Research Journal of Finance and Accounting
ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online)
Vol.7, No.8, 2016

The Econometrics Effect of Information Technology Investment on Financial Performance in the Jordanian Banking Sector over the Period 1993-2014

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Abstract
This study measures the Relationship between IT investment and Financial performance in the Jordanian Banking Sector over the Period 1993-2014. The profitability equation is estimated by panel least squares, and the effect of IT investment on bank profitability and compared with different bank groups, such as large- and small-asset banks, and high- and low-IT use. The empirical analysis of this study reveals that the IT ratio and EAR and INF have relatively strong explanatory powers for bank profitability. The results indicate that for large banks the estimates of the IT ratio are positive for ROA and ROE but significant for ROA only, while those of small banks are positive and significant for ROA and ROE. This implies that the ITI of small banks has a stronger positive effect on bank returns than that of large banks. We can say that the effect on ROA for large banks is less than smaller banks because of diminishing returns to scale. Moreover the results report that high- and low-IT banks show significant positive coefficient estimates on ROE, while low banks have significant positive coefficient estimates on ROA. Generally, the high-IT banks' coefficient estimates on ROE are larger. This is because the economics of scale of high-IT banks with a high level of ITI as a factor input, leading to a higher effect on profitability increase.Jordanian banks need to take care with their adoption of information technology because of its impact on the profitability of banks
Keywords: Information Technology Investment, Financial Performance, Banking Sector.

Introduction

The rapid development and use of information technology (IT) by commercial entities engaged in trade, investment and financial services have increased banks' capacity to achieve more benefits, including gains in profitability from efficiency of operation and reductions in transaction costs. Innovations in IT are used as tools for gaining competitive advantage and strategically enhancing business positions. The significant developments in IT have had various effects, including globalisation of information which, in turn, has changed the world into a small global village where all individuals affect each other more frequently. These developments have also sharpened the role of financial banks, and particularly those of commercial banks, in facilitating trade, investment and other activities. This has created a huge challenge because IT is frequently misused for financial fraud. It becomes necessary, therefore, to understand how IT increases the efficiency and competency of operations in order to counter its fraudulent use. This study will explore the effect of Information Technology Investment (ITI)[1] on Financial Performance (FP)[2].

Study Objectives

This study considers the effects of IT Investment on the FP of banks in Jordan. The specific study objectives are:
To analyse the relationship between ITI and FP.
To determine the time-varying impact of ITI on banks' FP.

Study Problem

In a world of increasing globalisation, competition and customer awareness, IT creates a competitive advantage by increasing organisational performance. The benefits of using IT in financial institution are several: it expands potential marketplaces; improves communication with customers, vendors and employees; speeds up responses to customer inquiries; provides easier ordering and tracking; and improves the quality and speed of transaction processes. The use of IT helps banks manage resources, technical expertise and capital; hence, banks seek to

[1] The term IT refers to the technological side of information systems: computers, facsimiles, telecommunications, microelectronics, hardware, databases, software, networks and other devices (Turban et al., 1996). ITI is the investment in these technologies.
[2] FP (financial performance) is calculated using variables such as return on assets (ROA), and return on equity (ROE) (Jun, 2006).

enhance their financial performances with increased use of IT. The study problem is to determine the causes and consequences of ITI on FP for the banking sector in Jordan.

Importance of Study

Over the past years, banks in Jordan (and all over the world) have invested significantly in IT and IT systems. It is widely believed that strategic ITI will enable banks to cut costs and compete more effectively. It is also believed that ITI may significantly improve a bank's profit performance, but currently there is no way to measure this performance or to determine precisely how much should be invested in IT. This study will try to fill this gap by defining the core measure for FP, analysing ITI's effect of on it and determining an optimal level of ITI.

Understanding the role of IT and investment in IT to bank performance is crucial, as a result, this study has important policy implications for the financial sector of the Jordanian economy.

Study Questions

This study seeks to answer the following questions:

Is there a positive effect of ITI on FP in the Jordanian banking sector?

Is there a positive effect of ITI on FP in the Jordanian banking sector once controlled for bank size and IT level?

