

THE PRODUCTIVITY PARADOX AND INVESTMENTS IN IT? EVIDENCE FROM SAUDI BANKS

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Abstract:

The study aims to examine the influence of information technology investments (IT) on the performance of Saudi banks listed on the Saudi stock market. The study used a panel data method, which has a time series and a cross-section. Least squares regression models were used to assess the study's hypotheses. The study used a combination of performance indicators from an accounting and market perspective. The study results show that investments in IT as an independent variable have no influence on earnings per share (EPS) and return on equity (ROE), that is, a productivity paradox exists. However, IT investments have positive impacts on ROA. The results also show that these investments have a direct influence on improving cost to income ratio (CTIR) and increasing market share (MS) as dependent variables. To reveal the banks' strategy on Investments in IT, the current study examined the influence of both CTIR and MS as independent variables on the profitability indicators as dependent variables. The results showed that CTIR and MS have positive influences on EPS, showing that the sample banks used IT to improve both MS and CTIR which in turn contributed to improving EPS. The results showed that investors in the Saudi capital market ignored Investments in IT when making investment decisions, as there is not a statistically relationship between these investments and SP., that is, IT investments have no relevant value. The study's results are beneficial for several stakeholders, including bank managers, shareholders, and market analysts, as it revealed banks' strategies adopted for investing in IT.

Keywords: Share Price – Operational Efficiency- Market Share– Saudi Capital Market.

1. Introduction

IT encompasses the processing, storage, and transmission of data, using processors, software, and computer networks. The increasing volume of Investments in IT has imposed enormous pressure on management, researchers, and regulators to consider the benefits and risks associated with these investments, which are drivers of sustainable competitive advantage, while others view the benefits of these investments as neutral or at best negative. Some earlier studies show a difference between industries in terms of the benefits of IT investments, with benefits increasing in less concentrated industries. Saudi banks have made huge Investments

in IT to achieve benefits that are difficult to measure financially, such as providing new banking services, increasing market share, updating work mechanisms, and better serving customers. Saudi banks conducted Investments in IT in the areas of infrastructure, ATMs, data centers, online banking, and risk management. Banks may adopt several strategies for IT investments, such as enhancing market shares, cost structure, risk management, profitability, and service quality. Past literature provided mixed results, as Tayeh et al. (2015), Khamees (2023) gave evidence on the existence of the productivity paradox, that is, Investments in IT did not pay off. However, other studies, such as Hairman and El-Abide (2018), Mohammed and Mann (2015), gave evidence that Investments in IT pay off. Investments in IT need time to pay off, Buallay & Al Marri (2022). Investments in IT are risky; therefore, banks should investigate the advantages and disadvantages of IT expenditure and align them with their strategies. The variance in the results of previous studies is attributed to the variance in measuring Investments in IT as an independent variable, the variance in measuring performance indicators as dependent variables, the variance in control variables, the variance in study periods, and the variance in study methodologies. Considering the above, the research gap is represented by a timing gap, as the phenomenon under study has not been studied during the current research period. A spatial gap, as in the current study, to the best of the researcher's knowledge, is the first of its kind to be applied to banks in the Kingdom. A methodological gap, as the study did not use any control variables to neutralize their effects, and the desire to measure the single effect of IT rather than the collective effect. A variable gap where the current study used a combination of performance indicators.

The current study contributed to the existing literature as it quantifies the influence of IT investment on the performance of Saudi banks, using a mix of accounting and market-based indicators. In addition, the study investigated the phenomenon of the productivity paradox of investments in IT to capture the single, direct, and indirect influence of Investments in IT on the sample banks, using diverse ratios to reflect operational efficiency, profitability, and market power. In addition, the study investigated the relevance value of Investments in IT to decide whether investors in the capital market relied on Investments in IT when pricing share prices. Managers can make informed decisions about Investments in IT if they can quantify the benefits of those investments on company performance. The best measurement of returns on Investments in IT requires a combination of accounting-based performance indicators that reflect the influence on retrospective performance and market indicators that reflect the influence on companies' prospective performance (Kohli et al., 2012). The study also spanned an 8-year period, which is sufficient to investigate the phenomenon in the long term.

