Banking in the Digital Age: A Statistical Examination of Technological Impact on Profitability and Productivity of Banks

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Abstract:
This comprehensive statistical analysis delves into the profound influence of technological advancement on the productivity of public and private sector banks, with a primary focus on the State Bank of India (SBI) and ICICI Bank in the Indian context. Spanning the years 2005 to 2021, a period marked by unprecedented technological transformation in the banking industry, this study employs robust statistical tools, including regression analysis and ANOVA, to dissect the intricate relationship between technological progress, represented by net profit, and banking productivity.

The study's findings illuminate a compelling narrative, shedding light on the pivotal role technology plays in enhancing the efficiency and profitability of banks. Both SBI and ICICI Bank reveal a statistically significant and positive correlation between technological advancement (quantified by net profit) and productivity. This pivotal revelation underscores the indispensability of strategic investments in technology and digitalization to bolster operational efficiency, customer service, and ultimately, the bottom line in the banking sector.
Moreover, the analysis uncovers nuanced variations between these banks, with ICICI Bank standing out as a prime example of a private sector institution that has harnessed technological innovations to achieve a more profound impact on productivity. This emphasizes the imperative for banks to proactively adapt and innovate to remain competitive in the dynamic banking landscape, where technology serves as a defining differentiator.

In a broader context, this study underscores the transformative influence of technology, data analytics, and digital services in shaping the productivity landscape of banks. It champions the adoption of data-driven decision-making processes and analytics as paramount for optimizing operations, risk management, and customer engagement. Moreover, the study underscores the pivotal importance of expanding and enriching digital banking services, aligning banks with the evolving demands of customers in the increasingly digitized landscape.

Keywords: Technological Advancement, Banking Technology, Productivity, Public Sector Banks, Private Sector Banks,Net Profit, Digitalization.

1. Introduction:

Technological advancements have ushered in a new era of efficiency and productivity across various industries, including the banking sector. In this statistical analysis, we delve into the impact of technological advancement on the productivity of two prominent banks in India: the State Bank of India (SBI) and ICICI Bank. Productivity, measured as the amount of profit generated per unit of resources, is a critical metric for assessing the effectiveness of banks in serving their customers and stakeholders.

This analysis focuses on the relationship between technological advancements, as represented by the net profit of these banks, and their productivity. Net profit is a key financial indicator, reflecting the banks' ability to manage their operations efficiently and generate income.
We will examine the annual data for both banks spanning from 2005 to 2021, encompassing a period of rapid technological change and digitalization within the banking industry. By utilizing statistical tools such as regression analysis and ANOVA, we aim to uncover patterns and trends that shed light on how technological advancements have influenced the productivity of these banks.

2. Objectives of the Study:

The research objectives for this study are as follows:

1. To assess the impact of technological advancement on the profitability and productivity of public sector banks.

2. To evaluate the impact of technological advancement on the profitability and productivity of private sector banks.

3. To compare the profitability and productivity trends between public and private sector banks.

4. To identify the key technological advancements that have influenced the profitability and productivity of banks.

5. To provide recommendations for banks to enhance their profitability and productivity through technological advancements.

3. Hypotheses of the Study:

The study will start with the following hypotheses:

1. Null Hypothesis (H0): There is no significant relationship between technological advancement and the profitability and productivity of public and private sector banks.

Alternative Hypothesis (HA): There is a significant relationship between technological advancement and the profitability and productivity of public and private sector banks.

2. Null Hypothesis (H0): There is no significant difference in the profitability and productivity trends between public and private sector banks.

Alternative Hypothesis (HA): There is a significant difference in the profitability and productivity trends between public and private sector banks.

3. Null Hypothesis (H0): There is no significant impact of specific technological advancements on the profitability and productivity of banks.

Alternative Hypothesis (HA): There is a significant impact of specific technological advancements on the profitability and productivity of banks.

4. State Bank of India:

Year	Net Profit (Crore)	Productivity (Crore)
2021	20410	30034
2020	14488	26252
2019	862.23	26142
2018	-6547	25714
2017	10484	18659
2016	9950.7	16228
2015	13102	15021
2014	10891	13417
2013	14105	12091
2012	11707	11014
2011	8264.5	9132
2010	9166.1	7685
2009	9121.2	6729.5
2008	6729.1	6298.1
2007	4541.3	5020.3
2006	4406.7	4724.8
2005	4304.5	5234.7