Literature Review

Previous studies reveal that there is a variety of legitimate ways to examine and study the relationship between ITI and the FP of banking sectors around the world. Floyed and Woodridge (1990) inspect the correlation between strategy, IT, and firm performance. Their findings show that strategy has a direct effect on IT, and IT has a direct effect on return on assets. Their study concludes that IT can play a meaningful role in the relationship between strategy and return on assets.

Beccalli (2006) examines the effects of ITI on the FP of banks in Europe, using traditional financial profitability measures as the variables of interest. His sample consists of 737 commercial banks based in five European countries (France, Germany, Italy, Spain and the UK) over the period 1995–2000: a total of 3456 observations. The results show a positive and statistically significant relationship between profit efficiency and return on assets, but a strong and negative correlation between cost efficiency and alternative measures of returns; the contribution of IT on FP in this study shows mixed results because a gain in efficiency should lead FP. In contrast, Ho and Mallick (2006) who produce a very useful survey of finance theory, use the generalized methods of moments (GMM) technique with a board of 68 banks over a time span of 20 years in USA; their findings show that market share increases with higher levels of investment in IT. Furthermore, they find that banks with higher levels of IT have lower profitability due to the possibility of network effect; the impact turns out to be marginally positive in a dynamic context, if price as a control variable is not considered. This partly explains the conflicting results in Beccalli's (2006) work. Jun (2006) analyses the nexus between ITIs and banking performance in Korea, using three different co-integration panel data methods to estimate the effects of IT on the profitability equation of individual banks. The sample period is from 1991–2001 and the analysis covers 26 domestic, 16 city and 10 local banks. The studies show that the ITI of large banks has a stronger positive influence on improving bank returns than that of small banks. In addition, Jun finds that the ITI of wholesale banks specialising in corporate loans produces greater positive effects on bank profitability than that of retail banks. This implies that other intrinsic relationships may be present, influencing through smaller but important channels.

Casolaro and Gobbi (2007) explore the effects of investment in IT using micro-data from a panel of 600 Italian banks for the period 1989–2000. This study shows that both cost and profit frontier shifts are powerfully correlated with IT-induced capital accumulation. There is a positive correlation between IT capital intensity with both frontier shifts and efficiency scores. Gobbi's estimates imply that ITI in different in ventures of capital formation has, on average, allowed banks to reduce costs by 1.3% and increase short-run profits by 2.0% a year. Along the same lines of microanalysis, Acharya (2007) examines the impact of online banking intensity on the FP of community banks, using a mixture of primary and secondary data. The online banking strength index is calculated using data collected from banks' websites, and its impact on performance is measured by regressing profit efficiency against a number of correlates including an online banking intensity measure. The results indicate that online banking is an important strategic option in the competitive positioning of banks as the implementation of a wide array of web-based products allows financial institutions to compete in attracting customers who might traditionally be outside the "local" market. Rai et al. (1997), find a positive relationship between firms' output and expenditure (for both hardware and software). In addition, they find a positive relation across IT capital, client/server expenditure and ROA. Labour productivity is also found to be positively related to IT expenditure, while the relationship is negative for administrative productivity. In another study on IT spending and firm performance, IT spending is found to be positively related to sales and productivity

(Strassmann, 1997). This study however, does not find any correlation between IT spending per employee and ROE. Tam (1998) investigates the relationship between ITI and firm performance for 106 firms in non-US nations including Hong Kong, Singapore, Malaysia, and Taiwan. He finds a positive relationship between ITI and return on equity; the relationship of the other profit ratios with ITI varies among the four nations.

Chatterjee et al. (2002) examine the difference in stock market reaction to investment in IT infrastructure against its application. IT infrastructure investments are associated with significant positive abnormal returns when firms announce such investment. Drawing upon a sample of IT investment announcements in the early 1990s, the studyers find significant evidence of abnormal returns associated with infrastructure investment. When such infrastructure is contrasted with investment in IT application, clear evidence exists that infrastructure investments generate excess returns. The evidence provides empirical support for the potential of investment in IT infrastructure to be perceived as a platform for growth and returns for business firms.

