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Relation between intangible assets, macroeconomic environment, and market value of German public companies: period from 1999 to 2016

The present paper is aimed to investigate the relation of intangible assets, macroeconomic data and market value of German public companies from 1999 to 2016. This paper innovates in relation to those who used the theoretical reference of the neoclassical production function by introducing ranges of variations for the main variables of the model (growth rate of sales, rate of return to fixed capital, rate of return for German bonds, internal product growth rates, discount rates) to verify if the contribution of intangibles is supported by significant changes in the variables essential for estimating the model. Entrepreneurs and executives believed that the key to success in business was associated with its tangible assets and what they were able to produce. Recently it was realized that the value of a company is not restricted to tangible assets, but also to the assets with no physical form, such as trademarks, intellectual capital, patents, and other intangible assets. The verification of the impact of the intangibles on the company's market value is made through proxies according to the methodology proposed by Gu & Lev (2011), the Euribor rate and the Credit Default Swap as a country risk proxy and sensitivity analysis for the weighting weighing of Ebitda and for economic growth assumptions. The methodological approach is a test-based quantitative research by using analysis of correlation and regression with panel data using STATA-15 software in order to determine the impact of intangible assets on the market value of the company. The sample was extracted from the Capital IQ database of all public companies listed in Germany from 1999 to 2016 on annual basis. As a result, it was verified that Ebitda is a consistency element of intangibility, and it impacts the IDE and IC calculation over time, with positive relation with Market Value of German companies, but partial evidences that generate added value to shareholders.

Keywords: Intangible Assets; Macroeconomic Data; Market value; Sensitive Test; Credit Default Swap; Panel Data; Germany.

Relação entre ativos intangíveis, ambiente macroeconômico e valor de mercado das empresas públicas alemãs: período de 1999 a 2016

O presente artigo tem como objetivo investigar a relação de ativos intangíveis, dados macroeconômicos e valor de mercado das empresas públicas alemãs de 1999 a 2016. Este artigo inova em relação àqueles que utilizaram o referencial teórico da função de produção neoclássica, introduzindo faixas de variações para as principais variáveis ??do modelo (taxa de crescimento das vendas, taxa de retorno ao capital fixo, taxa de retorno dos títulos alemães, taxas de crescimento interno do produto, taxas de desconto) para verificar se a contribuição dos intangíveis é suportada por mudanças significativas nas variáveis ??essenciais para estimar o modelo. Empresários e executivos acreditavam que a chave do sucesso nos negócios estava associada aos seus ativos tangíveis e ao que eles eram capazes de produzir. Recentemente, percebeu-se que o valor de uma empresa não se restringe a ativos tangíveis, mas também a ativos sem forma física, como marcas comerciais, capital intelectual, patentes e outros ativos intangíveis. A verificação do impacto dos intangíveis no valor de mercado da empresa é feita por meio de proxies, de acordo com a metodologia proposta por Gu & Lev (2011), a taxa Euribor e o Credit Default Swap como proxy de risco país e análise de sensibilidade para a pesagem de ponderação do Ebitda e para premissas de crescimento econômico. A abordagem metodológica é uma pesquisa quantitativa baseada em teste, usando análise de correlação e regressão com dados em painel usando o software STATA-15 para determinar o impacto de ativos intangíveis no valor de mercado da empresa. A amostra foi extraída da base de dados Capital IQ de todas as empresas públicas listadas na Alemanha de 1999 a 2016, anualmente. Como resultado, verificou-se que o Ebitda é um elemento consistente da intangibilidade e afeta o cálculo do IDE e do IC ao longo do tempo, com relação positiva com o valor de mercado das empresas alemãs, mas evidências parciais que geram valor agregado aos acionistas.

Palavras-chave: Ativos intangíveis; Dados macroeconômicos; Valor de mercado; Teste sensível; Swap de Crédito Padrão; Dados do painel; Alemanha.

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INTRODUCTION

Nowadays, in a globalized world, the competitiveness of companies in a market extended beyond their borders leads them to constant surpluses for their survival. Thus, they take on ongoing processes of innovation and improvement since they intend to remain in a competitive position in the global market (CARMONA et al., 2015). Pulido (2009) points out that since the 1990s, as a result of economic growth, intangible assets increasingly intensified in order to promote an increase in competitiveness among companies, such as technological capital, knowledge, human capital and social capital.

For Fuentes et al. (2016), intangible assets correspond especially to human capital, structural capital and relational capital. Human capital refers to the knowledge of people, both to manage the company and to generate new skills; structural capital is the ability to systematize business processes, and relational capital refers to the set of relations that the company maintains with market agents.

