Peer Pressure, Information Technology Adoption, and Bank Performance

Md Al Mamun, Mahfuja Malik* and Md Abdul Hannan Mia

ABSTRACT

Manuscript type: Research paper
Research aims: The study examines cross-sectional dependence among banks to invest in information technology-related assets. We also analyse the short- and long-term impacts of information technology (IT) adoption on banks' profitability and the variations in effects between early and late adopters.
Design/Methodology/Approach: The study uses autoregressive distributed lag (ARDL) with dynamic fixed approach, standard fixed-effect ordinary least square and random effect model with double clustering regressions.
Research findings: The study finds a positive effect of peer pressure on a bank's investment in IT assets. It also documents that IT adoption reduces short-term profitability, but the joint effect of early adoption increases both short- and long-term profitability.
Theoretical contribution/Originality: The study contributes to the banking and technology adoption literature by showing the evidence on a positive and significant effect of peer pressure on IT adoption.
Practitioner/Policy implications: The findings are significant for the banking sector's policy makers in emerging economies.
Research limitation: The findings may not be applicable in the context of a developed economy with a strong IT infrastructure.

Keywords: Cross-sectional dependence, IT adoption, Peer pressure, Bank profitability
JEL Classification: C22, G21, Z19

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1. Introduction

Bill Gates once argued that "banking is essential, banks are not," (Gani, 2019) and projected that traditional banks would eventually disappear, as electronic banking provides customers with unique, convenient, and user-friendly service. Since 1997, information technology (IT) in the banking sector has gained widespread attention (Stevenson, 1997), and the banking sector has become increasingly dependent on IT infrastructure for its operations, such as transfers, payments, settlements, collections, credit, and lending (UNCTAD, 2002). In its information communication for development initiatives, the World Bank (2011) called for more investment in IT to improve the efficiency of the financial services industry and achieve sustainable financial service development. Given the increased importance of IT infrastructure, we find it intriguing to examine the role of peer pressure in IT adoption in the banking industry and the short- and long-term impacts of IT adoption on bank profitability.

Using data from the banking industry in Bangladesh, the world's fourth-fastest growing economy, we find that IT adoption in the banking sector increases with its peer group's IT adoption, and that such adoption significantly impacts bank profitability. We also document that IT adoption reduces current and near-term profitability, but significantly increases long-run profitability. Although IT adoption reduces current and short-term profits due to the costs involved in IT investment, banks can receive short-term benefits and be early adopters. Thus, our study documents the first evidence for cross-sectional dependency as an essential determinant of IT adoption for banks, the benefits of early adopters, and the short- and long-term effects on creating value in the banking sector.

The financial service industry has always adopted IT to respond to new business needs and stay competitive. The central argument for IT-based automation is based on improved operating efficiency, customer satisfaction, new market opportunities, improved response times to market opportunities and threats, and removing information asymmetry from the marketplace. Prior literature tends to focus on the impacts of IT adoption on bank performance; however, the findings are inconclusive. For example, Kamel (2005), Delgado et al. (2006), DeYoung et al. (2007), Onay and Ozsoz (2012), and Acheampong and Moyaid (2016) document the positive impacts of IT adoption on bank performance, whereas Furst et al. (2002), Sathye (2005), and DeYoung (2005) document negative or insignificant impacts. On the other hand, Siam (2006) and Akhisar et al. (2015) present mixed findings regarding IT influence on banking sector

performance. However, these studies focus on the impacts of IT adoption, and there is no existing research on the motives and factors influencing IT adoption strategy. Our study fills this gap in the literature by identifying peer pressure as one of the significant factors for banks' IT investment decisions and examining the short- and long-term impacts of IT adoption on bank profits.

Using data from Bangladesh, we examine the cross-sectional dependency factor behind IT adoption and its impacts on bank profitability. Investigating IT adoption within the context of an emerging economy's banking system, especially in Bangladesh, is an intriguing idea for several reasons. First, Bangladesh is the world's fourth-fastest growing economy, measured by real GDP growth (Jenkins, 2011), and banking is one of its most significant economic sectors. The institutional settings of the banking industry in Bangladesh also differ from those in other countries because, for most banks, sponsor shareholders dominate ownership control and board composition (Reaz & Arun, 2006). More importantly, the economic dynamics, infrastructure, education, and IT awareness in emerging economies differ from those in developed countries.

Second, Bangladesh is one of only a few developing countries to make IT adoption its primary development agenda. The current government, which in the 2009 general election ran on the slogan 'Digital Bangladesh,' has invested heavily to improve Bangladesh's overall IT infrastructure. Responding to the increasing global trend of IT adoption, the government introduced its Information Communication and Technology Act 2006 (ICT, amended in 2009), which encouraged banks to engage aggressively in IT adoption, and IT investment in the Bangladeshi banking sector has since grown significantly. Given this unique setting, we examine whether IT adoption by most Bangladeshi banks is driven by profits, a need to prepare for future market opportunities, or, most importantly, to retain market share in a fiercely competitive market.

Our investigation uses a sample of 19 commercial banks, which comprises 40% of the entire banking industry in Bangladesh. The sample period of our study is 2006 to 2012, which was the period when most of the banks started automation and IT adoption. We argue that IT adoption in the banking industry is not necessarily an immediate profit-driven strategy but, more likely, a 'capacity-building' investment for 21st-century banks to maintain market shares in a competitive industry and ensure long-term profitability. We support our capacity building argument by examining other banks' influence on IT adoption within a specific bank. We use a

cross-sectional dependence test to find a positive and significant effect of peer IT adoption pressure on a bank's IT adoption policy. We also address the issue of whether there is an incentive for early IT adopters in their design and delivery of banking services.

Although IT adoption is negatively related to short-term profitability, the joint effect of early IT adoption and overall IT adoption in the long term positively contribute to a bank's profitability. Finally, our findings suggest that IT adoption in the banking industry is not driven by immediate profit motives but rather by industry trends and peer pressure, with long-term performance consequences. Our results are robust under various estimation techniques and modeling iterations.

We contribute to literature in several ways. First, we show evidence of a positive and significant effect of peer pressure on IT adoption in the banking industry, while prior literature shows nothing about this line of reasoning. Second, previous studies provide mixed evidence of the impact of IT adoption on bank profitability. Using an intuitive explanation of IT adoption, we demonstrate that while IT adoption does not translate into immediate profits, it contributes significantly to long-term performance. Third, we contribute to the literature by showing that while IT adoption is not immediately profit-driven, first movers can substantially augment their short- and long-term profits. This evidence is also new to banking literature. Finally, our study extends the literature related to emerging economies, whereas most of the research conducted in the banking sector focuses on the perspective of developed countries.