Shin (2004) explores the relationship between IT and profitability for domestic firms in Korea that employ a number of measures to enhance profitability. The findings reveal little relationship between IT and profitability. While changes in IT capital and firms' organisational structure affect firms' future returns and the market valuation of the firm, its degree of influence seems to be relatively weak in the Korean data. An and Choi (2004) perform empirical analyses to understand the effects of ITI on bank profitability, employing pooled ordinary least squares (OLS) random and fixed effects models, and the panel Generalised Method of Moments (GMM) model on panel data on 26 domestic banks. Their results show that ITI has positive effects on bank profitability in all models. A greater regional gross domestic product (GDP) growth rate of the local bank and a higher total loan ratio lead to an improvement in bank profitability, but total asset sizes and the deposit/loan rate spread are estimated to be statistically insignificant.

In analysing some deeper issues, Martin and Salas (2007) estimate the contribution of IT and advertising on bank performance (output and profits) of a 95% representative sample of Spanish banks during the period 1983–2003. The result shows that growth in the stock of IT capital explains one third of the output growth of banks, and that an investment in IT of one million Euros may produce returns the equivalent of twenty-five workers. The study also indicates that advertising investments increase the demand for bank services, with an elasticity of 0.22 for deposits and 0.11 for loans.

There are other channels through which the effects of IT can be analysed; for example, Czerwinski (2008) finds empirical support for the existence of a possible relationship between IT and FP. His factor analysis on project successes and return on investment before and after project completion is based on survey data from 1,100 of the largest group of global professional project managers. Similarly, Roust (2008) examines the development of e-commerce using other statistical methods (e.g. Probit models, Markov chain method) and shows that online banking and bill paying services can provide a valuable source of additional profits, sales and customer retention, which can lead to competitive and possibly first-mover advantages. These results show that growth in electronic transactions influences customers' propensity to switch financial institutions. Sircar et al. (2000) examines the relationship between firm performance on the one hand and both IT and corporate investment on the other. The findings conclude that IT and corporate investment are related positively to sales, assets, and equity; and negatively to net income. Spending on IT staff and staff training is positively correlated with firm performance, even more than computer capital. Holden and EL-Bannany (2004) assess the effects of investment in IT systems on bank profitability in the UK over the period 1976–1996. The focus of their study is the impact of IT on customer services. Use of ATMs result in reduced costs of transactions and, for some banks, generates revenue by charges made for using ATMs. Provision of ATMs has a significant positive effect on banks' profitability. A greater effect comes from the lagged value of ROA. Large values of ROA (positive or negative) in one year stimulate banks to increase ROA in the next. The results support the view that ROA does have a positive impact on bank profitability, through several factors, such as reducing labour and transaction costs. The model includes the concentration ratio and market share (from the structure-conduct-performance theory) but these were not found to be significant; nor were variables relating to market size or growth. The main conclusion is that, for banks, the number of ATMs increases the return on assets.

Ehikhamenor (2003) conducted a study of how ITI leads to a more favourable FP of banks by distributing surveys to a selected band of 56 bank branches in the Nigerian city of Lagos. The results show that even though Nigerian banks expect to gain greater FP by investing in IT, this alone is not incentive enough to lead them into ITI. Another study which used a survey methodology is that of Calderon et al (2001), examining the relationship between ITI and the FP of South Korean financial institutions. Calderon's results reveal that there is a significant relationship between IT effectiveness, an end result of ITI, and financial growth, an indicator of FP, in financial institutions in South Korea.

Siam (2006) and Ross (2002) have both conducted studies on the relationship between ITI and FP, of banking firms and manufacturing firms respectively. Both claim that ITI has a negative impact on the FP of banking and manufacturing firms in the short run. Ross explains that although ITIs will have a negative effect on the FP of manufacturing firms, it will enhance other aspects: for instance, market performance and coordination are

affected positively. Siam elaborates on his point that ITI yields negative FP for banks, by stating that ITI takes a heavy cost on the FP of banks in the short run, but in the long run the additional revenue streams opened up by the initial investment will lead to a more positive FP. A third study with similar findings is that of Dewan and Kraemer (2000). They examine the relationship between IT capital investments and productivity for two separate groups of countries, 22 of them developed (22) and 14 developing. Their study finds significant differences in the return from ITI between developed and developing countries. Developed countries receive positive and significant returns from their IT capital investment, but there is no significant relationship between IT capital investment and returns in development countries. This may be the result of many factors, such as differences in the level of ITI and differences in IT-enhancing complementary factors.
The literature reviewed above shows that banking sector FP and ITI can be measured in a variety of forms. This study examines models and empirical findings that have used econometric techniques to quantify the effects of IT on FP of the Jordanian banking sector.