Human capital is the knowledge, skills, competences and individual attributes that facilitate the creation of the personal social and economic well-being of the company (JONES et al., 2010). Intangible assets include investment in information technology, property innovation and economic competence, and investments in intangibles are usually classified as intermediary activities or expenditures. However, they are fundamental for the company's competitiveness and prosperity, and its reflexes are reflected for years and thus must be correctly measured (CORRADO et al., 2013).

According to Yang et al. (2017), literature on intangible capital is significant and includes its discussion as a source of growth in several countries, segments and types of industries. Academic works deal with intangible assets and with their influence on company performance and results. Hogan et al. (2002) consider the client an important intangible asset for the company's financial performance, while Kaplan et al. (2004) present strategies that allow the transformation of intangible assets into results. In his research, Qiu (2009) empirically identifies the influence of intangible assets on Return On Asset (ROA), Return On Equity (ROE) and Return On Invested Capital (ROIC).

Other works, such as those of Barney (1991), Dyer et al. (1998), Stewart (1999; 2003) and Joia (2000), among others, associate the intangibles of a company with its competitive advantage and business strategy. There are also studies that show intangible assets as important resources and associate them with Resource Based View (RBV) (BARNEY, 1991). However, there are still gaps in the knowledge about the relationship of intangible assets and the value of the company.

For Dusanjh et al. (2009), intangible assets represent a technology owned by companies, impacting financial and economic performance in the form of skills, administrative practices, and staff training. Intangible assets influence the market value of companies and can modify their capital structure and cash generation capacity, as well as adding value (DAMODARAN, 2006; ROSS et al., 2016). However, the question lies on the impact of intangible assets on financial performance and how they influence the company's market value.

The direction given by intangibles today is so relevant that Hand et al. (2003) and Lev (2004) state

that more traditional physical assets have become commodities because of the ease of obtaining the other companies and competitors, whereas intangibles are obtained by productivity, better profit margins, innovative products and processes.

Hand et al. (2003) attribute to intangible assets a macroeconomic role. These assets influence the variation of growth and cyclical trends of economy. In this manner, Gu et al. (2011) proposes a method to estimate the value of intangible assets that are not recorded in the company's balance sheet. The methodology is based on the economic concept of "production function", where the value of the intangible asset is estimated by subtracting the normal returns on physical and financial assets. The economic performance of the company is generated by physical, financial and intangible assets.

In this study, by using the methodology proposed by Gu et al. (2011) in order to homogenize different types of physical assets, the average inflation rate of the House Price Index was subtracted, obtaining the real percentage of real estate valuation used as a proxy for the calculation of physical assets. According to Edvinsson et al. (2007), in Germany the intellectual capital is so appreciated, interesting, valuableand in evidence that the German Federal Ministry of Labour and Economics became interested and decided to support programms on this business sector across political borders to develop the theme of knowledge management in Germany.

For the calculation of financial assets, in order to homogenize different types of financial assets and different risks, the Euribor average and the country risk of Germany by means of the Credit Defaut Swap - CDS were used as proxy. Sensitivity tests were performed in relation to the Ebitda weighing parameters and to the IDE growth rate proposed in Gu e Lev methodology (2011). By analyzing the econometric properties of the intensity of credit events, Pan and Singleton's (2008) studies demonstrate strong empirical evidence that, in CDS spreads, there is a risk premium associated with future changes in the intensity of credit events.

In this manner, the present study intends to answer the following research problem: What is the impact of intangible assets on the creation of value in Germany public companies? I order to do so, it is structured into (1) Introduction, (2) Theoretical Framework, (3) Methodology, (4) Results and (5) Final considerations.

THEORETICAL REVIEW

Intangible Assets

"An intangible asset is an identifiable asset with no physical substance, saved to be used in the production or supply of goods or services, to be rented to others, or for administrative purposes" (GRÃ BRETANHA, 2001). For Wulf (2009), intangible assets, intangible, intellectual capital, intellectual property, assets based in knowledge are terms usually regarded as synonymous, and that despite intangible assets are not properly considered in their wholeness , they generate economic benefits to the company.

As for Intellectual Capital, it is a set of intangible elements resulting from technological innovations that generate economic benefits for the company (LIU et al., 2011). Lev (2004) understands that the investors

recognition of the intangible assets and their respective values generates a market valuation superior to the values of the equity of the company.

Halim (2010) divide the intellectual capital in three categories, being the human, structural, and relationship capitals. It's influenced by professional competence, social competence, employee motivation, leadership ability, corporate culture, internal cooperation and knowledge transfer, leadership instruments, information tecnology, product inovation, process optimisation, customer relationship, suplier relationship, public relationship, investor relationship and relationship to cooperation partners.

