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Does investing in intellectual capital improve productivity? Panel evidence from commercial banks in India

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Abstract

In this current knowledge-based economy, firms' productivity and competitive advantage are no longer based on physical and financial assets but on intangible assets. This has compelled knowledge-intensive firms to look for a more reliable source for higher productivity and competitive advantage by focusing on their intellectual capital, which cannot be easily imitated. As banks are classified as knowledge intensive, this study examines investment in intellectual capital by banks and examines how it has improved bank productivity measured in terms of asset turnover (ATO) and employee productivity (EP). Using a panel of 73 commercial banks in India for a 12-year period (2006−2017), the study found that some components of intellectual capital improves productivity, and others do not.

1. Introduction

In recent years, global banking has been transformed by knowledge as a source of wealth, compared to other tangible and physical assets (Bontis, 1998). Knowledge has become the new engine driving organizations' wealth, and the World Bank (1999) stated that "knowledge is our most powerful engine of production." Banks as service firms have been classified as a knowledge-intensive sector (Branco, Delgado, Sousa, & Sa, 2011), and studies explore the relevance of knowledge to bank performance (Edvinsson & Malone, 1997; Firer & Mitchell Williams, 2003; Kamath, 2015). This makes the recognition and development of knowledge management (intangible asset) an important aspect of bank management. Originally, the entire operations of banks depended on creativity, offering edge products and providing unique services in creating competitive advantage. Therefore, Chen, Cheng, and Hwang (2005) stated that banks are sources of economic value, and higher productivity comes from their intellectual capital (IC). This phenomenon has made the concept of IC popular in the current era of knowledge economies, building on the knowledge-based theory (KBV) of a firm. Barney (1991) considered these intellectual assets resources that can be physical capital, organizational capital, and human capital resources.

Additionally, the resources are exactly what Pulic (1998) referred to as the components of IC that form the value-added intellectual coefficient (VAIC) model. This model is useful in evaluating IC and in distinct features of organizations (El-Bannany, 2008). The model combines capital employed and human and structural capital efficiency, which enables comparative analysis between firms, sectors, industries, and countries. Some studies (Mondal & Ghosh, 2012; Onyekwelu, Okoh, & Iyidiobi, 2017; Soriya & Narwal, 2015) that have investigated IC and bank performance have suggested that IC contributes to performance as an indicator of productivity, profitability, or efficiency of firms. Therefore, investigating IC in the banking sector is imperative because the sector is classified under knowledge concentrated/intensive firms.

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Acting mainly as a financial intermediary, banks offer indispensable services to stimulate and promote economic growth. In doing so, banks require physical and other intellectual assets for production (Goh, 2005). Moreover, in India, according to World Bank Group, 2017, about 46.2% of total production comes from the service sector, including banks. This means that bank productivity is an important element in the development of the Indian economy. Many studies have been conducted on Indian banks (Kamath, 2007; Mondal & Ghosh, 2012; Soriya & Narwal, 2015), however, few are on IC and bank productivity alone. Also, none of the studies focused on commercial banks with emphasis on how IC influences bank productivity. So the question remains as to how IC influences commercial bank productivity. This study, therefore, covers commercial banks with high market capitalization and the disclosure of IC has been recorded by commercial banks in recent years.

Aside from this, the growing internalization that has been driven by the continuous deregulation has increased competition and technological advancement in the Indian banking sector. Boden and Miles (2000) have hinted that these transformations are considered features of a knowledge-based economy. Deregulation, for instance, reduced public monopolies, which encouraged foreign banks to operate, creating a more competitive environment that is conducive to innovation and growth. This is because these foreign banks are already advanced in technology and acquainted with international banking standards and practices, hence desire high competition in the industry. This is why in the second phase of the Narsimham Committee recommendation in 1998 stated that the Indian banking system is completely outdated and needs technological support in this knowledge era (RBI report, 1999).

Because of these drawbacks, banks ought to be technologically sound and be more innovative to be able to compete. To build and maintain a sustainable competitive advantage, banks face a critical moment in managing their intellectual assets, given that they rely on their intangible assets to excel. That is, banks' potential in building their competitive advantage relies on the investment and efficient management of IC (Al-Musali & Ku Ismail, 2016). This is why it is so important to examine how investment in IC has influenced productivity of commercial banks in India.