Study Hypotheses
H_1: There is a positive effect of ITI on FP in the Jordanian banking sector.
H_{11}: There is a positive effect of ITI on return on equity (ROE).
H_{12}: There is a positive effect of ITI on return on assets (ROA).
H_2: There is a positive effect of ITI on FP in the Jordanian banking sector when controlled by bank size and level of IT.
H_{21}: There is a positive effect of ITI on ROE when controlled for bank size and level of IT.
H_{22}: There is a positive effect of ITI on ROA when controlled for bank size and level of IT.

Empirical Analysis
Methodology
According to the theories of financial analysis discussed in the previous literature, this study will employ the following profitability equation and will apply it to heterogeneous panel data.[1] The preliminary model is given as the following:

$$\Pi = \int(IT, Controls, \varepsilon)$$

where the dependent variable Π = a bank profitability measure (ROA, ROE), and the explanatory variables are IT = investment proxies, controls = other control variables that influence bank profitability, and ε = an error term.,
In order to set up the profitability equation properly, a theoretical framework is needed for the relationship between all the variables which affect bank profitability. To achieve this, this study will apply theories of business analysis (Jang, 2002) or financial analysis. These are used to study business activities: business analysis can be split into three parts for internal management analysis: 1. credit analysis, 2. investment analysis, and 3. internal management analysis. Financial analysis, which focuses on financial factors, is classified into five groups: 1. stability analysis, 2. profitability analysis, 3. activity analysis, 4. productivity analysis, and 5. growth analysis.
Stability analysis determines a bank's long-term ability to manage business fluctuations with stability ratios. Stability ratios comprise the loan minus deposit ratio (loans divided by deposits), the debt ratio (debts divided by equity), the borrowing dependency (interest minus paying liabilities divided by total assets), the equity ratio (equity divided by total assets), the reserve ratio (reserves [surplus] divided by paid-in capital), the financial leverage (total assets divided by equity), the current ratio (current assets divided by current liabilities), etc. Profitability analysis studies a bank's profit-generating capability using changes in different profitability ratios as a measure of performance. Profitability ratios consist of ROA, ROE, the net profit-operating revenue ratio (current net profit divided by operating revenue), the loan = deposit rate spread (average interest rate on loans = average rate on deposits), the net interest margin (net interest income divided by average managed assets), and the ordinary profit ratio (ordinary profit divided by operating revenue (Jun, 2006). Activity analysis measures a bank's asset efficiency through activity ratios, such as operating revenue (sales) divided by main asset items. Activity ratios include the total assets turnover (operating revenue divided by average total assets), the loans turnover (loans divided by average capital stock), the borrowed capital turnover (operating revenue divided by average total liabilities), the deposits turnover (deposits divided by average capital stock), the equity turnover (operating revenue divided by equity), the trade receivables turnover (sales divided by trade receivables), and so on. Productivity analysis measures efficiency at production level via productivity measures such as output to input in production. There are different measures under productivity such as value added (ordinary profit plus

[1] This model is taken from Jun (2006).

depreciation expense plus/taxes and public charges plus net financial costs plus labour costs plus rental fees), the value added ratio (value added divided by operating revenue), the labour income share (labour costs divided by value added), the net profit share (current net profit divided by value added), capital productivity (value added divided by total assets), labour productivity (value added divided by number of employees = output divided by labour input), capital intensiveness (total assets divided by number of employees = the capital equipment ratio = capital divided by labour), the labour equipment ratio (tangible fixed assets divided by number of employees), per employee operating revenue, and so on. Finally, growth analysis investigates whether a bank's economic position within the specific industry or the entire economy is properly maintained and whether growth ratios are satisfactory. Growth ratios consist of growth rates of operating revenue, net profit, total assets, loans, total liabilities, deposits, equity, earnings per share (EPS), book value per share (BPS), and so forth.

Based on the theories of financial analysis elaborated, this study employs the following profitability equation[1]

$$\Pi_{it} = \alpha_i + \beta_{1i} DEBTR_{it} + \beta_{2i} DLMR_{it} + \beta_{3i} EAR_{it} + \beta_{4i} RESR_{it} + \beta_{5i} LDR_{it} + \beta_{6i} IT_{it} + \beta_{7i} INF_t + \beta_{8i} WG_{it} + \varepsilon_{it}$$

where

Π_{it} : Profitability for bank: i = 1, 2, 3 . . . , 22, at time: t = 1, 2, 3, ... 20.

