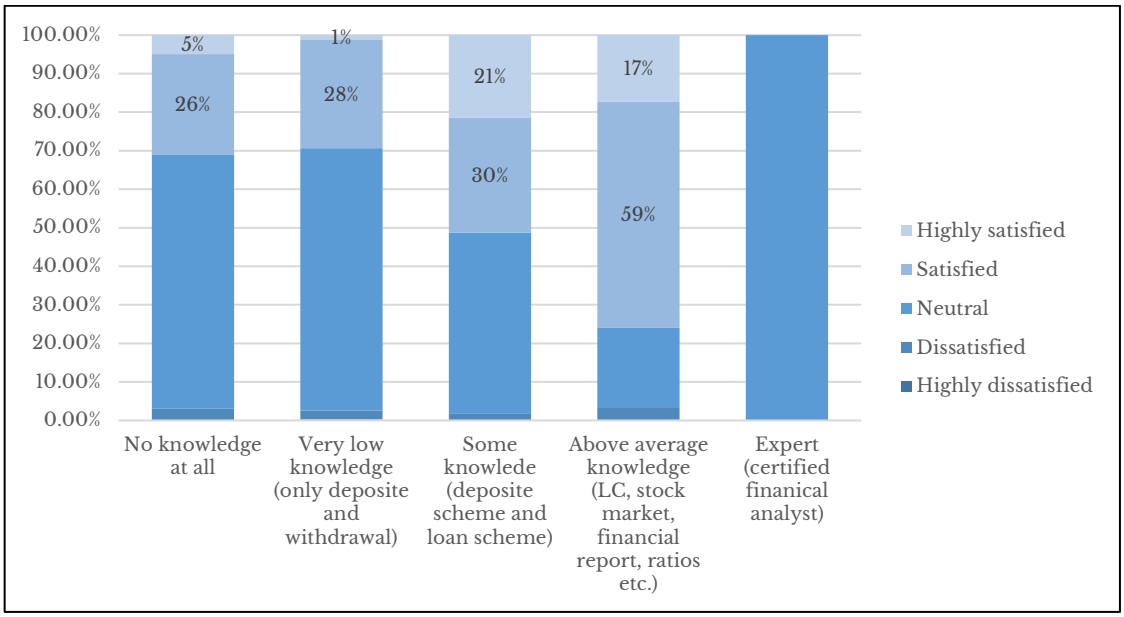


Figure 4.6-G Fintech satisfaction and financial knowledge

We also evaluated fintech satisfaction given existing levels of confidence among respondents in performing bank transactions alone. Satisfaction levels were noticeably high among individuals who reported they were 'confident' or 'very confident' in performing their bank transactions alone. We found next to none reporting higher satisfaction levels when confidence in banking alone was low. For example, for respondents who reported being 'not confident at all' in performing their banking activities alone, none were satisfied or highly satisfied with fintech services. 'Satisfied' customers accounted for only around 8% in the 'low confident' in performing banking alone category.

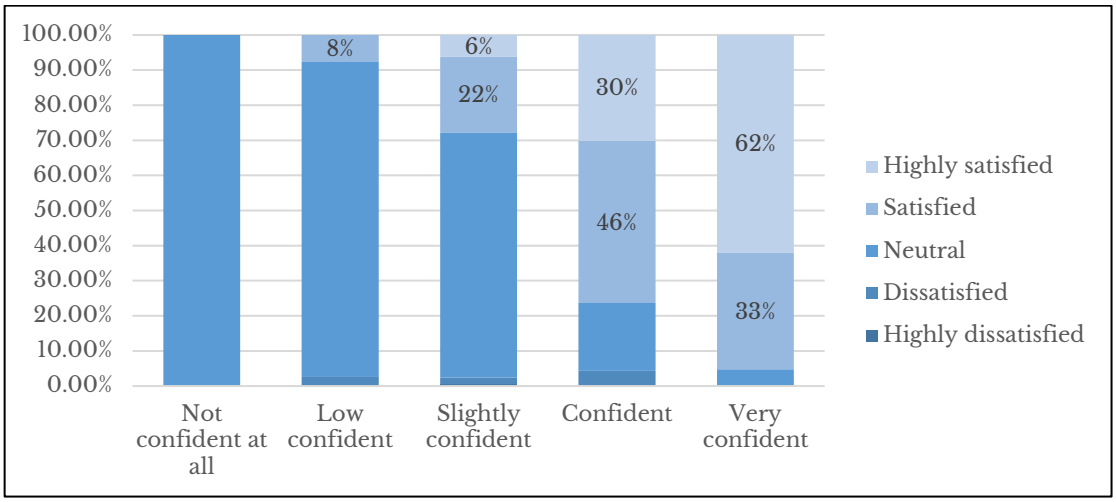


Figure 4.6-H Fintech satisfaction and confidence banking alone

Fintech service providers have a responsibility to educate and empower their customers. This is for the benefit of both the service provider and the service receiver. Clients are likely to use a fintech service they feel confident about; this translates into commercial success for the service provider. Mobile banking account platforms may look into in-app education material for new users, particularly in semi-urban and rural areas.

4.6.4. Attitude Regarding Costliness

A slightly larger share of respondents in the survey regarded existing fintech services as either 'cheap' or 'very cheap'. Around 8% of survey respondents reported fintech services were 'very cheap' and around 25% of the respondents said they considered these 'cheap'. Around 20% of the respondents reported fintech services to be 'costly'. And respondents who reported fintech services to be very cost made up around 1% of the survey sample.

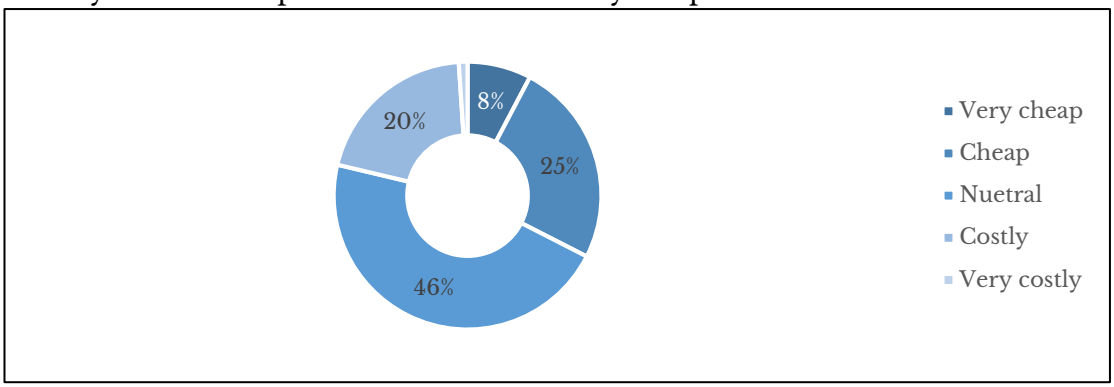


Figure 4.6-I Respondent sentiment on costliness of fintech services

Women's attitude towards the costliness of available fintech services was slightly more pronounced on both ends of the spectrum compared to men's. Around 16% of female respondents considered fintech services to be 'very cheap'. This was 7% among men. On the other hand, 2% of women considered fintech services to be 'very costly'. Across different ages, our survey data shows no specific trend except for younger respondents being more concentrated on either extreme side of the attitude spectrum.

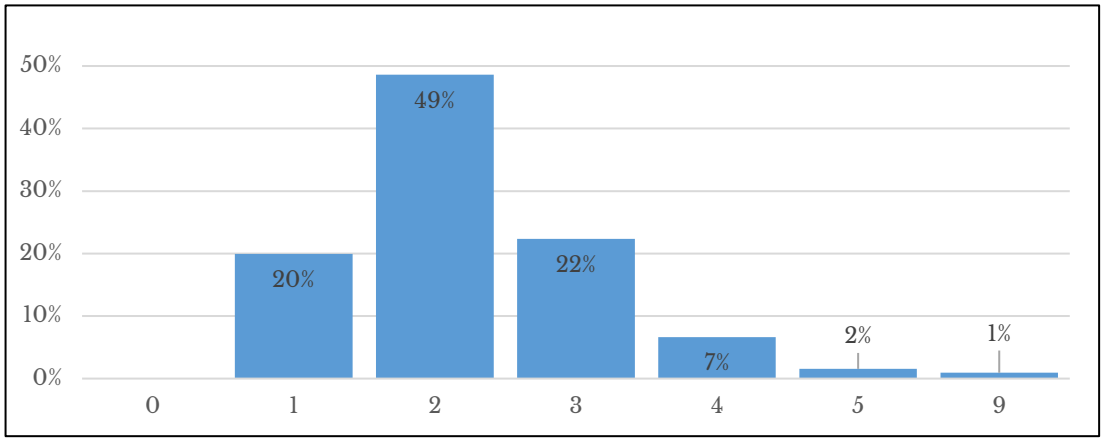


Figure 4.6-J Distribution of respondents as per mobile banking usage score

We looked into the costliness attitude given respondents' mobile banking usage. Money transfers and payments make up the majority of mobile banking services availed by users in Bangladesh. These also are the two costly services delivered on mobile banking platforms. We constructed a scoring scheme where respondents were ranked from 0 to 9 based on the number of different mobile banking services they used. The majority of our respondents (49%) used 2 mobile banking services per month on average. Around 22% used 3, and 7% used 4 mobile banking services. Above this level, only a minority of respondents were found.

4.6.5. Maximum Preferred Fee

Respondents were asked the maximum fee they were prepared to pay for BDT 1000 worth of cash out on mobile banking platforms. Our survey finds that on average, BDT 8.5 was the maximum fee respondents were ready to pay for BDT 1000 worth of cash out. The biggest group consisted of 50% of respondents reporting their maximum fee per BDT 1000 cash out between BDT 10 and 14. Interestingly, only 4% of the respondents reported their maximum preferable cash-out fee to be between BDT 20 and 25. Women's maximum cash-out fee on average was BDT 7.99 and men's was BDT 8.57.

Respondents in lower age groups were prepared to pay more compared to older respondents. Our data shows a distinct downward trend in maximum fee per BDT 1000 worth of cash withdrawal across higher age groups. Respondents aged between 15 and 24 were prepared to pay BDT 9.74. For respondents from ages 25-34, 35-44, and 45-54 the maximum fee was BDT 9.04, BDT 8.83, and BDT 7.87 respectively.

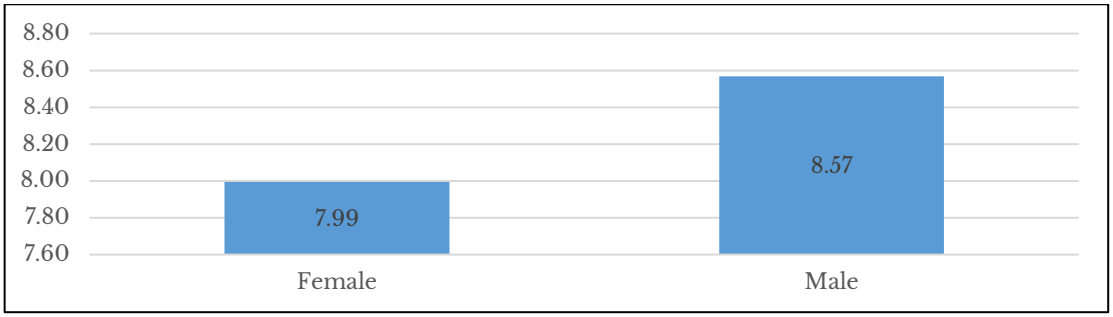


Figure 4.6-K Maximum fee for women and men

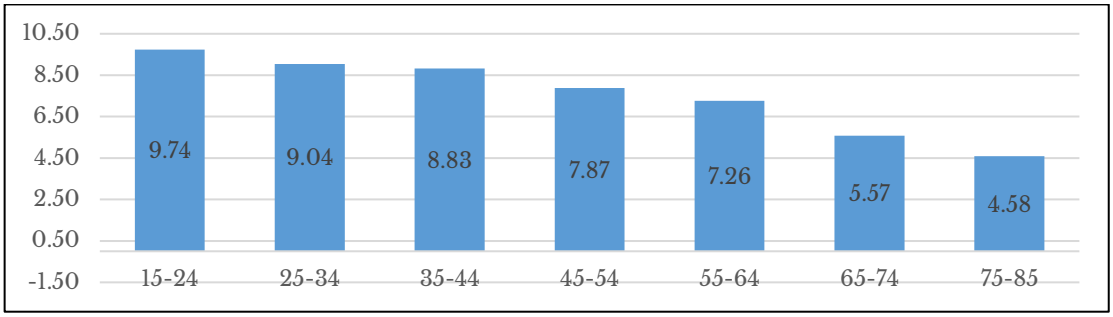


Figure 4.6-L Maximum cash out fee across age groups

Current mobile banking service providers need to carefully analyze their price points. At lower fees, a larger number of customers are willing to use fintech services. They are likely to increase the use of mobile banking services at a lower price point since the majority attitude to maximum cash-out charge compared to existing prices is significantly negative.

4.6.6. Maximum Fee and Mobile Banking Usage

Respondents who used a larger variety of mobile banking services were prepared to pay a higher fee for cash withdrawals. This implies the role of different services in forming respondents' attitudes toward the maximum cash-out fee. Respondents who mostly used 2 types of mobile banking services per month on average used their platforms for money transfer and cash out mostly. Respondents who used a wider variety of services most likely had a different attitude towards perceived value derived from fintech use. At the same time, their cost per unit of value was lower since a wide number of other mobile banking services don't have lower prices (e.g., bill payment, loan transaction, merchant payment).

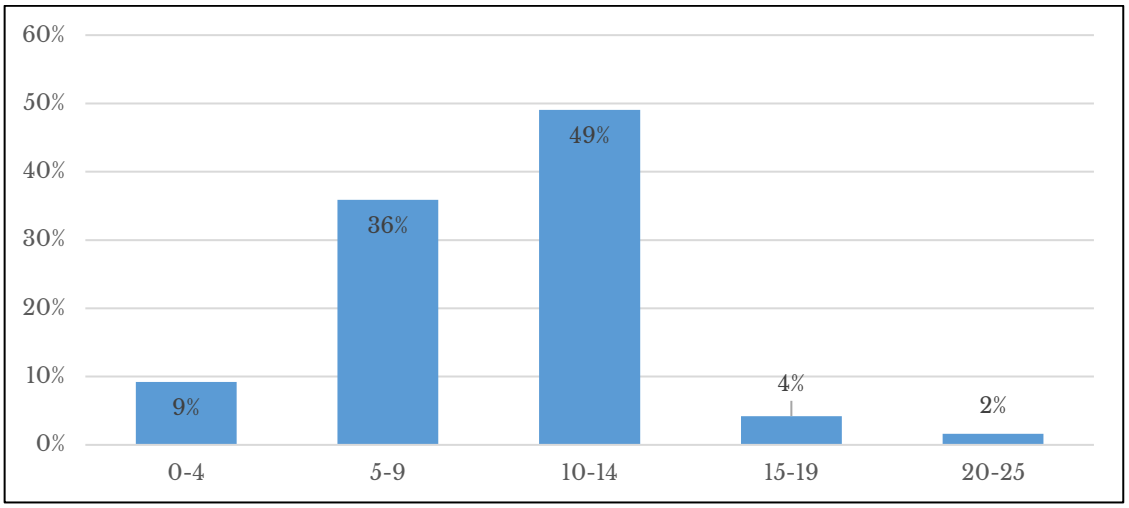


Figure 4.6-M Distribution of maximum preferred cash-out fee

We believe mobile banking wallets can look into ways to expand the scope of services customers use to drive down their perceived costliness of fintech. This has the two-fold benefit of attractive prices on the supplier side and greater perception for the customer.

4.7. Attitude Regarding Affordability

For fintech to positively change the lives of people it needs to be affordable for most users. Fintech platforms – similar to other technology platforms – benefit from the 'network effect': the value of the network to the user increases with each additional user added to the network. The more users there are of fintech services the more seamless services like P2P lending, payments, etc.

become. A larger user base will also help increase trust in fintech usage for a wider variety of services. In this case, persuading the customer that the service is affordable is important.

Our survey data shows that 18% of respondents think fintech services are 'affordable' while 3% think they are 'highly affordable'. Respondents who consider fintech services as either 'not affordable' or 'not affordable at all' constitute 22% of the survey sample. Around 14% of respondents were unsure of their opinion on affordability. Additionally, 44% of respondents were neutral on this. Regulators, in this case, we believe, have the responsibility of creating realistic expectations. Customers should be educated on what to expect from fintech service providers and the customers' bargaining power. In any case, we would expect respondents to have either a positive or negative opinion regarding the affordability of fintech services. The fact that a significant portion of the survey sample could not make up their mind proves, according to us, that there remains massive room for customer education. This theme is repeated in multiple places throughout different sections of our report.

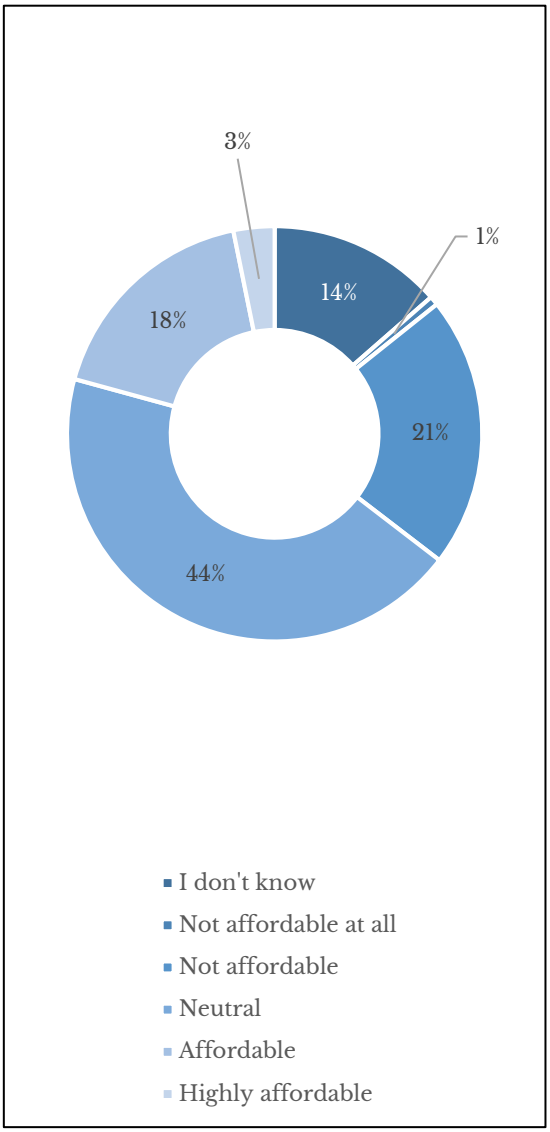


Figure 4.7-A Customer sentiment on fintech affordability

A larger share of women maintained that fintech services were 'not affordable'. Consistent with their lower maximum cash-out fee expectation, women have a larger share of users who think fintech affordability can be improved. On the other hand, they were also less unsure of their position regarding affordability compared to men.

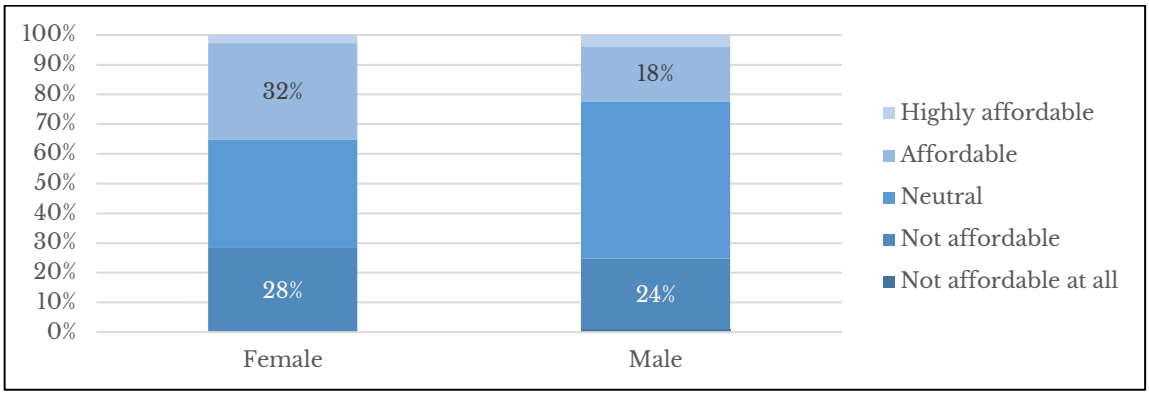


Figure 4.7-B Affordability sentiment among men and women

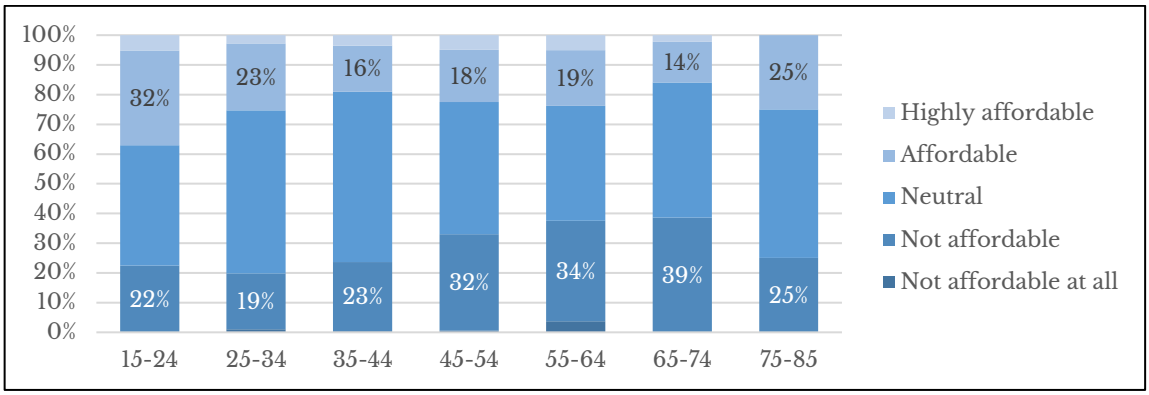


Figure 4.7-C Affordability sentiment across age groups

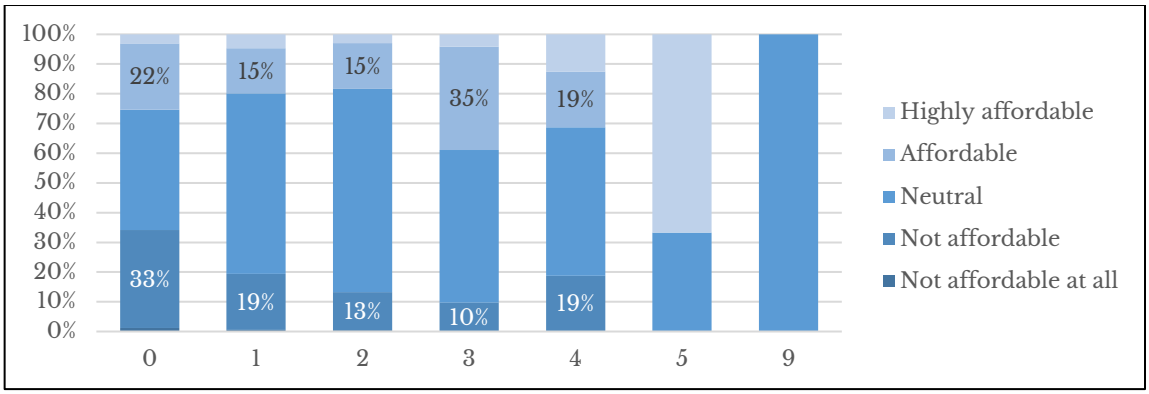


Figure 4.7-D Affordability sentiment and mobile banking usage

In higher age classes, we see a higher negative sentiment on fintech affordability. About 22% of people aged between 15-24 think fintech services are 'not affordable' for them. This increases to 34% for people aged between 45-54. Again, this is consistent with the fact that older users benefitted from a lower number of different fintech services, and their perceived value derived from fintech services was lower than younger users. If we look into affordability

sentiment across mobile banking usage scores, we see that higher-score users have a lower share of respondents who maintain fintech services are not affordable.

4.8. Summary of Obstacles

The top three obstacles that were ranked as either 'high' or 'very high' were technological skill, transaction knowledge, and educational qualification. Survey respondents thus clearly indicate their lack of skills and awareness in using fintech platforms – and digital technology in general – as primary obstacles to the use of fintech services. Fintech service providers and regulators have duties to empower users from varied socio-economic backgrounds with different levels of institutional education with the knowledge and skills to use fintech and derive its manifold financial and societal benefits. Going forward, Bangladeshi fintech users will have to be assisted to work around this problem to effectively reap the promised benefits of fintech.

The bottom three obstacles reported by respondents were government regulation, service intuitiveness, and geographic location. The location of the respondent in our survey did not constitute a major perceived obstacle to fintech usage. However, as discussed in subsequent sections, there is some room for improvement in terms of regulation and designing a seamless and intuitive user experience. This is especially the case for respondents of a specific gender, age, and income class.

4.8.1. Consumer Side Obstacles

Respondents were asked to what extent their current economic condition was a major obstacle to fintech usage. Around 9% of respondents reported 'very low' and around 33% responded 'low'. 22% of the respondents reported their current economic condition as a major obstacle to fintech usage. This is lower than respondents who reported geographic location as a major obstacle to fintech usage. Around 12% reported their geographic location as a major obstacle to fintech usage. Geographic location is not a major barrier to fintech service usage as evaluated by customers. Fintech service providers in Bangladesh have done an admirable job in bringing their services to places across the country. However, we maintain that costliness remains an issue for customers in different districts. A separate section on fintech costliness and affordability is dedicated later.

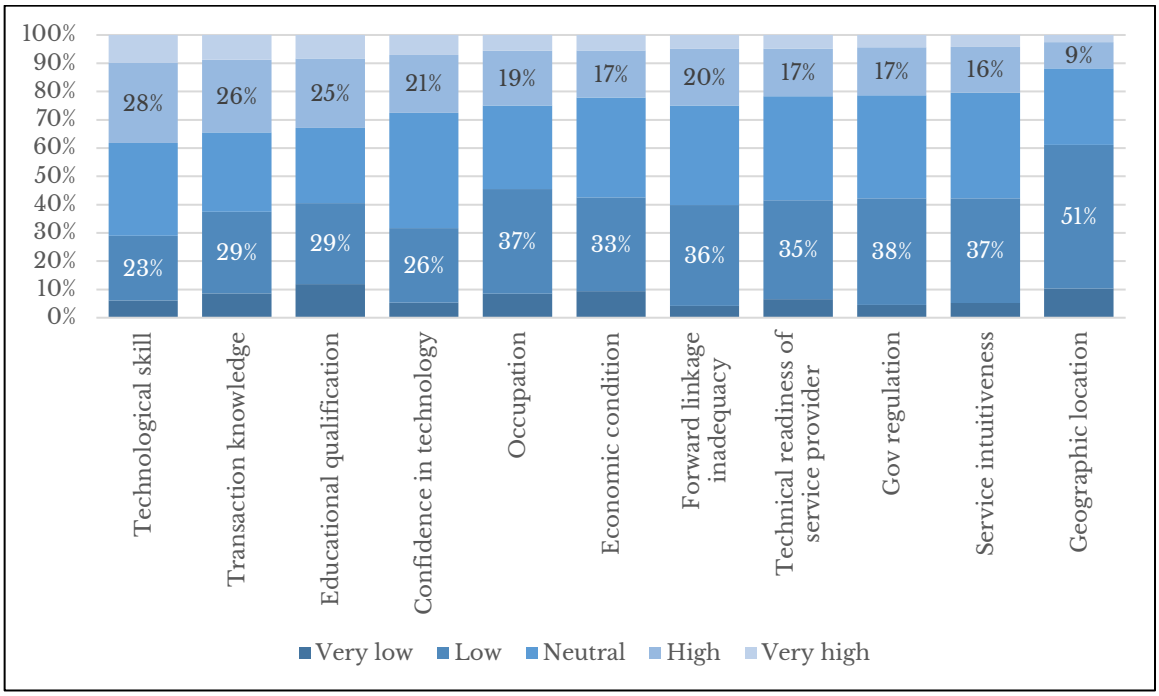


Figure 4.8-A Perceived obstacles in fintech use

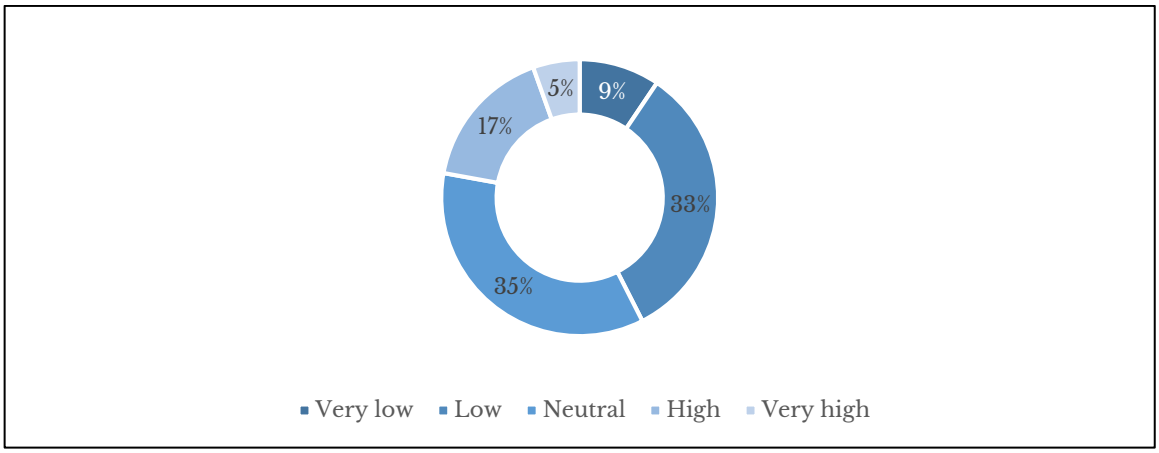


Figure 4.8-B Economic condition as obstacle to fintech use

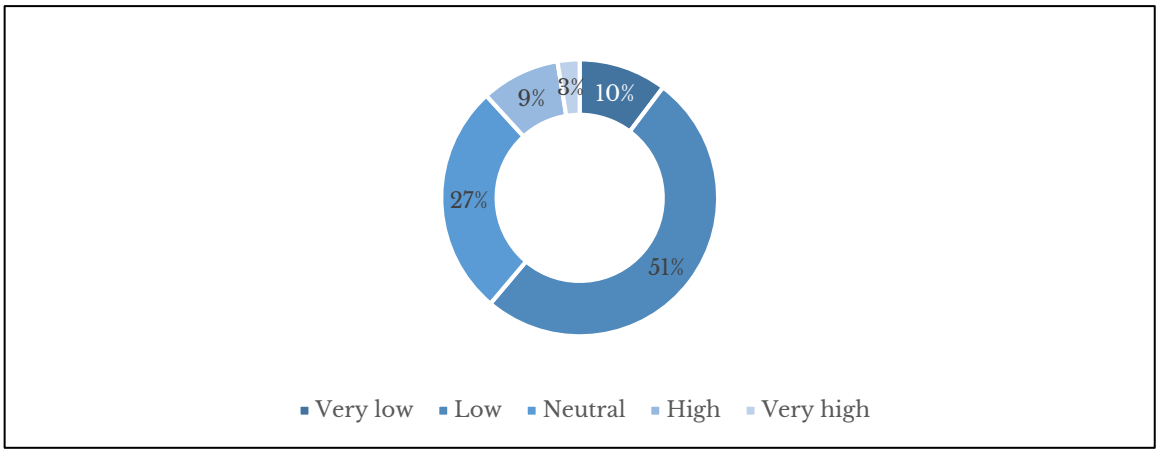


Figure 4.8-C Geographic location as obstacle to fintech use

We found around 33% of respondents said their educational qualification was an obstacle to fintech usage. The fintech service provider will have to take note here since one in three fintech users report difficulty using their services due to educational qualifications. We propose that there remains a significant improvement to streamline the user interface as well as service delivery channels. The overall service experience can be more intuitive for users from varying levels of institutional education.

Customers seem to regard their occupation as not a major obstacle to fintech usage; around 46% of respondents report that their occupation is a 'very low' or a 'low' obstacle to fintech usage. Fintech services in Bangladesh thus are mostly able to cater to a wide variety of financial activities across occupations.

Service intuitiveness is important in determining adoption and overall fintech satisfaction. We can gauge the level of service intuitiveness in fintech services platforms in Bangladesh from customer response to the technical difficulty of fintech service usage. We asked respondents to evaluate how fintech usage is affected by their confidence in technology use, technological skills, and transaction knowledge. Regarding transaction knowledge, 26% of respondents reported 'high' and 9% reported 'very high'. Around 28% of respondents reported confidence in technology use as a 'high' or a 'very high' obstacle to fintech usage.

In terms of technical skill, the portion of respondents reporting 'high' or 'very high' was 38%. From there, we may conclude that a significant portion of Bangladeshi fintech users report their technological skills as a major obstacle to fintech usage. At the same time, we see similar evaluations on the part of the customers regarding confidence in technology use and knowledge regarding financial transactions.

Fintech service providers and regulators should take note since this has important implications for adoption and future fintech use. Both service providers and government agencies are expected to do their parts to educate customers to feel more confident about fintech usage. This is not a task the customers can perform on their own. Going forward, pushing for greater financial inclusion, greater economic value, and a more vibrant fintech landscape in Bangladesh will remain ineffective if the inadequacy of technical skills and awareness on the consumer side continues at current levels.

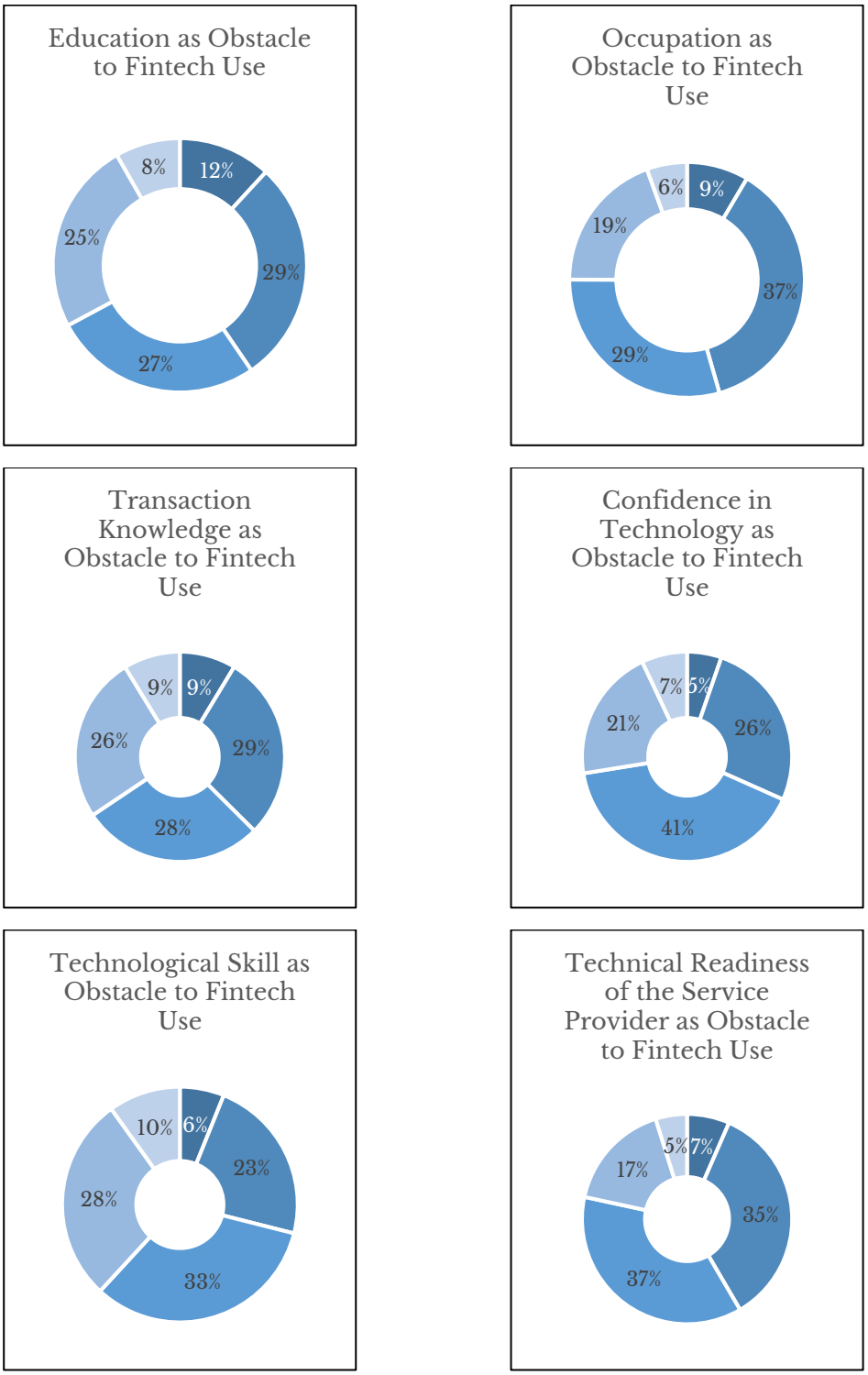


Figure 4.8-D Miscellaneous other obstacles in fintech use

4.8.2. Supplier Side Obstacles

The majority of respondents in our survey reported the technical readiness of service providers as either a 'low' or a 'very low' obstacle to fintech usage. Fintech service providers in Bangladesh currently have adequate technological infrastructures and processes in place to serve a wide range of customers. What is more, these capabilities are only going to expand in the coming years with the incorporation of fourth industrial revolution technologies e.g., artificial intelligence in financial advisory, credit rating, peer-to-peer lending; and blockchain in secure payment systems. However, service providers need to carefully evaluate demands in the future as well as security risks to remain prepared with the necessary technical capabilities. Since investments in these tend to be significant and successive modifications costly, thriving in an increasingly competitive fintech market will require strategic investment decisions. Both technological infrastructure and skilled human resources will be key.

Fintech service providers have been largely successful in making their user interfaces and overall service experience intuitive. Our survey data suggests about 20% of respondents reported 'service intuitiveness' as a 'high' and 'very high' obstacle to fintech usage. However, as reflected in the previous section, there remains room for improvement to make the fintech service experience more accessible for customers with varied educational, economic, and technical backgrounds. A slightly higher portion of fintech users reported 'forward linkage inadequacy' as 'high' or 'very high' obstacles to fintech usage (around 25%). Fintech platforms need to be seamless and incorporate as wide of a link of financial touchpoints as possible. "Super-apps" in China – followed by similar trends in other Southeast Asian markets and the West – attain full-scale integration by bringing all services under the umbrella of a single app. This can be regarded as a complete backward and forward linkage in the supply chain. The advent of "super-apps" necessitates several macroeconomic and technological breakthroughs. It also requires a regulatory framework that allows integration across multiple service domains.

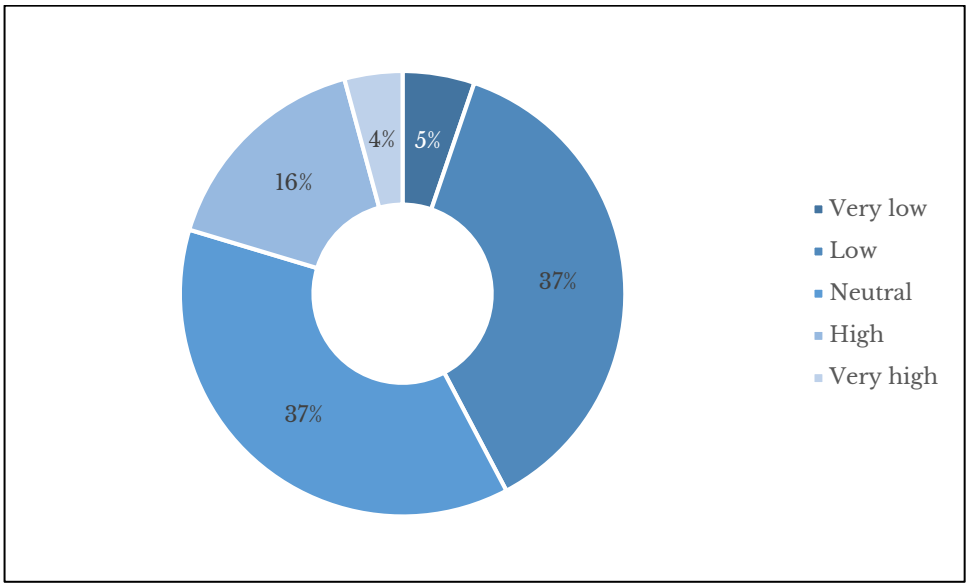


Figure 4.8-E-Government regulation as obstacle to fintech usage

Bangladesh is still not ready for the full-scale launch of "super-apps". But a more gradual journey towards that state is possible and necessary for customer value. Existing fintech service providers should focus on developing wider partnerships with merchants and financial institutions to make the user experience as seamless as possible. Government regulation plays a crucial role in the fintech landscape. Bangladesh's financial regulators – similarly to other parts of the globe where fintech has been in a boom – have facilitated the development and delivery of fintech services through prudent policy support. Around 21% of respondents in our survey still think government regulation was a hurdle to the use of fintech services. While complete regulatory freedom is not viable in the financial services industry, further investigation nonetheless should look into ways regulations can boost the fintech service experience for consumers. Particularly in areas of cost, data privacy, and service integration, we believe the Bangladesh financial and telecom regulators have unexplored avenues of growth.

4.8.3. Future Service Expectation

Customers were asked to report their future service expectations. To make reporting easy, we provided customers with a variety of options to choose from. Interestingly, many of these future service expectations were related to services that already exist in mainstream mobile banking applications available in the market in Bangladesh. Mobile recharge for example ranked first in customer expectations of future services according to our survey. Around 63% of

respondents said they expected mobile recharge service in the future. However, application platforms like bKash and Rocket already have this option in their interface. Customers are likely not aware enough. Mobile recharge service was followed by utility bill payment as the next most sought-after future service from customers. 61% of respondents reported they expected to be able to pay utility bill payments in the future.

Our data shows that 26% of those surveyed expected deposited services in the future. Investment service closely followed with 22% of respondents saying they wanted this in the future. 18% of respondents expected loan services as a future fintech service they expect to use. Apart from looking at these aggregate expectation figures, we analyzed customer expectations across age groups in particular. There were definite trends across respondents from different age groups in our survey. For example, younger users were more likely to expect to use mobile recharge services as a fintech service in the future. The proportion of users who expect to use mobile recharge services from fintech platforms in the future was largest in our youngest age group (years 15 to 24) and lowest in our oldest age groups (years 75-85). 83% of respondents aged 15 to 24 years expect to use their fintech platforms for mobile recharge in the future. However, in terms of gender, there was no discrepancy in terms of mobile recharge as a future fintech service expected to be used.

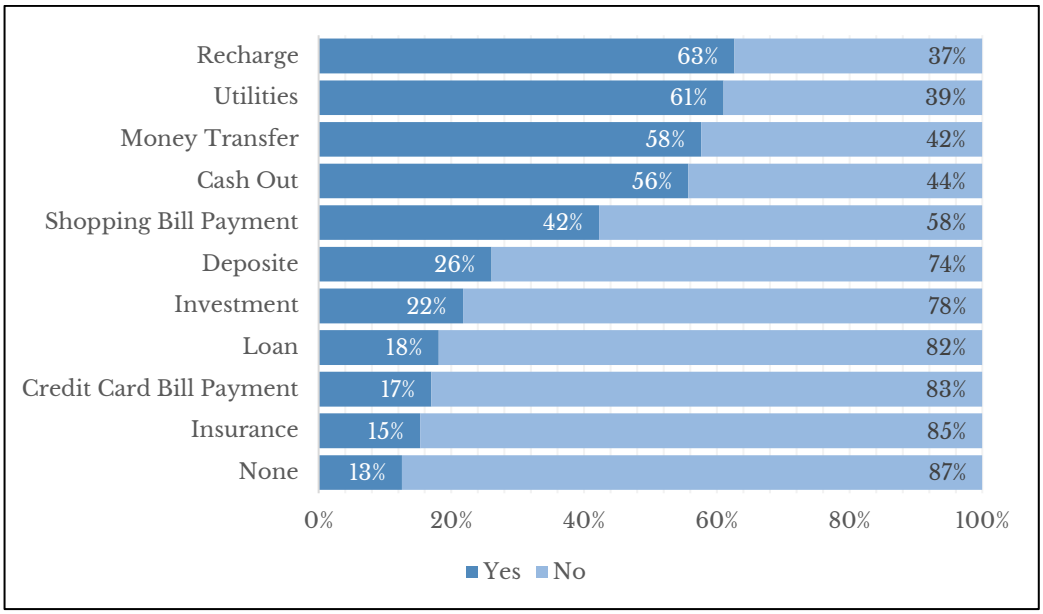


Figure 4.8-F Future services expectations

Similarly, the proportion of respondents reporting utility bill payment as a fintech service for expected future use was consistently higher in younger age

groups in our survey data. These were 74% for respondents aged between 15 and 24, 71% for ages between 25 and 34, 63% for ages between 35 and 44, and 53% for ages between 45 and 54. Men were more likely to report utility bill payments as a future fintech service expectation. 63% of men reported using fintech platforms for utility payments compared to 48% of women. We observed an identical trend across respondents from different age groups in terms of money transfer as a future expected fintech service use.

