University of Brasília (UnB)

Faculty of Economics, Administration, Accounting and Public Policy Management (FACE)

Department of Accountancy and Actuarial Science (CCA)

Postgraduate Accounting Programme (PPGCont)

KLEBER VASCONCELLOS DE OLIVEIRA

THE NATURE OF ACCOUNTING GOODWILL: AN INTERDISCIPLINARY THEORETICAL–EMPIRICAL APPROACH

Brasília/DF

2022

Professor Dr. Márcia Abrahão Moura
Rector of the University of Brasília

Professor Dr. Enrique Huelva Unternbäumen
Vice-Rector of the University of Brasília

Professor Dr. Lúcio Remuzat Rennó Junior
Dean of Research and Graduate Studies

Professor Dr. José Márcio Carvalho
Director of the Faculty of Economics, Administration, Accounting and Public Policy Management

Professor Dr. Sérgio Ricardo Miranda Nazaré
Head of the Department of Accountancy and Actuarial Sciences

Professor Dr. Jorge Katsumi Niyama
Coordinator, Postgraduate Accounting Programme

KLEBER VASCONCELLOS DE OLIVEIRA

THE NATURE OF ACCOUNTING GOODWILL: AN INTERDISCIPLINARY THEORETICAL–EMPIRICAL APPROACH

> Thesis submitted to the examination committee of the postgraduate accounting programme of the University of Brasília in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Accounting.

> Brasília/DF, August 12th, 2022

EXAMINATION COMMITTEE:

———————————————————————

Prof. Dr. Paulo Roberto Barbosa Lustosa
University of Brasília – UnB
Committee Chair

———————————————————————

Prof. Dr. Carla Manuela Teixeira de Carvalho
University of Aveiro – UA
Committee External Member

———————————————————————

Prof. Dr. Eliseu Martins
University of São Paulo – USP
Committee External Member

———————————————————————

Prof. Dr. Jorge Katsumi Niyama
University of Brasília – UnB
Committee Internal Member

———————————————————————

Prof. Dr. José Alves Dantas
University of Brasília – UnB
Substitute Committee Member

To my father and my grandfather on my mother's side (in memoriam).

ACKNOWLEDGEMENTS

...porque não somos só intuição;
nem só pé-de-chinelo, pé no chão.
Nós temos violência e perversão;
mas temos o talento e a invenção.

Desejos de beleza em profusão;
idéias na cabeça, coração.
A singeleza e a sofisticação;
o choro, a bossa, o samba e o violão.

Mas, se nós temos planos, e eles são
o fim da fome e da difamação;
por que não pô-los logo em ação?
tal seja agora a inauguração
da nova nossa civilização,
tão singular igual ao nosso pão;
e sejam belos, livres, luminosos
os nossos sonhos de nação.

Ecos do ão
Lenine

KLEBER VASCONCELLOS DE OLIVEIRA

THE NATURE OF ACCOUNTING GOODWILL: AN INTERDISCIPLINARY
THEORETICAL–EMPIRICAL APPROACH

Thesis submitted to the postgraduate accounting programme, department of accountancy and actuarial science, faculty of economics, administration, accounting and public policy management, University of Brasília.

adviser: Prof. Dr. Paulo Roberto Barbosa Lustosa.

Concentration Area: Accounting Measurement.

Research Line: Accounting impacts on the public sector, organisations and society.

Brasília

2022

Abstract

This dissertation focuses on the nature of accounting goodwill. Through a tetralogy of studies, I propose an alternative approach to the nature of goodwill, which considers an onto-epistemological inseparability between goodwill (intangible capital) and a firm's physical capital. I call this the "entanglement effect". It takes place through the "intra-action" between intangible capital and physical capital. My proposal is derived from concepts used in quantum physics, economics and psychology. I dialogue with these fields of knowledge to propose the nature of goodwill as being a set of forces (value drivers) acting in entanglement with other assets to create value for organisations. This set of forces does not exist either physically or economically separate from physical capital. In the first study, I rely on psychology-based factors to address the issue of failures in business combinations. In addition, I provide empirical evidence that suggests that only 15% of the goodwill reported by firms represents economic substance (core goodwill). The second essay is a theory-building exercise in which I provide a theoretical underpinning to the nature of goodwill. I dialogue with quantum physics and economics to explain the formation of economic residuals giving rise to goodwill (badwill). I hold that such residuals are generated by each managerial decision that occurs in the company's daily life. In particular, I explore concepts from quantum theory and agential realism such as entanglement, intra-action and diffraction, and interrelate them with accounting goodwill. In the third manuscript, I empirically test the entanglement effect. Using an unbalanced panel with 161,966 firm-year observations from 1980 to 2020, covering 67 countries and encompassing ten sectors of the economy, I find that the entanglement effect has a statistically significant association with firms' value creation. As the sample in the third essay has no available data for financial institutions, I then build the fourth article by testing the entanglement effect in the banking industry. The sample comprises 28,161 bank-year observations from 2002 to 2020, covering 122 countries. I also

find that the entanglement effect has a statistically significant relationship with banks' value creation. I conclude that the entanglement effect represents the very nature of goodwill and that it is a real force in organisations, regardless of industry. The findings of this thesis may be of particular importance for scholars, standard-setters, investors and regulators.

Keywords: Goodwill. Agential Realism. Quantum Physics. Psychology. Quantum Social Science. Entanglement Effect.

Resumo

O âmago desta tese é a natureza do goodwill. Por meio de uma tetralogia de estudos, proponho uma abordagem alternativa para a natureza do goodwill, que considera uma inseparabilidade onto-epistemológica entre o goodwill (capital intangível) e o capital físico da empresa. Eu chamo isso de "efeito emaranhamento". Ele ocorre por meio da "intra-ação" entre o capital intangível e o capital físico. Minha proposta é derivada de conceitos usados na física quântica, economia e psicologia. Eu dialogo com esses campos do conhecimento para propor a natureza do goodwill como sendo um conjunto de forças (*drivers* de valor) atuando emaranhadamente com outros ativos, a fim de criar valor para as organizações. Esse conjunto de forças não existe física ou economicamente separado do capital físico. No primeiro estudo, eu me baseio em conceitos da psicologia para abordar a questão dos fracassos que ocorrem nos processos de combinações de negócios. Adicionalmente, forneço evidências empíricas que sugerem que apenas 15% do goodwill relatado pelas empresas representa substância econômica (núcleo do goodwill). O segundo ensaio é um exercício de construção de teoria no qual eu forneço uma base teórica para explicar a natureza do goodwill. Eu dialogo com a física quântica e a economia para explicar a formação dos resíduos econômicos que dão origem ao goodwill (badwill). Considero que tais resíduos se originam em cada decisão gerencial que ocorre no cotidiano da firma. Em particular, eu exploro conceitos da teoria quântica e do realismo agencial, como emaranhamento, intra-ação e difração, e os relaciono com o goodwill. No terceiro manuscrito, eu testo empiricamente o efeito emaranhamento. Usando um painel desbalanceado com 161.966 observações empresa-ano de 1980 a 2020, abrangendo 67 países e dez setores da economia, eu descubro que o efeito emaranhamento tem uma associação estatisticamente significativa com a geração de valor das empresas. Uma vez que que a amostra do terceiro estudo não possui dados disponíveis para as instituições financeiras, eu construo o quarto artigo a fim de testar o efeito emaranhamento

especificamente no setor bancário. A amostra compreende 28.161 observações banco-ano de 2002 a 2020, abrangendo 122 países. Eu descubro que o efeito emaranhamento também possui uma relação estatisticamente significativa com a geração de valor dos bancos. Concluo, portanto, que o efeito emaranhamento representa a própria natureza do goodwill e que é uma força real nas organizações, independentemente do setor da economia. As descobertas desta tese podem ser de especial importância para acadêmicos, normatizadores, investidores e reguladores.

Palavras-chave: Goodwill. Realismo Agencial. Física Quântica. Psicologia. Ciência Social Quântica. Efeito Emaranhamento

Table of Contents

List of Tables

List of Abbreviations and Acronyms

ASC	Accounting Standards Codification
BANKMA	Bank Managerial Ability
BvD	Bureau Van Dijk
CAMELS	Capital, Assets, Management, Earnings, Liquidity and Sensitivity to Market Risk
CCM	CRSP/Compustat Merged Database
CEO	Chief Executive Officer
COGBIAS	Cognitive Biases Score
CR5	Concentration Rate of the Top Five Largest Banks
CRSP	Center for Research in Security Prices
DEA	Data Envelopment Analysis
DMU	Decision-Making Unit
ENTANG	Entanglement Effect
FASB	Financial Accounting Standards Board
FVM	Fair Value Measurement
GAAP	Generally Accepted Accounting Principles
GDP	Gross Domestic Product
GECON	Economic Management Information System
GICS	Global Industry Classification Standard
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IQ	Intelligence Quotient
MASCORE	Managerial Ability Score
M&A	Mergers and Acquisitions
NASDAQ	National Association of Securities Dealers Automated Quotations
PPE	Property, Plant, and Equipment
RESID	Residual Goodwill
RIV	Residual Income Valuation
ROA	Return on Assets
RQ	Research Quotient
R&D	Research and Development
SBM	Slacks-Based Measure
SFAS	Statements of Financial Accounting Standards
SIFI	Systemically Important Financial Institution

S&P 500   Standard and Poor's 500

VIF   Variation Inflation Factor

WRDS   Wharton Research Database Services

1. Introduction

In this chapter I contextualise the thesis, introducing the background that supported my proposal. In addition, I address the research problem, the general and specific objectives, and the reasons that justify my choice of topic. I also indicate in this chapter the research contributions. Finally, I explain the structure of the dissertation.

1.1. Contextualisation

The only consensus when we talk about the nature of accounting goodwill is that there is no consensus. Undoubtedly, goodwill is one of the most controversial and debated topics in accounting; we need only look at the number of standards and other documents issued throughout its normative lifetime (from Accounting Research Bulletin – ARB no. 24 in 1944 in the USA to the present day). Perhaps this scenario reflects a certain instability permeating the subject and, above all, the difficulty of finding an adequate and definitive accounting practice.

Let us examine this. Regarding the initial recognition of goodwill, it was previously treated as an immediate (or rapid) expensing, a write-off against shareholders' equity (or reserves) and is currently treated as an asset. In relation to its subsequent measurement, it was amortised over a period not exceeding 40 years (depending on the country, this could be 5, 10 or 20 years). Afterwards, both amortisation and impairment approaches began to coexist in the regulatory world. Today, the impairment-only approach is the rule. Notwithstanding, some countries have returned to systematic amortisation (in the case of small and medium-sized enterprises). Despite this endless back and forth, the main standard-setters are still debating the subject and considering the possibility of changes to current regulations.

Understanding the very essence of goodwill may be the cornerstone of an issue that has intrigued the accounting community for decades. Deepening the debates and research on the nature of goodwill can be the first step towards the accounting community reaching a

consensus on the topic. This is the purpose of this thesis: to propose an alternative approach to the nature of goodwill. As stated by Canning (1929, p. 44), "the analysis of the nature of things is a problem apart from the quantitative measurement of the same things, and must, in any sound statistical inquiry, or in any critical analysis of a statistical procedure, be dealt with first".

As there are already studies addressing the nature of goodwill, this task was quite challenging. I needed to look for an approach that could bring new contributions to the literature. To overcome this challenge, I sought support in other areas of knowledge, such as quantum physics, economics and psychology. At first glance, the use of quantum physics may seem somewhat strange, but it is important to emphasise that quantum theory is increasingly being used as a means of helping to explain socio-economic phenomena. Nonetheless, for my proposal to gain force, I needed to provide not only a robust theoretical framework, but also empirical evidence indicating that financial data reflects my proposal.

Quantum physics is the branch of physics that studies nature on a microscopic scale, invisible to the naked eye. In this microscopic universe, the laws of classical physics do not apply. In other words, quantum physics refers to the phenomena and characteristics of atomic and subatomic systems which cannot be explained by Newtonian physics (Schleich et al., 2016). Interestingly, these phenomena are part of humans' daily lives. French and Taylor (1978) assert that, although the microscopic world is remote from our senses, it shapes our everyday experience. Almost everything we see and touch "owes its character to the subtle architecture of atoms and molecules, an architecture whose building code is quantum mechanics" (preface. xi).

The main proposal of the thesis is to show that what accounting standards argue as the generator of residual earnings – goodwill – should be considered a driver of such residual earnings. I advocate the nature of goodwill as being a set of forces (value drivers) acting in a

state of "entanglement" with other assets to generate both normal and residual earnings. In fact, this set of forces does not exist either physically or economically separate from physical capital. By that, I mean that *goodwill alone* is not capable of creating abnormal earnings.

Underpinned by quantum theory, economics and general systems theory, I argue that there is a kind of intertwining or entanglement between intangible capital (goodwill) and the physical capital of organisations. This entanglement effect is the very nature of goodwill. It is this entangled relationship that generates both ordinary and abnormal profits. From this premise, I propose an onto-epistemological inseparability between physical capital and intangible capital.

In other words, I hold that intangible capital (goodwill) represents managerial decisions not yet implemented. It is latent potential wealth. It represents the present value of future economic residuals (positive or negative) that will arise in future asset exchanges. Thus, the total value of the firm as a going concern is made up of two dynamically entangled components: one physical – represented by managerial decisions already implemented, in the form of ideas, plans and strategies made material in the firm's assets and liabilities – and the other intangible. An economic measurement of these two wealth states would capture this entanglement effect, as both reflect the present value of expected future residual earnings.

To address my proposal, I take the following path. First of all, I discuss an issue that has been little explored in the accounting literature, which is the magnitude of failures in mergers and acquisitions (M&As). In fact, I start – and contextualise – the thesis with this issue. Studies have shown that fewer than half of M&As are successful. This suggests that most of the goodwill reported by companies may not be fulfilling its core role as an asset. Perhaps much of the controversy on the subject is due to the lack of perception by scholars and standard-setters of the portion of goodwill that really represents economic substance (core goodwill).

I consider it important not only to draw attention to this problem but also to understand the causes behind this phenomenon. I argue that the reason for such a high rate of failure may be related to psychological factors that permeate every decision-making process. Thus, I provide a theoretical framework that clarifies the formation of goodwill by considering the "human side" of M&A deals. In short, I explore a series of cognitive biases and link them to goodwill. I also conduct an empirical investigation to suggest, through numbers, that the human side has been superimposed on economic rationality. I present new evidence relating to core goodwill, indicating that it represents only 15% of reported goodwill. That's the ticket – core goodwill represents the smallest share of reported goodwill! Studies should take this into account.

After highlighting the problem observed in M&A processes, I discuss the nature of goodwill. I operate on two fronts. On the first, based on quantum mechanics, I provide a theoretical underpinning anchored in the entanglement between goodwill and the physical capital of organisations (the entanglement effect). One of the approaches taken in the field of quantum mechanics to which I draw attention is agential realism. I explore concepts from agential realism such as entanglement, intra-action and diffraction, and interrelate them with accounting goodwill. More specifically, I dialogue such concepts with others from economics to explain the formation of positive (negative) economic residuals that originate goodwill (badwill).

On the second front, I perform empirical tests looking into quantum entanglement. In short, I build a proxy for the entanglement effect by interacting a measure of intangible capital with a measure of physical capital. The measure I select for intangible capital is managerial ability. It was obtained from the database supporting the article by Demerjian, Lev and McVay (2012). However, this measure was built by the authors without data from financial institutions. For this reason, I perform an empirical analysis specifically for the

banking industry. In this case, I build a specific managerial ability score for banks and then interact this measure with a measure selected to represent banks' physical capital. An interesting point to highlight is that the sample mean of managerial ability score of non-financial firms is positive, while for the banking industry it is negative. This suggests that the physical capital of banks (e.g. deposits and financial instruments) plays, on average, an important role, which makes the role of managerial ability in this sector less dominant.

Consistent with theoretical concepts from quantum mechanics, the main findings depict that the entanglement effect is statistically significant for a series of tests performed regardless of the industry investigated. For example, entanglement is positively related to both firms' physical capital and the process of value creation. The findings suggest that the entanglement effect is a real force in organisations. I hold that such a positive association denotes that intangible capital (proxied by managerial ability) is renewed at a speed greater than its conversion into physical capital – that is, intangible capital is converted and is renewed for future conversions. This finding suggests that, on average, firms have an intangible capital that is in a permanent state of innovation, regardless of the sector. The approach I propose offers valuable insights that can help scholars, regulators and investors (I discuss this point in subsection 1.5 and in each of the articles that make up this thesis). Finally, it is worth noting that the findings remain robust for alternative measures for both intangible capital and the entanglement effect.

1.2. Research Problem

Both the prevalent literature and current accounting regulations have a widely agreed understanding that goodwill is an asset in isolation capable of generating residual income. On the contrary, though, I argue that the intangible elements that form goodwill do not have economic value just by virtue of "existing" in an organisation; that is, goodwill alone is not capable of creating value. This divergent position raises a research question about value

creation in organisations. Thus, the question that guides this thesis is **"how is goodwill able to create residual income?"** I maintain that to answer this question it is first necessary to discuss in depth the nature of goodwill.

1.3. General and Specific Objectives

The core objective of this thesis is to provide a new approach to the nature of goodwill. To reach this goal, I develop studies on the nature of accounting goodwill that encompass both a theoretical and an empirical approach. Each of these studies has specific objectives that, together, comprise my proposal.

The specific objective of the first essay is to show, from the outset, that a significant portion of reported goodwill does not represent economic substance. This could be one of the reasons why there is so much controversy on the subject. For example, some studies may be examining data representing core goodwill, while others are not. The objective of this article is also to show that financial data supports the M&A literature by empirically indicating that most M&A deals are unsuccessful.

The specific objective of the second study is to present a new conceptual approach to the nature of goodwill. To reach this objective, I develop an original interpretation that relates quantum theory to accounting. Based on the theory of agential realism, I propose the entanglement effect – an onto-epistemological inseparability between intangible capital and physical capital. This essay is the cornerstone of the thesis. I bring together concepts from quantum physics and economics to explain how the process of generating residual income occurs in organisations.

The objective of the third and fourth manuscripts is to provide empirical support for my proposal. I empirically test the entanglement effect by interacting intangible capital and physical capital. The third study uses a sample of firms encompassing ten industries.

However, due to the fact that data is not available, this sample excludes financial institutions. For this reason, I build the fourth study, which examines only banking.

1.4. Research Justification

The topic is quite contemporary, whether for scholars, preparers of financial statements or standard-setters. The International Accounting Standards Board (IASB) and Financial Accounting Standards Board (FASB) have been investigating possible improvements to goodwill accounting (Ferramosca & Allegrini, 2021). One of the concerns of the standard-setters probably has to do with the use of goodwill (impairment) as a form of manipulating earnings. Prior studies relate goodwill impairments with the practice of earnings management (Jordan & Clark, 2004; Beatty & Weber, 2006; Jahmani, Dowling & Torres, 2010; Li & Sloan, 2017). Furthermore, despite regulations, there is still no reasonably uniform global treatment. Martins (2020) states that heterogeneity in the accounting treatment of goodwill still persists in many countries to this day in individual balance sheets (since the International Financial Reporting Standards (IFRS) are, in most countries, applied only to consolidated financial statements). I argue that research that deepens the understanding of the topic can add valuable contributions and help standard-setters to find more suitable solutions.

In addition, scholars and regulators are far from reaching a consensus on the subject. The controversial nature of goodwill has been puzzling the accounting community for over a century (Baboukardos & Rimmel, 2014) and still remains in evidence (Wen & Moehrle, 2016; Rubio, Martínez & Mazón, 2020; Iatridis, Pappas & Walker, 2021). I believe that the difficulty of finding a definitive accounting practice for the treatment of goodwill reflects a deeper problem, which is the understanding of the very nature of goodwill. There are few studies addressing this issue. I consider this a knowledge gap that requires investigation. Perhaps for this reason, Garzella et al. (2020) claim that a univocal definition of the very nature of goodwill remains an open issue.

Finally, it is important to highlight the impact of goodwill on financial statements, which makes the discussion on the subject even more important. Goodwill is usually the primary asset in listed firms' balance sheets (Filip, Jeanjean & Paugam, 2015). Furthermore, M&As have become increasingly comprehensive and global phenomena. The data shows an increase not only in the number of deals but also in the volume of capital involved (Calipha, Tarba & Brock, 2010). The GIFT (Global Intangible Finance Tracker) report of 2019 shows that goodwill doubled in magnitude from $3 trillion in 2005 to $6 trillion in 2015, and that by 2019 that figure had reached $8.4 trillion. The same report also shows that disclosed goodwill continues to hover around 8% to 10% of a firm's total worth, and that undisclosed global intangible worth rose from $15 trillion in 2011 to $35 trillion in 2016 (Oliveira, Lustosa & Gonçalves, 2021).

1.5. Research Contributions

This thesis makes several contributions for scholars, regulators and investors. The first study contributes to the discussion about the share of goodwill that represents economic substance (core goodwill). Accounting information (reported goodwill) leads its users to consider the entire portion of goodwill as value-creating; however, the data suggests that this understanding may be wrong. As a consequence, the impairment-only method might not be effective in generating useful information for its users. The first article also contributes to the existing gap in the literature on studies relating cognitive biases with goodwill. In addition, the empirical analysis documents new findings about core goodwill that may be of special value to external users and regulators.

The second essay, by providing an alternative approach to the nature of goodwill, adds new knowledge to accounting not addressed in previous studies. The existing literature has suggested that accounting goodwill is made up of different components acting as a generator of residual earnings. Another stream of studies has suggested that intangible assets

need to be combined with other assets to create value. However, no previous study has examined a simultaneous or entangled relationship between physical assets and intangible capital as an explanatory factor of value creation.

The third article contributes to further studies that aim to examine an entangled relationship between intangible and physical assets. I am aware that I am only providing the very first empirical evidence of the entanglement effect. Notwithstanding, there is a contribution made by expanding the dialogue between accounting and quantum mechanics. The fourth study, by providing a complementary approach to measuring managerial ability in banking, contributes to the growing literature on this topic. Furthermore, it makes a contribution for regulators who use the CAMELS (capital, assets, management, earnings, liquidity and sensitivity to market risk) methodology to assess bank management.

Essays 2, 3 and 4 suggest that goodwill alone does not represent an asset that generates future economic benefits. This can be especially valuable for accounting standards and practice. Perhaps the best accounting practice in this context would be the one followed until recently in the United Kingdom (UK). The UK was influenced mainly by Dicksee (1897), Dicksee and Tillyard (1906) and Leake (1914), who did not consider goodwill as a recordable asset but rather as a reduction of the share premium (Cooper, 2007; Garcia, Katsuo & van Mourik, 2018). Finally, I consider that deepening the discussion into the nature of goodwill is an opportunity to expand knowledge on the subject, which is also a contribution.