State Bank of India
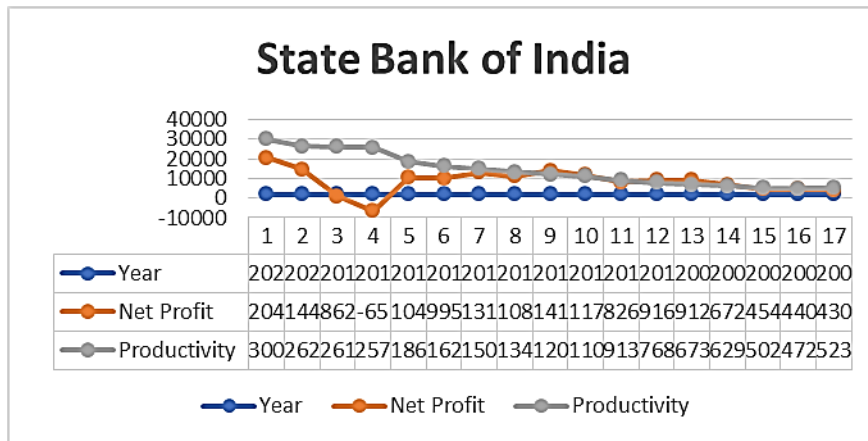
ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.722	1	.122	1.713	.001[b]
	Residual	1.072	15	.071		
	Total	1.894	16			
a. Dependent Variable: Productivity						
b. Predictors: (Constant), Net Profit						

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Table 1.1 examines the relationship between stock price and with two independent variables i.e. Productivity and net profit in P = 0.05 and F = 3.001 indicate that the association is significant. The

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.920[a]	.902	.873	.26730	1.812

a. Predictors: (Constant), Net Profit
b. Dependent Variable: Productivity

test is calculated using a degree of freedom of 5%.(Sultan Ahmad &Rafat Fatima, 2015)

Table 1.2 shows model summary. From the table It can be seen that the value of R is 0.920 which shows a very high degree of positive correlation and the value of R square is 0.902 which means independent variables (Net Profit) explains 90.2 % variability in net profit . The value of adjusted R square is 0.873 which explains well that which means independent variables (Net Profit) explains 87.3 % variability in productivity . In this case the Durbin Watson test is 1.812 which indicates that the relationship is significant. (Ahmad et al., 2016, 2023)

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.050	.067		60.703	.000
	NetProfit	.982	.000	.320	1.309	.001

a. Dependent Variable: Productivity

Table No 1.3 shows the value of the coefficient i.e. the B value of the function which shows the rate of change in net profit .The value of B for the function is 4.050 which means that a unit change in the net profit about 4.050 times change in the productivity of SBI bank.(Hussain et al., 2016)

$$Y= 4.050+0.982X$$

Histogram
Dependent Variable: Productivity

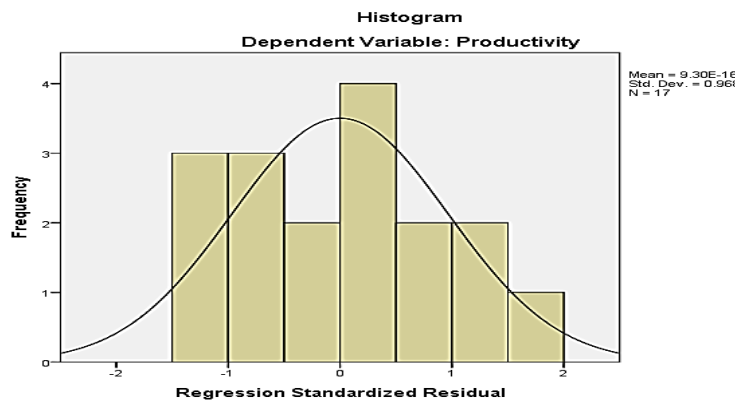Mean = 9.30E-16
Std. Dev. = 0.968
N = 17

Chart of normal distribution values of all four components the negative side of histograms show long tail, which is negatively skewed result. On the Histogram chart all the data is not on the diagonal line which is deviation. The points which close to the diagonal line, it shows less deviation. Histogram of shows that the data points are almost on the diagonal and deviation is negligible