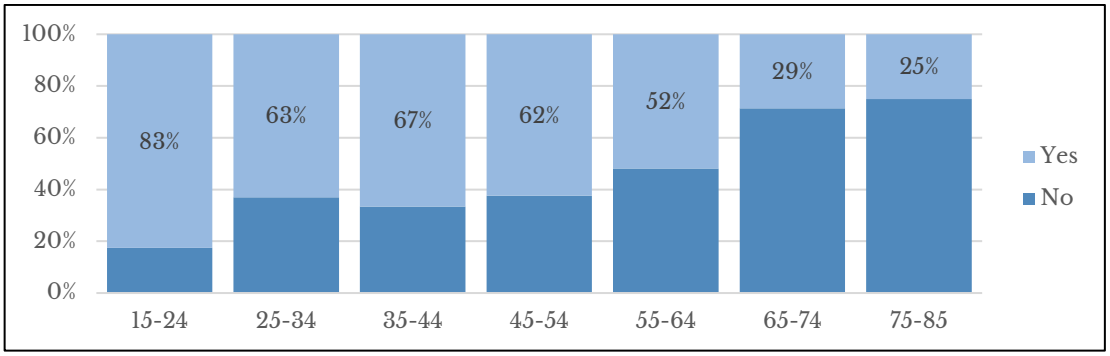


Figure 4.8-G Future service - recharge across age

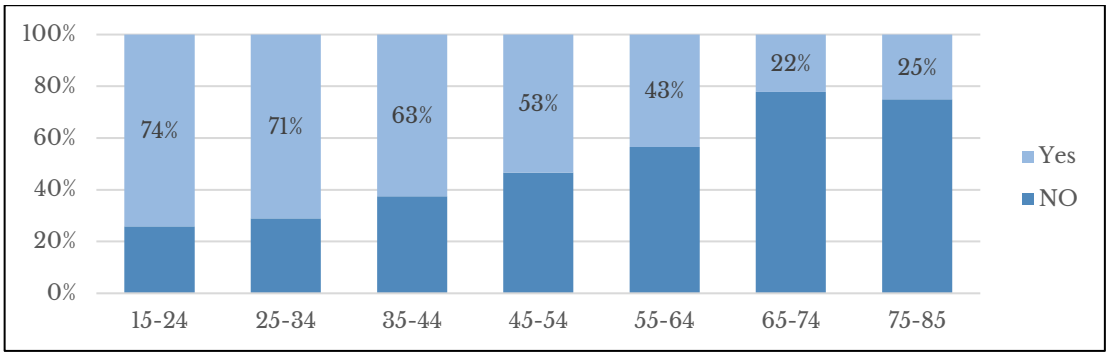


Figure 4.8-H Future service - utilities bill across age

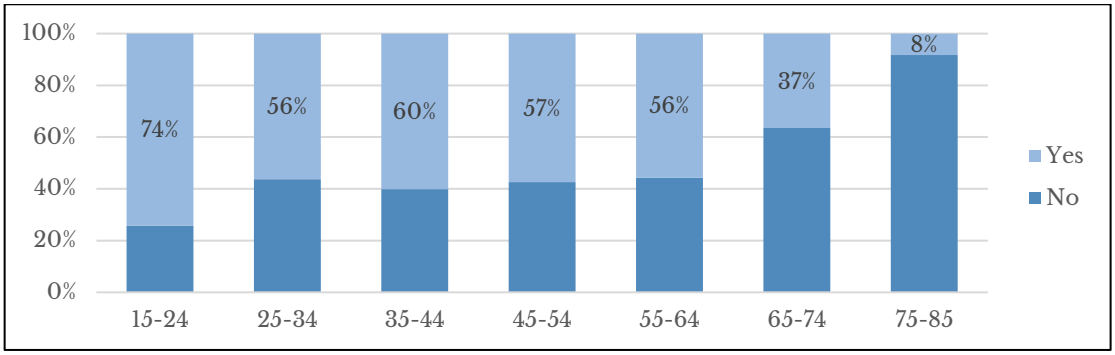


Figure 4.8-I Future service - money transfer across age

4.9. Expectations from Fintech Service Providers

The topmost expectation of customers from fintech service providers according to our survey was lower service charges. 73% of all fintech users surveyed said they wanted their fintech service provider to lower existing service charges. This is a significant proportion of users with the same expectation. Fintech service charges are particularly high in Bangladesh. As briefed in the opening of this section, regulators assumed a more lenient position at the beginning of the mobile banking industry in Bangladesh. However, after about a decade of the development of the mobile banking industry, customers are now convinced they want lower service charges for the services they receive from their fintech platform provider.

Equally intriguing a finding in our survey of expectations from fintech service providers was the fact that the second most reported expectation was a higher quality of service. 62% of respondents reported they want higher quality fintech service from their platform provider. Given some of the mainstream platforms are operating for a long time and charge significantly high charges compared to peer nation fintech platforms, we would expect fintech service providers here to have a majority of their customer base convinced of service quality. Our data suggests this is not the case and customers expect a higher quality of fintech services in the future.

Fintech service providers, regardless of what customer base their serving and their focus area of fintech products, should improve service quality. This has to be done for all sorts of service dimensions including, but not limited to, speed, convenience, backward and forward linkages, seamlessness, intuitive application platforms, educational content, and a more intuitive instructional design for first-time users. The third most reported expectation from the fintech service provider in our survey was faster service. Around 60% of respondents reported they wanted faster services from service providers. Fintech regulators in this case have an important role to play. Bangladesh should immediately come up with a service quality framework for existing and future fintech service providers in the interest of customers as well as for the long-term development of the whole industry.

Other expectations included fraud prevention. 54% of respondents reported they want fintech service providers to do more to prevent financial frauds and scams using the fintech platforms. Information security was a slightly higher

reported expectation (58%). On the other hand, 33% of respondents reported they want more cash points and a more diversified service portfolio from their fintech service providers.

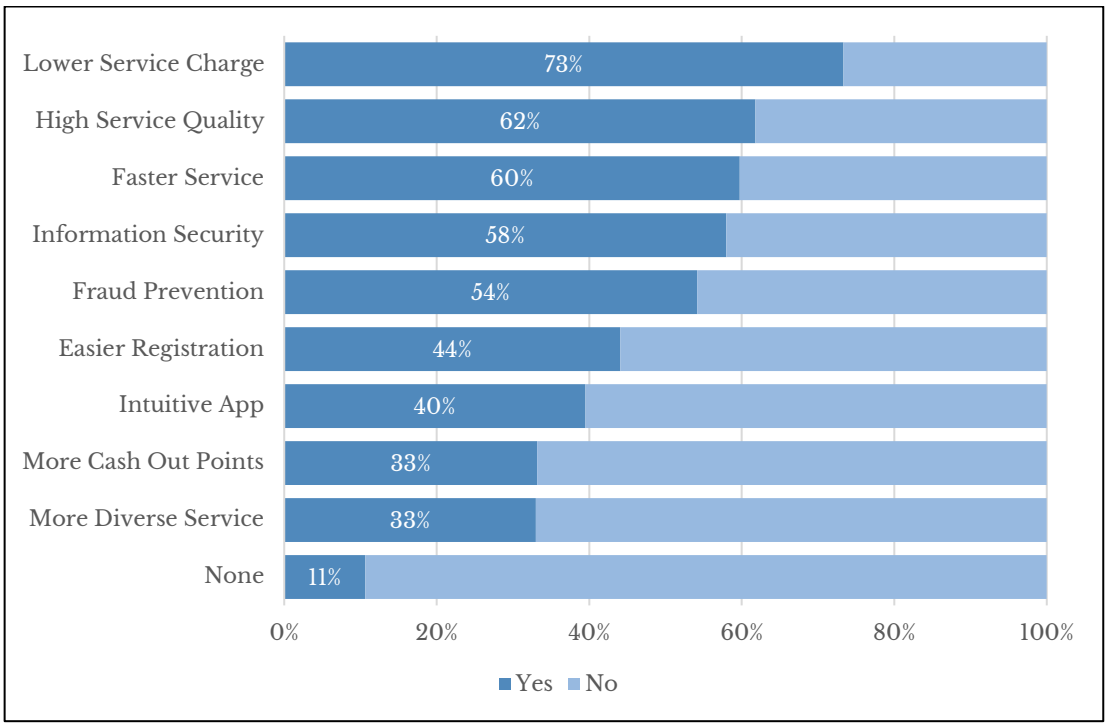


Figure 4.9-A Expectation from fintech service providers

In summary, we find that customers expect lower costs and higher scope of value-added services from their fintech service providers while making sure financial data is secured and users are protected against fraudulent financial activities on fintech platforms.

It is equally important to understand the difference across groups of users in terms of their expectations from fintech service providers. This can tell us approximately where the expectation of a certain dimension of service is the strongest and how fintech service firms can better target their product-service modifications. In terms of fraud prevention as an expectation, for example, men were ahead of women. 56% of men said they wanted fintech service providers to do more on fraud prevention. This expectation was more or less at par across all age groups indicating the universality of the problem and the expectation for a solution.

So universal was this expectation from service providers that we found no difference across levels of education of the respondents. Regardless of the reported level of institutional education for the respondent, users were almost

equally likely to demand more from service providers to take better preventive control against financial fraud.

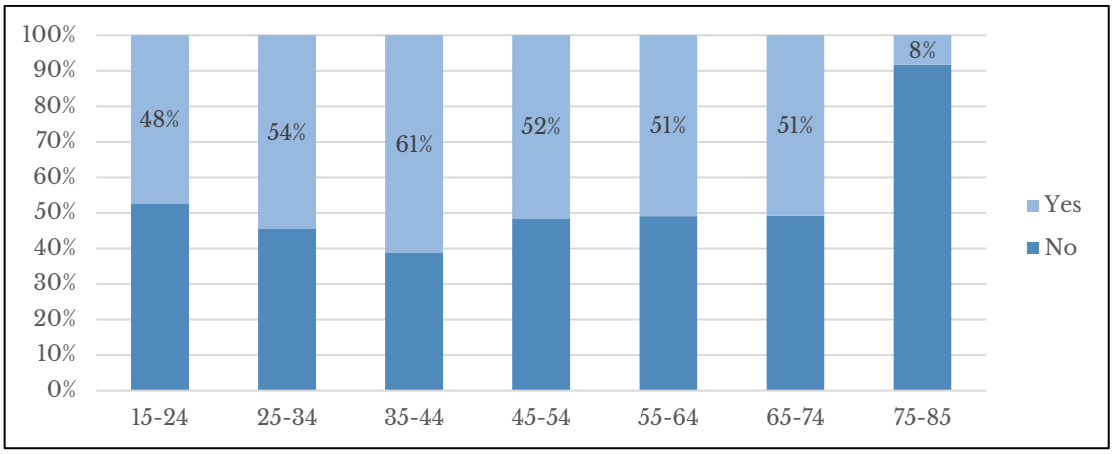


Figure 4.9-B Expectation of fraud prevention across ages

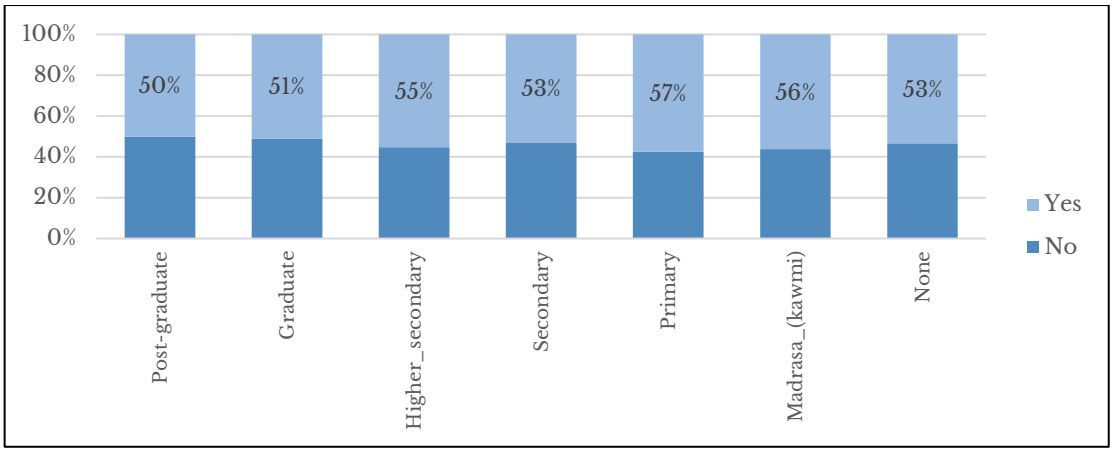


Figure 4.9-C Expectation of fraud prevention across levels of education

The expectation for better fraud control measures from service providers was slightly higher among respondents with lower monthly incomes.

Our data show an interesting correlation between service charges and expectations of higher qualities. We asked users to report their maximum preferred fee per BDT 1000 cash out. At present, the average fee for bkash is BDT 14.9. However, our respondents were dispersed across maximum fee levels ranging from as low as BDT 4 to a high of BDT 25. Respondents with a higher preferred maximum fee per BDT 1,000 of cash out were more likely to expect higher service quality from fintech service providers.

For example, 63% of respondents with a maximum preferred fee ranging from BDT 5 to 9 reported they want higher service quality. This was 83% for the maximum fee class of BDT 15-19 and 86% for respondents with a maximum preferred fee between 20 and 25.

There seems to be a customer segment ready to pay higher service charges. However, they were overwhelmingly not convinced of service quality from existing fintech service providers. In lower service charge groups too, a significant portion of users expects a higher quality of service in the future.

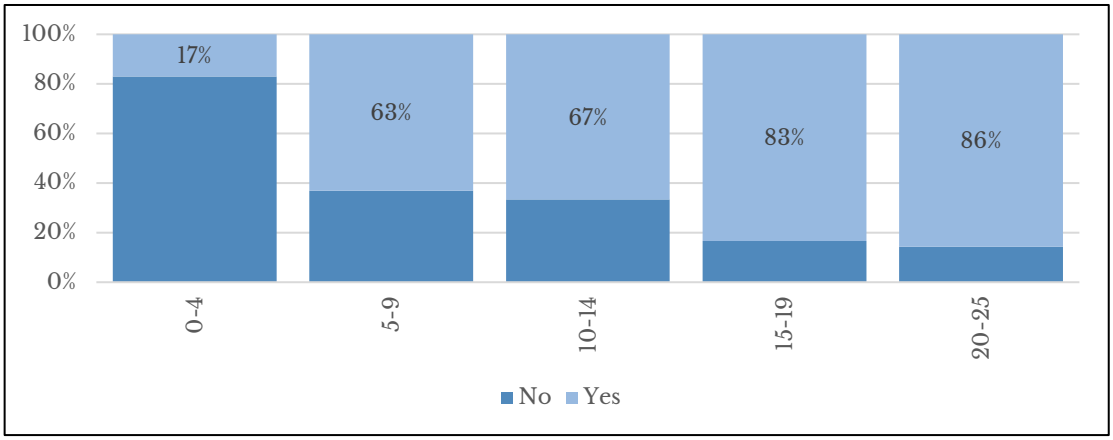


Figure 4.9-D Higher service quality expectation across max fee categories

Higher service fee groups also expected faster service. This is another dimension of fintech service quality where service providers need to improve and can serve niche markets with greater than average speed. This expectation was more pronounced in younger age groups. 69% of users in the 15-24 age group expected faster service. Among people aged between 45 and 54 years, 61% reported they want faster services.

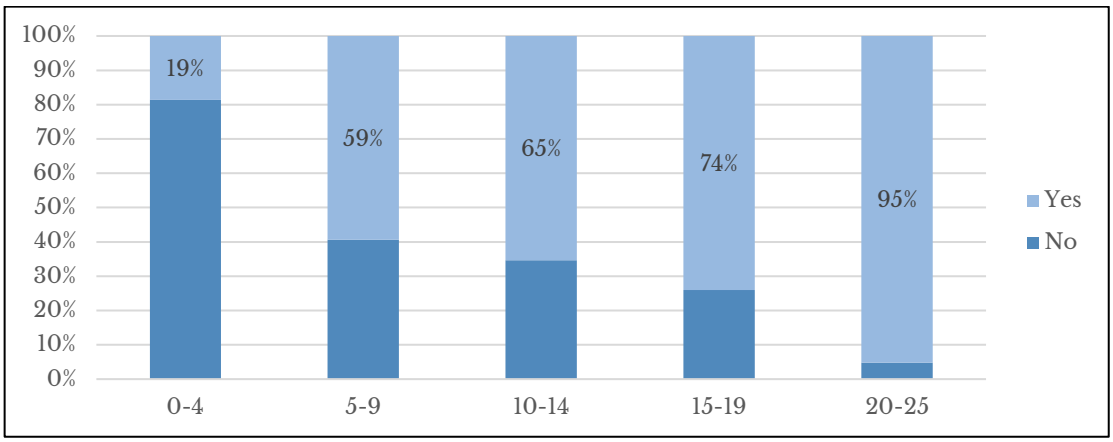


Figure 4.9-E Faster service expectation across maximum preferred fee categories

In terms of a more intuitive app design, women reported higher proportions. 78% of female respondents reported they want a more intuitive app for fintech use. Fintech service providers need to fundamentally rethink how their customers perceive and interact with their services through the app. Currently, as our data suggest, even 58% of men report a better and more intuitive app. There remains significant room for improvement in terms of app design. In particular, we would expect existing and future fintech service platforms to consider this as a key enabling factor. Fintech platforms should be easy and intuitive for women and elderly users as well.

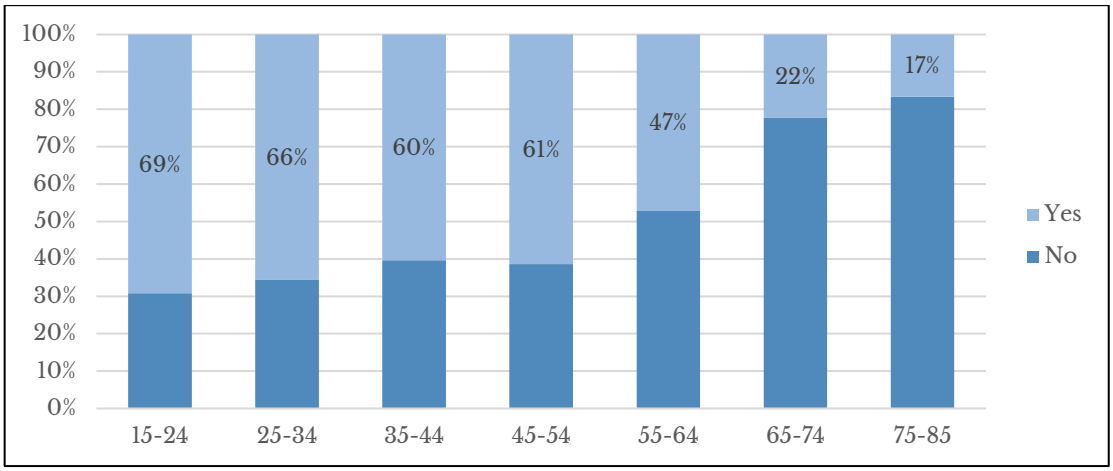


Figure 4.9-F Faster service expectation across age groups

An intuitive app design becomes even more important as more and more fintech services are included under the umbrella of a single application platform. Fintech service providers need to find a way to make app interaction easy while expanding the scope of their services.

4.10. Expectations from the Government

The government as the regulator of the fintech service landscape has a crucial role to play. In determining the trajectory fintech industry development will undertake for the next two or three decades, fintech regulators in Bangladesh will have to consider internal as well as global factors. A good benchmark to start from is best practices from regulators of Asian fintech hubs including Singapore, South Korea, China, as well as India. Regulators in these markets have already experimented with alternative models and have learned valuable lessons. Particularly in Singapore and India, there remain myriads of lessons to learn from.

Careful consideration of these should lay the groundwork for an effective fintech regulatory framework for Bangladesh. Equally important to consider is customer feedback. Our survey thus looked into customer expectations from government and regulatory bodies for a better fintech service landscape. Respondents prioritized several demands from regulators over others.

Interestingly, the issue of privacy and security of sensitive financial data ranked at the top. Around 75% of respondents maintained they wanted the government to do more to protect information secrecy. Regulators need to adopt ways to increase technical expertise in aiding as well as auditing the information technology infrastructure of existing and new fintech service providers as they continue to serve customers in the Bangladeshi market. At the same time, there will have to be a coherent and informed policy guiding information secrecy. Information security is a closely related issue. In our survey, this closely followed the top-ranking demand from governments as almost 75% of respondents maintained they also wanted governments to do more to safeguard the security of their financial data.

Similar to how scheduled commercial banks follow a tightly held set of regulatory requirements related to the generation, storage, distribution, and access to bank account and financial transaction data, the fintech industry needs similar policies for the long-term benefit of the customers. This will have to encompass how fintech service providers access data, how they store and manage data, how cybersecurity resilience of their information and connectivity infrastructure is measured and monitored, and how stakeholders of the fintech service industry can share information among each other for better value-driven services.

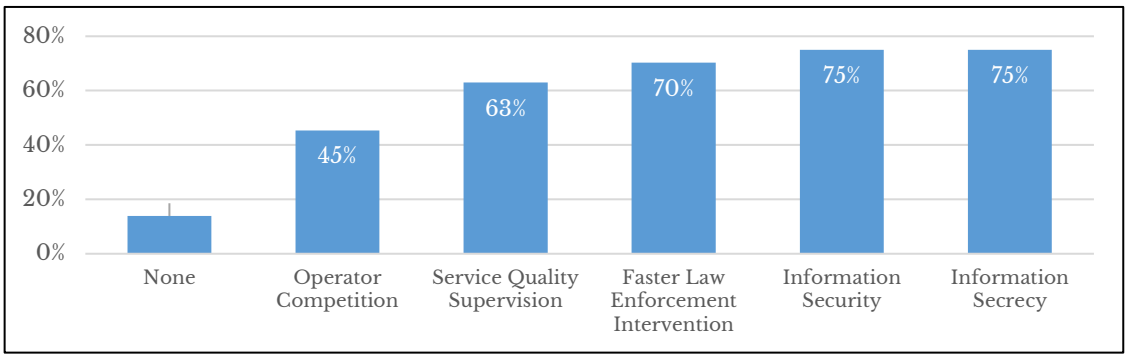


Figure 4.10-A Expectation from government

Customers also reported demands for faster intervention from law enforcement agencies. In the event of a financial scam or information security

breach, a prompt response from law enforcement can make a difference between aggravated financial loss and limited financial damage. Around 70% of our survey respondents reported wanting faster responses from members of law enforcement agencies in such an event.

At the same time, we see respondents also demanding service quality supervision (63%) and more intense competition among fintech service operators (45%). Service quality supervision will have to be another important area for a fintech industry policy. Similar to insights gathered from customers in other sections of this report – especially with regards to a reduced service charge in the future – operator competition is a need felt by customers across the board. This will be important going forward. Fintech regulators in Bangladesh can think of a variety of approaches. First, regulators can welcome new fintech service providers in niche service areas to increase the depth and scope of the fintech service landscape in Bangladesh. Second, they can – and should – look into ways to make entry barriers to the fintech industry lower for smaller fintech start-ups. This can happen through infrastructural and technical support. Financial assistance can also be considered. However, partnerships with existing banks and financial institutions will allow regulators to increase market depth and maintain firm control over financial transactions at the same time. Third, regulators can welcome foreign startups to experiment and create value for the customers in Bangladesh. In terms of information secrecy and the government's role in this in the future, our data suggest no particular difference across gender. More men and women we equally likely to demand better government oversight in this regard. Similarly, people in age groups below 65-74 and 74-85 years were more or less equally likely in this demand.

We looked into the likeliness of demand from the government for better information secrecy across customers with different levels of mobile banking usage scores. The expectation was that customers who used a wider variety and larger number of mobile banking services in a typical month are more likely to be concerned about the secrecy of information being generated and managed by the fintech service provider and their backward and forward linkages. Indeed, the proportion of respondents who maintained they want the government to take a more active role in protecting information secrecy was higher in customers with higher mobile banking usage scores.

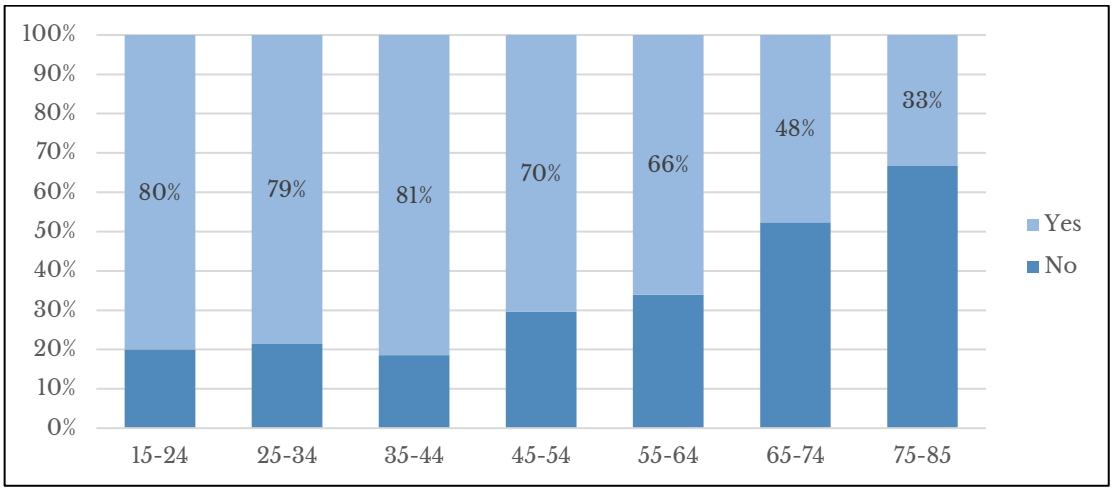


Figure 4.10-B Information secrecy expectation across age

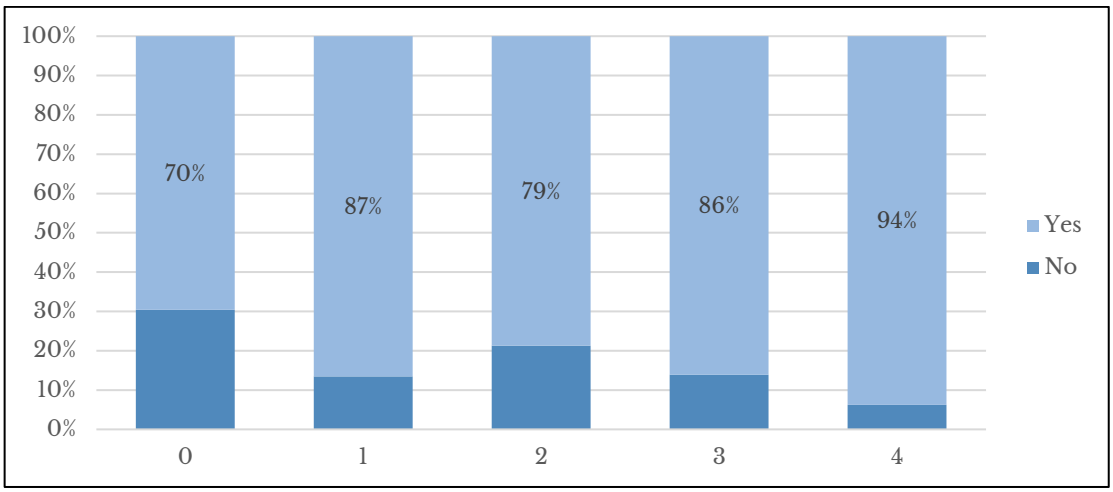


Figure 4.10-C Information secrecy expectation and mobile banking usage score

Across occupations, students constituted the largest group with demands for a government role in information secrecy oversight. 90% of students surveyed in our study said they wanted better information secrecy measures from the government. This was followed by government job holders (90%), non-government job holders (86%), unemployed individuals (79%), and business owners (76%). Indeed, government oversight in information secrecy remained a high priority across occupational categories in our survey.

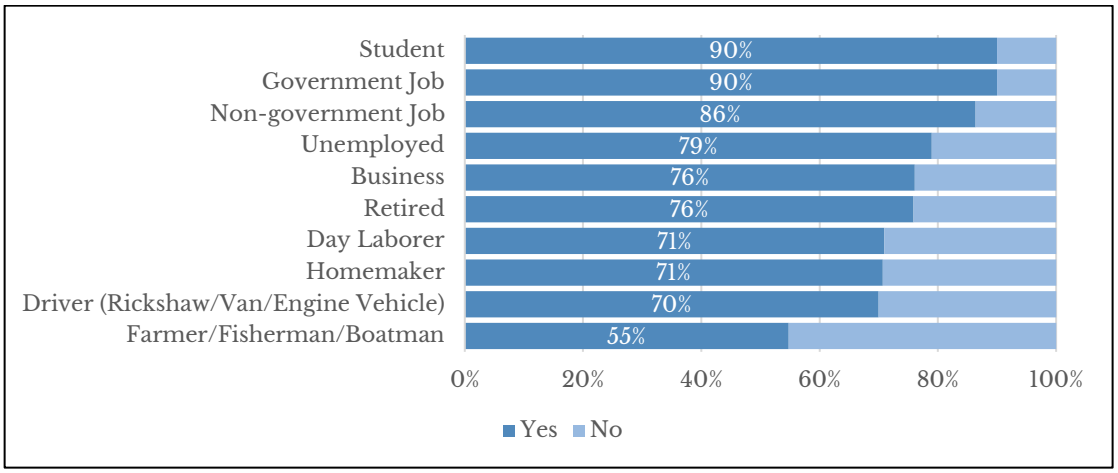


Figure 4.10-D Expectations from government across occupations

Men in our survey were slightly more likely to demand service quality supervision from the government. 64% of men maintained this demand compared to 55% of women. Across respondents from different age categories, however, we see a distinct downward trend. Young respondents were consistently more likely to demand service quality supervision compared to respondents from older age groups. This demand was 73% in respondents aged 15-24, 69% in ages 25-34, 68% in ages 35-44, and 55% in ages 45-54.

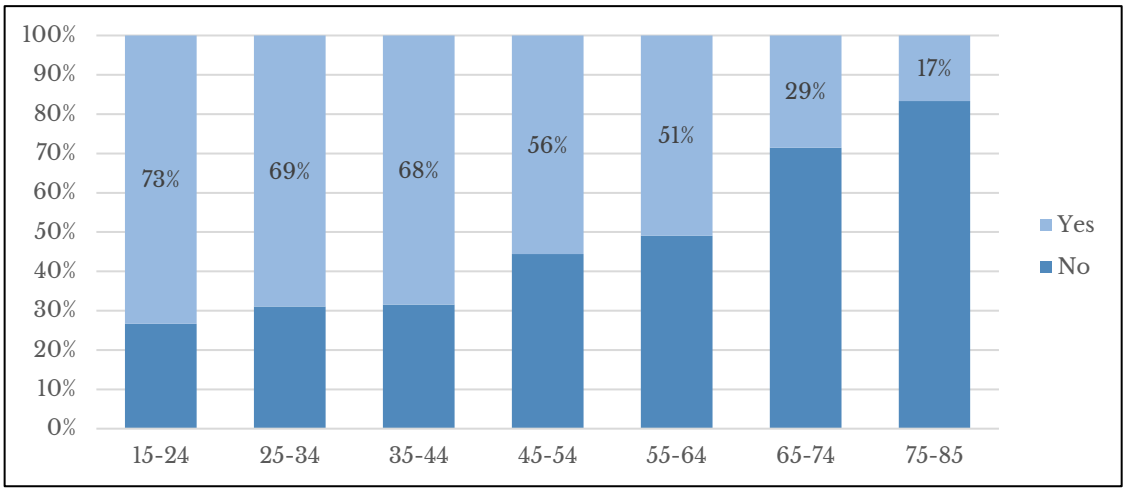


Figure 4.10-E Service quality supervision across age

A similar downward trend was also found in terms of demand for greater operator competition. We see that younger respondents are consistently more aware compared to their older counterparts regarding the need for a greater degree of competition among fintech service providers. Demand for this was 64% in ages 15-24, 52% in ages 25-34, 46% in ages 35-44, and 38% in ages 45-54.

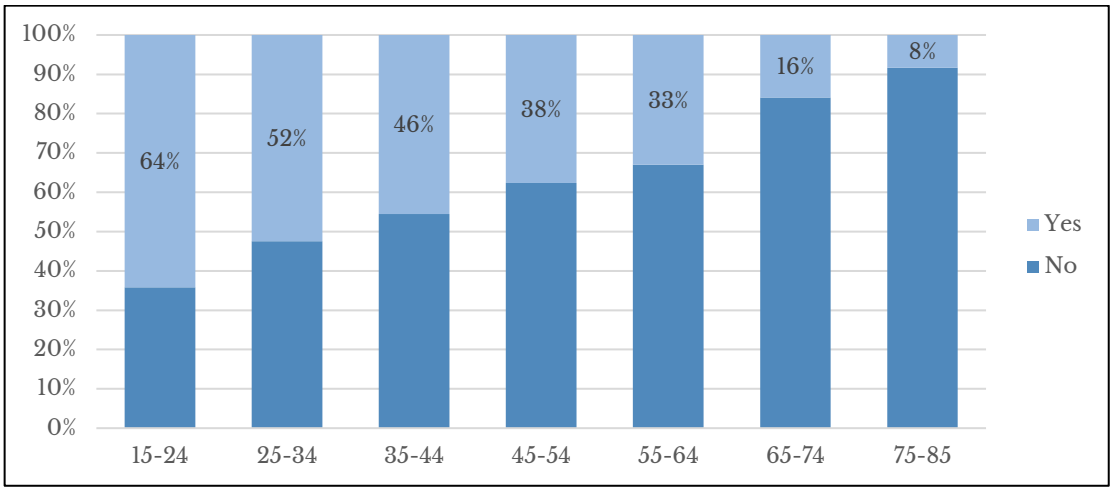


Figure 4.10-F Expectation of more operator competition across age

4.11. Concluding Remarks

Across different areas of insights on fintech use presented in this chapter, it is clear that overall readiness for fintech use is low. What is more, mental preparedness to use and concerns with security and privacy from fintech use are high – especially among women and older groups of respondents. If fintech is to be harnessed for sustainable economic development for all, these customer groups will need priority interventions. Low existing fintech preparedness among women and low satisfaction with existing fintech services among lower-income-class respondents point to a concerning trend from the NCS dataset. The two customer groups that stand to benefit from fintech-led gains in financial agency and financial resilience – women and lower-income individuals – are not convinced with existing fintech services. This may have inhibitory effects on large-scale fintech adoption among the target groups. Therefore, further investigation into the perception and possible barriers faced by these two target segments is required. To that end, the NCS provides a replicable format for data collection by researchers in the future. It can also be administered in areas not covered by the poverty-based stratified random sampling used in this study – thereby adding further geographic and income-based representation into the dataset.

5. Fintech Ecosystem: Globally and in Bangladesh

5.1. Introduction

Financial technology can be described as the technology used in the field of finance that improves and automate financial services. Primarily, fintech is utilized to assist companies, business owners, and consumers in better managing their financial operations, processes, and lives by utilizing specialized software and algorithms that are used on computers and, increasingly, smartphones. Financial technology (fintech) holds transformative potential for individuals and businesses across the planet. Harnessing the power of fourth industrial revolution technology, fintech brings new value to the customer and delivers old values at affordable prices and through efficient delivery channels. The expanse and score of fintech's customer base and product portfolio have reached new heights in recent years. With that, new investment has flown into fintech startups. Not only are venture capitalists eager to find the next fintech startup on its way to a billion-dollar IPO, but legacy institutions are also spending money developing their own fintech platforms and/or partnering with start-ups. The future of financial services is fintech. And that future is already here.

Fintech offers unique value to niche markets. However, for an emerging economy like ours, fintech's true revolutionary potential is reading marginalized communities and solving financial problems at fractions of the cost it would take legacy banks. In fact, fintech service providers can reach the farthest corners of the country and individuals disconnected from the formal banking channel. With services like safe and fast transfer of funds at affordable prices, paying for utility bills, opening bank accounts and depositing money, paying for shopping bills, making online payments for e-commerce and f-commerce purchases, and making investments – fintech is constantly opening new avenues of financial growth and freedom for the individual customer. Going forward, fintech

ecosystems around the globe will continue to become more vibrant with funding and innovation. Asia will become fintech's global hub with centers like China, Singapore, and India leading their way. All these mean beneficial growth for individual customers and small businesses across Asia.

Bangladesh has had remarkable macroeconomic stability since its independence in 1971. Despite political turmoil, natural disasters, and a huge population to feed and lift off of poverty, Bangladesh has achieved steady and impressive growth over the last five decades. Apart from domestic challenges, Bangladesh has had to face regional and global geopolitics that have not always worked on our behalf. Despite these challenges, Bangladesh has achieved food security, lifted millions out of poverty, and achieved laudable progress in ensuring education, healthcare, and maternal safety. However, going forward Bangladesh looks at a long list of challenges to overcome as we transition from a middle-income to an upper-middle-income country. One of the primary challenges is the equitable distribution of the benefits of an increasing economic pie. In other words, sheer aggregate-level growth is not enough to facilitate a healthy and sustainable life for all. Economic growth in itself needs to be sustainable. The role of digital technologies in leveling the field of opportunities and creating new ones is indispensable. In fact, it is the key to the next generation of growth opportunities for Bangladesh.

Facilitating sustainable economic growth is where fintech comes in. Fintech has already proved vital in generating financial inclusion and growth for marginalized communities in Africa, Eastern Europe, and Asia. Countries in these regions vary widely in terms of culture, level of education, climate, and political environments. Despite these, the common denominator was a scarcity of financial opportunities for the majority of the population. Fintech provides the right solution to this problem. Over the last decade, we have seen phenomenal growth of fintech platforms in Bangladesh. Somewhat limited to mobile banking wallets, fintech has still massive room for improvement here. The people of Bangladesh can benefit a lot from the introduction of fintech platforms powered by AI and the open sharing of data across platforms, to name just two areas. These and many other potential growths, however, rely on a few pre-requirements.

A phenomenal surge has been observed in the use of Fintech and e-commerce during the last few years, not barring the COVID-19 pandemic, causing a paradigm shift in digital commerce. Application of fintech is not limited to

digital purchase and selling, digital payment has also got a huge momentum. The role of Fintech has been substantially realized after the outbreak of COVID-19 when digital payments became an indispensable mechanism for making financial transactions from a safety perspective. Besides facilitating trade, digital payments also helped the governments in disbursing stimulus finance to firms and individuals during the COVID-19 pandemic.

Worldwide, FinTech is contributing to financial development by offering many diversified financial services that are ultimately contributing to the social development of any society. Due to the positive impact of fintech, the turnover of e-commerce has increased, and financial inclusion has reached a new level. It is also creating more favorable lending conditions for small and medium-sized enterprises (SMEs), especially in underdeveloped and developing countries. Due to the positive impacts on overall business, global fintech investments are also increasing. According to the Pulse of Fintech 2021 report by KPMG, Global fintech investments in 2021 recorded $210.1B with 5,684 deals (KPMG, 2021).

Financial technology can be an impacting force and driver of economic growth. This study explores the fintech progression globally. Then it explores the fintech ecosystem of Bangladesh using different fintech business models. The study explained the position of Bangladesh in the process model of fintech Ecosystem Development. The study also captured the fintech readiness of different stakeholders in Bangladesh. The study concludes with a discussion on the prospects of the contribution of fintech in the sustainable development of Bangladesh.

5.2. State of Global Fintech Ecosystem

The invention of the internet in the 1980s and the subsequent internet revolution in the 1990s ushered in a new era for the world which opened new horizons for all types of businesses. But it was the financial crisis of 2008 after which Fintech was catapulted into the limelight. Systematic risk in the system, created by the reckless bankers needed to be eliminated to bring back objectivity in the financial markets and ensure such an economic collapse never occurred. Thus, Fintech came of age. These values include venture capital, private equity, and mergers and acquisitions each year. We can see a general upward trend in the investments, which peaked at $ 213.8 billion in 2019, just before the Covid-19 pandemic. In 2020, global investments in Fintech lost steam but got back on track again in 2021 to reach $210.1 billion.

Thus, 2021 saw some of the largest deals in Fintech around the world. Refinitiv, a UK-based company, made a $14.8 billion merger and acquisitions deal. Nets, a Danish company, made a deal of $9.2 billion. If we see, most of the fintech deals happened among US companies. Other than the US, Sweden has two large deals, the UK, Canada, and Japan also made the top 10. These deals indicate how fintech is becoming mainstream. Figure 5.2-A shows the top 10 global fintech deals in 2021. If we look into the top 10 fintech companies worldwide, we can see five companies from the US topped the leaderboard. Two companies from China are on the board. Ireland, Sweden, and Brazil have a single presence in the top ten. Six of the companies are operating in the area of paytech. Visa is the top fintech company listed by CFTE.

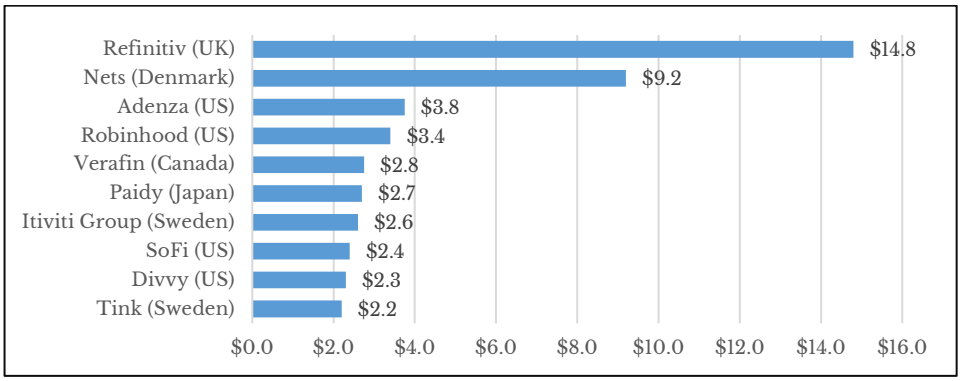


Figure 5.2-A Top 10 Global Fintech Deals in 2021 (in billions of USD)

Figure 5.2-B depicts the 100 largest fintech companies, according to market valuation, by country. Among the top 100 companies, 46 of the companies are from the USA. Interestingly, India has 9 companies among the top 100 largest fintech companies. The UK has 7 companies and China and Israel both have 4 companies each. There are several countries that have one company listed by CFTE in the top 100 companies. Figure 5.2-C depicts the largest 100 Fintech companies in 2021 by their area of activity. Twenty-seven companies are in the area of paytech. Sixteen of the top 100 companies are in the challenger bank. Fourteen of the companies are working in the area of cryptocurrencies and eleven of them are working in the area of Infrastructure. Before proceeding further, we need to discuss the areas of activity identified by CFTE.

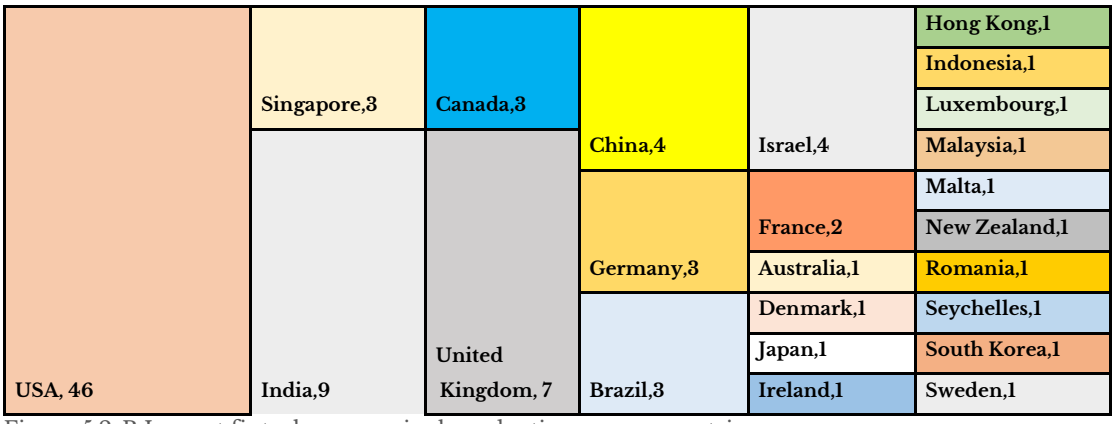


Figure 5.2-B Largest fintech companies by valuation across countries

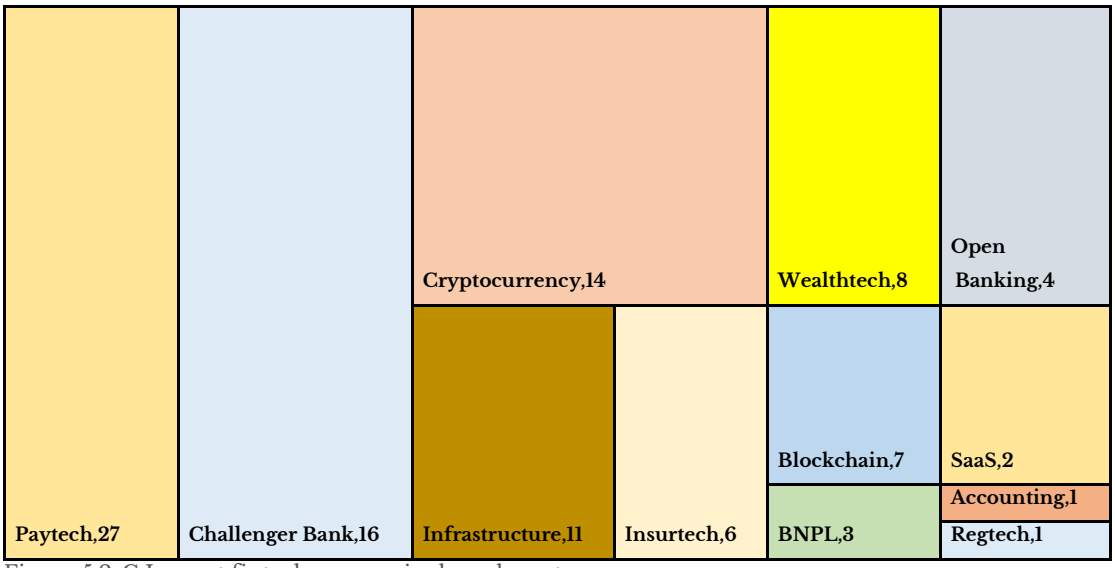


Figure 5.2-C Largest fintech companies by sub-sector

5.2.1. Paytech

Paytech is any payment involving technology. Paytech does not focus on the full range of financial services. It mainly covers financial transactions and payments. Paytech's basic premise is that before this, payments consisted solely of an exchange of money. However, with the advent of wearable technology, new payment methods, and integrated finance, transactions now play a far bigger role in a person's life. As of January 2022, Visa is the largest paytech company in the world with a market capitalization of 489 billion USD. (Statista, 2022)

5.2.2.Challenger Banks

A challenger bank is a bank that is smaller in size and operation and challenges traditional banks with modern financial services. They operate mostly online through an app without any branch. Some major challenger banks in the UK include Starling Bank, Monzo, Revolut, and Metro Bank (TheFintechTimes, 2021). Challenger banks are also known as neo-banks. NuBank has a substantial position in Latin America and it has a market cap of 41.5 billion USD. (CFTE, 2022)

5.2.3.Cryptocurrency

Cryptocurrency is a digital currency and it uses cryptography to secure transactions. There is no central bank that issues cryptocurrency and there is no regulatory authority. It is based on a peer-to-peer system that enables anyone from anywhere to send and receive payments (Hayes, 2022). Bitcoin, Ripple, Ethereum, and Litecoin are popular cryptocurrencies. Coinbase is the largest cryptocurrency-based fintech company that operates in the online space and has no physical headquarters. This American company has a market capitalization of 16.22 billion USD. (Market capitalization of Coinbase (COIN), 2022)

5.2.4.Infrastructure

Fintech infrastructure companies are the companies that are transforming the technology and financial services industry with the help of Application Programming Interfaces (APIs). APIs virtually can help any software company launch financial products to their customers through embedded fintech (Garcia, Rickli, & Sapru, 2020). UIPath is the largest infrastructure fintech company with a

market capitalization of more than 10 billion USD (Market capitalization of UiPath (PATH), 2022).

