

**ASSESSING THE IT INVESTMENT-PERFORMANCE PARADIGM IN
THE COMMERCIAL BANKING SECTOR: EMPIRICAL EVIDENCE
FROM THE BRICS AND EUROPEAN BANKING SYSTEMS**

BY

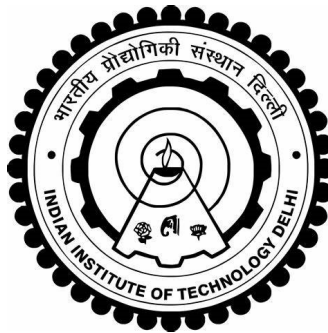
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CERTIFICATE

The thesis entitled “**Assessing the IT investment-performance paradigm in the commercial banking sector: empirical evidence from the BRICS and European banking systems**”, being submitted by **Mr. Navendu Prakash** to the **Indian Institute of Technology Delhi**, for the award of the degree of Doctor of Philosophy is a record bonafide research work carried out by him. He has worked under our guidance and supervision and has fulfilled all the requirements for the submission of this thesis, which has attained the standard required for a Ph.D. degree of this institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

The push toward information technology (IT) has revolutionised how banks have conducted their business over the last three decades. The role of IT in influencing business productivity depends on a variety of factors, including the nature and degree of innovation, its imitability by rival firms, business-specific characteristics, macroeconomic climate, and demand-side factors such as customer adaptability to innovations, the cost-convenience trade-off, and their demographic profile (Hitt and Brynjolfsson, 1996). Since the acquisition, processing, and dissemination of information constitutes a central function of banking, a study of the returns from IT becomes imperative. Further, IT-driven growth presents banks with an intriguing opportunity to differentiate their offerings in a monopolistic market, develop new products, improve customer service and satisfaction, streamline back-office processes, reduce transaction costs, and ultimately achieve the twin objectives of cost minimisation and profit maximisation.

However, there has been no persuasive explanation for the observed divergence in the literature on productivity payoffs from IT, raising scepticism on whether IT can genuinely boost business performance in contemporary banking markets. The apparent fallacy of productivity lends credence to Robert Solow's dictum, "You can see the computer age everywhere except in productivity statistics" (Solow, 1987). Carr (2003) attributes this phenomenon to the commoditization of IT, wherein investing in incremental innovations and a subsequent lack of protection erode its strategic value. Brynjolfsson and Hitt (1995) question the measurement side of the phenomenon, indicating that IT investments, being a blend of product and process innovations, have an extensive impact on the entire organization, labelling the study of productivity payoffs as providing a myopic view of IT. Another strand of literature (Harris, 2001; Cullmann et al., 2009; Kijek and Kijek, 2018; Ejdy, 2018; Bircan and Haas, 2020)

focuses on innovation as a moderator in solving the productivity paradox and highlights the importance of R&D expenditure in generating positive returns from IT capital.

Nevertheless, the interactions between information technology, R&D expenditure, and sectoral performance have garnered significant attention from academicians and policymakers worldwide. Indeed, IT-led productivity growth provides an attractive avenue for commercial banks, who currently find themselves caught in a web of shrinking profits, increased competition, and strict regulatory compliance (Juhro et al., 2020). Against the above background, the present study assesses the IT investment-performance paradigm of the BRICS and European banking systems.

The study addresses a void in the literature by evaluating the following performance aspects of IT investments. First, the impact of IT investments on the economic efficiency of commercial banks operating in the BRICS and European banking systems is investigated. This study dives into the theory of classical economics to identify two economic measures of efficiency that account for the inherent heterogeneity among input and output prices among banks. To this end, two competing efficiency benchmarking methodologies (a parametric, single-step stochastic frontier analysis and a nonparametric data envelopment analysis) are employed to gauge the cost and profit efficiency metrics.

Second, the role of IT investments in initiating efficiency catch-up and convergence is examined for the two geopolitical regions. Two kinds of catch-ups are studied. First, catch-up and convergence are analysed on an intra-industry level among the banking sectors of the two geographical areas in order to evaluate the importance of bank-specific features in affecting the success of technology adoption. Consequently, inter-nation convergence is examined to determine how developing nations (or industries) imitate the superannuated technology of the leaders to achieve significant efficiency gains.

Third, the productivity aspects of IT investments are investigated for the two banking systems. To this end, a DEA-based Malmquist productivity index is employed for measuring changes in total factor productivity (TFP). The index is applied to bifurcate TFP changes into four distinct components (EFFCH, TECHCH, PECH, and SECH), which facilitates an understanding of how IT investments drive productivity changes in banking industries in the two geopolitical blocs. Fourth, the potential persistence of IT investments and possible network effects are investigated by analysing one of the most significant IT developments implemented by the Indian banking sector – the implementation of core banking solutions (CBS). Fifth, the research delves into the intermediation and real aspects of developing an efficient payment and settlement system (PSS) network. To this end, the role of two transmission channels – currency demand and excess reserves of commercial banks are examined to determine the PSS-intermediation associations. Further, the impact of an efficient PSS network is examined on real economic aggregates within a VECM framework.

The findings of the study indicate the absence of the paradox of productivity in the banking sectors of the two geopolitical regions. Nevertheless, the influence of IT is highly heterogeneous among individual institutions. Intra-industry comparisons reveal that bank size is vital in driving IT-efficiency associations. Inter-regional comparisons indicate that BRICS banks are catching up to their European counterparts by leveraging IT solutions, which provides evidence in favour of the catch-up hypothesis, as banks of developing nations adopt the technology of the leader without sharing the cost of development. Further, IT investments positively associate with the TFP growth of BRICS and European banking systems. Nevertheless, how IT influences different productivity components is critical in understanding IT-productivity associations. Further, these associations vary across the level of banking sector development and, as such, provide an insight into how IT resources can explain productivity differences across nations.