2. Literature Review

2.1 IT in the Bangladeshi Banking Industry

IT-based automation in Bangladesh is a recent phenomenon. Although it has made significant progress recently, Bangladesh is ranked 88th out of 131 countries in the World Economic Forum's Network Readiness Index 2022. Despite having poor overall IT infrastructure in the early 2000s, the adoption of IT-based automation in Bangladesh's banking system grew at an advanced pace. Ali, Rahman, and Azam (2007) point out that IT-based automation services have been available in Bangladesh since 2001. In 2003, the Dutch-Bangla Bank (DBBL) became the first bank in Bangladesh to introduce fully automated banking services, and by 2005 other major banks had adopted or started to adopt IT-based automated banking systems. The government of Bangladesh, responding to the increasing

consciousness of IT-based automation in banking and other sectors, introduced its ICT Act in 2006, which was further amended in 2009. By 2011, almost all Bangladeshi banks had automated their banking services with ATM booths, e-banking, and mobile banking facilities.

2.2 Hypothesis

Understanding the economic impact of IT adoption is an essential issue, and a vast body of literature is investigating its value (Melville et al., 2004; Wade & Hulland 2004). In general, superior IT capabilities give companies a competitive advantage. Although the literature has investigated the association between the adoption of IT and bank performance (particularly profitability) in the contexts of various countries, the evidence indicates a mixed relationship between IT adoption and bank profitability (Fredric & Pritam, 2003; Shu & Strassmann, 2005; Mia et al., 2007; Beccalli, 2007; Hernando & Nieto, 2007; Ciciretti et al., 2009; Stella, 2010).

Theoretically, adopting new technology that leads to process improvements should lead to higher productivity and improved cost efficiencies. Sato, Hawkins, and Berentsen (2001) argue that the internet and technologies have a prominent effect on how financial services are delivered. Because higher investment in IT logistics improves operating efficiency, it should translate into improved financial bottom lines, i.e., return on assets, net interest margin, or net profit margin. However, the impact of IT on the banking industry's operating efficiency and profitability is sensitive to various bank-specific characteristics. Moreover, the result of IT adoption on profitability may not be direct since IT itself does not generate profits; rather, it depends on how banks use IT (Matthew & Ibikunle, 2012).

Although one of the most compelling arguments for IT augmenting profitability in the banking sector is in the reduction of operating costs, Ou, Hung, Yen, and Liu (2009), using a sample of 35 Taiwan banks from 1992 to 2001, analyse the impact of ATM intensity on cost efficiency. Surprisingly, they find that self-service technology (SST) in general and ATMs in particular have a negative impact on a firm's cost efficiency. However, Beccalli (2007), using a sample of 737 European banks, documents a positive influence of IT on profits, while acquisition costs of hardware and software had a negative effect. Fredric and Pritam (2003) use a sample of Asia-Pacific banks and find that IT investment increases productivity—although the study documents a weak relationship between IT infrastructure and productivity in Japanese banks compared to other Asia-Pacific banks. Unlike the Japanese experience, Shu and Strassmann (2005), using

a US banking setting, conclude that IT adoption is the only input variable that provides greater dollar value than its input cost—on the margin compared to the interest expense, non-interest expense, staff cost, and operating expense. Together, these results seem to suggest that the state of the economy may play a vital role in linking IT adoption and banking profitability.

Despite Bangladesh's remarkable growth in IT adoption, evidence of success or failure in its banking sector is hard to find. Prior research focus on the status of development and the prospect of electronic banking in Bangladesh (Shah Alam et al., 2007; Shamsuddoha, 2008; Baten, Kamil, 2010), its perceived usefulness, security, and privacy, customer attitude, problem and prospect, and customer satisfaction (Nupur, 2010) of IT-based banking. Hence, prior studies in Bangladesh are still silent on IT adoption's impact on the banking sector's profitability. Given the empirical gap in the literature and recalling the evidence of inconsistent international evidence, we formulate the following null hypothesis:

H_1: There is no cross-sectional dependency among banks concerning TI adoption.
H_2: IT adoption does not affect banks' profitability.

3. Sample Design and Variables

3.1 Sample Selection

When IT-based automation started in the early 2000s, there were 48 banks in Bangladesh. We intend to focus on the entire banking industry. However, data availability was a critical challenge, which reduced our sample to 19 banks. Our sample period is from 2006 to 2012, and several reasons exist for selecting these years. First, although Dutch-Bangla Bank (DBBL) was the first bank to introduce fully automated banking services in 2003, in Bangladesh, IT adoption in banking did not take off until late 2005.

Second, since early 2013, Bangladesh banks have undergone significant crises relating to non-performing loans, large-scale loan scams, and political unrest. A major scandal involved the Sonali Bank, one of Bangladesh's largest commercial banks. Between 2010 and 2012, one branch approved USD454 million in illegal loans, including nearly USD344 million to Hallmark Group, a textile business (Allchin, 2016). The same bank plundered USD212 million from 37 other commercial banks, including 25 private banks, five foreign banks, and seven government-owned banks—news of which surfaced in late 2012. More recently, USD951 millions of Bangladesh's

foreign exchange reserves were stolen from its account at the Federal Reserve in New York. Not surprisingly, the public lost confidence in the banking sector, bank profits declined, and non-performing loans increased.

Third, the aftermath of the 2013 banking crisis resulted in a severe liquidity crisis and a significant decline in depositor confidence. Moreover, in 2014 Bangladesh held a general election, which, marred by political violence, led to economic instability. Therefore, we restrict our sample to 2006 to 2012 and consider it a clean period that avoids the economy's banking sector's turmoil, and more importantly, these years capture the early stages of the IT adoption process in the banking industry of Bangladesh.