The study therefore applied the VAIC model with a sample of 73 commercial banks over a period of 12 years. A separate analysis has been done by dividing the full sample of banks into public, private, and foreign banks. The sample is sourced from the Prowess database and panel data modeling featuring fixed and random effects were applied for analysis. Hence, the study comprises five sections, and the next section discusses a literature review, followed by sections on our methodology, findings, and discussion.

2. Literature review and development of hypotheses

One of the most recognized theories of a firm is the resource-based theory (RB theory), which recognizes the resources of a firm as human, physical, or organizational and could be intangible or tangible (Barney, 1991). Based on this theory, scholars and practitioners opined that in this current knowledge era, intangible assets, also known as intellectual capital (IC), are what make the difference in firm performance (e.g., Edvinsson & Malone, 1997). Similarly, Pulic (1998, 2000) put forth a model known as value-added intellectual coefficients (VAIC), which measures a firm's intellectual efficiency in this current knowledge economy. According to Pulic (2000), the model is related to the physical/financial, structural, and human capital, which creates value for firms (See Figure S1, available online).

From a general perspective, human capital efficiency (HCE) as a component of the VAIC model constitutes the knowledge of employees and their competence (Bontis, 1998) which does not remain at the organization after the concerned employee leaves. Regarding this component, Goh (2005) provided evidence that HCE is the most dominant IC component and hinted that staff knowledge in the creation of value is indeed a sacrosanct aspect for banks. Similarly, in India, using a sample of 30 firms across manufacturing and services, Kamath (2015) assessed IC and performance and found that HCE was the major component of IC with an impact on productivity. Mondal and Ghosh (2012) also confirmed the positive significant relationship between HC and bank productivity. Tripathy, Gil-Alana, and Sahoo (2015) assessed the relationship between 164 firms in seven industries (including banks) and found a high impact of HCE on firm performance. Nimtrakoon (2015) found similar results, consistent with those of Wang et al. (2011), that HCE significantly affects firm performance. In addition, studies on India by Maji and Goswami (2016) documented similar results, indicating that HCE affects firm performance.

Based on these studies related to HCE and performance, we form the following hypothesis:

H1. HCE has a positive impact on bank productivity

The second component of IC, capital employed efficiency (CEE), is defined by Pulic (1998) as including all necessary financial funds and physical capital, therefore, CEE is an important consideration in the VAIC model. Scholars including Chen et al. (2005) found CEE to be positive and significant with corporate measures such as EP and ROA. Consistently, Chan (2009b) primarily assessed the impact of IC on organizational performance, revealing that CEE is positive with all performance measures, including productivity. Also, a study on Serbian hotels by Bontis, Janošević, and Dženopoljac (2015) showed that capital employed was an effective component of IC, which drives the productivity of the sample hotels. In India, studies by Venugopal and Subha (2012), Tripathy et al. (2015), and Maji and Goswami (2016) found a significant correlation between CEE and financial performance measures. Consistent with these studies, Deep and Narwal (2015) found a significant association between CEE and productivity at Indian firms in the manufacturing and service sectors. A study on Turkish banks by Ozkan, Cakan, & Kayacan, 2017 similarly records a strong association between CEE on bank performance for a period of 10 years (2005−2014). These studies show that different

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authors in different geographic areas have all verified that CEE has a positive influence on either productivity or profitability. Based on the results in different studies as discussed above, we formulate the following hypothesis:

H2. CEE has a positive influence on the productivity of banks
Regarding structural capital (SC), which includes a firm's process manuals, strategies and databases are properties owned by the organization (Riahi-Belkaoui, 2003) and continue to provide a supportive environment for employees, which in turn helps in building up productivity (Bozbura, 2004). Assessing the relationship between SCE and firm performance, the findings of Rehman, Chaudhary, Rehman, and Zahid (2011) were consistent with the results of Nimtrakoon (2015) that SCE and performance are highly correlated. The same result is found by Bontis et al. (2015), who confirmed that SCE has a significant relationship with productivity. More so, studies on Indian banks (Maji & Goswami, 2016; Tripathy et al., 2015) also revealed that SCE has a major impact on the performance of firms measured by ROA. Similarly, a study on Indian banks by Soriya and Narwal (2015) showed that SCE has a significant impact on employee productivity. Although few studies found an insignificant relationship between SCE and performance as measured by productivity or profitability, most studies observed that SCE positively affects firm performance. Consistent with these observations, we formulated the following hypothesis:

H3. SCE has a positive impact on bank productivity
Nevertheless, IC combines components such as capital employed and human and structural capital efficiency to construct the VAIC model (Pulic, 1998). Previous studies (Chen et al., 2005; Clarke, Seng, & Whiting, 2011; Mohiuddin, Najibullah, & Shahid, 2006; Mondal & Ghosh, 2012) have documented the connection between VAIC and firm performance. To demonstrate, Chen et al. (2005) and Mohiuddin et al. (2006) confirmed that IC is a major source of value creation at banks. In the same arena, Clarke et al. (2011) found that IC affects the performance of manufacturing firms in Australia. In Asia, Mondal and Ghosh (2012) examined the influence of IC on performance at Indian banks, and their results indicate a significant correlation between VAIC and performance. These studies established a positive relation among all components and confirmed that VAIC affects firm productivity. Based on this empirical evidence on VAIC and firm performance, we formulated the following hypothesis.

H4. VAIC has a positive impact on bank productivity in India
The empirical literature demonstrates the relevance of IC in enhancing firm productivity (Bontis et al., 2015; Chen et al., 2005; Kamath, 2015; Mondal & Ghosh, 2012) and firm profitability (Maji & Goswami, 2016; Tripathy et al., 2015), which is empirically tested for different firms, industries, sectors, and countries. However, only a few studies (Mondal & Ghosh, 2012; Soriya & Narwal, 2015) have been undertaken on the banking sector in India. And the existing studies did not employ both of the main productivity measures, employee productivity and asset turnover, to assess the IC effects on commercial bank productivity in India. Hence, this study attempts to fill the existing gap in the literature by assessing a panel of 73 banks with the application of VAIC model to address the following question: Does investing in IC affect productivity at commercial banks? We contribute to the existing literature and help banks to understand how productivity is influenced by IC over different times series.

3. Data description and methodology

3.1. Data

The data come from the Reserve Bank of India database and annual financial reports of banks that are available in the Prowess database (a center for monitoring the Indian economy). The sample consists of a panel of 73 commercial banks, including private, public, foreign, and regional rural banks, for twelve years, from 2006 to 2017. The main motivation for choosing this study period is to cover the global financial crisis, which affected most economies. As India became integrated into the global economy after globalization, liberalization, and deregulation, the country was not unaffected by the 2008 crisis. The effects included having growth in the gross domestic product, with a mean of 9.4 percent over three succeeding years (2005−2008), decline to 6.7 per cent in the financial year 2008−9. Moreover, some banks commenced operation in 2004, and with a goal of capturing all the commercial banks in order to generate findings with far-reaching generalizability, choosing a period earlier than our selected time period could have reduced our sample data. Overall, firm inclusion in our data is based solely on the availability of financial data for each period. We performed vigorous screening, and any missing firm-year observations are excluded from the data. In the end, our sample comprises balanced panel data of 73 commercial banks with 876 firm-year observations. Panel data are ideal for this study because they study the dynamics of change among our sample groups, which time series or cross sections alone cannot produce.

3.2. Variable definitions

Following most of the prior studies (see Clarke et al., 2011; Kamath, 2015; Mondal & Ghosh, 2012; Onyekwelu et al., 2017), we define the variables used in the study as shown in Table 1.

3.2.1. Dependent variables

Patton (2007) writes that a firm's productivity relies on its IC more than on physical assets. This means that investing in IC subsequently permits the reduction of average production cost and perhaps increases the firm's operating margins (Nakamura, 2001). According to the literature, most previous studies link IC influence with productivity measured by EP or

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Table 1
Description of variables used in the study.

Variable Type	Variable name	Variable abbreviation	Measurement method
Dependent	Employee Productivity	EP	Pre-tax income/number of employees. (a measure for the net valued added per employee)
	Asset turnover	ATO	Revenue/total asset. (Productivity indicator which measure efficiency of asset in generating revenue.
Independent	Human Capital Efficiency	HCE	HCE=VA/HC
	Capital Employed Efficiency	CEE	CEE= VA/CE
	Structural Capital Efficiency	SCE	SCE= SC/VA
	Value Added Intellectual Capital	VAIC	VAIC= HCE + CEE + SCE
Control	Firm size	SIZE	Log (Total assets)
	Leverage	LEV	Total debt/Book value of total assets
	Crisis	Crisis	A dummy variable taking the value of 1 for the years of 2008 and 2009, and the value of 0 otherwise.