5.2.5. Insurtech

Insurtech is related to technological innovations to improve the operation of the insurance industry (Tibco). Key applications of insurtech include verification of customer identity, managing claims, smart contract formulation, detecting fraud and risk prevention, and payment processing. While the US continued to account for the vast majority of insurtech deals, the emergence and expansion of insurtech ecosystems in other regions are helping to catalyze investment in the sector. Bolttech, a Singapore-based insurtech company, was the largest in the world in 2021 with a market capitalization of 11 billion USD (InsurTech entering its second wave, 2018).

5.2.6. Wealthtech

WealthTech refers to the use of technologies such as artificial intelligence and Big Data for companies that work with wealth management and investment services. It helps those firms to manage wealth and investments more efficiently and in an automated manner (What Is WealthTech?, 2021). In 2021, Lufax, a China-based company was the largest wealthtech company in the world with a market capitalization of around 10 billion USD. (Market capitalization of Lufax (LU), 2022)

5.2.7. Blockchain

Blockchain is a shared ledger that records all the transactions and tracks the footprint of assets in a business. An asset can be both in the form of tangible or intangible. Trades are easily tracked in any blockchain network. The network reduces risk and costs (What is blockchain technology?). Binance is a Chinese blockchain company with a market valuation of 38 Billion USD. (Market capitalization of Binance Coin, 2022)

5.2.8. Open Banking

Open banking provides third-party financial service providers with open access to banking transactions and other financial data of consumers of traditional banks and non-banking financial institutions. It uses the application programming

interfaces (APIs). Through open banking consumers, financial institutions and third-party service providers can access the networking of accounts and data across institutions (What is Open Banking?, n.d.). Ant Financial, based in China and formerly Alipay, is the largest open Banking Fintech in the world with a $240 Billion market capitalization (Market capitalization of Alibaba (BABA), 2022).

5.2.9.BNPL

Buy Now Pay Later, shortly known as BNPL, is a type of service that provides customers with short-term financing with almost zero interest rate to make purchases and pay later. Until you pay in full for your purchase, the payment will be billed to your credit or debit card. BNPL Fintech companies are becoming popular payment options nowadays (kodzilla, 2022). Affirm is the globally leading BNPL Fintech with a market capitalization of $7.58 billion. (Market capitalization of Affirm (AFRM), 2022).

5.2.10. SaaS

Software as a service (or SaaS) refers to a way of online delivery of applications over the Internet as a service. Customers can access the software from the internet without installing and maintaining them. SaaS applications are sometimes called on-demand software. The provider manages access, security, availability, and performance (Salesforce, n.d.). Salesforce is globally largest SaaS firm with a market capitalization of 182.26 Billion USD. (Market capitalization of Salesforce (CRM), 2022).

5.2.11. Accounting

Application of accounting through fintech is not very well-known or widely used. But for the last couple of years, it is getting traction. Even in the top 100 companies of fintech only one fintech company is doing business based on accounting solutions (CFTE, 2022). Intuit is the largest accounting Fintech in the world with a market capitalization of over $132.1 Billion. This company is based in the USA. (Market capitalization of Intuit (INTU), 2022)

5.2.12. Regtech

Regtech focuses on technologies that facilitate the delivery of regulatory requirements. It ensures that the delivery is more efficient and effective than existing ones. Regtech can also be defined as the management of regulatory processes within the financial industry through technology (Homann, 2022). Tencent, based in China, is the largest Regtech company in the world with a market capitalization of over $369.14 Billion (Market capitalization of Tencent (TCEHY), 2022).

5.3. Data and Methods

We conducted a focused group discussion with eight participants. They are from the University of Dhaka, Bangladesh Bank, Robi Axiata Limited, BRAC Bank Limited, Mastercard, Q-Cash /ITC Limited, Standard Chartered Bank, and Nagad. In that focused group discussion, the discussion took place on fintech ecosystem, challenges, and prospects of Bangladesh.

We conducted depth interviews with a panel of twenty-one experts (details available in Chapter 3). Experts came from academia, fintech startups, government regulatory authorities, traditional financial service providers, technology providers, and investors. Their average length of experience is more than twenty-two years. Their length of experience varied from six years to thirty-four years. Each expert opined about the fintech readiness of Bangladesh, remedies, and prospects of fintech's contribution to the economy of Bangladesh. We asked them about their opinion regarding the readiness of seven fintech players on a scale of five. We also asked them about the current stage of fintech ecosystem (disconnected/connected/organized). We asked them about how fintech can contribute to the sustainable economic growth now, in five years, and in the next fifteen to twenty years. In the last section, we asked for their suggestions to improve the readiness of fintech ecosystem players.

5.4. Overview of Fintech Ecosystem Scenario in Bangladesh

According to Tracxn, an Indian venture capital firm providing profiles of thousands of start-ups across the globe, there are 167 FinTech start-ups in Bangladesh as of 2022. (Tracxn, n.d.) Bangladesh ranked 61st in the Fintech World Ranking in 2020. It was on its way to slowly becoming the rising Fintech star in Asia. The current start-up ecosystem in Bangladesh is valued at $1.45 billion and has the potential to reach a $10 billion valuation. All FinTech combinedly processes $4 billion in monthly transactions in 2021 (Gomedici, n.d.). Recently, Bangladesh has ranked 78th among 83 countries in the Global Fintech Index 2021, indicating that the country is falling behind in terms of using technology to automate and digitalize financial activities. It went down 17 notches in the global ranking compared to the last index.

Bangladesh currently ranks lowest out of 16 countries in the Asia Pacific region. Dhaka is ranked 225th out of 264 cities globally. On the other hand, New Delhi is the only South Asian city to secure a place in the top 20. The index was released on 23 June 2021 by Findexable, a London-based global research, and analytics firm, in partnership with Mambu – a market-leading cloud banking and financial services platform. This ranking was done on the basis of the quantity of privately owned fintech companies, the quality of those companies, and the local business environment. According to the report, the largest improvement in the Asia Pacific occurred in New Zealand and Taiwan, while Vietnam, Bangladesh, and Thailand experienced the greatest drop in the ranking in this region (Farabi, 2021). One of the world's highest GDP growth rates has made Bangladesh one of the eleven developing markets.

The nation is gradually transitioning from its conventional industrial sector to a non-traditional industry as it moves towards upper middle-income status. (Ahmed, 2019). However, Bangladesh's banking industry is only one of several industries that lack modern technology. Despite having a sizable population, Bangladesh still has a severe deficit in the financial sector. More than 35 million individuals meet their financial necessities through informal channels and without any bank accounts. Therefore, Fintech has a critical role to play in removing this barrier with the appropriate technology. The main goals of fintech are to shorten transaction cycles, lower service costs, and boost service quality. Therefore, Fintech has the potential to promote financial inclusion and quicken the growth

of the financial sector in developing nations like Bangladesh. In Figure 5.4-A, we can see that in the Asia Pacific Bangladesh is among the bottom 3 countries in global fintech ranking with Pakistan and Vietnam.

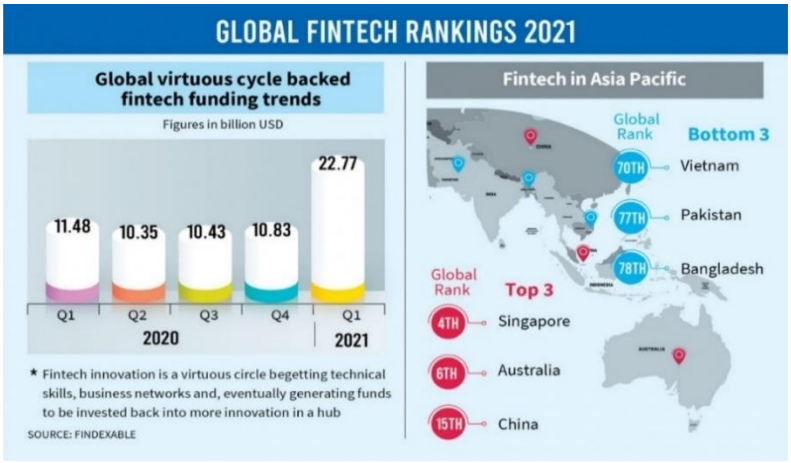


Figure 5.4-A: Global Fintech Rankings 2021 and Bangladesh (TBSNews, 2021)

By integrating the informal sector into the formal economy, increasing transparency, and improving tax collection, fintech-enabled payment systems have the potential to overhaul the system. Fintech can help reduce the operational expenses for payment banks and the central bank's present fraud risk. Fintech may help automate the loan approval method's verification procedure, which is now severely missing in Bangladesh. Enhancing client satisfaction and lowering the risk of bias might be possible by speeding up the loan approval/rejection process. Fintech may be leveraged to offer Robo Advisors to all various level stakeholders to deliver advisory services, which may further enhance the caliber of services. Chatbots can now take the role of customer support to cut costs and speed up services. All of these areas still have an opportunity for Fintech adoption and to flourish in Bangladesh.

The nation also benefits from having a sizable base of young people and very high mobile subscriber coverage. Fintech can operate as a catalyst for macroeconomic growth by combining the two variables, but effective regulatory bodies will be essential for the expansion (Chakraborty, 2020) The significance of the potential for Fintech in Bangladesh, according to Rubaiyat, is due to the country's underdeveloped financial system, increasing smartphone penetration, and startup sector's early-stage development. This is especially true given the numerous accelerators, incubators, and sponsored events currently being held by both public and private corporations. Therefore, it should come as no surprise

that mobile money services are the most popular Fintech, with firms like Bkash and Nagad dominating the market share and being followed by comparable services from banks like Rocket, mCash, and Upay. The majority of financial institutions have not yet automated other financial services, such as account opening, loans, and insurance. Because of this, independent businesses can disrupt the financial sector by using these new technologies (Rubaiyat, 2020).

It is estimated that 7.8 million MSMEs (including cottage industries) make up a significant portion of economic enterprises in Bangladesh (SMEFoundation). A study conducted by the Asian Development Bank (ADB) in 2015 said that MSMEs account for over 97 percent of all businesses. If properly estimated, the share of SMEs in GDP could be even higher. According to the Economic Census 2013, manufacturing units made up 10.9 percent of all units and were responsible for 30 percent of all non-farm employment. Trading and service units were responsible for the remaining 7 percent of non-farm employment. To guarantee that SMEs play a significant part in Bangladesh's growth and socioeconomic development, the advancements made in the SME sector to date need to be fostered and continued The SMEs are a major driver of growth, expanding at a rate of at least 6% yearly. SMEs provide an economic contribution not just on their own, but also by acting as a backward-linking industry for bigger industries.

The adoption of Fintech has enabled MSMEs to sustain their viability during COVID-19 in terms of continuing production activities through assessing market demand and maintaining the sustenance of the value chain. The findings from the survey by the World Bank and CCAF reveal that the use of FinTech has increased significantly since the outbreak of the pandemic; particularly digital payments and remittances (60% increase), digital banks (22%), and digital savings or deposits (19%) (CCAF, World Bank, and World Economic Forum 2020). The study found that the priority of Fintech has either increased or remained high after the outbreak of COVID-19.

In recent years, the Fintech and e-commerce sectors in Bangladesh have also undergone fast development, and the impact of COVID-19 has led to a paradigm shift in terms of consumer digitalized purchases, online selling platforms, and digital payments. After the COVID-19 epidemic, when digital payments became an essential tool for conducting financial transactions, the function of Fintech has been considerably recognized. Digital payments not only facilitated trade but also assisted the government in providing financial aid to the underprivileged

population during the COVID-19 epidemic (Lightcastle, 2020). Banks have seen a large rise in online transactions throughout the epidemic, and the amount of transactions via electronic fund transfer (EFT) 3 has significantly grown (BEFTN, 2020). Similar to other nations, Bangladesh has seen a rise in digital money as a result of the COVID-19 epidemic. In the third quarter of FY 2019–20 compared to the second quarter; the average daily volume of mobile financial services (MFS) transactions grew by 7% (Bangladesh Bank, 2021).

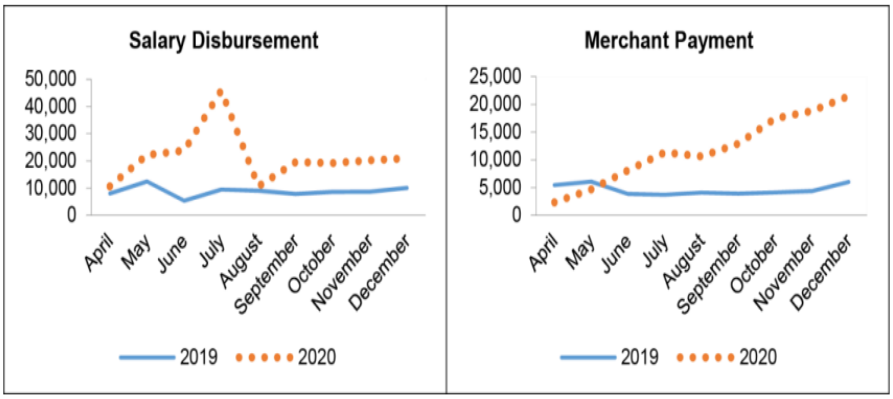


Figure 5.4-B: Month-wise salary disbursement (million BDT) and merchant payment (million BDT) through Mobile Financial Service in 2019 and 2020 (Source: Bangladesh Bank)

In 2019, there was a continuous increase in the number of monthly merchant payments made using mobile financial services, which trend continued in 2020. (Figure 5.4-B). Even though each month of 2020 had a greater monthly pay distribution through MFS than the corresponding month in 2019, the disbursement in 2020 had been increasing up until July of that year before declining to a stable trend in the months that followed. The lockdown up to July, when salary payments (particularly in the apparel industry) were paid using mobile phones, can be used to explain this abrupt increase (Chowdhury, 2022).

Figure 5.4-C displays the number of average daily transactions and average monthly transactions (in million BDT) for mobile financial services in 2019 and 2020. In comparison to 2019, the number of average daily transactions in 2020 was consistently higher each month. The average daily transaction volume (million BDT) increased steadily starting in August 2020.

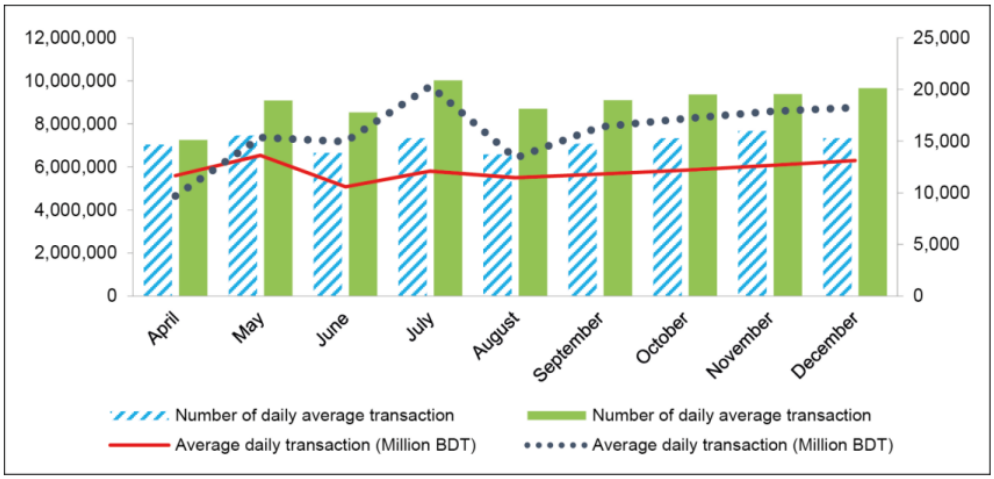


Figure 5.4-C: Month-wise average daily transactions (million BDT) and number of daily average transactions through Mobile Financial Service in 2019 and 2020 (Chowdhury, 2022)

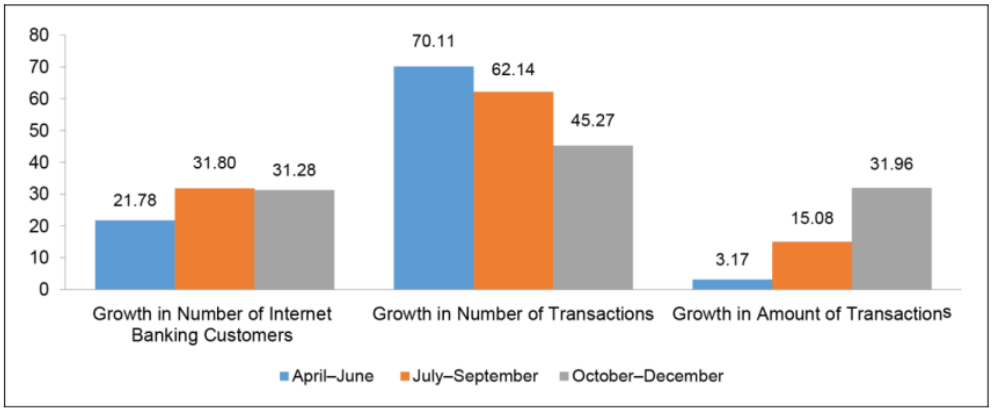


Figure 5.4-D: Point-to-point quarterly growth of Internet banking in 2019 and 2020

The overall number of transactions through online banking increased by 3.2 percent, 15.1 percent, and 32 percent in the three consecutive periods from April to June, July to September, and October to December as compared to the comparable three months in 2019. (Figure 5.4-D). In contrast, the volumes of transactions in the aforementioned three times for mobile banking were 11 percent, 42 percent, and 41 percent in 2020 compared to the transactions in the corresponding periods in 2019. We are particularly interested in the use of Fintech by manufacturing MSMEs and its impact on their recovery given the rapid growth of digital finance in Bangladesh during the COVID-19 epidemic.

5.5. Fintech Business Models

Fintech opens new ways of storing, borrowing, and investing financial assets, payments, and purchases, as well as providing security. There are nine basic types of fintech business models according to (Soloviev, 2018):

- Payments and Transfers;
- Asset Management;
- Crowdfunding;
- Peer-To-Peer Lending;
- Securities Trading;
- Online Banking;
- Online Accounting;
- Insurance;
- Blockchain And Cryptocurrencies

We discussed these business models in the context of Bangladesh. However, Bangladesh is yet to delve into 3 of the categories.

5.5.1. Payment and transfers

All fintech ventures include payment services in some capacity. This is because financial goods like payments are very straightforward. Firstly, payment-focused fintech firms may swiftly and affordably grow their client base. Secondly, current technological advancements in the payments sector enable the constant introduction of fresh chances built on innovations. Thirdly, payments are financial services that are quite popular with both individuals and legal businesses. bKash is a mobile financial service and payment system for consumers. It offers money transfers, mobile recharges, credit card bill payments, utility bill payments, and others.

Users can dial a number or use their app to initiate the transaction, fill in the bKash account, amount and the money will be sent to the receivers' mobile. The beneficiary can cash out at the participating agent locations or partnered locations and ATMs. bKash was founded in 2010 in Dhaka, Bangladesh, and has a funding of USD 11M. Investors include Bill & Melinda Gates Foundation and Gray Ghost Ventures (Tracxn, 2022).

Figure 5.5-A: bKash facilities and interface

Nagad offers similar offers to bKash. It offers an app-based wallet for providing banking services. It offers various services including savings accounts, money transfers, bill payments, online/offline payments, mobile recharges, and DTH recharges. Users can make payments via credit/debit cards. The application is available on iOS and Android devices. Figure 5.5-B shows Nagad's interface.

Figure 5.5-B: Nagad Interface

Digital Payments is the largest FinTech segment in mature and upcoming FinTech markets alike, mainly due to the acceptance and implementation of mobile technologies. Bangladesh is one of the economies where the payments segment of FinTech is performing well because of mobile phones. MFS Guidelines were issued in 2011. Since then the journey of MFS platforms in Bangladesh started under a bank-led structure. (Fintech Innovation in Bangladesh, 2020) According to the World Bank's 2017 Global Findex Database, financial inclusion in Bangladesh had increased from 3% in 2011 to 21% in 2017 and Digital Financial Services (DFS) and Mobile Financial Services (MFS) played a huge role in this. (The World Bank, 2021) bKash is the leading MFS platform with the highest number of users. Nagad, a digital financial service platform was launched in 2019 under the

authority of the Bangladesh Post Office that offers higher transaction ceilings for consumers.

5.5.2. Crowdfunding

A business model for services called "crowdfunding" enables users to generate money for the creation of new goods, the launch of businesses, or philanthropic endeavors. Interaction between project starters in need of money and potential donors who could be interested in sponsoring these initiatives is made possible via a crowdfunding website. The software automates the receiving of funding for the project through a variety of financing avenues and offers transactional documentation. The global crowdfunding market volume in 2020 was $12.27B (Market size of crowdfunding worldwide in 2020, 2022).

iFarmer is an online, Bangladeshi crowdfunding platform for farming communities. Any individual can invest in farming and livestock. This platform connects landowners, crop buyers, farmers, and sponsors to create a farming supply chain. Sponsors can fund projects for a social cause. Sponsors can even share the profits from farming businesses. Figure 5.5-C shows the application interface of iFarmer.

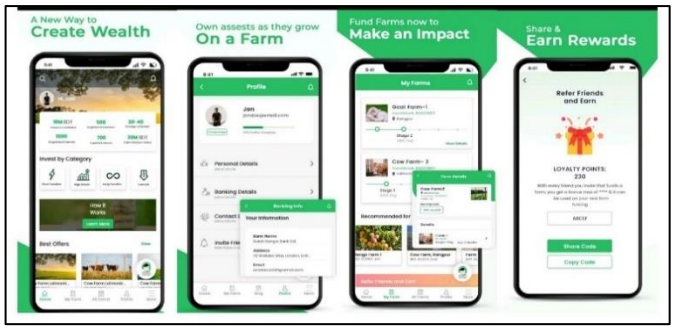


Figure 5.5-C: iFarmer interface (Tracxn, n.d.)

GoRiseMe is an online crowdfunding platform for nonprofit organizations. Users can raise funds for environment, hunger, education, orphans, health, etc. Their application is available both on the Google Play Store and Apple App Store.

5.5.3. Peer-to-peer Lending

Shadhin Fintech is Bangladesh's first peer-to-peer (P2P) lending and borrowing platform which also aims to be the leading P2P platform-based credit

evaluator in the country, states a press release. P2P lending and borrowing platforms, which connect lenders and borrowers on a sophisticated technology platform to meet the two parties' unique financial needs, are thriving in emerging nations and have grown into multi-billion-dollar businesses.

With nearly 165 million inhabitants, Bangladesh has the eighth-largest population in the world. Over 50% of the population still has limited or no access to financial facilities, though. As a result, a sizable portion of the unbanked population seeks loans between 20,000 and 100,000 takas. In addition, Shadhin Fintech is the only genuine peer-to-peer lending platform in Bangladesh that offers uncollateralized loans from peer investors to the unbanked populace. They have used their unique AI-powered credits-scoring engine to examine, assess, and preserve records for their customers, and they are following comprehensive end-to-end matching with investors and borrowers. By August 2021, Shadhin has received over 50,000 download requests totaling over Tk17 crore from little under 10,000 clients (ShadhinBD, 2022). Figure 5.5-D shows some snapshots of the Shadhin app.

Figure 5.5-D: Summary of facilities of Shadhin

Dana, a Lending-as-a-Service platform, is another Bangladeshi lending platform. It provides a technology that enables banks and other financial institutions to offer end users digital lending services. It offers patented credit ratings for individuals, a unique scoring method for farmers, as well as other things like digital onboarding solutions. Additionally, it offers a point-of-sale financing option that lets customers buy goods and pay for them over time inside the network of affiliated merchants. It was established in 2020 and has received USD 200,000 in financing. A growing portion of investors is from Asia (Dana, 2022).

5.5.4. Online Banking

Bangladeshi traditional banks and financial institutions are offering apps and websites through which citizens of Bangladesh can use Internet banking. Figure 5.5-E shows the growth of Internet banking in the last two years. In 2020, the number of customers of Internet banking was 27,22,327 while in 2021 we can see almost 30% growth. The total number of transactions grew by more than 40% in a year. The total transacted amount becomes more than double in one year. (Internet banking shines in pandemic, 2021).

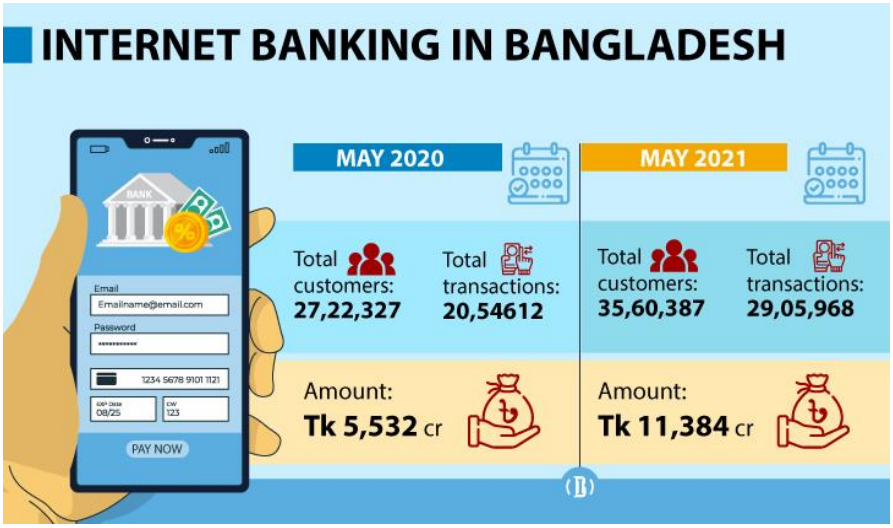


Figure 5.5-E: Internet Banking Progression of Bangladesh 2020 - 21 Source: Bangladesh Bank

5.5.5. Insurance

Fintechs seek to provide more direct interaction between the insurer and the client in insurance fintech business models. As the pool of potential consumers grows, clients are given products to suit their needs (such as a vehicle, life, health, or causality insurance), and they employ data analytics to quantify and match the risk. They also make healthcare billing procedures more efficient. Traditional insurance companies appear to be more amenable to the insurance fintech business model. Insurers may now augment their standard models with data from non-traditional sources thanks to technology, which enhances their risk analysis. Nirapod Bima provides an online insurance comparison platform for individuals and businesses in Bangladesh. It offers quotes for auto insurance, life insurance, health insurance, travel insurance, home insurance, and more. It also offers claims support through its app.

Figure 5.5-F shows the app interface of Nirapod Bima. Similarly, AamarTaka is an Online comparison platform for consumer loans, credit cards, and insurance services. It allows consumers to compare multiple loan products such as personal loans, auto loans & and home loans; check eligibility & and compare credit cards; and motor insurance services. Also offers various deals for fund deposit solutions including fixed deposits, DPS, monthly benefits, saving accounts, etc.

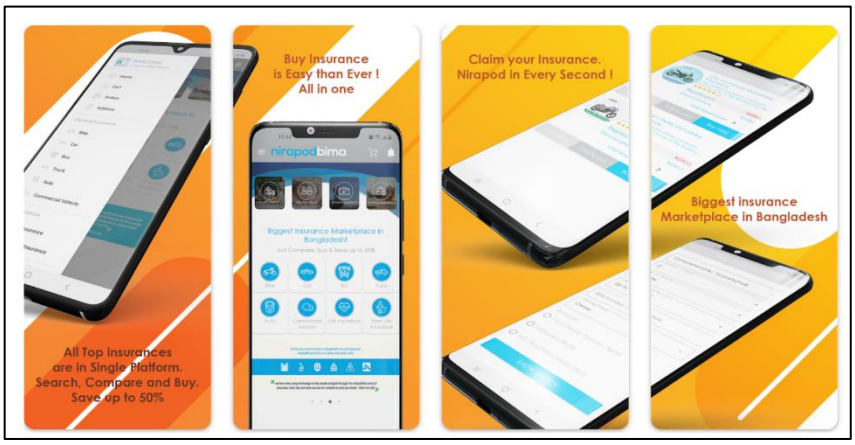


Figure 5.5-F: Nirapod Bima app

5.5.6. Securities

Smart Share & Securities Ltd., a concern of Smart Group, launched its own securities order management system to buy and sell shares online. They have done it together with Quant FinTech Ltd. (The Financial Express, 2022). As a result, customers of Smart Shares & Securities Ltd offer to trade directly on stock exchanges from anywhere in the world. Smart Share & Securities has become a TREC holder of both stock exchanges. Not only Smart Share & Securities, but there are other online share trading apps in the market as well. Most of the securities are bringing their own apps so that their customers can transact online securely and seamlessly. Royal Capital, Lanka Bangla Securities, Midway Securities, Amar Stock Limited, EBL Securities, IDLC Securities, MTB Securities, BRAC Securities, and City Brokerage Ltd are some of the top names that offer smart apps and websites for online transactions.

5.5.7. Asset Management

Fintech solutions for personal finance management are also popular among customers. These solutions allow clients to visualize their financial transactions on accounts in different banks, analyze cash flows identify patterns, and form personal recommendations. Working with personal finance management dashboards, customers realize the importance of controlling their expenses and savings, and they increase their interest in working with the bank. Visualization of expenditures and the forecast models help to plan vital activities and achieve financial goals.

One of the popular business models for financial asset management is Robo advising. The value proposition in these business models is an advisory application for automating money management by providing financial advice based on artificial intelligence and data processing for a small part of the cost of a real consultant. For example, the "Cash off" service allows managing the customer's budget by aggregating transactions into categories and providing expense reports and personal recommendations for reducing expenditures. Bangladesh has 53 asset management companies listed in the Bangladesh Securities and Exchange Commission (Bangladesh Securities and Exchange Commission, 2021). Very few companies are offering digital platforms for asset management. 3i Asset Management Company Limited offers a mobile application.

5.5.8. Online Accounting

Despite being a business model with high potential, there are not many companies that provide online accounting services in Bangladesh. AccountingBD is a Bangladeshi company that offers online Bookkeeping, remote Accounting, review of Financial Statement charts of Accounts, management Analysis of Financial Statements compilation, Financial Planning, Tax Preparation and Advising, Audit Assistance, and other accounting services virtually. (AccountingBD, n.d.)

TallyKhata is another online accounting Fintech company, mostly for MSMEs, that offers an app for maintaining transaction records, accepting digital payments, and accessing quick and simple working capital loans. It started during the pandemic in 2020. According to their website, they have 4 million registered

users and more than a million transactions every day. Figure 5.5-G shows some snapshots of TallyKhata mobile app.

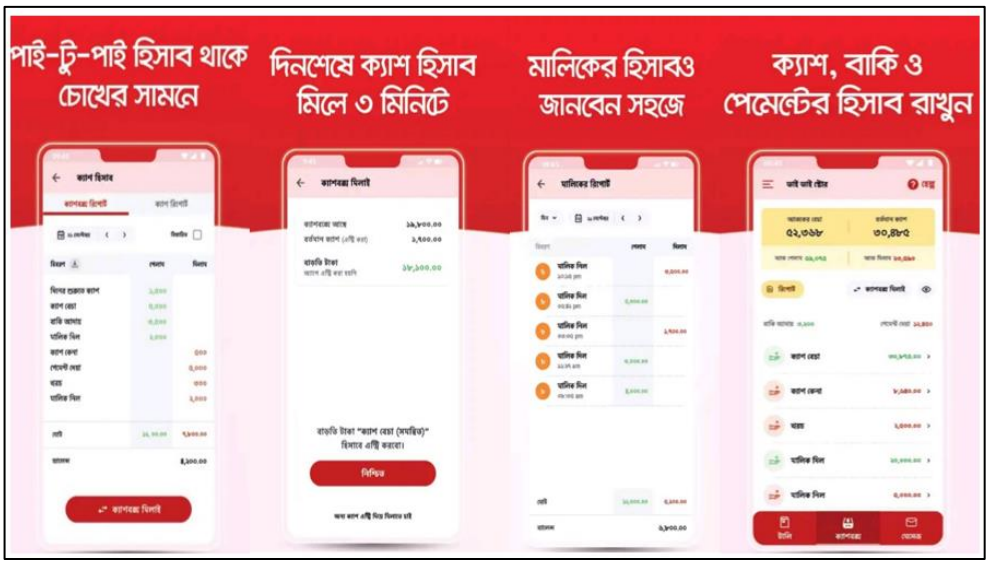


Figure 5.5-G TallyKhata app interface

5.5.9. Cryptocurrencies and Blockchain

A decentralized electronic system called blockchain is used to create, store, and exchange unique digital assets. In this situation, transaction information is often not secured because it is always accessible. Instead of limiting access to transaction data, cryptography is employed to guarantee that the chain of transactions remains unaltered. And even if, aside from cryptocurrencies, the majority of blockchain initiatives have not yet shown notable results, progress is visible: genuine projects based on the blockchain, rather than simply promises, are appearing in numerous fields.

The usage of smart contracts, which are cryptography-based algorithms that specify the conditions of transactions by the regulations of the platform in which they are implemented and ensure automated fulfillment of these requirements, is one of the key blockchain developments. Since everyone can track the voting process by joining the blockchain network, the usage of blockchain technology increases the degree of confidence in the votes and ensures the invariability of the outcomes.

Not many Bangladeshi company has ventured into the new world of blockchain and cryptocurrency, primarily because trading cryptocurrency is illegal in Bangladesh as mandated by Bangladesh Bank in a circular published on 24 December 2017. (StarBusinessReport, 2021) However, the Bangladeshi

Government is keen to embrace the Fourth Industrial Revolution in a bid to create a Digital Bangladesh and has decided to create a blockchain-enabled nation. In a report titled "National Blockchain Strategy: Bangladesh- Pathway to be a Blockchain-enabled Nation" published by the Information and Communication Technology Division in 2020, action plans such as building a team of blockchain experts, formulating plans to develop a blockchain-integrated national information infrastructure et cetera have been outlined (Information and Communication Technology Division, 2020). Orion Informatics Ltd. is a Bangladeshi company that provides services to build new blockchain-based systems and convert existing systems to blockchain-based ones (OrionInformatics, 2022).

5.6. Process Model of Fintech Ecosystem Development

A process model of Fintech Ecosystem Development was discussed in a study of the Fintech Ecosystem (FE) in Indonesia and concluded that there are three steps to this process: an Assessment phase, an Acceleration phase, and an Augmentation phase as shown in Figure 5.6-A (Muthukannan, Tan, Tan, & Leong, 2017). Each of the phases requires the participation of different groups of ecosystem entities and is associated with a particular stage of FE maturity (Rizzi, 2016) that leads to several distinct outcomes. A variety of developmental drivers and inhibitors, respectively, both help and hinder the transition between the stages. In the subsections that follow, the phases of the development of the fintech ecosystem are discussed, together with the involved entities, drivers, inhibitors, characteristics, and consequences of each phase.

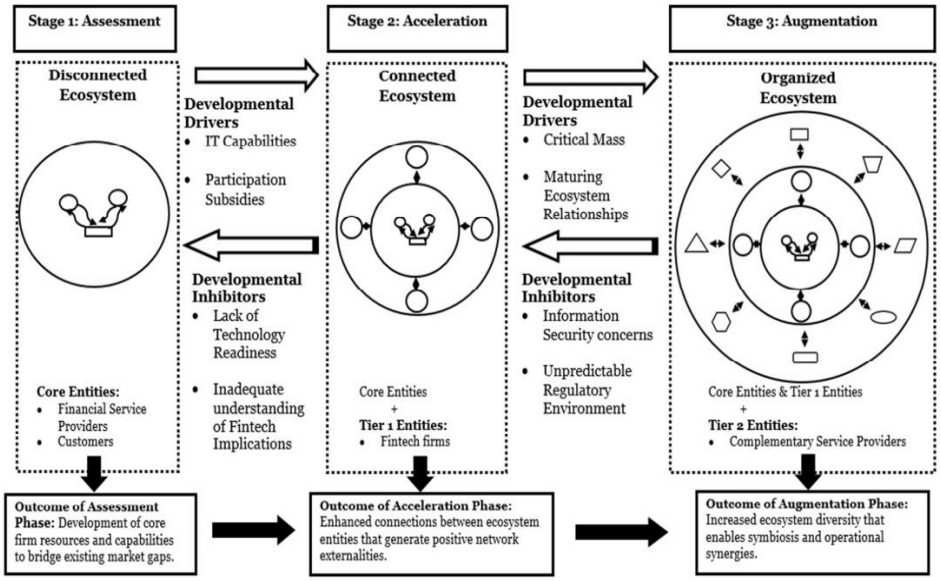


Figure 5.6-A The process model of Fintech Ecosystem Development (Muthukannan, Tan, Tan, & Leong, 2017)

5.6.1. Phase 1: Assessment

Assessment Evidence from the study by Keane (2015) suggested that Fintech Ecosystem Development is triggered by the emergence of opportunities within the financial sector (Keane, 2015). Fintech has made it possible to meet unmet financial demands that have historically been not offered by traditional financial service providers. This stimulates the formation of a Disconnected Ecosystem (Rizzi, 2016) that consists of financial service providers and customers. They are interested in forming connections but have not yet formed any. This initial stage is termed the Assessment phase. The Assessment phase forms the core of the Fintech Ecosystem (Osterwalder, 2010) and facilitates the development of the resources and capabilities of both the financial service providers and customers. At this stage, there are no fintech firms. There are some fintech services that are provided by other firms. The outcomes of the Assessment phase provide the foundation for the next phase of Fintech Ecosystem Development.

5.6.2.Phase 2: Acceleration

The next stage of Fintech Ecosystem Development is the introduction of fintech firms with IT capabilities (Tan, 2015). Better connectivity, improved technological infrastructure, and effective and efficient transactional processes are included in IT capabilities. This made it easier to draw attention of the new

customers and financial service providers. This phase is called the Acceleration phase in the development of the fintech ecosystem. In this stage, the ecosystem expands quickly through the development of networks and technology advancements. According to the model, two developmental inhibitors must be overcome before this stage of development can be attained: (1) A lack of technology readiness and (2) an inadequate understanding of the implications of Fintech (Annie, 2016). Positive network externalities make it easier for the core entities to connect and pool their resources to attract more ecosystem members.

5.6.3.Phase 3: Augmentation

The next stage of the development of the fintech ecosystem happens when a critical mass of core and Tier 1 companies is reached and their relationships within the FE mature. This follows the rapid expansion of the Acceleration phase. The mature relationships would lead to the accumulation of transactional data that could enhance the understanding of market demands and customer behaviors to facilitate the Fintech Ecosystem even more. This would enhance the value of ecosystem membership to attract a greater number and a wider variety of entities (financial advisory firms, enterprise software vendors, regulatory agencies, and other complementary fintech service providers) to the ecosystem (Tan, 2015). The inclusion of a variety of supplementary service providers to the ecosystem will boost the value of its core value proposition. The third stage of the development of the fintech ecosystem is known as the "augmentation phase". There are two more developmental bottlenecks that need to be addressed: (1) information security issues, and (2) an uncertain regulatory environment.

5.7. Fintech Ecosystem and Bangladesh

Expert panel members were asked to denote the stage of Bangladesh's fintech ecosystem readiness as per the process model of fintech ecosystem development. Table 5.7-1 shows the questions presented to the panel members. Their median value is two (second stage). As per this insight, Bangladesh is past phase 1 (Assessment stage) and is now in the Connected Ecosystem phase.

Table 5.7-1 Question presented to the panel on ecosystem development stage in Bangladesh

In what phase (Disconnected/ Connected/ Organized) Bangladesh is now?		
Disconnected Ecosystem (1)	**Connected Ecosystem (2)**	**Organized Ecosystem (3)**
Disconnected Ecosystem consists of financial service providers (Banks and NBFIs) and customers. This phase forms the core of Fintech Ecosystem and facilitates the development of the resources and capabilities of both the financial service providers and customers. **In this stage, there are no fintech firms.** There are some fintech services that are provided by traditional financial service providers.	This stage has better connectivity, improved technological infrastructure, effective and efficient transactional processes. **This made it easier to draw attention of the new customers and financial service providers.** In this stage, ecosystem expands quickly by the development of networks, technology advancements and **presence of fintech firms.**	This stage enhances the value of ecosystem membership to attract a greater number and a wider variety of entities (**insurance, financial advisory firms, enterprise software vendors, regulatory agencies and other complementary fintech service providers**) to the ecosystem. The inclusion of a variety of **supplementary service providers** to the ecosystem will boost the value of its core value proposition.

The evidence that are presented in the fintech ecosystem and different business models, suggests that multiple financial service providers are willing and ready to provide Fintech services. Some customers want to buy these services. However, digital and technological literacy should be increased to bring more customers to the fold and signal higher demand to the suppliers.

In its current state, Bangladesh has just delved into phase 2 (Acceleration). In this phase, the IT capabilities of companies such as connectivity, technological infrastructure, or more effective and efficient transactional processes are put to the test. However, Bangladesh has two major problems to surmount, namely the lack of technological readiness and inadequate knowledge and understanding of Fintech by a major part of its population. The fintech industry in Bangladesh needs to overcome these to flourish and move on to phase 3: Augmentation, where supplementary services are added to the existing Fintech to create a whole new ecosystem.

There are seven major key players in the fintech ecosystem. We wanted to explore the readiness of these seven key major players in fintech ecosystem. We asked the panel of experts about the readiness of fintech ecosystem players. We asked them to rate the readiness of fintech ecosystem players in a scale of 5.

Panel experts were asked to rate the "fintech ecosystem player (customer/government/technology provider/traditional financial organization/

fintech startups/investors/academia)" readiness of Bangladesh for fintech on a five-point Likert scale as shown in Table 5.7-2.

Table 5.7-2 Likert scale of ecosystem player readiness for expert panel response

1	2	3	4	5
Very Low	Less than average	Average	More than average	Very High

Figure 5.7-A shows the readiness in the median value on a scale of five. According to their expert opinion, Policymakers and Investors are less ready as the fintech ecosystem players. On the other hand, the readiness of customers, academia, technology providers, traditional financial institutions, and fintech startups are rated as average. Average means there are ample opportunities for these players to grow.

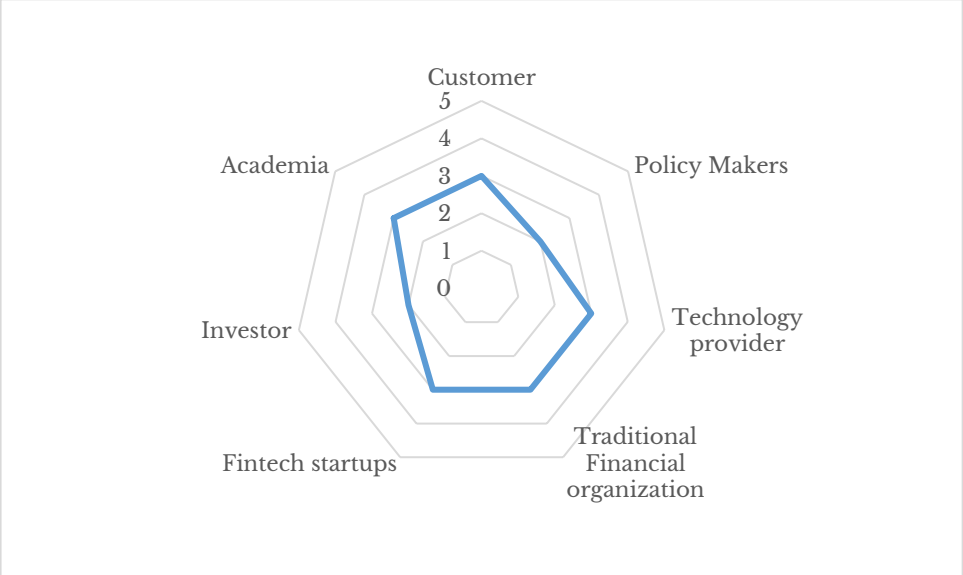


Figure 5.7-A Fintech ecosystem player readiness in Bangladesh

In terms of readiness, policymakers need to be more welcoming in terms of new financial products. They need to consider more business-friendly regulations to accommodate new financial products. Investors also need to be considerate towards new startups in the financial field. It is a fact that in an emerging economy like ours there are many risks associated with investments. But, in terms of returns, the pay is well also. Considering the volume of market and potential growth, investors can give special attention to the fintech startups in Bangladesh. Policymakers also need to cater to regulation in such a way that attracts investors to invest more in the financial market.

Moreover, panel experts were also asked about fintech's ability to contribute to sustainable economic growth as follows. As depicted in Figure 5.7-B, panel

experts are of the opinion that fintech has a “very high” potential to contribute to sustainable economic growth for Bangladesh in the long term. With reference to this timeline, it can also be expected that Bangladesh will graduate to the final stage of Organized Ecosystem. In such a state, fintech players and customers together will create value that will drive further opportunities for sustainable economic growth.

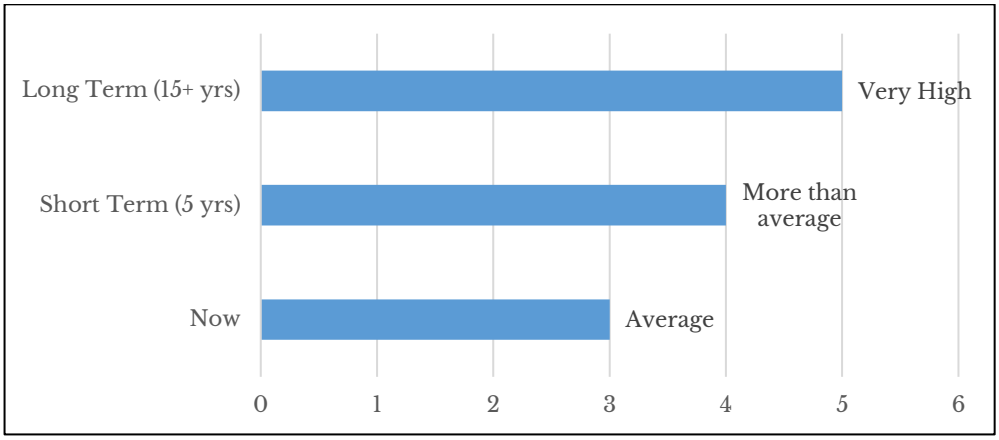


Figure 5.7-B Fintech's potential contribution to sustainable economic growth of Bangladesh

5.8. Suggestions from Key Informants

The participants urged that the Government should facilitate to implementation of favorable policies on fintech. Proactive policies like those taken in China should be considered instead of reactive policies and should ensure access to data (e.g. Credit score, NBR, Land, Utility, BRTA) for Fintech businesses to function seamlessly. The policymakers should also seriously look to rapid Infrastructure Development to attract all other stakeholders towards FinTech and help create a better Digital Bangladesh. Incentives, like the 2.5% incentive announced by Bangladesh Bank for inward remittances, can be considered to attract all other stakeholders to Fintech and facilitate its rapid adoption. Regulatory policy adjustment as well as interdependent coordination within government agencies is needed too. They also insisted that the government should issue a statement of assurance on Fintech to consumers.