3.2 Variables and Measures

To test our empirical prediction of a possible link between IT adoption and banking sector profitability, we use several variables—mobile banking transactions, internet banking transactions, the number of ATM booths, ATM investment, IT assets, and e-banking transactions—to capture a bank's overall IT adoption. Because understanding the impact of overall IT adoption is quite complex, we capture the accurate and maximum effects of IT adoption on the banking sector using principal component analysis (PCA) of factors such as IT investment, number of ATM booths, mobile banking transactions, internet banking transactions, and ATM investment. The PCA is a multivariate data analysis technique used to extract meaningful information from complex data sets by decreasing the dimensionality in data while retaining all available variation within it (Jolliffe, 2002). Unreported Eigenvectors of the PCA scoring coefficients show that the PCA construct of the IT adoption variable significantly retains the information of the most critical component variables. Our main dependent variable, profitability, is measured by the natural logarithm of net income.[1]

We also include several control variables such as total assets for bank size, director fee for governance quality, number of branches to proxy for geographical spread, and the number of employees to capture the reliance on human capital and residual technology. We also include loans and advances, non-performing loans to account for other potential factors in a bank's profitability. We use the natural

[1] Using net income to total assets (ROA) as a measure of profitability yields qualitative results similar to our main result. Since we control for bank size and other variables, our result is free from scaling issues.

logarithm of the variables. Since there is no central electronic database in Bangladesh, to develop our data set, we manually search annual reports of respective banks, the Dhaka Stock Exchange (DSE) library, the Bangladesh Bank (BB) library, and a library of the Bangladesh Institution of Bank Management (BIBM).

4. Estimation Techniques

4.1 Panel methodologies

We use several estimation techniques to test our main empirical relation, which is robust to various methodological and modeling variations. First, we use standard fixed-effect ordinary least squares (OLS) to capture the steady-state relationship (Demetriades & Law, 2006) and all possible bank-specific unobserved characteristics. We also use a random effect model to mitigate the concern that our result is free from unwanted multicollinearity (Baltagi, 2005). We also check the robustness of our main result by using double clustering (cluster by year and bank) regression. The double clustering technique lessens concerns about the data's potential cross-sectional and time-series dependence (Petersen, 2009).

$$Profitability_{i,t} = \beta_0 + \lambda IT_{i,t} + \lambda Controls_{i,t} + \mu_{i,t} \quad (1)$$

$$Profitability_{i,t} = \beta_0 + \lambda IT_{i,t} + \lambda Controls_{i,t} + + \upsilon_{i,t} + \delta_{i,t} \quad (2)$$

Finally, we capture the dynamic nature of IT adoption using dynamic fixed effects (DFE). The benefit of DFE is that it can overcome various assumptions of static models, including strict exogeneity in error terms (Loayza & Ranciere, 2006) and that the errors are conditionally homoscedastic and not serially correlated, which may not always be correct (Sean & Mehdi, 2009). Furthermore, the DFE estimator restricts all slope coefficients to be equal across banks but allows for different intercepts for different banks. Following Pesaran, Shin, and Smith's (1999) autoregressive distributed lag (ARDL) specification to allow for rich dynamics in a way that bank profitability adjusts to the change in IT adoption and other control variables, we run the ARDL (p, q) error correction model as:

$$\Delta Profitability_{i,t} = \mu_i + \varphi_i\left(Profitability_{i,t} - \theta_i' * IT_{i,t}\right) + \sum_{j=0}^{p-1} \lambda_{i,j} \Delta Profitability_{i,t-j} + \sum_{j=0}^{q-1} \delta_{i,j}^{*'} \Delta IT_{i,t-j} + \sum_{j=0}^{q-1} \delta_{i,j}^{*'} \Delta Controls_{i,t-j} + \varepsilon_{i,t} \quad (3)$$

where $\theta_{i,j}'$ defines as - $(\beta_i / \emptyset_i)$ the long-run or equilibrium relationship between Profitability$_{i,t}$ and IT$_{i,t}$. In contrast $\lambda_{i,j}$ and $\delta_{i,j}^{*'}$ are short-run coefficients relating growth to past values and other determinants like Controls$_{i,t-j}$. The error-correction coefficient $\emptyset_i$ measures the speed of adjustment of Profitability$_{i,t}$ toward its long-run equilibrium following a change in IT$_{i,t}$. The condition $\emptyset_i < 0$ ensures that a long-run relationship exists and that the significant and negative value of $\emptyset_i$ is treated as evidence of cointegration between Profitability$_{i,t}$ and IT$_{i,t}$.

4.2 Cross-sectional Dependence[2]

With a relatively low temporal dimension of the data, we investigate the indication of cross-sectional dependence among those banks adopting IT. The presence of cross-sectional dependence would indicate the role of competitive peer pressure as a driver for IT adoption. This is because panel data exhibit substantial cross-sectional dependence in error due to common shocks and unobserved components, spatial dependence, and idiosyncratic pairwise dependence (Pesaran, 2004; Baltagi, 2005).

The past two decades have seen increased regulatory control of the global financial system, and the Bangladesh banking industry is no exception. Financial sectors, especially banking, have been heavily regulated. They compete fiercely for customers while operating within the same rigid regulatory environment. From a methodological perspective, our $T < N$, the LM test statistic exhibits substantial size distortions. We use Pesaran's (2004) approach to examine the cross-sectional dependence among the banks' IT adoption.

[2] Prior literature on peer pressure ignores the cross-section dependence test before moving on to test the effect of peer pressure on various corporate outcomes. We believe that such an approach is incorrect.

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1} * \sum_{j=i+1}^{N} \widehat{\rho_{i,j}}\right) \quad (4)$$

5. Descriptive Statistics

5.1 IT Adoption Status in Sample Bangladesh Banks

Since 2005, Bangladeshi banks have invested substantially in IT assets, yielding significant growth in the number of ATM booths, IT investment, and e-banking transactions. Table 1 shows the banking automation years and the average bank-wise IT infrastructure, investment, and transaction during the sample period. We find significant cross-sectional variations in the number of ATM booths, ATM investment, IT assets, and m-banking (mobile) transactions.

Table 1: Bank IT adoption summary statistics

Banks	Automation year	ATM booth	ATM investment	E-banking transactions	IT assets	M-banking transactions	Total IT transactions
Dhaka Bank	2007	21.71	*23.13*	*4,804.14*	*51.73*	*16.39*	*4,820.53*
Premier Bank	2007	21.43	*30.27*	*7,088.46*	*46.44*	*0.01*	*7,088.48*
Brac Bank	2005	130.86	*92.02*	*23,075.43*	*116.81*	*169.30*	*23,244.73*
Bank Asia	2007	28.29	*28.05*	*12,815.08*	*80.94*	*0.01*	*12,815.10*
Jamuna bank	2007	17.86	*15.70*	*3,774.78*	*49.36*	*0.00*	*3,774.78*
Eastern Bank	2007	37.86	*26.96*	*63,84.54*	*114.04*	*51.37*	*6,435.91*
Southeast Bank	2007	24.14	*29.91*	*13,420.27*	*154.54*	*0.00*	*13,420.27*
Mercantile Bank	2007	22.71	*30.06*	*11,754.66*	*92.61*	*0.14*	*11,754.81*
Trust Bank	2007	40.00	*25.45*	*10,150.29*	*29.90*	*0.24*	*10,150.54*
UCBL	2007	21.86	*14.61*	*8,122.02*	*96.58*	*0.00*	*8,122.02*
MTB	2005	39.86	*27.09*	*5,954.66*	*58.14*	*0.00*	*5,954.66*
DBBL	2003	641.71	*171.81*	*23,031.88*	*190.89*	*126.13*	*23,158.01*
City Bank	2005	40.57	*27.17*	*10,722.50*	*143.66*	*0.00*	*10,722.50*
Prime Bank	2005	23.00	*27.56*	*719.36*	*50.51*	*0.00*	*719.36*
Al-Arafah Bank	2008	7.86	*10.13*	*1,423.22*	*87.23*	*0.00*	*1,423.22*