.2. Theories of IT investments

Despite huge Investments in IT, there is no definitive proof of a positive relationship between these investments and accrual-based accounting performance indicators (Gunasekaran et al., 2006; Kaplan & Norton, 1996; Wallman, 1996). Investments in IT rely on the assumption that there should be tangible benefits from IT investments, represented in improvements in efficiency and cost-effectiveness. In contrast, some argue that Investments in IT have become

a strategic necessity for gaining competitive advantages (Brynjolfsson, 1996; Clemons, 1991; Chatterjee et al., 2000; Dos Santos et al., 1993). One of the possible reasons for the inconsistency in the results of earlier studies on the feasibility of Investments in IT is attributed to the increase in agency costs resulting from overestimating the size of these investments. Based on agency theory, managers adopt the strategy of investing in IT to maximize their benefits at the expense of shareholders' benefits by undertaking large projects to enhance their chances of remaining in their jobs (Agarwal & Samwick, 2006; Jensen & Meckling, 1976; Shleifer & Vishny, 1989). According to agency theory, managers seek to maximize their benefits by using excessive resources to obtain greater power and higher salaries (Fama & Jensen, 1983; Graham, 1999). Managers can also imitate other companies in their IT investment decisions without needing these investments to improve their professional reputation. The economic benefits, consistent with the risk structure resulting from uncertain returns on these investments, create another problem between the CEO and the Board of Directors, as both are aware of the importance of these investments. However, they expect an immediate negative influence on net profit in the short run, given the uncertainty surrounding the future benefits of these investments (Masli et al., 2008). The CEO adopts a risk-averse policy by minimizing Investments in IT when compensation is linked to net profits for the period (Murphy, 1999). On the other hand, Shareholders are not risk-averse; therefore, they lose the long-term benefits of these investments when the CEO is risk-averse. Consequently, financial indicators are imperfect in measuring the tangible financial benefits of these investments, and the problem becomes more complicated when management engages in earnings management. (Davila & Venkatachalam, 2004). In addition, accounting measures are lagging indicators that reflect past performance, and as a result, Investments in IT typically take several years to yield a return (Kaplan & Norton, 2001). The microeconomic theory was utilized by Brenham and Timothy (1986), Banker and Kauffman (1988), and Loveman (1988) to form IT value models, as this theory provided a strong and insightful foundation, offering flexible, analytical, and testable empirical models that offer a robust framework for understanding the economic phenomena. Another theory that explains the influence of Investments in IT on bank performance is the Technology Acceptance Model, also known as the Technology Acceptance Theory. This theory assumes that the relationship between acceptance and use of modern technology is positive (Mohammad et al., 2020). In addition, resource-based theory assumes that if an organization has strategic resources, including IT investments, the organization expects these resources to generate a competitive advantage and achieve high profits (Shaw et al., 2013)

3. Literature Review and Hypothesis Development

The literature review section discusses the results of earlier studies on measuring the influence of Investments in IT on the performance of banks, the independent and dependent variables. The results are mixed due to the variance in measuring the IT variable, the variance of performance indicators, the variance of the study period, and the variance of the methodologies used. The study surveyed the earlier studies and summarized them in the following table.