In addition, the presence of a conjoint technological network has the potential to enhance the service delivery process and ensure superior returns to Indian banks. Network externalities from CBS provide a considerable incentive for banks to operate on the same technological platform. Nevertheless, the CBS-performance associations are highly susceptible to the structure of the banking industry. Further, the findings highlight the importance of an efficient and digital PSS network for positive macroeconomic and intermediation effects.

The study has important implications for bank managers and policymakers. From the managerial perspective, the findings highlight overinvestment in IT capital as a reason for the productivity paradox. Hence, it is not the magnitude but rather the management of IT resources that holds the key to achieving efficiency gains. Intra-industry comparisons reveal that if IT-driven productivity growth is assumed to be a nation's long-term objective, industry characteristics should dictate the allocation of knowledge capital. The present policy framework functioning on technological upgradation of state-owned banks may be too sanguine, considering the more dynamic and innovative technologies being adopted by private sector banks and foreign banks. Further, the Indian central bank should recognize the externalities effects of CBS adoption and consider such benefits as a blueprint for further upgradations in technological platforms. The positive intermediation and real effects of an efficient PSS network can serve as a roadmap for the Indian central bank toward establishing a digital payment ecosystem. Further, the findings are of relevance to other developing economies to leverage their PSS network for fostering economic development.

Improving sectoral performance has been the priority for banking regulators and hence, commercial banks and policymakers must recognize that technology is not a panacea; instead, it is a tool to enhance efficiency, and its implementation requires prudent planning, organizational capabilities, managerial skills, and entrepreneurship.

सार

सूचना प्रौद्योगिकी (आईटी) की ओर बढ़ने से पिछले तीन दशकों में बैंकों ने अपने कारोबार का संचालन करने के तरीके में क्रांति ला दी है। व्यावसायिक उत्पादकता को प्रभावित करने में आईटी की भूमिका विभिन्न प्रकार के कारकों पर निर्भर करती है, जिसमें नवाचार की प्रकृति और डिग्री, प्रतिद्वंद्वी फर्मों द्वारा इसकी अनुकरणीयता, व्यवसाय-विशिष्ट विशेषताओं, मैक्रोइकॉनॉमिक जलवायु और मांग-पक्ष के कारक जैसे नवाचारों के लिए ग्राहक अनुकूलनशीलता, लागत-सुविधा व्यापार-बंद, और उनकी जनसांख्यिकीय प्रोफ़ाइल (हिट और ब्रायनजॉल्फसन, 1996)। चूंकि सूचना का अधिग्रहण, प्रसंस्करण और प्रसार बैंकिंग का एक केंद्रीय कार्य है, आईटी से रिटर्न का अध्ययन अनिवार्य हो जाता है। इसके अलावा, आईटी-संचालित विकास बैंकों को एक एकाधिकार बाजार में अपनी पेशकशों को अलग करने, नए उत्पादों को विकसित करने, ग्राहक सेवा और संतुष्टि में सुधार करने, बैक-ऑफिस प्रक्रियाओं को सुव्यवस्थित करने, लेनदेन की लागत को कम करने और अंततः लागत न्यूनीकरण और लाभ अधिकतमकरण के दोहरे उद्देश्यों को प्राप्त करने के लिए एक दिलचस्प अवसर प्रदान करता है।

हालांकि, आईटी से उत्पादकता अदायगी पर साहित्य में देखे गए विचलन के लिए कोई प्रेरक स्पष्टीकरण नहीं है, इस पर संदेह पैदा करना कि क्या आईटी वास्तव में समकालीन बैंकिंग बाजारों में व्यावसायिक प्रदर्शन को बढ़ावा दे सकता है। उत्पादकता की स्पष्ट भ्रांति रॉबर्ट सोलो की उक्ति को विश्वास दिलाती है, "आप उत्पादकता आंकड़ों को छोड़कर हर जगह कंप्यूटर युग देख सकते हैं" (सोलो, 1987)। कैर (2003) इस घटना को आईटी के कमोडिटीकरण के लिए जिम्मेदार ठहराता है, जिसमें वृद्धिशील नवाचारों में निवेश और बाद में सुरक्षा की कमी इसके रणनीतिक मूल्य को नष्ट कर देती है। ब्रायनजॉल्फसन और हिट (1995) घटना के माप पक्ष पर सवाल उठाते हैं, यह दर्शाता है कि आईटी निवेश, उत्पाद और प्रक्रिया नवाचारों का मिश्रण होने के नाते, पूरे संगठन पर व्यापक प्रभाव पड़ता है, उत्पादकता अदायगी के अध्ययन को आईटी का एक मायोपिक दृश्य प्रदान करने के रूप में लेबल

करता है। . साहित्य की एक और कड़ी (हैरिस, 2001; कुलमैन एट अल।, 2009; किजेक और किजेक, 2018; एज्डिस, 2018; बिरकन और हास, 2020) उत्पादकता विरोधाभास को हल करने में एक मॉडरेटर के रूप में नवाचार पर केंद्रित है और अनुसंधान एवं विकास व्यय के महत्व पर प्रकाश डालता है।

फिर भी, सूचना प्रौद्योगिकी, अनुसंधान एवं विकास व्यय, और क्षेत्रीय प्रदर्शन के बीच की बातचीत ने दुनिया भर के शिक्षाविदों और नीति निर्माताओं का महत्वपूर्ण ध्यान आकर्षित किया है। दरअसल, आईटी के नेतृत्व वाली उत्पादकता वृद्धि वाणिज्यिक बैंकों के लिए एक आकर्षक अवसर प्रदान करती है, जो वर्तमान में खुद को सिकुड़ते मुनाफे, बढ़ी हुई प्रतिस्पर्धा और सख्त नियामक अनुपालन के जाल में फंसा हुआ पाते हैं (जुहरो एट अल।, 2020)। उपरोक्त पृष्ठभूमि के खिलाफ, वर्तमान अध्ययन ब्रिक्स और यूरोपीय बैंकिंग प्रणालियों के आईटी निवेश-प्रदर्शन प्रतिमान का आकलन करता है।