Banks	Automation year	ATM booth	ATM investment	E-banking transactions	IT assets	M-banking transactions	Total IT transactions
Exim Bank	2005	6.86	*11.80*	*1,882.08*	*96.30*	*0.00*	*1,882.08*
ICB Islamic Bank	2009	12.00	*7.58*	*237.18*	*83.41*	*0.00*	*237.18*
Shahjalal Bank	2007	13.14	*18.07*	*1,222.81*	*60.39*	*0.00*	*1,222.81*
NCC Bank	2007	24.00	*24.21*	*1,368.25*	*73.04*	*0.00*	*1,368.25*

Note: All figures in *italics* are in BDT million. The conversion rate during our sample period was roughly between BDT 64-80/USD1.

Table 2 presents the summary statistics related to IT status and other control variables explaining banking sector profitability. The results suggest that significant differences in size exist among the selected banks, as reflected in the high standard deviation of total assets. However, compared to large variations among banks in total assets, the size of the bank's IT assets significantly lowers variations. Moreover, e-banking transactions are larger in volume than mobile banking transactions, and the number of ATM booths is highly dispersed. Overall, the reported standard deviation suggests a significant difference in total IT-based transactions among the banks.

Table 2: Summary statistics of the variables

Variables	Mean	Std. Dev.	Min	Max
Number of ATM booths	61.65	203.62	0.00	1,940.00
Number of branches	48.91	22.63	6.00	115.00
Number of employees	1,382.61	1,107.49	273.00	7,619.00
ATM investment	*33.54*	*54.61*	*0.00*	*452.69*
E-banking transactions	*7,800.68*	*9,118.03*	*26.29*	*47,680.00*
IT assets	*88.26*	*64.23*	*1.46*	*398.18*
Mobile banking transactions	*19.14*	*131.36*	*0.00*	*1,185.10*
Total IT based transactions	*7,819.82*	*9,182.07*	*26.29*	*48,865.10*
Total assets	*64,108.99*	*10,2461.70*	*4,678.90*	*1,165,530.00*
Fixed assets	*1,030.25*	*1,237.92*	*14.65*	*7373.11*
Net income	*1,227.45*	*2,813.88*	*89.11*	*32,476.01*
Non-interest income	*1,020.29*	*1,112.78*	*-71.09*	*5,257.85*
Interest income	*3,071.37*	*6,967.51*	*167.07*	*44,566.30*
Director fee	*2.52*	*2.09*	*0.23*	*12.20*
Non-performing loan	*982.15*	*744.77*	*23.40*	*4,762.03*
Loan and advances	*8,639.60*	*21,002.67*	*5,380.00*	*16,8891.78*

Note: All figures in *italics* are in BDT million. The conversion rate during our sample period was roughly between BDT 64-80/USD1.

5.2 Growth Patterns of IT Status in Sample Bangladeshi Banks

We examine the growth pattern of the IT-based banking status in our sample using temporal and cross-sectional graphs presented in Figures 1 and 2 respectively. Figure 1 includes four panels: Panel A compares ATM booths and number of branches; Panel B the investment in IT assets and ATM infrastructure; Panel C the transaction to investment (ATM infrastructure and IT assets) ratio; and Panel D the ratio of ATM booths to total branches. Panel A illustrates that the number of ATM booths has grown significantly in Bangladeshi banks. In 2006, the number of ATM booths of 19 banks in Bangladesh was 81; by 2012, this had increased to 2,996, indicating an average growth rate of 56% over the period. However, compared to the growth of ATM booths, the number of bank branches increased somewhat steadily at approximately 17.24% over the period.

Panel B suggests that the ATM investment of our sample banks increased from USD1.73 million in 2006 to USD14.87 million by 2012—a growth rate of 53.74%. However, the growth of IT assets is much higher, accounting for 29.23% of the total. A comparison between ATM and IT investments suggests that a large chunk of IT assets is the investment cost of ATM booths rather than other IT investment areas—mobile banking or e-banking infrastructure. Consistent with the growth pattern of IT investment, total IT-based transactions increased significantly from USD663.80 million in 2006 to USD3.52 billion by 2012. Panel C shows that while the transition to ATM investment ratio has dropped (or somewhat stabilised) over time, the overall transition to IT assets investment increased steadily. Finally, Panel D suggests that the ATM-booth-to-branch ratio of our sample banks increased significantly over time. A closer look indicates that, compared to bank branches, the increase in ATM booths took a sharp upturn after 2008, and several ATM booths surpassed the number of physical branches. This probably indicates a period of slow adoption of ATM services by consumers and banks before 2008—after which a new government, with its slogan 'Digital Bangladesh', encouraged banks to move quickly to increase ATM networks rather than branches, the former being cheaper to build and operate.

In Figure 2, we present several two-way scatter plots to present the cross-sectional comparison of IT status among sample banks over our sample periods. Panel A presents the comparative position of various banks with regard to IT assets and total IT (ICT) transaction. Panel B presents the comparative position of various banks with regard to IT assets and m-banking transactions; Panel C present the

