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Artículos

Intangible assets and their effects on business performance: an analysis of Colombian companies

Activos intangibles y sus efectos en el desempeño empresarial: un análisis para empresas colombianas

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Abstract

Intangible assets (IAs) are fundamental for the creation of firm value. However, the literature is inconclusive regarding the relationship between IAs and profitability. This paper uses financial data from Colombian firms from 2005 to 2015 to determine if this relationship exists. Thirty dynamic panel models have been used to see whether IAs are related to Return on Equity, Return on Assets, Earnings Before Interest and Taxes, Earnings Before Interest, Taxes, Depreciation, and Amortization, Gross margin, and Net margin. The results, despite a limited sample size and missing variables, are related to the literature in that they signal the negative relationship between IAs and profitability. Thus, the capitalized value of IAs seems to negatively affect Colombian firms' performance in the short and long term.

Keywords: Profitability; Dynamic panel model; Accounting practices; Unbalanced panels; IFRS.

Resumen

Los activos intangibles (AI) son fundamentales para la creación de valor en las firmas. Sin embargo, la literatura no es concluyente con respecto a la relación entre los AI y la rentabilidad. Este documento utiliza datos financieros de empresas colombianas del periodo 2005 a 2015 para determinar si existe esta relación. Se utilizan treinta modelos de panel dinámicos para comprender si los AI están relacionados con las variables Rentabilidad sobre el patrimonio, Rentabilidad sobre los activos, Beneficio antes de intereses e impuestos, Beneficios antes de intereses, impuestos, depreciación y amortización, Margen bruto y Margen neto. Los resultados, a pesar de un tamaño de muestra limitado y variables faltantes, están relacionados con la literatura que señala la relación negativa entre los AI y la rentabilidad. Además, estos están relacionados con la imposibilidad de las empresas de explotar los AI para generar rentabilidad, pero también con una subexplotación de los AI en Colombia.

Palabras clave: Rentabilidad; Modelo de panel dinámico; Prácticas contables; Paneles desequilibrados; NIIF.

JEL Codes: C23; M41; M49.

1. INTRODUCTION

Intangible assets (IAs) have become an essential source of value for firms, especially in markets where networking, knowledge, and innovation are the new trade currency for high-growth companies (Andonova & Ruíz-Pava, 2016; Barth et al., 1998; Cardozo-Torres et al., 2021; Ciftci & Darrough, 2015; Dzenopoljac et al., 2017; Hall, B. H. et al., 2005, 2010; Lev & Daum, 2004).This has especially been true since the COVID-19 pandemic, when many firms understood that considerable investments in physical or tangible assets (TAs) would create impediments for companies to grow flexibly (De Nicola et al., 2021; Xiong et al., 2020).

IAs have been classified and defined in multiple ways in literature; however, there is no widely-accepted definition for their characteristics. Aside from this, ways of measuring them, and their impact on firm management, value, and performance are still under discussion (Barker et al., 2021).

It can be assumed that a high enough proportion of IAs should generate value for companies, yet the related scientific literature is not conclusive on this matter. Moreover, some results demonstrate a negative relationship between IAs and financial performance; in the case of Cardozo-Torres et al., several negative relationships between brand value and performance were reported (2021). Nevertheless, these divergences may be due to methodological differences exemplified by the companies chosen, how the data is collected, how IAs are measured, or even the financial system in which the measurement has been performed (Méndez-Morales & Yanes-Guerra, 2021).

The latter suggestion must be highlighted; some researchers measure IAs for companies traded on stock markets as the difference between market and book value; in such cases, IA value could be influenced by stock demand, causing prices to be volatile and creating either more or less Tobin's Q, goodwill or IA value. However, when this occurs, the relationship between performance and IAs goes from the accounting return to the value of market goodwill. Thus, the higher the return, the higher the demand for stocks, and the more significant the difference between book and market value (Haji & Ghazali, 2018). In those cases, higher IAs are possible whereas it is difficult to understand if this value is created by IAs or is influenced by market volatility.

In contrast, in other investigations, the value of IAs is based on how their accounts are represented, and there are discussions about how accounting standards allow companies to record their IAs (Barker et al., 2021). According to the International Financial Reporting Standards Foundation (IFRS), an IA is logged only when there is enough evidence of future related returns. Hence, under the IFRS, it can be assumed that a correlation between IAs and performance should arise, albeit in the long term, where returns are incurred after IAs are in the books.

Before the IFRS was created, countries used to apply their own accounting rules. Therefore, IAs were not only reported when the future return of IAs was proved but under firm accounting criteria. In the case of Colombia, our case study, pre-IFRS accounting standards did not underline the necessity of proving the future level of IA profitability (Andonova & Ruíz-Pava, 2016; Mesa Velásquez, 2012). Furthermore, most of the research about this topic has used data from publicly-listed companies because of the ease of access to their financial information, although these are not the norm in Colombia. Moreover, most research has been based on regions where companies tend to face less market stress and volatility, like the USA and Europe.

Despite the literature having many papers on the relationship between IAs and profitability, ours adds to it in various ways. Firstly, little research about this link has been

performed in Colombia or the rest of Latin America (Andonova & Ruíz-Pava, 2016; Chiarelo et al., 2015); thus, analyzing Colombian company information using a panel data technique that has never been used to probe this relationship may shed new light on this topic. Secondly, we have found consistent evidence of a negative relationship between IAs and performance in the case of ROA (Return on Assets) and ROE (Return on Equity) for Colombian non-listed firms. Thirdly, this evidence is consistent with short- and long-term profitability measures. Fourthly, the relationship is consistent and robust to different measures of IA.

At the same time, the firms used in our sample have not floated on stock markets; this is noteworthy because a considerable part of the literature on this topic has focused on large corporations which are established and are based in developed countries; thus, they have reached a high enough performance level to allow them to trade on stock markets. It can be assumed that they are more financially sustainable than their smaller non-traded counterparts, implying that there is a selection bias in the literature by focusing on traded firms since it could influence the reported relationship between performance and IAs (Méndez-Morales & Yanes-Guerra, 2021).

Data used in this research came from Colombian firms before IFRS was adopted in 2016. For this research, data could have been used from after the foundation was implemented although the relationship between IAs and performance can only be analyzed in the long term and the global crisis created by COVID-19 must have generated a bias in this data; this is because companies suffered from downturns in profitability which would have led to an additional source of bias, so it was decided that a more extensive set of data should be used instead of one from the period 2016-2022.

Despite this, the data is limited bearing in mind that it comprises 4.89 years per company and does not disclose the age of the firms. Therefore, the sample does not allow us to distinguish the five-year average observation of an established firm from an entrepreneurial young firm of five years-old or less, in which case we would expect there to be a differential in the capacity to exploit IAs and thus limits the scope of the results.

2. LITERATURE REVIEW

2.1 Fundamentals and characteristics of IAs

According to literature (Brennan, 2001; Edvinsson, 2013; Edvinsson & Malone, 1997; Lev and Schwartz, 2001), IAs constitute managerial and productive mediums helping firms create a competitive advantage. These can be divided into human capital (HC) associated with competencies, abilities, corporative culture and experiences, structural capital (SC) related to patents, copyrights, trademarks and databases, and relational capital (RC) linked to commercial-production collaborations with stakeholders.