Authors	Independent variables	Dependent variables	Results
Al-Amarneh et al., 2023	IT Investments, Financial Leverage	ROA, ROE, Net Interest Margin, CTIR	Investments in IT Have Positive influences on the Dependent Variables. Small-Sized Banks Invested Heavily in Investments in IT Than Large-Sized Banks, and Banks with High Financial Leverage Invested Heavily in Investments in IT Than Banks with Low Financial Leverage.
Pham et al., 2023	Investments In IT, Revenues, Bank Size, Bank Age, Inflation, Non-Interest Expenses,	ROA, ROE, Return on Sales, EPS	Investments in IT Have Positive Correlation with Expenses and Negative Correlation with Revenues.
Ghose & Maji, 2022	Internet Banking	ROA, ROE	Investments in IT Have Positive influences on ROA, ROE
Islam et al., 2019	Internet Banking	ROA, ROE	Investments in IT Have No Positive influence on ROA, ROE
Koroleva & Kudryavtseva, 2019	Digitization	ROA	Digitization In Banks with a Large Customer Base and High Transaction Volumes Improved Banks' Performance.
Chaarani & El-Abiad, 2018	Internet Banking, ATM Networks, Mobile Banking, and Computer Software	ROA, ROE	ATM Networks and Internet Banking Had Significant effects on Profit Indicators. Mobile Banking and Computer Software Have No influence on Profit Indicators.
Akhisar et al., 2018	Number of Branches to ATMs Ratio, Electronic Banking Services	ROA, ROE	The Independent Variables Improved Profit Indicators.
Mohammed & Mann, 2015)	Investments As a % of Revenues, % of expenditure on Employee Training, Number of Computers Per Employee	Return On Sales, ROA, Turnover, Ratio of Market Value to Book Value	Investments in IT Have Positive influences on Performance Indicators. The Results Are Sensitive to The Measurement of IT Investments.
Khamees, 2023	IT Governance	ROA, ROE, Tobin's Q	No Relationship Is Found Between the Variables.
Kombe & Wafula, 2015	Banking Internet	Time, Quality, Cost	Banking on the Internet Has Positive influences on Time and Quality, But No influence on Cost.
Muhammad et al., 2013	IT Investment	ROE, Efficiency	IT Investment Has Positive influences on ROE and Adverse influences on Efficiency.

Arora & Arora, 2013	Investments In IT	Operating Profits, Revenue Per Employee, Employee Profitability	IT Has Positive influences on Operating Profit and Employee Profitability. However, Investments in IT Have No Statistically Significant influence on ROA.
DAmgolani, 2011	Investments In IT	Time, Cost, Transactions	Investments In IT Reduced Time and Costs as Well As Facilitated Transactions.
Karim & Hamdan, 2010	Investments In IT	Net Profit Margin, ROA, EPS, Market Value Added, Operating Profit	Investments in IT Have Positive influences on ROA, EPS, Net Profit Margin, And Market Value Added

Prepared by the authors.

Several indicators were used for stock market performance. Mohammed and Mann (2015) used the market value-to-book value ratio as a proxy for the stock market performance. While Dadoukis et al. (2021) employed market returns, and Tam (1998) used stock returns. The current study used stock prices as the primary data source for calculating all market-based indicators, as they are the most important indicators for shareholders and management, which are influenced by long-term investments. Therefore, the stock price puts pressure on management to deliver value to shareholders (Zhou & Reesor, 2015). Chai et al. (2015) examined the effect of Investments in IT on the behavior of shareholders on the American stock exchange. The study's results showed that Investments in IT yield unusually positive returns. (Tam, 1998) showed that there is no correlation between Investments in IT and stock returns in the United States, and there is no similarity in measuring these investments. Tayeh et al. (2015) proved that Investments in IT had a considerable influence on market-based indicators, such as the market rate and Tobin's Q. Furthermore, the results showed that market-based indicators were more responsive to immediate performance. (Dadoukis et al., 2021) examined the influence of Investments in IT on banks' performance in the preliminary stages of the COVID-19 pandemic. The results showed that banks with significant volumes of Investments in IT showed high market returns. According to Tayeh et al. (2015), investments in IT have significant influences on the market rate and Tobin's Q.

Based on the literature review, the study developed the following hypotheses.

- H. 1. Investments in IT have effects on the ROA of Saudi banks.
- H. 2. Investments in IT have effects on the EPS of Saudi banks.
- H.3. Investments in IT have effects on the ROE of Saudi banks.
- H. 4. Investments in IT have effects on the CTIR of Saudi banks.
- H. 5. Investments in IT have effects on the MS of Saudi banks
- H. 6. Investments in IT have effects on the PS of Saudi banks

4. Methodology And Analysis Of Results

The study sample included eight banks registered in the Saudi Stock Market during the period from 2015-2022 shown in Table 1. These banks showed information on Investments in IT, as the study excluded two banks due to insufficient disclosure of information on Investments in IT. The study used secondary data from Saudi banks' financial reports to measure the independent and dependent variables, while the study relied on the Tadawul website to obtain stock prices. The study also used the panel data method and simple regression models to assess the research hypotheses.