However to Choong (2008), the intellectual capital is categorized in four groups: human capital, organizational capital, relational capital and intellectual property; and the companies have a lack of report matters and results linked to intellectual capital. For Zéghal et al. (2010) the intangible capital has a positive impact on economic and financial performance of the companies, that's the reason the innovation and value creation have high attention of managers, investors, economic institutions, goverments, academics and professional market in general.

Wulf (2009) presents the intangible assets as generators of economic results, and their possession results in returns that sustain the competitive advantage of the company in relation to its competitors; and Lev (2004) considers them an entitlement to future benefits with no physical or financial body.

According to Wyatt (2005), intangible assets are difficult for company external individuals to observe and monitor, and consequently their accounting record falls short of market expectations as a result of generally accepted accounting principles. IAS 38 defines intangible assets as non-monetary, identifiable and non-physical assets. It is understood that, because they are defined as assets, intangibles are controlled by the entity and provide future economic benefits.

According to Damodaran (2006), intangible assets are not physical in nature and that affect the company cash flow performance, while Sole et al. (2009) state that intangible assets role in the creation of value can be analyzed by means of the cause and effect relationships that connect these assets to their strategic objectives; creation of value means firstly defining and offering conditions that satisfy a company's key interest groups.

For Sveiby (1997), intangible assets are invisible assets, and he proposes their division into (1) employee competencies, (2) internal structure and (3) external structure. Another classification of intangible assets is given by Stewart (2003), where he states that intellectual capital is the sum (1) of human capital, composed by people's talent, experience and knowledge, (2) structural capital, by means of patents, processes, internal standards, etc., and (3) customer capital, which corresponds to the customer portfolio, loyalty, etc.

Regarding Lev (2004), intangible assets can be classified according to their generating factors: (1) innovation, which is related to research and development activities; (2) unique organizational designs, composed by exclusive structures and systems including database, information technology, etc.; (3) human resources, which is formed by the knowledge, talent and skills of the company's employees.

According to the methodology of the Intangible Assets Management (IAM), by DOM Strategy

Partners, four categories of capital that constitute corporative Intangible Capital stand out: Institutional Capital - is the capital resulting from the set of assets that the company generate based upon positive perceptions and coordination processes of its brands, symbols, image and reputation.

Organizational Capital - is formed by the set of corporate guidelines that makes the company capable of producing value in a recurring and continuous way based on its core business, competitive strategy and market positioning, resulting from tools and practices such as business models, planning strategic, management models, corporate policies, process architecture, operational readiness, systemic learning capacity, knowledge management, information systems, productive technologies, innovation systems, productive flexibility, logistics intelligence, customer and media services, business models, and selection and recruitment, among others.

Intellectual Capital - is the capital constituted by the intellectual product generated internally by the company's employees, either in an individual scope or by the synergy of the group, generating as patents product, intellectual property, industrial property, copyrights, corporate culture, leadership, innovations, knowledge generation, corporate thesis, proprietary methodology, legal intelligence, and competitive intelligence, among others.

Relationship Capital - is the capital that comes from the relationship network that the company has in interaction with the various stakeholders, such as the loyalty level of the customer portfolio, the bargaining power of the company in the value chain, their partnerships and alliances, their ability to access markets, their ability to influence the press and interact with public power, and their interaction with the community and social networks, among others.

Gu and Lev Proposal

Gu et al. (2011) propose a method to estimate the value of intangible assets not recorded in the balance sheet of the company due to accounting conservatism and the need of the market in the real valuation of its assets. The methodology is based on the economic concept of "production function", where the value of the intangible asset is estimated by subtracting the normal returns on physical and financial assets. The economic performance of the company is generated by physical, financial and intangible assets.

According to Solow (1956; 1957), the economic concept of "production function is a basic principle of economics, derivate from the classical theory of growth in economics. It's related to the scarcity of available resources, counteracting the needs of man that are unlimited, comprising the physical relationship between the quantities used of a certain set of inputs and quantities. This concept can be applied to a product or service, a company, a sector of activity or even an entire economy.

Algebraically, the production function can be presented as follows:

$$Q = Q * (L, K) \quad (1)$$

On what,
Q = quantity of product produced
L = quantity of productive factors of labor
K = quantity of productive capital factors

Empirically the capital and labor alone are incapable of explain the value creation, there has been a search for factors that could be incorporated into the production function in order to exhaust the factors responsible for value creation. Thus, the intangible factor was incorporated into the model. It should be emphasized that the discussion begins to be conducted in the most appropriate way to measure the contribution of capital and labor, since the contribution of intangibles is the surplus after the deduction of the capital contribution and labor.

Gu et al. (2003; 2011) proposal is based on an expanded production function, which contained only the factors of production: capital and labor. The expanded production function considers intangibles as a production factor, generating the company's economic performance (DE), composed of physical, financial and intangible assets.