Figure 1: Growth patterns of IT status in sample banks in Bangladesh

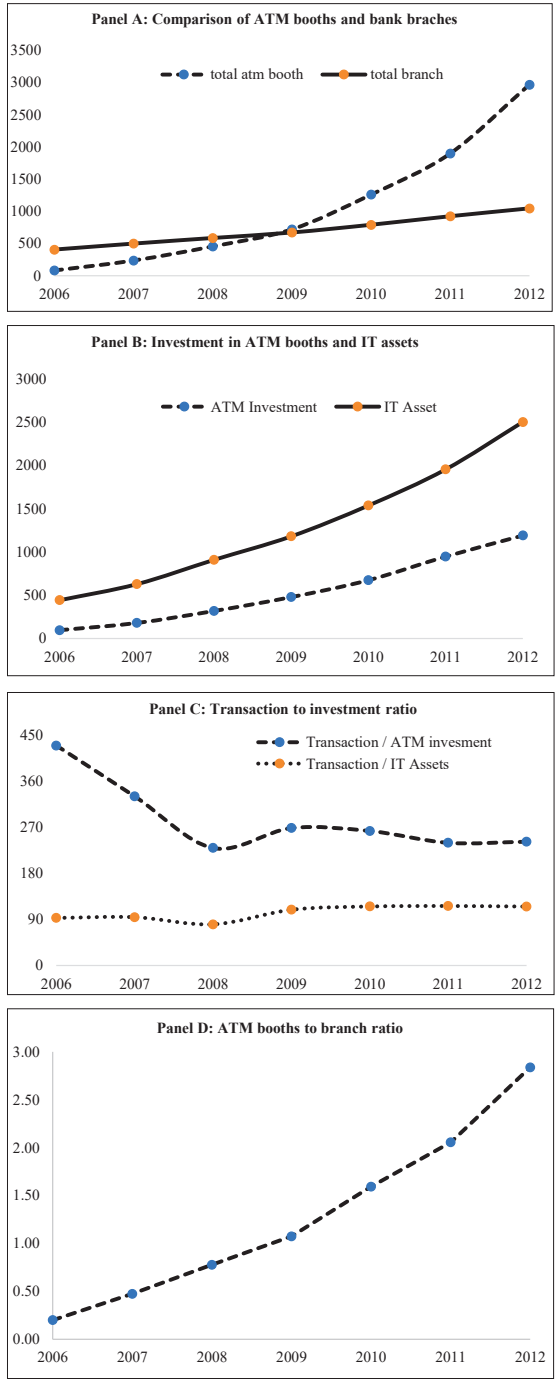
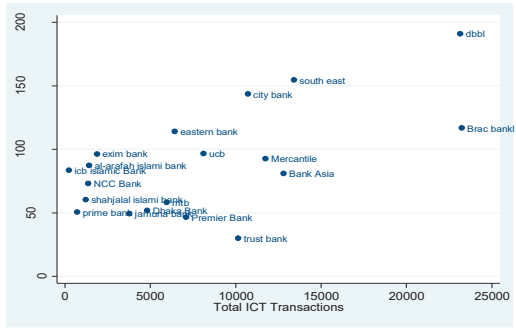
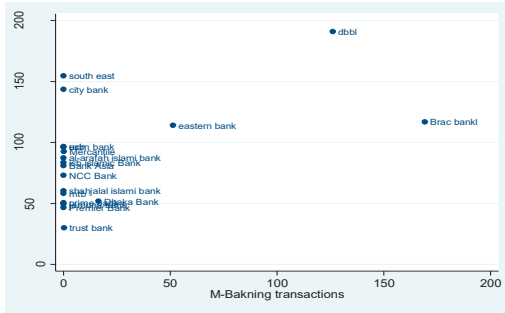


Figure 2: IT status among different banks in Bangladesh

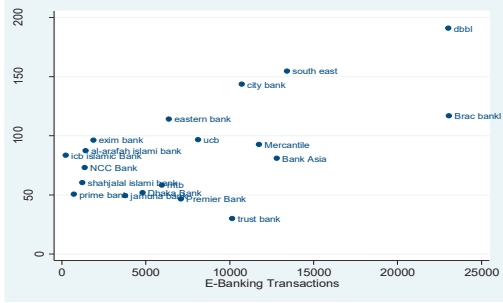
Panel A: Bank-wise IT asset vs. IT transaction



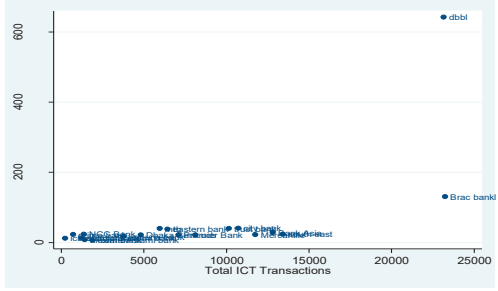
Panel B: Bank-wise IT asset vs. M-banking transaction



Panel C: Bank-wise IT asset vs. E-banking transaction



Panel D: Bank-wise ATM booth vs. total IT transaction



comparative position of various banks with regard to IT assets and E-banking transaction; and Panel D presents the comparative position of various banks based on ATM booth and total IT transaction. Panel A suggests a clear cross-sectional difference among banks regarding total IT transactions and investment. DBBL leads other banks in IT assets and IT transactions, while BRAC bank has relatively higher IT transactions with relatively lower IT assets than Southeast Bank, Eastern Bank, and City Bank. Other banks are clustered in lower bounds and present a cross-sectionality among them while trailing the leading banks. Panel B suggests a clear difference between various banks regarding total e-banking transactions and IT assets and that the cross-sectional differences are similar to the total IT-based banking transactions in Panel A. Panel C suggests a clear difference between various banks in total mobile banking transactions. BRAC bank is among the top in m-banking transactions with relatively low IT investment compared to other industry leaders—DBBL and Eastern Bank.

Interestingly, while most banks have IT assets, most do not offer m-banking services. Finally, Panel D suggests that DBBL and BRAC are industry leaders in several ATM booths compared to other banks and total IT-based transactions. With respect to the overall value of transactions, BRAC Bank has outperformed DBBL. The other banks are clustered in the graph's lower tail, indicating the possibility of cross-sectional dependence among the sample banks.

6. Empirical Results

In this section, we investigate the impact of IT adoption on bank profitability. Before proceeding to the main estimation, we use several customary checks of our data, including a possible multicollinearity test,[3] a test for heteroscedasticity,[4] and first-order serial autocorrelation.[5] Overall, the customary check suggests that OLS-based fixed effect, random effect, and double-clustered estimates are valid estimators. Our models control for bank and year effects

[3] Unreported results from Farrar-Glauber (1976) test suggest that the p-value of our respective variable is less than 1% for all the coefficients, alleviating the multicollinearity concern in our sample data.

[4] Untabulated results from Breusch-Pagan/Cook-Weisberg heteroskedasticity test show that the $\chi^2 = 7.18$ ($p > 0.00$), i.e., there is the presence of heteroskedasticity in our data set suggesting the robustness of the fixed effect model.

[5] Untabulated results from Wooldridge (2002) serial autocorrelation test show that the $F(1, 18) = 0.562$ with Prob. > F = 0.491, i.e., our data set does not have the first-order autocorrelation implying that OLS estimation is valid.

to account for the impact of any trend-specific and unobserved bank-specific variables. Results in Table 3 suggest that IT adoption decreases bank profitability, and this result is consistent under fixed effect, random effect, and two-way clustering estimators. Hence, our result supports the theory related to the learning curve effect of IT adoption (Robey et al., 2000).