1.6. Thesis Structure

This thesis is structured on a tetralogy of studies interconnected by a central pillar: the nature of goodwill. It should be highlighted that, during the research period, some essays that make up this thesis were presented at conferences in Brazil and abroad. One of them was

accepted for publication in a leading accounting journal. Thus, I call attention to the fact that some essays have received valuable contributions from reviewers, debaters and panellists.

After this introduction, the thesis moves on to the first article, which despite not directly addressing the nature of goodwill serves as a contextualisation as well as a background for the articles that follow. It is a theoretical–empirical article which addresses the issue of cognitive biases in the decision-making process and their relationship with goodwill. In this article, I dialogue with the psychology literature in order to explain the problem of failures in M&A deals. I discuss twelve cognitive biases with the aim of showing the strong influence of psychological factors in the decision-making process, especially regarding premium payment in acquisitions.

Still in the first article, I empirically examine the portion of reported goodwill that generates economic value. The main findings are: (i) on average, a firm's market value has a negative relationship with goodwill; (ii) firms with reported goodwill have lower returns than those without reported goodwill; (iii) more able managers, on average, carry out fewer M&A deals than less able managers; and (iv) only the portion of goodwill which is associated with more able managers – about 15% of reported goodwill – truly represents economic substance (core goodwill). It should be highlighted that this essay was presented at the 44th Annual Congress of the European Accounting Association (EAA), which took place in May 2022 in Bergen, Norway.

In the second essay I provide a new theoretical approach on the nature of goodwill. This is a theory-building exercise whose title refers to a famous quote by Albert Einstein about quantum physics. After reviewing concepts from agential realism, I develop a quantum interpretation for the accounting field and dialogue this approach with: (i) economic measurement theory, centred on the concept of opportunity cost (Coase, 1937; 1990); (ii)

general systems theory (von Bertalanffy, 1968; 1972); and (iii) the economic management information systems model (GECON).

I discuss quantum concepts such as entanglement, diffraction and intra-action to propose a physical and economic inseparability between goodwill and physical capital. I argue that intangible capital (goodwill) and physical capital are "entangled", and this entanglement forms a company's economic value. I conclude that the entanglement effect, through intra-action, is a form of wealth creation (or wealth destruction) in organisations. It should be highlighted that this theoretical essay was presented at the XV ANPCont congress, held virtually in December 2021. More importantly, it was recently accepted for publication in the *Accounting Forum* journal.

In the third manuscript, I empirically test the proposition of the entanglement effect. I build a proxy for entanglement by interacting a measure for physical capital with a measure for intangible capital. Since I hold that the nature of goodwill is directly related to the positive residuals of managerial decisions, the variable selected to represent intangible capital is managerial ability (Demerjian, Lev & McVay, 2012). The variable selected to represent physical capital is property, plant and equipment (fixed assets). The final sample totals an unbalanced panel with 161,966 firm-year observations from 1980 to 2020, covering 67 countries. The sample excludes financial institutions because the managerial ability database does not include such institutions.

After controlling for economic and country-year-fixed factors, I find a positive and statistically significant association between intangible capital and physical capital. I maintain that this positive relationship represents: (i) a conversion of intangible capital into physical capital; and (ii) the renewal of intangible capital for future conversions. After finding this relationship, I test the entanglement effect (entang). First, I find that entang is positive and statistically significant for firms' physical capital. I also find that changes in entang are

associated with changes in firms' physical capital. Then, I split the sample following the classification of the Global Industry Classification Standard (GICS). I find that entang is statistically significant for almost all sectors, with the exception of Communication Services. I call attention to the coefficients of the following sectors: (i) materials, (ii) health care, and (iii) information technology. Finally, I also find that entang is positively related to firms' market value and market return, suggesting that investors also incorporate the entanglement effect in their analysis. The findings remain robust for both sensitivity tests and alternative measurement methods, and suggest that the entanglement effect is a real force in organisations.

Finally, in the fourth study I empirically test the proposition of the entanglement effect in the banking industry. The approach is quite similar to the third article. As there is no managerial ability data available in the banking sector, I need to build such a measure. Based on data from the Orbis BankFocus database, I build a bank managerial ability (bankma) score following an approach similar to that adopted by Demerjian, Lev and McVay (2012). The final sample comprises 28,161 bank-year observations from 2002 to 2020, covering 122 countries.

In this article I interact bankma score with earning assets, which are assets that generate interest or dividends (since fixed assets are not sources of value creation in banks). Similar to the third article, I find a positive and statistically significant association between intangible capital (bankma) and physical capital, suggesting a conversion of bankma into physical capital in addition to its renewal (as bankma) for future conversions. Then, I test the entanglement effect and find a positive and statistically significant association with banks' physical capital. I also find that changes in entang are associated with changes in banks' physical capital. After that, I find that entang is positively related to banks' value creation and profitability. The findings suggest that the entanglement effect is also a real force in the

banking industry. Once again, the findings remain robust for both sensitivity tests and other measures of both bankma and entang.

In Chapter 6, I outline the concluding remarks of the thesis. I highlight the conclusions of the thesis, which encompass the main conclusions of each of the four articles. I also highlight some limitations of the thesis as well as pointing out suggestions for further research.

2.   Cognitive Biases in Accounting Goodwill: A Theoretical–Empirical Approach

2.1. Abstract

Studies show that fewer than half of M&As are successful, and understanding the causes behind this phenomenon is important for both future studies investigating goodwill and bodies seeking insight into its regulatory context. Using concepts borrowed from psychology, this theoretical–empirical article addresses the issue of cognitive biases in the decision-making process and their relationship to goodwill. This paper operates on two fronts: first, we provide a theoretical framework that clarifies the formation of goodwill by considering the "human side" of M&A deals; we discuss a number of cognitive biases and link them to goodwill. Second, we empirically examine the portion of reported goodwill that generates economic value. The key point is that a significant portion of accounting goodwill is overpayment – that is, the result of biased decisions by executives – and does not represent economic substance. The findings of our empirical investigation show that, on average, a firm's market value has a negative relationship with reported goodwill. Companies with reported goodwill have lower returns than those without reported goodwill. We also find that firms' reported goodwill is negatively related to managerial ability; that is, more able managers, on average, carry out fewer M&A deals than less able managers. More importantly, only the portion of goodwill which is associated with more able managers (the portion free – or with little influence – from cognitive biases) truly represents economic substance (core goodwill). Our findings suggest that this portion represents only 15% of the goodwill reported by companies.

2.2. Introduction

Mergers and acquisitions (M&As) have become increasingly comprehensive and global phenomena. However, the growth in M&As, the volume of capital involved, and their reach are in stark contrast to their high failure rate (Calipha, Tarba & Brock, 2010). For example, Moeller, Schlingemann and Stulz (2005) claim that, from 1998 through to 2001, US acquiring-firm shareholders lost about 12 cents around acquisition announcements per dollar spent on acquisitions, totalling a loss of $240 billion. In fact, studies show that fewer than 50 per cent of M&As are successful (Cartwright & Cooper, 1990; Cartwright & Cooper, 1993; Cartwright & Schoenberg, 2006; Calipha, Tarba & Brock, 2010). Marks and Mirvis (2000; 2001) maintain that three out of four mergers, acquisitions and alliances do not reach their financial and strategic objectives.

The context highlighted above raises some interesting questions: why are there so many cases of buyers paying values that do not represent any economic substance? Are these just misguided actions by decision makers? What is the impact of these biased decisions, which do not generate economic returns, on reported goodwill? These questions guide the present study, especially with regard to goodwill. "When a business combination results in an economic loss, accounting goodwill may have two components – the synergies that were paid for and the overpayment – with different predicted associations with future operating performance" (Yehuda, Vincent & Lys, 2017, p. 9). This theoretical–empirical article focuses on that second-named component of goodwill – or the sixth addressed by Johnson and Petrone (1998) – providing: (i) psychology-based arguments aimed at understanding the issue of overpayment; and (ii) empirical evidence that the portion of goodwill that is not related to economic returns seems to be the majority of goodwill reported by companies.

In fact, there is a dearth of research in the accounting literature into factors influencing failure in M&A deals. We explore this gap in the accounting literature by

presenting a conceptual framework that addresses psychological factors – especially

cognitive biases, such as outcome bias, anchoring bias, the bandwagon effect, projection bias

and the Dunning–Kruger effect – affecting the human side of an M&A agreement. Several

findings indicate that people systematically violate expected utility theory when making

decisions in uncertain conditions, thus showing their biases (Baron, 2008 p. 259). Biases in

judgement and in decision making have been called cognitive illusions (Kahneman & Riepe,

1998).

After presenting the theoretical basis of our proposal, we empirically examine the

influence of cognitive biases in companies with and without reported goodwill. The key point

is: if most M&A agreements fail to generate economic substance then, in practice, most

goodwill reported by companies is not "fulfilling its role as an asset" – that is, it is not

generating economic benefit (contrary to claims in the current accounting literature and

standards). In this regard, one can expect this situation to be captured by the market as well as

being reflected in the economic evolution of firms that present goodwill balances in their

financial statements.

Studies involving cognitive biases are based on non-positivist methodologies, with an

emphasis on experimental studies (e.g. Hammond, Keeney & Raiffa, 1998; Birnberg &

Ganguly, 2012; Lieder & Griffiths, 2020). This is because of the great difficulty in adopting

an empirical approach to examine the influence of behavioural biases on decision makers.

Considering this issue, our empirical strategy is to indirectly detect the influence of cognitive

biases through the actions of managers. To do this, we use public data on managerial ability

built into the study by Demerjian, Lev and McVay (2012)[1]. Our first assumption is that

highly skilled managers are less influenced by cognitive illusions.

---

[1] We are grateful to the authors for publicly sharing their database. Data are available at:
https://peterdemerjian.weebly.com/managerialability.html

There is no intention to empirically examine each of the twelve cognitive biases highlighted in our theoretical approach. Our objective is to capture the influence of such biases (in a broad way, which might mean the action of only one bias or that of several biases) through managerial ability scores associated with firms that have entered into a business combination (reported goodwill). Our second assumption is that the goodwill negatively related (or without a statistically significant relationship) to firms' market value and/or market return may have been influenced by behavioural biases.

To carry out our empirical investigation, we first merged the Compustat database with Demerjian, Lev and McVay's database. We obtained an unbalanced panel totalling 148,534 firm-year observations from 1988 to 2018, covering 62 countries. We then created a proxy of cognitive bias (cogbias), representing the interaction between accounting goodwill and the managerial ability score. We argue that more able managers are less influenced by cognitive biases and, therefore, add economic value when they decide to acquire other firms (and pay a premium for the acquisition).

We found that firms' market value and market return are negatively related to goodwill. Firms with reported goodwill have lower returns than those with no reported goodwill. In addition, more able managers, on average, carry out fewer M&A deals than less able managers. More importantly, we found that only the portion of goodwill which is associated with more able managers truly represents economic substance (we consider these would be decisions free, or with little influence, from psychological biases). Our findings place accounting goodwill in check since, on average, only a small portion of reported goodwill appears to generate economic benefit for the acquirer.

Even today the controversy around goodwill remains in evidence (Wen & Moehrle, 2016; Rubio, Martínez & Mazón, 2021; Iatridis, Pappas & Walker, 2021). Besides this, much remains that is not known about the components of goodwill, due to its complex nature (Wen

& Moehrle, 2016). Bringing the psychology literature to the discussion on the formation of goodwill can greatly contribute to the advancement of accounting science. Incidentally, psychology was the earliest and most influential progenitor of behavioural accounting (Colville, 1981). We will not address cases of bad faith or conscious action in overpayment by executives (e.g., buyers overpricing shares at acquisition (Gu and Lev (2011)), but rather will address unconscious psychological factors influencing decision making.

The understanding of human behaviour in the decision-making process around the acquisition of a company (with payment of goodwill) can contribute to a better understanding of goodwill and, consequently, help in discussing its regulation. For instance, when realising that a premium paid in an M&A agreement may have resulted from cognitive biases, market participants can better evaluate companies' executives or decision makers and make better decisions around investment and capital allocation. In other words, market participants can make better decisions if they are aware of the existence of cognitive biases in a company's decision makers. Additionally, the accounting or management team can make better decisions regarding the need for impairment tests or even write-downs when they detect signs of behavioural bias in decision makers.

This article makes some contributions to the literature and practice of accounting for goodwill. First, as mentioned above, this article contributes to the existing gap in the literature by documenting the relationship between cognitive biases and goodwill. Scholars have suggested that acquisition-premium decisions are tainted by biases. Besides this, research on cognitive heuristics in acquisition-premium decisions remains limited (Malhotra, Zhu & Reus, 2015). Second, we add significant empirical contributions that support our theoretical proposition. As far as we are aware, this is the broadest investigation yet made, both in terms of period and in terms of countries included in the sample. No previous studies

theoretically and empirically linking cognitive biases to accounting goodwill were found. We shed light on the trend of accounting for goodwill.

Third, the issues addressed in this article certainly affect investors and decision makers. For this reason, it could be of particular importance to regulators. For example, in current discussions around goodwill, and in particular in agenda paper 18A (updated in April and July 2022)[2], the IASB highlights the importance of subsequent-performance information. Namely, the IASB points out that it analyses possible ways forward to improve disclosure requirements for business combinations. One of these methods concerns evaluating whether management has paid a reasonable price for the acquired business. This has been met with some caution in the IASB, as noted by one of its members, as it would invite strong reactions because it is an area where it would be obvious whether management has made a good or bad decision. We believe that this scenario introduces new questions about behavioural influences on decision-making (e.g. cognitive biases).

The remainder of this article is organised as follows. The next section provides some background on the topic. Section 3 provides the theoretical basis, linking twelve types of cognitive bias with goodwill. In Section 4, we present our entire empirical approach (including the discussion of results). The final section summarises the article and contains our concluding remarks.

2.3. Background

2.3.1. Triangulating Accounting and Psychology

This section begins by addressing the importance of considering factors other than economic factors in order to better understand purchased goodwill. A meaningful economic interpretation can be developed for internally generated goodwill, but not for purchased or acquired goodwill (Ma & Hopkins, 1988). This is because "the process of striking a deal is

---

[2] Available at IFRS: https://www.ifrs.org/projects/work-plan/goodwill-and-impairment/#project-history

more like a game of poker than an engineering problem. Law structures the game. Economics adds powerful incentives and motivates strategic behaviour. Psychology influences how the game is played" (Bruner, 2004, p. 685). Indeed, the motivation to close an M&A deal may not be singular in nature, but rather intertwined and complex (Angwin, 2007). For this reason, we propose a triangulation with another area of knowledge in order to elucidate this highly complex phenomenon. Multiparadigm approaches aid exploration of particularly complex and paradoxical phenomena (Lewis & Grimes, 1999).

According to Mirvis and Mark (1992), Levinson (1973) proposed a timeless analogy regarding M&A deals: "… it's a lot like falling in love. They don't want to be dissuaded. And they certainly don't want to be careful about it. They just want to jump in" (Mirvis & Mark, 1992, p. 86). Thus, for the authors, if executives identify with an M&A candidate, "and, whether their aim is courtship or conquest, they may not consider the risks objectively or slow down their momentum once the other party is in their sights" (Mirvis & Mark, 1992, p. 86). Indeed, M&As are usually power games, and the seductive appeal of power is widely accepted (Cartwright & Cooper, 1990).

"M&A pricing is quite a difficult task as psychological factors have an important impact in such deals" (Agarwal & Zeephongsekul, 2013, p. 22). We therefore maintain that a significant part of the goodwill values on companies' balance sheets could be a result of biased decisions by their executives, and does not represent economic substance. It is these values, the result of cognitive biases, that feed empirical accounting research. This context should be considered carefully by accounting, as it can generate negative impacts on the reliability of the information disclosed. This imbroglio led Williams (2009, p. 277) to ask:

> how is it that one could ever demonstrate through an association of accounting data with behavioral outcomes […] that accounting information was useful to rational economic decision making? Such associations could equally as well be evidence that accounting data were useful for making irrational decisions; there is no way to tell.

Hayward and Hambrick (1997, p. 122) had already supported the idea that although acquisition values are an extremely "economic" phenomenon, the evidence suggests that the large sums of money involved in an M&A deal "[are] due more to social, psychological, and institutional forces than to financial optimization". The authors claim that hubris hypothesis (Roll, 1986), or exaggerated self-confidence, appears to drive up acquisition prices. Indeed, this complexity can distort the information-processing capacity of the human brain, creating cognitive biases. As stated by Hilbert (2012, p. 5):

> our mind is the result of biological evolution […] From this perspective, it should not be surprising that the design of the information processing system we employ when making decisions is imperfect and that a certain degree of distortion takes place arising simply from the sloppy design of the system.

The literature on management is rich in discussion of the influence of cognitive biases in everyday organisational life, but the same depth of research is not observed in the accounting literature. The accounting literature addressing this topic is restricted to a few empirical studies which provide no theoretical basis for such an occurrence. For instance, Henning, Lewis and Shaw (2000) break down recognised goodwill into four components, one of which is the overpayment or overvaluation of consideration (residual goodwill – RESID). They document a mean of 31 per cent of RESID in the sample analysed. Yehuda, Vincent and Lys (2017) investigated a sample of 2,123 M&A transactions in the 2002–2006 period from publicly traded companies in the US, and claim that investors see 41 per cent of these acquisitions as consistent with overpayment for the target. Not only is this component not part of the goodwill asset, but it is not part of any asset (Johnson & Petrone, 1998). Thus, our core purpose is to fill the existing gap in the accounting literature on the theoretical underpinning of the overpayment of goodwill.

Accounting is a human activity constructed from human values and intentions (Williams, Jenkins & Ingraham, 2006). In this way, the behavioural decision-making and

cognitive psychology literatures continue to have a significant influence on behavioural accounting research (Birnberg, 2011). Accounting has an interest in behavioural decision making, since a large part of accounting deals with the formation of judgements and the making of decisions based on judgements (Einhorn, 1976). One approach used in behavioural research is to study systematic biases in human decision making (Birnberg & Ganguly, 2012).

2.3.2. The Decision-Making Process

According to Hammond, Keeney and Raiffa (1998), making decisions is the most important, toughest and riskiest job of any executive. The authors ask "where do bad decisions come from?" and state that "sometimes the fault lies not in the decision-making process but rather in the mind of the decision maker. The way the human brain works can sabotage our decisions" (Hammond, Keeney & Raiffa, 1998, p. 47). In this context, and considering the high failure rate of M&As, the core motivation of this research is to provide insights into the relationship between the psychological factors related to this bilateral negotiation and residual goodwill or overpayment. An M&A is not only a financial transaction but also involves a "softer side" – that is, a human side that needs to be understood in a more fine-grained way (Sarala, Vaara & Junni, 2019).

Given the high failure rate of M&As, Angwin (2007) asks why executives continue to negotiate M&A agreements in massive numbers and dollar terms. The author provides eight archetypes of motivation, ranging from classical (maximise shareholder value) to non-maximising motives such as contextual pressures or contextual factors. However, these motivational types do not address personal factors affecting the decision maker. Seo and Hill (2005) identify six underlying theories to explain problems in managing the organisational-change process of M&As: anxiety theory, social identity theory, acculturation theory, role conflict theory, job characteristics theory, and organisational justice theory. However, they do

not address the issue of cognitive biases. In turn, there exists a stream of psychology

literature that addresses cognitive biases in the decision-making process. Some of these

studies investigate M&As. We expand the literature by bringing this discussion into the

accounting world – that is, by discussing psychological motives, especially cognitive biases,

influencing an acquisition premium in business combinations. The psychology literature may

help this investigation of accounting phenomena. We could mention, for instance, the

research of Chiu, Teoh and Tian (2013), who investigated the psychological factors driving

earnings management contagion via board networks.

It is important, too, to point out that discussions about cognitive biases influencing

decision making may also have gone unnoticed even by standard-setters when regulating the

topic. They did not recognise (or did not discuss) the possibility of unconscious overpayment:

> The boards acknowledged that overpayments are possible and, in concept, an overpayment
>
> should lead to the acquirer's recognition of an expense (or loss) in the period of the
>
> acquisition. However, [...] the boards are not aware of instances in which **a buyer knowingly**
>
> **overpays or is compelled to overpay a seller** to acquire a business (IFRS 3, BC382; FAS
>
> 141, B382 – emphasis added).

One could argue that the failure of an M&A process could be related to unforeseen

subsequent events. However, prior studies suggest that the cause of numerous goodwill

impairment losses is that the target firm is overpaid at the time of the original acquisition,

rather than post-acquisition events leading to performance deterioration of the firm (Gu &

Lev, 2011; Li et al., 2011; Olante, 2013).

Existing theoretical and empirical research suggests that acquirers often overpay for

the target because of agency conflicts (Li et al., 2011). Other research streams have also

sought to investigate the causes of failure in M&A processes such as technological and

process integration (Larsson & Finkelstein, 1999; Zollo & Meier, 2008; Henningsson, Yetton

& Wynne, 2018), human factors (Napier, 1989; Schuler & Jackson, 2001; Aguilera &

Dencker, 2004), cultural factors (Nahavandi & Malekzedah, 1988; Cartwright & Cooper, 1993; Weber, Shenkar & Raveh, 1996; Stahl & Voigt, 2008) and communication (Schweiger & DeNisi, 1991; Papadakis, 2005; Angwin et al., 2016;).

On the other hand, there are few studies in the accounting literature that seek alternative explanations, such as psychological factors, to theoretically explain overpayment. Even so, these studies mainly address the overconfidence (Malmendier & Tate, 2008; Billett & Qian, 2008) or hubris hypothesis (Roll, 1986; Seth, Song & Pettit, 2000; Churyk, 2005). We expand this literature by providing a number of other cognitive biases, addressed in the psychology literature, that impact the payment of a premium on M&As. Even the variables that seem to greatly influence the success of an acquisition – for instance, previous experience in M&As, payment method, level of the relationship between the companies and the type of company acquired – have not yet clearly and repeatedly explained or identified variables that impact an acquiring firm's subsequent results (King et al., 2004).

Behavioural biases – in addition to economic and financial forces – are an important factor in the decision to acquire a company (Dhir & Mital, 2012) or even to impair or write down goodwill values (Kim & Bay, 2017). For instance, Seth, Song and Pettit (2000) analysed data from cross-border acquisitions of American industrial corporations and found evidence of coexistence of the synergy hypothesis (their predominant explanation) with the hubris hypothesis highlighted in this article.

2.4. Theoretical Basis: Cognitive Biases and Accounting Goodwill

The process of striking an M&A deal, in general, results from negotiation between the parties (acquirer and target), not from a value defined by the market or by a supply-and-demand relationship. From initial discussions to final agreement, there is a long road to be travelled by the parties, and this bargaining process affects the result of the negotiation. Such a context opens the door to biases. There are also cases where an M&A occurs through

competition between multiple competitors. In a study on 1990s M&As, Boone and Mulherin (2007) find that half of the target firms were auctioned among multiple bidders. Even in these cases, excessive competition can be conducive to the appearance of biases – for example, buyers tend to bid more aggressively and offer hefty premiums to target companies (Alexandridis, Petmezas & Travlos, 2010). Therefore, this scenario of greater competition in the takeover market can also lead to the rise of biases such as the effects of overconfidence highlighted by Billett and Qian (2008). In summary, the M&A context – whether through negotiation or auction – can be considered conducive to the action of biases in decision makers.