अध्ययन आईटी निवेश के निम्नलिखित प्रदर्शन पहलुओं का मूल्यांकन करके साहित्य में एक शून्य को संबोधित करता है। सबसे पहले, ब्रिक्स और यूरोपीय बैंकिंग प्रणालियों में काम कर रहे वाणिज्यिक बैंकों की आर्थिक दक्षता पर आईटी निवेश के प्रभाव की जांच की जाती है। यह अध्ययन दक्षता के दो आर्थिक उपायों की पहचान करने के लिए शास्त्रीय अर्थशास्त्र के सिद्धांत में गोता लगाता है जो बैंकों के बीच इनपुट और आउटपुट कीमतों के बीच अंतर्निहित विषमता के लिए जिम्मेदार है। इसके लिए, लागत और लाभ दक्षता मेट्रिक्स को मापने के लिए दो प्रतिस्पर्धी दक्षता बेंचमार्किंग पद्धतियां (एक पैरामीट्रिक, सिंगल-स्टेप स्टोकास्टिक फ्रंटियर विश्लेषण और एक गैर पैरामीट्रिक डेटा एनवेलपमेंट विश्लेषण) कार्यरत हैं।

दूसरा, दो भू-राजनीतिक क्षेत्रों के लिए दक्षता कैच-अप और अभिसरण शुरू करने में आईटी निवेश की भूमिका की जांच की जाती है। दो प्रकार के कैच-अप का अध्ययन किया जाता है। सबसे पहले, प्रौद्योगिकी अपनाने की सफलता को प्रभावित करने में बैंक-विशिष्ट सुविधाओं के महत्व का मूल्यांकन करने के लिए दो भौगोलिक क्षेत्रों के बैंकिंग क्षेत्रों के बीच अंतर-उद्योग स्तर पर कैच-अप और अभिसरण का विश्लेषण किया जाता है। नतीजतन, अंतर-राष्ट्र अभिसरण की जांच यह निर्धारित करने के लिए की जाती है कि कैसे

विकासशील राष्ट्र (या उद्योग) महत्वपूर्ण दक्षता लाभ प्राप्त करने के लिए नेताओं की सेवानिवृत्त तकनीक का अनुकरण करते हैं।

तीसरा, दो बैंकिंग प्रणालियों के लिए आईटी निवेशों के उत्पादकता पहलुओं की जांच की जाती है। इसके लिए, कुल कारक उत्पादकता (TFP) में परिवर्तन को मापने के लिए एक DEA-आधारित Malmquist उत्पादकता सूचकांक कार्यरत है। इंडेक्स को TFP परिवर्तनों को चार अलग-अलग घटकों (EFFCH, TECHCH, PECH, और SECH) में विभाजित करने के लिए लागू किया जाता है, जो यह समझने की सुविधा प्रदान करता है कि कैसे आईटी निवेश दो भू-राजनीतिक ब्लॉकों में बैंकिंग उद्योगों में उत्पादकता में बदलाव लाता है। चौथा, आईटी निवेश की संभावित दृढ़ता और संभावित नेटवर्क प्रभावों की जांच भारतीय बैंकिंग क्षेत्र द्वारा कार्यान्वित सबसे महत्वपूर्ण आईटी विकासों में से एक - कोर बैंकिंग समाधान (CBS) के कार्यान्वयन का विश्लेषण करके की जाती है। पांचवां, अनुसंधान एक कुशल भुगतान और निपटान प्रणाली (PSS) नेटवर्क विकसित करने के मध्यस्थता और वास्तविक पहलुओं में तल्लीन है। इसके लिए, PSS-मध्यस्थता संघों को निर्धारित करने के लिए दो ट्रांसमिशन चैनलों की भूमिका - मुद्रा की मांग और वाणिज्यिक बैंकों के अतिरिक्त भंडार की जांच की जाती है। इसके अलावा, एक VECM ढांचे के भीतर वास्तविक आर्थिक समुच्चय पर एक कुशल PSS नेटवर्क के प्रभाव की जांच की जाती है।

अध्ययन के निष्कर्ष दो भू-राजनीतिक क्षेत्रों के बैंकिंग क्षेत्रों में उत्पादकता के विरोधाभास की अनुपस्थिति का संकेत देते हैं। फिर भी, व्यक्तिगत संस्थानों के बीच आईटी का प्रभाव अत्यधिक विषम है। अंतर-उद्योग तुलना से पता चलता है कि आईटी-दक्षता संघों को चलाने में बैंक का आकार महत्वपूर्ण है। अंतर-क्षेत्रीय तुलना से संकेत मिलता है कि ब्रिक्स बैंक आईटी समाधानों का लाभ उठाकर अपने यूरोपीय समकक्षों को पकड़ रहे हैं, जो कैच-अप परिकल्पना के पक्ष में साक्ष्य प्रदान करता है, क्योंकि विकासशील देशों के बैंक विकास की लागत को साझा किए बिना नेता की तकनीक को अपनाते हैं। इसके अलावा, आईटी निवेश ब्रिक्स और यूरोपीय बैंकिंग प्रणालियों के टीएफपी विकास के साथ सकारात्मक रूप से जुड़ा हुआ है। फिर

भी, आईटी विभिन्न उत्पादकता घटकों को कैसे प्रभावित करता है, यह आईटी-उत्पादकता संघों को समझने में महत्वपूर्ण है। इसके अलावा, ये एसोसिएशन बैंकिंग क्षेत्र के विकास के स्तर पर अलग-अलग हैं और इस तरह, यह एक अंतर्दृष्टि प्रदान करते हैं कि कैसे आईटी संसाधन राष्ट्रों में उत्पादकता अंतरों की व्याख्या कर सकते हैं।