Note: Value Added Intellectual Capital model (VAIC) developed by Pulic (1998; 2000) is used to measure intellectual capital on productivity of commercial banks operating in India. The model follows a number of phases as follows where VA= Output-Input (Output = Gross income & Input = operating expense); HC = employee cost; CE = physical capital; SC = VA − HC.

ATO (see Gan & Saleh, 2008; Clarke et al., 2011; Maji & Goswami, 2016; Phusavat, Comepa, Sitko-Lutek, & Ooi, 2011; Tripathy et al., 2015). We measure bank productivity using ATO and EP, following the literature.

- Asset turnover (ATO) is calculated as revenue/total assets. A measure of bank productivity from the use of assets to generate sales, ATO has been used in the literature on studies conducted in India and other economies (see Firer & Mitchell Williams, 2003; Mondal & Ghosh, 2012).
- Employee productivity (EP) is calculated as pre-tax income/number of employees. It measures each employee's net value added, which reflects employee productivity. EP has been used in the literature on studies conducted in India as a measure of bank productivity (see Soriya & Narwal, 2015).

3.2.2. Independent variables (VAIC model)

The VAIC, developed by Pulic (1998, 2000) as a measure of efficiency of IC, has attracted attention from scholars and practitioners (see Chen et al., 2005; Clarke et al., 2011; Joshi, Singh Ubha, & Sidhu, 2012) as calculation of IC efficiency. This is due to the advantages and superiority of using financial data as input variables (Clarke et al., 2011), and its reliability and simplicity make it an ideal measure for IC (Joshi et al., 2012). The VAIC method is a sum of three components: structural capital, capital employed, and human capital efficiency (VAIC = structural capital efficiency + capital employed efficiency + human capital efficiency), and follows series of calculations (See VAIC Model calculation Supplementary Material, available online).

3.2.3. Control variables

To minimize the effect of other variables that could explain bank productivity and lead to model misspecifications, the study added leverage and firm size as control variables. According to Riahi-Belkaoui (2003), the leverage ratio is one of the fundamentals in a firm's performance and value creation. Hence leverage (total debt/total assets) has been used to control for the effect of liabilities on bank productivity (see Clarke et al., 2011; Kamath, 2015; Mondal & Ghosh, 2012). Also, the natural logarithm of total assets is there to control for firm size effects on wealth creation (see Deep & Narwal, 2015; Firer & Mitchell Williams, 2003; Kamath, 2015). Finally, because the financial crisis is one of our main reasons for choosing the study period, we included a dummy variable to control for the impact of financial crisis (*CRISIS*), which takes a value of 1 for 2008 and 2009, and 0 otherwise (see Al-Musali & Ku Ismail, 2016).

4. Methodology and model construction

The application of pooled ordinary least squares regression in analyzing IC influence on firm performance has many drawbacks because of heterogeneity across groups. A more appropriate technique to deal with unobserved effects and possible heterogeneity is the application of fixed and random effects in panel modeling. According to Hsiao (2003), the panel data econometric method has various advantages, as it helps in controlling possible heterogeneity and in identifying effects that are not possible to detect using only cross-sectional or time-series analysis of data. Accordingly, the panel regression model for analyzing the influence of IC on bank productivity is as follows:

$$Y_{it} = \alpha_i + \beta_1 VAIC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 CRISIS_t + \varepsilon_{it} \quad \text{FE} \quad (1)$$

$$Y_{it} = \alpha + \beta_1 VAIC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 CRISIS_t + (\varepsilon_i + \varepsilon_{it}) \quad \text{RE} \quad (2)$$

$$Y_{it} = \alpha_i + \beta_1 HCE_{it} + \beta_2 CEE_{it} + \beta_3 SCE_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 CRISIS_t + \varepsilon_{it} \quad \text{FE} \quad (3)$$

$$Y_{it} = \alpha + \beta_1 HCE_{it} + \beta_2 CEE_{it} + \beta_3 SCE_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 CRISIS_t + (\varepsilon_i + \varepsilon_{it}) \quad \text{RE} \quad (4)$$

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where Y_{it} is a vector of the dependent variables, that is, ATO and EP. The term α_i indicates unobserved bank-specific effects assumed to be fixed over time and different across banks. VAIC, HCE, CEE, SCE are the independent variables; i is bank, t is time, and β is the coefficient(s); Crisis is a dummy variable to proxy for the financial crisis, which equals 1 in 2008 and 2009, and 0 otherwise; ε_i is an error term that varies across banks but not across time; and ϵ_{it} is an error term that varies for each bank at each point in time.