Conceptually, unrecognized IAs are calculated as the difference between market value and accounting value (Hall, R., 2001; Wyatt, 2012). Researchers have tried to relate these types of IAs to firm performance using listed firms' financial data. For example, when a firm with more market value than book value is found, it is said that it has hidden values which are not reflected in books, IAs, or goodwill. Nevertheless, firms could be thought to have an overvaluation related to market speculation whereas it may not have anything to do with there being an adequate management of IAs (Basu & Waymire, 2008). Hence, the use of publicly-traded companies to understand IA effects on performance may show some bias. However, what happens when researchers look for the relationship between IAs and performance in a country with less developed stock markets or decide not to use publicly-

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traded firms for the samples? The answer is that they need to use accounting data that, as already mentioned, can be influenced by norms and accounting regimes (Mesa Velásquez, 2012).

From an accounting point of view, IAs can be defined as the set of assets with no physical form that firms capitalize in their balance statement; generally, these assets refer to patents, trademarks, brands, licenses, rights, franchises, copyrights, industrial designs, software and goodwill, among others. Moreover, the IAs could be internally or externally generated. Most of the time, their accounting definition refers to structural capital and does not consider human or relational capital, given the difficulty of valuing and capitalizing such assets (Gravili et al., 2021; Johnson, 1999; Vishnu & Gupta, 2014; Xu & Li, 2019; Xu & Wang, 2019; Yao et al., 2019). In the case of this research, we have taken an accountable definition of IA on board; therefore, the data used has come from capitalized IAs in the balance sheet of the firms.

2.2 IAs as performance creators

According to the literature, investments in IAs have several advantages for firms, since they create better results for said firms in the long term; however, the theoretical notion of the competitive advantage created by IAs has practical ambiguities. Firstly, they cannot be managed as fixed assets; thus, the connections between their effects and their results in firms must be different than those of fixed assets. Additionally, they are susceptible to being accounted for in different ways depending on changes in national laws, creating a bias for researchers seeking the relationship between outputs (performance) and inputs (IAs) (Chaharbaghi & Cripps, 2006).

In recent literature, several papers have discussed the relationship between IAs and performance, typically using large publicly-traded firms (Alarussi & Gao, 2021; Balzer et al., 2020; Chiarelo et al., 2015; Denicolai et al., 2015; Haji & Ghazali, 2018; Hartsema et al., 2021; Ni et al., 2020; Pechlivanidis et al., 2022; Qureshi & Siddiqui, 2021; Rika Gamayuni, 2015; Wahyuni et al., 2023). The central hypothesis of our body of research is as follows: the higher the IAs, the better the performance of firms. Researchers have mainly used publicly-traded firms owing to the fact that their financial information is easier to find, are assumed to have accurate data, and follow similar accounting standards, allowing for the comparison between years and countries. In the case of listed firms, IAs can also be measured as the difference between market value and book value; however, it is difficult to separate the effects of the internally-generated IAs from the externally-generated ones or from those that derive from market speculation.

At the same time, some effort has been made to prove that this relationship stands in the case of non-publicly-traded firms (Andonova & Ruíz-Pava, 2016; Cheikh & Noubbigh, 2019; Chiao & Yang, 2011; Serpeninova et al., 2022; Skhvediani et al., 2022). In these types of companies, the hypothesis is the same: the higher the IAs, the higher the firm's performance, the difference, in this case, being that the number of IAs can be measured only by their book value. Although speculation is not an issue for them, their accounting standards and internal practices could affect the results.

Even when both types of methodologies try to prove the same point, there is no consensus about this relationship; for instance, Balzer et al. (2020) have noticed that companies of the S&P 500 index investing in IAs from 2007 to 2017 created higher growth opportunities, even during periods of negative profitability. What is more, Cheikh and Noubbigh (2019), using Tunisian publicly-traded non-financial firms from 2005 to 2011, have found that firms with a high quantity of IAs tended to have higher market capitalization and

more chain value contributions. Using a pooled regression methodology, Alarussi and Gao (2021) have discovered that IAs have a direct and positive relationship with the profitability of more than 300 non-financial companies in China.

In the case of publicly-listed pharmaceutical firms in China, Ge and Xu (2021) have measured the relationship between HC, SC, and RC, finding out that IAs had a high positive impact on variables like EBIT (Earnings Before Interest and Taxes), EBITDA (Earnings Before, Interest, Taxes, Depreciation, and Amortization), gross and net margins, Return on Assets (ROA), and Return on Equity (ROE). However, not all types of IAs showed the same effect. For instance, HC seemed to be more important for the performance of these companies, whereas IAs were found to harm market value and have no impact on sales.

At the same time, in the case of publicly-listed Taiwanese firms, Ni, Cheng and Huang (2020) have evaluated the effect of different proxies of IAs on Tobin's Q, finding a direct relationship. Likewise, Haji & Ghazali (2018), using large publicly-traded Malaysian firms, noticed a positive connection between ROA, ROE, net income, profit margin, and lagged investment in IAs. A valuable finding of this research was that companies with intangible liabilities (lower than 1 Tobin's Q) seemed to have lower performance.

In Pechlivanidis et al. (2022), authors have shown that including IAs in a deep learning model improved the performance of profitability-predicting models; this means that higher IAs values could signal the possibility of increasing profitability. Besides this, Serpeninova et al. (2022) have concluded that Slovakian software firms increased profitability when acquiring IAs; however, self-generated IAs did not create profit for these companies. Skhvediani et al. (2022), using 1,044 Russian information technology firms, showed a positive relationship between IAs and ROA. Using firms of the same sector, for Chile and Brazil, Chiarelo et al. (2015) found correlational solid evidence of a link between performance and IA disclosure.

Similarly, Denicolai et al. (2015), using data from 294 listed European firms, stated that IAs positively related to the firm compounded average growth rate. They also found that firm size moderated the relationship, as SMEs highly benefited from those effects. Wahyuni et al. (2023) noticed a positive relationship between ROA and IAs using data for Indonesian publicly-listed Sharia banks. Finally, Ge & Xu (2021) discovered that pharmaceutical firms in China obtained more profitability when increasing their investments in IAs.

Nevertheless, some investigations have shown that IAs are unrelated to higher performance. For instance, using a theoretical model, Matias-Gama et al. (2017) showed that a company in an early development phase tends to accrue substantial losses because it tries to grow organically. For a high technology firm, growth is based on investments in IAs like research and development (R&D) and others like marketing. Given that early-stage firms have trouble convincing investors and stakeholders that their investments in IAs can eventually create profitability, the effect of IAs on firms is an excess amortization expenditure decreasing profitability in the short term and creating an agency cost related to intangibles and information asymmetry. In Cañibano et al. (2000), a deep analysis of this effect can be seen.