इसके अलावा, संयुक्त तकनीकी नेटवर्क की उपस्थिति में सेवा वितरण प्रक्रिया को बढ़ाने और भारतीय बैंकों को बेहतर रिटर्न सुनिश्चित करने की क्षमता है। सीबीएस से नेटवर्क बाह्यताएं बैंकों को एक ही तकनीकी प्लेटफॉर्म पर काम करने के लिए काफी प्रोत्साहन प्रदान करती हैं। फिर भी, सीबीएस-प्रदर्शन संघ बैंकिंग उद्योग की संरचना के प्रति अतिसंवेदनशील हैं। इसके अलावा, निष्कर्ष सकारात्मक व्यापक आर्थिक और मध्यस्थता प्रभावों के लिए एक कुशल और डिजिटल पीएसएस नेटवर्क के महत्व पर प्रकाश डालते हैं।

अध्ययन के बैंक प्रबंधकों और नीति निर्माताओं के लिए महत्वपूर्ण निहितार्थ हैं। प्रबंधकीय दृष्टिकोण से, निष्कर्ष उत्पादकता विरोधाभास के कारण के रूप में आईटी पूंजी में अत्यधिक निवेश को उजागर करते हैं। इसलिए, यह परिमाण नहीं बल्कि आईटी संसाधनों का प्रबंधन है जो दक्षता लाभ प्राप्त करने की कुंजी रखता है। अंतर-उद्योग तुलना से पता चलता है कि यदि आईटी-संचालित उत्पादकता वृद्धि को देश का दीर्घकालिक उद्देश्य माना जाता है, तो उद्योग की विशेषताओं को ज्ञान पूंजी के आवंटन को निर्धारित करना चाहिए। निजी क्षेत्र के बैंकों और विदेशी बैंकों द्वारा अपनाई जा रही अधिक गतिशील और नवीन तकनीकों को देखते हुए, राज्य के स्वामित्व वाले बैंकों के तकनीकी उन्नयन पर काम करने वाला वर्तमान नीति ढांचा बहुत ही आशावादी हो सकता है। इसके अलावा, भारतीय केंद्रीय बैंक को सीबीएस अपनाने के बाह्य प्रभावों को पहचानना चाहिए और ऐसे लाभों को तकनीकी प्लेटफार्मों में आगे के उन्नयन के लिए ब्लूप्रिंट के रूप में मानना चाहिए। एक कुशल पीएसएस नेटवर्क का सकारात्मक मध्यस्थता और वास्तविक प्रभाव एक डिजिटल भुगतान पारिस्थितिकी तंत्र स्थापित करने की दिशा में भारतीय केंद्रीय बैंक के लिए एक

रोडमैप के रूप में काम कर सकता है। इसके अलावा, निष्कर्ष आर्थिक विकास को बढ़ावा देने के लिए अपने पीएसएस नेटवर्क का लाभ उठाने के लिए अन्य विकासशील अर्थव्यवस्थाओं के लिए प्रासंगिक हैं।

क्षेत्रीय प्रदर्शन में सुधार बैंकिंग नियामकों के लिए प्राथमिकता रही है और इसलिए, वाणिज्यिक बैंकों और नीति निर्माताओं को यह समझना चाहिए कि प्रौद्योगिकी रामबाण नहीं है; इसके बजाय, यह दक्षता बढ़ाने का एक उपकरण है, और इसके कार्यान्वयन के लिए विवेकपूर्ण योजना, संगठनात्मक क्षमता, प्रबंधकीय कौशल और उद्यमशीलता की आवश्यकता होती है।

TABLE OF CONTENTS

| | |
|--|--------------|
| Certificate | i |
| Acknowledgments | ii |
| Abstract | iv |
| List of figures | xviii |
| List of tables | xxi |
| List of abbreviations | xiv |
| | |
| CHAPTER 1: INTRODUCTION | 1 |
| 1.1 Background..... | 5 |
| 1.2 Performance aspects of IT investments..... | 7 |
| 1.2.1 The efficiency aspect..... | 8 |
| 1.2.2 The convergence aspect..... | 8 |
| 1.2.3 The productivity aspect..... | 9 |
| 1.2.4 The externalities aspect..... | 9 |
| 1.2.5 The intermediation aspect..... | 10 |
| 1.3 Banking sector of BRICS and Europe: An overview..... | 11 |
| 1.4 Problem statement..... | 21 |
| 1.5 Significance of the study..... | 23 |
| 1.6 Analytical framework..... | 24 |
| 1.7 Organization of the thesis..... | 27 |
| 1.8 Concluding observations..... | 29 |
| | |
| CHAPTER 2: LITERATURE REVIEW | 30 |
| 2.1 Introduction..... | 30 |
| 2.2 The efficiency aspect..... | 33 |
| 2.2.1 Technological diffusion in banking: A theoretical framework..... | 33 |
| 2.2.2 The quest for efficiency..... | 37 |
| 2.2.3 Solow's paradox: A clash of expectations?..... | 41 |