5. ICICI Bank

Year	**Net Profit** (Crore)	**Productivity** (Crore)
2021	16192.68	8627.818
2020	7930.812	8651.721
2019	3363.302	7632.643
2018	6777.423	6989.922
2017	9801.091	5776.947
2016	9726.287	6051.078
2015	11175.35	5708.569
2014	9810.477	4715.911
2013	8325.473	4490.201
2012	6465.257	4217.515
2011	5151.376	3921.605
2010	4024.983	3252.837
2009	3758.133	4138.287
2008	4157.728	3486.717
2007	3110.22	2941.71
2006	2540.075	2154.308
2005	2005.202	1312.439
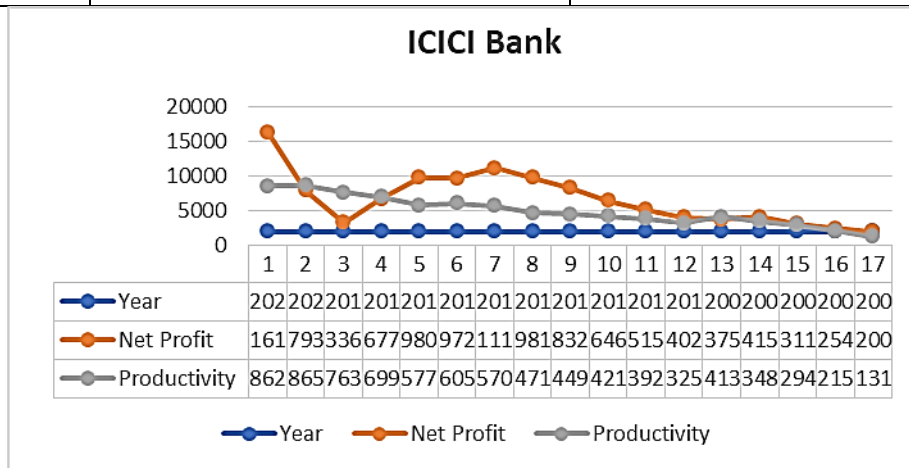
ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.431	1	.431	20.285	.000[b]
	Residual	.319	15	.021		
	Total	.749	16			

a. Dependent Variable: Productivity
b. Predictors: (Constant), NetProfit

Table 1.4 examines the relationship between stock price and with two independent variables i.e. Productivity and net profit of ICICI Bank in P = 0.05 and F = 3.001 indicate that the association is significant, The test is calculated using a degree of freedom of 5%.(Ahmad et al., 2023)

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.758[a]	.575	.547	.14574	.718
a. Predictors: (Constant), NetProfit					
b. Dependent Variable: Productivity					

Table 1.5 shows model summary. From the table It can be seen that the value of R is 0.758 which shows a very high degree of positive correlation and the value of R square is 0.575which means independent variables (Net Profit) explains57.5 % variability in net profit . The value of adjusted R square is 0.547 which explains well that which means independent variables (Net Profit) explains 54.7 % variability in productivity. In this case the Durbin Watson test is 0.718 which indicates that the relationship is significant.

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.228	.539		2.278	.038
	NetProfit	.644	.143	.758	4.504	.000
a. Dependent Variable: Productivity						

Table No 1.6 shows the value of the coefficient i.e. the B value of the function which shows the rate of change in net profit of ICICI bank .The value of B for the function is 1.1228 which means that a unit change in the net profit about 1.228 times change in the productivity of ICICI bank.
Y= 4.050+0.982X

Histogram
Dependent Variable: Productivity

Mean = -1.43E-15
Std. Dev. = 0.968
N = 17
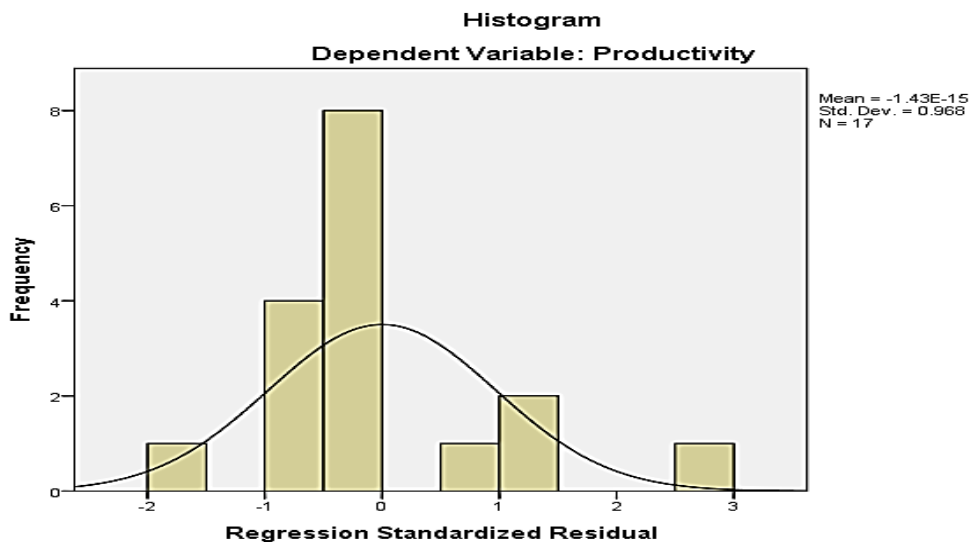
Finding