In Hartsema et al. (2021), a negative relationship between IAs and trade credit level has been shown in firms with more than US$10 million in assets. The authors have explained the reason for this as firms with negative operational cash flow not being able to afford to extend higher credit to clients or not needing to extend this type of credit. The investments leave the company without cashflow to cover its financial needs. Rika (2015) realized that there was a negative relationship between IAs and the debt-to-equity ratio for Indonesian publicly-listed firms, which meant that companies diminished the level of debt when investing in IAs. Debt is designed to back up non-risky investments. Typically, retained earnings are the best way to finance IA investments because financing them with debt implies a higher cost for firms;

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however, in this case, IA affects ROA positively. Meanwhile, Chiao and Yang (2011) found a U-shaped relationship between investments in advertising and performance measured by ROA, ROE, return on sales and return on stocks. Advertising could be related to RC, and this relationship means that low levels of this expenditure affect performance negatively. In addition, substantial investments tend to be related to solid performance.

Along similar lines, Qureshi and Siddiqui (2021) have shown that, in general, IAs represented by R&D had a negative relationship with ROA, ROIC (return on invested capital), ATO (asset turnover ratio), and the debt-to-equity and price-to-book ratio, for eighty large technology companies in fourteen countries. At the same time, the authors have proven that this relationship can change depending on the country concerned; the effect of IAs over performance is affected by the region of operation. Wahyuni et al. (2023) have spotted a positive relationship between IAs and ROA using data for Indonesian publicly-listed Sharia banks. However, this relationship was valid only in the short term, whereas in the long term, IAs were not related to ROA nor were they good predictors of future profitability.

Given that the data used in our papers has come from Colombia, a developing country, we have focused on literature on this South-American nation as well as other developing ones like China, Brazil, Chile, Indonesia, Tunisia, Taiwan, Malaysia, Pakistan, and South Africa (Alarussi & Gao, 2021; Andonova & Ruíz-Pava, 2016; Cheikh & Noubbigh, 2019; Chiarelo et al., 2015; Ge & Xu, 2021; Haji & Ghazali, 2018; Ni et al., 2020; Qureshi & Siddiqui, 2021; Rika, 2015; Wahyuni et al., 2023). In most of this literature, except for the Wahyuni et al. (2023) paper, authors have found a positive relationship between IAs and performance. Nevertheless, most of these papers have used data from publicly-listed firms, and only four of them have used panel data methods (Cheikh & Noubbigh, 2019; Ge & Xu, 2021; Haji & Ghazali, 2018; Ni et al., 2020a). Appendix A shows the relationship between the papers reviewed and the effects of IAs on all the variables listed.

These results may either be due to IA data being registered on books differently in several countries or using IAs in different nations with different management practices, even in places where the IFRS has been implemented. In some countries, a company registers its IAs only when there is certainty about its future returns, as recommended by the IFRS. That said, firms also register their IAs in other countries where the IFRS is not in place, or even years before its implementation, and with uncertainty about their future returns. Hence, registering IAs on books does not imply future related returns.

Accounting law in Colombia prior to IFRS's arrival required IA records to be used only when there was a likelihood of profitability; however, the fact that Colombia was a country in which companies tend to dismiss the use of IA in their firms, tend to reinforce the fact that firms would record IA, but not necessarily profit from those assets. Thus, recording IAs means that the firm is creating an asset that diminishes profitability via higher amortization, creation, and appraisal costs but does not balance out losses with future IAs-related earnings.

3. METHODOLOGY

The data that we have used came from the Legiscomex[1] database for the period 2005-2015. There was an unbalanced panel for 48,053 Colombian firms with an average of 234,952 observations and 4.89 years per firm. The Legiscomex database comprises companies' financial statements and calculated financial ratios. An unbalanced linear dynamic panel was

[1] www.legiscomex.com.

used that is expressed as:

$$Y_{i,t} = C + \delta Y_{i,t-1} + \sum_{j=1}^{J} \beta_j X_{i,t}^{j} + \sum_{k=1}^{K} \lambda_k Z_{i,t}^{k} + \phi IA_{i,t-p} + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where (Y_{it}) represents independent variables including return on assets (ROA), return on equity (ROE), net margin (NM), the EBIT[2] margin (EBM), and the EBITDA[3] margin (EBAM). Table 1 shows a summary of the profitability ratios used in this study and their correlations; all these ratios were calculated by the authors using final year figures and were winzorised at the 99% level. Appendix B shows the relationship between the variables used and past papers which adopted them.

Given that past profitability results of a company tend to reinforce contemporary profitability, a lag of return ratios ($\delta Y_{i,t-1}$) was included to make this model dynamic; this variable expresses that firms receiving high returns in the past tend to receive high returns in the present; in addition, this variable helped us control for possible endogeneity issues in the model. An attempt was made to develop the generalized method of moments (GMM), including the first differences of variables to control for possible correlations with the error term. Unfortunately, the database had several data gaps, meaning that important information was missing; at the same time, there were no adequate instruments to perform the GMM methodology with different data other than lagged variables; thus, a dynamic panel model was selected with a lagged return variable as the prime methodology. Having data from more than forty thousand firms and ten years helped reduce the possibility of the error term being related to the lagged explained variable, as reported by Roodman (2009). Serpeninova et al. (2022), Skhvediani et al. (2022), Ge and Xu (2021), Cheikh and Noubbigh (2019), Ni, et al. (2020), Haji and Ghazali (2018), and Hartsema et al (2021) have previously used similar methodologies to confirm the relationship between IAs and returns.

Table 1. Descriptive statistics of profitability ratios

Variable	Type	Mean	Sth. dev.	Min	Max	Observations
	overall	3.2%	16.1%	-82.9%	77.2%	N=212 051
ROA	between	NA	13.7%	-82.9%	77.2%	n=42 746
	within	NA	12.6%	108.4%	145.4%	T-bar=5.0
	overall	16.4%	60.6%	-247.9%	382.5%	N=234 855
ROE	between	NA	47.0%	-247.9%	382.5%	n=48 041
	within	NA	50.3%	-435.3%	556.7%	T-bar=4.9
	overall	4.3%	55.5%	-367.6%	225.8%	N=217 602
NET	between	NA	51.4%	-367.6%	225.8%	N=45 710
	within	NA	41.4%	-488%	538.3%	T-bar=4.8
	overall	-1.5%	62.1%	-475.2%	93.5%	N=217 602
EBIT	between	NA	58.9%	-475.2%	93.5%	n=45 710
	within	NA	44.7%	-494.8%	495%	T-bar=4.8

[2] Earnings Before Interest and Taxes.

[3] Earnings Before Interest, Taxes, Depreciation, and Amortization.

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Variable	Type	Mean	Sth. dev.	Min	Max	Observations
	overall	2.1%	54.5%	-402.2%	98.5%	N=177 638
EBITDA	between	NA	51.0%	-402.2%	98.5%	n=40 177
	within	NA	38.7%	-420.9%	431.2%	T-bar=4.4

Source: The authors' calculations based on the Legiscomex database.

Note: N: observations. n: individuals. T-bar: the average age of the observations in years.