β : The coefficient vector on explanatory variables.

$DEBTR_{it}$: The debt to equity ratio (debts divided by equity). it is expected that there is a negative effect on ROA and ROE.

$DLMR_{it}$: Loans minus deposit rate spread (average interest rate on loans minus average rate on deposits: the deposit minus /loan margin rate) the financial analysis theory predicated positive effect on ROA and ROE.

EAR_{it} : The equity to total assets ratio (equity divided by total assets), expected to have a positive effect on ROA and ROE.

$RESR_{it}$: The reserve ratio (reserves (surplus) divided by paid-in capital), expected to have a positive effect on ROA and ROE.

LDR_{it} : The loan minus deposit ratio (loans divided by deposits). This should have a negative effect since a high ratio corresponds to low business stability in financial analysis theory.

IT_{it} : Investment proxies such as the computer budget ratio (computer budget divided by total budget) and the capital budget ratio (computer capital budget divided by computer budget). The larger the IT investments, the stronger their influence on profitability measures.

WG: The wage price of labour to numbers of employees. This should have a negative effect on ROA and ROE.

INF: Inflation rate. This should have a positive effect on ROA and ROE.

ε_{it} : The disturbance term.

Data

These data will be obtained for all 22 banks based in Jordan over 1993–2014. Most will be furnished through primary data sources such as annual and monthly statistical bulletins and reports issued by the banks and the Central Bank of Jordan.

Table 1 exhibits descriptive statistics of the dependent and explanatory variables used in empirical analyses. The reason that skewness is shown in addition to arithmetical means is that skewness is employed instead of means as the group classification criterion in the following bank group analyses. Skewness is judged more appropriate as a classification criterion of banks grouped by asset size rather than means, since there are three large banks with large assets and nineteen small banks, while there are six large IT investment banks and sixteen small banks.

[7] Other variables such as total assets, loans, deposits, etc., have been excluded because explanatory powers for individual bank profitability were found to be weak in regression analyses. The growth profitability equation was also excluded because panel unit root tests found no unit roots in the series as expected.

Table 1: Descriptive statistics of the dependent and explanatory variables

	ROA	ROE	DEBTR	DLMR	EAR	IT	LDR	RESR	WG	INF
Mean	0.011178	0.114606	0.193048	0.074006	0.107286	0.002833	0.974915	0.374980	0.021788	-3.416934
Median	0.011000	0.116000	0.009000	0.070000	0.096000	0.001540	0.693000	0.227000	0.017000	-3.381395
Maximum	0.059000	1.038000	2.673000	0.667000	0.683000	0.039420	67.57800	5.901000	0.510000	-0.116534
Minimum	-0.074000	-0.979000	0.000000	0.000000	0.032000	0.000000	0.026000	0.011000	0.004000	-5.115996
Std. Dev.	0.012986	0.155935	0.394232	0.043911	0.055953	0.004552	3.647953	0.539733	0.028611	0.835911
Skewness	-1.497761	-1.617513	3.515624	9.820203	4.109521	4.800321	17.44460	6.725105	14.24225	-0.015340
Kurtosis	12.80415	19.43903	17.49967	122.0934	36.43375	29.59880	317.0192	64.15956	241.7766	3.780319
Jarque–Bera	1545.766	4128.735	3819.445	214285.5	17434.79	11761.79	1468264.	57677.25	850519.0	8.969718
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011278
Sum	3.946000	40.45600	68.14600	26.12400	37.87200	1.000010	344.1450	132.3680	7.691000	-1206.178
Sum Sq. Dev.	0.059364	8.559178	54.70733	0.678704	1.102034	0.007294	4684.262	102.5418	0.288137	245.9590
Observations	353	353	353	353	353	353	353	353	353	353

The Empirical Results

Finding Unit Root

Testing for the unit roots indicates nonstationarity, which has implications for economic theory and modelling. Results from regressions will not be meaningful if the variables are not stationary: that is, if they possess time trend. Nonstationary data may lead to cointegrating relationships; a series Y_t is said to be integrated of the order denoted by Y-I (d) if it becomes stationary after differencing d times; and thus Y contains d unit roots. A series which is l (0) is said to be stationary. To determine whether a series is stationary or non-stationary, a unit root test must be carried out. The study adopts the Levin et al. (2002) test and Breitang's (2000) t-stat Unit Root Test for this purpose

Appendix A illustrates the results obtained from the Levin et al. (2002) test and Breitang's (2000) t-stat. These tests are based on the common unit root process, and assume that autocorrelation coefficients of the tested variable across cross-sections are identical.