Systematic deviations from the laws of logic, probability theory and expected utility theory are known as cognitive biases (Lieder et al., 2018; Lieder & Griffiths, 2020), and are an ever-present ingredient in making strategic decisions (Das & Teng, 1999). The discovery of cognitive bias was influential because the rules of logic and probability were assumed to be the essence of rational thinking. This discovery, therefore, shook the foundations of economics and the social sciences (Lieder et al., 2018). Cognitive bias can become more pronounced in decisions involving M&As, as they are among the most critical decisions that a CEO makes (Bao & Edmans, 2011; Brown et al., 2015). Among other origins, cognitive biases can come from emotional or moral motivations, from social influences or from noisy information processing. This can lead to pre-judgements in decision-making processes (Hilbert, 2012). Cognitive biases can be understood as those cases in which human cognition reliably produces representations which are systematically distorted compared to objective reality (Haselton, Nettle & Andrews, 2005). The purpose of understanding the phenomenon of cognitive bias and its relationship to the decision-making process (and accounting goodwill) is to develop skills to recognise situations in which a specific type of error can occur (Kahneman & Riepe, 1998).

2.4.1. Outcome Bias

One of the first types of bias that can be identified in decision making related to M&As and goodwill is outcome bias (Baron & Hershey, 1988). Certainly, it is extremely important to evaluate the outcomes to be obtained when thinking about acquiring a company. However, the psychology literature has observed that when a risky option occasionally leads to a large gain, this gain tends to be more memorable than other results, and is therefore overweighted in further decisions (Madan, Ludvig & Spetch, 2014). An outcome bias occurs when people weigh outcomes in a way that is irrelevant to the true quality of the decision to be made (Baron & Hershey, 1988). This bias occurs when the outcomes of a decision – rather than of its opportunity and suitability – influence the decision maker's risk behaviour (Marshall & Mowen, 1993). The success of a business combination goes beyond the mere projection of future outcomes (even if they are based on great outcomes from the past). A number of other factors can jeopardise M&As (adaptation of employees, systems, technologies, etc.), and must be taken into account as otherwise they can cause an overestimation of the acquisition premium. As stated by Seo and Hill (2005, p. 423):

> M&A necessarily involves organizational change, integrating some or all parts of the original organization's functions and activities. The degree of organizational change can vary substantially across M&As because the motives and types of M&As differ widely.

This bias can be enhanced by the joint presence of optimism bias – the tendency to overestimate the likelihood of favourable future outcomes and to underestimate the likelihood of unfavourable future outcomes (Weinstein, 1980; Bracha & Brown, 2012). Psychological research has found that people judge negative events as less likely to happen to themselves than to others. This is interpreted as showing that people are "unrealistically optimistic" (Weinstein, 1980; Harris & Hahn, 2011). Certainly, the outcomes to be generated in an M&A process are important for decision makers. However, issues such as technological and operational integration and organisational culture are very important and must be carefully

considered so that an M&A can achieve the intended outcomes. According to Mazzocco, Alicke and Davis (2004), executives, despite identifying and routinely considering the available options, may see their best plans go awry. It is possible to infer that an executive influenced by these biases can let unrealistic optimism and/or great past results influence their decision making. This can result in overpayment when acquiring a target firm.

2.4.2. Anchoring Bias

Among the different conceptions that could be used to understand organisations (e.g. machines, brains, organisms, cultures, political systems – see, for example, Morgan, 1998), the view that companies can be seen as systems is widespread in the literature (von Bertalanffy, 1968; Rapoport, 1986). However, there is a type of cognitive bias that can produce an opposite effect. Anchoring bias, or the focalism effect, is the human tendency to rely too heavily on a single characteristic or piece of information when making decisions (Zhang et al., 2007; Iverson, Brooks & Holdnack, 2008). This bias was first discussed in the work of Tversky and Kahneman (1974), who state that it occurs because in many situations people make estimates of something unknown or uncertain by starting from an initial value (anchor) "that is adjusted to yield the final answer". The adjustments made to that anchor "are typically insufficient" (Tversky & Kahneman, 1974, p. 1128).

By "anchoring" their expectations in relation to a target company, a buyer can be misled and make decisions which are biased by this initial anchor. Some of the most difficult and important decisions that negotiators must make involve determinations properly made before the start of the negotiation (Whyte & Sebenius, 1997). Accordingly, the initial value of goodwill to be offered in a business combination may not reflect the expected economic benefits. This can occur when the acquirer is focused only on specific positive information from the target company, affecting the assessment that is made of it. Zhang et al. (2007) cite a classic example where a person buying a car tends to "anchor" their decision on reading the

odometer and looking at the age of the car, instead of considering the condition of the engine or transmission. In an interesting study, Malhotra, Zhu and Reus (2015) verify the occurrence of anchoring on acquisition-premium decisions based on other acquisition cases. They found that a focal premium decision may be anchored on the premium that another company paid for the acquisition directly preceding the focal acquisition in the same market.

2.4.3. Planning Fallacy

Another item that can affect the success of a business combination – consequently impacting the acquisition premium – is the assessment of the time required for the process to be completed. According to Marks and Mirvis, one way to mitigate the effects of "merger syndrome" is to consider a "realistic merger preview" (2011, p. 164), with detailed information regarding the timeline of an M&A (including how it will affect employees and other pertinent information). Making an acquisition is a dynamic process and involves numerous activities (Very & Schweiger, 2001). It is in this context that planning bias (or planning fallacy) can act on the behaviour of a decision maker and lead an acquirer to pay the wrong amount in goodwill. Planning bias is the tendency to underestimate the time needed to complete a project, even when there is considerable experience of previous failures in meeting similar project deadlines (Kahneman & Tversky, 1982, p. 415; Griffin & Buehler, 1999). Planning fallacy does not depend on deliberate deceit or untested technologies (Buehler, Griffin & Ross, 1994; 2002). It is a consequence of the tendency to neglect distributive or "external" data based on how long similar tasks have taken in the past. Instead, people tend to adopt a unique or "internal" perspective with a focus on specific aspects of the current task and an imagined scenario of how it will be completed. The internal approach to plan evaluation is likely to underestimate this issue (Kahneman & Tversky, 1982, p. 415; Kruger & Evans, 2004). Thus, an optimistic view that an M&A process will be fully completed in a given timeframe can lead to business-assessment errors. In this case, there is a

false illusion that the premium paid will be recovered in a satisfactory manner. Therefore, part of the premium paid will have no economic substance.

2.4.4. Bandwagon Effect

A considerable amount of research has shown that acquisition activity occurs in waves (Andrade, Mitchell & Stafford, 2001; Rhodes-Kropf & Viswanathan, 2004; Harford, 2005; Martynova & Renneboog, 2008; Ahern & Harford, 2013; Xu, 2017). Another type of cognitive bias may be related to the M&A waves observed in the literature: the so-called "bandwagon effect". This bias was initially defined by Leibenstein (1950) as the increase in demand for a commodity due to the fact that other people are also consuming it. The bandwagon effect is studied in a wide range of fields, but we emphasise the field of decision making and business combinations. This area of the literature has observed that the propensity of firms to form alliances is greatly influenced by the behaviour of other firms' alliances (Garcia-Pont & Nohria, 2002). The bandwagon effect is a diffusion process in which an organisation adopts an innovation not because of its individual assessments of efficiency or outcomes from innovation, but because of pressure generated by the large number of organisations that have already adopted it (Abrahamson & Rosenkopf, 1993). Those who do not follow the transformation model fear underperformance if many competitors profit from adoption.

Garcia-Pont and Nohria (2002) investigated the dynamics of forming alliances in the global auto industry between the years 1980 and 1989 and found evidence of a local bandwagon effect. The companies did not blindly imitate any other company in the sector, but mainly observed the actions of their closest peers. The authors draw attention to the fact that the bandwagon effect does not represent irrational behaviour by companies, as they observe the benefits of the new practice. Imitators adopt the new practice due to its ability to improve economic performance and maintain competitive parity. According to Xia, Tan and

Tan (2008), the bandwagon effect is particularly useful to explain the rise and decline of a dominant strategy when a large number of companies adopt a new structure or practice. "Decline" can be defined as a rejection process in which newcomers reduce the use of one strategy in favour of another. Martynova and Renneboog (2008) draw attention to those cases at the end of the wave. They observe that the acquisitions that occur at the end of each wave are generally motivated by non-rational and self-interested management decision making.

Examples such as those highlighted in the last paragraph show that pursuing an M&A process at any cost may lead an acquirer to offer a premium on the acquisition that is not completely related to the economic benefits to be generated by the process. The bandwagon effect may have influenced the behaviour of decision makers and therefore, as soon as signs of error are verified, the excess goodwill should be written off. It should also be noted that this bias may have a potential effect in the post-pandemic period when Covid-19 is under control. After the present phase of falling economic activity due to the pandemic, there may be an increase in optimism that influences a new wave of M&As, and some of these future business combinations may be due to the bandwagon effect. This is a question for future research.

2.4.5. Illusion of Control

The illusion of control is a type of cognitive bias defined as an expectation of a probability of personal success that is inappropriately greater than the objective probability would justify (Langer, 1975). In other words, it is a tendency to overestimate the degree of influence that a person can have on a given event. It is particularly likely to occur in contexts characterised by personal involvement, familiarity, prior knowledge of the desired outcome and focus on success (Thompson, 1999). Under this type of bias, executives may underestimate the risk of an M&A and may be prone to paying a premium on the acquisition with no economic foundation. A portion of this premium, therefore, is unrelated to physical

wealth. The context in which this type of bias occurs can trigger the provision of biased information, leading shareholders to approve an M&A. "Individuals exhibiting an illusion of control will underestimate risk because they believe their skills can prevent negative occurrences" (Keh, Foo & Lim, 2002, p. 131).

"Personal involvement" refers to someone who is the active agent, rather than having others act for them (Thompson, 1999). In this context, executives are personally involved in the processing of information necessary for an acquisition. An M&A process is highly complex (Shimizu et al., 2004; Gomes et al., 2013) and personal involvement can culminate in the abandonment of economic rationality under the influence of the emotions running through the executive's mind. In addition, managers who have been involved in or have led previous M&As may display this type of bias due to familiarity. When the circumstances or materials we are working with are familiar, it is easier to have inflated perceptions of our personal control than when the situation or task is new (Thompson, 1999).

2.4.6. Projection Bias

Projection bias is another item that can affect the value of goodwill. A decision maker may be imbued with some feeling due to a momentary situation, leading them to project an overly optimistic future. Mehra and Sah (2002) claim that when making their current choices, an individual behaves as if their current subjective parameters are likely to persist to a significant degree in the future. This optimism may be reflected, for example, in the discount factor and/or the level of risk aversion.

> Optimal decision-making often requires a prediction of future tastes, and future tastes may differ from current tastes due to such factors as habit formation, day-to-day mood fluctuations, social influences, maturation, and changes in the environment (Loewenstein, O'Donoghue and Rabin, 2003, p. 1209).

Therefore, in cases where this bias occurs, the value of goodwill and, consequently, its relationship to physical capital may fail. Grable, Lytton and O'Neill (2004) state that it is

possible that projection bias may exist in relation to stock prices and attitudes of tolerance to financial risk. Based on a questionnaire displayed on an investment education website, the authors concluded that, in a given week, the risk tolerance of interviewees was influenced by the closing prices of the previous week on the NASDAQ, Dow Jones and S&P 500. For the authors, this suggests that individuals exhibit a form of projection bias extrapolating recent trends in attitudes to take investment risks. Using data from the S&P 500 index (CRSP) between 1986 and 1995, Kliger and Levy (2008) claim to have found unequivocal empirical evidence of projection bias in the decision-making processes of investors. This bias predicts suboptimal patterns of behaviour when people make long-term decisions but experience highly variable day-to-day feelings. "The existence of advice such as 'count to ten before you respond' or 'never shop on an empty stomach' suggests that people are aware of projection bias on a meta-level" (Loewenstein, O'Donoghue & Rabin, 2003, p. 1239).

2.4.7. Endowment Effect, Loss Aversion, and Status Quo Bias

As previously stated, a business combination is a negotiation between seller and buyer to reach an agreement on the deal price (Agarwal & Zeephongsekul, 2013). This negotiation may be influenced by a factor that causes the acquirer to pay a premium which has no economic basis. This is one more ingredient – or rather bias – that can act in conjunction with the biases addressed so far. It is the reluctance of the owners of a target company to dispose of the business. This reluctance may be related to so-called endowment bias (or endowment effect): the tendency for people to demand much more to give up an object than they would be willing to pay to acquire it (Thaler, 1980). Loewenstein, O'Donoghue and Rabin (2003) highlight a combination of both projection and endowment biases. Projection bias leads to exaggerated feelings of loss aversion, enhancing the effects of endowment bias. For the authors, this combination of biases in bilateral economic transactions can cause distortions or

even cause negotiations to break down, because acquirers tend to underestimate owners'
desired prices and target firms tend to overestimate acquirers' desired prices.

Kahneman, Knetsch and Thaler (1991) have called attention to two other biases that
may have effects similar to endowment bias: loss aversion and status quo bias. Kahneman
and Tversky (1984) explain loss aversion with the example of betting on a coin-toss game:
"The attractiveness of the possible gain is not nearly sufficient to compensate for the
aversiveness of the possible loss" (Kahneman and Tversky, 1984, p. 342). In the second case,
Samuelson and Zeckhauser (1988) state that most real decisions, unlike those in economics
texts, have an alternative status quo: doing nothing or maintaining one's current or previous
decision. When choosing among alternatives, individuals exhibit a bias that leads to the status
quo. As highlighted in the previous example, the combination of these biases may also cause
the acquirer to agree to pay an acquisition premium without an economic underpinning.

2.4.8. Dunning–Kruger Effect

Another point that may cause the goodwill paid in a business combination not to
reflect its economic value is associated with people's self-assessment of their own individual
capacities. In other words, an unskilled person may consider themself prepared to conduct or
actively participate in an M&A agreement. Brütting (2011) maintains that there is the
possibility that decision makers act unintentionally to shareholders' detriment when they
overestimate their ability to manage the target, which might lead to an overpayment at
acquisition. This behaviour can be seen through various lenses of scientific knowledge, but
here it will be considered as a consequence of self-assessment bias, or the Dunning–Kruger
effect: the tendency of unqualified individuals to overestimate their own skills and highly
qualified individuals to underestimate theirs (Kruger & Dunning, 1999). Some authors call
this bias "ignorance of one's own ignorance" (Dunning, 2011; Huang, 2013).

Situations like this can boost cases of overpayment, since an M&A process is highly complex (Shimizu et al., 2004; Gomes et al., 2013) and involves information asymmetry – people are party to differing amounts of information when making decisions, but individuals do not know the exact amount of information they possess. Schlösser et al. (2013, p. 86) claim that it is necessary to "understand the circumstances surrounding the person in the 'low information' position […] and whether people know when they are that low information person". This can be crucial in setting the deal price, as people are generally over-optimistic when assessing their performance in social and intellectual tasks (Ehrlinger et al., 2008). This overestimation occurs, in part, because unskilled people in this situation suffer a dual burden: "not only do these people reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the metacognitive ability to realize it" (Kruger & Dunning, 1999, p. 1121).

2.4.9. Hot-Hand Fallacy

The next bias to be highlighted is hot-hand bias (the hot-hand fallacy). This term is more associated with random events, and was initially described by Gilovich, Vallone and Tversky (1985). The authors noted that players and fans tend to believe that a sportsperson's chance of hitting a shot is greater following a hit than after a mistake in the previous shot (even though the authors found no positive correlation between the results of successive shots). The hot-hand bias or fallacy arises from the experience of characteristic positive recency in serial fluctuations in human performance (Ayton & Fischer, 2004). M&As can occur at different times in a company's life. Success in one process does not necessarily mean a guarantee of success in the next. Hot-hand bias can push an acquiring company to this type of error and, if a premium has been paid, create erroneous expectations about goodwill. As previously mentioned, an M&A process is highly complex, so relying too much on the

success of past combinations may create an environment conducive to making the wrong decision.

2.4.10. *Normalcy Bias*

A bias that may be gaining prominence in the current pandemic phase of Covid-19 is normalcy bias: the tendency to minimise the probability of potential threats or of their dangerous implications, leading to the assumption that continuity does not require protection or restoration, since no serious disturbance is expected (Omer & Alon, 1994; Kinsey et al., 2019). As fears change, people tend to resist them and, in turn, the brain tries to simulate a normal environment (Murata, Nakamura & Karwowski, 2015). The literature dealing with this type of bias is mostly related to the study of accidents and natural disasters. However, it is possible to expand the concept to the field of decision making in the organisational environment. People and companies show normalcy bias during an unexpected disaster (Murata, Nakamura & Karwowski, 2015). They tend to believe less alarming options whenever conflicting or ambiguous information about the danger is presented (Omer & Alon, 1994).

It is possible that some M&A deals may have been biased by a false sense of normalcy. This type of bias can also influence decision makers to offer values to acquire a company without considering the crisis scenario that the world (or its sector) may face in the future. Although the current pandemic can open up opportunities for business combinations, a decision maker must correctly weigh the influence that a pandemic can have on the expected profitability of the business combination (e.g. the environment generated by the pandemic could affect employees' behaviour and hinder the merger process; potential customers may become more selective in their consumption of the new company's products; difficulties faced by suppliers may delay the completion of the business combination).

2.4.11. Neglect of Probability

The current scenario can also trigger another type of bias that is related to a business combination's likelihood of success. Indeed, some of the decisions that culminate in failed M&As could be avoided if decision makers take the chances of success more seriously. Neglect of probability bias comes into play when individuals do not perceive that the probability of different results is a relevant factor for decision making. As such, decision makers realise that a decision becomes much more difficult than it would have been if they had explicitly considered the probabilities (Baron, 2008, p. 508). An M&A process certainly involves risk and scenario analyses (Lau et al., 2012), and when people neglect probabilities they can also treat some risks as if they were non-existent (Sunstein, 2002). As stated by Baron, "probabilities matter, and sometimes asking about them can lead to a clear resolution of what would otherwise be a difficult decision" (2008, p. 508). Therefore, decision makers can act partially – for example, by paying a premium for an acquisition – when they fail to consider such issues. People reason differently about an individual case than about a set of cases, especially when the set is represented in the form of a summary statistic. The individual case arouses more empathy (and other emotional reactions) than the group of cases, because it is easier to imagine and identify with a single case (Griffin & Buehler, 1999).

2.4.12. Escalation of Commitment

Finally, once an impairment test detects that the investment in an M&A will not generate the expected synergy and abnormal earnings, the corresponding amount in accounting goodwill should be written off. However, the question that may arise for decision makers is: should we write off the goodwill and dispose of the investment that did not work, or commit even more resources and effort to try to obtain the expected outcomes? These are doubts that can affect decision making and have been studied in the scope of escalation of

commitment bias. These situations can occur where "losses have been suffered, where there is an opportunity to persist or withdraw and where the consequences of these actions are uncertain" (Staw, 1997 p. 192). Indeed, there are many cases where individuals can become stuck in an expensive course of action. This happens because people who have suffered a setback believe they can recover their losses through an even greater commitment of resources to the same course of action, creating a cycle of escalation of commitment (Staw, 1981) which tends to intensify as unsuccessful projects become more strongly linked to organisational performance (Hayward & Shimizu, 2006).

The literature on escalation of commitment claims that "decision makers who choose an initial course of action and who feel personally responsible for the decision outcomes become psychologically committed to the chosen course of action" (McCarthy, Schoorman & Cooper, 1993, p. 12). King et al. (2004, p. 190), mentioning Haspeslagh and Jemison (1991), hold that lack of acquisition experience may make a decision maker susceptible to this bias, which "can lead to the completion of deals at unreasonably high costs". This bias has aroused the interest of researchers in various fields as it occurs in a wide variety of decision-making situations (Lee, Keil & Wong, 2018).

2.5. Empirical Approach

After introducing a series of cognitive biases affecting M&A decision making, we conducted an empirical investigation in order to explore the influence of these behavioural biases on M&A deals. We explored the relationship between firms with and without reported goodwill, performing some empirical tests to validate the literature's proposition that most M&A agreements are flawed.

As a proxy to verify the influence of cognitive biases on decision makers, we employed the measure of managerial ability proposed by Demerjian, Lev and McVay (2012). We hold that the greater the manager's ability, the less likely they are to make decisions

influenced by cognitive biases. This is because more able managers "better understand technology and industry trends, reliably predict product demand, invest in higher-value projects, and manage their employees more efficiently than less able managers" (Demerjian, Lev & McVay, 2012, p. 1229).

Demerjian, Lev and McVay (2012) introduce a measure of managerial ability named "managerial ability score" (mascore) which is based on a manager's efficiency in generating revenues. The authors follow a two-step procedure to quantify managerial ability. First, they use the data envelopment analysis (DEA) approach to model firm efficiency. Based on seven inputs (cost of goods sold; selling, general and administrative expenses; property, plant and equipment; operating lease; research and development; goodwill; and other intangibles) and one output (sales), the authors create a total firm-efficiency score that captures both firm- and manager-specific efficiency factors. Second, to isolate manager-specific effects, they regress this firm-efficiency score on various firm characteristics (market share, size, cash availability, business concentration and foreign operations) to disentangle managerial performance from firm performance. The residual from this tobit regression – the total firm efficiency unexplained by the firm's characteristics – is the measure of managerial ability (Baik, Farber & Lee, 2011; Francis et al., 2016; Sun, 2016; Andreou et al., 2017; Bonsall IV, Holzman & Miller, 2017).

This measure of managerial ability effectively separates the managerial effect from the firm effect, as well as capturing the overall ability of the management team (Hasan, 2020; Doukas & Zhang, 2020). Since more able managers better foresee business opportunities, make better decisions, and maximise shareholder benefits (Sun, 2016), we can expect such managers to make fewer decisions biased by psychological factors that do not add economic value.

Custódio and Metzger (2013) investigated how CEO characteristics affect the performance of acquirers in diversifying takeovers. The authors found that industry-expert CEOs have superior negotiation skills, typically negotiating better deals and paying a lower premium for the target. In another example, Frésard, Hege and Phillips (2017) contend that industry specialisation reflects the geographical concentration of intangible resources such as management skills. From this premise, the authors found that firms in more specialised industries (i.e., with more skilled management teams) tend to take control of assets in less specialised industries. Furthermore, the acquirers' accounting performance post-acquisition is significantly higher when acquirers are from more specialised countries and industries than their targets.