Table 2. Correlations between profitability ratios

	ROA	ROE	NM	EBM	EBAM
ROA	1.0000				
ROE	0.5117*	1.00			
NET	0.4177*	0.1568*	1.00		
EBIT	0.2742*	0.1154*	0.5506*	1.00	
EBITDA	0.2587*	0.1099*	0.5218*	0.9438*	1.00

Source: The authors' calculations based on the Legiscomex database.

Note: *Significant at 0.05

In addition, independent control variables related to the financial behavior of the firm ($X_{i,t}^{j}$) were included. The first one was the logarithm of total assets. This variable is also linked to firm size, affecting performance since one can assume that large firms tend to have better scale economies.

Next, the logarithm of operative revenues, a control variable that considers a firm to have higher profitability if it receives higher operative income, other aspects being equal. Besides this, the lag of non-operative revenues was included, given that, other things equal, the higher the non-operative revenues, the higher the firm's profitability. The debt-to-equity proportion was also included because it is assumed that highly leveraged firms tend to pay higher interest, as well as having higher tax shields, the higher the leverage is. Finally, the logarithm of non-operative revenues was also included because the higher they are, the higher the net income. Prior to the logarithmical transformation, a windsorization transformation was performed for every variable at 99%, owing to the fact that the variables had high outliers on the right side of the distribution.

Table 3. Descriptive statistics of interest and control financial variables

Variable	Type	Mean	Sth. dev.	Min	Max	Observations
Log IA	overall	5.25	8.39	0	23.24	N=218 299
	between	NA	7.43	0	23.24	N=47 700
	within	NA	4.40	-15.22	25.92	T-bar=4.57
Log of total assets	overall	21.98	1.57	18.51	26.35	N=234 952
	between	NA	1.60	18.51	26.35	N=48 053
	within	NA	0.41	17.50	27.58	T-bar=4.89

Variable	Type	Mean	Sth. dev.	Min	Max	Observations
Log of operating revenue	overall	20.13	5.81	0	26.13	N=233 869
	between	NA	5.74	0	26.13	N=48 004
	within	NA	3.42	-3.12	43.34	T-bar=4.87
Log of non-operating revenue	overall	16.33	5.53	0	23.45	N=233 490
	between	NA	5.09	0	23.45	N=47 890
	within	NA	3.49	-4.7	36.63	T-bar=4.87
Debt to Equity	overall	49.23%	29.7%	0.14%	146.81%	N=234 900
	between	NA	30.1%	0.14%	146.81%	N=48 046
	within	NA	12.3%	-59.4%	173.45%	T-bar=4.89

Source: The authors' calculations based on the Legiscomex database.

Note: N: observations. n: individuals. T-bar: the average age of the observations in years.

A set of control parameters $Z_{i,t}^{k}$ was also included, formed of industry and localization dummies. The variable of interest in the model was $IA_{i,t-p}$, measuring the logarithm of the book value of the IAs reported by the firms. In this case, the interest was in the full effect of book-activated IAs instead of individual IAs like trademarks, patents, or rights. Due to the effect of IAs not necessarily appearing in the short term, several models were run, including lags of the IAs; thus, the models were designed to shed light on the past inclusion of IAs and how they affected the profitability of the firm, so that four lags of IA variable were included in our study.

Fixed effects models were run where individual effects were given as α_i. A Hausman test based on the estimated disturbance variance from the efficient estimator was utilized to perform this model. Finally, models for heteroskedastic panels to correct standard errors and autocorrelation were employed; in every case, the results of the models were satisfactory.

4. RESULTS

To present the results of this research, two different approaches were used; firstly, tables 3 to 8 show the results for the econometric models (30 in total), including calculated betas, standard errors, level of significance, population and R square, among others.

Aside from this, several tables have been presented in Appendix C with abstract results of tables 3 to 8. In this appendix, the tables have been grouped by explanatory variables related to explained variables and the number of lags introduced in each model for the IA variable (from zero to four lags). Each model shows the explanatory variable having either a positive or negative relationship with the financial return variable and either a significant or a non-significant relationship with it.

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Table 4. The impact of IAs on ROE

	(1) roe b/se	(2) roe b/se	(3) roe b/se	(4) roe b/se	(5) roe b/se
l.roe	-0.201***	-0.217***	-0.191***	-0.259***	-0.301***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
total_assets	-2.975***	-2.445**	-2.092*	-0.126	1.778
	(0.73)	(0.78)	(0.97)	(1.17)	(1.57)
revenues	1.743***	1.741***	1.836***	1.802***	1.724***
	(0.06)	(0.06)	(0.07)	(0.08)	(0.09)
no_orevenues	1.505***	1.550***	1.714***	1.919***	1.922***
	(0.05)	(0.06)	(0.06)	(0.07)	(0.08)
debt-equity	0.258***	0.243***	0.215***	0.149***	0.181***
	(0.02)	(0.02)	(0.03)	(0.04)	(0.04)
int_assets	-0.151***				
	(0.03)				
L.int_assets		-0.155***			
		(0.03)			
L2.int_assets			-0.168***		
			(0.04)		
L3.int_assets				-0.057	
				(0.05)	
L4.int_assets					-0.018
					(0.05)
constant	9.715	-1.879	-13.858	-57.684*	-99.716**
	(15.79)	(16.90)	(20.81)	(25.45)	(34.30)
R-sqr	0.099	0.107	0.106	0.144	0.182
N	172978	163487	124229	96333	72615
p	0.000	0.000	0.000	0.000	0.000

Source: The authors' calculations

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. To make it easier to read the table, the year, industry and location variables are not shown.

For every explained variable, ROE, ROA, Gross Margin, EBIT margin, EBITDA margin, and Net margin, the results of their own lagged observations were negative and significant (see the first line of results in tables 3 to 8); This means that past profitability results negatively influenced contemporaneous returns. A possible explanation for this result is that firms cannot maintain positive increases in return rates indefinitely; therefore, a period of positive returns is likely to be followed by a decreasing period of profitability, whereas one with poor return results is likely to be followed by one with high returns, i.e., with performance being highly volatile over time.

Except for the ROE model (Table 3), profitability was positively related to the value of assets; thus, high investment in total assets creates returns for the company. This result seems logical because these firms tend to invest in all types of assets to increase their value. Since total assets are measured without including IAs, it can be said that physical and current assets tend to boost returns in Colombia's companies.

The results of ROE may be because of the decomposition of this ratio which used the DuPont analysis being negatively associated with the level of assets. On top of this, firms investing high values in assets may tend to do it using high equity levels, especially when it comes to SMEs, which have almost no access to credit, thus causing a decrease in the ROE ratio, given that equity increases in those cases.