The equation proposed is:

$$Economic\ \ Performance = \alpha * Physical\ Assets + \beta * Financial\ Assets + \delta * Intangible\ Assets \quad (2)$$

Where α, β and δ represent the contributions of an asset unit to the company performance.

The value of intangible assets represents the contribution of intangible assets to the performance of the company, which has been called "Intangible-driven earnings" (IDE) (GU et al., 2003; 2011).

$$IDE = EP - \alpha * Physical\ Assets - \beta * Financial\ Assets \quad (3)$$

In order to calculate the contribution of the intangible assets, another five stages are proposed for the projection of the IDE and the calculation of the inventory of intangible assets.

Stage 1 – Economic Performance Calculation

For Gu et al. (2011), "normalized profits", taken as the average of 3 to 5 historic years of net income presented, and the same number of years for the projection of future profit. The authors noted that the measure based on historic data is strictly based on past earnings, so for a current projection, they would lose a significant proportion of the future economic benefit if they did not consider future investment in research and development (R& D) and staff training.

Basso et al. (2015) use Ebitda as a proxy for economic performance. In this study, a 13-year historic period of net profit is being used as "normalized profits", and 5 years for the projection years of future profit. The use of data from 1999 on was due to the use of Euro as a currency unit in the European common market. Thus, in this study, after a sensitivity test using Gu et al. (2011) proposal and a 6-year linear weighing method of 16.67%, the sensitivity of 0.85% in the IDE calculation is observed. In this manner, the weighing proposed by Gu et al. (2011) is used for calculations of the Ebitda data of the 6 subsequent years, respectively 4.76%; 9.52%; 14.29% 19.05%; 23.81% and 28.57% for each year.

Stage 2 – Calculation of Physical and Financial Assets

Poterba (1998) uses the real estate market data for the calculation of physical assets in the USA, while Nadiri et al. (1996) consider the factors of production and labor for the calculation of physical assets in

the USA, Korea and Japan. For this study, for the calculation of the physical assets, the House Price Index was considered, on an annual basis using Eurostat, which is the percentage of real estate valuation in Germany. The average for the period from 1999 to 2016 - the initial period of the use of the Euro as the single currency in the European Common Market - is calculated up to the most recent date in the database of the companies listed in this study.

In order to homogenize different types of physical assets, the average inflation rate of the House Price Index is subtracted, obtaining the real percentage of real estate valuation that was used as a proxy for the calculation of physical assets. For the calculation of financial assets, in order to homogenize different types of financial assets and different risks, the average of Euribor average and the country risk of Germany through the Credit Defaut Swap – CDS are used as a proxy.

Stage 3 – IDE Calculation

In this phase, the IDE for each year is calculated using the following equation :

$$IDE = EP - X\% * Physical\ Assets - Y\% * Financial\ Assets \quad (4)$$

The values of X are considered proxies for the average revaluation of physical assets, and Y are considered proxies for the average profitability of the financial assets, respectively -0.13% and 2.33%. As a limitation of this model, the historical cost of physical assets is used by the book value and not the replacement cost, tending to underestimate the EP and to overestimate the IDE, and consequently the Intangible Assets. The IDE calculation of the companies was the subtraction of the Economic Performance normalized from the Physical Assets by the proxy of the property valuation rate and the Financial Assets by the average percentage of the Euribor.

Stage 4 – IDE Calculation to 3 future periods

Finally, a series of IDEs are projected over three future periods based on a three-stage valuation model in which different values of economic growth are assumed. For the present study, in the first period, from 1 to 13 years, we used the IDEs calculated in the previous steps. In the second period, from 14 to 18 years, it was weighted up to a growth of 1.5%, and in the third period, from year 19 to infinity, after a sensitivity test, which was estimated a growth percentage of 0.5 % to 2.5%, IDE growth of 0.197% was recorded each period, so a steady growth rate of 1.5% per annum is used, according to estimates by the World Bank and the International Monetary Fund (IMF, 2017).

Then, given the value of economic performance and the values of physical and financial assets of the balance sheets of the company, the value of the intangible assets was given.

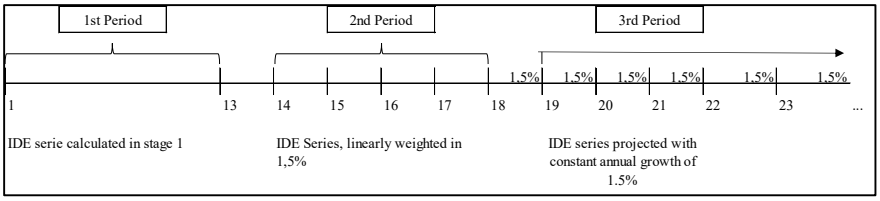

Figure 1: IDE series of three periods.