5. Results and analysis

5.1. Descriptive statistics

The descriptive statistics for the variables (See Table S1, available online), display the mean, minimum, maximum, standard deviation, kurtosis, skewness, and total observations. From the table, the VAIC performance of banks over the study period varies from −2.313 to the maximum value of 8.474 and a mean of 3.010. The negative VAIC value indicates that the cost incurred in investing in IC exceeds what it contributes to the banks in earnings. HCE has a mean value of 2.218 with a maximum value of 6.992 and consequently is the highest contributing factor among the three VAIC components. The mean value is higher for SCE (0.486) than CEE (0.305), but a negative minimum value of SCE shows that most Indian banks struggled to add value from their structural capital during the study period. EP has a mean value of 0.106, which indicates that a 10% increase in net bank value was contributed by the overall output of each employee over the sample period. Moreover, the low minimum of 0.026 against a maximum of 1.400 shows that a majority of bank employees were efficient. The mean for asset turnover (ATO), 1.683, indicates that sample banks were efficient at using assets for generating revenue.

5.2. Diagnostic tests

Checking for the normality of data is imperative in deciding which correlation matrix to apply. According to Brooks (2014), the normality assumption is also important for conducting single or joint hypothesis tests regarding the model parameters. The Shapiro Wilk test was applied, and since our data was not normally distributed, the Spearman correlation matrix is used to show the correlation among variables. Based on the suggestions of Kennedy (1985), a correlation coefficient of more than 0.8 shows the existence of multicollinearity, which is a serious problem. No evidence of high correlation between the explanatory variables was found (See Table S2, available online), except in the case of VAIC and HCE; however, this is still not a problem because the two are not included in the same equation in our study. We also conducted a multicollinearity analysis through the variance inflation factor (VIF), and the results show no multicollinearity among our main dependent variables based on suggestions by Gujarati (2010).

In panel data with series of more than 10 years, there is always the possibility of non-stationary shocks that will affect the long-term equilibrium of the series. So in order to check for data stationarity, a Levin-Lin-Chu (LLC) panel unit-root test is applied because it is more relevant for panels of moderate size and can easily accommodate balanced panel data, which produce efficient results (Levin, Lin, & Chu, 2002), though using an LLC test might cause size distortions when there is cross-sectional correlation as in our case. However, LLC (2002) suggest that removing cross-sectional averages from the data helps control for this correlation. Based on the results of LLC (See Table S3, available online), we reject the null hypothesis of a unit root at the 1% significance level, meaning that all the variables are stationary after cross-sectional correlation is controlled for by removing cross-sectional means.

To begin our panel regression analysis, the Breusch & Pagan, 1980 is applied, and the results show that variances across entities are not zero (i.e., a panel effect exists), meaning pooled OLS becomes an inconsistent estimator of our panel data. The application of fixed and random effects then follows, and Hausman test statistics are a basis for deciding between fixed and random effects. The results of the Hausman test favor a fixed-effect model (meaning that the unique errors are correlated with the regressors). Then, we checked for cross-sectional dependence, and the results reveal the presence of cross-sectional dependence, but it is not a problem in this study because it is not an issue in micro-panels with a large number of cases over a few years (Baltagi, 2008). We further used the modified Wald statistic for groupwise heteroskedasticity, and the test results rejected the null hypothesis, indicating heteroskedasticity. The Wooldridge (2010) test of autocorrelation was then applied, and the results confirmed the existence of first-order autocorrelation. Hence, in order to ensure a valid statistical inference amid problems of heteroskedasticity and autocorrelation in our models, we relied on the Rogers (1993) "clustered robust" standard errors. The advantage of this estimator is that it produces heteroskedasticity consistent standard errors that are robust, which is appropriate for balanced panel data, as in our case.

5.3. Results of panel models

5.3.1. Panel regression results: IC components and EP

Regression results on the contribution of various IC components are presented in Table 2, in which EP is the dependent variable. As per the results of the Hausman test, an FE model is presented in Table 2 for the full sample and public banks whereas private and foreign banks are analyzed based on the results of the RE model. According to our regression results, CEE is the only component of IC that has a positive and significant coefficient on employee productivity for the full sample, which confirms H2a. This finding is in line with Bontis et al. (2015), whose studies confirmed a significant association between CEE and employee productivity. However, both HCE and SCE are insignificant in influencing productivity, hence both H1a and H3a are rejected. This therefore indicates that most banks in India have still not realized the salient importance of their

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Table 2
Panel regression results of IC components and employee productivity.