Table 5. The impact of IA on ROA

	(6)	(7)	(8)	(9)	(10)
	roa	roa	roa	roa	roa
	b/se	b/se	b/se	b/se	b/se
L.roa	-0.211***	-0.228***	-0.195***	-0.266***	-0.339***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
total_assets	3.353***	3.561***	3.591***	4.369***	6.675***
	(0.22)	(0.23)	(0.29)	(0.37)	(0.50)
revenues	0.523***	0.516***	0.569***	0.556***	0.507***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
no_orevenues	0.386***	0.394***	0.458***	0.485***	0.484***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
debt-equity	-0.196***	-0.202***	-0.193***	-0.209***	-0.243***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
int_assets	-0.049***				
	(0.01)				
L.int_assets		-0.066***			
		(0.01)			
L2.int_assets			-0.060***		
			(0.01)		
L3.int_assets				-0.010	
				(0.01)	
L4.int_assets					-0.001
					(0.02)
constant	-79.845***	-84.124***	-87.825***	-104.489***	-153.244***
	(4.70)	(5.09)	(6.34)	(8.02)	(11.00)
R-sqr	0.138	0.145	0.143	0.176	0.239
N	156069	146537	109819	83190	59612
p	0.000	0.000	0.000	0.000	0.000

Source: The authors' calculations

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. To make it easier to read the table, the year, industry, and location variables are not shown.

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As seems logical, an increase in revenues is related to higher profitability levels in ROE, ROA, EBIT, EBITDA, and Net margin (Tables 3, 4, 6, 7, and 8); all in all, a company with increasing sales tends to have high returns and good scale economies. Therefore, although it seems curious that gross margins tend to decrease with higher revenues, Colombian firms do not have those scale economies for production costs but they do have them for operating ones; however, more research is needed to confirm this.

In Tables 3, 4, and 8, non-operating revenues can be seen to be directly related to positive performance. Due to the fact that ROE, ROA, and Net margin are directly linked to net profitability, this result appears logical; gaining high values with other activities except for operating ones tends to increase the net profit of firms, increasing the return ratios using this value.

However, Tables 5, 6, and 7 show that non-operating revenues were negatively related to Gross, EBIT, and EBITDA margins. In the case of gross margin, the effect was significant for the models with zero, one, and two lags of IAs (models 11, 12, and 13). The increase in non-operating revenues seems to have diminished positive performance, at least for the operation. When a company deviates its focus from operating activities to non-operating ones, it appears that its operating performance tends to vanish.

Table 6. The impact of IAs on Gross margin

	(11) gross b/se	(12) gross b/se	(13) gross b/se	(14) gross b/se	(15) gross b/se
L.gross	-0.080***	-0.099***	-0.099***	-0.164***	-0.209***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
total_assets	4.081***	4.363***	4.236***	4.815***	5.643***
	(0.22)	(0.23)	(0.28)	(0.36)	(0.47)
revenues	-6.450***	-6.490***	-6.351***	-6.409***	-6.276***
	(0.11)	(0.11)	(0.12)	(0.13)	(0.15)
no_orevenues	-0.106***	-0.088**	-0.100**	-0.026	0.010
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
debt-equity	-0.082***	-0.083***	-0.082***	-0.086***	-0.101***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
int_assets	0.019				
	(0.01)				
L.int_assets		0.007			
		(0.01)			
L2.int_assets			0.007		
			(0.01)		
L3.int_assets				-0.007	
				(0.02)	
L4.int_assets					0.006
					(0.02)

	(11) gross b/se	(12) gross b/se	(13) gross b/se	(14) gross b/se	(15) gross b/se
constant	103.597***	98.921***	98.658***	88.740***	69.245***
	(4.84)	(5.16)	(6.27)	(7.92)	(10.53)
R-sqr	0.148	0.154	0.154	0.177	0.205
N	156537	147703	113101	88256	66495
p	0.000	0.000	0.000	0.000	0.000

Source: The authors' calculations

Note: *p < 0.05, **p < 0.01, ***p < 0.001. To make it easier to read the table, the year, industry, and location variables are not shown.

As for the debt-to-equity ratio, in Tables 4, 5, 6, 7, and 8, one can see that capital structure is negatively related to performance. Thus, ROA, gross, EBIT, EBITDA, and Net margins tend to decrease if the company takes on more debt or diminishes the equity. Conversely, in Table 3, ROE is positively linked to debt structure. There is an intense discussion in financial literature about the effect of capital structure on performance; in several papers, negative relationships between both variables have been discovered, but in others, they have been positive (Abor, 2005; Ayaz et al., 2021). The fact that mixed relations have been spotted between performance and debt structure may strengthen the debate in the literature and be due to the diverse characteristics of firms in this sample.

IAs are negatively related to contemporaneous ROA and ROE; this means that the higher the IA levels, the lower the profitability ratios tend to be. Similar results can be seen in the literature (Cañibano et al., 2000; Chiao & Yang, 2011; Ge & Xu, 2021; Hartsema et al., 2021; Matias Gama et al., 2017; Qureshi & Siddiqui, 2021; Wahyuni et al., 2023). This result could be because of IA generation, book registration, and amortization causing a downturn in profitability in the short term. In addition, creating IAs is expensive and requires substantial investments in the firm.

Table 7. The impact of IAs on the EBIT margin

	(16) ebit_m b/se	(17) ebit_m b/se	(18) ebit_m b/se	(19) ebit_m b/se	(20) ebit_m b/se
L.ebit_m	-0.048***	-0.066***	-0.075***	-0.116***	-0.143***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
total_assets	4.192***	4.840***	5.647***	7.790***	11.134***
	(0.64)	(0.68)	(0.84)	(1.05)	(1.33)
revenues	18.009***	17.569***	17.175***	15.773***	14.549***
	(0.39)	(0.40)	(0.45)	(0.46)	(0.51)
no_orevenues	-2.770***	-2.781***	-2.799***	-2.781***	-2.820***
	(0.07)	(0.08)	(0.09)	(0.10)	(0.12)
debt-equity	-0.263***	-0.264***	-0.260***	-0.281***	-0.302***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)

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	(16) ebit_m b/se	(17) ebit_m b/se	(18) ebit_m b/se	(19) ebit_m b/se	(20) ebit_m b/se
int_assets	0.003				
	(0.02)				
L.int_assets		-0.044			
		(0.03)			
L2.int_assets			-0.014		
			(0.03)		
L3.int_assets				0.027	
				(0.04)	
L4.int_assets					0.002
					(0.05)
constant	-424.239***	-429.554***	-439.107***	-455.369***	-502.532***
	(14.82)	(15.74)	(19.60)	(24.45)	(30.84)
R-sqr	0.179	0.177	0.177	0.176	0.178
N	156543	147704	113101	88256	66495
p	0.000	0.000	0.000	0.000	0.000

Source: The authors' calculations

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. To make it easier to read the table, the year, industry and location variables are not shown.

Therefore, it could be assumed that increasing the number of IAs would create higher expenses for the firm. This would not only be because a firm would need to register some of the IAs with legal authorities but also because it would have to pay for appraisals, consultants, and other services to ensure that the registered fair value followed accounting rules.

In any case, Colombian companies need to amortize the value of IAs. The higher the amortization, the more the firm's profitability falls, even when this transaction does not affect cash flows. Since ROA and ROE are measured using net income, it seems logical for there to be a lower net ratio when firms increase amortized expenses.