It was calculated the IDE of the company for the three periods. The second period is a projection in which IDE may converge linearly to an average growth of 1.5%, and the third period is a projection of steady growth of 1.5%.

Stage 5 – Determination of the Intangible Capital Stock

Based on the calculation of the projections of IDEs, the series were calculated, and then the present value of the future gains and the perpetuity were calculated and discounted by the rate of 1.5%, reflecting the degree of risk for the calculation of the intangible capital, which after adding the IDEs, results in the Intangible Capital Stock.

Gu et al. (2011) show that this approach may be useful for investors looking for information about the future performance of intangible assets. This can also be used to identify overvalued and undervalued stocks. This method allows a more objective measure of the IC, and derives its value from the gains of the company and other attributes found in a traditional balance sheet. However, the model also requires the profit forecast of companies to be available, which may not be readily available to companies in some markets. According to Basso et al. (2015), the calculation of the IC value is the present value of the IDE series.

METHODOLOGY

The present quantitative research is aimed to verify the impact of intangible assets on public companies in Germany by means of the methodology proposed by Gu et al. (2011). As a proposal to improve their methodology, the country risk variable is used in the calculation of financial assets by means of the CDS, and two sensitivity tests are performed. In the Ebitda weighing for the calculation of the IDE that was observed an elasticity of the calculation of 0.85% between the use of the linear Ebitda weighing method and the method proposed by Gu et al. (2011) because the elasticity of the result of the sensitivity test is irrelevant, this study was performed using the Ebitda weighing proposed by Gu et al. (2011); and the other sensitivity test the percentage growth for the calculation of IDE in the three future periods, the World Bank and the International Monetary Fund (IMF, 2017) provides an estimate growth rate of 1.5%, thus for the performance of the sensitivity tests was considered a growth rate of 0.5%; 1.0%; 1.5%, 2.0% and 2.5%; after conducting the Growth Rate Sensitivity Test for the calculation of the FDI of all the companies in this study, there was a 0.197% for each 0.5% increase in the Growth Rate. After the sensitivity test and its result, it was decided to consider the 1,5% growth rate as forecasted by IMF.

This analysis is applied to a sample of companies whose data are obtained from 1999 to 2016. The database is the Capital IQ, and the econometric software is Stata-15, and the final sample of the survey is composed of 523 companies. To answer the research problem of this project, we used the hypotheses based on the proposal by Gu et al. (2011).

H1. The higher is the investment in research and development (R&D), capital expenditure (CAPEX) and sales, general and administrative expenses (SGA), the higher is the Intangible-Driven-Earnings (IDE) of the companies.

$$\mathrm{IDE_{it}} = \beta_{oi} + \beta_1 \mathrm{RD_{it-1}} + \beta_2 \mathrm{CAPEX_{it-1}} + \beta_3 \mathrm{SGA_{it-1}} + \varepsilon_{it-1} \quad (5)$$

H2. The higher is the investment in research and development (R&D), capital expenditure (CAPEX) and sales, general and administrative expenses (SGA), the higher is the Intangible Capital (IC) of companies.

$$\mathrm{IC_{it}} = \beta_{oi} + \beta_1 \mathrm{PD_{it-1}} + \beta_2 \mathrm{CAPEX_{it-1}} + \beta_3 \mathrm{SGA_{it-1}} + \varepsilon_{it-1} \quad (6)$$

H3. The higher is the degree of intangibility (IDE), the operational performance and its variation (EARN), the higher is the total return to the shareholder (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 IDE_{it-1} + \beta_2 \Delta IDE_{it-1} + \beta_3 EARN_{it-1} + \beta_4 \Delta EARN_{it-1} + \varepsilon_{it-1} \quad (7)$$

H4. The higher is the Comprehensive Value (CV), the higher is the market value (MV).

$$MV_{it} = \beta_{oi} + \beta_1 CV_{it-1} + \varepsilon_{it-1} \quad (8)$$

H5. The higher is the Intangible Capital Margin (ICM), the higher is the total shareholder return (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 ICM_{it-1} + \varepsilon_{it-1} \quad (9)$$

H6. The higher is the Margin of Intangible Gain (IDEM), the higher is the total shareholder return (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 IDEM_{it-1} + \varepsilon_{it-1} \quad (10)$$

H7. The higher is the Operational Intangible Capital Margin (ICOM), the higher is the total shareholder return (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 ICOM_{it-1} + \varepsilon_{it-1} \quad (11)$$

H8. The higher is the ratio between Intangible Capital and Book Value (ICBV), the higher is the total shareholder return (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 ICOBV_{it-1} + \varepsilon_{it-1} \quad (12)$$

H9. The higher is the ratio between Market Value and Comprehensive Value (MtCV), the higher is the total shareholder return (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 MtCV_{it-1} + \varepsilon_{it-1} \quad (13)$$

H10. The higher is the return on investment in research and development (IR), the higher is the total shareholder return (TSR).

$$TSR_{it} = \beta_{oi} + \beta_1 RI_{it-1} + \varepsilon_{it-1} \quad (14)$$

Search variables

Table 1 presents the search variables extracted from the Capital IQ database, as well as their respective acronyms, description and code in the database.