Variables	EP			
	Whole Sample	Public Banks	Private Banks	Foreign Banks
Intercept	0.199*** (0.017)	0.273*** (0.027)	0.155*** (0.021)	0.196*** (0.078)
HCE	0.004 (0.004)	0.006* (0.004)	0.000 (0.001)	0.009 (0.006)
CEE	0.018* (0.010)	−0.005 (0.014)	0.008*** (0.003)	0.042** (0.022)
SCE	0.002 (0.004)	0.029*** (0.007)	−0.004 (0.003)	−0.012 (0.010)
SIZE	−0.019*** (0.003)	−0.030*** (0.004)	−0.011*** (0.003)	−0.019** (0.010)
LEV	−0.004 (0.003)	−0.011*** (0.003)	−0.004*** (0.002)	−0.002 (0.002)
Crisis	−0.014*** (0.004)	−0.010 (0.007)	−0.013*** (0.002)	−0.013*** (0.004)
Adj R-square	0.744	0.313	0.030	0.052
F− stats	12.29***	5.21***	81.16***	11.49*
Groups	73	25	19	29
Observations	876	300	228	348
Hausman test	χ2 (6) 167.15***	χ2 (6) 22.56***	χ2 (6) 9.37	χ2 (6) 0.70

Note: Panel data (Fixed and Random effect estimates) are present in the table. Hausman specification test result determines the best model for analysis. Robust standard error estimates obtained from Rogers covariance matrix estimator is presented in parenthesis in order to deal with heteroscedasticity and autocorrelation in our models. ***, ** and * represents statistical significance at 1%, 5% and 10% levels, respectively.

Table 3
Panel regression results of IC components and asset turnover.

Variables	ATO			
	Whole Sample	Public Banks	Private Banks	Foreign Banks
Intercept	0.881*** (0.367)	0.812 (0.615)	0.406 (0.882)	1.762*** (0.477)
HCE	0.088*** (0.035)	0.126** (0.061)	0.149* (0.088)	0.032 (0.045)
CEE	0.483*** (0.136)	0.568*** (0.220)	0.389 (0.252)	1.341*** (0.356)
SCE	0.259*** (0.080)	0.399*** (0.119)	0.432*** (0.189)	0.137 (0.096)
SIZE	0.063 (0.061)	0.039 (0.102)	0.104 (0.152)	−0.116 (0.090)
LEV	0.001 (0.044)	−0.004 (0.067)	−0.081 (0.105)	0.071 (0.077)
Crisis	0.039 (0.069)	0.068 (0.113)	0.148 (0.128)	−0.031*** (0.116)
Adj R-square	0.063	0.271	0.036	0.249
F− stats	32.92***	4.36***	25.37***	3.56*
Groups	73	25	19	29
Observations	876	300	228	348
Hausman test	χ^2 (3) 9.73	χ^2 (3) 19.29***	χ^2 (3) 1.69	χ^2 (3) 14.66**

Note: Panel data (Fixed and Random effect estimates) are present in the table. Hausman specification test result determines the best model for analysis. Robust standard error estimates obtained from Rogers covariance matrix estimator is presented in parenthesis in order to deal with heteroscedasticity and autocorrelation in our models.
***, ** and * represents statistical significance at 1%, 5% and 10% levels, respectively.

employees or a lack of human development programs might be a cause. Also, the insignificant result of SCE means that banks' structures, routines, and process manuals do not have a significant impact on improving employee productivity (see Chen et al., 2005; Kamath, 2015).

Furthermore, we conducted a separate analysis by clustering banks into public, private, and foreign to evaluate how each IC component affects employee productivity. Interestingly, HCE and SCE components are only positive and significant, with EP of public banks implying that human assets as well as bank structure (routines and procedures) play a role in improving the productivity of public banks, unlike the other bank sectors. At the same time, the CEE component was significant with the EP of both private and foreign banks but insignificant for public banks. In addition, crisis as a dummy variable is negative and significantly correlated with the EP of the full sample and private and foreign banks, which conspicuously shows the high impact of crisis on banks. Moreover, the evidence obtained regarding the control variables shows that leverage is only significant with the productivity of public and private banks whereas bank size is negatively significant across all bank groups.