With respect to control variables, a bank's total loans and advances impart a positive and significant effect on its profitability, which is consistent with our expectations. We also find the bank's size's positive and significant impact on financial performance. Surprisingly, the director's fee, a proxy of corporate governance, is negatively and significantly related to financial performance. This raises concerns about the performance relevance of corporate governance in the Bangladeshi banking sector and the possible fragility of the governance mechanisms. Our findings echo the widespread historical record of troubled loans, political influence in lending, and the series of recent banking scandals in Bangladesh. We further find that the number of branches, a proxy for geographical coverage, imparts a negative but insignificant effect on financial performance and that the number of bank employees has a positive but insignificant effect on financial performance. To understand the precise nature of the impact of IT and other control variables on banking sector profitability, we find that an increase in IT status of 1% leads to a 0.064% decline in banking sector profitability as measured by net income margin. The economic significance of the result is similar to other estimators.

Table 3: IT adoption and banking sector profitability

	Fixed effect	**Random effect**	**Two-way clustering**
	Model 1	**Model 2**	**Model 3**
ITADP	*-0.064[a]*	*-0.064[a]*	*-0.064[c]*
	(-2.64)	*(-2.64)*	*(-1.69)*
ln (size)	1.325[b]	1.325[b]	1.325[b]
	(2.20)	(2.20)	(2.08)
ln (director's fee)	-0.103[c]	-0.103[c]	-0.103[a]
	(-1.94)	(-1.94)	(-2.71)
ln (branch)	-0.004	-0.004	-0.004
	(-0.67)	(-0.67)	(-0.55)
ln (employees)	0.122	0.122	0.122
	(0.56)	(0.56)	(0.45)

	Fixed effect	Random effect	Two-way clustering
	Model 1	**Model 2**	**Model 3**
ln (non-performing loan)	0.049	0.049	0.049
	(0.73)	(0.73)	(0.41)
ln (loan and advance)	-0.032	-0.032	-0.032
	(-0.12)	(-0.12)	(-0.07)
Constant	-0.659	-0.727	-0.614
	(-0.35)	(-0.38)	(-0.31)
Adjusted R-square	0.843	0.8801	0.884
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	133	133	133

Profitability is measures by net income. The values in parentheses are the standard errors of corresponding coefficient estimates. [a], [b], and [c] indicate significance level at 1%, 5%, and 10%, respectively. In panel A, t-statistics is reported in parenthesis.

6.1 IT Investment in the Banking Industry

6.1.1 Cross-sectional Dependency on IT Investment

This section analyses the possibility of cross-sectional dependence among banks undertaking IT investment. We argue that the banking industry's IT investments are driven by competitive pressures, irrespective of any contribution to profitability. In simple terms, most banks must automate to attract and retain customers. Furthermore, investment in IT assets should be considered an investment in future capacity-building, and the realisation of profits from such investments may require a significant time lag. The interplay of Bangladesh's highly competitive banking industry structure can push competing banks to make such investments, possibly contributing positively to long-term profitability.

Following Pesaran (2021), we test for the presence of cross-sectional dependence (CD) in IT investment in the banking industry. Pesaran suggests this test is suitable as N tends to infinity and T is sufficiently large. In our case, we have N larger than T. Moreover, the test is possible for homogeneous/heterogeneous dynamic and nonstationary models. We also use a nonparametric test based on Spearman's rank correlation coefficient proposed by Friedman (1937) and Frees (1995).

In Table 4, Panel A presents the result of cross-sectional dependence among banks with respect to investment in IT assets using various methodologies. Panel B presents the result of the peer pressure on the investment of IT assets by banks. The result in Panel A suggests that the CD test strongly rejects the null hypothesis of no cross-sectional dependence. Although a possible drawback of the CD test is that adding up all positive and negative correlations may result in failing to reject the null hypothesis, even if there is plenty of cross-sectional dependence in the errors, this is not the case with our result. The average absolute correlation is 0.352, a very high value. Hence, there is sufficient evidence to suggest the presence of cross-sectional dependence in the IT assets investment by banks in our sample. Additionally, both Frees and Friedman tests provide contradictory results—Frees rejects the null of cross-sectional independence while Friedman does not. Since T ≤ 30, we emphasise the result of the Frees test. Hence, based on the result of the CD test, we conclude that IT investment by banks in Bangladesh is not endogenously but rather exogenously determined, supporting H1. Therefore, it is natural that IT investment's contribution to their profitability may not appear immediately.

Table 4: Cross-sectional dependence, peer pressure on bank's IT assets investment

Panel A: Cross-sectional dependence in IT assets investment	
Tests	**FE (IT Assets based)**
Pesaran test of cross-sectional independence	2.761 (0.005)
Average absolute value of the off-diagonal elements	0.352
Fres test of cross-sectional independence	0.365 (0.767c)
Friedman test of cross-sectional independence	17.165 (0.511)
Note: Alpha = 0.01 [0.7678]	

Panel B: Peer pressure in IT assets investment			
	Fixed effect	**Random effect**	**Two-way clustering**
	Model (1)	**Model (2)**	**Model (3)**
Peer ITTA	*0.019[b]*	*0.023[a]*	*0.031[a]*
	(2.22)	*(3.13)*	*(3.31)*
ln (size)	3.743a	3.449a	2.480
	(4.70)	(4.87)	(1.56)
ln (director's fee)	-0.116c	-0.082	-0.066
	(-1.71)	(-1.41)	(-0.83)
ln (branch)	0.007	0.005	0.003
	(0.94)	(0.81)	(0.40)

Panel B: Peer pressure in IT assets investment			
	Fixed effect	**Random effect**	**Two-way clustering**
	Model (1)	**Model (2)**	**Model (3)**
	(1.17)	(1.51)	(1.13)
ln (non-performing loan)	0.171[c]	0.152[c]	0.075
	(1.92)	(1.85)	(0.39)
ln (Loan and advance)	-1.104[a]	-1.108[a]	-0.746
	(-3.16)	(-3.36)	(-0.95)
Constant	-6.636[c]	-4.496	-3.765
	(-1.69)	(-1.37)	(-0.77)
Adjusted R-square	0.763	0.6158	0.594
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	133	133	133

Note: Values in parentheses are the standard errors of corresponding coefficient estimates. [a], [b], and [c] indicate significant level at 1%, 5%, and 10%, respectively.