One could think that if IAs created value within the firm, it would see an increase in revenue or a reduction in costs, using R&D, patents, or trademarks, which would tend to cancel out the negative effect of IA-related expenditure. However, this did not happen in the models; therefore, it can be said that the effect of IA-related expenditure is higher in the short term than a possible increase in revenue or a reduction in costs.

The effect of lagged IAs on ROE and ROA can be seen in Tables 3 and 4. One- and two-lagged IAs tend to be related to lower profitability. According to the previous explanation, the cost creation of IAs is higher than the profits obtained by the firm, even after two years. Although the amortization effect and the expenses related to the creation and registration of IAs may appear to explain this result, two years after registration, it does not seem logical that these expenses are the cause, whereas amortization does.

Table 8. The impact of IAs on the EBITDA margin

	(21) ebitha_m b/se	(22) ebitha_m b/se	(23) ebitha_m b/se	(24) ebitha_m b/se	(25) ebitha_m b/se
L.ebitda_m	-0.111***	-0.111***	-0.123***	-0.177***	-0.232***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
total_assets	7.251***	7.279***	7.794***	9.461***	12.817***
	(0.66)	(0.66)	(0.83)	(1.07)	(1.41)
revenues	10.777***	10.775***	10.426***	8.998***	7.818***
	(0.37)	(0.37)	(0.42)	(0.43)	(0.47)
no_orevenues	-2.556***	-2.556***	-2.607***	-2.575***	-2.569***
	(0.07)	(0.07)	(0.08)	(0.10)	(0.11)
debt-equity	-0.218***	-0.217***	-0.205***	-0.224***	-0.234***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
int_assets	0.024				
	(0.03)				
L.int_assets		0.015			
		(0.03)			
L2.int_assets			0.069*		
			(0.03)		
L3.int_assets				0.072	
				(0.04)	
L4.int_assets					0.006
					(0.05)
constant	-339.917***	-340.449***	-344.223***	-348.850***	-397.507***
	(15.48)	(15.44)	(19.53)	(25.13)	(33.08)
R-sqr	0.117	0.117	0.118	0.121	0.137
N	130489	130452	99844	76049	54394
p	0.000	0.000	0.000	0.000	0.000

Source: The authors' calculations

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. To make it easier to read the table, the year, industry and location variables are not shown.

After the third lag, no relationship was found between IA, ROE and ROA. This result could be interpreted in two ways: firstly, companies may not obtain profits from IA registration in the short or the long term; secondly, the effect of expenses related to IA creation or registration seems to stop after the second year. It seems that even when accounting rules highlight that there should be proof that IAs will eventually create profitability, Colombian firms have IAs that do not create value for the firm.

Tables 5, 6, and 8 show that the book value of IAs was not related to gross, EBIT or net margin in contemporaneous or lagged periods. Thus, IAs did not affect all outcomes in the

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firm. More research needs to be done to understand why there are profitability ratios affected negatively by IAs while other margins seem to be independent of those effects.

Table 7 shows the effect of IAs on the EBITDA ratio. After two lags, there was found to be a positive and significant relationship between both variables, which seems to be an isolated case as no other positive effects of IAs on a firm's performance could be appreciated; therefore, it could be said that the effect was negative or non-existent in the short term.

Table 9. The impact of IAs on net margin

	(26)	(27)	(28)	(29)	(30)
	net_m	net_m	net_m	net_m	net_m
	b/se	b/se	b/se	b/se	b/se
L.net_m	-0.112***	-0.126***	-0.141***	-0.172***	-0.211***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
total_assets	10.931***	11.361***	12.288***	15.158***	19.228***
	(0.66)	(0.71)	(0.89)	(1.13)	(1.51)
revenues	4.432***	4.236***	3.833***	2.896***	2.179***
	(0.34)	(0.34)	(0.40)	(0.41)	(0.45)
no_orevenues	0.733***	0.723***	0.805***	0.864***	0.879***
	(0.07)	(0.07)	(0.08)	(0.09)	(0.11)
debt-equity	-0.445***	-0.455***	-0.463***	-0.510***	-0.549***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
int_assets	-0.033				
	(0.02)				
L.int_assets		-0.034			
		(0.03)			
L2.int_assets			-0.021		
			(0.03)		
L3.int_assets				0.040	
				(0.04)	
L4.int_assets					0.033
					(0.06)
constant	-328.726***	-333.654***	-347.238***	-390.296***	-464.199***
	(15.36)	(16.43)	(20.76)	(26.29)	(34.70)
R-sqr	0.053	0.054	0.055	0.062	0.075
N	156543	147704	113101	88256	66495
p	0.000	0.000	0.000	0.000	0.000

Source: The authors' calculations

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. To make it easier to read the table, the year, industry and location variables are not shown.

5. ROBUSTNESS CHECKS

Given that we used an accounting measure of IAs, how we measured these may have affected the results obtained. Thus, by changing the measurement of IA variables in different ways, we performed several robustness checks.

Following the methodology of Andonova and Ruíz-Pava (2016), we included a proxy of IA ownership that took the value of 1 if the company had an IA value higher than zero (Own. dummy). 27% of companies had positive IAs (Table 9). We also incorporated a variable accumulating the value of the dummy variable for a specified number of years; companies had an average of 1.15 years of IA ownership with a maximum of 10 years, the total of the studied period.

Additionally, several models were run using other IA variations. Given that the original model used the log of capitalized IAs, we also included the ratio of IAs over total assets and revenue. Finally, the models were run using only companies with positive IA values, as a zero-inflated IA distribution could have affected the regression results.

Table 10. Robustness variables

Variable	N.	Mean	Sth. Dev.	Min.	Max.
Own.dummy	234952	0.268	0.442	0	1
Own.cumulated	234952	1.15	1.92	0	10
IAs/asset ratio	218299	0.232	0.368	0	1
IAs/revenue ratio	201984	0.245	0.381	0	3.09

Source: The authors' calculations based on the Legiscomex database.

Note: Own.: Ownership. IAs: Intangible assets

In the case of the IA dummy, and its ratio over total assets and total revenue, the results were mostly the same as they were for the original models. IAs had a negative relationship with ROA and ROE and had no relationship with gross, net, or EBIT margins. EBITDA seemed to be affected positively but only after three years, with a 10% significance.

In the case of accumulated ownership, unlike the paper of Andonova and Ruíz-Pava (2016) we found no relationship in most of the models; however, we did note that after four years of ownership, IAs had a negative association with ROE and ROA, and a positive relationship with net margin after three years.

Including only positive values of IAs in the regression did not affect our results either; ROA and ROE had negative and significative relationships with IAs, but the gross, net, EBIT, and EBITDA margins were unaffected by IAs.

The results of these robustness checks seem to reaffirm the results of the original models in that IAs in in Colombian firms had either a negative or no relationship with performance when using accounting data. The results of these models are available upon request.

6. DISCUSSION

IAs are essential investments for companies worldwide; these assets tend to create high value, especially for firms in high technology sectors and for those where fixed physical assets

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do not affect business value. Most of the time, IAs are expected to create high returns in every firm, but according to the literature, it does not always do so.