2.5.1. Sample Construction and Descriptive Statistics

Table 2.1 depicts the operationalisation of all variables used in the study, as well as the sample construction. We use the CRSP/Compustat merged (CCM) database from Wharton Research Data Services (WRDS). The initial sample comprised all firms listed from 1980 to 2020. First, we excluded duplicate data (2,603 observations). We then merged this database with the mascore database[3] from Demerjian, Lev and McVay (2012), World Bank Indicators,[4] and Compustat Execucomp.

---

[3] We are grateful to the authors for publicly sharing their database. Data are available at:
https://peterdemerjian.weebly.com/managerialability.html

[4] Available at https://data.worldbank.org/indicator

Table 2.1

Variable Definitions and Sample Construction

Acronym	Operationalisation	Data source
gdwlat	The book value of goodwill (Compustat item: gdwl) scaled by total asset	CCM database
gdwlyes	Dummy variable equal 1 if firm has a non-zero value recorded for goodwill; 0 otherwise	CCM database
mascore	Managerial ability score by Demerjian, Lev and McVay (2012)	Peter Demerjian website
lat	Natural logarithm of the total asset	CCM database
ppenet	Net Property, Plant and Equipment - Total (Compustat item: ppent) scaled by total asset	CCM database
roa	Net income (Compustat item: ni) scaled by total asset	CCM database
leverage	The book value of liabilities (Compustat item: lt) scaled by total asset	CCM database
mkvalt	Market value – total	CCM database
stockprcc	Price close – annual (Compustat item: prcc_f)	CCM database
dividpshr	Dividends per share - pay date (Compustat item: dvpsp_f)	CCM database
spglobequity	Standard & Pools global equity index (annual % change) by country	World Bank website
realintrate	Real interest rate by country	World Bank website
gdpgrowth	GDP growth by country	World Bank website

Firm-year obs	Sample construction
179,845	Initial sample after merger databases and excluding duplicates
(31,311)	Goodwill missing values
148,534	**Final sample**
62	**Countries**

After these steps, our database consisted of 179,845 observations from 1980 to 2018. As data on goodwill is only available from 1988 onwards, we excluded data prior to 1988 (31,311 obs). The final sample totalled 148,534 firm-year observations from 1988 to 2018, covering 62 countries. Since Demerjian, Lev and McVay's database excludes financial institutions, our final sample also leaves out data from these institutions.

Table 2.2 depicts a summary of the variables. Goodwill represented on average 8.7% of total assets. About 44% of the companies in our sample carried out an M&A process with a goodwill payment. The mean managerial ability score is 0.001 (values range from -0.304 to 0.686). The mean return on assets (roa) is -0.06. Despite the extreme values, we chose neither to exclude outliers nor to winsorise our sample. The average market value of the companies in the sample is US$3.9 billion. The highest company market value was approximately US$1.07 trillion.

Table 2.2

Summary Statistics

	N	Mean	Std. Dev.	min	p25	Median	p75	max
gdwlat	117,077	.087	0.134	0	0	.013	.127	.958
gdwlyes	148,534	.444	0.497	0	0	0	1	1
mascore	130,459	.001	0.130	-.304	-.075	-.019	.042	.686
lat	130,459	5.474	2.276	-5.809	3.83	5.348	7.017	13.59
ppenet	130,423	.278	0.238	0	.088	.203	.408	1
roa	130,457	-.057	0.705	-173.262	-.054	.029	.074	24.586
leverage	130,186	.509	0.444	0	.3	.488	.657	74.934
mkvalt	75,480	3864.353	19842.451	.001	71.886	355.753	1545.386	1073390.5
stockprcc	130,022	29.812	892.857	0	4.05	11.375	25.68	141600
dividpshr	130,397	.247	1.194	0	0	0	.15	264.018
spglobequity	120,675	.092	0.188	-.842	-.015	.095	.235	2.84
gdpgrowth	128,855	.029	0.019	-.215	.019	.029	.04	.266
realintrate	123,815	.043	0.026	-.353	.024	.046	.063	.776

Table 2.3 shows correlation between the independent variables included in the model and the variation inflation factor (VIF). Overall, the variables included in the model have low correlation as well as low VIF values, indicating that the problem of multicollinearity is unlikely to be a concern for our results. It is also important to emphasise that all results of the regressions performed are based on White's (1980) adjustments (standard errors adjusted for heteroscedasticity). The starting point to which we call attention is the negative and statistically significant relationship between goodwill and the managerial ability variable (mascore).

Table 2.3

VIF Test and Correlation Matrix

Variables	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) gdwlat	1.28	1											
(2) mascore	1.10	**-0.073*****	1										
(3) lat	1.57	0.253***	0.084***	1									
(4) ppenet	1.29	-0.277***	-0.204***	0.194***	1								
(5) roa	1.19	0.038***	0.066***	0.166***	0.037***	1							
(6) leverage	1.17	0.036***	-0.044***	0.096***	0.096***	-0.328***	1						
(7) mkvalt	1.24	0.051***	0.203***	0.377***	0.016***	0.033***	0.020***	1					
(8) stockprcc	1.01	0.006**	0.034***	0.047***	-0.009***	0.005*	0.000	0.079***	1				
(9) dividpshr	1.09	0.022***	0.053***	0.215***	0.081***	0.039***	0.035***	0.168***	0.006**	1			
(10) spglobequity	1.06	-0.038***	0.004	-0.052***	0.007**	0.028***	-0.014***	0.015***	-0.001	-0.014***	1		
(11) gdpgrowth	1.16	-0.072***	0.012***	-0.094***	-0.012***	0.007**	-0.025***	-0.013***	-0.004	-0.031***	0.178***	1	
(12) realintrate	1.13	-0.128***	0.009***	-0.190***	0.048***	-0.012***	0.000	-0.048***	-0.004	-0.035***	0.150***	0.199***	1

Note(s): *, ** and *** represent significance at 10%, 5% and 1% levels, respectively.

2.5.2. Results

First of all, it is worth noting that the exploratory nature, both theoretical and empirical, of the present study makes dialogue and comparison with previous literature somewhat difficult. In this regard, commentary on the results obtained is based essentially on our theoretical support presented in the previous section. Nevertheless, whenever possible, we sought similar studies to situate our results. The results of our first regression are summarised in Table 2.4 and provide the starting point for analysis and discussion of our proposition. The table shows the firm's market value as a function of goodwill. Our approach follows the literature on the value relevance of reported goodwill (e.g. Dahmash, Durand & Watson, 2009; Oliveira, Rodrigues & Craig, 2010; Hamberg & Beisland, 2014; Burger & Wen, 2021) and adopts the accounting-based valuation model developed by Ohlson (1995). We then consider the following specification:

$$\text{mkvalt}_{it} = \beta_0 + \beta_1 \text{gdwlat}_{it} + \beta_2 \text{mascore}_{it} + \beta_3 \text{ppenet}_{it} + \beta_4 \text{lat}_{it} + \beta_5 \text{roa}_{it} +$$
$$\beta_6 \text{leverage}_{it} + \beta_7 \text{spglobequity}_t + \beta_8 \text{gdpgrowth}_t + \beta_9 \text{realintrate}_t + \text{year\_control} +$$
$$\text{country\_control} + \varepsilon_{it} \qquad (1)$$

We used four models to estimate the regression coefficients. The first two columns show the estimated coefficients using the variable from the CCM database (mkvalt) with and without year and country fixed effects. As this variable only has values from 1998 onwards, we chose to calculate an alternative measure for market value (mkvaltprc) by multiplying the stock price (stockprcc) by the number of shares outstanding (Compustat item: csho). Thus, the last two columns show the estimated coefficients using this variable with and without year and country fixed effects.

Table 2.4

Relationship Between Goodwill and Market Value

Dep. Var.	mkvalt		mkvaltprc	
	model (1)	(2)	(3)	(4)
gdwlat	**-2601.1***	**-7437.8*****	-1506.7	**-4174.5*****
	(-2.26)	**(-14.04)**	(-1.34)	**(-9.91)**
mascore	**6073.0*****	**26169.2*****	**5555.3*****	**25813.2*****
	(4.10)	**(47.92)**	**(4.39)**	**(61.87)**
ppenet	-563.8	-4727.2***	-2200.9	-1509.7***
	(-0.36)	(-14.26)	(-1.78)	(-6.11)
lat	3159.3***	3964.9***	2917.6***	3283.1***
	(6.55)	(102.47)	(8.40)	(115.11)
roa	-203.5	-1132.6***	-251.1	-1309.2***
	(-1.65)	(-12.73)	(-1.88)	(-17.48)
leverage	301.6*	-1057.3***	145.0	-1368.7***
	(2.50)	(-6.72)	(1.20)	(-10.54)
spglobequity	1321.3***	294.4	1646.3***	1797.1*
	(10.25)	(0.21)	(9.51)	(2.35)
gdpgrowth	20778.1***	9459.3	19288.6***	34732.7***
	(7.20)	(0.63)	(7.18)	(3.99)
realintrate	35.43	10645.3	-20994.2***	-21100.2***
	(0.01)	(0.92)	(-4.82)	(-3.89)
_cons	-15011.9***	-16551.3	-11796.8***	-11718.3
	(-4.79)	(-0.00)	(-6.00)	(-0.00)
Year Control	No	Yes	No	Yes
Country Control	No	Yes	No	Yes
N	67,340	67,340	103,052	103,052
R^2	0.04	0.19	0.05	0.20

Note(s): *t* statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

It can be observed that the market value of the companies in our sample has a negative relationship with accounting goodwill. These results indicate that the greater the share of goodwill in the firm's total assets, the lower its market value. This is the first demonstration that the market may not evaluate positively firms that present goodwill, especially when the weight of goodwill on the company's balance sheet is significant. On the other hand, the MA variable (mascore) has a positive relationship with market value,

indicating that the greater the skills of the management team, the greater the firm's value. We also found that firm size is positively related to market value, while fixed assets (PPE), leverage and profitability (ROA) are negatively related to market value. Previous studies have drawn similar conclusions (e.g. Shahwan, 2004, Zeitun & Tian, 2007; Balasubramanian, Black & Khanna, 2010). All macroeconomic control variables were statistically significant.

We now proceed to the next analysis, based on market return (Δmkvalt). The results are summarised in Table 2.5, which shows the firm's market return (ret1, ret2 and ret3) as a function of goodwill. We consider the following specification:

$$\Delta\text{mkval}_{it} = \beta_0 + \beta_1\Delta\text{gdwlat}_{it} + \beta_2\Delta\text{mascore}_{it} + \beta_3\Delta\text{ppenet}_{it} + \beta_4\Delta\text{lat}_{it} +$$

$$\beta_5\Delta\text{roa}_{it} + \beta_6\Delta\text{leverage}_{it} + \beta_7\text{spglobequity}_t + \beta_8\text{gdpgrowth}_t + \beta_9\text{realintrate}_t +$$

$$\text{year\_control} + \text{country\_control} + \varepsilon_{it} \tag{2}$$

In Table 2.5, ret 1, ret2 and ret3 are measured according to the following formulation:

$$\text{ret1} = \frac{\text{mkvalt} - \text{mkvalt[\_n−1]}}{\text{mkvalt[\_n−1]}} \tag{3}$$

$$\text{ret2} = \frac{\text{stockprcc} - \text{stockprcc[\_n−1]}}{\text{stockprcc[\_n−1]}} \tag{4}$$

$$\text{ret3} = \frac{\text{stockprcc} + \text{dividpshr} - \text{stockprcc[\_n−1]}}{\text{stockprcc[\_n−1]}} \tag{5}$$

Table 2.5

Market Returns and Goodwill

return	ret1	ret2	ret3	ret1	ret2	ret3
dgdwlat	-3.906	**-1.543*****	**-1.534*****	-4.115	**-1.713*****	**-1.705*****
	(-1.72)	**(-4.20)**	**(-4.17)**	(-0.86)	**(-6.89)**	**(-6.86)**
dmascore	-0.445	**0.899*****	**0.901*****	-0.775	**0.992*****	**0.995*****
	(-0.33)	**(5.12)**	**(5.13)**	(-0.29)	**(6.99)**	**(7.00)**
dppenet	-39.02	-2.734***	-2.723***	-28.87***	-2.545***	-2.540***
	(-1.08)	(-7.65)	(-7.62)	(-6.16)	(-12.27)	(-12.24)
dlat	0.0699	0.566***	0.562***	0.413	0.588***	0.582***
	(0.05)	(3.36)	(3.34)	(0.46)	(13.76)	(13.62)
droa	0.341	0.111	0.112	0.232	0.0796***	0.0807***
	(1.03)	(1.09)	(1.10)	(0.67)	(4.09)	(4.15)
dleverage	0.0168	-0.237	-0.236	-0.106	-0.220***	-0.219***
	(0.15)	(-0.99)	(-0.99)	(-0.19)	(-6.46)	(-6.45)
spglobequity	2.119***	1.237***	1.239***	-0.0403	0.529**	0.529**
	(3.44)	(22.35)	(22.38)	(-0.01)	(2.59)	(2.59)
gdpgrowth	-14.07	-4.529***	-4.589***	-7.924	-5.760*	-5.737*
	(-1.86)	(-5.76)	(-5.83)	(-0.13)	(-2.49)	(-2.48)
realintrate	3.649	-4.284***	-4.319***	-0.153	-0.642	-0.612
	(1.21)	(-5.97)	(-6.01)	(-0.00)	(-0.44)	(-0.42)
_cons	0.662***	0.441***	0.454***	7.319	-0.112	-0.109
	(5.78)	(17.15)	(17.62)	(0.11)	(-0.05)	(-0.05)
Year Control	No	No	No	Yes	Yes	Yes
Country Control	No	No	No	Yes	Yes	Yes
N	58,148	92,841	92,841	58,148	92,841	92,841
R^2	0.00	0.01	0.01	0.00	0.01	0.01

Note(s): *t* statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

The first three columns indicate the return models (3), (4) and (5) without year and country fixed effects, whereas the last three columns indicate the same return models with year and country fixed effects. Similar to market value, it can be observed that a firm's market return has a negative relationship with accounting goodwill – that is, a positive variation in the share of goodwill in the firm's assets decreases its market return (ret2 and ret3). These results seem to confirm what the literature has been saying for some time: that most M&A agreements are flawed. This finding is of particular importance, as it suggests that

most reported goodwill does not have the hallmark of an asset, which is to generate economic benefits for the entity.

In turn, changes in mascore has a positive relationship with the firm's market return (ret2 and ret3), indicating that a positive variation in managerial ability increases market return. Regarding the mascore, we can interpret the results as follows. Less skilled managers are related to lower firm market values/returns. This suggests that such managers make worse decisions either "just because" they are less skilled or alternatively, as proposed by the authors, because they are more influenced by other factors such as behavioural biases. Finally, we found that changes in both firm size and ROA are positively related to market return, while changes in PPE and leverage are negatively related to market return.

These initial results made us wonder whether the inverse relationship between goodwill and a company's market value or market return occurs only as a function of the share of the firm's total assets made up of goodwill (gdwlat). Thus, we carried out an additional investigation to verify the difference between companies that have reported goodwill, regardless of magnitude, and those that did not carry out M&A agreements (or at least did not present a balance for the goodwill account). We performed a binary logistic regression in which **gdwlyes** is a dummy variable equal to 1 if a firm has a non-zero value recorded for goodwill and equal to 0 otherwise. The results are reported in Table 2.6.

Table 2.6

Logistic Regression to Compare Returns Between Firms With/Without Goodwill

Dep. Var.	gdwlyes	gdwlyes	gdwlyes	gdwlyes	gdwlyes
mkvalt	-0.00000817***				
	(-5.69)				
mkvaltprc		0.00000167			
		(1.02)			
ret1			-0.0290***		
			(-4.28)		
ret2				-0.0111**	
				(-3.10)	
ret3					-0.0111**
					(-3.09)
ppenet	-3.535***	-3.179***	-3.905***	-3.493***	-3.493***
	(-17.07)	(-22.94)	(-16.76)	(-23.78)	(-23.78)
lat	1.781***	1.519***	1.883***	1.537***	1.537***
	(54.53)	(75.98)	(50.54)	(72.79)	(72.79)
roa	0.400***	0.208***	0.452***	0.296***	0.296***
	(6.94)	(5.15)	(6.62)	(5.97)	(5.96)
leverage	0.393***	0.510***	0.296***	0.496***	0.496***
	(6.38)	(10.15)	(5.59)	(9.09)	(9.09)
spglobequity	0.351***	0.196***	0.549***	0.237***	0.237***
	(4.46)	(3.39)	(6.27)	(3.92)	(3.92)
gdpgrowth	-0.506	-1.923**	0.443	-1.372	-1.373
	(-0.52)	(-2.68)	(0.43)	(-1.84)	(-1.84)
realintrate	-33.06***	-25.80***	-31.76***	-25.33***	-25.33***
	(-38.16)	(-39.78)	(-32.25)	(-37.40)	(-37.40)
N	38,492	65,814	32,818	60,393	60,393
pseudo R^2	0.28	0.27	0.27	0.27	0.27

Note(s): *t* statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1%

levels, respectively.

After controls for firm-level and economic-level variables, the results show a

significant and negative relationship both between market value and goodwill and between

market return and goodwill. As the company's market value increases, it is less likely to have

acquired goodwill. Similarly, the higher the firm's market return, the less likely it is to have

purchased goodwill. These results show that companies reporting goodwill are significantly

more likely to have lower market value and market returns than companies that do not have

goodwill. This finding is quite intriguing, as it suggests that the market reacts negatively simply because the company has acquired goodwill.

From this context, we ask: what is the role of the management team in this relationship? The correlation matrix has shown a negative relationship between goodwill and managerial ability. Does this relationship remain after controlling for firm and economic factors? We carried out another analysis to confirm the inverse relationship between the manager's ability and the probability of carrying out M&A agreements. We performed a stepwise logistic regression; the results are depicted in Table 2.7. They show an inverse relationship between managerial ability and the probability of a firm entering into an M&A agreement with a premium payment. The results suggest that with increasing managerial ability in the company's management team and CEOs, there is a decreasing likelihood that the company will enter into an M&A process. Table 2.7 also shows that larger, more profitable and more leveraged firms are more likely to pay an acquisition premium in a business combination. On the other hand, firms with more fixed assets are less likely to pay a goodwill premium.

Table 2.7

Logistic Regression to Compare Managerial Ability Between Firms With/Without Goodwill

Dep. Var.	gdwlyes	gdwlyes	gdwlyes	gdwlyes	gdwlyes	gdwlyes
mascore	-2.515***	-2.738***	-2.792***	-2.832***	-2.862***	-2.709***
	(-26.05)	(-27.76)	(-24.33)	(-24.39)	(-24.49)	(-21.26)
ppenet		-4.790***	-3.632***	-3.614***	-3.699***	-3.317***
		(-44.11)	(-29.44)	(-29.22)	(-29.68)	(-23.89)
lat			1.601***	1.599***	1.606***	1.508***
			(92.47)	(92.11)	(91.96)	(76.89)
roa				0.0866*	0.295***	0.345***
				(2.30)	(7.31)	(7.45)
leverage					0.645***	0.528***
					(13.94)	(10.62)
spglobequity						0.195***
						(3.37)
gdpgrowth						-1.687*
						(-2.34)
realintrate						-25.25***
						(-38.87)
N	75,943	75,863	75,863	75,863	75,632	66,061
pseudo R^2	0.01	0.04	0.24	0.24	0.25	0.28

Note(s): *t* statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

Considering the results found in Tables 2.5, 2.6 and 2.7, it can be suggested that, on average, companies without goodwill have significantly higher returns than those with goodwill. Furthermore, this relationship seems to be influenced by the decisions (not to acquire other companies) taken by high-skilled managers. As a result, we can suggest that, on average, more able managers (less influenced by cognitive biases) choose not to acquire other companies because they take into consideration the unlikelihood of obtaining economic returns in such transactions.

To assess the sensitivity of our results, we generated two additional market return variables by adjusting stock prices for the split (Compustat item: ajex) performed by some companies (with and without dividends). Non-tabulated results indicate that our findings

remain very consistent. Additionally, we included in the model some variables with the potential to impact our findings – for example, (i) compensation paid to executives (Execucomp item: TDC2) and (ii) other intangible assets (Compustat item: intano).[5] We believe that these variables could influence both reported goodwill and managerial ability. We also replaced net property, plant and equipment (ppnet) with gross property, plant and equipment (Compustat item: ppegt). Once again, the non-tabulated results indicate that our findings remain very consistent.

Finally, we performed two additional tests in order to verify the influence of the main standards issued during the period of our analysis. We first split the sample into the pre- and post-SFAS 142 (1988–2001 and 2002–2018) accounting periods, to examine the influence of this standard. Then, we split between the pre- and post-IFRS 3 (1988–2004 and 2005–2018) accounting periods with the same goal. Non-tabulated results indicate that, in general, our findings do not show significant differences between the two periods investigated, suggesting that our findings are not significantly influenced by the regulations in force.

The discussion presented so far raises quite an important question: doesn't entering into an M&A process generate economic returns for the acquirer? After all, there is a consensus in the literature that the value of accounting goodwill is the expected present value of the going business's future residual incomes (Leake 1921; Martins 1972; Colley & Volkan, 1988; O'Hanlon & Peasnell, 2002). Are there not skilled managers conducting profitable M&A deals? We maintain that there are indeed, but only in a small portion of M&A deals.

To support our proposition that most M&A agreements (with premium payment) are influenced by cognitive biases – and that only a small portion represents economic substance

---

[5] Keeping these variables in our model would significantly impact the number of observations from our sample, which is why we chose to use them only for robustness-testing purposes.

– we generated a variable in order to capture this relationship (Equation 6). We look at the interaction between accounting goodwill and managerial ability. Our purpose is to verify whether the goodwill reported in companies with more able managers (rather than accounting goodwill in general) represents economic substance for these same companies. In this way, the tests will be able to indicate from which scale of the managerial ability score the reported goodwill represents, in fact, the core/genuine goodwill highlighted by the literature.

$$\text{cogbias} = \text{mascore} * \text{gdwl} \tag{6}$$

Following the specifications of Equation (1), we regress the market value variables (mkvalt and mkvaltprc) and market returns (ret1, ret2 and ret3) as a function of **cogbias**. Our purpose is to investigate the magnitude of cognitive biases that influence decision making in an M&A agreement. Our proposition is that only the highest levels of managerial ability associated with goodwill would be free (or have little influence) from the action of cognitive biases and represent economic substance for the acquirer. For this, we rely on the decile rankings developed by Demerjian, Lev and McVay (2012). The authors classify the original mascore in deciles, ranging from 0.1 (the lowest decile of managerial ability) to 1 (the highest).

The results are presented in Table 2.8. It is important to point out that we regressed each dependent variable individually by mascore ranking. For space and for a better understanding, we choose to present the data summarised in a single table. For this reason, we omit the number of observations, the R-squared, and the coefficients of the control variables for each rank. We also omit the non-significant coefficients on the **cogbias** variable that occurred in each rank of the mascore.