Table 1: Sample Banks

No.	Bank Name	TADAWUL Code
1	Riyadh Bank	1010
2	The Saudi Investment Bank	1030
3	Banque Saudi Fransi	1050
4	The Saudi Arabia Awwal Bank	1060
5	Arab National Bank	1080
6	Bank Albilad	1140
7	The Saudi National Bank.	1180
8	Bank Aljazira	1020

Prepared by the author.

Table 2: Variables Measurement

Variables	Measurement
IT	The study measured this variable as Net Investments in IT as a % of long-term assets.
CTIR	The study measured this variable as non-interest expenses divided by net operating profit. The following studies utilized the CTIR as a proxy for banks' operational efficiency (Pham et al., 2023; Al-Amarneh et al., 2023; Pham et al., 2023; Khamees, 2023; Ghose & Maji, 2022; Islam et al., 2019; Koroleva & Kudryavtseva, 2019; Chaarani & El-Abide, 2018; Akhisar et al., 2018; Tayeh et al., 2015; Arora & Arora, 2013; Karim & Hamdan, 2010)
ROA	The study measured this variable as Net income divided by average total assets. The following studies utilized the ROA as a proxy for profitability (Al-Amarneh et al., 2023; Pham et al., 2023; Khamees, 2023; Ghose & Maji, 2022; Islam et al., 2019; Koroleva & Kudryavtseva, 2019; Chaarani & El-Abiad, 2018; Akhisar et al., 2018; Tayeh et al., 2015; Arora & Arora, 2013; Karim & Hamdan, 2010)
EPS	The study measured this variable as net income after excluding preferred stock dividends divided by the weighted average number of common shares outstanding. The following studies used the EPS as a proxy for profitability. (Pham et al., 2023; Karim & Hamdan, 2010)

ROE	The study measured this variable as Net profit after excluding preferred stock dividends divided by dividends, divided by average common stockholders' The following studies utilized the ROE as a proxy for accounting profitability y. (Al-Amarneh et al., 2023;Pham et al., 2023;Khamees, 2023;Ghost & Maji, 2022;Islam et al., 2019;Chaarani & El-Abiad, 2018; Akhisar et al., 2018;Tayeh et al., 2015;(Muhammad et al., 2013)
MS	The study calculated this variable as the Total assets of each bank divided by banks' total assets
SP	The study used closing share prices on March 31 of the following year from the Tadawul website. (Dadoukis et al., 2021).

Gathered From the Literature Review.

Model Specifications

The study developed a simple least squares regression model that includes Investments in IT as the only independent variable to study its influence on performance indicators without any control variables to neutralize their influences on the study results.

$$CTIR = \alpha + \beta \text{ investments in IT} + \varepsilon \quad (1) \quad ROA = \alpha + \beta \text{ investments in IT} + \varepsilon \quad (2)$$

$$EPS = \alpha + \beta \text{ investments in IT} + \varepsilon \quad (3) \quad ROE = \alpha + \beta \text{ investments in IT} + \varepsilon \quad (4)$$

$$MS = \alpha + \beta \text{ investments in IT} + \varepsilon \quad (5) \quad SP = \alpha + \beta \text{ investments in IT} + \varepsilon \quad (6)$$

Analysis of Results

Table 3 showed the results of the descriptive analysis for the study's variables. The results showed that the standard deviation of all study variables except the share price was lower than one, and that the CTIR recorded 40.8%, which is better than the international standard average. The results also showed that Saudi banks recorded high profitability indicators, as the average ROE was 0.1761.