| | |
|---|-----------|
| 2.2.4 Rejecting the paradox: Birth of a new economy?..... | 47 |
| 2.3 The convergence aspect | 56 |
| 2.3.1 The economics of localized technological change..... | 56 |
| 2.3.2 Catch-up and convergence..... | 59 |
| 2.3.3 The role of institutional characteristics..... | 60 |
| 2.4 The productivity aspect..... | 62 |
| 2.4.1 Total factor productivity, Malmquist index, and its decomposition..... | 62 |
| 2.4.2 Empirical studies..... | 66 |
| 2.5 The externalities aspect..... | 67 |
| 2.5.1 Long-term effects of IT adoption..... | 68 |
| 2.5.2 Network externalities and bank performance | 71 |
| 2.5.3 Core banking solutions (CBS): Introduction, mechanics, and adoption..... | 74 |
| 2.6 The intermediation aspect..... | 77 |
| 2.6.1 Evolution of payment systems | 77 |
| 2.6.2 Role of payment systems in financial intermediation: Transmission channels .. | 78 |
| 2.6.3 Payment systems and the real economy..... | 84 |
| 2.7 Research gaps..... | 90 |
| 2.8 Concluding observations..... | 94 |
| | |
| CHAPTER 3: RESEARCH OBJECTIVES AND METHODOLOGY | 95 |
| 3.1 Introduction..... | 95 |
| 3.2 Research questions..... | 95 |
| 3.3 Research objectives and hypotheses | 96 |
| 3.3.1 Research objectives..... | 96 |
| 3.3.2 Research hypotheses | 97 |
| 3.4 Research design | 98 |
| 3.4.1 Scope of the study..... | 99 |
| 3.4.2 Database and software | 103 |
| 3.4.3 Research methodology..... | 103 |
| 3.4.3.1 Stochastic frontier analysis (SFA) | 106 |
| 3.4.3.2 Data envelopment analysis (DEA)..... | 117 |

| | |
|---|-----|
| 3.4.3.3 Choice of input/output selection | 126 |
| 3.4.3.4 Methodological comparison of SFA and DEA..... | 130 |
| 3.5 Concluding observations..... | 160 |

CHAPTER 4: EFFICIENCY ASPECTS OF IT IN BRICS AND EUROPEAN BANKING SYSTEMS 161

| | |
|---|-----|
| 4.1 Introduction..... | 161 |
| 4.2 Stochastic frontier analysis | 163 |
| 4.3 Data envelopment analysis | 180 |
| 4.4 A methodological evaluation of SFA and DEA | 199 |
| 4.4.1 Efficiency distributions | 199 |
| 4.4.2 Spearman’s rank-order correlation test..... | 200 |
| 4.4.3 Identification of worst and best performers | 202 |
| 4.5 Concluding observations..... | 205 |
| Annexure 4. A..... | 208 |

CHAPTER 5: CATCH-UP AND CONVERGENCE ASPECTS OF IT IN BRICS AND EUROPEAN BANKING SYSTEMS 213

| | |
|--|-----|
| 5.1 Introduction..... | 213 |
| 5.2 Intra-industry catch-up and convergence..... | 218 |
| 5.2.1 Intra-industry convergence in BRICS..... | 219 |
| 5.2.2 Intra-industry convergence in Europe..... | 230 |
| 5.3 Inter-country catch-up and convergence..... | 241 |
| 5.3.1 Cost efficiency catch-up and convergence | 242 |
| 5.3.2 Profit efficiency catch-up and convergence..... | 247 |
| 5.4 Robustness checks | 252 |
| 5.4.1 Alternative revenue efficiency (ARE) | 253 |
| 5.4.2 Role of institutional characteristics on IT-revenue efficiency associations..... | 258 |
| 5.4.3 Alternative model specifications..... | 262 |
| 5.4.4 Tests for model specification | 262 |
| 5.5 Concluding observations..... | 268 |

| | |
|--|------------|
| CHAPTER 6: PRODUCTIVITY ASPECTS OF IT IN BRICS AND EUROPEAN BANKING SYSTEMS | 270 |
| 6.1 Introduction..... | 270 |
| 6.2 Preliminary analysis..... | 274 |
| 6.3 IT-productivity associations..... | 289 |
| 6.3.1 IT-TFPCCH associations..... | 289 |
| 6.3.2 IT-EFFCH associations..... | 292 |
| 6.3.3 IT-TECHCH associations..... | 295 |
| 6.3.4 IT-PECH associations..... | 298 |
| 6.3.5 IT-SECH associations..... | 301 |
| 6.4 Concluding observations..... | 304 |
| | |
| CHAPTER 7: IT-EXTERNALITIES ASSOCIATIONS – A CASE FOR CBS ADOPTION IN THE INDIAN BANKING SECTOR | 308 |
| 7.1 Introduction..... | 308 |
| 7.2 Pattern of CBS adoption in the Indian banking sector..... | 310 |
| 7.3 CBS-performance associations..... | 316 |
| 7.4 Role of structural characteristics..... | 320 |
| 7.5 Network externalities from CBS adoption..... | 332 |
| 7.6 Concluding observations..... | 336 |
| | |
| CHAPTER 8: INTERMEDIATION AND REAL EFFECTS OF PAYMENT AND SETTLEMENT SYSTEMS: AN INDIAN CASE | 338 |
| 8.1 Introduction..... | 338 |
| 8.2 Key trends in the Indian payment and settlement network..... | 340 |
| 8.3 The intermediation aspect of the PSS network..... | 344 |
| 8.4 PSS network and the real economy..... | 353 |
| 8.5 Substitution effects of electronic and paper-based clearing systems..... | 359 |
| 8.6 Concluding observations..... | 360 |
| | |
| CHAPTER 9: CONCLUSION | 363 |
| 9.1 Introduction..... | 363 |
| 9.2 Major findings from the research..... | 364 |
| 9.3 Recommendations..... | 373 |

| | |
|-------------------------------------|------------|
| 9.4 Contributions..... | 377 |
| 9.5 Limitations | 378 |
| 9.6 Future scope of the study | 379 |
| REFERENCES..... | 381 |
| CURRICULUM VITAE..... | 410 |