Table 1: List of search variables and code in the database.

Acronym	Code	Capital IQ
PPE	IQ_NPPE	Property, Plant and Equipment
FA	IQ_CASH_EQUIV	Cash and equivalents
CAPEX	IQ_CAPEX	Capital expenditure
DPS	IQ_TOTAL_DIV_PAID_CF	Dividends per share
EBITDA	IQ_EBITDA	Earnings before interest, taxes, depreciation and amortization
OP	IQ_OPER_INC	Operating Income
EQ	IQ_TOTAL_EQUITY	Equity
LSP	IQ_LASTSALEPRICE	Market price - Year End
SO	IQ_SHARESOUTSTANDING	Stock number
RD	IQ_RD_EXP	Research and development
SGA	IQ_SGA	Selling, General and administrative
TA	IQ_TOTAL_ASSETS	Total Assets
TL	IQ_TOTAL_LIAB_EQUITY	Total Liabilities
REV	IQ_TOTAL_REV	Revenue

Construction of variables

Table 2: List of database variables and Intangibility Indicators.

Variable	Variable description	Variable calculation
PPE	Properties, Plants and Equipment	Extracted Capital IQ
CASH	Represents cash and cash equivalents	Extracted Capital IQ
EBITDA	Earnings before interests, taxes, depreciation and amortization	Extracted Capital IQ
P&D	Research and development expenses	Extracted Capital IQ
CAPEX	Capital Expenditure: represents expenses with acquisition and investment in fixed assets	Extracted Capital IQ
CV	Comprehensive Value: value related to the difference in value of tangible and intangible assets between book value and market value	CV = IC + Book value
MV	Market value of shares	MV = QA * PFA
EARN	EBITDA variation	EARN = Ebitda n – Ebitda n-1
IDE	Intangible Drive Earnings: a variable defined by Gu & Lev (2003, 2011) for measuring the degree of intangibility of the company. The variable is based on the economic performance of the company, on the physical and financial assets.	$IDE = EP - \alpha * Physical\ Assets - \beta * Financial\ Assets$
IC	Intangible Capital: intangible capital calculated by Gu & Lev (2003, 2011)	IC = present value of the IDE series
SGA	Selling, General and Administrative Expenses: represents the expenses not attributed to the production process, but related to sales and general and administrative expenses	Extracted Capital IQ
TSR	Total Shareholder Return: represents the financial value created for the shareholder over time	TSR = ((final share price − Initial share price)/initial share price) + dividends. Share price and dividends
ICM	Intangible Capital Margin: Index of intangibility created by Lev (1999) and Gu & Lev (2003)	ICM = IC/ Sales
ICOM	Intangible Capital Operating Margin: index of intangibility created by Lev (1999) and Gu & Lev (2003)	ICOM = IDE / Operating Income
RI	Return on Investment of R & D: an index of intangibility created by Lev (1999) and Gu & Lev (2003)	RI = IC / R&D
MtCV	Market to Comprehensive Value: approximate value and indicator of the importance of the intangible and the proximity of the indicator to the market value. index of intangibility created by Lev (1999) and Gu & Lev (2003)	MtCV = Market Value/ IC
ICBV	Intangible Capital to Book Value: indicate how much of the company is based on intangible assets. Index of intangibility created by Lev (1999) and Gu & Lev (2003)	ICVB = IC/ Book value
IDEM	Intangible Gain Capital Margin: Margin of Intangible Gains. Index of intangibility created by Lev (1999) and Gu & Lev (2003)	IDEM = IDE/ Sales

According to Basso et al. (2015), with the purpose of analyzing the intangibility of the companies

based on conventional measures, the following variables were used and constructed indicating intangibility, according to table 2.

RESULTS AND DISCUSSION

After the econometric tests, the descriptive statistics and the correlation matrix are verified as a result, according to tables 3 and 4, and the summary of the results are shown as table 5.

Table 3: Descriptive statistics.