Table 2.8

Regressions as a Function of the cogbias Variable by the Rank mascore

	mkvalt	mkvaltprc	ret1	ret2	ret3
cogbias - mascore_rank_0.1	-19.22***	-14.58***			
cogbias - mascore_rank_0.2	-23.56***	-20.20***			
cogbias - mascore_rank_0.3	-28.70***	-15.37***			
cogbias - mascore_rank_0.4	-32.68***	-28.71***			
cogbias - mascore_rank_0.5	-26.07***	-29.60***	0.000367*		
cogbias - mascore_rank_0.6					
cogbias - mascore_rank_0.7	41.60***	38.98***			
cogbias - mascore_rank_0.8	25.61***	19.81***			
cogbias - mascore_rank_0.9	22.41***	16.68***		0.0000605*	0.0000622*
cogbias - mascore_rank_1.0	9.335***	9.385***	0.0000336*	0.0000172***	0.0000175***
ppenet					
lat					
roa					
leverage					
spglobequity			**omitted**		
gdpgrowth					
realintrate					
_cons					
N					
R2					

Note(s): *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

The results show that the dependent variables investigated are negatively associated (or do not present a statistically significant relationship) with the cognitive bias proxy in most observations. The first two columns show that market value is positively associated only in the last four deciles of the managerial ability ranking. This suggests that only at these last levels might decisions have occurred free (or with little influence) from psychological bias, thus representing economic substance for the acquirer. Considering the number of observations per rank, this positive relationship represents about 39% of the observations.

Even more restrictively, only in the last decile of the rank does the stock price show a positive and statistically significant relationship (non-tabulated).

Continuing with our analysis of Table 2.8, the last three columns indicate the relationship between market return (ret1, ret2 and ret3) and our proxy for cognitive biases (cogbias). As expected in our proposition, it was observed that only in the highest ranks (specifically, the highest two ranks) of the mascore is there a positive and statistically significant relationship. Considering the number of observations per rank, this positive relationship represents about 15% of the observations. In other words, our findings suggests that only 15% of the goodwill reported by companies has a positive relationship with market return. Only at these highest levels of mascore might decisions have occurred free (or with little influence) from psychological bias.

The results suggest that only M&A deals carried out by high-skilled managers could be "free" of cognitive biases and provide economic returns for acquirers. Although we have found no studies similar to this one, we can observe in the literature results that corroborate our findings. For example, Chen and Lin (2018) found that high managerial ability leads to M&A deals with significantly positive announcement abnormal returns and long-term buy-and-hold abnormal returns. The authors also found that M&A deals with high managerial ability, on average, pay lower premiums – that is, they are less likely to feature acquirers overpaying for target firms.

2.6. Concluding Remarks

In this article, we have developed a theoretical–empirical approach discussing a series of cognitive biases influencing decision making, and empirically investigating the difference between companies that have or do not have reported goodwill. The issues addressed in this article have been selected to show the influence of psychology-based factors on the decision-making process, especially on the payment of premiums in business combinations. These

factors cannot be overlooked by accounting, as most M&A agreements are considered flawed.

Although there is consensus on the recognition of acquired goodwill as an asset, our psychology-based argument and our empirical investigation support our proposition that "in theory and in practice" most reported goodwill may be related to decisions influenced by cognitive biases, and does not represent economic substance. Thus, we call special attention to the fact that our findings indicate that only a small portion of accounting goodwill, which is associated with high-skilled managers, truly represents an economic asset positively associated with the market. We believe this is the portion of reported goodwill that really generates residual income.

The literature has offered numerous indications of the influence of cognitive biases in the decision-making process. However, we see no in-depth investigations on the topic in the field of accounting. It is important to discuss such issues, because accounting is a key factor in this process. For Davenport (2020), decision making becomes more important in times of crisis, but it also becomes more challenging during periods of stress and more difficult when future results are uncertain. This fact occurs because cognitive biases appear in these deeply changeable and high-stress environments, influencing decisions in damaging ways. This may lead to ignoring or misinterpreting the information that conflicts with the decision, actively seeking information that confirms the decision or – if information that conflicts with the decision is overwhelming – changing the decision or the perception of its effectiveness (Kim & Bay, 2017).

"Research is a process of learning and little will be learned if the dominant manner in which we investigate accounting begins with the answer already in hand" (Williams, 2009, p. 277). For this reason, we have sought to examine the nature of accounting goodwill – or at least part of that nature – through other prisms of knowledge. This is necessary because the

decision-making process involves the most complex biological entity in the known universe: the human brain, which has approximately 100 billion neurons, more than 100,000 kilometres of interconnections and an estimated storage capacity of 1.25×10^{12} bytes (Hofman, 2014; Jorgenson et al., 2015).

In this empirical approach, no measure was developed to investigate the relationship between residual income and reported goodwill. We consider this one of the limitations of this study as well as a suggestion for future research. Finally, some questions could be used as inputs for future research: how do the checks and balances on the approval of boards of directors, consultants and investment bankers help to reduce bias? Do they reduce or increase bias? How important are these institutional features? Or is the acquisition the decision of an individual?

3. The Entanglement of Accounting Goodwill: Einstein's "Spooky Action at a Distance"

3.1. Abstract

The idea of applying quantum physics concepts or methods to economic and/or social phenomena is not new. Quantum mechanics is increasingly entering the social world as a means of helping to explain social phenomena. This article extends this approach to the accounting field, to explore the economic nature of goodwill. After reviewing Barad's concept of agential realism, we develop a quantum interpretation and present a new conceptual approach to accounting goodwill. In this theory-building exercise we discuss quantum concepts such as entanglement, diffraction and intra-action to propose a physical and economic inseparability between goodwill and other company assets. We maintain that intangible capital (goodwill) and physical capital are "entangled", and this entanglement forms the company's economic value. Unlike Einstein, we conclude that the entanglement of physical capital and intangible capital through intra-action is not "spooky action at a distance" but a form of wealth creation (or wealth destruction) in companies.

Keywords: goodwill; agential realism; quantum entanglement; quantum social science; economic measurement

3.2. Introduction

The controversial nature of goodwill has been puzzling the accounting community for over a century (Baboukardos & Rimmel, 2014), and finding an optimal solution to its treatment continues to challenge accounting standards setters (Betancourt & Irving, 2019). This underlines its persistent instability within the regulatory framework and the difficulty of finding a satisfactory accounting practice (Rubio, Martínez & Mazón, 2021). This is because most varied components of goodwill remain largely unknown, due to its unique and complex

nature (Wen & Moehrle, 2016; Mazzi et al., 2017). Perhaps for this reason, Garzella et al. (2020) assert that a univocal definition of the very nature of goodwill remains an open issue.

This context leads to the suggestion that it is necessary to dialogue with other areas of knowledge in order to elucidate this enduringly controversial topic. Scholars and standard-setters must still overcome unresolved issues related to the intrinsic nature of goodwill (Garzella et al., 2020), bearing in mind that unravelling the nature of goodwill is an interdisciplinary task (Kliestik et al., 2018). This theory-building exercise builds on the aforementioned context to investigate not concepts of goodwill but rather the very nature of goodwill. We bring together some concepts from other areas of knowledge, such as quantum physics and economics, to expose how the process of generating residual earnings occurs in firms. In particular, we seek support from agential realism (Barad, 2007; 2010; 2014) to answer the question: "how is goodwill able to generate residual income?" This question is explained by the entanglement of what we will call "physical capital" and "intangible capital". In short, entanglement is an odd phenomenon in which seemingly separated quantum systems behave as one (Bruza, Busemeyer & Gabora, 2009).

Agential realism is a holistic approach that uses insights from quantum theory to propose a new understanding of how discursive practices relate to the material world. "Agential" relates to the idea that everything does something; everything is performative, and nothing is delimited. Everything is always in intra-activity with something else. "Realism" refers to the fact that this "agentiality" has real effects: that is, realism is about the real effects of intra-activity (Højgaard & Søndergaard, 2011). "Intra-action" is a neologism referring to the mutual constitution of entangled agencies, and assumes that different agencies do not precede one another (Barad, 2007, p. 33).

Another term used in this essay to support our proposition about the nature of goodwill is quantum diffraction. This means the spreading or bending of waves around

obstacles (Agarwal, 2012; Cozza, 2021). The explanation for this phenomenon would be to imagine light behaving "as a fluid which upon encountering an obstacle breaks up and moves outwards in different directions" (Barad, 2014, p. 171). This concept will help explain the uniqueness observed in each merger and acquisition (M&A) agreement.

Due to the requirement for individualisation of balance sheet items, accounting treats goodwill as a separate item in a business entity's list of assets. This view occurs because accounting is based on the epistemological separation of tangible and intangible assets, each exercising a separate role in pursuing a company's objectives (the Cartesian view). This essay holds that the nature of goodwill should be seen as a set of forces that act as drivers of profit in excess. This set of forces does not exist either physically, or economically separate from physical capital. Therefore, goodwill alone is not capable of creating abnormal earnings.

In other words, value creation involves the transformation of ideas into physical (real) capital, with intangible capital remaining intertwined with the physical (as if it were a fingerprint). This is like saying that the inspiration of brilliant minds like Leonardo da Vinci or Nikola Tesla would be of no (or little) value if their ideas had not become physical capital in the forms of the Mona Lisa or the transmission of alternating currents (Oliveira, Lustosa & Gonçalves, 2021). This relationship between goodwill and physical capital creates the firm's oneness and drives the generation of residual income.

We thus argue that the total value of the firm as a going concern is made up of two dynamically entangled components, one physical and the other intangible. An economic measurement of these two wealth states would capture this entanglement, as both reflect the present value of expected future residual earnings. Physical capital represents management decisions already implemented – that is, ideas, plans and strategies made material in the firm's assets and liabilities. Such liquid assets, despite being represented separately on the balance sheet, are quantumly entangled in terms of economic value. Intangible capital (or

goodwill) represents management decisions not yet implemented. It is latent, potential wealth. It represents the present value of future residuals that will arise in future asset exchanges. We sustain that goodwill "becomes" physical capital and is renewed (or not) as new ideas, plans and strategies arise to feed the decision-making process.

It is important to emphasise that the subatomic world of quantum physics is increasingly used to explain social-economic phenomena. Haven and Khrennikov (2013) state that "employing quantum mechanical principles in a social science environment can provide for potential additional insights" (p. 5). Quantum social science is making significant progress as an emerging field (for reviews, see Haven & Khrennikov, 2013; Wendt, 2015); it is a recent development and no generally accepted criteria exist for mapping its borders (Höne, 2017). Thus, we use this approach to support the economic nature of goodwill and its relationship with other assets. Since larger systems consist of smaller systems, quantum mechanics also applies to large systems (Hardy, 1998).

Moore (2017) uses the approach of quantum entanglement to present an alternative to the concept of accounting entity. We expand this approach by providing a theoretical underpinning that supports comprehension of the dynamics of goodwill with the company's physical capital. We offer new insights that shed light on the nature of goodwill. We believe this article has practical implications, as we discuss some issues that involve accounting treatment of acquired goodwill.

The remainder of this article is organised as follows. Section 2 briefly addresses the nature of goodwill, entanglement and the separability assumption, and the link between accounting and quantum physics. Section 3 addresses our theoretical framework. We discuss agential realism, quantum entanglement, quantum diffraction, economic measurement, opportunity cost and general systems theory. The fourth section discusses our proposal in

more depth, making links between aspects of previous sections. The final section presents our concluding remarks.

3.3. Background

3.3.1. Discussing the Nature of Goodwill

Even today the controversy around goodwill remains evident (Wen & Moehrle, 2016; Rubio, Martínez & Mazón, 2021). The debate on the topic involves three main conceptual issues: (i) whether acquired goodwill should be recognised as an asset; (ii) whether goodwill should be amortised; and (iii) the conditions under which a company should recognise an impairment of goodwill (Iatridis, Pappas & Walker, 2021). Discussion of the topic is important because goodwill is usually the primary asset in listed firms' balance sheets (Filip, Jeanjean & Paugam, 2015).

In fact, confusion has surrounded goodwill since the first studies on the subject. In his doctoral dissertation, Hughes (1972) concluded that "problems associated with attempts to define and understand the nature of goodwill are symptomatic of the more general problem of understanding the nature of assets" (p. 476). Over time, the accounting community has investigated goodwill with a focus on intangible factors that contribute to the generation of abnormal future earnings, and not on the physical process as these surpluses occur. Thus, confusion about the real nature of goodwill is firmly rooted in the literature, as evidenced by accountants' attention to valuation formulas rather than underlying assets (Courtis, 1983). Perhaps because of that, the rejection of accounting standards on goodwill is common and the nature of goodwill remains poorly understood by most accountants (Ma & Hopkins, 1988). Understanding the nature of goodwill is the first step towards consensus on the topic. As stated by Canning (1929, p. 44), "the analysis of the nature of things is a problem apart from the quantitative measurement of the same things, and must, […] in any critical analysis of a statistical procedure, be dealt with first".

Existing studies have discussed the nature of goodwill and added valuable contributions to the accounting literature. Lee's (1971) proposal on the nature of goodwill is partly similar to that advocated in this article. Lee sees goodwill as an aggregate of several business resources, but holds that it is not an asset per se, even if some resources benefit the firm. For Lee, goodwill is simply a word to conveniently describe various business resources that contribute to the overall profitability of the firm. Advocating the opposite approach, Falk and Gordon (1977) hold that the fact that goodwill is added to the company and cannot be sold separately from it and/or be easily measured does not invalidate its nature as an asset, since goodwill can have significant value for the firm.

Myers (1977) uses economic concepts to show that a significant part of the market value of many companies is accounted for as assets that do not yet exist – that is, "by the present value of future growth opportunities" (p. 150). The author names these "real options". He does not refer explicitly to goodwill, but this issue seems evident when he states: "the real options may be firm-specific, having no value to any other firm. **This could occur if real options are to some extent embodied in real assets**, so that the options cannot be purchased separately" (Myers, 1977 p. 163 – emphasis added). Although the purpose of Myers's article is to address the determinants of corporate borrowing, we consider the concepts adopted by the author to be valuable for understanding the nature of goodwill.

Courtis (1983) carried out a study on the evolution of the meaning of goodwill by listing numerous authors who have addressed its nature from different perspectives. For Courtis, goodwill can be criticised for confusing the nature of the concept with a technique for ascertaining its value. Ma and Hopkins (1988) assert that the nature of goodwill continues to be misunderstood by most accountants. They discuss a dynamic open system perspective to explain the synergy from asset interaction (item 4 from Johnson and Petrone, 1998) as creating superior earnings. However, such a perspective is compatible only for internally

generated goodwill. Ma and Hopkins contend that there is an inability to identify the stream of benefits specifically associated with purchased goodwill. Unlike their perspective, our approach is compatible for both types of goodwill: (i) internally generated goodwill; and (ii) acquired goodwill.

The present study expands the literature on the nature of goodwill by postulating a new approach that considers goodwill an integral part of real assets – that is, as something intrinsically embedded (entangled) in the company's real assets. This differentiates this essay from previous studies on the nature of goodwill. The literature has linked the handful of attributes (good reputation, managerial ability, intellectual capital, strategic location, employee motivation, etc.) that make up goodwill directly to the final effect of value creation (residual earnings) as if goodwill itself (or acting with other assets) can generate residual earnings. The proposal of this essay is that goodwill is a kind of "intangible raw material" entwined in both the current and the future physical capital of the company. All this is supported by quantum theory foundations.

3.3.2. Entanglement Versus Separability

The requirement for an asset to be separable in nature (El-Tawy & Tollington, 2013), makes it very difficult to realise the entangled relationship between the various elements that make up goodwill and the company's physical capital. In fact, this has long been a difficulty for both accounting research and the accounting profession. In this regard, Moore (2017) asks, "the very essence of accounting practice is to carve the world into categories, but how do we know where to make the cuts?" (p. 125.) We build on the foregoing premise to argue that the nature of goodwill can be better understood if we consider a view that takes into account no predefined boundaries on the performance of intangible capital.

We believe confusion surrounding the nature of goodwill stems from the fact that studies do not consider the entanglement effect, that is, an entanglement of goodwill with the

company's real assets or physical capital. Without this perception, standard-setters and scholars can only perceive the final product of this relationship: residual income. Consequently, the prevailing view in the literature is that goodwill cannot be separated from the company as a whole (Falk & Gordon 1977; Wiese, 2005; Wen & Moehrle, 2016) or that goodwill is not directly associated with any specific identifiable rights (Zang, 2008). This is a challenging scenario for accounting measurement. Maybe that is why Allee (2008) states that:

> one of the most important and challenging questions in working with intangibles is how do we convert intangible assets such as human knowledge, internal structures, ways of working, reputation, and business relationships into negotiable forms of value? (p. 5)

Allee addresses the conversion and use of intangible assets based on value network analysis. Our approach differs, as we maintain there is an onto-epistemological coexistence of physical capital and intangible capital, which is converted into value for the organisation.

Some authors state that goodwill is connected to the other assets acquired in a business combination rather than being a standalone asset that meets the definition of an asset in the conceptual framework (e.g. Kaplan & Norton, 2004; Brouwer, Hoogendoorn & Naarding, 2015). However, the existing literature provides no theoretical basis to support such an assertion. We, in turn, postulate, based on agential realism, that goodwill cannot be separated from the physical capital of the firm because this is the onto-epistemology of goodwill. This is a subtle differentiation, but one that makes a huge difference for the understanding of the nature of goodwill – mainly because by stating that goodwill is entangled in the firm's real assets, we assert that goodwill, by its very nature, is not an asset that generates future economic benefits or residual earnings. What generates excess profits is both present and future physical capital entangled with intangible capital. Thus, we claim that goodwill is a constituent part of physical capital.

Mouritsen (2003) discusses the entanglement and disentanglement of all the company's intangible resources (intellectual capital and intangible assets) from a capital market perspective. Based on Callon's (1998) work, Mouritsen highlights that committing more items to the balance sheet is a process of disentangling these intangible elements. According to the author, "These are made visible by a procedure of inscription through which they are made recognisable and represented by names and numbers on paper" (p. 21). Our proposal differs from Mouritsen's approach, by dealing with an entangled relationship between goodwill and the company's physical capital. It is a kind of "till death do us part" relationship. For example, when a company's good reputation collapses, it is as if that organisational virtue is disentangled from its physical capital (a bad reputation arises that becomes entangled in products and services). This can lead to what Mouritsen (2003) calls "overflow": it can spill over into other intangibles such as customer loyalty. That is why Mouritsen claims that intellectual assets have more "overflow". Our proposal maintains that as long as this relationship exists (as in the example of good reputation), there is no way to physically and economically separate intangible from physical capital. Notwithstanding, we agree with Mouritsen that "the resource or asset does not conform with the requirements of an external rule-setting institution, but more with the idiosyncratic principles of value creation that can be found in the specific firm" (p. 22).

3.3.3. *Linking Accounting and Quantum Physics*

The idea of applying physics methods to social phenomena goes back to the nineteenth century (Stauffer, 2013; Kutner et al., 2019). In 1979, the French theorist and philosopher of science Bernard d'Espagnat stated that "the doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment" (d'Espagnat, 1979, p. 158). Bourdieu, Chamboredon and Passeron (1991, p. 23) state that:

Scientific rigour by no means obliges one to forswear all use of analogical schemes for explanation or understanding, as is shown by the use that modern physics can make of paradigms – even mechanical ones – for didactic or heuristic purposes. But they still have to be used scientifically and methodically.

Nowadays, sociophysics and econophysics (will "accountphysics" one day exist?) are approaches which use ideas, models and conceptual methods of physics applied to socio-economic phenomena (Kutner et al., 2019). As stated by Wendt (2015, pp. 2–3), "The mind and social life are macroscopic quantum mechanical phenomena (...) human beings and therefore social life exhibit quantum coherence (...) this argument is not an analogy or metaphor, but a realist claim about what people really are."

Since accounting uses statistical tools to analyse and understand patrimonial phenomena, it is surprising that little accounting research has used the concepts and methods of statistical mechanics or statistical physics. The tools of statistical physics turned out to be extremely useful when applied to complex systems (Chakraborti et al., 2011) – and organisations can be characterised as complex systems (Dooley & Van de Ven, 1999; Schneider & Somers, 2006; Scott & Davis, 2007). Nonetheless, there are incipient studies linking accounting and quantum theory. Moore (2017) draws attention to this fact, stating that:

… while some disciplines are beginning to view firms as entangled social organisms with problematic boundaries, the accounting profession's ability to adapt may be constrained by a philosophical foundation that treats boundaries of reporting units, accounting practice, and even academic discourse as self-evident. (p. 125)

In turn, concepts and methods from quantum mechanics have been used in many fields of knowledge outside physics. For example, Jimenez and Moya (2005) dialogue concepts from mathematics, game theory and economics with concepts from quantum mechanics to explain the mixed strategy Nash equilibrium. The Nash equilibrium is widely

used in accounting research (e.g. Dye, 2002; Liao & Radhakrishnan, 2020). Haven and Khrennikov (2013) indicate large avenues for potential research relating quantum mechanics to areas such as decision-making, economics, finance and statistics.

Among the scarce studies connecting accounting and quantum physics, Fellingham and Schroeder (2006) discuss the relationship between quantum information and double entry accounting. The authors address concepts such as quantum entanglement, quantum interference and quantum probability to show that due to quantum interference, performance measurement for two activities in an organisation is more efficient than independent evaluation of those two activities. Demski et al. (2006) explore a connection between quantum information and conceptual applications to accounting. They state that:

> … exploring the theory of quantum information provides us "a new and exciting way to think about the fundamental laws of accounting" […] Such thinking will undoubtedly enrich our approach to accounting in dealing with accounting information. (p. 460)

In another example, Abreu (2016) documents that some laws of physics have important implications for firm valuation. The author demonstrates the relevance of physics to accounting by developing a firm value model based on econophysics concepts. This model is a mathematical function of six economic effects – operational, investment, financial, dividends, tax and market – derived from corporate strategies adopted by the firm. Using quantum economics concepts, Orrell (2018) documents that money acts as an entanglement device:

> Financial instruments […] act as contracts between two parties, which means that a change in one, instantly affects the other. The debt/credit relationships in the economy, therefore, act to create an intricate web of entanglements […] What distinguishes these entanglements from classical network links, is that they represent ties between abstract numbers and real assets. (p. 67)

We expand the literature relating quantum physics to accounting, providing a solid theoretical basis for the nature of goodwill not addressed in previous studies. Quantum theory holds that when two particles (or systems) are entangled, they affect each other instantaneously, regardless of distance. This relationship between the two particles is a phenomenon Einstein called "spooky action at a distance" (we will discuss it in detail in the next section). From this famous phrase, we develop a quantum argument to show that the relationship between goodwill and a firm's physical capital is not spooky action, but a natural relationship developed by organisations.