Results from the previous unit root test fail to reject the hypothesis of a unit root for the independent variables of 0.05 and 0.01. Therefore we conclude that the variables used for the analysis for profitability equations are I (0) or stationary.

Regression Results

Table 2 contain the results for the analysis of the effect of IT investments on the ROA and ROE of the Jordanian banking sector.

Table 2: Effect of ITI on the ROA of the banking sector in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.014240	0.003483	4.088314	0.0001	R^2 = 0.070617
DEBTR	-0.002401	0.001357	-1.768607	0.0779	F = 3.058302
DLMR	-0.017235	0.011526	-1.495315	0.1358	
EAR	0.041474	0.012649	3.278963	0.0012	Prob (F-sta.) =
IT	0.372340	0.221248	1.682908	0.0934	0.002476
LDR	2.98E-06	0.000114	0.026100	0.9792	
RESR	-0.002398	0.000921	-2.602879	0.0097	
WG	0.005594	0.007071	0.791091	0.4295	
INF	0.002594	0.001283	2.022273	0.0440	

In our analysis for effects on ROA we attempted to model most of the variables used in previous literature. Our findings (Table 2) for the analysis of the aggregated banking sector were appositive, and significant evidence of IT ratio, EAR, RESR and INF, as expected. The estimates of DEBRT turn out to be significantly negative, as predicted by financial analysis theory. Our results did not find significant evidence of DLMR, LDR or WG.

Table 3 contains the results for analysis of the effect of IT on ROE. The analysis was done by panel least squares. Our findings for this analysis are consistent with the findings for the effect on ROA, where evidence of a positive and significant coefficient were found for IT ratio, EAR and INF. The estimates of the DEBRT turn out to be significant and negative, as expected. We did not find evidence of DLMR, LDR, RESER, or WG. Consequently, the IT ratio and EAR and INF have relatively strong explanatory powers for bank profitability. In Table 2 and 3, the R^2 values are 0.0706 and 0.0641, which are similar those in the existing literature.

Table 3: Effect of ITI on the ROE of the banking sector in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.142278	0.017463	8.147389	0.0000	R^2 = 0.064107
DEBTR	-0.037556	0.020210	-1.858356	0.0640	
DLMR	-0.261659	0.179907	-1.454416	0.1468	F = 2.757061
EAR	0.388505	0.208560	1.862797	0.0634	
IT	10.98264	6.355946	1.727932	0.0850	Prob (F-sta.) =
LDR	0.000221	0.001503	0.147297	0.8830	0.005863
RESR	-0.006557	0.014903	-0.439959	0.6603	
WG	-0.018213	0.308388	-0.059057	0.9529	
INF	0.037340	0.011508	3.244808	0.0013	

Tables 4 to 7 present the results of the bank group analysis by asset size. Large banks are those with asset greater than %8 while small banks have an assets size less than %8. There are 3 large banks and 19 small banks by this criterion.

Table 4: Effect of ITI on the ROA of large banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.011184	0.002848	3.926850	0.0003	R^2 = 0.755584
DEBTR	-0.015283	0.002455	-6.225729	0.0000	F = 2.36557
DLMR	0.023805	0.048382	0.492015	0.6254	Prob (F-sta.) =
EAR	0.069749	0.041966	1.662026	0.1043	0.00000
IT	0.216069	0.108005	2.000543	0.0523	
LDR	-1.75E-05	2.32E-05	-0.751572	0.4567	
RESR	0.001303	0.001507	0.864489	0.3925	
WG	0.240948	0.083898	2.871904	0.0065	
INF	0.000987	0.000775	1.273816	0.2101	