Hypothesis	Variable	Obs.	Mean	Std. deviation	Min.	Max.	Nº of Companies
1	IDE	7019	521,49	2207,34	-1260,50	26838,65	523
	RD	1571	313,00	965,53	-12,23	7660,44	135
	CAPEX	6427	296,24	1596,87	-64,20	33276,47	507
	SGA	6296	663,04	2517,48	-16,01	34480,48	507
2	IC	7019	35462,72	150074,80	-85735,44	1816082,00	523
	RD	1571	313,00	965,53	-12,23	7660,44	135
	CAPEX	6427	296,24	1596,87	-64,20	33276,47	507
	SGA	6296	663,04	2517,48	-16,01	34480,48	507
3	TSR	5760	2,58	15,11	-1,00	409,76	468
	IDE	7019	521,49	2207,34	-1260,50	26838,65	523
	EARN	6932	477,84	2094,10	-14679,54	28192,05	520
4	MV	5842	3109,92	11614,20	-74266,55	159947,90	489
	CV	7019	40885,02	173247,30	0,17	2248608,00	523
5	TSR	5760	2,58	15,11	-1,00	409,76	468
	ICM	7016	-484,78	33435,95	-2792747,00	52337,75	523
6	TSR	5760	2,58	15,11	-1,00	409,76	468
	IDEM	7016	-7,13	491,59	-41059,49	769,02	523
7	TSR	5760	2,58	15,11	-1,00	409,76	468
	ICOM	7016	1,42	19,89	-523,10	779,43	523
8	TSR	5760	2,58	15,11	-1,00	409,76	468
	ICVB	6939	7,05	23,07	-209,65	904,54	523
9	TSR	5760	2,58	15,11	-1,00	409,76	468
	MtCV	5830	0,10	2,37	-78,38	92,30	489
10	TSR	5760	2,58	15,11	-1,00	409,76	468
	RI	1571	523,84	4839,78	-86166,98	114209,10	135

The Unit Root Test was not considered as a stationary data assumption in order not to lose a degree of freedom, since the series is short. Due to the missing data the non-balanced panel, there are different numbers of companies in the independent variables. As a result of the database being composed of all public traded companies in Germany, regardless of sector and size, a high standard deviation of the variables can be verified.

There are negative values of dependent and independent variables verified in the negative Ebitda database, reflecting losses over time for part of the companies in the study period. It was consider a lag of 1 period on Independent Variables in relation to the Dependent Variable, reflecting the action and influence of them in post-generate periods.

In hypothesis 1 and 2, respectively, IDE and IC were highly correlated with SGA and RD; and in hypothesis 4 MV with CV. For each hypothesis, (1) Chow Test or F-Test was performed in order to verify the best model between Polled and the Fixed Effects model, after the (2) LM Breuch-Pagam Test in order to verify the best model between the Polled and the Random Effects model and finally the (3) Hausman Test in order to verify the best model between Fixed Effects and Random Effects.

For the hypothesis 1, 2, and 3 the econometric tests indicated the use of the panel with Fixed Effects model, and for Hypotheses 4, 5, 6, 7, 8, 9 and 10 the tests indicated the use of the panel with Random Effects model. For all hypotheses, (4) Wald test was performed, indicating the presence of heteroskedasticity, and (5) Wooldridge test indicating the presence of correlated data.

According to the use of Fixed or Random Effect of each panel, tests were performed to correct the residues with Heteroskedasticity and Auto-correlated data. In hypotheses 1, 2 and 3 by R^2 Overall, it was checked a good explanation of the Independent Variables on the Dependent Variable, however, on the hypotheses 4, to 10, there was a low explanation of Independent Variables by the Independent Variable. The F-Tests results indicated a significance level to the hypothesis 1 to 6 and 10, however, the hypothesis 7, 8 and 9 showed no significance.

Table 4: Correlation matrix.

Hypothesis 1	**IDE**	**PD**	**CAPEX**	**SGA**
IDE	1,000			
RD	0,873	1,000		
CAPEX	0,652	0,682	1,000	
SGA	0,904	0,924	0,646	1,000
Hypothesis 2	**IC**	**RD**	**CAPEX**	**SGA**
IC	1,000			
RD	0,873	1,000		
CAPEX	0,653	0,682	1,000	
SGA	0,904	0,924	0,646	1,000
Hypothesis 3	**TSR**	**IDE**	**EARN**	
TSR	1,000			
IDE	0,609	1,000		
EARN	0,643	0,907	1,000	
Hypothesis 4	**MV**	**CV**		
MV	1,000			
CV	0,846	1,000		
Hypothesis 5	**TSR**	**ICM**		
TSR	1,000			
ICM	0,003	1,000		
Hypothesis 6	**TSR**	**IDEM**		
TSR	1,000			
IDEM	0,017	1,000		
Hypothesis 7	**TSR**	**ICOM**		
TSR	1,000			
ICOM	0,017	1,000		
Hypothesis 8	**TSR**	**ICVB**		
TSR	1,000			
ICVB	0,023	1,000		
Hypothesis 9	**TSR**	**MtCV**		
TSR	1,000			
MtCV	0,023	1,000		
Hypothesis 10	**TSR**	**RI**		
TSR	1,000			
RI	-0,070	1,000		