The approach discussed in this essay goes beyond delineating particular physical assets or spaces. It challenges currently accepted standards, since accounting is an inherently territorialising activity (Mennicken & Miller, 2012; Miller & Power, 2013). It also challenges the role of accounting numbers as inscriptions (Latour, 1987) by moving from focusing on writing, graphs, tables, spreadsheets etc. to focusing on organisational phenomena such as entanglement and intra-action. In this essay we call attention to a deeper reflection on the relationship between "quantifying" and "qualifying" (Robson, 1992) for the development of knowledge. The entanglement proposed by agential realism provides the clues for accounting numbers to better reflect the multiple attachments that make up the accounting phenomenon (Justesen & Mouritsen, 2011). The approach proposed in this essay can also greatly reduce the incompleteness of accounting information (Jordan & Messner, 2012; Busco & Quattrone, 2018). For example, the quantum measurement (discussed in Section 3.4) of organisational phenomena can support the decision-making process.

It is in this spirit that an alternative proposal was sought to understand the nature of goodwill. Accounting, as a social science, must also enter this quantum world. Perhaps much of the controversy and lack of consensus on the topic can be elucidated from this approach. Ma and Hopkins (1988) claim that to understand the nature of goodwill we must go beyond

the question of measurement and ask why residual income exists. In addition to this, we argue that it is also necessary to question the relationship between physical and intangible capital. How do they interact? Are they really separate entities? Does one prevail over the other? These and other questions directed our research on theoretical literature to the field of sociomateriality (addressed in the next section).

3.4. Theoretical Framework

The theoretical space of this essay includes: (i) the theory of agential realism (Barad, 2007; 2010; 2014), to show that physical and intangible capital are entangled on the quantum level and that the economic output of this entanglement is the intra-action or cuts that give economic meaning to transactions; (ii) economic measurement theory, centred on the concept of opportunity cost (Coase, 1937; 1990), to provide insights into the nature of the formation of residuals that originates goodwill (or badwill) in the dimension of physical and intangible capital; and (iii) general systems theory (von Bertalanffy, 1968; 1972), to demonstrate that the intangible dimensions of the business system materialise in the physical operational, or tangible, dimension.

3.4.1. Agential Realism

The initial context of agential realism is embedded in the theoretical assumptions of sociomateriality (for reviews, see Orlikowski 2007; 2010; Orlikowski & Scott 2008; Scott & Orlikowski 2009), which makes the general theoretical assumption that the social and the material are so fundamentally related that it makes little sense to speak of one without speaking of the other (Leonardi, 2013). In other words, sociomateriality is a theory that posits the constitutive entanglement of the social and the material in everyday life (Orlikowski, 2007). Leonardi (2013) states that these first debates about sociomateriality were influenced by the works of Latour (1987; 2005), maintaining that phenomena can only be described properly if researchers "direct their attention to the empirical reality that people, ideas,

objects, artifacts, nature, and the like are all joined together in an intricate network of associations that develop momentum over time" (p. 61).

Barad's agential realism has consequences for understanding of the social world. Even using quantum physics, which involves subatomic scales, as a basis does not prevent the application of scientific perceptions to understanding human beings' daily lives (Fonseca, 2018). Reflecting on the concepts addressed in sociomateriality for the field of physics, especially the quantum theory studies by Nobel laureate Niels Bohr, Barad (2003) questions the paramount importance attributed to language and culture at the expense of the material:

> How did language come to be more trustworthy than matter? Why are language and culture granted their own agency and historicity while matter is figured as passive and immutable, or at best inherits a potential for change derivatively from language and culture? (p. 801).

Thus, Barad seeks to raise materiality to the same level as language and culture. With this objective, Barad (2003) denies any ontological distinction between the representations and the entities represented. In fact, the need to adopt an asymmetrical view in relation to representations rather than things is just a Cartesian habit of mind. Barad's intention is to (re)construct a whole theory about space, time, matter and causality, among other aspects, that interconnects the material (physical) and social (personal) worlds. In the same way, we present the interconnection between intangible and physical capital. Barad does not postulate the physical world and the social world as belonging to different orders and scales of magnitude. Rather, she emphasises exactly the dynamism of the interactions between these two axes (Büscher & Veloso, 2018). "The social and the material are constitutively entangled in everyday life […] the social and the material are considered to be inextricably related – there is no social that is not also material, and no material that is not also social" (Orlikowski, 2007, p. 1437).

Despite Latour's influence, the agential realist approach, used to support the nature of goodwill, differs from the actor-network theory as the latter proposes an action of different

actors in a given context. It is used, for example, to explain the impairment test of goodwill, but not its nature. In Huikku, Mouritsen and Silvola (2017), actor-network theory is intelligently used to show that the joint action of several actors (human and non-human) external to the organisation influences the preparation of financial statements (including the calculation of goodwill impairment). Agential realism goes beyond such an approach by proposing an onto-epistemological relationship between the physical and social worlds. There is not an interaction between two autonomous actors, but rather an entangled relationship of different agencies that reveals itself in social phenomena. Cecez-Kecmanovic et al. (2010) point out that technologies, people and organisations are not seen *a priori* as autonomous entities influencing each other through impacts or interaction. Instead, technologies, people and organisations are seen as constitutively entangled, implying that we can only separate them analytically.

We postulate that understanding of the nature of goodwill is anchored in the assumptions of sociomateriality, in particular the agential realism proposed by Barad. This theory helps us to understand materiality as part of a social phenomenon (Orlikowski, 2007; Schatzki, 2010), given that this essay proposes the physical and economic inseparability of physical capital from intangible capital. Barad does not make a distinction between the material and the discursive, but usually connotes them as a single "material-discursive", highlighting their inseparability (Tobias-Renstrøm & Køppe, 2020). Such an inseparability (entanglement effect) is the onto-epistemological characteristic of the relationships between technology and science, nature and culture, space, time and matter.

3.4.2. Quantum Entanglement

Quantum entanglement was proposed by John S. Bell (1964), who showed mathematically an incompatibility between quantum mechanics and the concept of local realism proposed by Einstein, Podolsky and Rosen (1935) in their "EPR paradox". Local

realism is a foundation of classical physics (Nagata et al., 2004). The term "realism" refers to the fact that an external reality exists independent of observation – that is, the results of observations are a consequence of properties of physical systems (Gröblacher et al., 2007). The term "local" refers to the fact that objects cannot signal one another faster than the speed of light (Shalm et al., 2015), meaning "local events cannot be affected by actions in space-like separated regions" (Gröblacher et al., 2007, p. 871). It turns out that in the quantum world things happen differently. Quantum entities continue to interact no matter how far apart they are (Nicolescu, 1999).

Bell's theorem nowadays stands as a cornerstone of modern quantum information science (Shalm et al., 2015). His proposal took the form of a set of inequalities, known as "Bell inequalities", which can be violated only by entangled systems (Souza, 2008). When two systems are entangled, a local measurement performed on one instantaneously collapses the state of the other (Wittmann et al., 2012). That is why quantum mechanics does not allow a local realistic interpretation (Nagata et al., 2004). By maintaining local realism as a fundamental concept, Einstein sought an alternative explanation by introducing a "spooky action at distance", either between independent systems or within a single extended system (d'Espagnat, 1979).

The tipping point in this part rests on "intra-action", since interaction presupposes the pre-existence of separate individual agencies. The neologism "intra-action" refers to the mutual constitution of entangled agencies, and assumes that different agencies do not precede one another, but emerge through their intra-action. This "difference" is only in a relational sense, not absolute: that is, "agencies are only distinct in relation to their mutual entanglement; they don't exist as individual elements" (Barad, 2007, p. 33).

The concept of entanglement allows us to disagree with Einstein: there is no spooky action at a distance. What happens is a relationship in which one is rapidly affected by the

other due to entanglement. This makes perfect sense in the "physical–intangible" relationship. For example, a variation in a firm's intellectual capital, a new idea in the organisation's environment or damage to the firm's reputation can each directly impact a firm's physical capital (products/services). Likewise, trouble with physical capital impacts its intangible capital, as people, technologies and the organisation are constitutively entangled (Cecez-Kecmanovic et al., 2010). When quantum entities become entangled, one cannot manipulate one constituent without simultaneously affecting the other (Bruza, Busemeyer & Gabora, 2009). Therefore, in the same way that quantum entanglement explains the relationship between two particles, the entanglement of accounting goodwill explains the relationship between physical and intangible capital.

3.4.3. Quantum Diffraction

Diffraction is at the core of quantum mechanics (Sanz, Borondo & Miret-Artes, 2002). The term was coined by the physicist Francesco Grimaldi, who observed the diffraction (from the Latin *diffringere*, "to break into pieces") of light within a shadow. For him, "there is no sharp boundary separating the light from the darkness: light appears within the darkness within the light within" (Barad, 2014, p. 170). For Højgaard and Søndergaard (2011), diffraction is "the way in which waves combine and move […] The movements **implicate differences as generated from within**" (p. 344 – emphasis added). The term appears as a metaphor in Haraway (1992), as a feminist tool to rethink differences beyond binary opposition and as an alternative to reflexivity (Kaiser & Thiele, 2014; Bozalek & Zembylas, 2017).

Haraway is inspired by the optical phenomenon of diffraction as a metaphor and a method of knowledge production (Sehgal, 2014). Diffraction can serve, according to Haraway, "as a useful counterpoint to reflection: both are optical phenomena, but whereas the metaphor of reflection reflects the themes of mirroring and sameness, diffraction is marked

by patterns of difference" (Barad, 2007, p. 71). Barad's agential realism advances the use of diffraction as a concept, as she does not consider it merely an optical metaphor, but also a method and a practice (Bozalek & Zembylas, 2017). As stated by Kaiser and Thiele (2014, p. 165), "with Barad's quantized diffraction, a relational ontology emerges that can no longer be categorically separated from its epistemological processes".

"Diffraction does not produce 'the same' displaced, as reflection and refraction do" (Haraway, 1992, p. 300). That is why goodwill finds support in the concept of diffraction: goodwill (whether generated internally or acquired) has peculiar characteristics even in similar companies – characteristics which vary according to companies' intention to use the assets. Given that intangible capital is latent in the minds of managers in the form of ideas, plans and strategies, and given the inherent individuality of each person and organisation, goodwill is also expected to manifest in a particular way in each organisation. Its effects manifest in the firm's results – an idea supported by diffraction. According to O'Donnell et al. (2003) plans, ideas and strategy making are probably much closer to a quantum probability wave that changes its shape each time we observe it than to a linear and predictable Newtonian equation.

Haraway (1992, p. 300) states that "a diffraction pattern does not map where differences appear, but rather maps where the effects of difference appear". It is precisely in the difference between companies that goodwill shows one of its main characteristics. As stated in the previous section, creating residual earning is a difficult task. It requires that a company differentiate itself from competitors and be in a constant process of change – of constant reinvention of itself. This occurs diffractively through the innovation of its products, services offered, work processes and so on. Regarding acquired goodwill, a company offers an acquisition premium based on the unique characteristics conferred on it and how these characteristics can become entangled to generate a synergistic value created by the

acquisition (Henning, Lewis & Shaw, 2000). This depends on a number of unique factors such as systems, machines, employees and suppliers. "Systems influence individuals, and individuals call forth systems. It is this relationship that evokes the present reality. Which potential becomes real depends on the people, the events, and the moment" (Wheatley, 2006, p. 36). Perhaps because of this, applications of quantum theory have appeared in decision-making literature (e.g. Busemeyer, Wang & Townsend, 2006; Trueblood & Busemeyer, 2011; Yukalov & Sornette, 2011; Busemeyer & Bruza, 2012).

The physical–intangible relationship will always change after a business-combination process. The new business environment, however small the impact of the acquisition, will be different to the environment before the combination. When quantum entities become entangled, they form a new entity with properties different from either constituent (Bruza, Busemeyer & Gabora, 2009). This is supported by diffraction. Diffraction is not a defined pattern, nor is it a single event that takes place in space and time; on the contrary, it is a dynamism that is essential for space–time. Each moment is an infinite multiplicity (Barad, 2014). The incorporation of a company brings with it a minimum of ingredients that, added to other factors, modify the organisation's decision-making environment. Sometimes this change is imperceptible in the eyes of management, but it is there. Perhaps this is why economic measurement can help to clarify the behaviour of goodwill.

3.4.4. Economic Measurement

Rather than referring to "objects" in the world, with certain limits and properties, Barad's basic unit of reality is what Bohr calls phenomena, "which are temporarily bounded and continuously performed through intra-action" (Hetherington et al., 2018, p. 162). Following this premise, this essay focuses on economic phenomena, more precisely "economic events" – characterised as decisions made in the company that affect its economic value. Analysing the concepts of capital, income and economic profit proposed by Fisher

(1906) and Canning (1929), Lustosa (2017) states that, in any business, the wealth-generation process occurs continuously through thousands of interactions, in each of which new wealth (service) is generated from the use of existing wealth (disservice).

According to Cabrita and Vaz (2005), intellectual capital (part of goodwill) is a phenomenon of interactions, transformations and complementarities. In this way, the economic earnings for a period can be monetarily quantified. They would be the present value of the difference between the value of all new services generated (which increase wealth) and old services consumed (disservices, which decrease wealth).

In Coase's view, businessmen use opportunity cost to make their decisions, but accountants do not help them to do so properly since they have a different view of costs. Coase thus introduces the idea that the decisions of businesspeople are based on an opportunity cost analysis (Bertrand, 2015). Opportunity cost is the value of a resource in its best alternative use (Coase, 1937). This means that the valuation of a resource (asset or liability) depends on the intended use by those controlling it. Lustosa (2017) shows that the economic value of an asset obtained in a transaction can be derived from the mathematical rearrangement of the variables in the decision model. The resulting equation is adjusted at the transactional level to the notation that Ohlson (1995) used to characterise the residual income valuation (RIV) model at the company level. The sum of individual decisions from the beginning of the company until the current moment t generates an RIV for physical capital, resulting from all management decisions already implemented. The remaining portion to obtain the total economic value of the company will be an RIV of potential management decisions, from t to a defined future T – intangible capital or goodwill.

This economic vision has been implemented in the economic management information system GECON,[6] which can be considered a prototype of what Coase (1990, p. 12), for whom "accounting system theory is part of the firm theory", had devised. GECON operationalises the concept of opportunity cost as defined by Coase (1937): "the value of a resource in its best alternative use". GECON labels as a "transaction" each one-time exchange of one asset (disservice) for another (service). A set of transactions of the same nature is called an "event". The transaction is the central object in a manager's decisions, similar to Canning's "desirable event" (1929), since it produces the change in wealth (Lustosa, 2017). In line with this reasoning, Lima et al. (2011) maintain that a company's activities and operations produce economic results and, consequently, modify its equity situation (which is why they are called economic events). In fact, this approach is widely used in economics. According to Ricci and Magni (2014), the notion of residual income implies that the economic value of the asset itself may be calculated with recourse not to cash flows, but only to abnormal earnings.

In GECON, each managerial decision (already implemented and to be implemented) that implies an exchange of assets with the market is measured by the opportunity costs of the resources involved, which in turn define the economic value of the asset obtained in the decision. Accordingly, the value of the asset obtained – its opportunity cost – equals the costs directly sacrificed plus the residual margin or economic profit of the decision. In other words, in GECON the measurement of assets fully preserves its definition as a net flow of benefits (Iudícibus, 2015). Each asset, and consequently the company as a whole, is measured at the present value of expected future residual earnings, as if the company's RIV model (Edwards & Bell, 1961; Ohlson, 1995) were applied at the level of each asset-exchange transaction.

---

[6] GECON is a theoretical model of the nature of organisations that was developed at the University of São Paulo (USP) by professor Armando Catelli, between the late 1970s and the early 2000s (it is addressed in detail in section 3.4).

Using this approach, we can see that intangible competitive advantages should not be valued separately as goodwill, since their effects are the residual profits that are incorporated into the economic value of assets obtained in external management decisions.

3.4.5. General Systems Theory

For the economic approach proposed above to work successfully, a systemic view of the organisation is also needed. Managers' ability to successfully meet future environmental conditions revolves around their understanding of organisations as integrated, dynamic wholes (Miles et al., 1978). The systemic view of a firm strengthens the understanding of the entanglement between physical and intangible capital. This systemically and harmoniously integrated whole would not be the same if any part were missing, or if any part stood out at the expense of another.

The objective of the integrated system and of each of its elements is not, therefore, the maximisation of partial values. The systemic view of a company's effectiveness implies the best way for an element to act for the objectives of the system. This integration of the effectiveness of functional areas into the organisation's overall effectiveness is measured by the result.

The systemic view also implies the belief that a firm's subsystems are equally important. All of them work towards the firm's objectives. This systemic approach is also recommended by the GECON model, which states that a company's system comprises an interrelation of its subsystems, forming a dynamically integrated whole with a specific objective (Pereira, 2001, p. 37). This relationship can be described as follows (Guerreiro, 1989, pp. 170–171):

> … people (social subsystem), with certain authority and responsibility (formal subsystem), provided with the necessary information (information subsystem) and conditioned by certain principles (institutional subsystem) interact in the decision-making process (management

subsystem). Through the interaction of these subsystems, business functions (buying, selling, finance, etc.) are performed in order for the company to fulfil its mission. (Our translation)

GECON is also based on von Bertalanffy's general systems theory in order to model the macro-systems of organisations. With this, GECON aims to fit the theory of the accounting information system to the theory of the firm. More specifically, we can say that the characteristics and requisites of the firm's intangible systems explain the formation of residual income, which takes place in the tangible system, known in GECON as the physical operational subsystem.

The vision of the company as a system is important, as we are dealing with economic measurement at the level of each managerial decision. It is essential that decisions are made with the company as a whole in mind. For example, a decision maker, when seeking to maximise his results, must ensure that he is not harming another department in the firm. A good result for one profit centre may cause deterioration in the results of another. As such, the net margin for the company as a whole can be null or even negative. It is for this reason that the company needs to be understood as a set of entwined subsystems, each one exercising its role in an integrated way and aiming at the result of the firm as a whole.

This section has demonstrated that understanding the nature of goodwill involves, in addition to the quantum issue, an economic approach as well as a systemic approach. With this perspective we are not trying to propose a new form of measurement, but just suggesting that the process of generating residual earnings can be better understood by using such concepts. The objective of using the concepts of opportunity cost and measurement at the decision-making level is to measure each phenomenon that alters a firm's economic wealth.

3.5. Further Discussion

From the various concepts discussed in the previous section, we can now present a deeper discussion of the nature of goodwill. Agential realism proposes that discursive

practices and material phenomena do not stand in a relationship of externality to each other. Instead, they are mutually involved in the dynamics of intra-activity, and the relationship between them is one of mutual entailment (Barad, 2007). From this perspective, we maintain that physical and intangible capital also overlap in the dynamics of intra-action. In other words, despite being valued in a business combination in the form of goodwill, intangible capital does not exist separately from physical capital (assets, products and services). Neither prevails over the other, so the economic value of the company is composed of the sum of the two.

It is proposed that goodwill does not exist separately from the firm's other, physical, elements. Rather, it only reveals itself during the phenomenological process through the intra-action between physical and intangible capital. Thus, we hold that physical capital can be understood as the result of the application of acquired knowledge, idiosyncratic skills, experiences and the way the executive runs the company. This virtuous circle is renewed as new ideas and strategies emerge and are put into practice. These phenomena arise from the decisions of managers (the countless decisions made) as a result of their business's performance.

Decisions occur frequently in the day-to-day life of companies, most of whom change their wealth status without being subject to measurement by traditional accounting. But there is no claim in this article for any change in accounting procedures or standards in this regard. What is intended is to show that "traditional" accounting measurements do not allow the real nature of goodwill to be identified. For this reason, goodwill is treated as a residual value (Martins, 1972; Colley & Volkan, 1988; Eckstein, 2004; Huikku, Mouritsen & Silvola, 2017), and discussions about its nature remain limited to the knowledge generated by a few authors.

The literature addressing fair value measurement (FVM) helps to reduce the gap between the company's book value and its market value. Even so, FVM does not reach the purposes related to the nature of goodwill, mainly because for a predominance of core operating assets, fair value is unknowable, due to the absence of the institutional reality on which fair value implicitly depends (Barker & Schulte, 2017). Looking to agential realism, we see that the method of measurement must be based on the phenomenon. For agential realism, primary reality is based on activities or phenomena which consist of the dynamic entanglement between various agents and objects (Holford, 2018). For Barad (2003, pp. 817-818):

> The primary ontological units are not "things" but phenomena […] phenomena are constitutive of reality. Reality is not composed of things-in-themselves or things-behind-phenomena but "things"-in-phenomena […] it is through specific intra-actions that phenomena come to matter – in both senses of the word.

The economic measurement of each managerial decision allows capture of the entanglement effect proposed in this essay. It can be seen, for example, when negotiating a loan at advantageous rates (skills of finance staff); when negotiating the purchase of raw material, machinery or equipment under more advantageous conditions than the average competitor (skills of the purchasing area); when manufacturing a product or service under different conditions from competitors (competitive advantages); when taking advantage of an adverse situation, such as the current pandemic (ability to reinvent the business); and when strengthening the institutional brand (skills of the marketing area). These business phenomena occur diffractively – that is, they are specific to that moment and context (organisational, economic, social, political, technological …) experienced by a company.

These are examples of situations where a company may be able to make residual earnings, but traditional accounting cannot capture this relationship when they occur. In turn, economic measurement allows verification of the contribution margin of each managerial

decision. It is this contribution margin that is carried over to the firm's final product. All the virtues entangled in today's products and services are the results of past decisions. Likewise, today's decisions will be incorporated into future products and services (and the market prices these future profits at every moment). Finally, to obtain a complete picture of the company's value, it is necessary to add the portion of the decisions that are still to be implemented.

Finally, we emphasise that the process of intra-action between physical and intangible capital must be seen in a diffractive, unique way. By this, we mean that the nature of goodwill is closely related to management's "intention to use". This intention to use, in turn, is based on the specific ideas, plans and strategies of each administration. We illustrate this with an example which is well known in Brazil: the Banespa case. Spanish bank Santander paid a premium of about R$7 billion for the acquisition of Banespa bank, as its plans allowed it to predict excess profits justifying such payment. This amount differed considerably from other bidders. Certainly, whoever won the bid, the value attributed to goodwill would be different, given the particularities of each bidder. This strategy is idiosyncratic. It depends on the specific operational and financial circumstances the acquirer is experiencing, the regional and global economic realities of the time, the moment when the manager ponders the opportunity and perhaps even the psychological conditions of those involved in the M&A process. All of these and other factors are unique to any decision making.

This economic measurement is unique, since the forces acting at the time of the manager's decision are also unique: the cost of the opportunity overlooked, the economic scenario (macro and micro), the company's finances, the sector's budget, pressure from employees and/or shareholders, the institutional environment, politics, the decision maker's mood and so on. The unique environment experienced by the decision maker also finds support in the concept of diffraction. By acting in this scenario, accounting could better

reflect socio-economic phenomena, as they are "spread out in time and space towards heterogeneous elements that help to make their identity" (Justesen and Mouritsen, 2011, p. 184).