Overall, the adjusted R^2 of 0.744 (full sample) is a strong significant (model fit) indicator of how the explanatory variables influence the dependent variable. Also, the adjusted R^2 indicates that the models are able to explain 31% of the variation in EP as a dependent variable for public banks and 3% and 5% for private and foreign banks, respectively.

5.3.2. Panel regression results: IC components and asset turnover

In Table 3, the regression results presented on public and foreign banks are based on the FE model ($p < 0.05$) whereas the results on the full sample and private banks are based on

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the RE model. With asset turnover as the dependent variable, the coefficients of the three IC components (HCE, CEE, and SCE) are positive and significant at the 1% level with banks' ATO for the full sample. However, among them, CEE has the highest coefficient, 0.483, which is a true signal that both the physical and financial capital of banks has more influence on generating revenue for banks than the other components of IC. This result is consistent with earlier research studies (see Bontis et al., 2015; Gan & Saleh, 2008; Mondal & Ghosh, 2012) and hence supports H1b, H2b, and H3b. The results can also be attributed to the KBV theory, which places more emphasis on the role of intangible assets in knowledge-intensive firms such as banks.

Regarding the estimations on bank groups, it is found that HCE and SCE are significant and positive with the asset turnover of public and private banks, except foreign banks. Similarly, CEE has a significant association between public and foreign banks but an insignificant relation with private banks' ATO. As for the control variables, the results indicated that both size and leverage are insignificant in determining the productivity of banks in our full sample as well as bank groups (public, private, and foreign). However, the impact of the 2008−2009 global financial crisis is negatively significant only with the ATO of foreign banks. This is an indication that foreign banks operating in India faced a massive downfall in their sales revenue during the economic crisis.

The adjusted R^2 for the full sample, 0.063, is a reflection of the weak explanatory power of the independent variables used. Among the bank groups, public banks had the highest model explanatory power of 27%, followed by foreign and private banks (25% and 4%).

5.3.3. Panel regression results: overall IC and employee productivity

In Table 4, the results of the Hausman test are significant, hence the FE model is shown for full sample, for public and foreign banks, whereas the RE model is used for analyzing the regression results of private banks. The results presented show that VAIC is significant at a 5% confidence level for full sample, confirming H4a. The finding implies that when banks invest in IC, it positively influences the productivity of their employees.

The results corroborate the findings of Clarke et al. (2011), who confirmed the positive impact of VAIC on employee productivity. However, when the full sample is clustered into bank groups, VAIC is significant only with the EP of foreign banks. The adjusted R^2 for the full sample, 0.740, shows good model fit, indicating that the explanatory variables explained about 74% of the variance in the dependent variable. Among the bank groups, the adjusted R^2 indicates that the models are able to explain 27% of the variation in the EP as a dependent variable for public banks and 26% and 80% for private and foreign banks respectively.

Moreover, size as a control variable is significant but negative, unlike leverage, which has no significant impact on productivity. On account of the global financial crisis, it is negatively significant with the EP of the full sample and all bank groups (public, private, and foreign).

5.3.4. Panel regression results of VAIC and asset turnover

Table 5 shows the regression results of overall IC influence on asset turnover. The FE model is reported for public and foreign banks whereas the RE model is reported for the full sample and private banks. The result of the VAIC has a positive and significant influence on ATO at 1% for the full sample and public and private banks, except foreign banks, which is significant at 10%.

These results confirm H4b proving that investing in IC improves asset turnover at banks. Similarly, Mondal and Ghosh (2012) found that VAIC positively affects bank performance in India. Moreover, Clarke et al. (2011) indicated that VAIC has a positive association with productivity. Although R^2 is not very high, the VAIC and other control variables explain 6% of the variance in the dependent variable for the full sample, 26% for public banks, 6% for private banks, and 21% for foreign banks. As for the control variables, none of them had a significant impact on IC, which means that size, leverage, and crisis do not explain asset turnover at banks.

Table 4
Panel regression results of VAIC and employee productivity results.