Table 5: Summary of results

Model	**Hypothesis 1**	**Hypothesis 2**	**Hypothesis 3**	**Hypothesis 4**	**Hypothesis 5**	**Hypothesis 6**	**Hypothesis 7**	**Hypothesis 8**	**Hypothesis 9**	**Hypothesis 10**
Dependent Variable	**IDE**	**IC**	**TSR**	**MV**	**TSR**	**TSR**	**TSR**	**TSR**	**TSR**	**TSR**
Constant	449,9479**	31003,93*	2,668042*	30214,89*	2,178187*	2,178187*	2,17162*	2,196553*	2,187602*	2,517624*
RD	0,7854413**	52,85705**	-	-	-	-	-	-	-	-
CAPEX	-0,1375683**	-9,107694**	-	-	-	-	-	-	-	-
SGA	0,3542757*	23,76815**	-	-	-	-	-	-	-	-
IDE	-	-	-0,0027413*	-	-	-	-	-	-	-
EARN	-	-	0,0028962*	-	-	-	-	-	-	-
CV	-	-	-	5,565787*	-	-	-	-	-	-
MV	-	-	-	-	-	-	-	-	-	-
ICM	-	-	-	-	0,000000499*	-	-	-	-	-
IDEM	-	-	-	-	-	0,000034*	-	-	-	-
ICOM	-	-	-	-	-	-	0,0048184	-	-	-
ICBV	-	-	-	-	-	-	-	-0,0021037	-	-
MtCV	-	-	-	-	-	-	-	-	0,0011184	-
RI	-	-	-	-	-	-	-	-	-	0,00000372**
Chow Test| F Test	41,6*	41,9*	10,92*	65,45*	25,13*	25,13*	25,13*	24,9*	24,55*	56,68*
Breusch-Pagan	5817,15*	5824,65*	7494,5*	23749,64*	23935,44*	23935,44*	23934,44*	23852,42*	23863,81*	9426,78*
Hausman	133,41*	141,93*	278,938	-1311,95*	4,00E-02	0,040	0,930	2,050	0,060	1,20E-01
R^2 / Within	0,4297	0,4250	0,0564	0,3732	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
R^2 / Between	0,8365	0,8373	0,0002	0,8358	0,0001	0,0001	0,0010	0,0038	0,0002	0,0009
R^2/ Overall	0,8296	0,8301	0,0169	0,7477	0,0000	0,0000	0,0001	0,0004	0,0000	0,0000
Heterodedasticity	7,8E+38*	8,3E+36*	4,4E+38*	1,9E+41*	31288,88*	31288,88*	31289,47*	31226,47*	30575,31*	4818,93*
Autocorrelation	429,629*	433,98*	6,877**	38,671*	6,943**	6,943**	6,931**	6,878**	6,878**	10,677**
Model Statistics	11,41*	11,36*	3,40**	3186,70*	203,20*	202,07*	0,94	0,68	0,09	5,50**
Observations	1550	1550	5712	5842	5760	5760	5760	5710	5610	1376

*Significance at the level of 1% **Significance at the level of 5% ***Significance at the level of 10%.

CONCLUSONS

The present paper is aimed to verify the relation of the impact of intangible assets, macroeconomic environment and market value of public companies in Germany, according to the model proposed by Gu et al. (2011) by means of the IDE and IC. In order to do so, it was used a sample composed of 523 companies whose data are obtained in the Capital IQ database from 1999 to 2016. These companies are analyzed by means of a regression model with panel data.

As a result, there is evidence of a positive relationship between Ebitda and intangible assets, their contribution to market value and partially the creation of shareholder value. Investment in Research and Development and sales and administrative expenses contribute to the increase of IDE and IC, and the increase in CAPEX contributes to the reduction of IDE and IC; which in turn compose the calculation of the IDEM and RI that contribute with a positive relation for the total shareholder return over time (TSR); on the other hand, ICOM, ICBV and MtCV were checked, with no significance in the statics model to TSR. The Comprehensive Value, or CV, is an indicator of total company value measured by intangible capital and book value is related to the company's Market Value, MV.

Although randomized, data cannot be generalized, so it is suggested, as an evolution of these analyzes, a study carried out with companies (1) from other countries in order to compare the results obtained; (2) segment companies by sector; (3) segment companies by size of billing; (4) segment companies between tangible-intensive and intangible-intensive; and (5) use of other value measures such as net income, changes in research and development investment, and marketing, training and other income statement intangible capital.

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