Goodwill, according to our proposal, is the positive residual that arises in each asset exchange (if the residual is negative, there would be badwill on that particular exchange). In aggregate terms, over a period of time, goodwill would exist only when the economic value of all net assets obtained in actual – past and present – and potential transactions (i.e. to occur in the future) were greater than the economic value of all resources sacrificed or to be sacrificed in obtaining these assets (included in these sacrifices is the cost of capital mobilised to operationalise the transactions).

We can describe intangible capital as "pulsating" in the moment before its realisation as physical capital. We can perceive this in several ways, such as the recognition of great corporate management or the intellectual capital of an organisation. We can also perceive the final product of the relationship between physical and intangible capital– that is, residual incomes. However, because of our Cartesian view (or even space–time action), we still cannot perceive the process of intra-action between them at the moment they happen. When considering the economic measurement of each managerial decision, the systemic view of the firm and the quantum approach, we can comprehend this complex process.

Pinnuck and Shekhar (2013) claim that one of the most significant properties of accounting is binary classification (the profit versus loss heuristic). However, we swim against the tide by proposing an agential realist approach in the field of accounting. Our goal is to draw attention to the physical–intangible relationship. These are not two separate assets – each achieving results by itself – but form a dynamic, intra-active process. Perhaps the tangible and intangible account classification is also a mere Cartesian habit of mind (as stated by Barad; see Section 3.1). By relaxing this Cartesian dualistic approach (Burrel & Morgan,

1979; Hopper & Powell, 1985) – moving away from the traditional sense of linearity and the binary dichotomy – one can understand in an alternative way the generation of residual earnings.

3.6. Concluding Thoughts

"Research is a process of learning and little will be learned if the dominant manner in which we investigate accounting begins with the answer already in hand" (Williams, 2009, p. 277). This theory-building exercise has addressed an alternative approach that seeks to explain the interaction between subject and object, mind and body, ideas and actions. Such an approach can contribute to a deeper understanding of the nature of goodwill. Theoretical approaches based solely on market and hierarchy are inadequate for conceptualising the intangible nature of intellectual capital (O'Donnell et al., 2003), and consequently of goodwill.

By proposing goodwill as the intangible capital of organisations, we argue that the techniques, expertise, qualities and virtues of human actions are value drivers for physical capital. The actions of both (physical and intangible capital) are entangled in the process of generating residual income. When advocating goodwill as that intangible residing in the ideas and plans of senior management not yet embodied in physical capital, we argue that organisations are valued for what they think and can decide and put into practice. The intangible forces characterising a particular company are elements that create its physical – real – wealth.

Our approach expands the literature on the nature of goodwill. By borrowing the concepts of entanglement, diffraction and intra-action, among others, from quantum physics, we provide a solid basis for this new approach to accounting goodwill. For example, entanglement helps us to understand the simultaneity of the relationship between intangible capital and physical capital. Precisely because they are entangled, we can infer that there is

none of Einstein's spooky action at a distance. Furthermore, quantum mechanics helps us understand this as an economic and social phenomenon in organisations' everyday lives. For this reason, accounting can and should enter this microscopic universe as a way to improve its informational mission.

We conclude, therefore, that the economic reality of an asset is agential. That is, it builds up (mattering) dynamically, in an intra-active process, according to the "quality" of its relationships with other assets and intangible forces and in each specific context. Once again: there is no spooky action at a distance linking goodwill to physical capital, but rather a symbiotic relationship in which one depends on the other to generate superior gains. Put differently, in the going concern, physical capital does not exist without intangible capital, and vice versa. Each exists in function of and for the other. Each reveals the other. Each renews the other. Physical capital and intangible capital are "entangled" to form the economic value of a company.

As it is a theoretical essay, this study has some limitations. First, it has not developed a model to measure the relationship between intangible capital and physical capital. This is an issue for further empirical studies that can corroborate our new approach. Second, our study does not address issues related to the irrational behaviour of managers (Becker, 1962). For example, it may be that many decisions to pay a premium on acquisition do not make economic sense (e.g. overpayment). This is because there are other factors influencing the decision-making process (e.g. psychological factors), and this essay does not discuss this issue.

Should the theory proposed in this article appear promising, an avenue of opportunities for future empirical research would open up, just as is happening in other areas of the quantum social sciences. The most promising trend would be for accounting to use the tools available in statistical physics to evaluate predictive models or models that involve risk

analysis. For example, some studies are using quantum algorithms and quantum computers to price securities and evaluate risk measures such as Value at Risk (Woerner & Egger, 2019); to estimate credit risk (Egger et al., 2020); or to price options and portfolios of options (Rebentrost, Gupt & Bromley, 2018; Stamatopoulos et al., 2020). In the decision-making literature, the fundamentals of quantum probability are also gaining ground, since the trajectory of knowledge and creation in the future is hardly linear (Mouritsen, 2003). Some scholars have argued that classical probability theory is too restrictive to fully describe human cognition (Pothos & Busemeyer, 2009; Trueblood & Busemeyer, 2011; Wang et al., 2013). Thus, this is a field where room can also be found for accounting research, especially for management and behavioural accounting research.

4. Empirical Evidence on the Nature of Accounting Goodwill: An Interdisciplinary Approach

4.1. Abstract

The purpose of this paper is to empirically test the relationship between goodwill (intangible capital) and physical capital. Supported by concepts from quantum theory, we maintain that goodwill alone is not able to generate residual incomes. Instead, the elements that make up goodwill act, entangled with the company's physical capital (present and future), in pursuit of residual incomes. From this assumption, we build a proxy for the entanglement effect by interacting a measure of physical capital (property, plant and equipment) with a measure of intangible capital (managerial ability). Before carrying out the interaction between the variables, we found a positive association between intangible capital and physical capital. We argue that this positive relationship represents: (i) a conversion of intangible capital into physical capital and (ii) the renewal of intangible capital for future conversion. After carrying out the interaction between the variables and controlling for economic and country-year-fixed factors, our findings depict that the entanglement effect is statistically significant for a series of tests performed. For example, entanglement is positively related to both physical capital and the value creation of companies. Our findings suggest that the entanglement effect is a real force in organisations. Our approach offers valuable insights that can help regulators, scholars and investors in forecasting firms' performance. The findings remain robust for sensitivity tests and for other measures of intangible capital.

Keywords: Goodwill, Managerial Ability, Intangible Capital, Quantum Mechanics

4.2. Introduction

Academic literature has long reached a consensus that the value of accounting goodwill is the expected present value of a going business's future residual incomes or "superprofits" (Leake, 1921; Martins, 1972; Colley & Volkan, 1988; O'Hanlon & Peasnell,

2002). This consensus, however, does not exist when it comes to an understanding of the nature of goodwill, which in turn defines how it should be accounted for in financial statements. The controversial nature of goodwill has puzzled the accounting community for over a century (Baboukardos & Rimmel, 2014) and remains in evidence (Wen & Moehrle, 2016; Rubio, Martínez & Mazón, 2021; Iatridis, Pappas & Walker, 2021). Garzella et al. (2020) state that a univocal definition of the very nature of goodwill remains an open issue.

Our purpose in this paper is to shed new light on this issue. Supported by quantum physics and economics, we hold that the nature of goodwill is directly related to the residuals (positive or negative) generated in each managerial decision that occurs in the company's daily life. These economic residuals occur from intangible capital acting not alone, but in entanglement with physical capital. From this perspective, goodwill is considered a set of forces that act as drivers of excess profit, rather than an accounting item capable of generating residual income on its own. In other words, we hold that the intangible elements that make up goodwill (e.g. ways of working, managerial ability, brand image, workforce motivation, organisational IQ, reputation) are intrinsically "entangled" in the organisation's present (implemented decisions) and future (decisions not yet implemented) physical capital.

Oliveira and Lustosa (2022) provide new theoretical discussion about the nature of goodwill. The authors use concepts from quantum mechanics and economics to propose that intangible capital and physical capital are entangled, and this entanglement forms the economic value of a company. Briefly, entanglement is an odd phenomenon in which seemingly separated quantum systems behave as one (Bruza, Busemeyer & Gabora, 2009). Oliveira and Lustosa's proposal regarding goodwill considers its coexistence with physical capital. In a going concern, the two wealth states coexist "intra-actively",[7] because intangible

---

[7] Intra-action is a neologism that refers to the mutual constitution of entangled agencies and assumes that different agencies do not precede one another, but emerge through their intra-action (Barad, 2007 p. 33).

assets need to be combined with other assets to create value (Kaplan & Norton, 2004). In this paper, we expand this proposition to the empirical field. We examine the relationship between intangible capital and physical capital in different research frameworks, using a broad sample of firms over a wide range of time.

Due to the issue of endogeneity among financial variables, our empirical strategy starts with the search for an external variable that can be used as a proxy for accounting goodwill. Since we are claiming that the nature of goodwill is directly related to the residuals of managerial decisions – the "economic events" addressed in Oliveira and Lustosa (2022) – the variable that comes closest to our proposal on the nature of goodwill is managerial ability. The current fair value of goodwill is a function of management's future actions, including managers' conceptualisation and implementation of firm strategy (Ramanna & Watts, 2012). Superior managers are better able to effectively select and execute positive net present value projects (Demerjian, Lev & McVay, 2012), thus differences in managerial ability can have important effects on shareholder wealth (Hayes & Schaefer, 1999).

In particular, we follow the managerial ability approach adopted by Demerjian, Lev and McVay (2012). First, we merge the CRSP/Compustat merged (CCM) database with Demerjian, Lev and McVay's database on managerial ability.[8] Next, we merge it with other databases (Execucomp and Research Quotient from Wharton Research Data Services (WRDS), and indicators from the World Bank database). To create a proxy that indicates the entanglement between intangible capital and physical capital, we select net property, plant and equipment (Compustat item: ppent) as a representative of physical capital; Demerjian, Lev and McVay's (2012) managerial ability score is used as a representative of intangible

---

[8] We are grateful to the authors for publicly sharing their database. Data are available at: https://peterdemerjian.weebly.com/managerialability.html

capital. The proxy of the entanglement effect arises through the interaction between these two variables.

First, we examined the association between intangible capital and physical capital, and found it to be positive and statistically significant. We maintain that this positive relationship indicates two findings, namely: (i) conversion of intangible capital into physical capital; and (ii) renewal of intangible capital for future conversions. Next, we examine the entanglement effect. After controlling for economic and country-year-fixed factors, our main findings demonstrate that the coefficient of the interaction of managerial ability and property, plant and equipment – the entanglement effect (entang) – is positive and statistically significant for a series of tests performed. For example, entang is positively related to firms' physical capital, market value and market return. Our findings suggest that entanglement is a real force in organisations and that investors incorporate the entanglement effect when making decisions. It is observed that entanglement is present in most of the economic sectors investigated. Our findings remain robust for other measures of intangible capital. For example, we used a research quotient[9] measure as a proxy for intangible capital, and the findings remained very consistent.

This paper makes some contributions that may be of special importance to scholars, investors and regulators. First, by deepening the discussion on the nature of goodwill we can take a further step towards a better understanding of this highly controversial topic. Understanding goodwill value correctly is important for investors, auditors and regulators (Hayn & Hughes, 2006). Second, the literature has shown that less than half of all mergers and acquisitions (M&As) are successful. Understanding the role of goodwill as an item capable of generating future residual incomes in this process is of fundamental importance to

---

[9] Research Quotient (RQ) is the Firm's R&D productivity (created by Anne Marie Knott) – that is, the output elasticity of R&D (discussed in detail in the robustness section). Available at WRDS: www.wharton.upenn.edu/.

the accounting research community. Third, we are dealing with a topic that has not previously been covered. Our findings shed light on this topic and open many avenues for future studies, especially for those using quantum physics tools.

After this introduction, the rest of the paper is organised as follows. Section 2 provides a background on the subject. Section 3 reviews the theoretical framework and presents our research hypotheses. In Section 4 we outline our research methodology. Section 5 reports our data and sample construction. In Section 6 we discuss the main empirical findings. Section 7 highlights the robustness test performed. The final section outlines our conclusions.

4.3. Background

One of the most important and challenging questions in working with intangibles is: how do we convert intangibles (e.g. human knowledge, ways of working or reputation) into negotiable forms of value? (Allee, 2008). This paper advocates that the goodwill "becomes" physical capital and is renewed (or not) as new ideas, plans and strategies arise to feed the decision-making process. Thus, we propose an epistemological (or even ontological) inseparability between goodwill and physical capital. This is like saying that the inspiration of brilliant minds like Nikola Tesla or Leonardo da Vinci would be of no (or little) value if their ideas had not become physical capital in the forms of the transmission of alternating currents and the *Mona Lisa* (Oliveira, Lustosa & Gonçalves, 2021).

When we observe any material good or service – for example, AT&T's service, a Toyota car or Apple's iPhone® – a certain amount of intangible capital is entangled with it. The product or service is not only the physical item, but a whole entangled range of thoughts, motivations, ideas, beliefs, expertise, etc. These intangible items seldom affect financial performance directly. Instead, they work indirectly through complex chains of cause and effect (Kaplan & Norton, 2004). When some differential in this (physical–intangible)

entanglement is present – such as in the examples mentioned – it can generate abnormal earnings. Creating residual income is difficult; it is not always possible for companies to achieve. Very few organisations are capable of maintaining a continual or long-lasting flow of residual income. For this to happen, companies must be in a permanent state of innovation.

Prior economics and strategy literature has suggested the complementarity of tangible and intangible assets (e.g., Teece, 1986; Helfat, 1997; Radhakrishnan et al., 2017). This study differs from that literature by proposing an original inseparability between such assets. The onto-epistemological inseparability proposed in this article finds support in quantum theory, especially in the literature on agential realism (for reviews, see Barad, 2007; 2010). Agential realism clarifies the nature of the causal relationship between discursive practices and material phenomena (Barad, 2007, p. 34) and helps us to understand materiality "as an ingredient of social phenomena" (Schatzki, 2010, p. 134). This is closely related to our research goals, given that this article proposes the physical and economic inseparability of physical capital from intangible capital. Concepts from agential realism are important for discussions of subjects previously considered distinct. For example, Holford (2018) discusses the entangled nature of tacit and explicit knowledge.

Quantum social science[10] is a term used to refer to the application of quantum physics concepts to the modelling of social interactions (Bawden, Robinson & Siddiqui, 2015). It has as its goal the investigation of problems within the wide remit of the social sciences, whether in economics, finance, psychology, sociology or other domains of inquiry (Haven & Khrennikov, 2013, p. 62). This field of knowledge proposes an entangled relationship between the material and the immaterial. We extend this approach to the empirical field by examining whether the financial numbers mirror such entanglement.

---

[10] For reviews, see Haven and Khrennikov (2013) and Wendt (2015).

4.4. Literature Review and Hypothesis Development

4.4.1. Is Accounting Goodwill an Asset?

There is already extensive literature discussing goodwill as an asset. Since both the prevalent literature and current accounting regulations have a widely agreed understanding that goodwill is an asset, we focus this section on the scarce literature that argues just the opposite. The point is that the prevailing trend in the literature is to recognise these competitive advantages as intangible assets of indefinite useful life (Tearney, 1973; Lev, 2004). We, on the other hand, follow the literature that questions goodwill as an asset.

According to Martins (2020), the problem of whether to conceptualise goodwill as an asset or not should be analysed primarily from the definitions of assets themselves. First, whether goodwill can be interpreted as an economic resource or not. Second, which right represents goodwill? Brouwer, Hoogendoorn and Naarding (2015) state that "Although future economic benefits may be expected, goodwill consists of unidentified items and not of rights that are controlled by the entity" (p. 153).

When carrying out an M&A agreement with payment of an acquisition premium, the figure of "promised goodwill" (O'Hanlon & Peasnell, 2002) arises. Notwithstanding, this is not a right to receive future residual income. This is an expectation that may or may not be fulfilled. Actually, the highest probability is an absence of residual earnings, as the literature considers that most M&A agreements are unsuccessful (Cartwright & Cooper, 1990; 1993; Seo & Hill, 2005; Cartwright & Schoenberg, 2006; Calipha, Tarba & Brock, 2010).

Perhaps due to the uniqueness of these elements (managerial ability, creativity, expertise, organisational IQ, employee motivation, personal skills, etc.), several scholars argue that goodwill is not an asset. For example, Johnson and Petrone (1998) assert that goodwill has the capacity "**in combination with other assets**" (p. 6, our emphasis) to contribute to cash flows. However, goodwill lacks the capacity to singly contribute directly to

future net cash inflows. Market penetration and a superior operating team are not rights which could be described as being controlled by an entity (Booth, 2003). Intangibles are frequently embedded in physical assets, leading to considerable interactions between physical and intangible assets in the creation of value (Lev, 2001). Booth (2003) names goodwill as "the identified unidentifiables", and holds that they:

> do not qualify either as a "right" or as future economic benefits, which can be controlled by an entity. It is thus perhaps preferable that accounting for goodwill should be accepted as one of accounting's many anomalies, rather than attempting to mould the framework to accommodate it (pp. 311–312).

In this paper we propose that goodwill alone cannot generate residual incomes. Instead, it is entangled with a company's physical capital (present and future) in pursuit of such profits. Thus, we propose goodwill as a kind of intangible raw material for organisations. This intangible raw material progressively transforms into real wealth, or physical capital, as time passes and new assets' exchange transactions with the external environment are carried out by the firm in the form of purchasing, sales, production and environmental changes. This is a virtuous cycle that links physical capital, intangible capital and the "soul of the company" – after all, intangible resources "are entangled not only with other assets but also with strategy and organisational visions" (Mouritsen, 2003, pp. 24–25).

We argue, therefore, that the intangible elements that form goodwill cannot be represented as assets either in isolated form or in groups (as goodwill). They are the forces that drive future sales and residual earnings. Existing research has already carried out this kind of investigation, but has taken a theoretical approach. The present study conducts an empirical investigation of the relationship between the goodwill and physical capital of organisations. Our core objective is to show that the organisational virtues that characterise goodwill produce economic benefits not in isolation, but because they are entangled with the company's physical capital.

4.4.2. Is Reported Goodwill Value Relevant?

When we assert that goodwill is not an accounting asset, a very particular question arises: what about previous studies that found evidence of value relevance for goodwill? Since the early 1990s, studies have shown the value relevance of reported goodwill. For example, Amir, Harris and Venuti (1993) analysed firms that do not adopt the US Generally Accepted Accounting Principles (GAAP), but need to reconcile their accounting data to US GAAP (firms registered outside the United States and listed on a primary US exchange). The authors found that, from that reconciliation, investors view capitalised goodwill as value-relevant. McCarthy and Schneider (1995) examine firms incorporated in the US and reporting goodwill in the five-year period 1988–1992, and found that the market includes goodwill when valuing a company.

This is an issue that needs to be explored in depth, bearing in mind that the nature of goodwill complicates interpretations of direct empirical tests of its value relevance (Burger & Wen, 2021). First, it should be recognised that previous studies have focused on the value relevance of the impairment or write-off of goodwill (e.g. Xu, Anandarajan & Curatola, 2011; Hamberg & Beisland, 2014; Bepari & Mollik, 2017). There are few studies that focus only on reported goodwill. This latter literature has provided evidence that the market assigns relevance to the goodwill recognised by firms (Jennings et al., 1996; Henning, Lewis & Shaw, 2000; Bugeja & Gallery, 2006; Al Jifri & Citron, 2009; Dahmash, Durand & Watson, 2009; Yehuda, Vincent & Lys, 2017; Cordazzo & Rossi, 2020; Burger & Wen, 2021).

However, previous studies have certain limitations. One of these limitations is the focus on just a single country. For example, Bugeja and Gallery (2006) and Dahmash, Durand and Watson (2009) looked at Australia's public firms; Oliveira, Rodrigues and Craig (2010) at non-financial Portuguese public companies; Souza and Borba (2017) studied publicly traded Brazilian firms, and Cordazzo and Rossi (2020) examined Italian companies.

Another limitation is the time ranges investigated in previous studies. Some studies explore a narrow range of time, which hinders the generalisation of results. For example, Jennings et al. (1996) looked at a sample of US firms from 1982 to 1988; Henning, Lewis and Shaw (2000) considered a period between 1990 and 1994; Godfrey and Koh (2009) looked at one year (1999); Al Jifri and Citron (2009) studied the year 2002, and Yehuda, Vincent and Lys (2017) sampled US publicly traded firms during the period 2002–2006.

In general, these studies have found significant evidence of a positive relationship between reported goodwill and the market value of companies. However, when goodwill breaks down into several components, the literature has shown a relevant portion of accounting goodwill associated with economic losses. For example, Henning, Lewis and Shaw (2000) break down recognised goodwill into four components, one of which is the overpayment or overvaluation of consideration, known as residual goodwill (RESID). They document a mean of 31% of RESID in the sample analysed. Yehuda, Vincent and Lys (2017) find that of the acquisitions investigated, 59% have an estimated economic profit, whereas 41% have an expected economic loss.

In a recent study, Cordazzo and Rossi (2020) investigate the value relevance of intangible assets of non-financial public Italian firms from 2000 to 2015. The authors find that goodwill is significantly correlated with stock prices when Italian accounting standards were applied prior to 2005. Furthermore, they find that goodwill (and other intangible assets) increases in value relevance when intangible-intensive firms are considered in the post-IFRS (International Financial Reporting Standards) adoption period. In another recent study, Burger and Wen (2021) investigate the value relevance of goodwill using a sample of non-financial US public firms from 1988 to 2017. They find that reported goodwill provides greater value relevance relative to other accounting information after SFAS (statements of financial accounting standards) 142.

On the other hand, there are also studies that find no significant evidence between goodwill and the market value of firms. For instance, Souza and Borba (2017) investigate publicly traded Brazilian firms between 2010 and 2013, and find no significant evidence of goodwill recognised in business combinations to explain the share price (although on average it has a significant transaction value).

Finally, it is worth mentioning that this study differs from most of the studies mentioned above. First, our sample comprises both firms with reported goodwill and firms without reported goodwill. Our focus is on comparing firms that did not carry out M&A deals (or at least did not pay a premium in those agreements) with those that reported goodwill. We expand the literature on the topic by exploring a large sample of companies belonging to different countries to strengthen the robustness of our findings. Our study contributes to the literature because the large sample investigated allows a more comprehensive overview of the role played by goodwill in financial statements.

4.4.3. *The Formation of Economic Residuals Giving Rise to Goodwill*

In this subsection, we seek support in the theory of economic measurement, centred on the concept of opportunity cost (Coase, 1937; 1990), to provide insights into the nature of the formation of residuals originating goodwill (or badwill). We also use general systems theory (von Bertalanffy, 1968; 1972) to demonstrate that the intangible dimension of the business system materialises in the physical operational, or tangible, dimension.