Variables	EP			
	Whole Sample	Public Banks	Private Banks	Foreign banks
Intercept	0.203*** (0.017)	0.267*** (0.081)	0.154*** (0.021)	0.162*** (0.370)
VAIC	0.004** (0.001)	0.003 (0.002)	−0.000 (0.001)	0.005* (0.003)
SIZE	−0.019*** (0.003)	−0.030** (0.014)	−0.011*** (0.003)	−0.010 (0.007)
LEV	−0.005* (0.003)	−0.009* (0.006)	−0.004** (0.002)	0.003 (0.006)
Crisis	−0.014*** (0.004)	−0.012*** (0.003)	−0.013*** (0.002)	−0.015* (0.009)
Adj R-square	0.744	0.271	0.255	0.802
F− stats	17.89***	3.50***	66.54***	2.38**
Groups	73	25	19	29
Observations	876	300	228	348
Hausman test	χ^2 (4) 19.00***	χ^2 (4) 9.61**	χ^2 (4) 4.59	χ^2 (4) 127.15***

Note: Panel data (Fixed and Random effect estimates) are present in the table. Hausman specification test result determines the best model for analysis. Robust standard error estimates obtained from Rogers covariance matrix estimator is presented in parenthesis in order to deal with heteroscedasticity and autocorrelation in our models. ***, ** and * represents statistical significance at 1%, 5% and 10% levels, respectively.

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Table 5
Panel regression results of VAIC and asset turnover results.

Variables	ATO			
	Whole Sample	Public Banks	Private banks	Foreign Banks
Intercept	0.930*** (0.357)	0.988* (0.613)	0.555 (0.866)	1.841*** (0.509)
VAIC	0.132*** (0.028)	0.212*** (0.048)	0.189*** (0.069)	0.073* (0.039)
SIZE	0.065 (0.059)	0.014 (0.102)	0.096 (0.150)	−0.079 (0.095)
LEV	0.010 (0.043)	0.004 (0.071)	−0.079 (0.105)	0.095 (0.057)
Crisis	0.043 (0.069)	0.081 (0.111)	0.141 (0.127)	−0.049 (0.112)
Adj R-square	0.057	0.262	0.066	0.219
F− stats	23.58***	5.21***	8.84*	2.14*
Groups	73	25	19	29
Observations	876	300	228	348
Hausman test	$\chi 2$ (4) 8.20	$\chi 2$ (3) 9.13**	$\chi 2$ (3) 1.49	$\chi 2$ (3) 13.04***

Note: Panel data (Fixed and Random effect estimates) are present in the table. Hausman specification test result determines the best model for analysis. Robust standard error estimates obtained from Rogers covariance matrix estimator is presented in parenthesis in order to deal with heteroscedasticity and autocorrelation in our models. ***, ** and * represents statistical significance at 1%, 5% and 10% levels, respectively.

6. Conclusion

The inevitable importance of IC on firm performance has gained momentum among practitioners and researchers around the globe. Several studies have considered the effects of IC on performance because intangible assets also create value, along with the tangible firm assets. Because intangible assets also play a role in firm productivity, leading to higher performance, in this paper, we answer the question of whether investment in intangible assets (also called intellectual capital) influences bank productivity. In doing so, the study employed the VAIC model developed by Pulic (1998), which allows the use of financial statements in an analysis. Panel data modeling was conducted using 73 commercial banks in India over a period of 12 years (2006−2017).

First, we analyzed the individual influence of all the IC components on EP. The study found that among the three IC components, only CEE had a meaningful influence on EP at banks (full sample). This result shows the significance of financial capital in improving bank productivity (also consistent with Kamath, 2015; Mondal & Ghosh, 2012; Bontis et al., 2015). The results demonstrated the proposition of the RB theory of a firm that physical or financial resources may provide above-average returns (Barney, 1991). In shedding light on the influence of IC components on the three main bank subgroups, i.e. public, private, and foreign, it was evident that HCE and SCE can influence the productivity of public banks more than the others. This documents that public banks operating in India invest in human and structural capital more than other banks. Second, in line with the literature, our study finds a convincing positive association between the three IC components and asset turnover at the full sample of banks. The results reflect the principles of RB theory, that to act smart and gain competitive advantage, unique resources (whether physical, human, or organizational) help to build competitive advantage and generate economic returns for a firm. Overall, our study results answered our research question: When banks invest in IC, a subsequent positive influence on their productivity follows. This is wakeup call to the managers of various types of banks to pay much more attention to their intellectual assets because they are what drive their productivity in this modern knowledge era. We are in a knowledge economy, and banks, which are classified as a knowledge-intensive sector, can only rely on their intellectual assets to improve productivity. Our study demonstrated the influence of IC on bank productivity, yet it is not free of deficiencies. For instance, this study did not factor in the dynamic nature of IC, therefore future studies can delve into this, and if it exists, dynamic panel estimator GMM could be applied.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bir.2019.03.001.

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