Table 3: Descriptive Analysis

	Mean	SE	Median	SD	Variance	Kurtosis	Min.	Max.
MS	0.015	0.001	0.013	0.012	0.000	7.086	0.003	0.068
EPS	2.08	0.133	1.885	1.070	1.146	2.7678	-2.01	4.66
ROA	0.029	0.004	0.018	0.034	0.001	12.11	-0.015	0.180
ROE	0.1761	0.0302	0.110	0.2423	0.058	9.982	-0.0821	1.233
SP	24.86	1.66	22.65	13.34	178.13	1.271	9.37	70.9
IT	0.1509	0.0131	0.105	0.10498	0.011	0.1902	0.02	0.4
CTIR	0.408	0.0113	0.0113	0.091	0.008	-0.384	0.3	0.62

Table 4 showed the existence of an inverse correlation between the CTIR and Investments in IT, with a coefficient of -0.3299. That is, the operational efficiency is enhanced when Saudi banks increase Investments in IT.

Table 4: Correlation Matrix

	EPS	ROA	ROE	SP	IT	CTIR
EPS	1					
ROA	0.19331	1				
ROE	0.1737	0.9741	1			
SP	0.4065	0.1396	0.1067	1		
IT	-0.0555	0.0018	-0.0650	0.023	1	
CTIR	-0.461	0.01897	0.0982	-0.486	-0.3299	1

Significance level is 5%.

Table 5 presented the results, as the results showed a statistically significant inverse relationship, based on a t-test between investments in IT and CTIR, showing that increasing the size of these investments improves banks' operational efficiency. The results also showed a statistically significant direct relationship, as decided by the T-Test, between investments in IT and market share, which is a measure of the competitive advantage of banks. This suggests that increasing the size of these investments generates a competitive advantage in the form of increased market share. The results also showed that there is no statistically significant relationship between investments in IT and ROA, ROE, EPS, and share price. The results showed that the phenomenon of productivity paradox is found for investments in IT in terms of profits for Saudi banks, as there is no direct influence of these investments on the profitability of the Saudi banks.

Table 5: Results of Models 1, 2, 3,4,5,6

Dependent variable	Adjusted R Square	F test	Significance F	t Static	P-value
CTIR	0.094482694	7.573490843	0.007757517	-2.752	0.007758
ROA	-0.01613	0.000209444	0.988499744	3.277245	0.00172
EPS	-0.01183	0.19205999	0.662730803	-0.43825	0.662731
ROE	0.040264	0.263320589	0.609671686	-0.51315	0.609672
MS	0.040264	3.643083176	0.060934335	1.908686	0.060934
SP	-0.01558	0.033581251	0.855198353	0.183252	0.855198

The independent variable is investments in IT as a % of non-current assets. Significance level is 10%.

The study aims to examine the influences of the CTIR, and MS as independent variables on profit indicators as dependent variables. The results of model eight showed that Investments in IT have a positive influence on EPS. Table 6 shows a statistically significant direct correlation, as decided by the T-test, between MS and EPS, suggesting that investments in IT have a positive influence on MS, which in turn has a positive influence on EPS. The results of model seven also showed an inverse correlation, as decided by the t-test, between the cost-to-income ratios

and EPS, suggesting that improving operational efficiency leads to increased EPS. The results showed that the EPS indicator is superior to returns on equity and assets as a proxy for profit.

$$\text{EPS} = \alpha + \text{CTIR} + (7)$$

$$\text{EPS} = \alpha + \text{MS} + (8)$$

Table 6: Results of Models 7, 8

Independent variable	Adjusted R Square	F test	Significance F	t Static	P-value
MS	0.228407	19.64	0.0000	0.0000	0.000
CTIR	0.2005093	16.0	0.0000	-4.0988	0.000

The Independent Variable Is EPS. Significance level is 5%.

Robustness Test

This test aims to investigate the stability of study results to the re-measurement of IT investments. Following Dewan and Gurbaxani (2007), Joanna et al. (2010), and Pham et al. (2023), the study re-estimated Investments in IT as % of total assets, while the Investments in IT variable in the basic study is measured as a % of long-term assets. According to Table 7, Investments in IT have direct influences on market share. However, Investments in IT have no considerable influence on profit indicators. The Robustness test confirmed the results of the basic analysis. That is, the study's results are not sensitive to re-measuring the independent variable.