LIST OF FIGURES

| | |
|--|-----|
| Figure 1.1: Research trend of Solow’s paradox in the commercial banking sector | 4 |
| Figure 1.2: Research trend on information technology in commercial banking..... | 6 |
| Figure 1.3: Performance aspects of IT investigated in the thesis | 7 |
| Figure 1.4: Percentage growth in GDP per capita (constant USD) | 12 |
| Figure 1.5: Growth in bank deposits to GDP (constant USD)..... | 13 |
| Figure 1.6: Average Z-score values across time | 14 |
| Figure 1.7: Growth in deposits for the developed regions | 17 |
| Figure 1.8: Return on average assets (ROAA) in developed banking regions | 18 |
| Figure 1.9: Average Z score values in developed banking regions | 18 |
| Figure 1.10: GII scores of BRICS nations..... | 19 |
| Figure 1.11: GII scores of European nations | 19 |
| Figure 1.12: Research trends on IT in BRICS and European banking systems | 20 |
| Figure 2.1: Roadmap of literature review | 32 |
| Figure 2.2: Decomposition of the Malmquist index for a single input, single output firm | 64 |
| Figure 2.3: Network effects | 72 |
| Figure 2.4: Core banking solutions mechanics | 75 |
| Figure 3.1 Research design overview | 101 |
| Figure 3.2: Methodological framework of RO1 | 105 |
| Figure 3.3: Input slacks | 119 |
| Figure 3.4: Comparison of efficient frontiers in CRS and VRS models | 121 |
| Figure 3.5: Mediation framework..... | 152 |
| Figure 4.1: Movement of efficiency scores across time (SFA) | 170 |
| Figure 4.2: Marginal effects of IT and R&D on the economic efficiency of BRICS (SFA) | 176 |
| Figure 4.3: Marginal effects of IT and R&D on the economic efficiency of Europe (SFA) | 177 |
| Figure 4.4: Movement of efficiency scores across time (DEA) | 185 |

| | |
|---|-----|
| Figure 4.5: Marginal effects of IT on the economic efficiency of BRICS (Tobit) | 191 |
| Figure 4.6: Marginal effects of IT on the economic efficiency of EU (Tobit) | 192 |
| Figure 4.7: FRM-based marginal effects of IT on the economic efficiency of BRICS..... | 194 |
| Figure 4.8: FRM-based marginal effects of IT on the economic efficiency of the EU | 197 |
| Figure 4.9: Correlation plots between SFA and DEA estimates | 201 |
| Figure 4.10: Pattern of cost efficiency in BRICS and European banking systems (SFA) | 208 |
| Figure 4.11: Pattern of profit efficiency in BRICS and European banking systems (SFA) . | 209 |
| Figure 4.12: Pattern of technical efficiency in BRICS and European banking systems (DEA) | 210 |
| Figure 4.13: Pattern of cost efficiency in BRICS and European banking systems (DEA) ... | 211 |
| Figure 4.14: Pattern of profit efficiency in BRICS and European banking systems (DEA) | 212 |
| Figure 5.1: Marginal effects of IT and R&D on economic inefficiency across bank size (BRICS) | 221 |
| Figure 5.2: Marginal effects of IT and R&D on economic inefficiency across bank age (BRICS) | 224 |
| Figure 5.3: Marginal effects of IT on economic inefficiency across R&D intensity (BRICS) | 228 |
| Figure 5.4: Marginal effects of IT and R&D on economic inefficiency across bank size (EU) | 232 |
| Figure 5.5: Marginal effects of IT and R&D on economic inefficiency across bank age (EU) | 235 |
| Figure 5.6: Marginal effects of IT on economic inefficiency across R&D intensity (EU) .. | 238 |
| Figure 5.7: Marginal effects of IT and R&D on revenue inefficiency across bank size | 259 |
| Figure 5.8: Marginal effects of IT and R&D on revenue inefficiency across bank age | 261 |
| Figure 5.9: Marginal effects of IT on revenue inefficiency across R&D intensity | 262 |
| Figure 6.1: TFP change and its components | 274 |
| Figure 6.2: TFP movements across time (2006-2020) | 279 |

| | |
|---|-----|
| Figure 6.3: Pattern of TFP change in BRICS and European banking systems | 280 |
| Figure 6.4: Technical efficiency movements across time (2006-2020) | 281 |
| Figure 6.5: Pattern of TE change in BRICS and European banking systems | 282 |
| Figure 6.6: Technical progress across time (2006-2020) | 283 |
| Figure 6.7: Pattern of technical change in BRICS and European banking systems | 284 |
| Figure 6.8: Pure technical efficiency movements across time (2006-2020) | 285 |
| Figure 6.9: Pattern of pure TE change in BRICS and European banking systems | 286 |
| Figure 6.10: Scale efficiency movements across time (2006-2020) | 287 |
| Figure 6.11: Pattern of scale efficiency change in BRICS and European banking systems | 288 |
| Figure 7.1: CBS adoption across time | 311 |
| Figure 7.2: CBS adoption across bank ownership | 312 |
| Figure 7.3: CBS adoption across bank size | 313 |
| Figure 7.4: CBS adoption across bank age | 314 |
| Figure 7.5: Pattern of network effects from CBS adoption | 315 |
| Figure 8.1: Volume of transactions executed through RTGS (LVPS) | 341 |
| Figure 8.2: Volume of transactions executed through the RPS network | 343 |
| Figure 8.3: Proportion of paper-based and electronic clearing (2005-2020) | 344 |
| Figure 8.4: RTGS and excess reserves (2005-2020) | 345 |
| Figure 8.5: Retail payment systems and currency demand (2005-2020) | 346 |
| Figure 8.6: Roots of the companion matrix (GDPPC) | 357 |
| Figure 8.7: Roots of the companion matrix (Trade) | 358 |
| Figure 8.8: Roots of the companion matrix (Consumption) | 358 |