Our results appear to concur with this. We believe that this evidence is related to the fact that Colombian firms, especially those not trading on stock markets, record IAs in books because they must do it to follow accounting rules, but in some cases, they use poor accounting practices for IA valuation. However, even when accounting rules require IAs to generate profitability, Colombian firms seem not to exploit them to create positive financial outcomes. According to Lev and Daum (2004), IAs by themselves do not create value. They should be combined with other production factors, and if they are used only for reporting purposes, they will negatively affect the firm's performance. A possible explanation for our results is that, on average, IAs in Colombian firms are capitalized but not exploited because they are not combined with other strategic investments to obtain positive results.

Another issue with IAs is that they create additional costs that seem substantial in the short and middle term. We could only see the benefits of IAs in the EBITDA ratio, and just for a specific period. By not using publicly traded firms in the used database, we were able to signal that for small, financially and operationally restricted firms, IAs did not create profits, or at least, any that would be traceable using accounting books. As may seem logical, such firms should gain some kind of benefit out of creating and maintaining IAs, although this should arise outside financial books.

On the other hand, the Colombian market may simply not be widely using IAs bearing in mind its poor positioning on international innovation indexes and the low investment that Colombian companies have made to create these assets (Cuellar et al., 2021; Méndez-Morales, 2019; Méndez-Morales & Yanes-Guerra, 2021). Therefore, even when a company develops and records IAs, the likelihood of its exploiting them to create profitability is low; IAs create additional costs that these firms cannot recover meaning that they should focus on exploiting them to create value for shareholders or to make profit.

The fact that we have found a clear negative relationship between ROE, ROA, and IAs makes it urgently needed for researchers in developing countries to study this phenomenon thoroughly. We do not believe that IAs are detrimental to a company per se; however, we need to understand how they can create value, going from accounting registration to value creation.

Finally, Governments in developing countries primarily focus on policies to enhance the creation of IAs, like patents and trademarks; nevertheless, our results have shown that the creation and capitalization of IAs is not enough to increase profitability; thus, governments should reinforce policies aimed at exploiting them rather than creating them.

7. CONCLUSIONS

We developed several models to determine if the book value of IAs was related to the profits of Colombian firms. Firstly, we used financial data for an unbalanced panel of 48,053 Colombian firms with an average of 234,952 observations and 4.89 years per firm.

After running more than 30 different dynamic panel models, we found that IAs negatively impacted ROE and ROA in the short and middle term and that the interest variable had no relationship with profitability ratios like gross, EBIT or net margins. Finally, we discovered a positive relationship between the EBITDA margin and IAs after two years; however, this was the only positive outcome in this research.

We have matched our results to two facts; firstly, Colombian companies do not exploit IAs to create profits, and these assets only create internal costs, which arise from the creation,

appraisal and recording of IAs. Secondly, in Colombia, where there are poor results in innovation and low investments in R&D, the market and the possibility to exploit IAs is minimal. Finally, we used a set of firms that were not publicly-traded; consequently, these were more operationally and financially restricted than the floated ones used typically in literature.

The results of this study have opened new lines of research. Firstly, systematically comparing the differences between publicly and non-publicly-traded firms in several countries would be fascinating to unravel the effects of IAs. Secondly, given that our data from Colombia may be biased and its IAs market is rather limited, comparing our results against the ones in other developing countries and using accounting data would be interesting. Finally, more research needs to be done to understand why ratios like gross, EBIT and net margin have no relationship with the profits of Colombian firms.

8. LIMITATIONS

We selected a dynamic panel model to run our data. Therefore, we attempted to develop a generalized method of moments (GMM), including the first differences of variables to control for possible correlations with the error term. Unfortunately, our database had several data gaps, which meant that a considerable amount of important information was missing; at the same time, we did not have adequate instruments to perform the GMM methodology with data other than lagged variables; thus, we selected a dynamic panel model with a lagged return variable as our main methodology.

The data used in this research came from the financial records of Colombian firms. In most of the literature, the outcomes related to IAs were related to market capitalization. In this case, we used this data for a purpose: to aim to understand whether non-publicly-listed firms in a developing country behaved like the large publicly-traded firms in the literature; however, according to our results, non-publicly-listed Colombian firms did not obtain profitability from IAs like large publicly-traded firms in developed countries did.

Besides this, the database used had its limitations and the findings must be interpreted with caution for the following reasons: firstly, because the sample used had data for only 4.89 years per company on average, suggesting that companies over ten years old were rare in our sample, making it impossible to see the long-term effect of IAs in depth; secondly, we were unable to determine each company's age and could not contrast the results of the most recently created companies with the oldest ones as a result, preventing the findings of previous literature where companies could exploit intellectual property in the long term from being distinguished. In addition, the analysis did not include a measure of prior innovative capacity (e.g., number of patent applications), which could explain why some companies could obtain more significant financial value from some assets than others (e.g., patents), considering the limitations of innovative capacity.

Author contribution

Conceptualization, A.M.M., L.E.R.A. and C.A.M..; Methodology, A.M.M. and C.A.M..; Validation, A.M.M. and C.A.M.; Data Curation, L.E.R.A.; Formal Analysis, A.M.M. and C.A.M.; Funding Acquisition, A.M.M., L.E.R.A., and D.A.C.M.; Methodology, A.M.M. and C.A.M.; Writing – Original Draft Preparation, A.M.M., L.E.R.A., and D.A.C.M.; Writing – Review & Editing, A.M.M., L.E.R.A., and D.A.C.M. All authors have read and agreed to the published version of the manuscript.

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Appendix

Appendix A

	Types of companies*	IA measure**	Type of country***	Panel data	Type of effect
Andonova & Ruíz-Pava. (2016).	NLC	AD	Ing	No	Positive
Serpeninova et al (2022)	NLC	AD	D	Yes	Positive
Skhvediani et al (2022)	NLC	AD	D	Yes	Positive
Chiao & Yang (2011)	NLC	AD	D	No	Negative/Positive U shaped effects
Cheikh & Noubbigh (2019)	NLC	AD	Ing	Yes	Positive
Balzer, et al. (2020).	LC	AD	D	No	Positive

	Types of companies*	IA measure**	Type of country***	Panel data	Type of effect
Alarussi & Gao X. (2021)	LC	AD	Ing	No	Positive
Pechlivanidis et al. (2022)	LC	AD	D	No	Positive
Wahyuni et al (2023)	LC	AD	Ing	No	Positive
Ge & Xu (2021).	LC	AD	Ing	Yes	Negative
Chiarelo, et al. (2015)	LC	MD	Ing	No	Positive
Ni, Cheng, & Huang (2020)	LC	MD	Ing	Yes	Positive
Haji & Ghazali (2018)	LC	MD	Ing	Yes	Positive
Denicolai et al (2015)	LC	AD	D	No	Positive
Hartsema et al (2021)	LC	MD	D	Yes	Negative on trade credit
Rika (2015)	LC	MD	Ing	No	Negative on D/E, Positive on ROA
Qureshi & Siddiqui (2021)	LC	AD	Ing / D	No	Negative