The participants opined that the Association of Bankers Bangladesh (ABB) and Bangladesh Association of Bankers (BAB) should advocate and push the government for Fintech as it will be a new stream of revenue for the traditional Banks. A positive mindset (towards data sharing) and a more holistic approach to

integrating FinTech in our lives and economy are needed. Financial institutions should also assign importance to technology adoption by partnership with technology providers, start-ups, banks, and NBFIs, as well as accept API-based open banking. The responsibility to create awareness in rural areas, develop innovative products, development of skilled workforce, and value chain creation also falls upon them.

Local technology providers should groom themselves to be professional and be introspective for self-development. Technology providers should perennially be on the lookout for new skilled workforce and technology, both locally and internationally. Introduction and adaption of the latest standard technology such as interoperable open-loop technology and connection through API are a must for them, all the while making their product customer-friendly. They should work closely with finance professionals to ensure they can operate, market their products, and build a successful business model and not go out of business. They should also be aware of the regulation, compliance, customer privacy, data protection, and privacy rules. To ensure data protection they should integrate robust fraud monitoring by using a secured network.

Financial service provider start-ups should identify the right products and services for their niche market with clear USP and tap into a sustainable business model through product market feed. They must consider barriers to entry critically and understand the funding game, managing funds, and terms like burning rate et cetera. To operate successfully, they must develop innovative products and services.

Consumers must be aware of privacy, security, and ownership of financial data, and that their data is not the property of any institutions but their own. Low-cost availability of smartphones and low-cost internet access are some of the ways to increase their digital literacy and footprint. The low-cost availability of smartphones and the Internet can boost consumer awareness and digital and financial literacy due to increased connectivity. Moreover, consumers must get user-friendly Fintech platforms so that they are not deterred from using Fintech. To do all these, consumers should be brought within the fold of an advanced digital ecosystem.

Improving the VC ecosystem in Bangladesh will pave the way for increased investments in Fintech. Bangladesh should focus more on fintech startups and local investors should collaborate more with foreign VCs. They should also

abandon the premise of short-term profits and invest in long-term projects for a higher ROI over time. They must understand that the basic service of any Fintech company might not be profitable right then but by-products can prove to be extremely profitable. Investors should look beyond Bangladesh and invest in other countries in Africa and other emerging Fintech regions. In this regard, they should look into strategic partnerships and try to acquire other companies.

A strong industry-academia collaboration is needed to foster the growth of Fintech in Bangladesh. An overhaul of secondary and tertiary education curricula is needed to include basic knowledge about 4IR and Fintech from secondary-level education as well as in technical institutions. Degrees on the subject should be offered, and training that is being offered should be adopted to a proper degree. Startup incubation & and seed investment programs by universities should be part of their curricula. R&D with incubators should be developed and R&D commercialization should be advocated. These will increase the awareness of tertiary-level consumers, minimize the gap with academia, and allow them to play an active role in nurturing the Fintech ecosystem in Bangladesh.

5.9. Discussion

The participants in the focused group discussion urged that the Government should facilitate to implementation of favorable policies on fintech. Proactive policies like China should be considered instead of reactive policies and should ensure access to data (e.g. Credit score, NBR, Land, Utility, BRTA) for Fintech businesses to function seamlessly. The policymakers should also seriously look to rapid Infrastructure Development to attract all other stakeholders towards FinTech and help create a better Digital Bangladesh. Incentives, like the 2.5% incentive announced by Bangladesh Bank for inward remittances, can be considered to attract all other stakeholders to Fintech and facilitate its rapid adoption. Regulatory policy adjustment as well as interdependent coordination within government agencies is needed too. They also insisted that the government should issue a statement of assurance on Fintech to consumers.

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Improving the VC ecosystem in Bangladesh will pave the way for increased investments in Fintech. Bangladesh should focus more on fintech startups and local investors should collaborate more with foreign VCs. They should also

abandon the premise of short-term profits and invest in long-term projects for a higher ROI over time. They must understand that the basic service of any Fintech company might not be profitable right then but by-products can prove to be extremely profitable. Investors should look beyond Bangladesh and invest in other countries in Africa and other emerging Fintech regions. In this regard, they should look into strategic partnerships and try to acquire other companies.

A strong industry-academia collaboration is needed to foster the growth of Fintech in Bangladesh. An overhaul of secondary and tertiary education curricula is needed to include basic knowledge about 4IR and Fintech from secondary-level education as well as in technical institutions. Degrees on the subject should be offered, and training that is being offered should be adopted to a proper degree. Startup incubation & and seed investment programs by universities should be part of their curricula. R&D with incubators should be developed and R&D commercialization should be advocated. These will increase the awareness of tertiary-level consumers, minimize the gap with academia, and allow them to play an active role in nurturing the Fintech ecosystem in Bangladesh.

5.10. Concluding Remarks

Using FinTech to benefit the economy by providing adequate financial services to SMEs and start-ups seems to be the focus of the Digital Bangladesh initiative. The country-wide transformation of the unbanked semi-urban and rural population can play a critical role in the development of the economy. Despite remarkable progress, Bangladesh remains one of the economies with the largest unbanked population. The integration of digital financial services (DFS) with microfinance institutions (MFIs) can enable MFIs to reach the last mile of the country. This will also open the door for other Fintech services to start to expand their businesses.

Bangladesh needs to focus more on reducing costs in financial transactions for the customers. This will have a positive impact on GDP and job creation. Through fintech innovation, the Bangladesh government needs to address security and trust issues on technology. If security and trust issues can be addressed, more banks and non-bank financial institutions will move forward. Digital banking, fintech lending, and equity or debt crowdfunding have all shown the ability to speed up the process and expand the number of borrowers.

In Bangladesh, FinTech can increase government and private investments and reach a large unbanked consumer base. Except for payments and transfers, many different Fintech business models are yet to be tapped in Bangladesh. Bangladesh Bank, the central bank of Bangladesh, has also adopted the Digital Bangladesh approach. The government is working on updating the National ICT Policy for universal and more affordable access to digital devices. With unbound opportunities, FinTech can benefit the economy by offering adequate financial services to MSMEs and other industry start-ups, as well as to the general public, and take us one step towards creating a Digital Bangladesh. FinTech in Bangladesh is evolving, and it is yet to catch up with global giants. Nurturing this sector can contribute to the sustainable economic growth of Bangladesh.

6. Customer Fintech Readiness

6.1. Introduction

Progressively cost-effective computing power and internet connectivity changed millions of lives in the last three decades. Sophisticated computers and high-speed networks achieved two things over time – simultaneously and often in interrelated ways: gathering bigger, more varied datasets (often in real-time) and harnessing new and more useful insights. Such a paradigm has transformed industries. Financial services is one where digital technologies enable innovative delivery of existing services and allow the creation of new ones. Financial technologies (hereafter fintech) combine the "digital" with financial services. Indeed, computers were incorporated into the legacy banking system for decades to lower costs and raise customer experience. Today, fintech has reached a new "tipping point" (Ghose et al. 2016). Unique technological paradigms of the "Second Machine Age" (Brynjolfsson and McAfee 2016) are promoting new business models: venturing into hitherto unexplored customer segments, making previously unthinkable products and/or services commercially viable for a variety of customers.

This chapter is conceived at a time when the literature absorbs a steady increase in research on fintech (Allen et al. 2020). Indeed, fintech may as well be a defining technology of the ongoing decade, lifting thousands out of poverty, allowing greater access to capital and customers, eliminating market asymmetries (or at the least addressing them), and creating new opportunities for businesses and individuals (Douglas W. Arner et al. 2020b; Di Maggio et al. 2022; I. Lee and Shin 2018; Mohamed et al. 2021). New technological paradigms of the fourth industrial revolution hold unique opportunities for developing countries (Brynjolfsson and McAfee 2016; Buckley and Webster 2016; Schwab 2017). Customers across the developing world have started reaping the benefits of innovative platforms and services. For example, the promising development of

massive online open courses (MOOCs) in Bangladesh, along with countries in Asia-Pacific such as India points to high acceptance of innovative digital platforms for traditional services e.g., secondary and tertiary education (Amit et al. 2022). Yet the degree to which digital solutions can address problems at scale depends on strategic market priorities determined at the policy level (Amit et al. 2023; Senan et al. 2022). Similarly, in promoting financial inclusion across industries and communities in Bangladesh through fintech, technology is only part of the solution (Caire and Spohn 2022), albeit an important one but not entirely adequate (Amit et al. 2023).

Fintech offers new avenues for legacy banks (King and Nesbitt 2020). It has already disrupted traditional finance; going forward it promises to decouple, decentralize, and demystify financial services altogether (Basole and Patel 2018; I. Lee and Shin 2018). These prove to be exciting developments for incumbents – as well as unique challenges to their once unquestionable hold on the industry. For instance, a startup with an innovative idea for a customized financial solution for the tech-savvy generation can radically challenge existing financial service providers worth billions: Examples can be given for Robinhood in trade and investment, Venmo for payments, M-Pesa for mobile payment services, and Revolut for integrated services.

Fintech offers another potent opportunity: making financial services accessible to previously unreached customers (Douglas W. Arner et al. 2020a; Beck 2020; Di Maggio et al. 2022; Kong and Loubere 2021). A great many of these customers (e.g., unbanked and underbanked populations) are marginal socio-economically and thus stand to benefit enormously. A simple yet demonstrative example is robo-advisory service for affordable wealth management and/or personal financial advisory (Baker and Dellaert 2017). Even more, fintech platforms can be harnessed to close the gender gap such as reducing wage discrimination, making access capital a reality for more women, and managing their financials for greater resilience (S. Chen et al. 2021; Guo et al. 2021; Mohamed et al. 2021).

Realizing these desirable transformations depends on the effective adoption of fintech services at scale. Especially for marginalized communities that stand to benefit the most, fintech-enabled sustainable development (Al-Okaily et al. 2021; Douglas W. Arner et al. 2020b; Deng et al. 2019; Shin and Choi 2019) presupposes that customers adopt these novel fintech services and continue to use them. It

follows that an assessment of customer readiness to adopt these services is in order. The adoption of technology has been studied extensively. However, seminal works such as the Technology Adoption Model (TAM) (F. Davis 1985) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) provide a basis to investigate, validate, and expand current understanding of technologies in general. These models and their subsequent expansions do not deal with fintech specifically. Subsequently, the need for a readiness measurement means for fintech adoption and usage, much like the Technology Readiness Index (TRI) for technologies in general, is felt.

Extant literature continues to expand in scope in identifying factors that relate to adoption of fintech products and services. A large and increasing number of studies identify factors such as demographic variables (Ahmed et al. 2020; Carlin et al. 2017; R. Hasan et al. 2021), literacy level (Agarwalla et al. 2015; M. Hasan et al. 2022), concerns with security issues (Ali et al. 2021; Kin Leong Tang et al. 2020; Mahmud, Joarder, and Muheymin-Us-Sakib 2023; Xie et al. 2021a) and others. But few efforts were taken to synthesize them into a single measurement scale to assess the readiness of customers to adopt and use fintech. This study, as part of a series of investigations into fintech ecosystem and sustainable development in Bangladesh, attempts to fill that gap. The paper constructs an integrated fintech readiness scale for customers of retail fintech services.

6.2. Customer Fintech in Bangladesh

Globally, fintech has evolved significantly since its earlier days in banks and financial institutions. The term encompasses a wide range of technologies for delivering existing as well as novel financial services to customers. The primary focus of the current paper, however, is on customer-facing fintech: technology-enabled financial services distributed mainly over online platforms allowing mass delivery of affordable and innovative financial services. Fintech can serve numerous segments of the market – some of which were not viable to serve before e.g., AI algorithms enabling credit access to middle-income households with zero to no credit history (Loten 2022).

Bangladesh over the preceding two decades has achieved noteworthy progress in extending the reach of the financial system to customers. Data from Bangladesh Bank suggests that across several parameters –number of physical

bank branches, ATM machines, POS, CRM machines – expansion is visible. As of November 2022, Bangladesh Bank data showed there were a total of 11,057 bank branches of which 5,777 were in urban centers and 5,280 in rural areas. In December 2018, the total number was 8,471. The branch network expansion was commendable for a country of 148, 460 sq. Km of total land mass. But it was not comparable with neighboring countries like India considering the average area covered by each existing branch. Table 6.2-1 provides comparative figures for Bangladesh between December 2018 and November 2022. Figure 6.2-A and Figure 6.2-B also depict the steady rise in issue cards and MFS accounts.

A key highlight of Bangladesh's evolving fintech ecosystem is Mobile Financial Services (MFS). Within roughly 10 years, MFS providers like bKash, Rocket, Nagad, and Upay saw massive sign-ups. As of November 2022, 188 million accounts were registered. Account numbers rose at a compound annual growth rate (CAGR) of 29.89% over the preceding four years. MFS providers subverted traditional banks' limitations to reach frontier customers in remote concerns of the country. Despite efforts by the central bank and Bangladesh's fiscal administration to raise banking penetration, it remains low. Data from the World Bank's Global Findex Database 2021 elucidate this point further. Excluding MFS accounts, only 38% of Bangladeshis had accounts with registered banks and non-bank financial institutions; this was 51% in Indonesia, 77% in India, 88% in Malaysia, and 95% in China (Demirgüç-Kunt et al. 2021). Average account ownership across developing countries stood at 71% in 2021 (Demirgüç-Kunt et al. 2021). MFS uptake compensated for this gap in account ownership.

MFS expansion was made possible by the country's deep mobile network penetration on which MFS services were built. Data from the Population and Housing Census 2022 showed 56% of Bangladeshis used mobile phones; internet penetration stood at 31%. The rise in MFS accounts in conjunction with mobile users has facilitated, among others, mobile payments which is the predominant service in these platforms. Other common fintech services customers can access through popular MFS platforms in Bangladesh include mobile recharge, cash-out services, utilities, internet service bill payments, access to credit, and paying government bills. However, services like credit card bill payments, and advances from credit cards only work for users with credit access which most users do not have. The Global Findex Database 2021 data also suggested that only 5% of Bangladeshis have access to a credit card.

A host of ancillary services have been added to MFS platforms recently. Convincing data have not emerged yet to suggest that customers have adopted them at scale. For instance, MFS users in Bangladesh can now buy mutual fund shares from their apps. Within a year, around 650,000 people signed up for these savings schemes (The Business Standard 2022). Considering Bangladesh's macroeconomic performance and evolving demographics, a larger number is expected. This is true for a range of other fintech services as well. They are either in the early stages of market penetration or entirely unavailable in Bangladesh. Internal market demand exists for these services to become widely adopted for greater customer convenience and value creation. This necessitates identifying factors that contribute to customer readiness for fintech adoption. Importantly, before introducing new fintech services in the market by fintech firms and/or legacy banks, it is necessary to assess the current state of customer readiness for fintech service use in daily life.

Table 6.2-1 Comparative Banking and MFS Data between December 2018 and November 2022

	Urban	**Rural**	**Total**
Physical Bank Branches			
December 2018	4842	3629	8471
November 2022	5777	5280	11057
Automated Teller Machines (ATMs)			
December 2018	7,361	2,919	10,280
November 2022	9,171	4,196	13,367
Point of Sale (POS)			
December 2018	47,027	1,201	48,228
November 2022	94,039	8,992	103,035
Cash Deposit Machine			
December 2018	916	408	1,324
November 2022	769	444	1,213
Cash Recycling Machines (CRMs)			
December 2018	118	8	126
November 2022	1,866	425	2,291
MFS Agents			
December 2018	505,623	437,887	943,510
November 2022	751,394	780,011	1,531,405
MFS Male Accounts			
December 2018	15,053,470	21,030,462	36,083,932
November 2022	48,667,875	60,368,899	109,036,774
MFS Female Accounts			
December 2018	8,491,129	23,093,199	31,584,328
November 2022	33,695,799	45,393,551	79,089,350

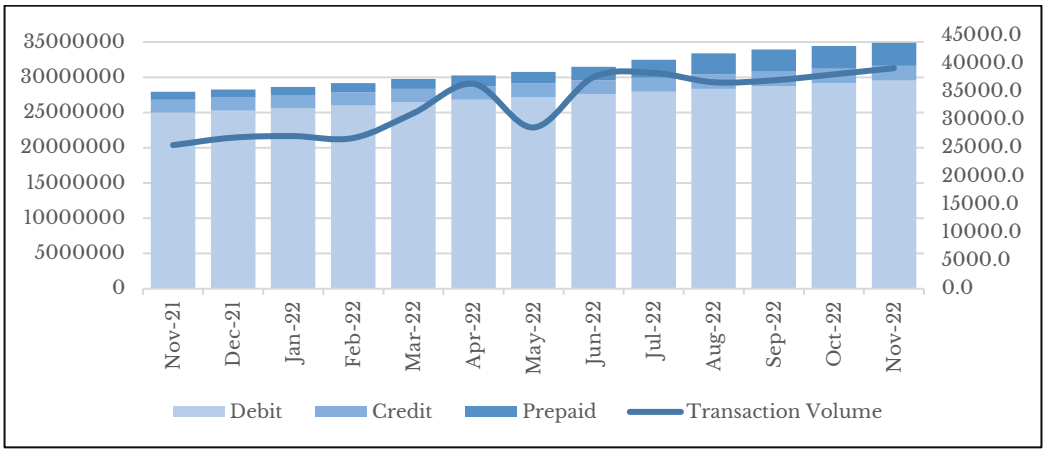

Figure 6.2-A Monthly Issued Cards and Total Volume of Transaction

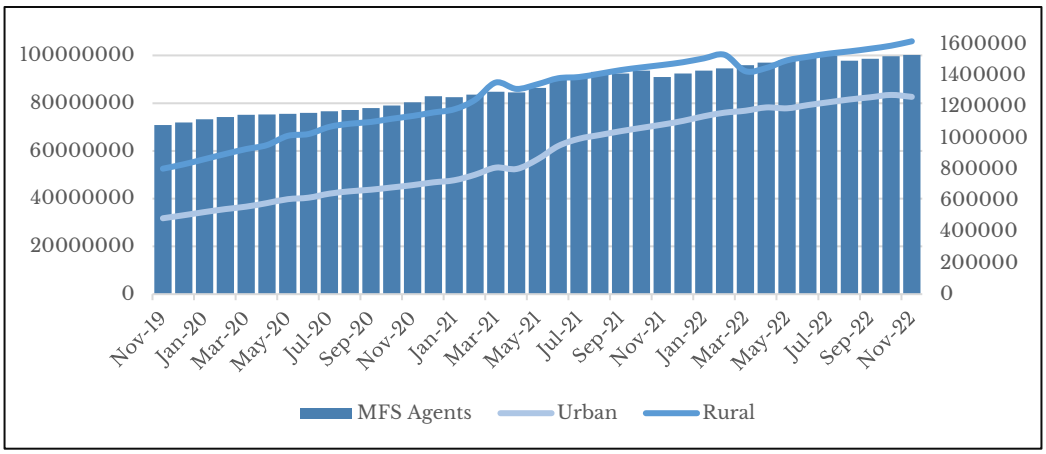

Figure 6.2-B Monthly Registered MFS Account Numbers and MFS Agents

6.3. Constructing the Customer Fintech Readiness (CFR) Index

Readiness to use fintech on a daily basis encompasses technological, demographic, economic, and sentimental variables. As briefly discussed, extant literature delves into each of these to investigate their relationship with fintech use. As literature continues to grow with corroborative evidence from different markets, patterns are increasingly discernible. On the basis of these patterns, our approach was to construct a readiness index for customer-facing fintech.

Bangladesh has achieved remarkable progress on the macroeconomic and socio-political development front during the last two decades. In that time, millions have been lifted out of poverty. Under the "Digital Bangladesh" initiative, significant policy priorities were assigned to revamp government processes; the endeavor continues as of writing this chapter under an extended vision of a "Smart Bangladesh". Despite encouraging progress made, much is to be done. There

remain, for example, stark economic inequalities, which continue to worsen. Any effort to assess overall preparedness to use fintech should have to consider a broad spectrum of characteristics.

6.3.1. Data Collection

Our readiness assessment approach is founded on the National Citizen Survey (NCS) undertaken by the authors. The standardized questionnaire survey was conducted face-to-face with citizens from across 16 districts. Digital penetration is a work in progress. Conducting surveys over the phone and online would introduce additional biases in the sample. Moreover, customer-facing fintech services promise benefits to a wide customer audience – especially for marginalized communities. Keeping in mind policy priorities to facilitate technology-enabled banking penetration, our sample included individuals from both sides of the economic spectrum. Importantly, we selected the 16 districts (from among 64 in total) based on poverty ranking.

Selected individuals (and households) were approached physically with a standard questionnaire; 206 data points were gathered from each respondent. These relate to demographic characteristics, financial health and practices, banking service propensity and practices, current technology use, frequency, volume, and nature of previous fintech use (if any), concerns with fintech, mental preparedness to use fintech, current satisfaction and obstacles faced, and more. The survey also allowed one open-ended response at the end to allow participants to express normative recommendations and/or personal feedback on fintech use in their respective lives. Datapoints were gathered by survey representatives and recorded onto handheld tablet computers. The entire dataset was then compiled, coded, and cleaned by the authors for further analysis and index construction. Our dataset consisted of 1282 responses. Survey respondents consisted of 14% female citizens and 86% male. As per the 2022 census, female and male ratios were approximately 50.50% and 49.50% respectively (Bangladesh Bureau of Statistics 2022). As such, our sample was gender imbalanced. However, given the poverty-based stratified random sampling conducted in this study, gender ratios at the household level could not be controlled. Table 6.3-1 provides descriptive statistics of continuous variables.

Table 6.3-1 Descriptive Statistics of Selected Variables from NCS Dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
RespondentAge	1282	38.635	12.88	18	85
Monthly expenditure	1282	18249.532	13153.52	2000	200000
Exp HouseRent	1282	529.866	2119.534	0	25000
Exp Food	1282	9617.813	6680.842	0	100000
Exp Utilities	1282	1237.066	1316.735	0	9000
Exp Education	1282	2239.807	3347.995	0	35000
Exp Healthcare	1282	1512.286	2754.498	0	60000
Exp Entertainment	1282	483.241	970.461	0	10000
Exp HouseHelpSalary	1282	155.359	817.157	0	14000
Exp Misc	1282	1478.31	2071.427	0	30000
Monthly Income	1282	22219.64	17974.89	0	250000
Annual Savings	1282	22157.331	91474.191	0	2500000
Bank visit month	428	2.163	2.437	.005	25
Data usage	501	16623.695	45662.006	20	900000
FrequencyMB	1282	3.677	16.325	0	506
VolumeMB	1282	3665.583	15022.018	0	401000
InternetBankingFre~y	1282	.023	.331	0	8
InternetBankingVol~e	1282	181.747	3094.296	0	90000

6.3.2. Readiness Dimensions

Table 6.3-2 distills selected works in the literature into seven key dimensions of customer readiness for fintech: a) demographic characteristics, b) financial health, c) literacy, d) e-readiness, e) mental preparedness, f) existing fintech use, and g) overall sentiment. CFR was based on patterns of factors emerging in extant literature. Variables under each dimension were coded and normalized on a scale of 0 to 100. For customer-rated data (e.g., mental preparedness) on a multiple-point Likert scale, equal interval levels in appropriate order were assigned to derive a numeric value.

For instance, in mental preparedness to use fintech in daily use value labels were as follows: not prepared at all (20), low prepared (40), average preparedness (60), prepared (80), and adequately prepared (100). The average of variables in each dimension was then taken as the dimension score. We briefly describe here the seven dimensions, the variables used in each, and the corresponding transformation methods and value labels. Appendix C provides more details on variable operationalization.

6.3.2 (a) Demographic Characteristics

Following evidence from previous studies of a negative correlation with age (M. Hasan et al. 2022; Imam et al. 2022) and a largely positive association with higher levels of institutional education (Niu et al. 2020), we included the two variables appropriately. The respondent's age was normalized. On average, we assumed a 20-step increment in fintech readiness with each additional level of institutional education. Higher levels of institutional education equip a person for wider fintech use and address some of the concerns related to security, financial fraud, and privacy (Laidroo and Avarmaa 2020; Niu et al. 2020).

6.3.2 (b) Financial Health

To construct the financial health dimension, two variables were used: monthly income and annual savings of respondents. Monthly savings for the respondents varied significantly among respondents. Citizens from the lower quintiles reported savings on an annual basis since most have a yearly savings goal. Both of these variables were normalized from 1 to 100 and averaged for dimension score.

6.3.2 (c) Financial Literacy

The financial literacy dimension in our index consists of three variables measuring the frequency of bank visits per month, confidence level respondents have in performing banking activities, and level of awareness of bank transactions. The state of online banking in Bangladesh is inadequate in semi-urban and rural areas. Despite the spread of MFS accounts, interaction with banks is possible primarily through physical visits to the nearby bank branch. The number of times the respondent visited a bank in a given month was normalized. To label respondents' assessment of their confidence in performing banking activities, we used equal intervals for the five-point Likert scale.

6.3.2 (d) E-Readiness

Citizens' e-readiness was measured with four variables: type of access to a computer, reported levels of computer operation skill, reported levels of smartphone use skill, and monthly data usage measured in megabytes of internet data purchased each month. Computer access, although formerly a prerequisite for Internet banking, can be argued to have decreased in importance given a majority of Internet banking services are accessible through smartphones.

Table 6.3-2 Factors Affecting Fintech Adoption and Use Distilled in Seven Key Dimensions

Dimension	Factors	Related Work
Demography	Demographic characteristic of the customer/user e.g., age, gender	Alice Huong et al. 2021 Clements 2020 Chen et al. 2021 Gulamhuseinwala et al. 2015 M. Hasan et al. 2022 Imam et al. 2022 Pedrosa and Do 2011 Sioson and Kim 2019
Financial Health	Financial and economic characteristic of the customer/user e.g., current income, savings, consumption pattern	Amit et al. 2023 Hau et al. 2019 Mohamed et al. 2021 Rizvi et al. 2018 Senan et al. 2022 Solarz and Swacha-Lech 2021
Literacy	Institutional as well as non-institutional literacy e.g., level of education, financial literacy	Agarwalla et al. 2015 M. Hasan et al. 2022 Laidroo and Avarmaa 2020 Niu et al. 2020
E-Readiness	The extent to which customers/users are ready to adopt digital technologies e.g., connectivity, digital literacy	Azad 2016 Gerlach and Lutz 2019 Jünger and Mietzner 2020 Nathan et al. 2022 Parasuraman 2000 Salman and Abd.Aziz 2015 Setiawan et al. 2021
Mental Preparedness	Factors affecting customer/user mental preparedness to adopt and continue use of fintech services in daily lives e.g., customer reported level of acceptance	Dishaw and Strong 1999 R. Hasan et al. 2021 Jin et al. 2019 Kong and Loubere 2021 Kusumawati et al. 2020 Le 2021 Salman and Abd.Aziz 2015 Setiawan et al. 2021 Stewart and Jürjens 2018
Fintech Use	Degree of existing use of fintech services e.g., mobile banking, internet banking, ATMs	Amit et al. 2022 Azad 2016 Carlin et al. 2017 Gabor and Brooks 2017 Gerlach and Lutz 2019 R. Hasan et al. 2021 Hwang and Kim 2018 Shareef et al. 2018 Urumsah et al. 2022
Sentiment	Perceived variables that affect customer/user sentiment towards fintech services and/or platforms e.g., security risk, privacy concerns, usefulness	Ali et al. 2021 R. Hasan et al. 2021 Hwang and Kim 2018 Kin Leong Tang et al. 2020 Le 2021 Mu and Lee 2017 Poerjoto et al. 2021 Xie et al. 2021

Nonetheless, familiarity with computer-based fintech use and computer literacy, in general, can be expected to help customer fintech readiness. Multiple studies have found a positive association between internet use and fintech adoption. Not least because of the need to stay connected over the internet for receiving the vast majority of fintech services. The first of the four factors in this dimension was labeled appropriately and data usage was normalized.

6.3.2 (e) Mental Preparedness

Respondents' reported level of mental preparedness was labeled appropriately. This is the only variable in this dimension, thus no average was calculated. We used equal interval labeling for the five-point Likert scale used to collect data. Customers who report being mentally prepared to use fintech in their daily lives can be expected to adopt new fintech services, all other factors held constant.

6.3.2 (f) Fintech Usage

Our dataset consisted of both fintech users and non-users. Respondents who used a fintech service at least twice a month were defined as fintech users for our calculation. We found around 30% of our respondents were fintech users. Almost all of that stemmed from mobile banking platforms e.g., money transfers, deposits, bill payments, etc. The frequency and volume of mobile banking usage varied significantly, however. We normalized monthly frequency of mobile banking use and monthly volume of transactions in such platforms to calculate score in this dimension.

6.3.2 (g) Overall Sentiment with Fintech

Apart from financial and technological readiness, customer perception of the costliness of fintech use as well as satisfaction with previous fintech use should play a major role in determining readiness. Three variables were considered for this dimension. In this case, all three were collected using multiple-item Likert scales. Customer perception of costliness of fintech services contributes negatively to willingness to use new fintech services. Accordingly, we reverse-ordered the equal interval value assignment for this costliness (Urumsah et al. 2022; Xie et al. 2021a). Customer satisfaction was labeled as before. The survey also collected respondent agreeableness on ease of fintech availability. We hypothesize that

respondents are better prepared to use fintech if they already perceive these as available around them (logistically), as opposed to on paper only (theoretically).

6.3.3. CFR Index

An important decision had to be made in combining the seven dimensions of the CFR index. One alternative was to take another iteration of the arithmetic average. Although an average-of-average approach would be simple and easily replicable, it had one major problem. The presupposition that all of the seven dimensions contribute equally to customer fintech readiness was neither logically defendable nor empirically founded. As a country transitions from one stage of fintech development into another (Soloviev 2018), the relative weight of each dimension should evolve to reflect varying importance. For instance, as citizens achieve higher levels of financial prosperity, more weight would shift to "usage", replacing proportionally weight on "financial health". Average-of-average would not account for a mechanism to change weights accordingly. Specifically, when deployed through arithmetic mean for both iterations, another problem is the implicit compensation. If averaged arithmetically, a high score in one dimension would compensate lower score in another. Enough empirical evidence is unavailable, to the best of our knowledge, to justify the use of average-of-average with arithmetic mean despite these two drawbacks.

Previous studies used a different statistical approach. The Technology Readiness Index (TRI), for instance, was constructed using dimensionality reduction (Parasuraman 2000). We avoid this path. Using Principal Component Analysis (PCA) and its accompanying statistical methods provides a rigorous way of working with multiple items in survey data. However, PCA-induced dimensionality reduction and its resultant indices become unique to the context in which the survey was conducted, thereby limiting replication and mass use in cross-national circumstances.

Fintech is rising across a multitude of markets each having its own unique set of challenges and opportunities. We adopt a much simpler yet situationally appropriate means: weighted average of dimension scores. For this, we conducted depth interviews with a panel of twenty-one experts. Participants were from industry, academia, development, finance, and advisory services with respective experiences ranging from 6 years to 34 years (mean of 22 years). Each expert assigned weights to the seven dimensions. In calculating CFR, we weighted each

dimension as per the average weight assigned by the panel. Table 6.3-3 provides dimension weights for the CFR.

Table 6.3-3 Weights Assigned to the Seven Dimensions of CFR

Dimension	Demographic	Financial Health	Financial Literacy	E-Readiness	Mental Preparedness	Fintech Usage	Overall Sentiment
Weights	12.82%	10.82%	15.78%	21.06%	11.96%	16.41%	11.16%

The weighted average approach addresses the aforementioned drawbacks while being fairly simple. Researchers in other markets can replicate the scale without significant alteration to the weights assigned, provided the markets in which CFR is being replicated fall largely within the development stage Bangladesh is currently in. Additionally, researchers should also note the maturity of their respective fintech markets of interest to assess readiness through CFR.

6.4. Assessment of CFR's Validity

Apart from proposing the CFR, one key objective of the current paper was to asses customer readiness for fintech adoption and use in Bangladesh. The promises of fintech can only be realized for the broader population if customers are ready to embrace them in the first place. Readiness as such incorporates both willingness and capability. CFR incorporates both of these facets through seven dimensions: demographic characteristics, financial health, financial literacy, and e-readiness broadly fall under the capability to use fintech. Mental preparedness, current use of fintech, and overall sentiment encompass willingness. However, the other purpose of the study was to construct a widely applicable, easily replicable index for customer fintech readiness assessment. Both of these require establishing the validity of the scale proposed here.

With regards to CFR's construct validity – the extent to which the scale measures key facets of what it aims to measure – significant efforts were taken to review extant literature and map factors that contribute specifically to readiness for customer-facing fintech services. The seven dimensions, by and large, incorporate all key facets. The Nationwide Citizen Survey (NCS) gathered a large number of data points from individuals of varying demographic, economic, and

technological features. Incidentally, the current paper is part of a series of research works the authors performed to investigate the fintech ecosystem in Bangladesh, adoption factors of fintech among Bangladeshi customers, and fintech's impact on sustainable development for emerging economies. The current work drew heavily from insights gathered from these.

Additionally, we followed two ways of assessing CFR's construct validity (Parasuraman and Colby 2015). First, three multivariate regressions were estimated with CFR score as the predictor. To address confounding variable concerns, we add respondents' age and monthly expenditure as predictors. For predicted variables for the three models, we used three expectations. In NCS, respondents answered a series of questions related to expectations of near-future fintech services use (e.g., making investments through fintech platforms). We calculated the total number of expectations for each customer from three different sources. This was also done for expectations from fintech service providers (e.g., more cash-out points) and the government (e.g., service quality supervision). Customers selected multiple from these as per their expectations.

Assuming CFR adequately measures customer readiness for fintech use, CFR score should be a significant predictor of aforementioned expectations. Moreover, the CFR score should be positively associated with number of customer-reported expectations in each of the three cases. This follows logically from the premise that readier customers are clearer in what to expect as well as are more engaged in expecting to use a range of services.

Results from the three regression models suggest that CFR score is positively associated with a) number of fintech services expected to be used in the near future, b) number of expectations from fintech service providers, and c) number of expectations from the government. Below Table 6.4-1, Table 6.4-2, and Table 6.4-3 provide regression coefficients, levels of significance, and R-squared values for the three models respectively. These models explain 17.18%, 17.32%, and 13.94% of the three expectations (in that order). All three models are significant at the 1% level. More importantly, in each case, CFR coefficients are positive and statistically significant at the 1% level.

Table 6.4-1 Validity assessment with regression - number of future fintech services as dependent variable[1]

Future_services	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CFR	.112	.009	13.12	0	.095	.129	***
RespondentAge	-.001	.007	-0.08	.938	-.014	.013	
Monthly_expenditure	0	0	-2.13	.034	0	0	**
Constant	1.067	.4	2.66	.008	.281	1.852	***

Mean dependent var	3.775	SD dependent var	2.960
R-squared	0.172	Number of obs	1282
F-test	88.361	Prob > F	0.000
Akaike crit. (AIC)	6185.744	Bayesian crit. (BIC)	6206.369

Table 6.4-2 Validity assessment with regression - expectations from fintech service providers as dependent variable

Exp_FSP	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CFR	.105	.008	13.49	0	.09	.121	***
RespondentAge	-.005	.006	-0.85	.396	-.018	.007	
Monthly_expenditure	0	0	-5.20	0	0	0	***
Constant	2.648	.366	7.23	0	1.93	3.366	***

Mean dependent var	4.674	SD dependent var	2.709
R-squared	0.173	Number of obs	1282
F-test	89.258	Prob > F	0.000
Akaike crit. (AIC)	5956.360	Bayesian crit. (BIC)	5976.985

Table 6.4-3 Validity assessment with regression - number of expectations from the government as dependent variable

Exp_GOV	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CFR	.049	.004	11.04	0	.041	.058	***
RespondentAge	-.006	.004	-1.69	.092	-.013	.001	*
Monthly_expenditure	0	0	-2.85	.004	0	0	***
Constant	2.524	.209	12.07	0	2.114	2.934	***

Mean dependent var	3.425	SD dependent var	1.517
R-squared	0.139	Number of obs	1282
F-test	68.990	Prob > F	0.000
Akaike crit. (AIC)	4521.832	Bayesian crit. (BIC)	4542.457

To further assess construct validity of CFR, we performed one-way ANOVA. The mean CFR score and ANOVA were estimated for two instances. First, for groups of customers with different levels of agreeableness on fintech's impact on social development. We did the same for impact national economic development and betterment of the environment. All three were from a five-point Likert scale with an additional option for citizens who did not know much about the impact. Table 4 shows the mean CFR scores, F-statistics, and Bartlett's chi-square test

[1] *** *p<.01*, ** *p<.05*, * *p<.1*

statistics for equality of variance. All F-statistics are significant at the 1% level. The three domains of impact in Table 6.4-4 are ordered according to F-statistic; social development domain has the highest F-statistic. As expected, we saw consistently higher mean CFR scores for respondents at higher levels of agreeableness (with the only exception being "agree" for social development domain, the small decline in CFR score compared to the previous group being insignificant). Respondents who had higher mean CFR scores agreed more on the beneficial impact of fintech for society, the national economy, and the environment.

Second, we calculated mean CFR scores and performed ANOVA for different groups of customers. This grouping was based on perception of obstacles faced during fintech use (Likert scale) e.g., - technological skill being an obstacle to fintech use. Mean CFR scores, F-statistics, and Bartlett's Chi-2 square statistic are summarized in Table 6.4-5 below. All test statistics are significant at the 1% level. Mean CRF scores were consistently lower in groups that reported high degrees of perceived obstacles to using fintech. This was expected as well. Respondents with higher CFR scores are less likely to perceive high obstacles to fintech. In both instances of comparison of means, CFR scores exhibited expected patterns across groups. This analysis further provided evidence in support of CFR's construct validity.

Table 6.4-4 Mean CFR Scores by Perception of Fintech's Impact

Domain of Impact	Not agree at all	Slightly agree	Neutral	Agree	Totally agree	F-statistics	Bartlett's Chi-2 Test Statistic	Sig
Social Development	21.23	23.95	29.24	28.17	34.61	103.59	72.21	***
Economic Development	21.41	23.89	25.92	28.87	33.49	91.90	79.56	***
Betterment of the Environment	21.77	26.42	27.49	29.36	33.39	77.03	38.80	***

Table 6.4-5 Mean CFR Scores by Perceived Degree of Obstacle in Fintech Use

Obstacles	Very low	Low	Neutral	High	Very high	F-statistics	Bartlett's Chi-2 Test Statistic	Sig
Economic conditions	39.12	30.19	25.21	19.01	15.77	116.27	55.12	***
Service intuitiveness of the platform	40.00	29.90	25.19	20.33	17.86	68.72	19.65	***
Confidence in using technology	38.88	31.25	25.70	22.18	18.23	65.96	17.90	***
Knowledge of financial transactions	41.18	31.79	24.75	20.64	18.75	143.83	24.96	***
Educational qualification	39.72	31.73	24.12	20.43	16.59	173.70	19.23	***
Technological skill	42.09	35.44	25.68	20.88	16.24	206.60	49.84	***

6.5. Customer Fintech Readiness in Bangladesh

In the last two decades, significant policy support was provided for financial inclusion in Bangladesh. MFS providers like bKash, Nagad, and Upay brought mobile payment services to customers across the country. Even though people were outside of the banking system – bank accounts being a non-mandatory requirement for opening MFS accounts – an alternative payment system nonetheless allowed marginal customers to benefit from reduced cost and more convenience. For households where the main income earner migrated to a city from a rural area, remitting money back home on time was now possible and very much affordable.

Similarly, for small and medium enterprises (SMEs) owners, MFS platforms provided an affordable and safe transaction medium alternative. As described in Section 2, the rise in MFS account numbers was accompanied by a steady increase in total transaction volume. In all likelihood, MFS is expected to see phenomenal growth as new services are added to their mobile application interfaces e.g., mutual fund schemes, shopping bill payments, and applications for emergency loans. These platforms seem to move towards the "superapp" status enjoyed by the largest platforms in places like China.

But popularity and mass adoption of MFS platforms did not translate into a wider variety of fintech services in Bangladesh's financial ecosystem per se.

Essential fintech infrastructure like white label automated teller machines (WLATM), for instance, are still to come. Alternative credit rating algorithms have not taken hold till now, despite the availability of data from the gigantic user base of MFS platforms. The vast majority of shops outside of the most developed urban centers in the country lack point-of-sales or QR code mechanisms. In short, fintech ecosystem in the country is in the early stages in terms of variety of services and acceptance of novel platforms at scale. However, fintech holds enormous potential for Bangladesh. Digital penetration, access to the internet, a large young customer base with growing purchasing power, and increasing awareness of benefits from technology-based services means the domestic market is ripe for fintech innovation.

Applying the CFR index proposed in this chapter to NCS data yielded a number of insights. Our findings suggest the market is not entirely ready for innovative services yet. Shortcomings are primarily in areas of citizen financial health, e-readiness, and financial literacy as mentioned in this section. Bangladesh scores 26.62 on CFR. Table 6.5-1 lists average scores in the seven dimensions. As suggested by the data, the country ranks well in terms of demographic characteristics conducive to fintech use, mental preparedness of customers for daily fintech use, and overall sentiment on uses of fintech. Poor scores are obtained for financial health of customers, financial literacy, and e-readiness. The dimension that measures existing fintech usage provided a particularly bleak picture. The near-zero figure for existing fintech use is notable but not unexpected. Existing and novel players are trying to venture into new segments. But seen in the context of overall fintech readiness, existing MFS use is not significant.

Table 6.5-1 Average Scores Across Seven Dimensions of CFR

Dimension	Female Score	Male Score	Aggregate Score
Demographic Characteristic	51.85	56.02	55.45
Financial Health	4.15	5.00	4.89
Financial Literacy	15.69	20.81	20.12
E-Readiness	12.18	19.58	18.57
Mental Preparedness	48.62	53.79	53.09
Fintech Usage	0.17	0.92	0.82
Overall Sentiment	45.21	49.03	48.51

Average CFR was lower among women (23.02) compared to men (27.18). Interestingly, overall readiness was higher in higher age categories. Younger

customers were found to adopt fintech services easily in previous studies. In terms of sentiment and mental preparedness, younger users were more likely to accept new fintech services and continue to use them. Similar to other technologies, fintech was not an exception. However, along the CFR scale which considers seven key dimensions, younger customers in Bangladesh are not as ready as they would appear on the surface. Indeed, CFR from NCS data tells us fintech readiness is higher consistently in older age groups. It was lowest for citizens 20 years of age or below and highest for senior citizens aged 60 or above.

Fintech readiness was not equally distributed across districts. Considerable variation was observed in average CFR scores across the 16 districts included in our survey. Among the eight divisions Dhaka and Chittagong ranked the highest. Not surprisingly these two were the most prominent urban centers in the country. While fintech promises benefits for customers across the socio-economic spectrum, overall readiness in our findings was higher in areas where economic development is most at work. This pattern was true for the individual districts within each division as well. Places with a greater prevalence of extreme poverty had significantly lower CFR scores. Across occupations, we see consistent trends as seen in other parts of the chapters presented earlier in this report. Government job holders are ahead of almost all other occupations across fintech use and awareness measures. In this case, they are also at the top of occupations in terms of fintech readiness scores. Bangladesh Government with its Digital Bangladesh agenda has been pushing for higher levels of digital literacy for more than a decade now.

It is understood those who are working at the frontline of government policy implementation will hold a wider understanding of fintech use and their expected benefits. Thus, government job holders having higher levels of fintech readiness scores in our survey makes sense according to this line of reasoning. Government hob holders are followed by non-residents. Since mobile financial services platforms provide unique cost-saving advantages to non-resident Bangladeshis who regularly send money to members at home, fintech readiness score is higher in this category too. Students constitute another major group with a high level of fintech readiness score. All three of these groups exhibited an average fintech readiness score of above and around 40% which is considerably higher than the overall average of 28.78%.

Socio-economic background influences fintech readiness score. Perhaps as another confirmation of this, our data shows respondents living in cemented houses with a fintech readiness score of around 33%, higher than the overall average. Those who reported living in traditional houses (in semi-urban and rural areas especially) had a lower than average fintech readiness score of around 23%.

Monthly expenditure is a proxy for financial health. Even at the aggregate level, higher monthly expenditure can accurately reflect overall likelihood of fintech readiness since respondents in high monthly expenditure groups also fall into higher education, higher levels of awareness, and higher use of current fintech use. At the same time, they are likely to have better access to technology and likely to exhibit lower levels of concern over fintech use. Our survey data confirms this. Respondents with higher levels of monthly expenditure consistently had higher average fintech readiness scores. Future commercial efforts for fintech penetration and policy intervention will have to focus on individuals and households with lower levels of monthly expenditure.

Customers with higher levels of monthly income generally scored higher in CFR. At the lowest range of monthly income, the average CFR was 21.34. This increased to as much as 64.59 – around three times that of the national average. Notably, financial health was but one of the seven dimensions. In fact, a very high monthly income and savings are not required per se for the type of fintech services currently operating in the country. However, going forward more niche services may be targeted for specific income groups. Financial health had a 10.82% weight CFR scale. Nonetheless, the effect of the financial health of the customer in determining overall fintech readiness and in overriding other factors was notable.

Individuals who have high levels of concern for information security and cashless community had low fintech readiness scores. A major hurdle fintech service providers need to overcome to penetrate larger parts of the population is the sheer power of the habit of using physical currencies. It is difficult for users to shift from the centuries-old notion of using a currency with physical and tactile presence to something that is almost abstract and lacks any physical presence at all. This logically affects the perceived security and trustworthiness of fintech service for users at an early stage of fintech use. In our data, individuals who reported their concern for a cashless community to be “very high” had an average fintech readiness score of 28%. This was higher for individuals reporting their

concern for cashless community to be “very low” at 38%. More importantly, individuals who reported not knowing anything at all about concerns over the cashless community had fintech readies score of around 18%. Fintech service providers need to focus more on the undecided part of the current and future customer base to formulate a positive and rational view of fintech services and the benefits it represents for the communities of the future.

A marked difference was found in average CFR for citizens from urban and semi-urban/rural areas. The NCS questionnaire also asked citizens to specify their house type, and transportation medium among other things. For urban citizens, notwithstanding any other variable, average CFR was 30.75. In semi-urban/rural areas it was 20.48. With lower education, readiness fell. In NCS, the highest category of institutional education was a post-graduate degree, where average CFR was 42.76. For citizens with only primary schooling, this was 8.48. On average, we found a 57% increase in CFR for each additional degree in the national institutional education system. This corroborates evidence from other markets where literacy and fintech readiness were observed with positive association between them. Citizens with higher levels of education are more likely to be aware of benefits from these services. At the same time, they are more likely to rationally judge the potential risks associated with fintech use and a way to mitigate them.