6.1.2 Peer Pressure on IT Investment

Motivated by the result of the CD test, we perform an additional test to corroborate our explanation of cross-sectional rather than profit for a bank's IT investment. The extant literature documents the existence of 'peer pressure' on various firm-specific decisions—capital structure (Leary & Roberts, 2014), investment decision (Foucault & Fresard, 2014), corporate social responsibility-related decisions (Malik et al., 2019), and the extent of financial misconduct (Kaustia & Rantala, 2015). Given the evidence of cross-sectionality in bank IT assets, we examine the 'peer pressure' on investing in IT.

We construct an 'industry IT asset' variable by adding all the banks' IT assets net of the respective bank for each year. Using industry IT assets as a proxy for peer pressure, we investigate whether peer pressure contributes to the decision to invest in IT assets. Results in Panel B of Table 4 show that industry IT assets positively drive IT asset investments. The coefficients are positive and significant under all estimators. This indicates that while there is a cross-sectional effect (peer effect) on a bank's IT assets investment, the temporal impact is also significant. Our result provides evidence of peer pressure on banks to invest in IT assets.

6.2 *Early IT Adopters and Profitability*

Basu and Fernald (2007) document that industries with higher IT capital growth in the 1980s had higher productivity growth rates in the late 1990s. However, after controlling the lagged effect of IT capital growth in the late 1990s, this negatively relates to contemporaneous productivity growth. This indicates that growth in IT capital early on has a more critical effect than IT assets growth in later stages. Given this productivity phenomenon, we examine the impact of the early adopter of IT in the banking sector on a firm's profitability. We define a bank as an early adopter with a dummy variable as one in which a firm adopts IT in its operation in the year before the start of our sample. Since our sample period started in 2006, we consider DBBL, City Bank, Mutual Trust bank, BRAC Bank, and Prime Bank as early adopters of IT in banking operations. Although IT adoption does not contribute to contemporaneous and short-term profitability for our overall sample, early adopters may enjoy an immediate positive effect of IT adoption on their financial performance.

Table 5 presents the result of the role of the early adopter on the link between IT adoption and banking sector profitability. We define early adopter with a dummy variable as one if the bank adopts IT in its operation in years before the start of our sample. Specifically, DBBL, City Bank, Mutual Trust bank, BRAC Bank and Prime Bank are early adopters of IT in operations.

Consistent with our expectation, we document that the joint effect of IT adoption and the early adopter positively affects the banking sector's profitability. The result is significant in fixed and random effect estimators controlling bank and year effects. Overall, our result shows that early adopters enjoy a positive impact of IT adoption with a significant increase in profitability.

Table 5: IT adoption and banking sector profitability: Role of early adopters

	Fixed effect	**Random effect**	**Two-way clustering**
	Model (1)	**Model (2)**	**Model (3)**
ITADP	-0.158[a]	-0.140[a]	-0.066
	(-3.02)	(-2.75)	(-0.92)
Early adopter	0.001	-0.068	-0.132
	0.000	(-0.34)	(-0.49)
Early adopter* ITADP	*0.091*[b]	*0.086*[c]	*0.083*
	(2.02)	*(1.95)*	*(1.38)*

	Fixed effect	Random effect	Two-way clustering
	Model (1)	**Model (2)**	**Model (3)**
IT status	1.557[b]	1.203[b]	-0.275
	(2.57)	(2.25)	(-0.38)
ln (size)	-0.124[b]	-0.107[b]	-0.099
	(-2.33)	(-2.38)	(-1.46)
ln (director's fee)	-0.006	-0.004	-0.001
	(-0.95)	(-0.96)	(-0.45)
ln (branch)	0.096	0.072	0.027
	(0.45)	(0.49)	(0.16)
ln (employees)	0.046	0.009	-0.128
	(0.70)	(0.14)	(-1.13)
ln (non-performing loan)	-0.008	0.108	0.773
	(-0.03)	(0.42)	(1.47)
Constant	-1.725	-0.958	0.126
	(-0.89)	(-0.61)	(0.07)
Adjusted R^2	0.848	0.7260	0.730
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	133	133	133

Note: The values in parentheses are the standard errors of corresponding coefficient estimates. [a], [b], and [c] indicate significance level at 1%, 5%, and 10%, respectively.

6.3 IT Adoption and Cost Reduction

Achieving cost efficiency is one of the central arguments for adopting IT banking operations (Ou et al., 2009). While we do not document a contemporaneous improvement of a bank's profit, we believe that IT adoption by a bank would reduce its cost, mainly the operating and overhead expenses that would translate into future profitability. Hence, we examine the effect of IT adoption on a bank's non-interest fees, which include operating and overhead costs. Table 6 presents the result of the contemporaneous and one-year ahead role of IT adoption on banks' non-interest expenses. We measure the cost efficiency as the size of non-interest expense. Controlling bank size, governance, employees, and the geographical spread of a bank, we find that IT adoption has an adverse impact on the contemptuous cost structure of the banking sector. IT adoption's significant and negative effect on a bank's cost structure also holds for a one-year ahead

forecast level. Interestingly, the coefficient of IT adoption is higher in one-year-ahead models than that of the contemptuous model, suggesting that IT adoption is likely to contribute to the bank's profit in the long run.

Table 6: IT adoption and cost efficiency

Panel A: Cost efficiency at year t			
	Fixed effect	**Random effect**	**Two-way clustering**
	Model (1)	**Model (2)**	**Model (3)**
ITADP	*-0.141[a]*	*-0.141[a]*	*-0.141*
	(-3.43)	*(-3.43)*	*(-1.63)*
ln (size)	0.512	0.512	0.512[c]
	(1.20)	(1.20)	(1.87)
ln (deposits)	-0.718[a]	-0.718[a]	-0.718[s]
	(-3.89)	(-3.89)	(-3.25)
ln (director's fee)	-0.173[b]	-0.173[a]	-0.173
	(-2.61)	(-2.61)	(-1.54)
ln (employees)	0.650	0.650	0.650[b]
	(1.59)	(1.59)	(2.18)
ln (non-performing loan)	-0.052	-0.052	-0.052
	(-0.40)	(-0.40)	(-0.35)
ln (branch)	0.459	0.459	0.459
	(1.22)	(1.22)	(1.26)
Constant	5.458[c]	6.082[b]	6.733[b]
	(1.88)	(2.05)	(2.23)
Adjusted R^2	0.354	0.715	0.628
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	133	133	133