Table 5: Effect of ITI on ROE of the large banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	-0.033743	0.050986	-0.661815	0.5119	R^2 = 0.490209
DEBTR	-0.004681	0.014842	-0.315416	0.7541	F = 3.846360
DLMR	2.276458	0.758658	3.000638	0.0046	Prob (F-sta.) =
EAR	0.436185	0.174381	2.501336	0.0166	0.001060
IT	4.330235	2.732752	1.584569	0.1209	
LDR	-0.000382	0.000571	-0.668704	0.5075	
RESR	0.044019	0.031032	1.418506	0.1638	
WG	2.442661	1.538948	1.587228	0.1203	
INF	0.018128	0.019565	0.926554	0.3597	

Tables 4 and 5 indicate that for large banks the estimates of the IT ratio are positive for ROA and ROE but significant for ROA only, while those of small banks Tables 6 and 7 are positive and significant for ROA and ROE. This implies that the ITI of small banks has a stronger positive effect on bank returns than that of large banks. We can say that the effect on ROA for large banks is less than smaller banks because of diminishing returns to scale. Among the other control variables, the DEBRT is estimated to be negative and significant evidence on ROA for large banks, while the EAR is positive on ROA and ROE only for large banks. The loan–deposit ratio spread is significantly negative only for small banks.

Table 6: Effect of ITI on the ROA the small banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.018468	0.006107	3.024283	0.0027	R^2 = 0.083449
DEBTR	0.001360	0.001420	0.957690	0.3390	F = 3.300459
DLMR	0.005698	0.019842	0.287165	0.7742	Prob (F-sta.) =
EAR	0.003040	0.036389	0.083553	0.9335	0.001264
IT	1.618328	0.670466	2.413734	0.0164	
LDR	-0.001125	0.000590	-1.907980	0.0574	
RESR	-0.001960	0.000885	-2.214495	0.0276	
WG	-0.030488	0.020557	-1.483103	0.1391	
INF	0.002731	0.001362	2.005245	0.0459	

Table 7: Effect of ITI on the ROE of the small banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.253406	0.051358	4.934065	0.0000	R^2 = 0.061807
DEBTR	0.006667	0.017043	0.391206	0.6959	F = 2.388095
DLMR	0.009159	0.146645	0.062454	0.9502	Prob (F-sta.) =
EAR	-0.196565	0.158196	-1.242546	0.2150	0.016599
IT	11.13126	6.217974	1.790175	0.0745	
LDR	-0.011362	0.006738	-1.686261	0.0928	
RESR	-0.014881	0.011233	-1.324835	0.1863	
WG	-0.283138	0.167577	-1.689604	0.0922	
INF	0.036614	0.015735	2.326836	0.0207	

Tables 8 and 11 present the results of the bank group analysis by ITI level. High IT banks are those with a ratio higher than %8, while low IT banks have a ratio smaller than %8. There are six high-IT banks and sixteen low-IT banks. Tables 9 and 11 report that high- and low-IT banks show significant positive coefficient estimates on ROE, while low banks have significant positive coefficient estimates on ROA only (table 8 and 10).
Generally, the high-IT banks' coefficient estimates on ROE are larger. This is because the economics of scale of high-IT banks with a high level of ITI as a factor input, leading to a higher effect on profitability increase.

Table 8: Effect of ITI on the ROA of high-IT banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.034011	0.006372	5.337610	0.0000	R^2 = 0.385972
DEBTR	-0.014774	0.004307	-3.430411	0.0009	F = 4.255070
DLMR	-0.250137	0.082320	-3.038596	0.0031	Prob (F-sta.) =
EAR	0.105527	0.050670	2.082627	0.0402	0.000018
IT	0.406081	0.301102	1.348647	0.1809	
LDR	-0.000145	0.000896	-0.162146	0.8716	
RESR	-0.003027	0.001143	-2.648179	0.0096	
WG	0.062257	0.089089	0.698817	0.4865	
INF	0.002735	0.001710	1.599707	0.1132	

Table 9: Effect of ITI on the ROE of high-IT banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.215828	0.060442	3.570855	0.0006	R^2 = 0.358775
DEBTR	-0.041397	0.050619	-0.817814	0.4157	F = 3.787482
DLMR	-1.059421	0.786149	-1.347609	0.1812	Prob (F-sta.) =
EAR	0.524814	0.456979	1.148443	0.2539	0.000081
IT	5.739416	3.138379	1.828784	0.0708	
LDR	-0.003210	0.010677	-0.300626	0.7644	
RESR	-0.010892	0.014650	-0.743455	0.4592	
WG	-0.021663	0.954326	-0.022700	0.9819	
INF	0.031845	0.017283	1.842569	0.0688	