6.6. Discussion

Within a context of rising MFS acceptance, favorable demographics and economics, and transformative potential for financial landscapes of emerging economies, this chapter proposed an index to assess citizens’ level of readiness to use fintech products and services. To do so, a multiple-domain readiness index, the Customer Fintech Readiness (CFR), was constructed. CFR considered a range of variables measuring citizens’ demographics, financial health, financial literacy, existing fintech usage, e-readiness, mental preparedness, and fintech sentiment. This study was done on Bangladesh – a country where decades of commendable macrocosmic growth and stability have created a conducive digital and infrastructure environment for further fintech development. As mentioned earlier, fintech holds the potential to create significant value for customers. Importantly, it can facilitate financial inclusion in places where the banks lagged behind in bringing people into the financial system. That facilitating role is

underpinned by the large-scale adoption of fintech services. But fintech's potential is limited if acceptance and usage of fintech products and services are inadequate.

This chapter reviewed extant literature for factors and theoretical underpinnings. Our findings corroborate a number of patterns while providing new evidence for further analysis. Similar to previous findings we found institutional education positively contributing to overall fintech readiness. But contrary to others (Gulamhuseinwala et al. 2015b; Yonghee Jack Kim et al. 2015) CFR for older age groups in our findings was consistently higher. This can be explained. First, we used a multi-dimensional index where mental preparedness and overall sentiment constituted only two of the seven dimensions. These are two areas where younger users were found to be ahead of their older counterparts. Another dimension was concerned with e-readiness where regardless of age, citizens in Bangladesh have room for improvement. As a result, the relative weight of these variables meant financial health and literacy gained greater importance. The latter two are areas where older citizens were ahead.

Consistently in our analyses, gender-disaggregated CFR showed lower average readiness of women. Women ranked lower than men across all seven dimensions in CFR. Moreover, the dimension score shows that gender difference was most pronounced in financial literacy. Whether through reducing wage differential, access to capital for entrepreneurship, or increasing financial resilience fintech has proven to close the gender gap (S. Chen et al. 2021; Guo et al. 2021; Sioson and Kim 2019). For a country such as Bangladesh, women's empowerment can be further propelled by fintech. To do so, policy interventions will be necessary to address the asymmetry of average scores across the seven dimensions of CFR, as shown in this chapter. Such intervention will have to be on top of macro efforts to raise fintech readiness at the granular level.

It is important to discuss the clear pattern observed with regard to fintech readiness and institutional education. With higher institutional education, fintech readiness increased substantially. Considering all other factors constant, this alone raised readiness by a big margin. The increase was larger at tertiary than in secondary or primary stages. Fintech platforms do not require a sophisticated understanding of financial transactions. In fact, the entire point of fintech is to democratize, de-couple, and demystify finance for customers in specialized segments of the market (Allen et al. 2020; Jagtiani and Lemieux 2017; I. Lee and

Shin 2018). Intuitiveness of the user interface is one way to attract and retain customers within fintech service ecosystem (S. Lee 2017; Wahab et al. 2021). Most fintech platforms offer such intuitive user interfaces to optimize customer experience. Assuming a lack there is putting friction in customer attraction and retention, lower readiness can be attributed to perceived factors in our sample.

The CRF index and its attendant findings for citizens in Bangladesh contribute to the literature in a number of ways. To the best of our knowledge, this is the first attempt to "package" the idea of customer readiness of fintech along with all its relevant dimensions and variables. Previously, theoretical models and index constructions were aligned with broad technology adoption. Considering the phenomenal rise in customer fintech applications, services, and products across the globe during the last decade, and expecting a boom in the ongoing one, assessment of customer readiness is important for countries that stand to benefit from fintech's transformative potential. Although CRF is critically evaluated for reliability and validity, future research work can further expand and modify components in our proposed index.

Our work is also first to measure fintech readiness in Bangladesh. It is a market where fintech has taken off with notable success of MFS platforms and where novel fintech solutions stand to capture significant value. However, it is also a market where enough investigation has not been conducted for further insights. An investigation of the Bangladesh fintech ecosystem will yield fundamental learnings for other markets. A plethora of economic and behavioral variables make the Bangladesh ecosystem intriguing to study. However, overall readiness for fintech adoption and use demands an ecosystem view. In particular, the role of open innovation dynamics in fintech startups and the financial services ecosystem is key. Such dynamics impact firms, innovation clusters, industries, and the economy. Open innovation dynamics among three actors i.e., SMEs, big businesses, and communities at large cyclically affect economic growth dynamics – both at firm and country levels (JinHyo Joseph Yun et al. 2018). As such, economic systems are in a constant state of flux wherein interaction between actors cyclically either preserve or influences overall balance. This results in either accelerated growth or the stifling thereof.

Open innovation dynamics have also been investigated within a network of firms where incumbent firms interact with open innovation elements from emerging startups (Gay 2014). While the pharmaceuticals industry was explicitly

investigated, fintech as an ecosystem should also retain such open innovation dynamics. Incumbent financial institutions are constantly interacting with fintech SMEs, being challenged by alternatives, acquiring new technologies, business models, and target segments, and providing ecosystem and legacy support to create win-win business cases (Hornuf et al. 2021; Juengerkes 2016; Mikhaylov et al. 2023).

The new technological paradigms of the Second Machine Age have paved the way for an evolution of innovation dynamics from a closed state to an increasingly more open dynamics (Poot et al. 2009). There is evidence that SMEs in recent years are increasingly engaged in open innovation practices and systems (van de Vrande et al. 2009). In fact, an "ambidextrous" approach to manage the transition towards open innovation in the fintech ecosystem is both required and enabled by Industry 4.0 technologies i.e., Artificial Intelligence, big data, blockchain, and the Internet of Things (IoT) (Jinhyo Joseph Yun et al. 2021). Internal and external organizational policies definitely have a role to play (Igartua et al. 2010). Here too, technology is a predominant but not sufficient driver. To foster open innovation dynamics within organizations and among collaborating firms in the innovation ecosystem, firms need appropriate cultural transitions – not least in the financial services landscape that is poised for fundamental transformations (Fasnacht 2018). But at the same time, organizational key figures such as founder entrepreneurs or CEOs through their characteristics and approaches also influence such transitions towards open innovation dynamics (Barrett et al. 2021). The roles of entrepreneurs, incumbent banks, and ecosystem enablers (e.g., regulators, and technology providers) need to be further assessed in light of open innovation dynamics for better fintech adoption readiness.

6.7. Concluding Remarks

Fintech holds transformative potential. Disrupting traditional finance, technology-enabled financial services can create value for customers and promote more inclusive and resilient financial services for specialized segments of the market. To enable such an environment would require customers to adopt fintech services at large. At later stages of ecosystem development, the adoption of fintech requires a range of readiness dimensions. Considering these, this chapter proposed an index that measures fintech readiness for customers in Bangladesh.

The scale considered demography, financial health and literacy, e-readiness, mental preparedness, and sentiment on fintech for a broader view of readiness. Further research can critically evaluate and expand the proposed construction and organization of the CFR and replicate it for different markets. Apart from empirical corroboration, such work is expected to result in a readiness assessment of other ecosystems as well as directions for policy interventions.

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7. Adoption Factors of Fintech

7.1. Introduction

Fintech is poised to bring transformative changes by combining the power of digital technologies of the fourth industrial revolution (4IR) and innovative new financial services. With fintech, innovative financial solutions are delivered to users formerly either "unbanked" or "under-banked", thereby enabling communities to be financially included (Ahmad et al. 2020; Kim et al. 2018). Fintech promises financial inclusion, financial resilience, cost efficiency, better transparency, and much more (Alwi 2021; Arner et al. 2020; Beck 2020; Deng et al. 2019). Moreover, businesses can reach customers left out by traditional banks. For high-end customer segments too, fintech service providers are direct competitors of traditional banks and financial institutions. In fact, some of the more lucrative customer segments for fintech are also some of the most profitable ones for legacy financial institutions. Fintech emerged to challenge banks as the Global Financial Crisis of 2008 reduced customer trust in legacy banks (Hansen 2014; Shim et al. 2013). Success in customer value generation today depends on fintech service providers "partnering" with legacy banking firms to create a win-win situation (Ernst & Young 2019b). Banks benefit from the technological innovativeness of fintech firms, whereas startups with fintech solutions can access certain market segments through banks without going through the full regime of regulatory and compliance hurdles.

As a result of the promised value, the future of fintech holds enormous potential for all relevant stakeholders. Customers, both novel and loyal, can expect to benefit from a widening array of fintech solutions; and service providers as ecosystem enablers will benefit from expanding market opportunities. Deriving these benefits for sustainable development in some of the world's most marginalized communities is dependent on effective adoption. Solving the technology part of the equation is just the beginning.

A large and growing body of extant literature is dedicated to the investigation of factors of effective fintech adoption, continuance intention, and customer behavior (Gomber et al. 2017; Rabbani et al. 2020; Sangwan et al. 2019; Suryono et al. 2020). The investigation of adoption factors is either from a country-level perspective or with regard to individual usage. There is evidence of heterogeneity between and within countries (Ernst & Young 2019a). Even on the macro scale, diverging strands of evidence point to differing levels of impact of variables, e.g., financial literacy (Setiawan et al. 2021). On the individual level, fintech use and adoption are influenced by a host of factors (Islam et al. 2017). There are demographic factors (Clements 2020; Imam et al. 2022; Pedrosa and Do 2011), customers' evaluation of satisfaction (Alkhazaleh and Haddad 2021; Alwi et al. 2019; Barbu et al. 2021), security risk perception, perceived ease, and usefulness (Al-Okaily et al. 2021; Poerjoto et al. 2021; Wang et al. 2019). Coffie et al. (2020) find a host of human, business, and technology-centric factors creating the environment for optimal fintech diffusion among these SMEs. Gerlach and Lutz (2021) investigated the relationship concerning demographic variables (e.g., gender, age), economic variables (e.g., disposable income), and, attitude variables (e.g., risk tolerance, knowledge regarding financial services).

Factors can also be seen from a provider-receiver perspective. Hwang and Kim (2018) divided possible factors into two dimensions. On the one side, they looked at characteristics of fintech services largely defined by service providers. These include service dimensions like complexity, underlying risk with fintech use, and trust. On the other hand, factors unique to the individual user were considered such as the user's previous experience of a security-related incident on a fintech service platform. Consistent with other studies from the extant literature, their binary logistic regression model showed a negative effect of complexity, lack of trust in service providers, and previous security experience on fintech adoption (Hwang and Kim 2018). Positive effects from users' innovative attitudes were also observed. However, a systematic investigation of adoption factors for fintech in emerging economies like Bangladesh is still underdeveloped in the literature.

Bangladesh, as one of the fastest-growing emerging markets, has made significant strides in terms of financial inclusion. Under the digital-first policy of the government, banks and financial institutions have extended the reach of the financial system into remote areas, bringing thousands into the formal banking channel. Despite these, a sizeable portion of the population remains out of the

banking system (Das 2021). Emerging fintech solutions, Mobile Financial Services (MFS) in particular, have contributed significantly to bringing financial services to marginalized communities (J. N. Lee et al. 2021). However, huge work remains to enable more users to adopt fintech services. Marginalized communities in rural areas (e.g., subsistence farmers) and in urban, semi-urban centers (e.g., ready-made garment workers) can benefit from financial inclusion with accessibility and financial resilience. Adoption of fintech services, essentially through Mobile Financial Services (MFS) platforms, e.g., bKash, Nogod, Rocket, and Upay would allow these communities to better access financial services for a better life.

To fight poverty, prudently manage personal finance, and access financial services for a better standard of living through fintech, it is important to understand what factors drive adoption. Fintech solutions can contribute to the financial well-being and resilience of users when they are open to adopting these services in the first place. Developing an understanding of fintech adoption factors of Bangladeshi customers will enable fintech service providers to better target customers and take effective marketing interventions. Such understanding will equip policymakers, financial services regulators, and ecosystem enablers (e.g., mobile network operators, and investors) for effective policy directions. This study, as part of our ongoing series of research work on fintech use and sustainable economic impact for Bangladesh, takes the step towards that understanding.

In this chapter, we contribute by investigating a range of demographic, economic, and qualitative factors for fintech use. Our nationwide representative sample from Bangladesh is one of the most balanced samples used in extant literature. After incorporating a wide range of features informed by previous and existing studies, we deploy Recursive Feature Elimination (RFE) to estimate a multivariate logistic regression model for predicting fintech adoption. We find that respondents with mobile access, lower levels of reported concerns with security, and lower levels of reported geographic obstacles are more likely to use fintech services. Respondents with high levels of concerns for security and financial scam issues on fintech services, low levels of confidence using new technological solutions, and high reported levels of obstacles with service intuitiveness are less likely to use fintech services. These features add further evidence to the existing literature. The contribution of this chapter is mainly twofold. First, we use a nationwide representative dataset incorporating wide demographic variation and both sides of the socio-economic spectrum.

Representation of all segments was limited in previous works (Clements 2020; Coffie et al. 2021; Solarz and Swacha-Lech 2021). Second, we allow a large set of features to be selected through RFE. This enables us to input all relevant factors into the model, yet select the most important ones without possible interference from researcher bias. Consequent findings allow fintech service providers, regulators, and future researchers to target the most salient features of individual users predicting fintech adoption.

7.2. Data, Method, and Model

7.2.1. Dataset

The modeling of fintech adoption factors in this chapter is based on NCS dataset discussed in detail in Chapter 3. A nationwide representative survey collected data between April 2022 and June 2022, covering 2 districts from each of the 8 administrative divisions in Bangladesh. Each district was selected from either side of the poverty spectrum. Eighty responses were collected from each district. This resulted in 1282 fully completed responses. After data wrangling and cleaning, our sample size stood at N = 1036. To gain a comprehensive view of fintech usage and related factors, the questionnaire covered a wide number of demographic, economic, behavioral, technological, and perceptual/opinion-related questions. Table 7.2-1 provides a full list of variables used for our modeling purpose. The steps of our study method are visualized in Figure 7.2-A.

7.2.2. Dataset Train, Test Splitting and Oversampling

In our original dataset (after cleaning) of 1036 instances, 29.25% were fintech users. Fintech user was defined as respondents with a minimum monthly frequency of using a fintech service of two. Before training the logistic regression model, the dataset was split into training- and test sets with an 80-20 ratio. Since the two classes of the dependent variable were imbalanced, we used Synthetic Minority Oversampling Technique (SMOTE) to increase the number of instances in the minority class (non-users in this case).

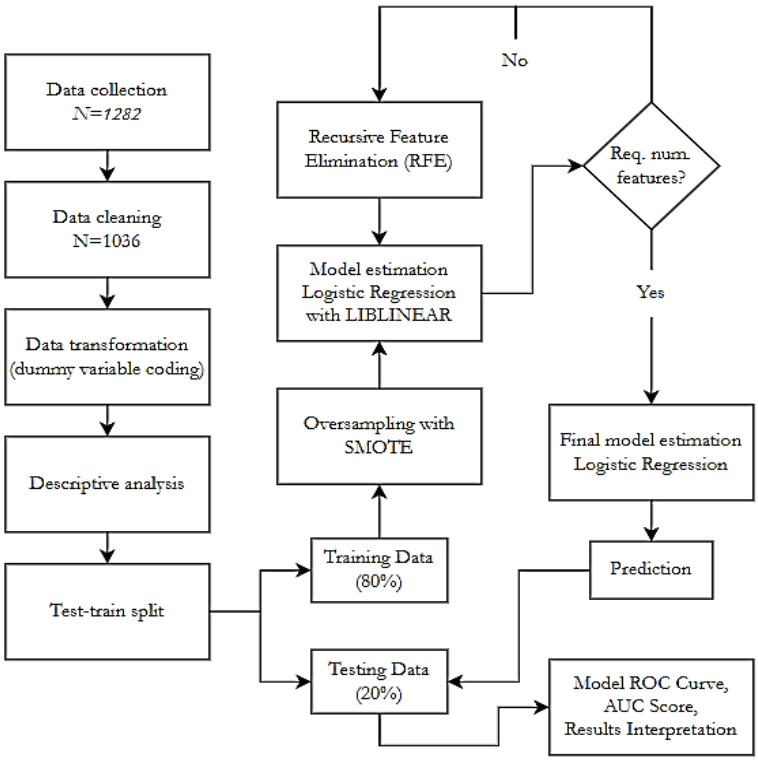

Figure 7.2-A Methodological flow diagram

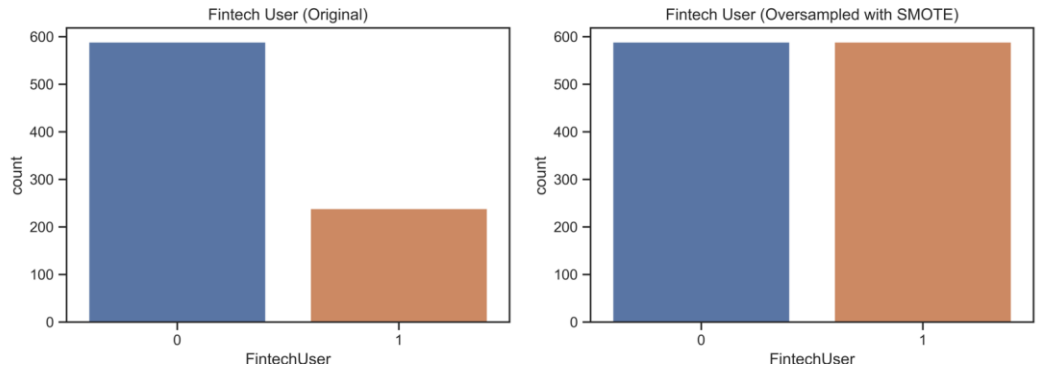

Figure 7.2-B Distribution of fintech users and non-users in the original set after split (left) and distribution after SMOTE. Fintech users are denoted by "0" (in blue) and fintech users are denoted by "1" (in orange).

Table 7.2-1 List of variables included for fintech adoption modelling

Variable	Levels
Gender	Male, Female
Age	-
Education	Primary, Secondary, None, Higher secondary, Graduate, Post-graduate, Madrasa_(kawmi)
Marriage	Married, Single
Occupation	Business, Day Laborer, Homemaker, Non-government Job, Retired, Student, Unemployed, Driver (Rickshaw/Van/Engine Vehicle), Farmer/Fisherman/Boatman, Government Job, Government Allowance, Non-resident. Others
Household	-
Expenses	-
ExpRent	-
ExpFood	-
ExpUtilities	-
ExpEducation	-
ExpHealthcare	-
ExpEntertainment	-
ExpClothing	-
ExpHouseHelp	-
ExpMisc	-
Income	-
AnnualSaving	-
House	Traditional House, Cemented House
BankAccount	No, Yes
BankVisit	-
BankAwareness	Very low knowledge (only deposited and withdrawal), Some knowledge (deposited scheme and loan scheme), No knowledge at all, Above average knowledge (LC, stock market, financial report, ratios etc.), Expert (certified financial analyst)
Computer	No, Yes
Mobile	No, Yes
SmartphoneSkill	Not skilled at all, Very low skills, Some skills, Skilled, Very skilled
Internet	No, Yes
Data_usage	-
Concern_Information_Secrecy	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Unknown_Issues	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Limited_GovControl	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Financial_Scandal	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Cashless_Community	I don't Know, Very Low, Low, More or less, High, Very High
Concern_Information_Security	I don't Know, Very Low, Low, More or less, High, Very High
MentalPreparedness	Low prepared, Not prepared at all, Average preparedness, Prepared, Adequately prepared
Fintech_satisfaction	I don't use fintech, Satisfied, Neutral, Dissatisfied, Highly dissatisfied, Highly satisfied
Max_fee_per_1000	-
Obstacle_economic_condition	Very low, Low, Neutral, High, Very high
Obstacle_geographic_location	Very low, Low, Neutral, High, Very high
Obstacle_confidence_in_technolog	Very low, Low, Neutral, High, Very high
Obstacle_service_intuitiveness	Very low, Low, Neutral, High, Very high
Fintech_service_affordability	Very low, Low, Neutral, High, Very high
Fintech_costliness	I don't know, Not affordable at all, Not affordable, Neutral, Affordable, Highly affordable

In classification problems, one of the challenges researchers face is the non-availability of instances across classes uniformly. The result is asymmetry across classes. Model results based on asymmetric classes may lead to inaccurate predictions with potentially serious results depending on the use of the model. As an example, false negatives due to model inaccuracy that can be traced to sampling asymmetry may lead to serious health hazards (Chawla et al. 2002). To address the issue, a number of techniques have been deployed in the literature. SMOTE oversamples the minority class to bring symmetry. The method has widely been used in computer science, software development, biological classification, and more (Amirruddin et al. 2022; Ijaz et al. 2018; Pears et al. 2014).

SMOTE is widely used in multiple disciplines due to its ease of use and effectiveness in a wide range of scenarios. The algorithm works by choosing a required number of "k-nearest neighbors" for each instance in the minority class and applying linear interpolation to randomly generate instances until the class imbalance is addressed. The synthetic instances are added and a new dataset is then constructed. Since random selections of minority class data are not repeated, SMOTE successfully avoids model overfitting issues (Chawla et al. 2002). Figure 7.2-B shows that the imbalance problem has been addressed through SMOTE and the ratio of fintech users and non-users in the training set is 1:1.

7.2.3. Recursive Feature Elimination (RFE)

In our dataset, there were 133 features. In order to reduce the number of features to a desired level, we used Recursive Feature Elimination (RFE) to obtain the most important 55 features. RFE is an iterative process of fitting and refitting a machine learning model until a desired number of features with the highest-ranking scores are retained as a final estimation. RFE can be implemented for a wide range of models including Linear Regression, Logistic Regression, and Random Forests. The initial model is estimated using all features specified. In each step, the algorithm calculates a performance score, known as variable ranking, for all included features. Each successive step consists of the elimination of lower ranking variable(s) and re-estimation of the model with remaining features (Kuhn and Johnson 2013). The process continues till a specified number of features is reached and the best-fitting model is retained.

The success of RFE depends largely on the classifier used and its relationship with the underlying loss function. Li and Yang (2005) found that the ability of

classifier to “penalize[…] redundant features and [to] promote[…] independent features” during the iterative process contributes to its success. RFE has been used in a wide range of disciplines including bioinformatics, clinical studies, early diagnosis of cancerous cells, as well as in computer vision and natural language processing (Basak et al. 2021; Bedo et al. 2006; Bursac et al. 2008). Although computationally intensive, RFE offers one major advantage over manual feature selection. In logistic regression in particular, and regression modeling in general, the key challenge is the selection of some combination of variables/features while eliminating others (Bursac et al. 2008). Selection may prove difficult when a large number of features are involved and related theoretical supports are under development. In this case, RFE aids feature selection by prioritizing model fit.

7.2.4. Logistic Regression

Logistic regression is an econometric tool used widely for classification and predictive modeling. In binary logistic regression, the dependent variable assumes either 0 (e.g., failure, absence, negative, etc.) or 1 (e.g., success, presence, positive). In this study, the dependent variable is binary, where 0 indicates no use of fintech and 1 indicates use of fintech services. Logistic regression as a method has been deployed by a number of authors for the investigation of fintech adoption. After using a binary logistic regression for intention to shift to fintech services among German households, it was found that young people had a higher probability of shifting to new fintech services compared to their older counterparts (Jünger and Mietzner 2020). This relationship between age and fintech usage intention and adoption, in general, confirms similar findings in emerging markets as well. Jünger and Mietzner (2020) also found an interesting relationship between the consumer-assessed need for transparency and the probability of fintech usage. Users who had a higher emphasis on transparency in banking activities were more likely to adopt fintech services. Their logistic regression models also find households with higher levels of fintech expertise more likely to adopt fintech services (Jünger and Mietzner 2020).

Solarz and Swacha-Lech (2021) undertook a more comprehensive dataset. Their logistic regression model used a variety of demographic and attitude features with N = 1236. Data were collected from Poland. Findings revealed that high-income millennials with a tolerance towards technological novelties were more likely to adopt fintech services. Moreover, logistic regression as a methodical

approach has not been limited to individual fintech adoption behavior. The country-level investigation, such as by Okoli and Tewari (2020) for 32 African economies during 2002–2018 and by Zarrouk et al. (2021) in the United Arab Emirates (UAE), through multivariate logistic regression, also yields important findings. The role of structural support systems (i.e., regulatory support, availability of complementary resource bases) was highlighted as an aid to fintech adoption.

In logistic regression, the hypothesized probability of occurrence is determined by the Sigmoid function (Dougherty 2011):

$$p_i = F(Z_i) = \frac{1}{1 + e^{-z_i}}$$

whereas Z tends to infinity, e^{-z} tends to 0 and p has an upper bound of 1. Conversely, as Z tends to minus infinity, e^{-z} tends to infinity and p has a lower bound of 0. Figure 7.2-C depicts a hypothetical sigmoid function. In multiple logistic regression, Z is dependent on a vector of observed covariates X_i and a linear function of these covariates with coefficients β_i:

$$Z_i = \beta_0 + \beta_i X_i + \varepsilon$$

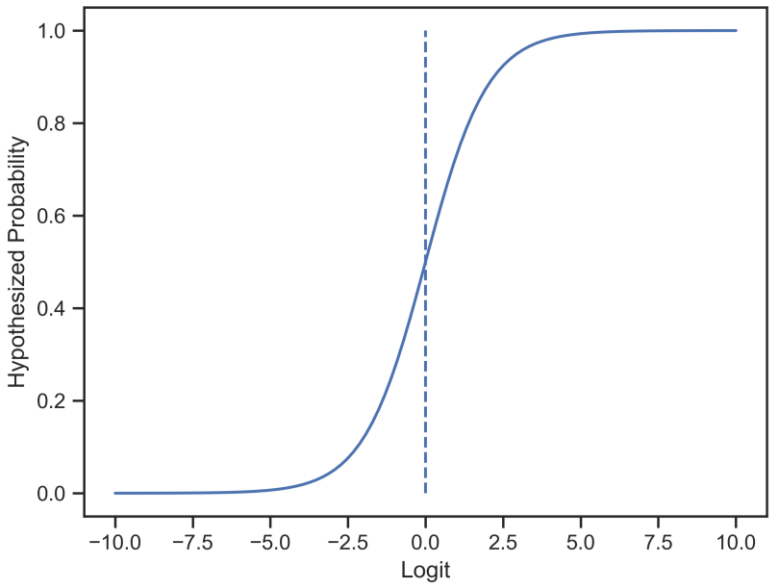

Figure 7.2-C Hypothetical sigmoid function on the coordinate plane.

For our estimation purposes, the dependent variable was fintech adoption, binary coded 0 and 1 for non-adoption and adoption, respectively. We defined fintech adoption as "yes" when a respondent's frequency of using any fintech service over the last one month was greater or equal to 2. Table 7.2-2 provides a

summary of dependent and independent variables in our logistic regression model.

Table 7.2-2 Dependent and Independent Variables for Multivariate Logistic Regression

Variable Class	Variable Name	Labels
Dependent	Fintech adoption	1 if frequency of monthly fintech of use during the preceding month is ≥2; 0 otherwise
Independent/Predictor	See Table 7.2-1 for full list	-

7.2.5. Model Estimation with LIBLINEAR

Selection of optimization/solver algorithm for logistic regression estimation is influenced by dataset characteristics, research methods, and underlying advantages/disadvantages of the algorithms themselves. Widely-used solver algorithms include Newton's Method, Library for Large Linear Classification (LIBLINEAR), Stochastic Average Gradient (SAG), Limited Memory Broyden–Fletcher–Goldfarb–Shanno algorithm (L-BFGS) (large scale bound constrained algorithm). For our purposes, we deployed LIBLINEAR. This was done both in feature elimination with RFE and final model estimation. LIBLINEAR is an open-source, easy-to-use package for large-scale linear classification (Fan et al. 2008). LIBLINEAR has been proven to outperform other modeling algorithms not just for linear modeling scenarios. For non-linear estimation purposes, LIBLINEAR was found to be computationally less intensive (Fan et al. 2008). The result is a shorter estimation time and better model fit. There have been updates on the original class of large-scale linear classification algorithms; in many applications, these have been found to reach accuracy equal to non-linear classification methods (Yuan et al. 2012).

7.3. Summary and Model Results

7.3.1. Description of Sample and Fintech Use

A large number of variables in the dataset were categorical. Numerical data was collected, as well. Table 7.3-1 presents descriptive statistics on numerical variables included in the logistic regression for this chapter. A number of statistical analyses were performed for both numerical and categorical variables including cross-tabulations, chi-2 test of independence among groups, and correlation

analysis among the numeric variables. The following sections summarize some of the insights gathered

The respondents in our survey were aged between 18 and 85 years. In total, 75% of the respondents were aged below 47. Male respondents accounted for around 86% of the respondents. We observed significant variation in gender-disaggregated age across fintech usage. Taking house type as a proxy for the urban/rural area of the respondent, fintech user was found to be more prevalent in urban areas, as expected. Due to incorporating sixteen districts from the country and both sides of the poverty spectrum, our survey consisted of a wide range of income. In fact, income was significantly skewed to the right with a few extreme positive values. Fintech usage was concentrated mostly around the middle of the spectrum. Fintech usage was more prevalent among young users with a minimum level of monthly income. These patterns are depicted in Figure 7.3-A.

In the original NCS dataset, 30.79% owned a bank account while the rest did not have bank accounts. However, 68.83% owned mobile banking accounts, and around 31.17% did not. Lack of bank account ownership was more prevalent in rural/semi-urban areas compared to urban areas, as expected. The difference was less pronounced for mobile banking account ownership. Account ownership was also found relatively higher in higher classes of institutional education.

Table 7.3-1 Descriptive Statistics of Numeric Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	1036	39.758	13.018	18	85
Household	1036	5.02	1.768	1	12
Expenses	1036	15,511.486	8003.895	2000	70,000
ExpRent	1036	430.106	1609.094	0	16,000
ExpFood	1036	8740.287	5840.052	0	85,000
ExpUtilities	1036	962.074	992.533	0	7000
ExpEducation	1036	1682.082	2397.988	0	30,000
ExpHealthcare	1036	1118.972	1649.737	0	20,000
ExpEntertainment	1036	217.693	347.913	0	1500
ExpClothing	1036	958.605	875.719	0	7000
ExpHouseHelp	1036	83.966	521.206	0	8000
ExpMisc	1036	1260.523	1523.562	0	10,000
Income	1036	18,372.201	10,952.253	0	100,000
AnnualSaving	1036	11,334.555	32,170.068	0	450,000
BankVisit	1036	0.433	0.918	0	5
Data usage	1036	5553.042	13,071.003	0	90,000
Max fee per 1000	1036	8.145	3.862	0	20

Of the respondents surveyed in the original dataset, 36.97% had access to the Internet. Of female respondents, only 21% had access to Internet. The share of

male respondents with access to the Internet was 40%. The average data usage per month (measured in megabytes) for the entire sample was 5553.042 MB.

We included a wide range of variables to measure respondents' level of concern on a five-point Likert scale. These included concern for financial scandal, information security, information secrecy, limited government control, and a cashless community, among others. Variations were observed in levels of concern in fintech usage across age, gender, levels of education, and occupation. In general, concerns were higher in older age groups and lower in higher-income groups in our dataset. Respondent mental preparedness was measured on a five-point Likert scale. Respondents who used fintech services reported relatively higher levels of mental preparedness. Conversely, low reported mental preparedness was observed more frequently among non-users. Mental preparedness, on average, was lower in higher age groups, as expected from evidence in the literature. Table 7.3-2 provides a cross-tabulation of mental preparedness and fintech use. Younger users were generally ahead in technology adoption and openness to using new technological solutions. There are extremely outlier instances in lower levels of mental preparedness to use fintech.

Table 7.3-2 Cross-tab of existing fintech use and mental preparedness to use fintech in daily lives

Mental Preparedness	**Fintech User**		
	No	**Yes**	**Total**
Not prepared at all	26.06	2.64	19.21
Low prepared	31.65	31.35	31.56
Average preparedness	30.29	44.88	34.56
Prepared	10.64	16.83	12.45
Adequately prepared	1.36	4.29	2.22
Total	100.00	100.00	100.00

We expected higher levels of reported perceived obstacles to be associated with low probability of fintech use. The association was also expected in terms of perceived affordability and perceived costliness of the fintech service. The reason both "affordability" and "costliness" were used in the survey is due to a nuance between the two terms in Bangla, which was the medium of instruction for the questionnaire. Costliness is an impersonal assessment of how expensive the service is. Affordability, on the other hand, has a more personal connotation, and respondents evaluate how easily they can access the fintech service. We observed significant variations in levels of reported obstacles, affordability, and costliness of fintech services across demographic and behavioral categories.

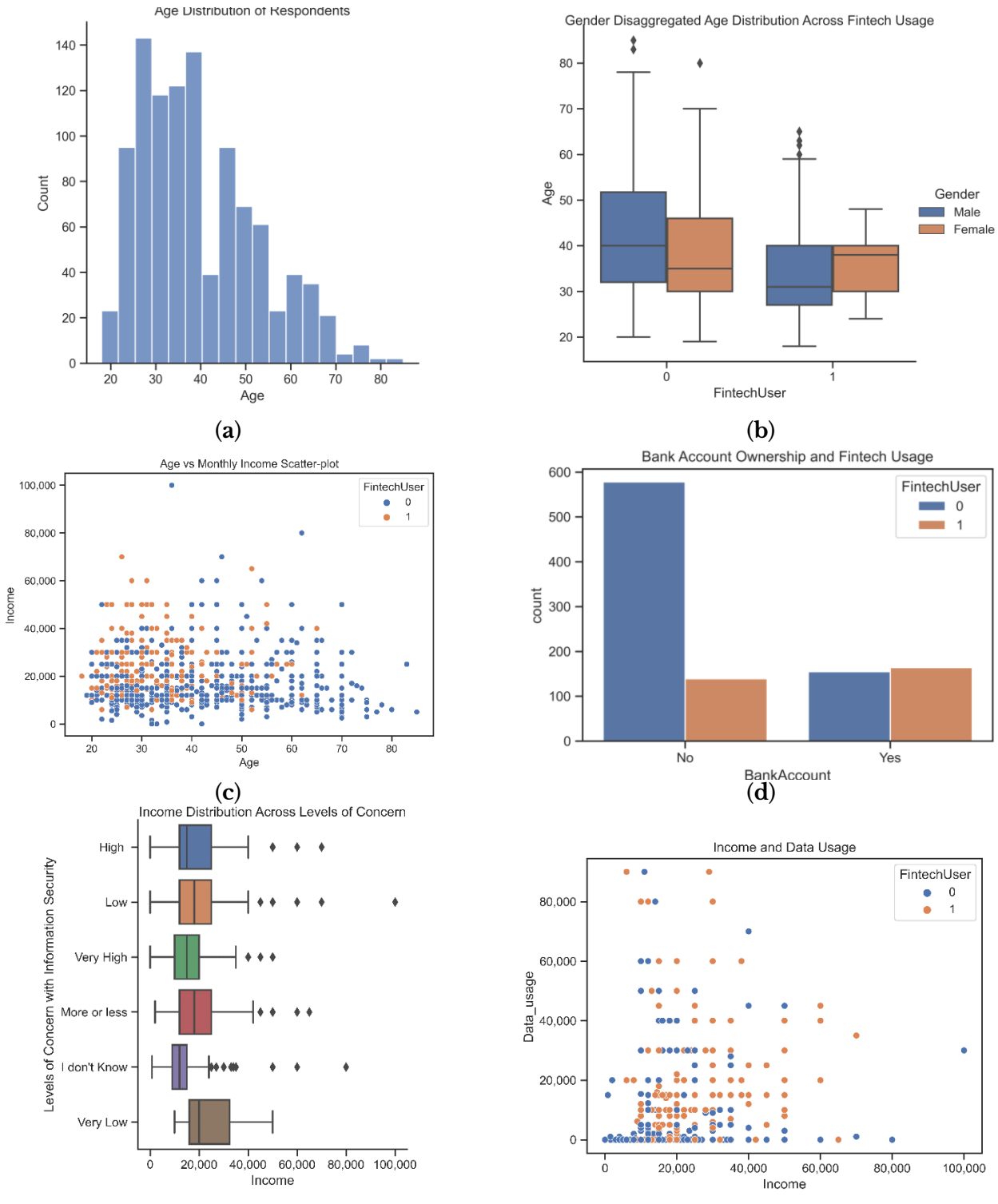

Figure 7.3-A (a) Distribution of respondent ages; (b) Gender-disaggregated box-plot of age; (c) Scatter-plot of age and monthly income; (d) fintech use and bank account ownership; (e) Distribution of monthly income across concern for information security; (f) Scatter-plot of monthly income and data usage.

7.3.2. Logistic Regression Results

Model parameters, feature coefficients, and *p*-values for our final logit model are presented in Table 7.3-4. We note that McFadden's pseudo R-squared for our model is 0.677, which is satisfactory considering the target variable is a complicated social and behavioral phenomenon. Figure 7.3-B depicts Receiver Operating Characteristics (ROC) Curve and the AUC score of the estimated logistic regression model. For our model, AUC score was 76.22% (Table 7.3-3). ROC Curve can be summarized as a plot of the sensitivity and specificity, where true positive rates are plotted against false positive rate. Area Under Curve (AUC) is a single metric summary of usefulness of the model from ROC perspective. Generally, an AUC score of 0.50 is of no use, as it indicates no better results than a random guess. AUC scores between 0.7 and 0.8 are regarded as acceptable; scores between 0.8 and 0.9 are regarded as good; and those above 0.90 are regarded as "outstanding" (Mandrekar 2010).

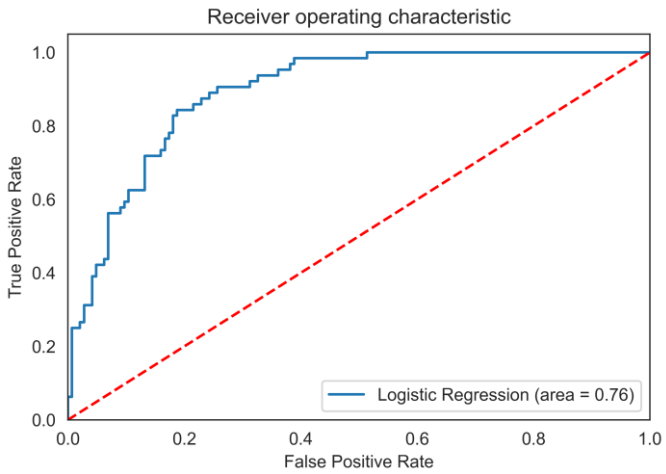

Figure 7.3-B Receiver Operating Characteristic (ROC) curve and Area Under Curve (AUC) score for the estimated model.

Table 7.3-3 Classification report table for the estimated model

Outcome	Precision	Recall	f1-Score	Support
0	0.85	0.87	0.86	144
1	0.69	0.66	0.67	64
Accuracy			0.80	208
Macro Avg.	0.77	0.76	0.77	208
Weighted Avg.	0.80	0.80	0.80	208

ROC is widely used to assess the fit of a diagnostics test across disciplines. In biomedicine, tolerance for an acceptable AUC score is generally high. Relying on

Table 7.3-4 Logistic regression model results, feature coefficients, p-values, significance

Feature	Coef.	Std.Err.	z-Value	*p*-Value	[95% Conf.	Interval]	Sig.
Gender_Male	0.242	0.612	0.395	0.693	−0.958	1.442	
Education_Madrasa_(kawmi)	1.535	0.93	1.65	0.099	−0.288	3.358	
Marriage_Married	−0.73	0.373	−1.957	0.05	−1.461	0.001	
Occupation_Government Allowance	−21.912	31200	−0.001	0.999	−61,100	61,100	
Occupation_Homemaker	−1.065	0.693	−1.536	0.124	−2.424	0.294	
Occupation_Non-government Job	0.669	0.388	1.723	0.085	−0.092	1.431	
Occupation_Others	−1.076	0.863	−1.246	0.213	−2.768	0.617	
Occupation_Retired	−0.877	0.865	−1.015	0.31	−2.572	0.817	
Occupation_Student	0.527	0.571	0.924	0.356	−0.591	1.646	
Occupation_Unemployed	−1.208	0.581	−2.081	0.037	−2.346	−0.07	***
House_Traditional House	−0.69	0.262	−2.63	0.009	−1.203	−0.176	***
BankAccount_No	−0.372	0.266	−1.399	0.162	−0.892	0.149	
BankAwareness_Above average knowledge (LC, stock market, financial report, ratios etc.	2.103	1.601	1.313	0.189	−1.035	5.242	
BankAwareness_Expert (certified finanical analyst)	−42.155	832,000,000	0	1	−1,630,000,000	1,630,000,000	
BankAwareness_Some knowlede (deposite scheme and loan scheme)	−0.628	0.328	−1.914	0.056	−1.272	0.015	
Mobile_No	−15.358	36,300	0	1	−71,200	71,200	
Mobile_Yes	9.052	1.271	7.122	0	6.561	11.543	***
Internet_No	−0.944	0.262	−3.599	0	−1.458	−0.43	***
Concern_Information_Secrecy _High	−1.621	0.474	−3.422	0.001	−2.549	−0.692	***
Concern_Information_Secrecy _Low	−1.23	0.511	−2.408	0.016	−2.23	−0.229	***
Concern_Information_Secrecy _More or less	−0.748	0.467	−1.602	0.109	−1.663	0.167	
Concern_Unknown_Issues_I don't Know	−0.834	0.853	−0.978	0.328	−2.506	0.837	
Concern_Unknown_Issues_Very High	−0.749	0.562	−1.333	0.183	−1.851	0.353	
Concern_Unknown_Issues_Very Low	−1.143	0.809	−1.413	0.158	−2.728	0.443	
Concern_Limited_GovControl _High	−1.961	0.809	−2.424	0.015	−3.546	−0.375	***
Concern_Limited_GovControl _I don't Know	−1.358	1.084	−1.253	0.21	−3.483	0.766	
Concern_Limited_GovControl _Low	−1.61	0.824	−1.953	0.051	−3.225	0.006	
Concern_Limited_GovControl _More or less	−1.811	0.813	−2.227	0.026	−3.404	−0.217	***
Concern_Limited_GovControl _Very High	−2.365	0.894	−2.645	0.008	−4.116	−0.613	***
Concern_Financial_Scandal_I don't Know	−2.853	0.636	−4.489	0	−4.099	−1.607	***
Concern_Financial_Scandal_ More or less	−1.338	0.343	−3.897	0	−2.011	−0.665	***

Feature	Coef.	Std.Err.	z-Value	*p*-Value	[95% Conf.	Interval]	Sig.
Concern_Financial_Scandal_Very Low	−2.718	1.346	−2.019	0.044	−5.357	−0.079	***
Concern_Cashless_Community_High	−0.545	0.312	−1.747	0.081	−1.157	0.066	
Concern_Cashless_Community_Very High	−1.064	0.492	−2.161	0.031	−2.029	−0.099	***
Concern_Information_Security_High	−2.326	0.831	−2.798	0.005	−3.955	−0.696	***
Concern_Information_Security_I don't Know	−2.177	1.034	−2.106	0.035	−4.203	−0.151	***
Concern_Information_Security_Low	−2.437	0.837	−2.91	0.004	−4.078	−0.795	***
Concern_Information_Security_More or less	−2.362	0.844	−2.797	0.005	−4.017	−0.707	***
Concern_Information_Security_Very High	−1.832	0.89	−2.059	0.04	−3.576	−0.088	***
MentalPreparedness_Average preparedness	−0.931	0.291	−3.199	0.001	−1.501	−0.36	***
MentalPreparedness_Not prepared at all	−1.181	0.595	−1.986	0.047	−2.347	−0.015	***
MentalPreparedness_Prepared	−1.653	0.377	−4.387	0	−2.392	−0.915	***
Fintech_satisfaction_Highly satisfied	−1.309	0.763	−1.715	0.086	−2.805	0.187	
Fintech_satisfaction_I don't use fintech	−2.487	0.487	−5.107	0	−3.441	−1.533	***
Fintech_satisfaction_Neutral	0.47	0.291	1.616	0.106	−0.1	1.039	
Obstacle_geographic_location_High	−1.425	0.546	−2.609	0.009	−2.496	−0.355	***
Obstacle_geographic_location_Very high	−0.799	1.182	−0.676	0.499	−3.117	1.518	
Obstacle_geographic_location_Very low	1.045	0.421	2.484	0.013	0.22	1.87	***
Obstacle_confidence_in_technolog_Neutral	−0.704	0.254	−2.771	0.006	−1.202	−0.206	***
Obstacle_service_intuitiveness_High	−1.322	0.542	−2.44	0.015	−2.384	−0.26	***
Obstacle_service_intuitiveness_Low	−0.893	0.486	−1.838	0.066	−1.846	0.059	
Obstacle_service_intuitiveness_Neutral	−0.888	0.485	−1.832	0.067	−1.838	0.062	
Fintech_service_affordability_Highly affordable	1.383	1.229	1.125	0.26	−1.026	3.792	
Fintech_service_affordability_I don't know	−0.816	0.748	−1.091	0.275	−2.282	0.65	
Fintech_service_affordability_Not affordable	−0.6	0.311	−1.93	0.054	−1.21	0.009	

tests with low scores can prove to be fatal (Cook 2007; Jones and Athanasiou 2005). However, complex social phenomena are affected by a host of factors with possible interactions among them. Moreover, human behavior is involved in a target variable like fintech use. In these scenarios, an expected model AUC score

above 0.9 may not be warranted. In fact, Jagtiani and Lemieux (2017) deployed machine learning to evaluate the role of alternative datasets in fintech lending platforms with logistic regression analysis with AUC scores in the range of 58.74% to 68.88%. Higher AUC scores were achieved by Huang et al. (2020) with combinations of scorecards and the Random Forest model. Even in that case, the highest AUC score was 0.84.

7.4. Discussion

7.4.1. Theoretical Contribution

This chapter makes a number of theoretical contributions. First, we use a nationwide representative dataset which allowed us to consider demographic, socio-economic, and geographic variations in the target user base. Because of our large sample, constructed from rigorous stratified sampling, this study was able to investigate fintech adoption from a macro perspective. Previous studies employing machine learning on primary datasets have mostly worked with smaller sample sizes (Di Maggio et al. 2022; Hwang and Kim 2018; Mukherjee and Badr 2022; Sharma et al. 2021). Second, we use RFE on the original dataset containing 133 features in total. RFE is an automated feature elimination process based on model accuracy at each iteration. This allowed us the option of not having to specify a weighing scheme for domains of variables, thereby possibly avoiding researcher bias and/or limitations of existing theory. Third, previous work, for instance by Carlin et al. (2017), Ryu (2018), Chen (2021), showed there were differences across age and gender groups regarding fintech's implications and adoption. In fact, a large number of studies in the literature investigate fintech use, usage intention, and effect of fintech across demographic groups. Contrary to these findings, our model shows little evidence of any significant effect of demographic variables when it comes to fintech adoption. Instead, the main factors that determine fintech adoption are related to customer perception of risk, costliness, and obstacles, among other things.