Panel B: Cost efficiency at year t+1			
	Fixed effect	**Random effect**	**Two-way clustering**
	Model (1)	**Model (2)**	**Model (3)**
ITADP	*-0.235[b]*	*-0.235[b]*	*-0.235[c]*
	(-2.41)	*(-2.41)*	*(-1.67)*
ln (size)	-0.479	-0.479	-0.479
	(-0.53)	(-0.53)	(-0.57)
ln (deposits)	-0.198	-0.198	-0.198
	(-0.95)	(-0.95)	(-0.63)
ln (director's fee)	-0.475[a]	-0.475[s]	-0.475
	(-3.18)	(-3.18)	(-1.43)
ln (employees)	0.954*	0.954[b]	0.954[c]
	(1.97)	(1.97)	(1.90)
ln (non-performing loan)	-0.313[b]	-0.313[b]	-0.313[b]
	(-2.08)	(-2.08)	(-2.13)
ln (branch)	0.184	0.184	0.184
	(0.41)	(0.41)	(0.34)
Constant	5.745	6.367	8.858
	(1.39)	(1.48)	(1.41)
Adjusted R-square	0.173	0.684	0.570
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	114	114	114

Note: The values in parentheses are the standard errors of corresponding coefficient estimates. [a], [b], and [c] indicate significance level at 1%, 5%, and 10%, respectively.

6.4 IT Adoption and Long-term Profitability

If IT is a capacity-building investment that reduces costs, helps retain market share and keeps companies competitive, then it should positively affect long-term performance. However, given the adverse effect of IT adoption on the banking sector profitability under the OLS method, we estimate that our main result using long-term (year t+1, t+2, and t+3) profitability is our dependent variable.

Table 7 presents the result of the role of IT adoption and its influence on the long-term profitability of the banking sector. Panel A uses profitability at t+1 as the dependent variable, Panel B uses profitability at t+1 as the dependent variable, and Panel C uses

profitability at t+3 as the dependent variable. Consistent with our main result, we document that IT adoption negatively affects banking sector profitability when profitability is measured at t+1. However, its effect is inconclusively related to banking sector profitability when the latter is measured at t+2. Finally, IT adoption is positively and significantly related to banking sector profitability when it is measured at t+3. Our result indicates that while competitive pressures and industry dynamics drive investing in IT, adopting IT positively contributes to long-run profits in the banking industry.

We supplement our findings by using the dynamic fixed model (DFE) to extract the long-run and short-run effects of IT adoption on banking sector profitability in one single estimator. Table 7 presents some interesting findings. The error correction coefficient is negative and significant, indicating that the short-run disturbance adjusts to the long-run equilibrium relation between IT adoption and the bank's profitability. The effect of IT adoption on the banking sector's profitability is negative and significant in the short run but positive and significant at 1% in the long run. Moreover, the negative coefficient of short-run equilibrium is smaller than the positive coefficient of the long-run equilibrium. More importantly, the long-run coefficient is higher than the negative coefficient of IT status under all static models in Table 3. This indicates that although IT adoption has an immediate negative effect on the financial performance of banks, it alters over time. Our findings are consistent with the idea that the successful implementation of IT investing requires reorganising firms around the new technology (Yang & Brynjolffson, 2001). While our sample period represents a period of IT implementation in the banking industry, a negative effect on IT status on performance is unlikely under the OLS method. However, the dynamic fixed effect model nicely captures the impact of IT adoption during the period of transition as well as the potential long-run consequences of IT adoption on banking sector profitability.

Table 7: IT adoption and long-run banking sector profitability

	Fixed effect	Random effect	Two-way clustering
	Model (1)		Model (2)
Panel A: Profitability at year t+1			
ITADP	*-0.106[c]*	*-0.106[c]*	*-0.106[b]*
	(-1.90)	*(-1.90)*	*(-2.01)*
Constant and baseline controls	Yes	Yes	Yes
Adjusted R^2	0.799	0.602	0.855
Bank effect	Yes	No	No
Year effect	Yes	Yes	Yes
N	114	114	114
Panel B: Profitability at year t+2			
ITADP	-0.084	-0.084	-0.084
	(-0.92)	(-0.92)	(-0.66)
Constant and baseline controls	Yes	Yes	Yes
Adjusted R^2	0.732	0.558	0.814
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	95	95	95
Panel C: Profitability at year t+3			
ITADP	*0.058[c]*	*0.062[c]*	*0.052[b]*
	(1.67)	*(1.72)*	*(1.94)*
Constant and baseline controls	Yes	Yes	Yes
Adjusted R^2	0.688	0.469	0.798
Bank effect	Yes	No	Yes
Year effect	Yes	Yes	Yes
N	76	76	76
Panel D: Dynamic fixed effect model			
Variables	**Coef.**	**Std. Err.**	**z-value**
Long-run coefficients			
ITADP	*0.553[a]*	*0.151*	*3.650*
ln (size)	-2.308	1.544	-1.490
ln (director fee)	0.148	0.109	1.360
ln (branches)	-0.009	0.010	-0.970
ln (employees)	0.079	0.388	0.200
ln (non-performing loan)	-0.286[c]	0.148	-1.930
Error correction	-0.821[a]	0.107	-7.650
Short-run coefficients			
Δ ITADP	*-0.395[a]*	*0.109*	*-3.630*
Δ ln (size)	1.423	0.968	1.470
Δ ln (director fee)	-0.208	0.131	-1.590
Δ ln (branch)	0.022[b]	0.009	2.400
Δ ln (employees)	-0.322	0.407	-0.790
Δ ln (non-performing loan)	0.118	0.100	1.180
Δ ln (loan and advances)	-0.333	0.422	-0.790
Constant	6.362[c]	3.761	1.690

Note: The values in parentheses are the standard errors of corresponding coefficient estimates. [a], [b], and [c] indicate significance level at 1%, 5%, and 10%, respectively.

7. Conclusion

We investigate the impact of IT adoption on banking sector profitability in Bangladesh. Our study has several significant findings. First, IT adoption in the banking industry is exogenously determined, not endogenously, and various banks have a cross-sectional dependence on IT status investment. We document the significant impact of peer pressure on IT investment decisions. Second, despite significant growth in IT adoption in the banking sector in Bangladesh, the profitability implication of IT adoption is negative and significant for the short term. However, early adopters of IT enjoy a positive effect on their profitability.

Moreover, IT adoption positively and significantly affects long-run profitability for all adopters. Third, unexpectedly, corporate governance mechanisms proxied by director fees have a statistically significant adverse impact on a bank's profitability. Our findings have significant implications in developing economies and provide guidelines for the banking sectors' policymakers and executives in making investment decisions in IT assets and expectations of getting economic benefits from it.

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