LIST OF TABLES

| | |
|---|-----|
| Table 2.1: Summary of select relevant studies | 86 |
| Table 3.1: Global Innovation Index (GII) rankings | 102 |
| Table 3.2: Net profit indicator (NPI) adjustment..... | 116 |
| Table 3.3: Variable description | 128 |
| Table 3.4: Key variables for the long-term effects of CBS adoption | 147 |
| Table 3.5: Variables for determining the impact of payment and settlement system network on financial intermediation | 153 |
| Table 3.6: Descriptive statistics | 158 |
| Table 4.1: Likelihood ratio test for meta-frontier versus pooled frontier analyses | 164 |
| Table 4.2: Frontier estimates of the translog function | 165 |
| Table 4.3: Average country-wise efficiency scores across time (SFA) | 168 |
| Table 4.4: Average marginal effects on economic inefficiency (SFA) | 173 |
| Table 4.5: Model specification tests | 179 |
| Table 4.6: Average country-wise efficiency scores across time (DEA) | 183 |
| Table 4.7: Impact of IT investments on economic inefficiency (Tobit) | 188 |
| Table 4.8: Impact of IT investments on economic inefficiency (FRM) | 193 |
| Table 4.9: Direction of the determinants of bank inefficiency across various models..... | 198 |
| Table 4.10: Efficiency distributions DEA and SFA scores | 200 |
| Table 4.11: Spearman’s rank correlation test between SFA and DEA estimates | 201 |
| Table 4.12: Coherence between DEA and SFA estimates of worst and best performers | 203 |
| Table 4.13: Country-wise coherence between DEA and SFA efficiency estimates | 204 |
| Table 5.1: Tests for β – convergence of efficiency scores across bank size (BRICS)..... | 222 |
| Table 5.2: Test for σ – convergence of efficiency scores across bank size (BRICS)..... | 223 |
| Table 5.3: Tests for β – convergence of efficiency scores across bank age (BRICS)..... | 226 |
| Table 5.4: Test for σ – convergence of efficiency scores across bank age (BRICS) | 227 |

| | |
|---|-----|
| Table 5.5: Tests for β – convergence of efficiency scores across R&D intensity (BRICS) | 229 |
| Table 5.6: Test for σ – convergence of efficiency scores across R&D intensity (BRICS) | 230 |
| Table 5.7: Tests for β – convergence of efficiency scores across bank size (EU) | 233 |
| Table 5.8: Test for σ – convergence of efficiency scores across bank size (EU) | 234 |
| Table 5.9: Tests for β – convergence of efficiency scores across bank age (EU) | 236 |
| Table 5.10: Test for σ – convergence of efficiency scores across bank age (EU) | 237 |
| Table 5.11: Tests for β – convergence of efficiency scores across R&D intensity (EU) | 240 |
| Table 5.12: Test for σ – convergence of efficiency scores across R&D intensity (EU) | 241 |
| Table 5.13: Average marginal effects on the mean and variance of cost inefficiency | 245 |
| Table 5.14: Average marginal effects on the mean and variance of profit inefficiency | 249 |
| Table 5.15: Tests for β – convergence of efficiency scores across BRICS and European banks | 251 |
| Table 5.16: Tests for σ – convergence of efficiency scores across BRICS and European banks | 252 |
| Table 5.17: Average marginal effects on the mean and variance of revenue inefficiency | 255 |
| Table 5.18: Marginal effects on inefficiency mean under alternative model specifications | 265 |
| Table 5.19: Model specification tests | 267 |
| Table 6.1: Average country-wise change in TFP and its components across time | 277 |
| Table 6.2: Impact of IT investments on TFP change (TFPCH) | 291 |
| Table 6.3: Diagnostic tests (TFPCH) | 292 |
| Table 6.4: Impact of IT investments on technical efficiency change (EFFCH) | 294 |
| Table 6.5: Diagnostic tests (EFFCH) | 295 |
| Table 6.6: Impact of IT investments on technical progress (TECHCH) | 297 |
| Table 6.7: Diagnostic tests (TECHCH) | 298 |
| Table 6.8: Impact of IT investments on pure technical efficiency change (PECH) | 300 |
| Table 6.9: Diagnostic tests (PECH) | 301 |
| Table 6.10: Impact of IT investments on scale efficiency change (SECH) | 303 |

| | |
|---|-----|
| Table 6.11: Diagnostic tests (SECH) | 304 |
| Table 6.12: Direction of the determinants of bank productivity across various models | 307 |
| Table 7.1: Akaike information criterion (AIC) for optimal lag length | 316 |
| Table 7.2: Short-run and long-run mechanics of CBS-performance associations | 319 |
| Table 7.3: Short-run and long-run mechanics of CBS-performance associations across bank ownership | 322 |
| Table 7.4: Short-run and long-run mechanics of CBS-performance associations across bank size | 326 |
| Table 7.5: Short-run and long-run mechanics of CBS-performance associations across bank age | 330 |
| Table 7.6: Network effects of CBS adoption | 334 |
| Table 8.1: Mediating impact of excess reserves on LVPS-financial intermediation associations | 349 |
| Table 8.2: Mediating impact of currency demand on RPS-financial intermediation associations | 351 |
| Table 8.3: Augmented Dickey-Fuller (ADF) test for stationarity | 353 |
| Table 8.4: Selection of optimal lag length (GDPPC) | 354 |
| Table 8.5: Selection of optimal lag length (Trade) | 354 |
| Table 8.6: Selection of optimal lag length (Consumption) | 354 |
| Table 8.7: Johansen cointegration test (GDPPC) | 355 |
| Table 8.8: Johansen cointegration test (Trade) | 355 |
| Table 8.9: Johansen cointegration test (Consumption) | 355 |
| Table 8.10: Long-run impact of payment systems on the real economy | 356 |
| Table 8.11: Substitution effects of payment systems on the real economy | 359 |