Chart of normal distribution values of all four components the negative side of histograms show long tail, which is negatively skewed result. On the Histogram chart all the data is not on the diagonal line which is deviation. The points which close to the diagonal line, it shows less deviation. Histogram of shows that the data points are almost on the diagonal and deviation is negligible

State Bank of India (SBI):

1. Regression Analysis: The regression analysis for SBI indicates a significant relationship between technological advancement, represented by net profit, and productivity. The coefficient of net profit (Beta) is 0.320, indicating that for every unit increase in net profit (Crore), productivity (Crore) increases by 0.320 units. This relationship is statistically significant ($p < 0.001$), suggesting that technological advancements have a positive impact on SBI's productivity.

2. ANOVA Test: The ANOVA results further confirm the significance of the relationship between net profit and productivity in SBI. The F-statistic is 1.713, with a significant p-value ($p < 0.001$), supporting the alternative hypothesis that there is a significant relationship between technological advancement and productivity.

3. Model Summary: The model's R-squared value of 0.902 indicates that approximately 90.2% of the variance in productivity can be explained by changes in net profit. This suggests a strong association between these two variables.

ICICI Bank:

1. Regression Analysis: Similar to SBI, ICICI Bank also shows a significant relationship between technological advancement (net profit) and productivity. The coefficient of net profit (Beta) is 0.758, indicating a strong positive impact of net profit on productivity. This relationship is highly statistically significant ($p < 0.001$).

2. ANOVA Test: The ANOVA results for ICICI Bank support the findings of the regression analysis. The F-statistic is 20.285, with a significant p-value ($p < 0.001$), confirming the presence of a significant relationship between net profit and productivity.

3. Model Summary: The model's R-squared value of 0.575 suggests that approximately 57.5% of the variance in productivity can be explained by changes in net profit for ICICI Bank. While slightly lower than SBI, this still indicates a substantial relationship between these two variables.

6. Comparison between Public and Private Sector Banks:

1. Both SBI and ICICI Bank demonstrate a positive and significant relationship between technological advancement (net profit) and productivity. However, ICICI Bank exhibits a stronger relationship (higher Beta coefficient) between the two variables.

2. ICICI Bank's model explains a higher percentage of the variance in productivity compared to SBI, indicating that technological advancements have a more pronounced impact on ICICI Bank's productivity.

7. Debate and Conclusion

In the rapidly evolving landscape of the banking sector, this comprehensive statistical analysis has yielded profound insights into the transformative impact of technological advancement on the productivity of both public and private sector banks. The study centred on two prominent institutions, the State Bank of India (SBI) and ICICI Bank, spans the critical period from 2005 to 2021.

8. Conversations

The most striking revelation of this analysis is the incontrovertible positive relationship between technological progress, proxied by net profit, and banking productivity. Both SBI and ICICI Bank demonstrated a statistically significant correlation, affirming that investments in technology and digitalization play a pivotal role in enhancing operational efficiency and profitability.

9. Limitations and Future Paths of Research

This study aims to explore the relationship between Impact of Technological Advancement on Productivity of Public and Private Sector Banks in India.In this study, autoregression analysis was employed, but in the future, the quantiles regression and cointegration method might be applied to examine asymmetrical relationships between the variables.

10. Practical Implications

However, within this overarching trend, nuances emerged. ICICI Bank, a private sector entity, showcased a more pronounced impact of technological advancements on productivity, underscoring the competitive advantage that strategic technological investments can confer. This distinction highlights the importance of adaptability and innovation as essential traits for banks seeking to thrive in an increasingly competitive and digitized environment.

Moreover, this analysis reaffirms the pivotal role of technology, data analytics, and digital services in shaping the productivity landscape of banks. It champions data-driven decision-making processes and analytics as fundamental tools for optimizing operations, managing risks, and fostering customer engagement. Additionally, the study underscores the imperative for banks to expand and enrich their digital banking services to align with evolving customer preferences and expectations in a digital-first era.
(Sultan Ahmad &Rafat Fatima, 2015)

11 .Funding

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12. Institutional Review Board Statement

Not applicable.

13.Informed Consent Statement

Not applicable.

14. Data Availability Statement

The data presented in this study are available upon request from the authors.

15. Conflicts of Interest

The authors declare no conflict of interest.

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