Table 7: Results of Models 1, 2, 3,4,5,6

Dependent variables	Adjusted R Square	F test	Significance F	t Static	P-value
CTIR	0.004	2.800	.0264	-1.128	0.0264
ROA	.005	1.325	0.254	-1.151	0.254
EPS	.012	1.771	.188	-1.33	.188
ROE	0.012	1.736	0.193	-1.317	.193
MS	0.37	3.449	0.068	1.857	.068
SP	-.015	.068	.796	-.260	.796

The independent variable is investments in IT as a % of total assets. Significance level is 10%.

Table 8: Results of Testing Hypotheses

	Dependent variable	Results
H 1	ROA	Accepted
H 2	EPS	Rejected
H 3	ROE	Rejected
H 4	CTIR	Accepted
H 5	MS	Accepted

H 6	SP	Rejected
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5. Discussions and Conclusions

The study aims to examine the influence of IT on the performance of banks listed on the Saudi capital market using least squares regression models to assess the study's hypotheses. The study used the CTIR as an indicator of banks' operational efficiency, and the ROA, ROE, and EPS ratios as measures of profitability. MS was used as a measure of bank size and a measure of market power. The study used the MS as an indicator of market performance. The study results showed a statistically significant positive influence of Investments in IT on both the CTIR and MS of the banks under study. On the other hand, the results showed no statistically significant influence of these investments on profit indicators except ROA. The results contradicted the results of (Koroleva & Kudryavtseva, 2019; Chaarani & El-Abiad, 2018; Akhisar et al., 2018; Mohammed & Mann, 2015; Kombe & Wafula, 2015; Arora & Arora, 2013; Al-Amarneh et al., 2023; Damara et al., 2023; Islam et al., 2019; Chaarani & El-Abiad, 2018), as these studies found positive influences for IT investments on the traditional accounting indicators. One plausible reason for the differences in the results is that these studies employed control variables that might have strengthened the impact of IT investments. The results of the current study show that Investments in IT did not pay off; in other words, the phenomenon of the productivity paradox is clear in terms of ROE and EPS for Saudi banks. Based on the results of the study, the study concludes that the banks listed in the Saudi capital market used Investments in IT to improve operational efficiency and increase market share. This, in turn, contributed to improving EPS, which is considered the best indicator of profits. About the influence of Investments in IT on the share price, the results show that there is no statistically significant influence of these investments on the share price. As investors in the Saudi stock market realize that all banks under study have the same competitive advantage about Investments in IT, and therefore, this information on these investments was not one of the inputs for decision-making, because they have no relevant value. The study conducted a robust test of the results, where the variable of Investments in IT was re-measured as a % of total assets rather than as a % of total long-term assets. The results confirmed the results of the basic study, and thus the insensitivity of the results to the variance in the measurement of the independent variable.

The scope of disclosure by banks listed in the Saudi capital market about Investments in IT is limited, as banks did not include details and types of IT to measure the influence of each type of investment in hardware and investments in software separately. Based on the study's results and limitations, the study recommends conducting a cross-country study to investigate the influences of differences in cultural structures, social structures, economic systems, and infrastructures on banks' performance. In addition, the proposed studies can investigate the separate influences of both hardware and software on bank performance, using non-financial performance metrics, stochastic and deterministic efficiency scores.

The study's results have significant implications for several stakeholders, including bank managers and stock market investors. The results showed that the interpretation of the

relationship between Investments in IT and bank performance should be done with caution, as there are no direct influences of investments in IT on the profitability or stock prices of Saudi banks. These investments become a strategic necessity for competition and survival, rather than achieving tangible financial returns. On the other hand, the study revealed that investments in IT had no relevant value, as it did not find a statistically significant relationship between investments in IT and share prices. Additionally, the study has scientific implications, as it examined the relationship between Investments in IT and bank performance from multiple perspectives and suggested research ideas to expand the scope of the study and overcome the limitations of the case study approach adopted in the current study.

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