* Types of companies: NLC (Non-publicly-listed companies); LC (Publicly-listed companies)

** IA measure: AD (Intangible assets measured with capitalized accounting data); MD (Intangible assets measured with market data)

*** Type of country: D (Developed); Ing (Developing)

Appendix B

Variable	Papers using the variable											
ROA	Alarussi & Gao (2021)	Pechlivanidis et al. (2022)	Andonova & Ruíz-Pava (2016)	Serpeninova et al (2022)	Skhvediani et al (2022)	Wahyuni et al (2023)	Ge & Xu (2021)	Chiarelo, et al. (2015)	Cheikh & Noubbigh (2019)	Haji & Ghazali (2018)	Rika (2015)	Qureshi & Siddiqui (2021)
EBIT	Andonova & Ruíz-Pava (2016)	Serpeninova et al. (2022)	Chiao & Yang (2011)									
EBITDA	Pechlivanidis et al. (2022)											
ROE	Pechlivanidis et al. (2022)	Chiarelo et al. (2015)	Cheikh & Noubbigh (2019)	Haji & Ghazali (2018)	Qureshi & Siddiqui (2021)							
Gross margin	Serpeninova et al. (2022)											
Net margin	Serpeninova et al. (2022)	Skhvediani et al. (2022)	Chiarelo et al. (2015)	Ni, Cheng & Huang	Haji & Ghazali (2018)	Qureshi & Siddiqui						

Variable	Papers using the variable											
				(2020)		(2021)						
Size (Logarithm of total assets)	Pechlivanidis et al. (2022)	Alarussi & Gao (2021)	Serpeninova et al. (2022)	Skhvediani et al (2022)	Haji & Ghazali (2018)	Hartsema et al. (2021)						
Capital structure (D/E)	Pechlivanidis et al. (2022)	Alarussi & Gao (2021)	Ni, Cheng & Huang (2020)	Rika (2015)	Chiao & Yang (2011)	Qureshi & Siddiqui (2021)						

Appendix C

Explained variable	Explanatory variable	Lags for the IA variable in the model					Table
L0	L1	L2	L3	L4			
ROE	L1.ROE	Negative	Negative	Negative	Negative	Negative	Table 3
ROA	L1.ROA	Negative	Negative	Negative	Negative	Negative	Table 4
GROSS	L1.GROSS	Negative	Negative	Negative	Negative	Negative	Table 5
EBIT	L1.EBIT	Negative	Negative	Negative	Negative	Negative	Table 6
EBITDA	L1.EBITDA	Negative	Negative	Negative	Negative	Negative	Table 7
NET	L1.NET	Negative	Negative	Negative	Negative	Negative	Table 8

Negative: The variable had a negative and significant relationship with the explained variable.

Positive: The variable had a positive and significant relationship with the explained variable.

NS: The variable had no significant relationship with the explained variable.

Explained variable	Explanatory variable	Lags for the IA variable in the model					Table
		L0	L1	L2	L3	L4	
ROE	Assets	Negative	Negative	Negative	NS	NS	Table 3
ROA	Assets	Positive	Positive	Positive	Positive	Positive	Table 4
GROSS	Assets	Positive	Positive	Positive	Positive	Positive	Table 5
EBIT	Assets	Positive	Positive	Positive	Positive	Positive	Table 6
EBITDA	Assets	Positive	Positive	Positive	Positive	Positive	Table 7
NET	Assets	Positive	Positive	Positive	Positive	Positive	Table 8

Negative: The variable had a negative and significant relationship with the explained variable.

Positive: The variable had a positive and significant relationship with the explained variable.

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NS: The variable had no significant relationship with the explained variable.

Explained variable	Explanatory variable	Lags for the IA variable in the model					Table
		L0	L1	L2	L3	L4	
ROE	Revenues	Positive	Positive	Positive	Positive	Positive	Table 3
ROA	Revenues	Positive	Positive	Positive	Positive	Positive	Table 4
GROSS	Revenues	Negative	Negative	Negative	Negative	Negative	Table 5
EBIT	Revenues	Positive	Positive	Positive	Positive	Positive	Table 6
EBITDA	Revenues	Positive	Positive	Positive	Positive	Positive	Table 7
NET	Revenues	Positive	Positive	Positive	Positive	Positive	Table 8

Negative: The variable had a negative and significant relationship with the explained variable.

Positive: The variable had a positive and significant relationship with the explained variable.

NS: The variable had no significant relationship with the explained variable.

Explained variable	Explanatory variable	Lags for the IA variable in the model					Table
		L0	L1	L2	L3	L4	
ROE	No oper. revenues	Positive	Positive	Positive	Positive	Positive	Table 3
ROA	No oper. revenues	Positive	Positive	Positive	Positive	Positive	Table 4
GROSS	No oper. revenues	Negative	Negative	Negative	NS	NS	Table 5
EBIT	No oper. revenues	Negative	Negative	Negative	Negative	Negative	Table 6
EBITDA	No oper. revenues	Negative	Negative	Negative	Negative	Negative	Table 7
NET	No oper. revenues	Positive	Positive	Positive	Positive	Positive	Table 8

Negative: The variable had a negative and significant relationship with the explained variable.

Positive: The variable had a positive and significant relationship with the explained variable.

NS: The variable had no significant relationship with the explained variable.

Explained variable	Explanatory variable	Lags for the IA variable in the model					Table
		L0	L1	L2	L3	L4	
ROE	Debt-equity	Positive	Positive	Positive	Positive	Positive	Table 3
ROA	Debt-equity	Negative	Negative	Negative	Negative	Negative	Table 4
GROSS	Debt-equity	Negative	Negative	Negative	Negative	Negative	Table 5
EBIT	Debt-equity	Negative	Negative	Negative	Negative	Negative	Table 6
EBITDA	Debt-equity	Negative	Negative	Negative	Negative	Negative	Table 7
NET	Debt-equity	Negative	Negative	Negative	Negative	Negative	Table 8

Negative: The variable had a negative and significant relationship with the explained variable.

Positive: The variable had a positive and significant relationship with the explained variable.

NS: The variable had no significant relationship with the explained variable.

Explained variable	Explanatory variable	Lags for the IA variable in the model					Table
		L0	L1	L2	L3	L4	
ROE	Int. assets	Negative	Negative	Negative	NS	NS	Table 3
ROA	Int. assets	Negative	Negative	Negative	NS	NS	Table 4
GROSS	Int. assets	NS	NS	NS	NS	NS	Table 5
EBIT	Int. assets	NS	NS	NS	NS	NS	Table 6
EBITDA	Int. assets	NS	NS	Positive	NS	NS	Table 7
NET	Int. assets	NS	NS	NS	NS	NS	Table 8

Negative: The variable had a negative and significant relationship with the explained variable.

Positive: The variable had a positive and significant relationship with the explained variable.

NS: The variable had no significant relationship with the explained variable.

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