Through Recursive Feature Elimination (RFE), we obtained 55 important features from the 133 fed into our model. These were used to estimate a logistic regression model with fintech use as the dependent variable. As shown in Table 7.3-4, of the 55 features selected, a total of 26 were found significant at the 5% level.

Interestingly, most of these are related to customer-reported levels of concern, obstacles faced, satisfaction, and costliness with fintech use. We also observe that almost none of the demographic and economic variables fed into the model turned out to be significant predictors of fintech use. In order of their presentation in our logit model table, we briefly look at what these variables are and what their coefficients indicate in terms of the relationship.

The only two features found significant from the demographic domain is "unemployed" as an occupation category and "traditional house" as a housing category of the respondent. Both of these variables have negative coefficients, indicating unemployed respondents were significantly less likely to use fintech services; and the use of fintech services was less prevalent in rural or semi-urban areas compared to urban areas in our survey. As expected, we observe that coefficients for mobile use and lack of access to the internet were both significant, with positive and negative signs respectively. Our survey collected data on customers' use of a wide range of fintech services. Broadly, they were either accessed through mobile phones (e.g., mobile banking and payment services) and through a computer or internet banking application (e.g., remittance, deposit payment scheme installments). Most were users of mobile fintech services. While mobile banking services in Bangladesh are accessible through mobile operators without direct access to the internet on the user's end, availing more sophisticated fintech services, e.g., utility bill payment and load disbursement, required accessing the internet through a smartphone. Hence, a negative and statistically significant coefficient for lack of internet makes sense in the context of our data.

After Recursive Feature Elimination (RFE), 21 features survived from the customer concern class. Given they amount to 38.18% of the total features included in the model, we conclude that reported customer concerns on various issues constitute a dominant part of the classification process. Of these 21 features, 14 were found to be significant at the 5% level. Overall, we observe that all statistically significant concern-related features, regardless of customers' reported levels on the Likert scale, were associated with negative coefficients. These concern features were related to "information secrecy", unknown issues", "limited government control" over emerging new fintech services and their operations with respect to customer welfare, "financial scandal" in fintech platforms, and "information security". In general, reported levels of "high" or "very high" concern on these issues were associated with larger negative coefficients. It is thus evident that

higher levels of concern were prominent predictors of fintech usage, albeit negatively. This evidence supports findings in extant literature. As an example, Chowdhury and Hussain (2022) observed that perceived security of the system exerts strong influence on users for fintech adoption.

Customers' reported mental preparedness was found to be a significant predictor. Interestingly, among three levels of mental preparedness found to be significant, the largest negative coefficient was found for customers who reported being "prepared" to use fintech services, followed by "not prepared at all". We explain this by noting that customers currently not using fintech services may have interpreted the question differently, thus overestimating mental preparedness for fintech use. Moreover, we observe that customers' perception of "geographic", "technological confidence" and "service intuitiveness" obstacles were significant predictors of fintech use. Customer feature of "very low" levels of reported geographic obstacles to fintech use was associated with a positive coefficient. Whereas, obstacle features related to "neutral" technological confidence and "high" service intuitiveness were associated with negatives. Indeed, Shareef et al. (2018) found evidence of the perceived ability to use a service to have a significant influence on mobile banking adoption. We expect consumers' confidence in dealing with technology-driven services to have a major influence on perceived ability, thereby affecting adoption. Our results support this conjecture.

7.4.2. Practical Implication

The main implication of our findings for fintech service providers and regulators is to focus on customer perception in driving fintech adoption. More precisely, the design of intervention programs should primarily be informed by customer perception of obstacles, mental preparedness, etc., and customer concerns on security, privacy, and financial fraud issues while using fintech platforms. More than the demographic and economic profile of the target audience, these perception variables significantly determine adoption of fintech across Bangladesh. This design recommendation is true for both commercial market campaigns, as well as government programs, to raise awareness and drive fintech use. Our insight can help fintech service providers expand their user base more effectively in Bangladesh.

Mobile financial services have taken a firm foothold in Bangladesh during the last decade. The network of agent banking has expanded into increasingly remote locations (Hossain and Hossain 2015; Islam and Salma 2016; Siddik 2014). Contrary to theoretical expectations, we find geographic obstacles constitute a significant predictor of fintech use in our study. To what extent is this due to proximity to physical agent banking and other financial services networks or due to social driving factors of new technology use can be an interesting area of further investigation. Indeed, there is a growing body of literature on facilitating conditions, perceived variables, expectancies, social effects, and personal factors contributing to mobile banking adoption and use (Islam et al. 2017). Some authors have also investigated the moderating effect of demographic variables on this relationship.

In addition, the respondent feature of a "high" level of satisfaction regarding fintech services exhibited lower negative but statistically significant coefficients compared to the respondent feature with no fintech use. Khan et al. (2021) found evidence of all dimensions of service quality connected to fintech satisfaction for customers in Bangladesh. In particular, the beta coefficient for responsiveness was strongest across dimensions, indicating service providers' responsiveness determines a large part of customer satisfaction for fintech in Bangladesh. When it comes to fintech service satisfaction, tangibility is a less significant factor (Khan et al. 2021).

Finally, service intuitiveness of the fintech product was found to be one of the significant obstacle features in our model. Azad (2016) used a neural network approach in investigating factors of adoption for mobile banking in Bangladesh. With robust 10-fold cross-validated findings, ease of use of the mobile banking service was observed as the most important factor behind mobile banking adoption. Our evidence supports this finding. In this study, a wide range of respondent ages was incorporated. For older users who have recently shifted to fintech products, service intuitiveness is an important factor for fintech use. Particularly for new and more targeted fintech services, ease of use can determine whether customers adopt these offerings. Considering a combination of all the significant features and their relationship with fintech use, we conclude that respondents with access to mobile, lower levels of reported concerns with fintech use, average mental preparedness to use fintech services, and low levels of perceived geographic obstacle to fintech use were more likely to use fintech

services. Conversely, respondents from semi-urban areas, high levels of reported concerns with fintech use, low levels of mental preparedness to use fintech services, high reported levels of technological confidence, and service intuitiveness obstacle were less likely to use fintech services in our dataset.

7.5. Concluding Remarks

To aid financial inclusion and financial resilience through innovative fintech solutions, understanding fintech adoption factors is important. The value of such insights is even more relevant for service providers and policymakers in an emerging economy like Bangladesh. Here, large parts of the population still remain unbanked or underbanked. We conducted a nationwide representative survey and collected data on a wide range of demographic, economic, and perceptual variables. We also collected data on technology use and banking activity. Our dataset also included respondents' fintech use and opinions related to concerns and obstacles faced.

Our binary logit model, estimated from selected features with fintech use as the dependent variable, yields important insights on contributing factors for the fintech user. We observe that fintech use is most prominently determined by customer security concerns and reported levels of obstacles faced with fintech use. Despite incorporating a wide range of demographic and economic variables, we find little evidence of the influence of these factors from our dataset. We suggested that on a macro level, fintech service providers, ecosystem enablers, and financial policymakers need to concentrate their efforts on addressing customer concerns and perceived obstacles. This can have, according to our findings, the biggest possible gain in facilitating wider adoption of customer-facing fintech services in Bangladesh, leading to greater access to financial services and better financial resilience of customers.

One of the key aspects of our study design was a nationwide representative sample covering a wide range of geographic, socio-economic, and demographic diversity. However, a central limitation of the study remains customer-reported data. Respondents were asked to rate their perception of mental preparedness, concerns, and perceived obstacles on Likert scales. The absence of an existing dataset makes independent validation of these ratings difficult. Moreover, due to using recursive feature elimination (RFE), the authors had no control over which

domains of variables get relatively higher importance in the feature selection process based on existing theory. Instead, the authors took a bottom-up approach and tried to connect the remaining features with implications thereof.

Future research can contribute in a number of ways. First, replication of our methodology for a comparable sample can be carried out in Bangladesh. In fact, the methodology can also be deployed in peer emerging markets experiencing a similar expansion in fintech adoption. They include Vietnam, Nigeria, Kenya, Pakistan, and Thailand, among others. Another area that future researchers can look into is the use of weighted methods where certain classes of variables can assume greater importance in the feature selection process. Future research may also delve deeper into effective ways to address customer concerns and perceived obstacles and assess the impact of such intervention on fintech adoption intention.

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8. Fintech and Sustainable Economic Growth

8.1. Introduction

The literature on development theory is rich, borrowing from several hundred years of economic philosophy among others. There are as many branches of the narrative as arguments within each. What has become apparent, however, is the inadequacy of economic growth as the all-encompassing end game for human societies to journey towards prosperity for their citizens. Development requires careful consideration of the interconnected systems of social interactions, environmental ecosystems, and political institutions (Henderson et al. 2011; Milenkovic et al. 2014). Indeed, a definite set of measurements for development policy has not been found yet. But any effort towards this goal invariably takes into account the multifaceted interdependencies. For example, Milenkovic et al., (2014) proposed a multivariate approach to assessing socioeconomic development. In fact, measuring development per se need not be limited to administrative and economic data as the advent of new technologies and attendant expansion of different measurement avenues allow for alternative and possibly more relevant measures of economic activities given a specific geographic area (Henderson et al. 2011). A case in point is a strand in the literature that relies on "remote sensing" data to measure and evaluate economic growth (Z. Chen et al. 2022; Gu et al. 2022; Keola et al. 2015; Yeh and Li 1997).

Climate change has undoubtedly shifted the narrative of development literature during the past two decades. This is not to say that the role of the physical environment was not deemed important prior to the realization of the sheer scale and severity of the consequences of climate change on human societies across the globe. In fact, the economic literature focused on development theory investigated the dynamics between natural resources and human social progress – Resources Curse Hypothesis (RCH) and Environmental Kuznets Curve (EKC) are two salient reminders (Milenkovic et al. 2014). However, more careful attention

has shifted to the underlying dynamics between humans and their physical environment within the context of social development and progress. Immediately, it has been realized that measurements play a crucial role in not only understanding the role of policy interventions to save the environment for the development of human societies – but also in taking corrective actions where needed. Bergh and Botzen (2018) show that replacing GDP with Human Development Index – a widely accepted composite measurement of human development measures – can turn the narrative upside down for developed countries in their efforts to reduce carbon emissions.

Across the world, communities face enormous challenges in economic, social, and environmental spheres (Flint 2013). Economic inequality is at a record high, the socio-political institutions once seeming to reach a stage of relative stability have emerged as institutions standing on shaking ground with the advent of technological and social upheaval at the turn of the century (Dixit and Weibull 2007; Orlikowski and Barley 2001; Prior 2013). The need for a development narrative that addresses these underlying issues has been felt more and more. Not only does development need to be representative and sustainable for future generations, but it also needs to account for the manifest complexities underlying social, economic, and political systems. In fact, the inability of frameworks to account for these complexities resulted in, during the earlier phase of the post-Brundtland literature on development and its sustainable form, contradictions in priorities and means of achieving equitable distribution of developmental benefits (Flint 2013; Parris and Kates 2003).

Fintech is poised to bring transformative changes by combining the power of digital technologies of the fourth industrial revolution (4IR) and innovative new financial services. With fintech, innovative financial solutions are delivered to users formerly either "unbanked" or "under-banked", thereby enabling communities to be financially included (Ahmad et al. 2020; Kim et al. 2018). Fintech promises financial inclusion, financial resilience, cost efficiency, better transparency, and much more (Alwi 2021; Arner et al. 2020; Beck 2020; Deng et al. 2019). Moreover, businesses can reach customers left out by traditional banks. For high-end customer segments too, fintech service providers are direct competitors of traditional banks and financial institutions. In fact, some of the more lucrative customer segments for fintech are also some of the most profitable ones for legacy financial institutions. Fintech emerged to challenge banks as the

Global Financial Crisis of 2008 reduced customer trust in legacy banks (Hansen 2014; Shim et al. 2013). Success in customer value generation today depends on fintech service providers "partnering" with legacy banking firms to create a win-win situation (Ernst & Young 2019b). Banks benefit from the technological innovativeness of fintech firms, whereas startups with fintech solutions can access certain market segments through banks without going through the full regime of regulatory and compliance hurdles.

Despite recent expansion in extant literature on fintech and its implication on communities and marginalized segments, there remains a paucity of empirical evidence of fintech supporting sustainable economic growth. Indeed, such investigation invariably faces the issues of measuring development per se and considering a wide range of factors in an integrated framework. Moreover, across the developing world, fintech is growing in scope and scale to bring financial services to the doorstep of individuals and communities who were previously unbanked or underbanked. Moreover, for conventional segments of the market, technology-enabled financial services allow for the dissemination of state-of-the-art products at fractions of cost. Provided fintech allows for the larger community to progress towards sustainable economic growth, policy intervention should aim for scalable penetration of fintech services. In fact, such interventions are informed by adequate empirical evidence in a cross-country setting. As a result, the need to search for cross-country evidence in support of fintech's contribution to sustainable economic development is felt.

This chapter aims to fill this gap in the literature. In investigating the relationship between fintech and sustainable economic growth, a two-step approach is taken to address the challenge of conceptual ambiguity and measurement complexity of "development". First, fintech's contribution to conventional economic growth is investigated. Second, fintech's effect on sustainable development indicators worldwide is established.

8.2. Data and Methods

This section provides an overview of the data and methods used to assess fintech's impact on sustainable economic growth. In investigating this impact, a three-step process is followed. A select number of case studies look at fintech and sustainable economic growth for a number of countries. Cases are also constructed

on fintech companies. The panel data model is estimated to establish fintech's effect on economic growth. This is followed by univariate analysis to investigate fintech and sustainability indicators.

8.2.1. Data

8.2.1 (a) Cases

The case studies under this chapter are constructed from publicly available data on fintech companies and ways they are changing the socio-economic status of target market segments and target communities across the world. Data were collected from various sources including, but not limited to, company websites, newspapers, magazines, regular publications focusing on fintech news, analyst reports, and market reports. The list of countries and companies included in the case analysis is given in the following table.

For country cases, three particular economies were considered: 1) India, 2) Indonesia, and 3) Kenya. India and Indonesia are both countries in Asia. In particular, India has a socio-economic and demographic markup very similar to Bangladesh. Indonesia on the other hand is ahead of Bangladesh in a number of areas including crude measures e.g., per capita income, balance of payments, etc. More importantly, India, Indonesia, and Kenya all have dynamic fintech ecosystems. Due to their shared socio-economic and development models and vibrant ecosystems, these countries were relevant in understanding the impact of fintech on sustainable economic growth in countries like Bangladesh.

In constructing cases on fintech companies with an impact, the four cases included in this chapter provide a diverse perspective on a range of fintech's impact on targeted segments e.g., on women's financial independence, access to credit for small business owners, transaction risk management for e-commerce businesses, and fintech solution for sustainable consumption and climate action. These are: 1) Ellevest, 2) CreditVidya, 3) Riskified, 4) Deedster.

8.2.1 (b) Panel Data

To estimate panel data regression model for investigating fintech's association with economic growth, data were collected from Bank for International Settlements (BIS) and World Development Indicator (WDI) from the World Bank. Three alternative measures of fintech growth included ATM transaction growth, debit card transaction growth, and credit card transaction

growth. The Committee on Payments and Market Infrastructures of the BIS accumulated country-level data from the payment systems of 26 member countries. The panel data regression is estimated with data for the period from 2013-2021 – the most recent years of data availability. However, the estimated panel for this chapter includes 22 countries (list provided in Appendix C). The United States, United Kingdom, Germany, and Hong Kong were excluded for the unavailability of country-year data for most variables used. Consequently, the panel included 22 countries for the period 2013-2021. Table 8.2-1 below provides a list of variables used and respective data sources.

Table 8.2-1 List of variables and data sources for panel data model

Variables	**Description**	**Unit Measurement**	**Data Source**
GDP	Gross domestic product growth rate	Annual % growth	WDI
Fintech variables			
ATM	Growth in cash withdrawals from Automated Teller Machines	Annual % growth	CPMI, BIS
Debit	Growth in transactions performed through cards with debit function	Annual % growth	CPMI, BIS
Credit	Growth in transactions performed through cards with credit function	Annual % growth	CPMI, BIS
Control variables			
Inflation	Consumer Price Inflation (CPI) Index inflation	Annual %	WDI
Life	Growth in average gender aggregated total life expectancy	Annual % growth	WDI
Education	Growth in allocation for education as a percentage of GDP	Annual % growth	WDI
Export	Growth in Export volume indexes are derived from UNCTAD's volume index series	Annual % growth	WDI
Import	Growth in Import volume indexes are derived from UNCTAD's volume index series	Annual % growth	WDI
Additional variables for Omitted variables bias test			
GCF	Growth in gross capital formation	Annual % growth	WDI
FDI	Growth in foreign direct investment	Annual % growth	WDI
RD	Growth in expenditures on research and development (R&D) as a percent of GDP	Annual % growth	WDI
Branch	Growth in number of bank branches within the jurisdiction	Annual % growth	WDI

8.2.1 (c) Univariate Analysis

To investigate fintech's impact with regard to sustainability, a series of univariate analyses were performed. These aim at assessing differing levels of growth in selected sustainable development indicators from the SDG 2030 framework across ranked as per growth in fintech variables. Two broad classes of variables were used: a) country-level fintech data for ranking, and b) country-level

sustainability indicators. Country-level fintech data were collected from Global Findex Dataset from the World Bank. On the other hand, Sustainable Development Report (formerly SDG Index and Dashboards) dataset from Sustainable Development Solutions Network of the United Nations provided country-level data on national progress on SDG 2030 index, goals, and indicators. Table 8.2-2 below provides a full list of both classes of variables and their measurements.

Table 8.2-2 List variables for univariate analysis

Variable Name	Description	Measurement
Ranking Variables		
DCRD	Debit card ownership, % of population aged 15+	Growth between 2014 and 2021
CCRD	CeBIT card ownership, % of population aged 15+	Growth between 2014 and 2021
MMNY	Mobile money account ownership, % of population aged 15+	Growth between 2014 and 2021
DGPM	Percentage of population made or received digital payments	Growth between 2014 and 2021
WAGC	Percentage of wage recipients received wages to card	Growth between 2014 and 2021
Development Indicators		
SDGI	SDG Index score	Growth between 2014 and 2021
Goal 1	Score on Goal 1	Growth between 2014 and 2021
Goal 5	Score on Goal 5	Growth between 2014 and 2021
Goal 8	Score on Goal 8	Growth between 2014 and 2021
Goal 9	Score on Goal 9	Growth between 2014 and 2021
Goal 11	Score on Goal 11	Growth between 2014 and 2021

8.2.2. Methods

Investigation of fintech's impact on sustainable economic growth in this chapter takes a two-step process. First, fintech's impact on economic growth per se is estimated. The fintech literature continues to grow with multiple facets – yet, empirical evidence in support of fintech's impact on economic growth in still inadequate. Panel data model in this chapter seeks to fill this void. In the next step, fintech's association with sustainable development is investigated. Importantly, a quantitative investigation of fintech's sustainable economic growth impact is complemented in this chapter with a few select cases. Three country-level cases and four fintech company-cases provide a better picture of how exactly fintech brings positive socio-economic opportunities for target market segments across economies.

8.2.2 (a) Cases

The selection of cases in this chapter follows two principles. First, for the country-cases peer nations of Bangladesh are selected. The overarching focus of this report is to investigate fintech ecosystems, its participants, and sustainable economic growth. However, this was to be done with special reference to Bangladesh. In other words, countries in a similar development stage as Bangladesh would deliver a more relevant picture of fintech's role in aiding sustainable economic growth. Second, for fintech company cases, business models with an explicit focus on social and economic impact were prioritized. Moreover, incumbent firms were preferred. In most of the developing world, inadequate banking infrastructure, large swaths of unbanked and underbanked populations, and lack of technological innovation mean unique challenges – as well as opportunities. Fintech startups play an important role in utilizing these and bringing innovative solutions for marginal customers.

Aggregate-level growth figures such as GDP and GNI provide only half of the entire picture. At the granular level, fintech seeks to bring more equality of access to financial products, thereby allowing formerly overlooked target segments to become financially independent and resilient. These phenomena are more difficult to reflect on than the more commonly used macro-level measurements. Consequently, quantitative investigation in a cross-country context is obstructed. Case-method on the other hand relies on the narrative method – and is not limited to statistical constraints. Subsequently, the "narratives" complement the quantitative well in this chapter.

8.2.2 (b) Panel Data Model

On the other hand, the quantitative investigation in this chapter is further divided into two sections. First, a panel regression is estimated. The base model is given below.

$$GDPij = \beta_0 + \beta_1 Fintech_{ij} + \beta_2 Inflation_{ij} + \beta_3 Life_{ij} + \beta_4 Education_{ij} + \beta_5 Export_{ij} + \beta_6 Import_{ij} + \mu_{ij} + \varepsilon_{ij}$$

Here, GDP growth is the dependent variable. The independent variable is fintech growth (with three alternative variables). Control variables include consumer price inflation rate, annual growth in total population life expectancy,

annual growth in the allocation of GDP to education, and annual growth in export and import volume index. After estimating base models, a number of possible statistical biases are addressed, and robustness is checked. Endogeneity concerns plague a surprisingly large number of panel data models across many disciplines. The problem is disproportionately higher in social science and business literature. Endogeneity in this chapter is addressed through use of instrumental variables. The three alternative variables used as predictors in the base models are instrumented and the model is re-estimated with instrumented variables.

Next, omitted variable bias is addressed through use of additional variables added to baseline models. Additional variables include gross capital formation growth, foreign direct investment growth, growth in research and development allocation, and growth in the number of branches of banks operating within a jurisdiction. These factors have an impact on determining economic growth. Lastly, the effect of outliers in the predictor variables is addressed. Often, extreme outliers in the predictor skew estimates significantly. This can lead to misspecification of model and provide evidence of association that is statistically significant whereas there is none. This chapter addresses outlier bias with winsoziation technique. Winsorizing a variable involves replacing extreme outliers beyond pre-specified percentile cutoffs with these cutoff values. This provides superior results compared to the simple exclusion of outlier instances.

8.2.2 (c) Univariate Analysis

The relationship between fintech and sustainable development indicators is assessed through univariate analysis methods in this chapter. Countries are ranked on a number of fintech variables into four groups. Top quartile consists of best-performing countries in terms of these fintech growth variables. The second, third, and bottom quartiles consist of progressively lower-performing countries. As listed in table x above, these rankings are performed on the basis of five fintech variable growth: 1) debit card ownership, 2) credit card ownership, 3) mobile money account ownership, 4) digital payments, and 5) receipt of wages to cards. The univariate analysis then investigates average growth rates in sustainable development indicators across the four quartiles of countries. This chapter incorporated five measures of sustainable development indicators from the SDSN dataset as mentioned in table x above: 1) SDG index score, 2) Goal 1 score: no

poverty, 3) Goal 5 score: gender equality, 4) Goal 8 score: decent work and economic growth, 5) Goal 9 score: industry, innovation, and infrastructure. These indicators are selected specifically for their relationship with sustainable economic growth. Growth rates are both classes of variables – for quartile ranking and average growth in sustainable development indicators – are calculated between 2014 and 2021.

Across the four quartiles of countries, based on all five fintech growth variables for ranking, average growth in sustainable development indicators is calculated. T-test, Z-test are performed for equality between average growth in sustainable development indicators between the top and bottom quartiles of countries. F-test for one-way ANOVA is performed for equality across groups i.e., all four quartiles of countries. If fintech does play a role in promoting sustainable economic growth, a positive can be expected of top quartile average growth rates over those at the bottom quartile. Moreover, this difference should be statistically significant. This should provide strong cross-country empirical evidence of the association of fintech with sustainable economic growth. Put simply, countries that experienced the highest growth in fintech also experienced considerably higher growth in the selected sustainable development parameters (and vice-versa). Notably, this univariate analysis is conducted at two levels. First, the analysis is performed for all countries. Second, the analysis is performed only for lower middle-income countries (LMIC) as per the World Bank classification. This group is, in fact, colloquially, referred to as "developing economies". Bangladesh is included in this list in particular.

An advantage of the univariate analysis is non-assumption of linearity of the relationship between fintech growth and growth across the selected sustainable development parameters. Moreover, the inclusion of a large number of countries in the first part allows for heterogenous cross-country evidence of fintech's association with sustainable economic growth. On the other hand, univariate analysis for LMIC countries only provides more relevant empirical evidence of sustainable economic growth for Bangladesh – as well as developing countries.

8.3. Selected Cases on Fintech's Impact

8.3.1. Country Cases

8.3.1 (a) India

It is no secret that India's banking, payments, wealth management, insurance, and lending sectors have all been revolutionized by fintech (the delivery of financial services through technology). The need to provide affordable and accessible financial products to a large and diverse population, particularly those who are underserved or unbanked by traditional institutions, is one of the primary drivers of fintech innovation in India. Furthermore, fintech may aid in achieving sustainable development targets by providing novel approaches to vexing social and environmental problems.

Robo-advisory is one of India's emerging fintech trends. Robo-advisory is a form of automated investment management that employs algorithms and artificial intelligence to provide personalized investment advice and portfolio allocation based on a client's risk profile, goals, and preferences. According to a report by Inc42 DataLabs, the Indian robo-advisory market is expected to reach $53.9 billion by 2025, with a compound annual growth rate of 43 percent (Dayalani 2021). Scripbox, Kuvera, Zerodha, Groww, and Upstox are among the notable startups that are shaping the robo-advisory industry in India (Alam 2022).

AI investment is another trend gaining momentum in India's fintech sector. AI investment refers to the use of AI tools such as machine learning, natural language processing, computer vision, and deep learning to improve aspects of investing including data analysis, decision-making, risk management, fraud detection, and customer service. Sqrrl, Smallcase, Clearfunds, Wealthy.in, and Arthayantia are examples of Indian startups that utilize AI-based investment technologies.

In India, fintech innovations have also disrupted the domain of wealth management. Using digital platforms, data analytics, artificial intelligence, and blockchain technologies, fintech has made wealth management services more accessible, affordable, transparent, and personalized. According to a report by Boston Consulting Group and FICCI, India's fintech sector is poised to reach a valuation of $150-160 billion by 2025, implying a $100 billion opportunity for value creation (PwC 2021). Paytm Money, ET Money, Moneyfront, Finpeg, and

Goalwise are examples of startups that offer innovative wealth management services in India (Aggarwal 2022).

By providing products that promote social and environmental well-being, fintech business models can also support India's sustainable development goals. There is an increasing number of examples of fintech products promoting sustainable development in India (The Economic Times 2021). For example, Aye Finance seeks to make a good social effect by aiding MSMEs with job development, income growth, and female empowerment. Aye Finance aims to have a positive social impact by assisting MSMEs with job creation, income generation, and women's empowerment.

Similarly, Kaleidofin is a fintech platform that provides low-income households and informal sector workers with customized financial solutions. Kaleidofin provides customers with goal-based savings, insurance, and investment products by leveraging data analytics, behavioral nudges, and partnerships with financial institutions.

GramCover is a fintech startup that provides rural India with insurance solutions. GramCover utilizes technology to bridge the gap between insurance providers and rural customers, who frequently face obstacles including lack of awareness, access, and affordability. GramCover provides crop, livestock, health, and auto insurance products tailored to the risks and requirements of rural communities.

Indeed, fintech is rapidly transforming the financial sector in India by providing affordable and accessible financial products to a large and diverse population, particularly those who are underserved or unbanked by traditional institutions. With the emergence of robo-advisory, AI investment, and innovative wealth management services, Indian startups are revolutionizing the way individuals invest and manage their finances. Furthermore, fintech has the potential to contribute significantly to India's sustainable development goals by addressing social and environmental challenges with innovative solutions. As the fintech sector continues to grow and evolve, it is poised to have a significant impact on India's economy and society in the years to come.

8.3.1 (b) Indonesia

The future of finance and sustainable development in Indonesia is changing thanks to fintech, and the application of digital technology to financial services

(Feyen et al. 2023). Indonesia is one of Southeast Asia's largest and fastest-growing fintech markets, with more than 270 million people and a digital economy worth $44 billion in 2020. There are more than 200 million internet users and 160 million smartphone users in the country, creating a tremendous opportunity for fintech adoption (Clynch 2022).

Micro, small, and medium-sized businesses are one of the key segments fintech can serve in Indonesia (MSMEs). MSMEs account for more than 60 percent of the gross domestic product and employ more than 97 percent of the labor force (Shu 2021). However, they face numerous obstacles, such as a lack of access to formal credit, high interest rates, complex regulations, low financial literacy, and limited digital infrastructure. By providing innovative solutions such as peer-to-peer (P2P) lending platforms, digital payment systems, e-commerce platforms, accounting software, online marketplaces, and data analytics tools, fintech can assist MSMEs in overcoming these obstacles (Aryusmar 2020; Caisar Darma et al. 2020; Florene 2021).

BukuWarung, Modalku, and Tokopedia are examples of fintech startups that are shaping the MSME landscape in Indonesia. BukuWarung is a digital accounting application that allows SMBs to monitor their cash flow, invoices, and payments. In addition, it provides credit scores and access to loans from lender partners. Modalku is a P2P lending platform that connects micro, small, and medium-sized enterprise (MSME) borrowers with individual or institutional lenders. It offers loans between $200 and $300,000 with annual interest rates beginning at 12%. Tokopedia is an e-commerce platform that enables Indonesian SMBs to sell their products to millions of online customers. It also provides logistics support, payment solutions, official stores, instant commerce, interactive commerce, and rural commerce, among other features. Tokopedia has raised $18 billion from investors including Alibaba, SoftBank, and Google.

In various ways, fintech services in Indonesia are transforming the lives of customers and businesses. They provide access to convenient and affordable financial products that can increase income and welfare. They generate new opportunities for entrepreneurship, innovation, and the creation of new jobs. They promote financial literacy and inclusion among underserved segments of society. In addition, they support sustainable development objectives including poverty reduction, gender equality, climate action, and social justice.

Utilizing artificial intelligence, big data, cloud computing, and blockchain to improve customer experience, risk management, fraud detection, and operational efficiency are among the technologies and business models that are assisting in achieving this transformation. Adopting mobile-first, customer-centric, and platform-based strategies takes advantage of network effects, economies of scale, and cross-selling opportunities (Global Legal Group 2022; Law 2021).

Indonesia's regulators and policymakers play a crucial role in fostering an environment conducive to fintech innovation and growth. Bank Indonesia (BI) and the Financial Services Authority (OJK) are the primary regulators of fintech in Indonesia (Law 2021). They oversee various aspects of fintech, including payment systems, lending platforms, digital banking, and consumer protection. In Indonesia, fintech is reshaping the future of finance and sustainable development, creating new opportunities and transforming the lives of millions of people (Law 2021).

As these examples suggest, the fintech industry is rapidly altering the financial landscape of Indonesia, particularly among micro, small, and medium-sized businesses. Due to the country's large population, expanding digital economy, and widespread use of smartphones and the internet, fintech represents a tremendous opportunity for financial inclusion and economic growth. Fintech startups such as BukuWarung, Modalku, and Tokopedia have leveraged innovative technologies and business models to provide affordable and convenient financial products, while also fostering entrepreneurship and job creation and advancing sustainable development objectives. Collaboration between regulators, policymakers, and stakeholders is essential for fostering an environment conducive to fintech innovation and expansion. Fintech is shaping the future of finance and sustainable development in Indonesia, creating new opportunities and transforming the lives of millions of individuals.

8.3.1 (c) Kenya

Millions of unbanked and underbanked individuals are now able to access formal financial services such as savings, credit, insurance, and pensions, thanks to the revolutionary impact of fintech on the financial industry (TechArena 2022). According to the World Bank, 82.9% of adults in Kenya had access to formal financial services in 2019 due to the success of fintech in improving financial inclusion rates.

M-Pesa, launched by Safaricom in 2007, is the most popular mobile money service in Kenya, with over 40 million active users and over 11 billion transactions processed annually as of 2021. Mobile money is one of the most successful fintech innovations in Kenya. Mobile money services have emerged as a major driver of financial inclusion in Kenya, particularly among low-income earners and rural populations who lack access to conventional banking. Mobile money services such as Tigo Pesa and Airtel Money in Tanzania, MTN Mobile Money and Airtel Money in Uganda, and others across Africa are helping to increase the rate of financial inclusion which is essential for economic growth (Chitavi et al. 2021).

Peer-to-peer (P2P) lending is yet another fintech innovation transforming the Kenyan financial sector. Without the need for traditional financial institutions such as banks, P2P lending platforms connect borrowers and lenders. P2P lending is especially advantageous for small business owners and individuals who may not be eligible for loans from conventional financial institutions. Several P2P lending platforms, including Pezesha, Branch, and Tala, have emerged in Kenya. These platforms assess the creditworthiness of borrowers and determine the interest rates that should be charged by lenders using algorithms. Pezesha has provided more than KSH 2 billion ($18 million) in loans to small businesses and individuals in Kenya as of 2021.

In Kenya's financial sector, blockchain technology is also gaining traction. Blockchain is a digital ledger that securely and transparently records transactions. It has the potential to revolutionize numerous facets of the financial industry, such as payments, settlements, and record-keeping. In Kenya, multiple blockchain-based projects are underway, including BitPesa, a blockchain-based payment platform that enables cross-border transactions. BitPesa has partnered with several African banks to expedite and reduce the cost of cross-border payments, a necessity for businesses that operate internationally.

Insurtech is an additional fintech innovation that is transforming Kenya's financial sector. Insurtech refers to the use of technology to improve the efficiency and accessibility of insurance services. In Kenya, several insurtech startups have emerged, including BimaAfya, GrassRoots Bima, and Bluewave Insurance. These startups use mobile phone technology to deliver insurance services to low-income earners and rural populations who have been traditionally excluded from the insurance market. Fintech has had a profound impact on the financial industry in Kenya. Mobile money, P2P lending, blockchain, and insurtech are just a few

examples of how fintech is improving financial inclusion and driving economic growth in Kenya. With the emergence of more fintech innovations, Kenya's financial industry is likely to continue evolving and transforming in exciting new ways.

In Kenya, fintech has played a vital role in enhancing financial inclusion in Kenya, allowing millions of unbanked and underbanked individuals access to formal financial services. Mobile money, peer-to-peer lending, blockchain, and insurtech have all significantly contributed to this development. As more fintech innovations emerge, Kenya's financial industry will likely continue to evolve and transform, fostering further economic expansion and enhancing financial inclusion.

8.3.2. Fintech Firms

8.3.2 (a) Ellevest

Ellevest is an investment platform and financial literacy program built by women, for women, but open to all. Research conducted by the Boston Consulting Group in 2016 suggests that 71% of women are dissatisfied with the services offered by their financial institutions (Desjardins 2019). Sensing a business opportunity in this lack of gender-sensitive financial services, Ellevest started its journey with an aim to provide women with their own investing platform and give them access to an innovative and cost-effective investment service as an alternative to traditional Wall Street firms. Founded in 2014, this New York City-based company has played a transformational role in removing the gender gap in the investment sector by creating a specially tailored investment experience to cater to women's needs and help them meet their financial goals. Ellevest distinguishes itself from other digital advisors with its unique investing algorithm that factors in women's pay gaps, longer life spans, and more frequent career breaks. Besides, one can also avail services from a human advisor at a minimal cost. Ellevest addresses the challenges women face when investing through traditional firms, such as-women being stereotyped as risk-averse, lack of financial literacy, not getting the same attention and consideration from financial advisors as their male counterparts. Ellevest's investment model doesn't factor in the risk appetite of the investors, rather it focuses on goal and value-based investing.

Ellevest has been catering to the needs of women through its diverse service portfolio including financial advice, unique investment strategy to address the

challenges women face while investing through traditional platforms, financial literacy programs featuring expert advice and coaching, private wealth management, etc. Ellevest enables women to not only invest and transform their lives but also create a positive impact in society. Keeping the interests of its investors in promoting sustainability and undertaking social responsibility, Ellevest has expanded its service portfolio to create a positive impact. Its socially responsible portfolio options allow clients to invest in impact portfolios, which comprise 53% of the portfolio in ESG and impact funds (Benson 2023).

In 2022, it launched the Ellevest Climate-Conscious Impact Strategy. Under this program, it has introduced an environmentally focused public equity portfolio — by actively screening out companies whose business practices don't meet its standards for environmental stewardship, thus enabling women to invest in companies that have noticeably committed to environmental sustainability. Ellevest is also promoting diversity in its employer base with 84% women and 50% people of color in leadership teams, in contrast to 23% and 11% industry averages respectively. Ellevest is pioneering the change within the financial services industry by promoting gender parity and impact or value-based investing. With the emergence of Ellevest, the financial services industry has finally come to realize the importance of gender-sensitive investment models and views women as a target segment.

8.3.2 (b) CreditVidya

CreditVidya is an alternative credit rating fintech platform based in Hyderabad and Mumbai, India that offers lending-as-a-service. It started in 2012 with a mission to create a world where everyone has access to affordable credit. CreditVidya amalgamates artificial intelligence (AI) and machine learning (ML) models to assess the creditworthiness of loan applicants and their intent to repay loans by leveraging payment data, financial behavioral data, and device data stored on smartphones. Its alternative and superior method of credit underwriting helps lenders process loan applications with cost-effectiveness and increased profitability, while it helps underserved people access institutional credit at the same time. Since working with CreditVidya, lending partners—which include 55 leading banks and non-banking financial institutions in India—have seen loan approval rates increase by 25 percent and delinquency rates decrease by 33 percent (AWS 2021).

Conventional credit underwriting focuses on a limited number of data points such as bureau scores, bureau reports that consider various aspects of credit such as the credit utilization ratio of a credit card and valid information submitted by the loan applicant. Unfortunately, credit bureaus cover just 20% of the adult population in India, thus depriving a large segment of the population of accessing reasonably priced credit. CreditVidya's AI and ML-based platform named Medhas solves this issue by continuously optimizing the parameters for scoring applicants' creditworthiness based on a large number of data points. It offers SDKs (Software Development Kits) which are integrated into the lenders' app, and analyses around 10,000 data points gathered from the applicants' commercial SMSs, including utility bill payments, e-commerce purchases, other financial transactions, and phone-related location data to provide a more accurate assessment of the applicants' credit risk profile. CreditVidya's credit underwriting can be applied to a whole range of applicants comprising new-to-credit, thin-file, and old-to-credit. To value the applicants' privacy and data security, CreditVidya has designed its data collection framework to be consent-driven and privacy-preserving by ensuring multi-factor authentication, periodic vulnerability assessments, and a robust threat detection system. From enabling small business owners to expand their businesses, to helping single mothers pay the tuition fees of their children, to creating job opportunities for many by providing them access to small loans for buying digital devices, CreditVidya has come a long way to make a difference in the community by harnessing the power of technology. Today, scores of people in India can have access to formal loans who were previously deemed ineligible owing to low credit scores, thus safeguarding them from the hassle of high-risk loans from informal lenders. Similarly, it safeguards the lenders against the risk of default loans, allowing them to extend credit to the marginalized population of India. A case study revealed that default risk was lowered by 33% at the same level of approval.

CreditVidya has set an example in the fintech industry by developing a tech-driven, cost-effective, and efficient credit underwriting framework and by utilizing the power of technology to promote an inclusive loan market in India, expanding the service to over 250 million previously financially excluded citizens (AWS 2021).

8.3.2 (c) Riskified

Riskified is a SaaS (software as a service) company that works with e-commerce companies as fraud management partners, utilizing a machine learning platform driven by a global merchant network, a 100% chargeback guarantee in the event of fraud, and premium partnership models to eventually reduce fraud and increase net revenue. This online risk management platform currently has 400 million shoppers in 180+ countries on its platform. Besides its robust guaranteed chargeback product, Riskified has developed a holistic portfolio of solutions to safeguard and support online retailers throughout their customer lifecycle, helping them to increase sales and customer satisfaction. Its “policy protects” program helps to prevent customers from abusing store policies unfairly, allowing retailers to increase their profit margin by cutting costs. Its “account secure” program helps to block unwanted ATOs (authorization to operate) from compromising the shoppers’ store accounts.

Partnering with Riskified allows companies to worry less about fraud and focus more on revenue-generating opportunities. Its quick and frictionless fraud review system enables companies to make swift decisions, streamline their operations, and drive e-commerce sales by approving orders that would otherwise be declined. Retailers are increasingly choosing to outsource their fraud management to Riskified owing to its powerful fraud detection model. Riskified’s powerful behavioral analysis models can accurately detect e-commerce fraud and identify good customers. Its self-optimizing machine-learning models are trained to link historical transaction data in its entire ecosystem with new orders to deliver accurate decisions. Retailers can have full insight into Riskified's decisions and can monitor its performance and track the KPIs (key performance indicators) in real time. The entire risk analysis and authentication process is invisible to the customers, ensuring that their shopping experience is uninterrupted and hassle-free. Retailers can control how to leverage the Riskified platform by pinning down specific orders, or by filtering orders on the basis of parameters like geographies, volume, payment methods, and more. In the constantly evolving world of e-commerce fraud, Riskified has helped e-commerce companies to safeguard against such fraud, increase their net revenue, maintain good relations with their customers, and advance their businesses in the process. Riskified has come a long way to ensure a safe and secure cyber-environment for e-commerce companies to ensure these companies can grow sustainably.

8.3.2 (d) Deedster

Deedster was founded by Anders Åkerlund, Daniel Dellham, Monika Martinsson, and Niclas Persson in 2016 with the motto "We need a new attitude in caring for our planet and a change in attitude starts with a change in behavior" (Deedster.com, 2020) This Swedish app aims to provide a digital platform for guiding sustainable consumption, especially in banks and financial institutions. Its goal is to engage in climate impact by promoting SDGs (Sustainable Development Goals) 12 and 13, namely sustainable production and consumption and climate action respectively. Deedster is a digital platform that calculates one's carbon footprint depending on one's consumption and way of living. It allows the users to compare their personal CO2 footprint with the average footprint of people living in different countries such as Sweden (8.1 tons CO2/year) so that users can understand their impact on the environment. The mobile app encourages people to lessen their environmental impact through advice and challenges presented in a gamified fashion. The Deedster app helps users approach sustainability in three ways. First is awareness or the footprint calculator—it helps to calculate carbon footprint based on consumption patterns. The second is knowledge or the quiz—this is the gamified part of Deedster where users get to answer numerous climate and sustainability-related multiple-choice questions in every step of the game. The third is the action or the deeds—this suggests deeds or actions that a user can perform to promote sustainability based on his user profile. It offers customers personalized suggestions on reducing their carbon footprints and introducing environment-friendly habits in their daily lives according to their consumption profile.

"Deedster retail" is a service aimed at banks and financial institutions that helps them to participate in climate action by integrating climate data and tools on their digital platforms. It also helps to add climate to Personal Finance Management (PFM) and progress toward sustainability and a greener lifestyle. Deedstar Retail's data security system has been prepared by taking the high standards of the bank into consideration. It helps banks to be more cost-effective and to attract more customers, especially GenZ and millennial clients who are interested in sustainability. For instance, SEB in the Baltics collaborated with Deedster to integrate sustainability into its banking offerings by enabling its clients to get an insight into their carbon footprint from their spending habits and suggesting innovative ways to reduce it in a fun and engaging way. Similarly,

“Deedstar at Work” tries to enhance employee engagement in sustainable behavior at an organization. Deedster has also launched various campaigns from time to time to raise awareness among the public such as the First Earth Hour Challenge, where participants completed 48000 climate actions avoiding 256 tonnes of CO2, or the Veguary challenge, where users were motivated to eat vegetarian for the month of January 2020.

Deedster has established itself as an impact-driven fintech company that enables the shift to more sustainable production and consumption practices by developing tools and technical solutions that engage retail customers, employees, and individuals in taking climate action.

8.4. Panel Data Estimates

8.4.1. Baseline Results

Below in Table 8.4-1 estimation results for the baseline model are presented. Columns 1, 2, and 3 contain results with ATM cash withdrawal growth (ATM), debit card transaction growth (Debit), and credit card transaction growth (Credit) as predictors respectively. All three baseline estimates include the five control variables i.e., annual consumer price index inflation rate, annual growth in total population life expectancy, annual growth in allocation to education as a percentage of GDP, annual growth in export volume index, and annual growth in import volume index. The table lists co-efficient values, standard errors in parentheses, and p-value significance.

As is observed from the table, controlling for the five factors across countries, ATM and Debit are found to be positively associated with GDP growth ($p<0.01$) for the period under consideration. Credit is not found to be significantly associated with GDP growth during the same period. Hence, ATM and Debit are observed to positively influence GDP growth.

Table 8.4-1 Baseline results from panel data estimation (random-effects model)

	(1)	(2)	(3)
ATM	**.056 (.015)*** **		
Debit		**.05 (.015)*** **	
Credit			**.006 (.004)**
Inflation	-.137 (.041)***	-.136 (.043)***	-.094 (.039)**
Life	2.043 (.233)***	2.065 (.236)***	2.02 (.234)***
Education	.111 (.043)***	.124 (.043)***	.119 (.041)***
Export	-.017 (.021)	-.014 (.022)	-.015 (.021)
Import	.073 (.021)***	.076 (.022)***	.076 (.022)***
_cons	.019 (.004)***	.012 (.004)***	.019 (.004)***
Observations	156	156	137

*Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

8.4.2. Addressing Endogeneity

One of the principal concerns in non-experimental research design is endogeneity problem. Endogeneity problem arises when the independent variable is correlated with the error term in the model. In other words, the predictor variable in that case is endogenous – being influenced by another variable that is determining it. In social sciences and business research where many studies depend on non-experimental research design endogeneity is often unaddressed – leading to biased estimates. In fact, a surprising number of studies in the field in recent past have failed to account for endogeneity. The presence of an endogeneity problem yields sub-optimal estimation results. In worse cases, it results in misguided policy guidance. In fact, model results not addressed for possible endogeneity problem cannot be included in recommending policy support in any case.

One of the common ways possible endogeneity is addressed is through the use of instrumental variables. The two-stage-least-square (2SLS) method first explains the predictor variable(s) (ATM, Debit, Credit) as a function of the exogenous variable. Incidentally, the exogenous variable should be selected based on their theoretical relationship with the endogenous variable and non-significant relationship with the dependent variable of the model. This first-stage regression model is then used to determine residuals. Residuals of the first stage regression then is used as instrumented predictor variables in the second stage and the model is re-estimated. For panel data, Stata 13.0 provides this functionality through the xtivreg2 package.