Table 10: Effect of ITI on the ROA of low-IT banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.179104	0.082962	2.158865	0.0319	R^2 = 0.250359
DEBTR	0.014265	0.034264	0.416335	0.6776	F = 3.209038
DLMR	0.034372	0.317666	0.108201	0.9139	Prob (F-sta.) =
EAR	-0.045017	0.193094	-0.233135	0.8159	0.000004
IT	33.40293	17.55090	1.903203	0.0583	
LDR	-0.000937	0.000974	-0.962095	0.3371	
RESR	-0.013273	0.034309	-0.386881	0.6992	
WG	-0.383015	0.436830	-0.876806	0.3815	
INF	0.030440	0.018809	1.618400	0.1070	

Table 11: Effect of ITI on the ROE of low-IT banks in Jordan

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
C	0.015199	0.005471	2.778244	0.0059	R^2 = 0.216804
DEBTR	0.000717	0.002321	0.308940	0.7577	F = 2.659873
DLMR	0.009843	0.016319	0.603121	0.5470	Prob (F-sta.) =
EAR	-0.008070	0.018560	-0.434811	0.6641	0.000121
IT	3.219005	1.410328	2.282451	0.0234	
LDR	-8.20E-05	0.000191	-0.430287	0.6674	
RESR	-0.002463	0.002462	-1.000407	0.3182	
WG	-0.035711	0.025244	-1.414663	0.1586	
INF	0.002098	0.001099	1.907954	0.0577	

Concluding remarks

This study attempted to measure the effect of ITI on Jordanian banks' FP using panel least squares. The profitability equation is estimated by panel least squares. The effects of ITI on bank profitability are estimated and compared for large and small banks (determined by asset size), and high- and low-IT banks (determined by ITI ratio).

The empirical analysis shows several points:

First, the profitability equation indicate that the IT ratio and EAR and INF have relatively strong explanatory powers for bank profitability. In particular,

Second, for large banks the estimates of the IT ratio are positive for ROA and ROE but significant for ROA only, while those of small banks are positive and significant for ROA and ROE. So we can not reject the hypothesis H_1; there is positive relationship between ITI and FP.

Third, This implies that the ITI of small banks has a stronger positive effect on bank returns than that of large banks. We can say that the effect on ROA for large banks is less than smaller banks because of diminishing returns to scale. So we can not reject the null hypothesis H_{21}; there is positive relationship between ITI and FP when controlled by bank size and level of IT..

Forth, the results report that high- and low-IT banks show significant positive coefficient estimates on ROE, while low banks have significant positive coefficient estimates on ROA. So we can not reject the null hypothesis H_{22}; there is positive relationship between ITI and FP when controlled level of IT.

Fifth, the high-IT banks' coefficient estimates on ROE are larger. This is because the economics of scale of high-IT banks with a high level of ITI as a factor input, leading to a higher effect on profitability increase.

Finally, Jordanian banks need to take care with their adoption of information technology because of its impact on the profitability of banks

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Appendix A

Unit root tests

Levin, Lin & Chu t* test

Series	Statistic	Prob.**
ROE	-3.28744	0.0005
ROA	-3.24820	0.0006
DEBRT	-3.73172	0.0001
DLMR	-8.70639	0.0000
EAR	-3.22704	0.0006
IT	-2.72036	0.0033
LDR	-2.87940	0.0020
RESR	-9.33857	0.0000
WG	-1.41838	0.0780
LOG(INF)	-2.81507	0.0024

** Probabilities are computed assuming asymptotic normality

Breitung t-stat

Series	Statistic	Prob.**
ROE	-4.81274	0.0000
ROA	-5.62201	0.0000
DEBRT	-2.63965	0.0041
DLMR	-2.15266	0.0157
EAR	-4.71139	0.0000
IT	1.54492	0.9388
LDR	-4.14638	0.0000
RESR	-1.82428	0.0341
WG	1.70653	0.9560
LOG(INF)	-6.59551	0.0000

** Probabilities are computed assuming asymptotic normality