LIST OF ABBREVIATIONS

| | |
|----------|--|
| ACH | Automated Clearing House |
| ADF | Augmented Dickey-Fuller |
| AIC | Akaike Information Criterion |
| APE | Alternative Profit Efficiency |
| API | Application Program Interface |
| ARDL | Auto Regressive Distributed Lag |
| ARE | Alternative Revenue Efficiency |
| ATM | Automated Teller Machines |
| BCBS | Basel Committee on Banking Supervision |
| BRICS | Brazil, Russia, India, China, and South Africa |
| CAGR | Compounded Annual Growth Rate |
| CBS | Core Banking Solutions |
| CCIL | Clearing Corporation of India Limited |
| CDTFED | Customer Deposits to Total Funding Excluding Derivatives |
| CE | Cost Efficiency |
| CES | Constant Elasticity Substitution |
| CORE | Centralized Online Real-Time Exchange |
| COVID-19 | Coronavirus Disease 2019 |
| CPI | Consumer Price Index |
| CRR | Cash Reserve Ratio |
| CRS | Constant Returns to Scale |
| CTI | Cost to Income |
| CTS | Cheque Truncation System |
| DBIE | Database on Indian Economy |
| DCPS | Domestic Credit to Private Sector |
| DEA | Data Envelopment Analysis |
| DEAP | Data Envelopment Analysis Program |

| | |
|--------|--|
| DGP | Data Generating Process |
| DMU | Decision Making Unit |
| DPB | Domestic Private Banks |
| DRS | Decreasing Returns to Scale |
| ECB | European Central Bank |
| EECA | Eastern European and Central Asian |
| EFT | Electronic Fund Transfer |
| EFTA | European Free Trade Area |
| ERP | Enterprise Resource Planning |
| EU | European Union |
| EVA | Economic Value Added |
| FDI | Foreign Direct Investment |
| FE | Fixed Effects |
| FPB | Foreign Private Banks |
| FPE | Final Prediction Error |
| FRM | Fractional Regression Model |
| FRTB | Fundamental Review of the Trading Book |
| GDP | Gross Domestic Product |
| GFC | Global Financial Crisis |
| GII | Global Innovation Index |
| GLS | Generalized Least Squares |
| GMM | Generalized Method of Moments |
| HQ | Hannan-Quinn |
| IDRBT | Institute for Development and Research in Banking Technology |
| IFTAS | Indian Financial Technology and Allied Services |
| IIAIEA | Interest Income to Average Interest Earning Assets |
| IMF | International Monetary Fund |
| INSEAD | Institut Européen d'Administration des Affaires |
| IRS | Increasing Returns to Scale |

| | |
|--------|--|
| IS | Information Systems |
| IT | Information Technology |
| KYC | Know Your Customer |
| LADSTF | Liquid Assets to Deposits and Short-Term Funding |
| LM | Langrangian Multiplier |
| LOU | Letter of Undertaking |
| LR | Likelihood Ratio |
| LSDV | Least Squares Dummy Variable |
| LVPS | Large Value Payment System |
| MC | Monte Carlo |
| MICR | Magnetic Ink Character Recognition |
| ML | Maximum Likelihood |
| MPI | Malmquist Productivity Index |
| NBFC | Non-Banking Finance Company |
| NE | Network Effects |
| NEFT | National Electronic Fund Transfer |
| NPCI | National Payments Corporation of India |
| NPI | Negative Profit Indicator |
| NPL | Non-Performing Loans |
| NPV | Net Present Value |
| OLS | Ordinary Least Squares |
| OME | Output Mix Effect |
| PE | Profit Efficiency |
| PECH | Pure Technical Efficiency Change |
| PMG | Pooled Mean Group |
| POS | Point of Sale |
| PPI | Prepaid Payment Instruments |
| PPS | Positive Pay System |
| PSB | Public Sector Banks |

| | |
|-------|--|
| PSO | Payment System Operators |
| PSS | Payment and Settlement Systems |
| QML | Quasi-Maximum Likelihood |
| R&D | Research and Development |
| RBI | Reserve Bank of India |
| RBV | Resource Based View |
| RID | Ratio of Indirect to Direct Effects |
| RIT | Ratio of Indirect to Total Effects |
| RMO | Relationship Marketing Orientation |
| ROA | Return on Assets |
| ROAA | Return on Average Assets |
| ROE | Return on Equity |
| RPS | Retail Payment System |
| RRR | Required Reserve Ratio |
| RTGS | Real-Time Gross Settlement |
| RTS | Returns to Scale |
| SBM | Slacks-Based Measure |
| SEBI | Securities and Exchange Board of India |
| SECH | Scale Efficiency Change |
| SEM | Structural Equation Modeling |
| SFA | Stochastic Frontier Analysis |
| SIC | Schwarz Information Criterion |
| SLR | Statutory Liquidity Ratio |
| SOB | State-Owned Banks |
| SPE | Standard Profit Efficiency |
| SUR | Seemingly Unrelated Regression |
| SWIFT | Society for Worldwide Interbank Financial Telecommunications |
| TA | Total Assets |
| TAM | Technology Acceptance Model |

| | |
|--------|--|
| TC | Total Cost |
| TE | Technical Efficiency |
| TECHCH | Technical Change |
| TFP | Total Factor Productivity |
| TFPCH | Total Factor Productivity Change |
| TOPS | Technically Optimal Production Scale |
| TR | Total Revenue |
| TRAI | Telecom Regulatory Authority of India |
| UNCTAD | United Nations Conference on Trade and Development |
| UK | United Kingdom |
| UPI | Unified Payments Interface |
| USA | United States of America |
| UTAUT | Unified Theory of Acceptance and Use of Technology |
| VAR | Vector Autoregression |
| VECM | Vector Error Correction Model |
| VRS | Variable Returns to Scale |
| WIPO | World Intellectual Property Organization |
| WTO | World Trade Organization |