Annual growth in number of ATM machines within the country is taken as exogenous for ATM cash withdrawal growth in the baseline model. Growth in cash withdrawal in ATM machines should be positively affected by the growth in machines available within the country. Moreover, for debit card transaction growth and credit card transaction growth, the exogenous variable is growth in the number of mobile subscribers. Point-of-Sale (POS) terminals account for a major portion of debit and credit card transactions, particularly in the developing world. Moreover, ownership and use of cards for financial transactions presuppose minimum network connectivity. Mobile subscriber growth is expected to be a balanced overall proxy in both cases. Table 8.4-2 below shows estimated results from using instrumented variables.

Table 8.4-2 Results from baseline model with instrumented predictor variables (2SLS)

	(1)	(2)	(3)
ATM_instrumented	**.24 (.068)*** **		
Debit_instrumented		**.177 (.055)*** **	
Credit_instrumented			**.398 (.651)**
Inflation	-.315 (.084)***	-.277 (.077)***	-.502 (.757)
Life	1.379 (.401)***	1.803 (.298)***	.326 (3.383)
Education	.078 (.062)	.113 (.051)**	-.03 (.435)
Export	.007 (.032)	.001 (.026)	-.003 (.179)
Import	.031 (.034)	.049 (.029)*	-.169 (.449)
_cons	.019 (.005)***	-.003 (.009)	-.019 (.064)
Observations	154	156	137

*Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

Columns 1, 2, and 3 list estimation results with instrumented ATM, Debit, and Credit variables respectively. All control variables are included. The table shows co-efficient values, standard errors in parentheses, and p-value significance. The effect of instrumented ATMs and Debit on GDP growth is positive and statistically significant ($p<0.01$). The relationship between GDP growth and instrumented Credit is positive and non-significant. These results correspond to the earlier baseline model results.

8.4.3. Addressing Omitted Variable Bias

The exclusion of variables that significantly explain variations in the dependent variable can bias model results to the point of misguided findings. To address such omitted variable bias, baseline models here are re-estimated by including four theoretically justified additional variables. This process is followed for all three alternative predictor variables in the baseline model.

Table 8.4-3 below shows results for ATM and provides co-efficient values, standard errors in parentheses, and p-value significance. Columns 1 through 4 provide model results with gross capital formation growth, foreign direct investment growth, research and development allocation growth, number of bank branches growth added to the baseline model, in that order. Column 5 shows results with all four additional variables added simultaneously. In all five cases, ATM is positively associated with GDP growth and this relationship is significant. Table 8.4-4, similarly, shows model results for Debit. Again, Debit is found to be positively associated with GDP growth with statistical significance. Results for Credit were non-significant.

8.4.4. Addressing Outliers

Outliers can bias model estimates to a large extent. In cases of extreme outliers, model results can be affected to the point of misguided results and misinformed policy recommendations. Statistically, outliers can be treated in a number of ways e.g., exclusion of extreme outlier values, normalization of model variables, etc. For the current modeling purposes, winsorization of the predictor variable was used. In winsorization, variable cut-off points are selected (often 1st and 99th percentiles). Values outside of cutoff points on both sides of the distribution are then replaced by the respective cutoff values in each direction. For all three alternative variables of fintech growth in this chapter, winsorization was performed at the 1st and 99th, and at the 5th and 95th percentiles. Table 8.4-5 and Table 8.4-6 below show model results with ATM and Debit as explanatory variables respectively. The tables show results for ATM/Debit and provide co-efficient values, standard errors in parentheses, and p-value significance. It is noted that ATM and Debit, after accounting for outliers, still exhibit a positive relationship with GDP growth and with statistical significance ($p<0.01$ and $0<0.05$ respectively). Similar results were obtained for Credit but the association was not significant. Results for Credit are suppressed here for brevity.

Table 8.4-3 Baseline model with additional variables for OVB test - ATM

	(1)	(2)	(3)	(4)	(5)
ATM	**.03367 (.01392)****	**.0571 (.01565)*****	**.05164(.01621)*****	**.0538(.01689)*****	**.03796(.0154)****
Inflation	-.07952(.04017)**	-.13576(.03973)***	-.1011(.04113)**	-.12549(.04028)***	-.03228(.03565)
Life	1.74782(.23239)***	2.0496(.23831)***	1.83005(.24965)***	2.00352(.24142)***	1.31383(.2448)***
Education	.10197(.03826)***	.11064(.04396)**	.12918(.05401)**	.11276(.04415)**	.10146(.04801)**
Export	.03172(.02113)	-.01461(.02199)	-.02638(.02938)	-.01816(.02223)	.02473(.03096)
Import	-.0084(.02353)	.07189(.02196)***	.07448(.02611)***	.0764(.02263)***	-.00421(.02961)
GCF	.1782(.03046)***				.20939(.03306)***
FDI		-.00006(.00004)			-.00003(.00003)
RD			-.00325(.00778)		-.01066(.02089)
Branch				.00527(.01684)	.01008(.01425)
_cons	.01429(.00425)***	.01928(.00353)***	.01947(.00379)***	.01677(.00358)***	.01068(.00311)***
Observations	132	156	138	148	111

*Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

Table 8.4-4 Baseline model with additional variables for OVB test - Debit

	(1)	(2)	(3)	(4)	(5)
Debit	**.02662(.01431)***	**.04333(.01595)*****	**.04621(.01631)*****	**.04922(.01548)*****	**.04017(.0142)*****
Inflation	-.06545(.04033)	-.12957(.04336)***	-.0996(.04295)**	-.12926(.04078)***	-.04361(.03313)
Life	1.71932(.23601)***	2.09702(.23995)***	1.90343(.25301)***	2.04948(.2455)***	1.19819(.27434)***
Education	.10917(.03858)***	.12044(.0436)***	.13591(.05548)**	.12337(.04465)***	.09157(.05515)*
Export	.03325(.02165)	-.01784(.02224)	-.02222(.03032)	-.01253(.02261)	.04622(.03169)
Import	-.00647(.02431)	.07527(.02279)***	.08002(.02765)***	.07564(.02331)***	-.01898(.03102)
GCF	.19437(.03162)***				.24076(.03581)***
FDI		-.00005(.00004)			-.00004(.00004)
RD			-.00102(.00448)		-.00024(.00378)
Branch				.00556(.01706)	.02025(.0156)
_cons	.00816(.00426)*	.01248(.00454)***	.01186(.00417)***	.0116(.00374)***	.00501(.00306)
Observations	124	148	135	156	108

*Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

Table 8.4-5 Model results with Winsorized predictor - ATM

	1st and 99th Percentile	5th and 95th Percentile
ATM	**.05539(.01912)*** **	**.08456(.02493)*** **
Inflation	-.04425(.0357)	-.04676(.0343)
Life	1.27291(.24417)***	1.21661(.24351)***
Education	.09842(.04807)**	.09289(.048)*
Export	.031(.031)	.03338(.03067)
Import	-.01121(.02976)	-.01378(.02945)
GCF	.21099(.03292)***	.21473(.03268)***
FDI	-.00003(.00003)	-.00004(.00003)
RD	-.00533(.02101)	-.00363(.02069)
Branch	.01203(.0142)	.01265(.0141)
_cons	.01029(.00301)***	.00951(.00293)***
Observations	111	111

*Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

Table 8.4-6 Model results with Winsorized predictor - Debit

	1st and 99th Percentile	5th and 95th Percentile
Debit	**.04371(.01909)** **	**.05278(.02122)** **
Inflation	-.04243(.03511)	-.04384(.03424)
Life	1.23277(.2782)***	1.23701(.27707)***
Education	.08981(.05654)	.08922(.05673)
Export	.05168(.03286)	.05494(.0331)*
Import	-.02457(.03213)	-.02612(.03227)
GCF	.24248(.0365)***	.24192(.03654)***
FDI	-.00004(.00004)	-.00004(.00004)
RD	-.00017(.00383)	-.00001(.00381)
Branch	.02106(.0159)	.02093(.01594)
_cons	.00451(.00351)	.00321(.00371)
Observations	108	108

*Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

8.5. Results from Univariate Analysis

In the following sections, univariate analysis results are presented for selected sustainable development parameters. Each table consists of two panels: all countries and LMIC countries only. All-countries univariate results show fintech's association with sustainable development parameters across all countries around the world (as per data availability). On the other hand, the same set of results are also presented in the lower panel of each table for LMIC countries only.

8.5.1. Fintech and SDG Index

The combined SDG Index incorporates all 17 goals under SDG 2030 agenda. Country-level SDG Index scores are thus a balanced overall representation of sustainable development for that country during the period considered. Table 8.5-1 below shows univariate results for SDG index. For all counties (in Panel A) with the exception of mobile money account ownership (MMNY), in all four other cases T-test and Z-test statistics are significant. F-value from one-way ANOVA is also found significant in these four cases. Moreover, across all four cases i.e., DCRD, CCRD, DGPM, WAGC, average SDG index growth at the top quartile of countries was higher than that in the bottom quartile of countries. This provides strong worldwide evidence of fintech's positive association with overall sustainable development during the period under consideration. Here, fintech is represented by debit card ownership, credit card ownership, digital payments, and wages received through cards respectively.

Interestingly, results for LMIC countries only (in Panel B) also show that SDG index growth in top quartile countries is consistently higher than that in bottom quartile countries. But this difference is significant only in the case of digital payments (DGPM). Within the developing world, fintech holds transformative potential in facilitating financial inclusion. So far only average debit and credit card ownership remains low, however. And in general, digital payments and mobile money account ownership has taken off. Univariate results from this analysis show that only growth in digital payments has a significant differentiating impact

Table 8.5-1 Univariate results for SDG Index

Statistics	DCRD	CCRD	MMNY	DGPM	WAGC
Panel A: All Countries					
Top quartile	0.042	0.044	0.034	0.04	0.042
Third quartile	0.032	0.026	0.03	0.034	0.026
Second quartile	0.025	0.026	0.04	0.033	0.029
Bottom quartile	0.028	0.029	0.048	0.02	0.022
Sample size	112	110	52	112	83
T-statistic	2.33346**	1.935*	-1.22	3.881***	2.131**
Z-statistic	2.333***	1.935**	-1.22	3.881***	2.131**
F-value	2.571*	3.679**	0.849	3.629**	2.678*
Panel B: LMIC Countries Only					
Top quartile	0.05	0.045	0.05	0.064	0.045
Third quartile	0.054	0.06	0.042	0.055	0.046
Second quartile	0.039	0.036	0.035	0.046	0.037
Bottom quartile	0.033	0.034	0.049	0.024	0.05
Sample size	33	32	33	21	28
T-statistic	1.245	0.786	0.095	2.469**	-0.31
Z-statistic	1.229	0.786	0.095	2.497***	-0.31
F-value	1.038	1.529	0.469	2.515*	0.208

8.5.2. Fintech and SDG Goal 1

Goal 1 under the SDG 2030 framework aims at eradicating extreme poverty from the world. Panel A in Table 8.5-2 below shows that only for wages received through card (WAGC) the test statistics are significant across all countries. For LMIC countries only, for digital payments (DGPM) statistically significant difference among top and bottom quartile countries is observed. Overall, this evidence suggests that policy intervention aimed specifically at poverty reduction through the use of fintech should focus on wages and digital payments – the two channels members of extremely marginalized communities are most likely to adopt in their daily lives.

Table 8.5-2 Univariate results for Goal 1

Statistics	DCRD	CCRD	MMNY	DGPM	WAGC
Panel A: All Countries					
Top quartile	0.061	0.111	0.031	0.1	0.145
Third quartile	0.056	0.024	0.079	0.023	0.005
Second quartile	0.014	0.025	0.082	0.04	0.034
Bottom quartile	0.052	0.02	0.107	0.02	-0.014
Sample size	112	110	52	112	83
T-statistic	0.187	1.618	-1.3	1.800*	2.457**
Z-statistic	0.187	1.618*	-1.3	1.800**	2.457***
F-value	0.46	1.988	0.251	1.432	3.898**
Panel B: LMIC Countries Only					
Top quartile	0.146	0.195	0.185	0.293	0.119
Third quartile	0.182	0.22	0.063	0.201	0.156
Second quartile	0.123	0.013	0.119	0.109	0.057
Bottom quartile	0.065	0.074	0.14	0.024	0.177
Sample size	33	32	33	21	28
T-statistic	0.716	1.533	0.378	2.186*	-0.54
Z-statistic	0.698	1.533*	0.386	2.375***	-0.54
F-value	0.476	2.019	0.478	1.706	0.439

8.5.3. Fintech and SDG Goal 5

Under SDG 2030 index, goal 5 aims to bring improved gender equality. An economy where all gender identities have equal access to economic opportunities is one that is more resilient and more innovative. Interestingly, as suggested by test statistics in Panel A and B of Table 8.5-3 below, univariate results are not indicative of any significant association of fintech with gender equality. This quantitative evidence contradicts expectations of fintech creating better opportunities for financial inclusion, independence, and resilience for women. Future policy measures should specifically investigate likely areas of shortfall to find pathways of fintech driving gender equality.

Table 8.5-3 Univariate results for Goal 5

Statistics	DCRD	CCRD	MMNY	DGPM	WAGC
Panel A: All Countries					
Top quartile	0.065	0.075	0.066	0.061	0.078
Third quartile	0.052	0.055	0.046	0.072	0.055
Second quartile	0.059	0.046	0.044	0.05	0.042
Bottom quartile	0.063	0.06	0.12	0.056	0.075
Sample size	112	110	52	112	83
T-statistic	0.053	0.616	-1.27	0.219	0.164
Z-statistic	0.053	0.616	-1.27	0.219	0.164
F-value	0.154	0.703	1.756	0.42	1.229
Panel B: LMIC Countries Only					
Top quartile	0.104	0.051	0.066	0.094	0.081
Third quartile	0.038	0.112	0.028	0.065	-0.001
Second quartile	0.038	0.021	0.089	0.061	0.079
Bottom quartile	0.04	0.017	0.037	0.045	0.064
Sample size	33	32	33	21	28
T-statistic	1.286	0.888	0.714	1.395	0.402
Z-statistic	1.345*	0.888	0.735	1.516*	0.402
F-value	1.089	2.349*	0.797	0.193	1.331

8.5.4. Fintech and SDG Goal 8

Goal 8 under SDG 2030 focuses on decent work and economic growth – an area directly pertinent to the current line of investigating fintech's impact on sustainable economic growth. In this regard, univariate results in Table 8.5-4 below show promising results. For all countries (in Panel A), Countries ranked higher in growth in debit card ownership (DCRD) and digital payments (DGPM) experienced higher growth in Goal 8 during the study period. The difference in growth in average Goal 8 score growth in the top and bottom quartiles of countries was statistically significant. For LMIC countries (in Panel B) similar results are obtained but for growth in debit card ownership and mobile money account ownership.

Table 8.5-4 Univariate Results for Goal 8

Statistics	DCRD	CCRD	MMNY	DGPM	WAGC
Panel A: All Countries					
Top quartile	0.041	0.029	0	0.042	0.036
Third quartile	0.032	0.025	0.041	0.033	0.031
Second quartile	0.015	0.025	0.004	0.028	0.008
Bottom quartile	0.016	0.023	0.033	0.002	0.043
Sample size	112	110	52	112	83
T-statistic	1.793*	0.443	-1.37	3.316***	-0.39
Z-statistic	1.793**	0.443	-1.37	3.316***	-0.39
F-value	1.597	0.068	1.962	3.235**	1.96
Panel B: LMIC Countries Only					
Top quartile	0.048	0.031	0.059	0.01	0.036
Third quartile	0.019	0.036	0.016	0.035	0.016
Second quartile	0.064	0.036	0.061	0.028	0.046
Bottom quartile	-0.008	0.016	-0.011	0.035	0.034
Sample size	33	32	33	21	28
T-statistic	2.209**	0.394	2.560**	-0.74	0.07
Z-statistic	2.278**	0.394	2.529***	-0.72	0.07
F-value	2.914*	0.178	3.813**	0.137	0.332

8.5.5. Fintech and SDG Goal 9

Goal 9 under SDG 2030 framework focuses on industry, innovation and infrastructure – the ingredients for sustainable economic growth in the long run. Fintech itself is a product of innovation in business models and technological infrastructure. But a two-way simultaneous relationship can also be theorized. Heightened and scalable access to innovative financial products for the broader customer segment can be expected to open up new business opportunities, reduce cost of doing business, and make risk minimization possible for small business owners. A case in point is "Riskified" presented in an earlier section in this chapter. Univariate results in Table 8.5-5 below, consequently, show promising results. For all countries (in Panel A), countries that experienced higher growth in debit card ownership (DCRD), credit card ownership (CCRD), digital payments (DGPM), and wage receipts through cards (WAGC) exhibited higher average growth in Goal 9 scores during the study period. Differences in average Goal 9 growth rates

between top and bottom quartile countries were statistically significant. Interestingly, no significant difference between top and bottom quartile average growth rates in Goal scores was observed for LMIC countries only (in Panel B).

Table 8.5-5 Univariate results for Goal 9

Statistics	DCRD	CCRD	MMNY	DGPM	WAGC
Panel A: All Countries					
Top quartile	0.823	0.851	0.982	0.866	0.704
Third quartile	0.604	0.377	0.665	0.697	0.336
Second quartile	0.362	0.407	0.869	0.418	0.569
Bottom quartile	0.516	0.562	0.841	0.324	0.279
Sample size	112	110	52	112	83
T-statistic	1.906*	1.799*	0.519	3.250***	2.605**
Z-statistic	1.906**	1.799**	0.519	3.250***	2.605***
F-value	3.279**	4.645***	0.518	5.887***	3.481**
Panel B: LMIC Countries Only					
Top quartile	1.047	1.051	1.191	1.365	1.333
Third quartile	0.979	1.329	1.216	1.011	1.007
Second quartile	1.211	1.136	0.903	1.084	1.145
Bottom quartile	1.14	0.735	1.077	0.834	0.893
Sample size	33	32	33	21	28
T-statistic	-0.29	1.031	0.302	1.435	1.204
Z-statistic	-0.3	1.031	0.312	1.407*	1.204
F-value	0.213	1.516	0.419	0.73	0.62

8.5.6. Fintech and SDG Goal 11

Finally, univariate analysis on Goal 11 under the SDG 2030 framework – sustainable cities and communities – shows varied results. Table 8.5-6 below includes results for all countries and LMIC countries only. Without sustainable cities and communities that support them, economic growth cannot be sustained over the long run. Results from Panel A suggest countries that experienced higher growth in credit card ownership (CCRD) experienced higher growth rates in Goal 11 scores during the study period. However, Panel B shows a different result for LMIC countries only where Goal 11 scores were higher for countries that experienced higher growth rates in digital payments (DGPM) instead. Overall, access to credit is important for sustainable cities and communities across the

globe. But for LMIC countries, it's the growth in digital payments that was significantly associated with Goal 11 scores. The role of greater access to credit through credit card ownership in LMIC countries, where such ownership is historically low, can further be investigated for better policy intervention.

Table 8.5-6 Univariate results for Goal 11

Statistics	DCRD	CCRD	MMNY	DGPM	WAGC
Panel A: All Countries					
Top quartile	0.015	0.039	-0.006	0.023	0.012
Third quartile	0.002	0.01	0.005	-0.002	0.003
Second quartile	0.022	0.018	-0.046	0.022	0
Bottom quartile	-0.014	-0.028	0.052	-0.017	-0.013
Sample size	112	110	52	112	83
T-statistic	1.097	2.188**	-1.65	1.61	1.006
Z-statistic	1.097	2.188**	-1.65	1.610*	1.006
F-value	0.799	2.840**	2.380*	1.246	0.382
Panel B: LMIC Countries Only					
Top quartile	0.05	0.006	0.044	0.087	0.016
Third quartile	0.003	0.045	0.038	-0.054	0.023
Second quartile	-0.001	0.017	-0.054	-0.054	-0.058
Bottom quartile	-0.036	-0.036	-0.014	-0.046	0.054
Sample size	33	32	33	21	28
T-statistic	1.371	0.602	0.892	2.342**	-0.58
Z-statistic	1.336*	0.602	0.869	2.231**	-0.58
F-value	0.749	0.669	1.308	2.076	1.125

8.6. Bangladesh Perspective

Over the last two decades, Bangladesh has taken significant strides forward in fintech ecosystem development. The most impressive changes came in mobile financial services and subsequent digital payment systems. According to Global Findex Dataset, an estimated 29.01% of the entire population owns a mobile money account. However, with reference to other fintech variables considered in this chapter i.e., debit and credit card ownership, digital payments, and wages received through card, Bangladesh's position among peer nations is lagging. Table 8.6-1 below shows comparative data along these variables for selected peer nations along with Bangladesh for the years 2014, 2017, and 2021. Comparatively,

Bangladesh ranks well in mobile money account ownership and percentage of population with experience in digital payments. With regards to debit and credit card ownership, Bangladesh ranked lowest among nearly all peer nations. Debit and credit card ownership at the end of 2021 stood at approximately 5% and less than 1% respectively.

A large mobile money base and a deepening market for digital payments in Bangladesh are a welcoming development. As of writing this report, MFS providers are trying to expand scope of fintech products delivered through their respective channels. However, there is a limit to the variety of fintech services that can be delivered through mobile money only. Sooner or later, customers need to get into the financial system through account ownership and the use of cards needs to rise.

Table 8.6-1 Comparative fintech data - Bangladesh and peer nations

Comparative Data	Bangladesh	India	Indonesia	Kenya	Malaysia	Nigeria	Pakistan	Thailand
Panel A: Debit card ownership								
2014	5.17%	22.07%	25.94%	34.66%	41.17%	35.61%	2.94%	54.75%
2017	6.20%	32.72%	30.81%	37.55%	73.76%	31.55%	8.30%	59.85%
2021	4.86%	27.07%	35.10%	22.42%	83.25%	35.33%	7.74%	63.20%
Panel B: Credit card ownership								
2014	0.34%	4.18%	1.60%	4.63%	20.15%	2.76%	0.13%	5.69%
2017	0.20%	3.00%	2.44%	5.69%	21.31%	2.59%	0.97%	9.80%
2021	0.62%	4.62%	1.60%	6.35%	7.89%	1.61%	0.22%	22.61%
Panel C: Digital payments use								
2014	7.68%	22.24%	23.31%	69.44%	62.60%	37.02%	9.45%	36.77%
2017	34.11%	28.69%	34.61%	78.96%	70.42%	29.66%	17.69%	62.27%
2021	45.26%	34.93%	37.19%	77.56%	79.30%	33.74%	17.62%	92.03%
Panel D: Digital payments use								
2014	2.69%	2.35%	0.45%	58.39%	2.83%	2.29%	5.80%	1.30%
2017	21.25%	1.99%	3.12%	72.93%	10.88%	5.61%	6.89%	8.26%
2021	29.01%	10.44%	9.29%	68.66%	27.98%	8.65%	8.54%	60.00%

With regard to growth in selected sustainable development parameters, Bangladesh's performance is notable. Overall, CAGR in SDG index score for the period 2014-2021 was 3.19%. Table 8.6-2 below provides historical annual growth in selected parameters. The two most notable areas of improvement were poverty alleviation (Goal 1), industry, innovation, and infrastructure (Goal 9), and decent

work and economic growth (Goal 8). Good progress was also made in promoting sustainable cities and communities – with a CAGR between 2014-2021 of 6.9%. Interestingly, within the same timeframe significant growth in fintech is also observed. Despite relatively low penetration of fintech services e.g., card ownership compared to peer nations, Bangladesh has nonetheless made steps towards making financial inclusion a key priority. Given the evidence presented in this chapter on fintech and sustainable economic growth, it is expected that with further scaling up of fintech and financial inclusion, Bangladesh can reap the benefits of sustainable development for all.

Table 8.6-2 Growth in selected scores in SDG 2030 framework for Bangladesh

Period	SDGI	Goal 1	Goal 5	Goal 8	Goal 9	Goal 11
2001	0.18%	0.00%	0.21%	-0.34%	0.00%	0.17%
2002	-0.10%	0.00%	-10.50%	-0.26%	0.00%	0.17%
2003	0.31%	0.00%	0.21%	-0.41%	0.20%	0.17%
2004	0.04%	0.00%	4.47%	0.06%	0.00%	0.16%
2005	1.62%	0.00%	22.92%	-0.01%	0.20%	1.63%
2006	0.28%	0.00%	0.43%	0.63%	0.41%	0.16%
2007	-0.16%	0.00%	1.26%	-0.52%	0.20%	1.29%
2008	0.33%	0.00%	-10.68%	-0.44%	1.15%	9.06%
2009	0.65%	0.00%	18.29%	-0.40%	1.68%	-8.02%
2010	1.20%	0.00%	8.06%	1.57%	2.05%	10.40%
2011	1.12%	1.70%	-3.86%	-0.37%	2.09%	-2.72%
2012	0.11%	1.67%	1.00%	-0.33%	1.92%	-2.59%
2013	1.61%	1.66%	7.96%	-0.30%	4.95%	5.94%
2014	0.73%	1.62%	0.66%	-0.16%	1.81%	5.15%
2015	0.60%	1.70%	0.69%	-0.45%	6.85%	2.57%
2016	2.33%	3.97%	0.91%	0.02%	66.82%	17.15%
2017	1.39%	16.21%	1.40%	1.94%	6.88%	-6.56%
2018	2.52%	20.24%	-1.00%	-0.44%	35.62%	4.49%
2019	2.76%	4.37%	8.95%	0.95%	12.09%	5.73%
2020	0.32%	6.01%	-0.57%	0.00%	6.69%	-2.96%
2021	0.30%	4.53%	0.00%	0.17%	1.69%	0.00%

8.7. Discussion

This chapter focused on the sustainable economic growth aspect of fintech. Using both qualitative and quantitative methods, the chapter sought to understand and establish the relationship fintech has with sustainable economic growth across markets. In so doing, the fundamental challenge in development discourse was acknowledged and development's detitanation ambiguities and measurement

difficulties were addressed by first, taking a look at the evolution of the concept of development in recent decades, and then, following the SDF 2030 framework as the benchmark. Due to its consideration of a wide range of factors, the SDG 2030 framework – itself a successor the Millennium Development Goals – remains true to the "pluralistic" view necessary to accommodate manifold aspects proposed forward to conceptualize what development should entail.

In the qualitative section of this segment, three country-level mini-cases allow the development of a narrative on fintech promoting change in the financial landscape of a country. Fintech start-up cases, of which there were four in this chapter, enable an understanding of the transmission channels of fintech's sustainable development impact. The number of fintech products is large and growing across the world. Specific business models are aimed at specifically defined target market segments. Therefore, different fintech services and business models have the ability to touch specific segments of the population – each standing to benefit from digitally-enabled financial services. The case of Ellevest, for instance, demonstrates how the company targets multiple sustainable development goals at the same time through its service offerings. First, the platform is specifically designed for women – a segment that is traditionally overlooked in the financial services landscape. In particular, women face difficulties in making investment decisions and there are information asymmetry problems. Ellevest not only provides investment management decision support for women investors. The company has for-women financial literacy programs to bridge the gap in financial knowledge. At the same time, the platform enabled investors to make "climate-conscious" investment decisions – therefore allowing another layer of sustainable development contribution.

CreditVidya's alternative credit rating provides a classic example of fintech breaking traditional information asymmetry barriers and allowing underbanked and unbanked communities with little to no credit history to gain access to funds that are put to productive purposes. Alternative credit rating is a business model with significant promise in developed and developing markets alike. The model harnesses intelligent algorithms and non-traditional data points to come up with an accurate prediction of creditworthiness of potential borrowers who have no credit history. This will enable "invisible primes" – customers who are creditworthy but are not easily detectable by the traditional financial services system due to lack of conventional data points – to access credit. Whereas this

accounts for higher profit margins and better loan portfolios for service providers, the impact it has on consumers will most likely have second, and third-order positive ripple effects. Provided regulators are able to foster a system with the right mix of security measures to protect customer data security and privacy, and flexibility for the development and adoption of innovative new fintech services, these emerging fintech business models can effectively change how funds have been collected and allocated to economic units across the economy for centuries.

While fintech innovation affects customers across the globe – a conclusion further strengthened by empirical evidence established through quantitative investigations in this chapter – the transformative powers of financial technologies mean novel paradigms for developing economies. Again, assuming regulatory and policy prudence, fintech stands to benefit customer segments in these places more. Since developing economies do not have financial systems as mature and as structured as those in developed countries, regulators have more leeway in maneuvering policy toward the optimal mix for fintech innovation. At the same time, the ability to empower marginalized communities that fintech has exhibited in many parts of the world has a far larger potential beneficiary audience in developing countries – places conventionally characterized by larger, younger populations with inadequate access to financial services.

One key objective of the current segment of this research – and indeed of the entire study – is to establish empirically supported relationship fintech has with sustainable economic development. The clear lack of empirical investigations in cross-country fintech and sustainable economic development led to a policy blind spot, which this study aimed to fix. Our panel data regression results and univariate analysis results provide inspiring evidence of fintech's contribution to sustainable economic growth. At the same time, they point towards areas where further work is needed.

Panel data results led to two key insights from the cross-country heterogeneous panel. First, fintech growth has a positive effect on macro-level growth. But this relationship was statistically significant for ATM cash withdrawal and debit card transactions – not for transactions through credit cards. Indeed, credit card penetration rates are extremely low in developing countries compared to the rate of credit card ownership in high-income countries included in the panel. Moreover, it is important to consider where the transaction is heading towards. Is the money flowing into productive or consumption purposes? Credit

card owners in general use the credit line to purchase personal consumption goods. Scarcely are these facilities used to finance productive purposes. Second, the positive association between ATM cash withdrawal growth and debit card transaction growth with macroeconomic growth holds true for both developed and developing nations – thereby indicating the universal positive contribution of fintech to economic growth. However, the variation in its degree across income groups could not be determined through panel data regression methods.

A number of crucial insights emerge from univariate results. First, across almost all fintech growth variables considered (with only the exception of mobile money), fintech growth is associated with SDGI score growth for all countries throughout the world. This was also statistically significant. Therefore, regardless of country-specific heterogeneity, fintech growth is positively associated with overall progress made in sustainable development as measured by the composite SDG Index. Second, in the panel consisting of only LMIC countries, the positive and statistically significant difference was observed for only one of the fintech growth variables considered: digital payments growth. Mobile money is the principal fintech service that has gained large scale adoption by the population in developing countries. As such, the growth of digital payments indicates a range of new economic opportunities for individuals and businesses across the socio-economic spectrum. These can be considered in the forms of secure, fast, and reliable funds transfer, supporting online commerce, reducing fraud, and allowing better financial health in general.

We also observed fintech's contribution to the reduction of poverty – measured by growth in Goal 1 score of the SDG 2030 framework across countries. Interestingly, this significant and positive association was observed only in the case of growth in wages received in cards. People in the labor force received wages in cards, resulting in a safer transfer of funds. Moreover, to receive such services would mean being formally included in the financial system – thereby opening up new doors to further financial services and support throughout the lifetime of the wage earner. In the case of female wage earners – like RMG workers in Bangladesh – the inclusion into the financial system also has important positive spillover effects: both social and economic. All in all, this evidence exemplifies how fintech can boost financial inclusion for the marginalized segments of the market by acting as a gateway to the broader financial system.

Across Goals 8, 9, and 11, fintech growth was associated with progress made on respective SDG goals scores. Particularly strong evidence is observed for Goal 8 – creating decent economic opportunities and this was more evident in the LMIC countries. In the all-countries panel, we see strong evidence of fintech's contribution in terms of Goal 9 but not for the LMIC country panel. This can be explained with reference to the lack of well-developed infrastructure networks in developing countries. Similarly, in the case of Goal 11 – creating sustainable cities and communities – significance is observed in the all-countries panel, not in the LMIC-only panel. These findings suggest that fintech's ability to make a difference across these areas of sustainable development in developing nations requires further investigation for identification of possible obstacles.

One cautionary observation from the univariate results is in Goal 5 – promoting gender equality. Fintech promises to enable women with financial agency and resilience. As the case of Ellevest exemplifies, financial technologies have the ability to create a more equitable financial system that is sensitive to the unique obstacles faced by women and allows them to gain more financial freedom. Contrary to expectations, no positive significant relationship was observed between fintech growth and progress made in gender equality – measured by growth in Goal 5 scores across the countries. In fact, this as true for both panels. If policy is to bring a more level playing field through use of technology-enabled financial services, a closer look at whether existing fintech can effectively make a difference is in order. A more targeted approach may be necessary. On the other hand, it can also be that fintech products with the promise of promoting a more gender-equal economic development are simply not scaled up enough to reach women across the globe.

All in all, fintech is a force for good. Narrative and quantitative evidence points to its manifold and significant abilities to drive sustainable economic development. There is variation in what transmission channels contribute the most and which beneficiaries get to derive the fruit first. For achieving SDG 2030, fintech's power to drive sustainable economic growth is to be channeled more equitably and effectively – keeping these in mind.

8.8. Concluding Remarks

Fintech holds transformative potential through democratizing access to financial services and enabling marginalized communities to access state-of-the-art financial products for financial agency and resilience. Extant literature continues to delve deeper into fintech services and business models. The mechanisms through which these bring positive economic benefits for different target segments are investigated. However, there remained a clear gap in cross-country empirical evidence of fintech's contribution to sustainable economic growth. Notwithstanding the broader discourse on what constitutes development, and indeed sustainable development per se, this chapter made due reference to extant literature on sustainable development and sustainable economic growth and investigated fintech's contribution.

In doing so, a threefold mix-method approach was taken; case studies, panel data models, and univariate analyses allowed a multifaceted approach to understanding fintech's relationship with sustainable economic growth. As these investigations reveal, fintech has a significant contribution to sustainable economic growth through various mechanisms and this effect is significant across the world. Fintech positively contributes to macroeconomic growth, controlling for other factors. Indeed, across the world and in lower-middle-income countries (LMIC) in particular, growth in various fintech channels contributes to progress made on sustainable development indicators under the SDG 2030 framework of the United Nations. This provides a strong impetus for development as well as fiscal policy to effectively prioritize scaling up of fintech solutions. In fact, the more rich, diverse, and consistent such services, the better it is more different target segments to gain financial freedom and resilience.

It is also noted that Bangladesh made significant strides during the last two decades in promoting fintech channels. Digital payment is the segment where the biggest growth took place. Among peers, Bangladesh ranks consistently low in card ownership, thereby indicating significant room for improvement for future fintech services to take hold in the market. Bangladesh, thus, needs to seriously look into ways to increase access to these channels. The channels specifically highlighted in this chapter from univariate analyses for LMIC countries only should provide policy guidance in this regard.

9. Implications and Policy Recommendations

9.1. Introduction

In the preceding chapters, our discussion revolved around key fintech themes in the context of Bangladesh. In understanding the fintech ecosystem, adoption, and fintech's impact on sustainable economic development, global and developing-nation perspectives relevant to Bangladesh were adopted. The state of fintech ecosystem, readiness and evolution thereof in Bangladesh were determined. Customer readiness to adopt fintech products and services was the subject of interest – once the focus shifted from the ecosystem to the user. Following this, the current research looked at the adoption factors of fintech in Bangladesh. However, up until that point, it was still not clear what relationship fintech had with sustainable economic development. More importantly, empirical evidence in support of fintech's implications on sustainable economic development was lacking – not just for Bangladesh, rather across nations. Hence, our focus was to search for empirical evidence to investigate fintech's impact on sustainable economic development.

So far, insights from these chapters have pointed to key recommendations. For example, customer readiness for fintech in Bangladesh provides an overall readiness, as well as areas of lacking. Readiness across groups of customers also yields important insights e.g., which target demography requires special attention for policy intervention and how might such intervention best be directed. Similarly, adoption factors allow for targeted awareness-raising and addressing customer concerns with fintech products. Fintech's impact on sustainable economic development has been established with empirical evidence in cross-country settings – this will aid policy decisions to support the growth of a healthy and dynamic fintech ecosystem for sustainable economic development. It is important to summarize inisights from previous chapters and provide specific recommendations out of the current research. That is the aim of this chapter. It

summarizes and synthesizes insights gathered from previous segments of the current study and provides policy recommendations in a systematic manner. Sections 9.2 through 9.6 summarize. Recommendations are listed in section 9.7.

9.2. Summary of Findings from NCS

This section presents a summary of findings from our descriptive analysis of the NCS dataset. Findings are categorized into sub-sections. Overall, significant variation was observed across gender, age, and income groups regarding almost all variables. Women, in general, lagged behind men: in terms of awareness, confidence, and readiness to participate in banking and fintech services. Similarly, younger respondents were found more likely to use fintech and they were, in general, ahead in e-readiness. However, these were mediated by effects of income and annual savings – thereby revealing the influence of economic variables on fintech readiness. Across the dataset, concerns with fintech on multiple service delivery and security aspects were high.

9.2.1. Banking Behavior of the Survey Respondents

I. According to data gathered from our survey, gender-disaggregated account ownership in a bank was around 62%. Account ownership was higher in females (70%) compared to males (61%) as per NCS dataset.
II. Bank account ownership varied with age of respondent: higher account ownership was observed among people aged between 25 and 44 years. Beyond this, bank account ownership steadily declined.
III. Bank account ownership rose with average monthly income, as expected. A similar trend was present in terms of annual savings.
IV. Average frequency of monthly bank visits in females was slightly higher; although maximum monthly bank visit frequency was found to be significantly higher in male customers. Thus, the distribution of bank visit frequency had a long tail at the right.
V. Older customers visited banks far less frequently than customers in younger age groups. The number of monthly bank visits declined steadily with age.
VI. Male customers expressed that they are confident in performing banking transactions on their own far more so than females.

VII. Overall banking confidence, however, was found higher among female customers in NCS dataset.

VIII. Female knowledge of banking transactions and awareness related to banking activities were lower compared to levels in male customers. Banking awareness was also consistently lower in older age groups.

9.2.2. Digital Access

I. About 20% of male customers in NCS datatset had access to a computer compared to 7% of female customers.

II. Of those who had access to a computer, a majority (64%) had also access through personal computer ownership as opposed to shared access or through as cybercafe.

III. Considerable variation was found in computer access across districts (at the top was Rajshahi with 44% and at the bottom was Mymensing with 0%).

IV. Females with computer access reported higher skills operating a computer compared to males with computer access.

V. Around 90% of customers had access to a mobile phone.

VI. Phone ownership was higher in men (91%) and lower in women (83%).

VII. Across ages, phone ownership declines consistently with older customers. The highest percentage of phone ownership was observed in the 15-24 age group (97%).

VIII. Variation in phone ownership across districts was not as wide as that in computer ownership. The lowest gender-aggregated phone ownership in our survey was in Patuakhali (73%).

IX. Smartphone ownership outweighed ownership of normal phones. 54% of customers reported owning a smartphone. Smartphone ownership was lower among female customers.

X. Considerable variation was observed in the proportions of smartphone ownership across districts.

XI. Smartphone ownership was nearly 100% in higher income classes.

XII. Female customers reported lower levels of skills in operating a smartphone compared to male customers.

XIII. 46% of customers in our survey reported using the internet. Internet usage was 49% among males and 32% among females.

XIV. Significant variation was observed in access to the internet across districts included in the survey.

XV. Internet usage considerably varied across age groups. Younger customers had higher levels of internet access.

XVI. The average monthly data usage in our survey was found to be 16,641 megabytes (approximately 16.25 gigabytes) per month. Data usage was higher in males compared to females. Younger users reported progressively higher monthly data usage.

XVII. Higher-income classes reported above-average data usage.

XVIII. Significant variation in data usage across districts was observed.

XIX. Customers reporting higher levels of smartphone skills used more data per month compared to customers with lower levels of reported smartphone skills.

9.2.3. Customer Concerns and Mental Preparedness

I. In general, concern for privacy was high among survey respondents.

II. Privacy concern was higher among male customers.

III. The percentage of respondents who reported not knowing anything related to concerns for privacy was higher consistently in older age groups.

IV. Concern for unknown issues was higher among female customers.

V. Concern for limited government control was equal across genders.

VI. Concern for limited government control was associated with age, monthly income, concern for information security, and concern for financial scams among respondents. Among these, respondent age was negatively associated with concern for limited government control. The rest exhibited positive correlation.

VII. Concern for the financial scam was also negatively associated with respondent age.

VIII. With higher levels of fees customers were willing to pay, concern for financial scams increases.

IX. In general, with higher levels of data usage concern for various issues in fintech increased.

X. 16% of respondents reported that they were not prepared at all to use fintech for daily use, while 34% reported average preparedness.

XI. Mental preparedness was lower among females.
XII. Mental preparedness to use fintech in daily life was consistently lower in older age groups.
XIII. Mental preparedness to use daily fintech was higher in higher-income classes.
XIV. Considerable variation was observed in mental preparedness to use fintech for daily use among districts included in our study.
XV. Monthly expenditure and annual savings were positively associated with mental preparedness among customers.
XVI. Customer perception of fintech costliness had a negative influence on mental preparedness.

9.2.4. Mobile Banking Usage

I. Around 73% of respondents in our survey reported having a mobile banking account. Mobile banking account ownership was slightly lower among females (67%).
II. At higher levels of annual savings, mobile banking account ownership was close to 100%.
III. Considerable variation existed in mobile banking account ownership across districts.
IV. Mobile banking account ownership varied little across occupations.
V. A respondent's age was negatively associated with mobile banking account ownership. Conversely, having a banking account, using smartphone, or having higher monthly income were positively associated with mobile banking account ownership.
VI. bKash (91%), Nagad (38%), and Rocket (31%) constituted the three most popular mobile banking wallets in the NCS dataset.
VII. The most common mobile banking service used by customers was money transfer (56%), followed by mobile recharge (42%) and utility bill payment (11%).

9.2.5. Internet Banking Usage

I. Only 2.52% of the respondents reported using internet banking services in our survey – thereby indicating an obvious gap in fintech service landscape in Bangladesh in this area.

II. Most internet banking users were male in NCS dataset.
III. Money transfer (73%), overseas transactions (20%), and mobile recharge were the top three use cases of internet banking for customers included in our survey.

9.2.6. Fintech Services Satisfaction

I. About 37% of respondents reported being either satisfied or highly satisfied with fintech services in NCS dataset.
II. When asked to choose, 93% of respondents picked mobile banking as the most satisfactory fintech service – as opposed to Internet banking service.
III. Satisfaction with fintech services was slightly higher in female customers as per the NCS dataset.
IV. In general, satisfaction with fintech services was relatively higher in younger age groups.
V. Satisfaction was found to be considerably higher in higher-income classes.
VI. We also found that respondents with higher levels of smartphone skills had a higher likelihood of being satisfied with fintech services. Similar results are applicable for levels of computer skills.
VII. People confident performing banking transactions alone were more likely to report higher satisfaction with fintech services – implying previous experience with legacy banking interfaces may allow customers to appraise fintech service benefits better.
VIII. Fintech satisfaction was positively associated with monthly income, levels of smartphone skills; it was negatively associated with concern for financial scams and perceived costliness.

9.2.7. Obstacles to Use of Fintech

I. Technological skills, transaction knowledge, and educational qualification were the top three obstacles to fintech usage as reported by respondents in the NCS.
II. Technological skill as an obstacle to fintech use was not independent of the gender of the respondent.

III. Technological skills as an obstacle to fintech use reduced with age among the respondents.
IV. Likewise, transaction knowledge obstacle declined with age among the respondents.
V. Transaction knowledge obstacle was positively associated with age and negatively associated with the levels of education.

9.2.8. Fintech Costliness and Affordability Perception

I. Around 8% of respondents regarded existing fintech services as “very cheap” while another 25% regarded them as “cheap”.
II. Almost 49% of respondents used 2 types of mobile banking services; a lesser portion of respondents were found to use higher numbers.
III. For respondents with a higher number of mobile banking service usage, perceived costliness was lower.
IV. With higher volumes of money transfers through mobile banking wallets, perceived costliness declined.
V. On average, customers were willing to pay BDT 8.5 per BDT 1000 worth of cash withdrawal. The average was slightly higher for males than for females.
VI. The maximum preferred fee per BDT 1000 worth of cash withdrawal declined steadily with the age of the respondent.
VII. With the higher number of different mobile banking services used, the maximum preferred fee increased.
VIII. With higher levels of monthly income, the maximum preferred fee also increased.
IX. Around 21% of respondents said they find fintech services affordable. This was higher in males compared to females.
X. Perceived affordability decreases with the age of the respondent.
XI. Considerable variation was observed in perceived affordability across districts.
XII. Among factors that were associated with perceived costliness were bank account ownership and levels of smartphone skills. Both of these were positively associated with perceived affordability.

XIII. Respondent age was negatively associated with the maximum preferred fee and positively associated with monthly income and mobile banking usage.

XIV. With higher levels of fintech satisfaction, the maximum preferred fee increased. Also, concern for the financial scam was negatively associated with the maximum preferred fee.

9.3. Summary from Fintech Ecosystem Assessment

The following key points emerge from our assessment of fintech ecosystem in Bangladesh in comparison with peer nations and global benchmarks.

I. Bangladesh's fintech ecosystem was in the second stage of the ecosystem development model. Here, ecosystem participants were connected with each other and explored to create value for customers.

II. Policymakers, investors, and technology providers lagged behind in readiness to promote a vibrant fintech ecosystem in Bangladesh. This is evident from a comparison with global and peer-nation fintech ecosystems, products, and business models. Bangladesh needs to actively push for regulatory provisions that allow for a more dynamic environment. Investors, start-ups, legacy banks, academia, and customers are to collaborate and find unique opportunities for financial services.

III. It was largely accepted, as maintained by our expert fintech panel, that fintech will contribute positively to sustainable economic growth for Bangladesh in the long term. The extent of fintech's contribution to sustainable economic development in the short- and medium-term depends on the environment in which fintech ecosystem participants are engaged. A more dynamic environment will allow for wider innovation and better fintech service experience for customers.

9.4. Summary from Customer Readiness Assessment

I. The market has considerable room for improvement in democratizing innovative fintech services in Bangladesh. Customers are not fully ready for innovative fintech services. Measured through

CFR index, Bangladesh stands at about the 26th percentile of customer fintech readiness.

II. Shortcomings were primarily in areas of citizen financial health, e-readiness, and financial literacy.

III. The country ranked well in terms of demographic characteristics conducive to fintech use, mental preparedness of customers for daily fintech use, and overall sentiment on uses of fintech.

IV. Although account numbers continued to rise in MFS platforms, the majority of users utilized them for small-scale mobile payments – thereby leaving a gap for a plethora of innovative fintech services.

V. Female CFR score – both aggregate and dimension-wise – was consistently lower than in males. There was significant variation in mean CFR scores across different districts as well. Keeping such variation in consideration, policy intervention should target areas of gap so that fintech truly becomes a tool for balanced and sustainable economic development in Bangladesh.

9.5. Summary of Findings on Fintech Adoption Factors

I. Customer adoption of fintech in Bangladesh, as suggested by our dataset, revealed the predominant influence from perceived factors e.g.,
   a. security concerns
   b. mental preparedness
   c. perceived obstacle

II. Policy intervention to expand the reach of fintech into the wider population in Bangladesh across demographic and economic segments should focus on addressing these perceived variables.

9.6. Summary of Fintech's Contribution to Sustainable Economic Development

I. Growth in SDGI (SDG Index) varied significantly across quartiles of fintech growth during the period under consideration. This was

evident from nearly all proxy variables used for fintech e.g., DCRD, CCRD, DGPM, WAGC.

II. In all cases, top quartile countries experienced higher growth in SDGI scores – indicating fintech growth was associated with higher growth in SDG index across the world.

III. Interestingly, no statistically significant difference was observed across quartiles in terms of growth in country-level Goal 5 (Gender Equality) scores. This necessitates a further investigation into fintech's true impact on promoting gender equality.

IV. In terms of poverty alleviation, differences were observed only for WAGC. This intuitively made sense but requires further investigation. People living in extreme or moderate levels of poverty are wage earners. Incorporating this segment into a fintech infrastructure should constitute an effective poverty reduction tool.

V. A statistically significant difference was observed across quartiles in terms of Goal 11 (Sustainable Cities and Communities) but only when ranked by CCRD. This was explained with reference to the fact that higher-income countries saw greater growth in CCRD during the study period.

VI. Goal 9 (Industry, Innovation, and Infrastructure) scores exhibited statistically significant differences across quartiles in case four out of the five ranking variables used – thereby providing strong evidence of fintech's contribution in this domain.

VII. Univariate results for LMIC only suggest that digital payments and debit card growth is associated with a few sustainability indicators

VIII. This is true for SDGI, Goal 1 (No Poverty), Goal 8 (Decent Work and Economic Growth), Goal 11.

IX. Moreover, univariate results in this group suggested no significant association of fintech growth on gender equality. This corresponds with results for all countries.

X. Policy intervention in developing nations thus can focus more on digital payments, debit cards, and fintech-enabled wage disbursement

9.7. Recommendations

In this part, policy recommendations are based on synthesized findings from our study. Recommendations are provided in two forms. First, recommendations that directly follow from our four major segments of work are presented in terms of fintech ecosystem, fintech customer readiness, fintech adoption, and fintech's impact on sustainable economic development.

The current research relied on a variety of data –qualitative and quantitative. Since the broad focus was fintech in Bangladesh, secondary research insights enable authors to suggest a number of related policy recommendations for the effective fintech ecosystem development for sustainable economic development in the Bangladesh context. These "indirect" recommendations are provided in the second part. Moreover, in presenting these specific recommendations, an ecosystem player structure is followed: recommendations are provided for fintech start-ups, governments, financial institutions, fintech customers, technology enablers, investors, and academia. The development of a dynamic fintech ecosystem that utilizes innovative fintech products and business models for customer value requires each segment to develop.

9.7.1. Direct Policy Recommendations

9.7.1 (a) Fintech Ecosystem Development in Bangladesh

The following key recommendations can aid the development of a dynamic and vibrant fintech ecosystem in Bangladesh:

1. From the assessment fintech ecosystem readiness and development stage, it appears clear that Bangladesh's fintech ecosystem is underdeveloped. This may not be evident from the recent boom in Mobile Financial Services (MFS). Global fintech markets provide a wider variety of fintech products – each with its unique value proposition for selected target markets. MFS has undoubtedly created a strong base for further fintech development. But MFS offers only baseline services i.e., mobile money transfers, digital payments, etc. Moreover, the use of MFS services does not require opening banking accounts – thereby limiting the inclusion of fintech user base into the formal financial system. For the development of the fintech ecosystem in Bangladesh, efforts should be directed to bring a greater

variety of fintech products e.g., InsurTech for insurance and risk management services, WealthTech for management of the wealth of higher ends of the market, and RegTech for the regulation of fintech players. Spurring innovation and experimentation with fintech business models requires policy impetus and a supporting innovation environment.

2. Fintech has emerged as a challenger to the legacy financial system. In Bangladesh too, MFS service providers have forced banks to roll out their own fintech solutions – primarily through online banking platforms for mobile users. Going forward, banks and financial institutions need to invest further into fintech innovation within their organizations. Banks in Bangladesh are uniquely positioned to harness fintech innovation due to a number of factors including close relationships with regulatory bodies, extensive branch networks, and conduits of the majority share of customer deposits in the country. Non-banking financial institutions like insurance companies and capital market investment firms are not as popular in the local market as of yet. As such, commercial banks in particular can push newer fintech innovation – making new fintech products viable as well as acceptable within a larger customer base.
3. The role of a secure and agile digital infrastructure cannot be underlined for fintech ecosystem development. Acting as a backbone, the digital infrastructure determines the speed and ease with which existing and novel fintech service models can deliver to the customer. Over the last two decades, the digital infrastructure of Bangladesh has improved tremendously; mobile subscriber network and internet penetration have both expanded significantly. However, Bangladesh does not have a truly interoperable framework that allows multiple fintech products and business models to connect to shared resources e.g., data, insights, and markets. Going forward, Bangladesh will have to review global and regional best practices in interoperable digital infrastructures for fintech development. Moreover, this framework will have to be properly complemented by regulatory provisions to promote secure, fast, and transparent sharing of data for fintech innovation.

4. Bangladesh's ranking in fintech globally and regionally is low. Among the 16 Asia-Pacific countries, Bangladesh ranks the lowest. Regional countries, however, can offer more relevant policy insights. As such regional benchmarking of fintech innovation clusters e.g., Singapore, India, and China needs to be prioritized over global benchmarking. It is expected that the socio-economic shared markup of regional countries will present a far more replicable and effective picture of fintech ecosystem evolution. Moreover, regional partnerships in fintech ecosystem development through knowledge sharing, investment, and technological assistance will prove valuable for Bangladesh.
5. Although individual customers take the front seat in the discussion of fintech products and business models, small business owners offer another attractive segment where policy focus needs to be driven. In fact, small and medium enterprises (SMEs) account for the lion's share of employment generation and economic contribution to the country. In developing an ecosystem of innovative fintech products, specific attention to SME-relevant fintech solutions is warranted. This can foster a dynamic fintech ecosystem with varied products and business models while contributing immensely to SME development in the country – thereby offering dual contributions to the national economy. Fintech solutions for the management of small business accounting and finance, innovative payments, secure investments into the financial markets, and peer-to-peer lending services will prove helpful for SME owners across the country. These represent attractive business opportunities for fintech start-ups.
6. New fintech business models need to be explored for the local market context. At present, payments and online banking are predominant fintech business models. Peer-to-peer (P2P) lending can be explored for alternative lending channels for individual and SME owners – taking pressure off the commercial banking channel. The crowdfunding model can similarly create capital raising for start-ups and small businesses. Selective use of blockchain-based solutions for investment and lending products should be on the agenda. As the middle class gain more purchasing power and larger disposable

income for investment, PropTech in real estate, InsurTech in insurance, and fintech-based asset management models can offer a wide array of business opportunities, customer value creation, and pockets of economic contributions to the country. Both policy support and private sector investment in fintech innovation will be key in generating these alternative business model cases in the country.

7. Bangladesh is in the second phase of ecosystem development as per the process model of fintech ecosystem development. This implies that fintech players in the country have started to get more connected. In phase three, fintech ecosystem is further enhanced with greater variety. Policymakers need to pay close attention to drivers and inhibitors of phase three ecosystem development. First, policy should aim to generate "critical mass" for the next stage of ecosystem development. This incorporates scaling up existing fintech business models. Second, digital infrastructure development will have to scale up so it can accommodate a new wave of varied fintech business models. At the same time, customers are to be made aware of the benefits of emerging fintech business models with government backing. Possible measures on the agenda may include insurance guarantees for fintech firms. Third, security risk concerns need to be addressed – for customers and for businesses. Awareness alone will not achieve this. Capability development for regulators and private sector investors regarding cybersecurity and digital infrastructure is important. However, the most crucial requirement in a vibrant fintech ecosystem development in the third stage is talent. And finally, to attract investment from local and global markets and to welcome innovation from regional partners, a "predictable" policy framework needs to become the norm. In supporting fintech ecosystem development with consistent and time-appropriate policy response, regulators can again learn from regional fintech hubs.
8. In assessing the readiness of key fintech ecosystem players, it was clear that all players have significant room for readiness improvement. However, investors and policy markers are found to have the lowest levels of readiness for dynamic fintech ecosystem

development. Therefore, the greatest initial effort is recommended for investment cluster development and prudent policy frameworks. These will support other fintech ecosystem players in the country.

9. The impact on sustainable economic development is deemed strong in the long run. To harness a developing ecosystem for national economic and social development agenda in the medium- and short-terms, dedicated research efforts are required to "localize" fintech innovation from the regional landscape. Importantly, the swift translation of regional business models into locally relevant fintech solutions and execution thereof can bring fintech's transformative potential in the near-term future for the country.

9.7.1 (b) Customer Fintech Readiness in Bangladesh

The following key recommendations are expected to effectively address customer readiness in Bangladesh and pave the way for innovative fintech adoption:

1. Measured by CFR Index, Bangladesh is positioned in the 26th percentile in overall customer readiness. That is to say, customer readiness for fintech use on a regular basis, after accounting for seven key dimensions of factors, is very low as of now. If a dynamic fintech ecosystem is to be supported by a vibrant customer base ready to adopt and continuously use innovative fintech services for sustainable economic benefits in Bangladesh, policy priority should be to increase overall customer readiness – an objective that is necessary to achieve fast.
2. Broad awareness raising is one way to approach increasing customer readiness in Bangladesh. However, it should not be as effective as a more targeted campaign. NCS descriptive findings, presented in Chapter 4, indicate areas of gaps. Two major trends emerge from these findings. Female respondents are less prepared. Mental preparedness is also consistently lower among older respondents. Moreover, it is observed that perceived satisfaction is lower in lower income classes. To harness fintech for sustainable economic development, low-income users need to be incorporated under fintech services networks. As such, fintech service providers need to

specifically look into product and business model innovation that benefits the bottom-of-the-pyramid market in Bangladesh. Raising the perceived satisfaction of this group can bring network effects to benefit the fintech ecosystem.

3. Mental preparedness for daily fintech, regardless of age, gender, and income was found below expected levels. To raise preparedness, it is recommended that two separate lines of policy interventions be pursued parallelly. First, the promotion of varied fintech services and business models relevant to a wider array of customers. Second, nationwide targeted awareness campaigns. Importantly, customer concerns with fintech use can be more effectively addressed if awareness campaigns are publicly validated by technological and regulatory competence.
4. In this research, significant variation in customer mental preparedness was observed across the 16 districts included in NCS. Even across Upazilas, variation was also observed. However, a low level of mental preparedness was not necessarily associated with poverty levels in districts. Thus, it would not be wise to target low-income administrative levels exclusively in an effort to scale up the use of fintech. Such efforts need to be taken across urban, semi-urban, and rural areas depending on the most relevant fintech business model for the respective areas.
5. Apart from the lack of varied fintech use, customer usage of services available through MFS platforms was concentrated in baseline services e.g., mobile money transfer, digital payments, mobile airtime recharge, utility payment, etc. Internet banking was used by only a handful of users included in the NCS. Slightly more advanced usage e.g., investments, and insurance were barely used by customers in Bangladesh. This again points to the need to diversify fintech use among customers by providing a wider array of fintech services. It is important to note that use of more advanced fintech services might be a function of larger socio-economic variables and not all are within the scope of fintech ecosystem in particular.
6. In dealing with low levels of overall customer readiness as measured by CFR, special attention is needed for financial health, financial

literacy, e-readiness, and existing fintech use of customers. These were the four domains with the lowest average scores in Bangladesh. Scores in these four dimensions were low for respondents of both genders – implying these dimensions contributed significantly to overall low customer readiness. Policy priorities should therefore be given to raising customer financial health, addressing existing gaps in customer financial literacy, raising digital literacy of customers, and boosting use of existing fintech services. The addressing of these four dimensions can be expected to lead to a more prepared customer base across the nation for future innovative fintech use. Interestingly, all four represent opportunities for new fintech business models as a channel for addressing customer readiness. As such, fintech products that aim at financial health, financial literacy, digital readiness, and existing fintech use among customers can act as a tool for increasing customer readiness for more innovative and varied fintech use in the country.

7. Respondents' opinions on the greatest perceived obstacle to fintech use revealed an important trend. Across the country, customers mainly faced technical and service-related obstacles. Four of the top obstacles faced by the customers included technological skills, transaction knowledge, educational background, and confidence in technology. If fintech is to be harnessed for changing economic lot of bottom-of-the-pyramid markets, these barriers need to be eliminated. Policymakers can consider a regulatory framework that explicitly requires development of intuitive service interfaces that engage customers with little to no technical knowledge of institutional education. Fintech service providers and technology enablers have a role to play here.
8. A customary look at future expected fintech use reveals a lack of variety in expectations. Most respondents planned to use baseline fintech services. Service providers need to push for innovative services more effectively. A nationwide barometer of expected future fintech use, conducted on a yearly or quarterly basis, can help measure periodic improvements and provide better policy guidance.

9. The main concerns customers have with fintech service use relate to different forms of information and financial security. Similarly, the main expectation they have for the government is for better monitoring of service providers and swift law-enforcement response to fraudulent cases. In raising awareness and building national capacity for dynamic fintech ecosystem development, service providers and the government should focus on these two.

9.7.1 (c) Adoption of Fintech in Bangladesh

The following key recommendations are expected to help increase the adoption of existing and novel fintech products in Bangladesh:

1. Customer adoption of fintech in Bangladesh is determined predominantly by concerns with security and regulation. Customers' level of concern with possible security threats and regulatory capacity to prevent such cases determine fintech adoption. Trust plays the overriding role. Therefore, efforts to increase fintech adoption should be aimed at building, raising, and preserving customer trust in fintech. Importantly, it is unlikely that trust is compartmentalized in customers' minds. It is unlikely that customers have separate notions of trust in the service delivery model i.e., trust in digital infrastructure, trust in regulatory prudence, and trust in fintech service providers. Rather, trust in "fintech" is an amalgamation of all these. This is shaped by customers' experience of interacting with the integrated system. Sustainable economic development through fintech, thus, requires a policy that is capable of generating public trust in fintech services.
2. It can further be proposed that innovative fintech services need proper screening for their possible effect on public trust in "fintech". Equally important, however, is not to add excessive friction. One way this trade-off is achieved in best-practice cases is "regulatory sandbox".

9.7.1 (d) Fintech for Sustainable Economic Development

The following key policy recommendations are expected to assist in the utilization of fintech as a transformative channel for sustainable economic development in Bangladesh, and across the developing world in general:

1. Evidence from cross-country panel data in this research showed strong evidence in support of ATM and debit cards as channels of positive contributions to economic growth – but not for credit cards. For Bangladesh, and developing countries in general, this bears important policy insight. ATM networks across the country should be expanded. So should efforts be taken to increase debit card penetration. In fact, as mentioned in subsequent points, debit card ownership has positive implications for sustainable development. As presented in the Bangladesh perspectives section in Chapter 9, card ownership in the country is among the lowest in the region. Card ownership acts as a gateway to a wide array of fintech platforms. Most fintech business models mentioned in Chapter 5 require debit or credit card connectivity for innovative fintech services. A principal policy priority in the immediate term in Bangladesh should be scaling up debit card ownership. This is to happen across the country and across the income spectrum – which will inevitably increase ATM transactions. Such expansion in card ownership will open doors for fintech services, will support e-commerce transactions, and will help expand the reach of the formal banking network into underbanked and unbanked segments.
2. Univariate results in Chapter 9 across selected sustainable development indicators reveal a trend for lower-middle-income countries. Among the fintech growth variables, debit card growth and digital payment growth exhibit significant associations with progress on multiple development indicators. Therefore, more than any other, Bangladesh should focus on the expansion of the current fintech services along with a larger footprint of debit card ownership. Incidentally, debit card ownership increases digital payment footprint automatically since more customers with cards mean more customers for digital services and/or products sold through digital

channels. Moreover, universal card access will allow for a balanced distribution of benefits of digital payments.

3. In poverty alleviation for LMIC countries, wages distributed through card was found to have a significant positive association. This is policy insight to push for fintech services for the bottom-of-the-pyramid market. If a majority of wage earners – including ones in the informal sector – are in a debit card network, manifold benefits are expected. The influx of data will allow for the mining of customer insights and facilitate smarter, and arguably more affordable, financial services through fintech platforms. The inclusion of this market segment makes the biggest difference. A large market with card-holding customers will open opportunities for bottom-of-the-pyramid focused fintech business models to thrive – allowing for the customers in this segment to derive the benefits of services tailored to their specific needs and limitations. And finally, a larger card footprint will help alleviate extreme poverty. One important consideration, however, is ensuring gender-balanced expansion in card footprint across the country benefits to be equally and sustainably distributed.
4. In progress gained on Goal 8 (Decent Work and Economic Growth), two significant channels were debit card ownership and digital payments. Developing economies, including Bangladesh, should once again focus on the expansion of these two as newer fintech channels and business models of fintech get introduced into the market.
5. Noticeably, no significant association was observed for LMIC countries for Goal 9 (Innovation and Infrastructure Development). This gap, present in Bangladesh too, denotes fintech development has taken place mostly with customer-facing business models. Large-scale business-to-business (B2B) and business-to-government (B2G) spaces are still dominated by conventional financial market players where the role of financial technologies is subdued at best. Going forward, there should be ways fintech can help in infrastructure development and innovation. Examples include blockchain-based financial contracts in B2B and B2G spaces.

6. Gender equality has important economic implications. It is established: gender-equal communities are economically more resilient. Fintech has exhibited promising solutions to create a more gender-equal economy – with women gaining greater financial independence. Narrative evidence points to the various channels through which fintech can administer such benefits. Surprisingly though, univariate results from our research do not corroborate these notions. In all-country panel as well as the LMIC-only panel, fintech growth was not significantly associated with the progress made on gender equality. Policymakers need to take note. In Bangladesh, fintech-led development agenda should prioritize the needs of women and their financial agencies. However, this lack of empirical association can be attributed to two possible reasons. One, gender-equal economic progress is mediated by a number of other factors where fintech may not play an overriding role. Further investigation is needed to find potential channels through which fintech may subvert socio-economic factors and create unique opportunities for women's economic development in particular. The private sector, academia, and the state might have to play a collaborative role. Two, existing channels of fintech are capable of reducing gender inequality effectively, but have not been scaled up and/or targeted well. Therefore, women in need of these opportunities have either not received them at scale or are struggling to utilize their transformative potential. In both cases, specific policy interventions will be necessary. Government policy in Bangladesh, and across the developing world, should prioritize the needs, constraints, and aspirations of women in the conception, innovation, design, delivery, and supervision of fintech products and business models. This push is needed from all key players in the fintech ecosystem. However, it can only be effectively coordinated at the regulatory level.

9.7.2. Indirect Recommendations

The following secondary recommendations emerge from insights gathered at various stages of our research. They are sub-divided by key players of fintech ecosystem:

9.7.2 (a) Fintech Service providers/Start-up

I. Innovation of novel products and services should be prioritized.
II. Well-defined products with clear USPs and niche markets can be more effective for expanding fintech footprint.
III. Entry barriers need to be critically evaluated in different segments, and subsequently addressed through technology, service design, and awareness.
IV. Understanding factors for global fundraising, focusing on criteria valued for venture capital funds, and highlighting key local opportunities at bottom-of-the-pyramid will prove helpful.

9.7.2 (b) Government Policy Makers

I. The government should facilitate favorable policies on fintech innovation development. Indeed, "proactive" policies like China took should be considered instead of reactive policies.
II. Regulation should ensure the access to and sharing of data e.g., Credit score, NBR, Land, Utility, BRTA. Multiple government agencies need effective modalities for interoperability.
III. The infrastructure development agenda should attract all stakeholders towards fintech ecosystem development for a smart, secure, transparent, and resilient fintech ecosystem in the country.
IV. Incentive mechanisms for the use of novel and innovative fintech to attract all stakeholders should be considered.
V. Support in the form of statements of assurance from government to customers and state-sponsored insurance mechanisms can help build trust.

9.7.2 (c) Financial Institutions

I. An open policy towards data-sharing and a more holistic approach to integrating fintech in financial institution operations can be effective in staying ahead of the innovation curve.

II. Adoption of novel technologies and business models can be spearheaded by experimentation. This requires top-management appreciation for the long-term value that can be created by fintech.
III. Collaboration with technology providers, startups, banks and NBFIs can be more effective if the focus is on customer value creation.
IV. Acceptance for open banking, API-based banking (e.g., Jupiter from India) is needed among local banks and financial institutions.
V. ABB and BAB should advocate and push for fintech to the government as a new stream of revenue for the traditional Banks.
VI. Banks need to push fintech awareness in rural areas and lay down the grounds for future fintech development across these customer bases.
VII. Human resources development is of paramount importance for the continued development of fintech in Bangladesh

9.7.2 (d) Consumer

The following key enabling factors are recommended for the customer domain:

I. Consumer awareness
II. Digital and financial literacy
III. Awareness of privacy and security
IV. Awareness of financial data ownership
V. Low-cost availability of smartphones
VI. Low-cost internet access
VII. User-friendly and intuitive platforms for fintech services

9.7.2 (e) Technology Providers

I. Professionalism and self-development should be pursued among local technology providers.
II. Latest technology standards need to be incorporated to promote secure and fast enabling systems.
III. Technology providers should work closely with finance professionals to ensure they can operate and market their products successfully and not go out of business.
IV. Develop robust fraud monitoring through secured networks to retain customer trust.

V. Adopt global benchmarks in data security and privacy issues to attract regional and local capital and trust.

9.7.2 (f) Investors

I. Improve the ecosystem of venture capitalists, fintech startups, and local investors, and collaborate with foreign investors, VC funds, and early-stage fintech startup incubators.
II. New investors should be nurtured with knowledge resources and best-practice guidance.
III. Investors should change their mindset of getting short-term profits. They should invest in long-term projects to get a higher ROI over time.
IV. Investors should look beyond Bangladesh to invest in countries in Africa and emerging Fintech regions i.e., middle-East and south-east Asia. Throughout the process, local fintech firms should collaborate for knowledge sharing, market insights, and innovation.
V. Strategic investment should be looked into e.g., acquiring other companies, especially in Asia-Pacific.

9.7.2 (g) Academia

I. Strong industry-academia collaboration is needed for talent development, research insights, technological innovation, and best-practice benchmarking.
II. There is a need for a fundamental overhaul of the national curriculum to include more technical knowledge of 4IR, and Fintech, starting from secondary education.
III. The funding of academia-led fintech incubators for early-stage launchpads should rank high across tertiary institutions – especially ones focusing on technology, engineering, business, and economics.
IV. Continuous scanning of global fintech and their subsequent localization for rapid ecosystem development in Bangladesh should be a key priority of academia.

10. Conclusion

10.1. Concluding Remarks

This study undertook a detailed examination of financial technology and its role in sustainable economic development for developing nations. In doing so, the study focused on Bangladesh. Through dedicated segments of the research, the current work looked at fintech ecosystem, customer readiness for fintech, adoption factors of fintech, and fintech's association with sustainable economic growth and empirical validation thereof. The preceding chapters have discussed at length the findings and implications. A 30,000-feet view of the current work leads to an interesting conclusion. We observed that fintech ecosystem in Bangladesh is not entirely ready with diverse products, business models, and ecosystem player readiness – but the ecosystem is growing and has potential. With proper regulatory oversight and a confluence of innovation, talent, and funding, Bangladesh can learn from the dynamic fintech hubs of the region and grow its own vibrant fintech ecosystem. We also observed that customers in Bangladesh are not ready for innovative fintech services yet and macro-level policy interventions will play a key role in addressing that gap. This will be important if Bangladesh wants to reap the benefits of a dynamic fintech landscape in the country. Our investigation of the adoption factors of fintech services in the context of Bangladesh reveals that perceived concerns with various issues related to fintech use among customers constitute the preliminary determinants of adoption of fintech – thereby leading to a policy pathway for higher fintech adoption. This study also empirically established fintech's contribution to sustainable economic growth across the world and in developing countries – providing further impetus for fintech expansion for customer value creation. It is hoped that the insights generated by this research will prove to be directly relevant for the policy discourse in fintech in developing nations – and in Bangladesh in particular.

Before concluding the dissertation with future research directions, briefly delineated in the next section, we would like to reflect on the significance of the

current work. We have mentioned ways this dissertation makes several contributions to pertinent literature in Section 1.6. Here, it can be reflected in light of existing practical realities – especially in Bangladesh.

Bangladesh, since independence in 1971, maintained macroeconomic stability the likes of which are rarely seen in the global arena. Considering the manifold challenges e.g., radical policy changes, natural disasters, a large population, scarce natural resources, and human development challenges over the last five decades, Bangladesh truly made astounding progress in lifting millions of people out of abject poverty, extending basic healthcare and education, and promoting gender equality. During the past decade, Bangladesh's overall development trajectory has been even more encouraging. However, this dissertation does not digress into the complex inner workings of development theory. Neither does it consider within its scope an adequate analysis of the factors and constraints behind Bangladesh's development miracle. As the focus is on sustainable development growth through fintech ecosystem, the current study nonetheless hopes to make some relevant contributions for the continuation of the said development miracle, albeit for the next decades which are expected to be characterized by a different set of opportunities and challenges altogether.

Importantly, even though the development story of Bangladesh is an exemplary one, fundamental challenges remain for the coming days. On the economic front, for example, it is important to answer the questions of severe economic inequality, empowering women through greater financial opportunities, creating jobs for millions of young people, and making industries and local economies more resilient at times of geopolitical crises and shocks expected from climate change. A dynamic fintech ecosystem, with its variety of products and business models, offers possible answers to all of these. This is demonstrated in the case studies presented in this study. Fintech has something to offer for each market segment – provided the policy is supportive of growth and innovation. More importantly, our work provides empirical validation to the hitherto optimistic notion that fintech can aid economic development in a sustainable manner. We show this is indeed the case. Our empirical evidence provides strong support for policy that aims to harness fintech for sustainable economic development. For a country like Bangladesh, fintech can bring new opportunities to create value and make sure, at the same time, that the benefit of

such growth is more equitably distributed through financial freedom, agency, and resilience in marginal segments of the market.

10.2. Future Research

Future researchers can extend some of the approaches undertaken in this research and can explore new research directions where enough insights have not yet been generated. In studying fintech ecosystem and its readiness in Bangladesh, the need for a more detailed study dedicated to investigating the state of readiness of fintech firms operating in the country was felt. Future research work can look specifically into the challenges faced by local fintech players and shed light on possible pathways as per regional best practice guidelines. The development of a dynamic and vibrant ecosystem for fintech products in Bangladesh – and in any country for this matter – depends among other things on a timely, transparent, and consistent regulatory framework. A study may be dedicated especially to analyzing global and regional best practices in regulatory approach and considering existing and upcoming technological opportunities and challenges. After a careful account of these, the study may then propose guiding principles for a fintech regulatory framework in Bangladesh – one that is sensitive to local needs and capable of meeting global standards

With regards to assessing customer fintech readiness, the current study proposed the Customer Fintech Readiness (CFR) index to measure readiness to adopt fintech services in daily lives by customers across a country. Measuring customer readiness to adopt innovative fintech services at scale is important since such adoption is a prerequisite to the socio-economic benefits fintech promises. Our study is one of the first in the literature to attempt to measure such readiness from the perspective of seven dimensions. However, there were at least two limitations to CFR that future research should consider and possibly address. First, CFR relied on customer-reported data. The standard questionnaire used in National Citizen Survey collected responses from 1282 individuals through interviewers. Despite best efforts to control for interviewer bias, we recognize that customer reporting may have been influenced by interviewer differences across districts. Moreover, customer-reported data could not be independently validated. There were no nationwide datasets compiled by independent researchers or government agencies on customer use of fintech or technology in

general. Future replication efforts can account for possible interviewer bias by maintaining interviewer uniformity (e.g., same group of interviewers across districts). However, online survey questionnaires cannot be used. The target population in high-poverty areas will have difficulty accessing these.

Second, our dataset was gender imbalanced. This was due to the poverty-based stratified random sampling used in the study. Each successive iteration of administrative subunits were ranked according to poverty and the two extreme candidates were selected to preserve representation of both sides of the socio-economic spectrum. This ensured good economic representation but compromised on gender representation. The use of statistical tools e.g., Synthetic Minority Oversampling Technique (SMOTE) can be used to address such sample imbalances (Chawla et al. 2002; Ijaz et al. 2018; Pears et al. 2014). For instance, to investigate factors contributing to fintech adoption, sample imbalance was addressed with SMOTE by Mahmud et. al. (2023). While SMOTE is an effective method in modeling scenarios, the purpose of this chapter was to assess readiness.

Future researchers can also replicate the index and perform a country-level comparative analysis of fintech readiness – overall as well as dimension-specific. In that regard, the CFR provides a way to quantify readiness for further investigation. Macro-level investigation of readiness and other factors can be performed only when there is a reliable and valid way to measure customer fintech readiness. Future research is important to further fine-tune the variables and construction methods of CFR. The current work was constrained by absence of national dataset on citizens' use of other technologies. As such, National Citizen Survey was conducted by the authors to collect data from citizens across the country. Existing and interested customers of fintech self-reported. Researchers can critically evaluate the appropriateness of self-reported data in assessing fintech readiness. Further review may be necessary on the logic and mathematical construction used for the CFR. Whether the use of confirmatory factor analysis and feature elimination tactics would bring more rigor to the CFR needs to be investigated.

In further extending the investigation of fintech's contribution to sustainable economic development, future researchers can look into a more detailed list of goals, indicators, and alternative proxy measurements as sustainable development parameters and look at the effect of a larger number of fintech growth variables

on these. This will provide further empirical justification for our conclusions – and may lead to more nuanced insights.

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Appendix A: District Ranking for NCS Sampling

Division	District	Total	(1)	(2)	(3)	(4)	(5)	Weighted Average Score
Barisal	Barguna	6	0	0	1	5	0	3.83
	Barisal	10	0	0	4	5	1	3.70
	Bhola	7	0	5	0	2	0	2.57
	Jhalokati	4	0	1	2	0	1	3.25
	Patuakhali	8	0	0	2	4	2	4.00
	Pirojpur	7	0	0	4	2	1	3.57
Chittagong	Bandarban	7	0	0	0	1	6	4.86
	Brahmanbaria	9	7	2	0	0	0	1.22
	Chandpur	8	0	0	3	3	2	3.88
	Chittagong	30	8	11	8	3	0	2.20
	Comilla	17	0	6	11	0	0	2.65
	Cox's Bazar	8	0	4	2	1	1	2.88
	Feni	6	5	1	0	0	0	1.17
	Khagrachhari	9	0	0	0	1	8	4.89
	Lakshmipur	5	0	0	2	1	2	4.00
	Noakhali	9	2	2	2	1	2	2.89
	Rangamati	10	0	0	1	1	8	4.70
Dhaka	Dhaka	55	45	8	1	1	0	1.24
	Faridpur	9	6	3	0	0	0	1.33
	Gazipur	13	7	6	0	0	0	1.46
	Gopalganj	5	0	0	3	2	0	3.40
	Kishoreganj	13	0	0	0	1	12	4.92
	Madaripur	4	4	0	0	0	0	1.00
	Manikganj	7	0	2	4	1	0	2.86
	Munshiganj	6	6	0	0	0	0	1.00
	Narayanganj	5	5	0	0	0	0	1.00
	Narsingdi	6	4	2	0	0	0	1.33
	Rajbari	5	0	0	2	3	0	3.60
	Shariatpur	6	0	4	2	0	0	2.33
	Tangail	12	0	3	7	2	0	2.92
Khulna	Bagerhat	9	0	2	6	1	0	2.89
	Chuadanga	4	0	0	3	1	0	3.25
	Jessore	8	0	0	4	4	0	3.50
	Jhenaidah	6	0	0	1	4	1	4.00
	Khulna	15	0	1	1	13	0	3.80
	Kushtia	6	1	3	2	0	0	2.17
	Magura	4	0	0	0	0	4	5.00

	Meherpur	3	0	0	2	0	1	3.67
	Narail	3	1	2	0	0	0	1.67
	Satkhira	7	1	6	0	0	0	1.86
Mymensingh	Jamalpur	7	0	0	0	0	7	5.00
	Mymensingh	13	0	1	5	6	1	3.54
	Netrokona	10	0	0	0	7	3	4.30
	Sherpur	5	0	0	0	3	2	4.40
Rajshahi	Bogra	12	1	2	5	4	0	3.00
	Joypurhat	5	0	2	3	0	0	2.60
	Naogaon	11	0	0	1	7	3	4.18
	Natore	7	0	3	2	2	0	2.86
	Chapai Nawabganj	5	0	0	0	1	4	4.80
	Pabna	9	0	0	6	1	2	3.56
	Rajshahi	15	3	10	1	1	0	2.00
	Sirajganj	9	0	0	3	6	0	3.67
Rangpur	Dinajpur	13	0	0	0	0	13	5.00
	Gaibandha	7	0	0	0	0	7	5.00
	Kurigram	9	0	0	0	0	9	5.00
	Lalmonirhat	5	0	0	0	3	2	4.40
	Nilphamari	6	0	0	0	0	6	5.00
	Panchagarh	5	1	1	2	1	0	2.60
	Rangpur	8	0	0	0	4	4	4.50
	Thakurgaon	5	0	0	0	5	0	4.00
Sylhet	Habiganj	9	1	6	2	0	0	2.11
	Moulvibazar	7	3	2	2	0	0	1.86
	Sunamganj	11	0	6	3	1	1	2.73
	Sylhet	13	4	9	0	0	0	1.69

Appendix B: NCS Questionnaire

Institute of Information Technology
University of Dhaka

Phone: 8801779482994
Website: http://www.iit.du.ac.bd
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Study Title: Challenges and Way outs of Sustainable Economic Growth through Fintech Ecosystem in Bangladesh

Instrument Category: Questionnaire for Household Survey

Respondent: Household Head/ Spouse of the Household Head

Project

Centennial Research Grant (CRG)
University of Dhaka

Conducted By

Institute of Information Technology
University of Dhaka

March, 2022

Consent Form

Greetings,

My Name is: ----------. I have come from the Institute of Information Technology, University of Dhaka to collect data for the study titled "Challenges and Way outs of Sustainable Economic Growth through Fintech Ecosystem in Bangladesh". Now, I am explaining the details of the study.

One of the major objectives of the study is to capture the readiness of citizen for fintech services. You have been selected as one of the respected respondents of this study. I would like to ask you some questions regarding this study, for example, areas of concern using fintech, challenges and obstacles you are facing, your level of satisfaction, ways of improving user friendliness etc. Your responses will only be used for research purpose. The name of any respondent of this study will not be mentioned in the report or data set. Nonetheless, there is a possibility of contacting again with the respondent, if needed.

Now I seek your cooperation in this regard. I hope you will response to my questions properly. Your responses may help the policy maker to design policies for improving the fintech services and thus, the nation and the country will be benefited. Please be assured that if you like to withdraw from the study at any point, you may do so without any restrictions from the investigators.

If you want to know more details of the study, please communicate with Dr. Md. Mahbubul Alam Joarder, Professor, Institute of Information Technology, University of Dhaka, Chief Investigator of the study, Mobile: 01755000011. You can ask me if you want to know any further information.

Do you have any further question about this research? **(Advise: If the respondent asks any question, please try to answer properly)**

May I now start to ask you questions in this regard?

- □ Yes ----------1
- □ No ----------2 (Stop interviewing)

Interviewer's signature

(Sign after getting proper consent)

				2	0	2	2

Date

Day Month Year

Interview starting time : | | | | | Hour | Minute

Interview ending time : | | | | | Hour | Minute

Section-1: Socio-demographic information of the respondent

Sl.	Question	Response	Code
101	Name of the respondent		×
102	Phone number		×
103	District		
104	Upazila		
105	Union/ Municipality		
106	Ward		
107	Gender		Male---------- 1 Female ---------- 2 Others ---------- 3
108	Age		×
109	Highest Level of Education		No formal education ---------- 1 Primary (Class-1 to class 5) ---------- 2 Secondary (Class 6-12) ---------- 3 Higher Secondary (11-12) ---------- 4 Undergraduate ---------- 5 Post graduate & above ---------- 6
110	Marital status of the respondent		Married ---------- 1 Unmarried ---------- 2 Others ---------- 3
111	Main occupation		No job ---------- 01 Government service holders---------- 02 Private jobs---------- 03 Business owners ---------- 04 Teaching---------- 05 Farming/ Fishing/ Boating ---------- 06 Driver (Rickshaw/ van/ motor vehicle) ---------- 07 Housewife ---------- 08 Remittance earner ---------- 09 Daily wage basis ---------- 10 Government allowance receivers ----- 11 Retired ---------- 12 Others (Specify ……) ---------- 13
112	Household size		×

Section-2: Financial Health

Sl.	Question	Response		Code
201	How much is your household's average monthly income?			BDT
202	What is the average monthly expenditure of your household?			BDT
	Expense category	**Amount**	**In %**	
	202.1 House Rent			
	202.2 Utilities			
	202.3 Education			
	202.4 Health care			
	202.5 Entertainment			

Sl.	Question	Response	Code
	202.6 Clothing		
	202.7 Support staffs		
	202.8. Others (specify)		
203	How much is your household's annual savings?		BDT
204	What is the ownership status of your house?		Own House ---------- 1 Rented house ---------- 2 Govt quarters ---------- 3
	Structure of the house		Concrete house---------- 1 Other house ---------- 2 Govt quarters ---------- 3
205	What is the main mode of transport you used regularly?		Own vehicle ---------- 1 Ride sharing/UBER/Pathao ---------- 2 Public transport/Bus/Train/ water vehicle---------- 3 Auto rickshaw/ CNG ---------- 4 Rickshaw/Van ---------- 5 Others (specify----------) ---------- 6

Section-3: Financial Literacy

Sl.	Question	Response	Code	Skip
301	Do you have a bank account?		Yes---------- 1 No ---------- 2	➡302 ➡306
302	Name of the bank		×	
303	How frequently do you go to bank?		Once a week---------- 1 Twice a month ---------- 2 Once a month---------- 3 4 to 5 times a year ---------- 4 Once a year ---------- 5	
304	Do you take any support/ assistance for your banking transaction?		No, I can do my transaction by myself ---------- 1 Yes, I take support from someone in the bank---------- 2 Yes, I take a person with me while I go to a bank 3	➡ 305 ➡ 306
305	How confident you are to complete any financial transactions alone?		Not confident at all ---------- 1 Low confidence ---------- 2 Moderately confident ---------- 3 Confident ---------- 4 Very much confident ---------- 5	
306	Rate your financial knowledge		No knowledge at all ---------- 1 Low knowledge (Understand deposit and withdrawal of money) ---------- 2	

			Moderate knowledge (Understand different deposit schemes and loan products) ---------- 3 More than average people (Comfortable with LC, stock market analytics, financial reports, financial ratios, etc.) ---------- 4 Expert (Certified financial expert) ---- 5	

Section-4: e-Readiness

Sl.	Question	Response	Code	Skip
401	Do you have access to computer?		Yes---------- 1 No ---------- 2	➡ 402 ➡ 403
402	If yes, then how?		I have my personal computer ---------- 1 I have a computer in my home for all the people ---------- 2 I have to go to cybercafé/ school/ ask favor to a known person to use a computer ---------- 3 Shop ---------- 4	
403	Do you have a mobile phone?		Yes---------- 1 No ---------- 2	➡ 404 ➡ 405
404	What type of phone you have?		Feature phone ---------- 1 Smart phone ---------- 2	
405	Do you use internet?		Yes---------- 1 No ---------- 2	➡ 406 ➡ 408
406	If yes, what type of internet you use?		LTE ---------- 1 2G ---------- 2 3G---------- 3 4G ---------- 4 5G ---------- 5 I don't know ---------- 6	
407	If yes, how much data you use monthly basis?		MB/ GB	
408	How comfortable you are to use smart phone and computer applications?		Not comfortable at all ---------- 1 Low comfortable---------- 2 Moderately comfortable---------- 3 Comfortable ---------- 4 Very much comfortable ---------- 5	

Section 5: Mental readiness

501. Rate your major concerns related to trust/mental readiness regarding fintech.

Areas of concerns	Level of concerns					
	1. Very low	2. Low	3. Moderate	4. High	5. Very High	6. Don't know
501.1 Data Privacy						
501.2 Fear of the unknown						
501.3 Limited regulations						
501.4 Scandals						
501.5 Cashless society/ transactions						
501.6 Data security						

Sl.	Question	Response	Code	
502	How ready you are mentally to use fintech services for your daily financial transactions?		Not at all ----------	1
			Low ----------	2
			Moderate ----------	3
			More than average----------	4
			Very much ----------	5

Section-6: Usage of Financial Technology

Sl.	Question	Response	Code		Skip
601	Do you have a mobile financial account?		Yes----------	1	➡602
			No ----------	2	➡604
602	If yes, where? (Multiple response)		bkash----------	01	
			Rocket ----------	02	
			SureCash ----------	03	
			Nagad ----------	04	
			M-Cash ----------	05	
			Upay ----------	06	
			TCash ----------	07	
			Ok-wallet ----------	08	
			My cash ----------	09	
			Others ----------	10	

603. What kind of services you use through mobile financial account?

Services	Status 1. Yes 2. No 3. Doesn't know	Number of transactions in a month	Monetary value (BDT) in a month
603.1 Money transfer			
603.2 Utility bill payment			
603.3 Mobile phone bill payment			
603.4 Shopping/ vendor payment			
603.5 Credit card bill payment			
603.6 Cash out			
603.7 Savings			
603.8 Investment			
603.9 Insurance			
603.10 Loan			

604. Do you use internet banking (i.e., transaction through website of the bank)?

- Yes ➡ 605
- No ➡ 701

605. If yes, what kind of services you receive using internet banking?

Services	Status 1. Yes 2. No 3. Doesn't know	Number of transactions in a month	Monetary value (BDT) in a month
605.1 Money transfer			
605.2 Utility bill payment			
605.3 Mobile phone bill payment			
605.4 eCommerce payment			
605.5 Credit card bill payment			
605.6 DPS instalment payment			
605.7 Savings			
605.8 Investment			
605.9 Insurance			
605.10 Loan			
605.11 Foreign transactions			

Section 7: Level of satisfaction and degrees of obstacles

Sl.	Question	Response	Code	
701	How satisfied (overall) you are using the financial technology services?		Not satisfied at all ----------	1
			Low satisfaction ----------	2
			Moderately satisfied----------	3
			Satisfied ----------	4
			Very much satisfied ----------	5
			I don't use any financial technology services----------	6

702	With what financial technology service you are most satisfied?		Internet Banking 1 Mobile Banking 2 I don't use any financial technology services---------- 3
703	With what financial technology service you are least satisfied?		Internet Banking 1 Mobile Banking 2 I don't use any financial technology services---------- 3
704	According to you how expensive the financial technology services are?		Cheapest ---------- 1 Low expense ---------- 2 Moderately expensive ---------- 3 Expensive---------- 4 Very much expensive ---------- 5
705	How much you are willing to pay for every 1000-taka cash out transactions?		BDT

706. What are the degrees of each the obstacles for you to use financial technology services?

Obstacles	1. Very low	2. Low	3. Moderate	4. High	5. Very high
Your own financial health					
Your geographic location					
Your academic background					
Your occupation/ profession					
Your knowledge about Financial Literacy					
Your trust to financial technology providers					
Personal technological capabilities					
Lack of technological readiness of the service providers					
Lack of better user experience of the services					
Support service inadequacy					
Government restrictions					

Sl.	Question	Response	Code
707	How available financial technology services are to you?		Not at all ---------- 1 Low ---------- 2 Moderate ---------- 3 Satisfactory---------- 4 Very much ---------- 5
708	How affordable financial technology services are to you?		Not at all ---------- 1 Low ---------- 2 Moderate ---------- 3 Satisfactory---------- 4 Very much ---------- 5

709	Name fintech services you expect to use in coming days. (Multiple response)		Money transfer 01 Utility bill payment 02 Mobile phone bill payment 03 Shopping/ vendor payment 04 Credit card bill payment 05 Cash out 06 Savings 07 Investment 08 Insurance 09 Loan 10 Others (please mention) 11
710	List your expectations from the service providers in coming days. (Multiple response)		User friendly mobile application 01 Low charge for financial technology services 02 Quality service 03 Quick response for services 04 More money outlet points 05 More and different types of financial technology services 06 Easy registration 07 Information system security 08 Protection from fraudulent activities 09 Others (please mention) 10
711	List your expectations from the government authorities in coming days.		Sustainable competitive environment among the operators 01 Service quality supervision 02 Quick law agency responses for fraudulent activities 03 Information security 04 Privacy 05 Others (please mention) 06

Section 8: Sustainable Growth

Sl.	Question	Response	Code
801	Do you agree that financial technology may contribute to social development?		Not at all ---------- 1 To some extent ---------- 2 Moderately ---------- 3 Strongly ---------- 4 Very strongly---------- 5
802	Do you agree that financial technology may contribute to economic development of the country?		Not at all ---------- 1 To some extent ---------- 2 Moderately ---------- 3 Strongly ---------- 4 Very strongly---------- 5
803	Do you agree that financial technology may improve environmental situation?		Not at all ---------- 1 To some extent ---------- 2 Moderately ---------- 3 Strongly ---------- 4 Very strongly---------- 5

804. Any other comment:

- End of Questionnaire -

Appendix C: List of Countries in Panel Data Regression

Sl. No.	Country	Group	ATM Growth	POS Growth	GDP Growth
1	Argentina	UMIC	4.52%	5.03%	-0.18%
2	Australia	HIC	-1.77%	2.73%	2.35%
3	Belgium	HIC	-9.66%	9.53%	1.25%
4	Brazil	UMIC	-0.92%	20.85%	0.37%
5	Canada	HIC	1.70%	9.62%	1.56%
6	China	UMIC	10.58%	22.24%	6.69%
7	France	HIC	-0.99%	7.68%	0.91%
8	India	LMIC	9.49%	24.51%	5.46%
9	Indonesia	LMIC	1.34%	14.73%	4.34%
10	Italy	HIC	-1.17%	12.10%	-0.20%
11	Japan	HIC	-1.03%	3.91%	0.52%
12	Korea	HIC	-0.51%	#DIV/0!	2.63%
13	Mexico	UMIC	4.05%	10.84%	1.46%
14	Netherlands	HIC	-17.40%	7.41%	1.26%
15	Russia	UMIC	10.79%	22.55%	1.37%
16	Saudi Arabia	HIC	3.18%	31.70%	1.87%
17	Singapore	HIC	-0.34%	10.93%	3.26%
18	South Africa	UMIC	3.27%	6.72%	0.98%
19	Spain	HIC	-1.76%	4.74%	0.53%
20	Sweden	HIC	-4.18%	4.68%	1.92%
21	Switzerland	HIC	0.04%	6.82%	1.62%
22	Turkey	UMIC	6.44%	3.03%	5.22%