We consider that the intangible elements that form goodwill (or intangible capital) do not have economic value just by virtue of "existing" in an organisation. In fact, the monetary effect of those virtues that characterise goodwill would be incorporated into both the value of existing physical assets and the value of those that will exist in the future, if they were measured by economic criteria. What we mean by this is that daily business decisions are the facts that generate residual earnings. For example, the decisions to (i) manufacture (rather

than buy) a certain item, (ii) spend surplus cash on a certain investment, (iii) negotiate raw material under better conditions than competitors and (iv) obtain a loan on favourable terms.

Our proposal is based on GECON,[11] which is a thought experiment that conceives the firm's information system as an economic accounting model in which each managerial decision that implies an exchange of assets with the market is measured by the opportunity costs (Coase, 1937; 1990) of the resources involved, which in turn define the economic value of the asset obtained in the decision. Opportunity cost is now a cornerstone in finance, economic theory and decision theory (Ricci & Magni, 2014). Thus, each managerial decision (based on opportunity cost) may generate an economic residual that can be positive (surplus) or negative (loss). The sum of these residuals[12] is the final portion of the firm's goodwill (or badwill).

Therefore, we follow Lustosa (2017) and the GECON model and use the concept at the decision-making level, starting with each transaction, whether it is initiated by management or comes from nature. This implies that a company's areas are treated as profit centres through the market-based transfer-pricing mechanism. Such an approach assumes that the managers will seek to achieve marginal gains in each decision they make, because economically it only pays to use a resource (asset), in any decision, if the gain is at least equal to what would be received in the best alternative use of the asset.

Consequently, the value of the asset obtained – its opportunity cost – equals the costs directly sacrificed plus the residual margin or economic profit of the decision. In other words, in GECON the measurement of assets fully preserves its definition as a net flow of benefits (Iudícibus, 2015). Each asset, and consequently the company as a whole, is measured at the

---

[11] The economic management information system Gecon is a theoretical model of the nature of organisations that was developed at the University of São Paulo (USP) by professor Armando Catelli between the late 1970s and the early 2000s.

[12] This is a simplification, as the Gecon approach also considers the residuals of the change of conjuncture (economic, monetary, etc.), the cost of equity and the value of money in time, among other factors.

present value of expected future residual earnings, as if the well-known residual income valuation model for the company (Edwards & Bell, 1961; Ohlson, 1995) were applied at the level of each asset-exchange transaction.

It should also be highlighted that some authors maintain that goodwill can be derived from liabilities (e.g. Martins & Martins, 2015; Martins & Santos, 2017; Martins, 2020). At this point, we make some remarks. We maintain that, actually, it is the effect of managerial actions becoming entangled with items from liabilities that produces economic residuals. For example, if the company's management is able enough to acquire inputs or loans under more advantageous conditions than its opportunity cost, then this company is certainly generating economic value for itself. Bonsall IV, Holzman and Miller (2017) document that higher managerial ability is associated with better credit ratings. De Franco, Hope and Lu (2017) find that more able managers are more capable of obtaining loans with lower interest spreads; that is, lenders provide more favourable loan prices to firms with higher managerial ability. This ability to obtain advantageous conditions on the debts assumed will make this company worth more than the fair value of its net assets.

Martins and Martins (2015) and Martins and Santos (2017) present an interesting discussion of goodwill originating from debt (financing obtained). We argue that behind those examples lies the managers' skill in obtaining competitive advantages in the form of financing for their activities. For this reason, we assert that goodwill is not "originated" from debt, but is only "detected" by the authors in this way. Actually, it is originated by intangible capital (managerial ability, intellectual capital, etc.), and is materialised in physical capital (financing agreements). Both forces (intangible and physical) act entangled with one another in order to originate economic residuals.

This entanglement effect is the very nature of goodwill. Each force acting alone is unable to generate residual income. No company can finance itself advantageously at

random. Bui et al. (2018) find that borrower firms showing superior managerial ability enjoy lower loan spreads. It is the firm's managers who analyse the various possibilities, consider their opportunity cost (or the cost of the neglected opportunity) and decide on the best choice – that is, the choice that will result in the greatest returns or gains for the firm. According to Demsetz (1973), experience teaches us which choices will succeed and which will fail. Hence, when results are accounted for, it means that "the shareholder has captured (some of) the value, positive or negative, of past decisions" (p. 3).

4.4.4. *Managerial Ability*

Our measure of intangible capital is managerial ability, which is difficult to observe directly (Baik, Farber & Lee, 2011). "Managerial ability reflects the ability of managers to comprehend the economies of the firm and to take prudent and timely economic decisions that enable them to transform the corporate resources efficiently into revenues" (Hasan, 2020, p. 4). In this study, we predict that managerial ability is closely related to physical capital, acting as a booster mechanism for residual earnings.

We employ the measure of managerial ability developed by Demerjian, Lev and McVay (2012), as it has been widely used in recent empirical studies (Doukas & Zhang, 2020; 2021; Banker, 2013; Sun, 2016; Andreou, Philip & Robejsek, 2016; Andreou et al., 2017; Hasan, 2020; Baik, Choi & Farber, 2020). We hold that this managerial ability measure is suitable for our research setting mainly because we hold that managers' skills act entangled with physical capital (to generate residuals). Indeed, manager-fixed effects matter for a wide range of corporate decisions, especially in acquisition or diversification decisions (Bertrand & Schoar, 2003).

Demerjian, Lev and McVay (2012) introduce a measure of managerial ability based on managers' efficiency in generating revenues. The authors build their model in two steps: (i) they first use data envelopment analysis (DEA) to estimate relative efficiency within

industries. They use seven stock and flow variables as inputs: net property, plant and equipment (PP&E); net operating leases; net research and development (R&D); purchased goodwill; other intangible assets; cost of inventory; and selling, general and administrative expenses (SG&A), which contribute to the generation of revenue (output). They use DEA to solve the following optimisation problem:

$$\max_v \theta = \frac{\text{Sales}}{v1\text{CoGS} + v2\text{SG\&A} + v3\text{PP\&E} + v4\text{Op.Lease} + v5\text{R\&D} + v6\text{Goodwill} + v7\text{Ot.Intang}}$$

(1)

In short, DEA is a nonparametric method that has been used to measure and evaluate the relative efficiency of a set of decision-making units (DMUs) with common crisp inputs and outputs (Bowlin, 1998; Guo & Tanaka, 2001). DEA uses linear programming to create an efficient frontier of observed production points to maximise a ratio of outputs to inputs (Baik, Choi & Farber, 2020). DMUs (e.g. firms) operating on the frontier are fully efficient with a score of 1, while DMUs below the frontier are considered less efficient with a score below 1 ($0 < \text{efficiency} < 1$). The lower the DMU's score, the further it is from the frontier (Andreou et al., 2017; Huang & Sun, 2017).

Since such a measure captures both firm- and manager-specific efficiency factors, Demerjian, Lev and McVay (2012) then proceed to the second step: (ii) they regress the total firm-efficiency measure using a tobit model on the firm characteristics that affect firm efficiency (size, market share, cash availability, life cycle, business segment concentration and the presence of foreign currency transactions):

$$\text{Firm Efficiency} = \beta_0 + \beta_1 \ln(\text{Total Assets})_i + \beta_2 \text{Market Share}_i +$$
$$\beta_3 \text{Free CashFlow Indicator}_i + \beta_4 \ln(\text{Age})_i + \beta_5 \text{Business Segment Concentration}_i +$$
$$\beta_6 \text{Foreign Currency Indicator}_i + \text{Year Fixed Effects}_i + \varepsilon_i$$

(2)

The residual term derived from this second step (tobit regression) is the element reflecting managerial ability score. This measure of managerial ability captures the ability of managers to generate revenue "through efficient exploration of resources through decisions and choices encompassing capital, labor, investment, and other revenue-generating practices" (Andreou et al., 2017, p. 110). The managerial ability measure effectively separates the managerial effect from the firm effect as well as capturing the overall ability of the management team (Hasan, 2020; Doukas & Zhang, 2020).

The idea that supports Demerjian, Lev and McVay's proposal is that high-ability managers better foresee business opportunities, better understand technology and industry trends, reliably predict product demand, invest in higher-value projects and manage their employees more efficiently than low-ability managers. For this reason, we choose mascore as a measure of (or proxy for) intangible capital. Companies with more able managers are more capable of effectively selecting and executing positive net present value projects that yield superior performance. This is because more able managers have better knowledge of the trends in and the ongoing environment of the industry, and they are likely more capable of achieving significant cost reductions (Demerjian, Lev & McVay, 2012; Koester et al., 2016; Andreou et al., 2017; Chen & Lin, 2018; Hasan, 2020).

Previous research has related managerial ability to characteristics that point to the generation of abnormal earnings. For example, the impact of managerial ability on the profitability of M&As (Chen & Lin, 2018); earnings quality (Demerjian et al., 2013), value relevance of earnings (Francis et al., 2019) and CEO relative peer quality (Francis et al., 2016). In a recent study, Baik, Choi and Farber (2020) document that more able managers enhance earnings informativeness, since they incorporate more forward-looking information about cash flows into current earnings through smoothing. They claim that smoothing

associated with more able managers improves stock price informativeness about future cash flows.

These studies have provided insights into our proposal, which aims to investigate the cause-and-effect relationship between intangible capital and physical capital. From the aforementioned, we predict that there is a statistically significant relationship between them. However, as we are jointly examining several firms from different sectors – some demanding more innovative capacity and others not so much – there is no way to predict the direction of the force that will prevail in this relationship, making it an empirical question.

H1. Intangible capital (mascore) has a statistically significant association with a firm's physical capital.

A positive relationship indicates that, on average, intangible capital is strong enough to convert itself into physical capital and still maintain its growth (or renewal). This is an expected behaviour in those sectors that demand high innovative capacity. On the other hand, a negative value indicates that, on average, physical capital "absorbs" more intangible capital than intangible capital can renew itself.

4.4.5. *Quantum Entanglement*

Oliveira and Lustosa (2022) dialogue accounting with quantum mechanics, economics and general systems theory to elucidate the nature of goodwill. They seek support from agential realism (Barad, 2007; 2010; 2014) to answer the question "how is goodwill able to generate residual income?" The authors propose the entanglement of physical capital and intangible capital. Entanglement implies the existence of global states of composite systems which cannot be described as a product of the states of individual subsystems (Horodecki et al., 2009). "The entangled states are linear superpositions of the internal states of the system which cannot be separated into product states of the individual atoms" (Ficek & Tanás, 2002, p. 369).

The quantum approach followed by the authors has been gaining notoriety in the social sciences in recent years. Sociophysics and econophysics are approaches which use ideas, models and conceptual methods of physics applied to socio-economic phenomena (Kutner et al., 2019). However, we observe very few studies linking accounting and quantum physics (with all of those that do addressing a theoretical perspective). We quote Demski et al. (2006), who explore a connection between quantum information and its conceptual applications to accounting.

In another example, Fellingham and Schroeder (2006) discuss the relationship between quantum information (quantum entanglement, quantum interference and quantum probability) and double entry accounting. Abreu (2016) advocates the relevance of physics to accounting. The author develops a firm value model based on econophysics concepts, and holds that some laws of physics have important implications for firm valuation. Moore (2017) uses the approach of quantum entanglement to present an alternative to the concept of accounting entity.

Oliveira and Lustosa (2022) conclude that the qualities and virtues of human actions are value drivers for physical capital. Therefore, physical capital and intangible capital are entangled in a symbiotic relationship in which each depends on the other to generate superior gains. From this perspective, we created our main research hypothesis, which considers the entanglement proposed by the authors.

Despite the fact that we are jointly examining several firms from different sectors, we can predict, supported by the theory addressed in this study, a direction of the force that will prevail in this relationship. Since going concern firms, on average, tend to earn positive gains from their operations, we can predict that the entanglement effect is positively influencing firms in general regardless of their economic sector. Therefore, we expect to find a positive coefficient on the variable that represents the entanglement effect.

H2. There is a positive entanglement effect on companies, which is capable of creating physical capital and generating value for them.

Haven and Khrennikov (2013) indicate many potential research fields relating quantum mechanics to areas such as economics and finance. We contribute to this growing literature by providing empirical evidence of the entanglement effect. In other words, we provide an empirical underpinning that supports comprehension of the dynamics of goodwill with the company's physical capital.

4.5. Research Methodology

First, we examine the cause-and-effect relationship between intangible capital and physical capital. To do this, we follow the specification from Equation (3). We expect to find a statistically significant relationship between the two forms of capital, albeit without predicting the direction of the force that will prevail. Regardless of the direction, a statistically significant relationship would suggest that the cause of physical capital (physcap) is intangible capital (intcap).

$$\text{physcap}_t = \text{f(intcap; } \Delta \text{intcap)}_t + \sum_n \beta_n \text{ Control Factors} \tag{3}$$

Control factors are variables related to firm factors, macroeconomic factors, and year and country effects. Thus, Equation (3) can be rewritten to the following specification:

$$\text{physcap}_t = \text{f(intcap; } \Delta \text{intcap)}_t + \sum_a \beta_a \text{ Company Factors}_{it} +$$
$$\sum_b \beta_b \text{ Macroeconomic Factors}_{it} + \text{ year fixed effects}_{it} + \text{ country fixed effects}_{it} + \varepsilon_{it} \tag{4}$$

Oliveira and Lustosa (2022) hold that physical capital represents management decisions already implemented – that is, ideas, plans and strategies made material in assets

and liabilities. In this regard, we consider that physical capital can be represented by the comprehensive income of the firm. Aggregate comprehensive income is theoretically defined as a measure of all changes in the value of net assets (equity) of an entity that result from recognised transactions and other economic events of the period, except for transactions with owners (Hodgson & Russell, 2014; Black, 2016).

We include two variables in the regression model in order to control the isolated influence of both physical and intangible capital. We select net property, plant and equipment (ppenet) to control the isolated influence of physical capital, and goodwill to control the isolated influence of intangible capital. To avoid a possible autocorrelation with the other RHS variables (which are scaled by total assets), we choose to scale goodwill by shares outstanding. We include two variables (size and leverage) to control for the presence of unobserved heterogeneity at the firm level. We also control for macroeconomic factors. Finally, we control for the presence of unobservable heterogeneity both across countries and over time in our panel data by including year and country fixed effects.

$$\text{compincat}_{it} = \beta_0 + \beta_1 \text{mascore}_{it} + \beta_2 \text{ppenet}_{it} + \beta_3 \text{gdwlshrout}_{it} + \beta_4 \text{size}_{it} +$$
$$\beta_5 \text{leverage}_{it} + \beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_control} +$$
$$\text{country\_control} + \varepsilon_{it} \tag{5}$$

where compincat is the comprehensive income of firm i in year t scaled by total assets, mascore is the managerial ability score, ppenet is net property, plant and equipment (Compustat item: ppent) scaled by total assets, gdwshrout is the book value of goodwill (Compustat item: gdwl) scaled by total shares outstanding, size is the natural logarithm of total assets, leverage is total liabilities scaled by total assets, spglobeq is the Standard & Poor's global equity index for each country, rintrate is the real interest rate for each country, and gdpgrowth is the gross domestic product (GDP) growth for each country.

To complement our analysis, we also investigate a variation, or changed version, of the Equation (5) model. Such a model allows us to examine whether changes in physical capital are also associated with changes in intangible capital. Thus, we rearrange Equation (5) to present the variables as changes (except for economic factors):

$$\Delta \text{compincat}_{it} = \beta_0 + \beta_1 \Delta \text{mascore}_{it} + \beta_2 \Delta \text{ppenet}_{it} + \beta_3 \Delta \text{gdwlshrout}_{it} + \beta_4 \Delta \text{size}_{it} +$$
$$\beta_5 \Delta \text{leverage}_{it} + \beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_control} +$$
$$\text{country\_control} + \varepsilon_{it} \tag{6}$$

where Δ means changes in the variables already specified in the Equation (5) model.

After this first investigation, we created a proxy for the entanglement effect to verify whether there is a positive and statistically significant relationship between entanglement and both firms' physical capital and their value creation. To create a proxy for entanglement we interact managerial ability score with net property, plant and equipment (entang = mascore × ppenet). To examine the role of entanglement in a firm's physical capital, we follow the model proposed in Equation (5). We also examine the entanglement by economic sector according to the Global Industry Classification Standard (GICS).

$$\text{compincat}_{it} = \beta_0 + \beta_1 \text{entang}_{it} + \beta_2 \text{ppenet}_{it} + \beta_3 \text{gdwlshrout}_{it} + \beta_4 \text{size}_{it} +$$
$$\beta_5 \text{leverage}_{it} + \beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_control} +$$
$$\text{country\_control} + \varepsilon_{it} \tag{7}$$

Once again, we investigate a variation. From the Equation (7) model we examine whether changes in the entanglement effect are associated with changes in physical capital.

Thus, we rearrange Equation (7) to present the variables as changes (except for economic factors).

$$\Delta\text{compincat}_{it} = \beta_0 + \beta_1\Delta\text{entang}_{it} + \beta_2\Delta\text{ppenet}_{it} + \beta_3\Delta\text{gdwlshrout}_{it} + \beta_4\Delta\text{size}_{it} +$$
$$\beta_5\Delta\text{leverage}_{it} + \beta_6\text{spglobeq}_t + \beta_7\text{rintrate}_t + \beta_8\text{gdpgrowth}_t + \text{year\_control} +$$
$$\text{country\_control} + \varepsilon_{it} \tag{8}$$

where Δ means changes in the variables already specified in the Equation (5) and Equation (7) models.

Finally, we examine the relationship between entanglement and firms' value creation. To do this, we follow the accounting-based valuation model developed by Ohlson (1995). We then consider the following specification:

$$\text{mkvalt}_{it} = \beta_0 + \beta_1\text{entang}_{it} + \beta_2\text{ppenet}_{it} + \beta_3\text{gdwlshrout}_{it} + \beta_4\text{size}_{it} +$$
$$\beta_5\text{leverage}_{it} + \beta_6\text{spglobeq}_t + \beta_7\text{rintrate}_t + \beta_8\text{gdpgrowth}_t + \text{year\_control} +$$
$$\text{country\_control} + \varepsilon_{it} \tag{9}$$

where mkvalt is the natural logarithm of the market value of the firm. We also use an alternative measure for market value (mkvalprc) calculated by multiplying the stock price (Compustat item: prcc_f) by the number of shares outstanding (Compustat item: csho). As in the previous case, we use the natural logarithm of this measure. After that, we proceed to the final analysis based on market return (Δmkvalt) as a function of Δentang. We consider the following specification:

$$\Delta\text{mkvalt}_{it} = \beta_0 + \beta_1\Delta\text{entang}_{it} + \beta_2\text{ppenet}_{it} + \beta_3\text{gdwlshrout}_{it} + \beta_4\text{size}_{it} +$$

$$\beta_5\text{leverage}_{it} + \beta_6\text{spglobeq}_t + \beta_7\text{rintrate}_t + \beta_8\text{gdpgrowth}_t + \text{year\_control} +$$

$$\text{country\_control} + \varepsilon_{it} \tag{10}$$

where Δmkvalt is the market return of the firm measured in six different ways:

$$\text{ret1} = \frac{\text{mkvalt} - \text{mkvalt}[\_n-1]}{\text{mkvalt}[\_n-1]} \tag{11}$$

$$\text{ret2} = \frac{\text{mkvaltprc} - \text{mkvaltprc}[\_n-1]}{\text{mkvaltprc}[\_n-1]} \tag{12}$$

$$\text{ret3} = \frac{\text{prcc\_f} - \text{prcc\_f}[\_n-1]}{\text{prcc\_f}[\_n-1]} \tag{13}$$

$$\text{ret4} = \frac{\text{prcc\_f} + \text{dvpsp} - \text{prcc\_f}[\_n-1]}{\text{prcc\_f}[\_n-1]} \tag{14}$$

$$\text{ret5} = \frac{\text{aj\_prcc} - \text{aj\_prcc}[\_n-1]}{\text{aj\_prcc}[\_n-1]} \tag{15}$$

$$\text{ret6} = \frac{\text{aj\_prcc} + \text{dvpsp} - \text{aj\_prcc}[\_n-1]}{\text{aj\_prcc}[\_n-1]} \tag{16}$$

where prcc_f is the closing stock price, dvpsp is the common dividends paid per share, and aj_prcc is the closing stock price adjusted for stock splits.

4.6. Sample Construction and Descriptive Statistics

Table 4.1 depicts the operationalisation of all variables used in the study as well as the sample construction. Our sample starts with the entire database from the CRSP merged with Compustat (CCM). The data ranges from 1980 to 2020. First, we merged CCM with Demerjian, Lev and McVay's database on managerial ability.[13] After that, we merged it again with other databases (Execucomp and Research Quotient from WRDS, and indicators from the World Bank Data[14]), which are the source of the other variables used in this study. All

---

[13] We are grateful to the authors for publicly sharing their database. Recently, Demerjian's website updated the mascore database for the year 2020. Data are available at: https://peterdemerjian.weebly.com/managerialability.html

[14] Available at https://data.worldbank.org/indicator

data sources were merged in Stata using the combined gvkey-datadate which uniquely identifies each observation. After all merges, our initial sample comprised all firms listed from 1980 to 2020, totalling 167,907 firm-year observations.

Table 4.1

Definition of the Main Variables and Sample Construction

Acronym	Operationalisation	Data source
compincat	Total comprehensive income (compinc) scaled by total assets	CCM database
mascore	Managerial ability score by Demerjian, Lev and McVay (2012)	Peter Demerjian website
ppenet	Total net property, plant and equipment (Compustat item: ppent) scaled by total assets	CCM database
gdwshrout	The book value of goodwill (Compustat item: gdwl) scaled by shares outstanding	CCM database
size	Natural logarithm of total assets	CCM database
leverage	The book value of liabilities (Compustat item: lt) scaled by total assets	CCM database
spglobeq	Standard & Poor's global equity indices, by country	World Bank website
rintrate	Real interest rate by country	World Bank website
gdpgrowth	GDP growth by country	World Bank website
entang	Entanglement variable proposed by the authors. entang = mascore × ppenet	---
resquot	Research quotient. A measure of a firm's R&D productivity	CCM database
mkvalt	Market value – total	CCM database
prcc_f	Price close – annual	CCM database
ajex	Adjustment factor for stock splits and stock dividends	CCM database
aj_prcc	Price close adjusted for stock splits and stock dividends (prcc_f / ajex)	CCM database
csho	Common shares outstanding	CCM database
mkvaltprc	Alternative measure for market value by multiplying the stock price (prcc_f) by the number of shares outstanding (csho)	CCM database
ret*	Market return measured by six different forms (from ret1 to ret6. See page 20)	---
dvpsp_f	Dividends per share – pay date	CCM database
compensat	Total executive compensation paid (Execucomp item: TDC2)	Execucomp database
intanoat	Other intangibles (Compustat item: intano) scaled by total assets	CCM database
intangat	Total intangible assets (Compustat item: intan) scaled by total assets	CCM database
ppegross	Total gross property, plant and equipment (Compustat item: ppegt) scaled by total assets	CCM database

firm-year obs.	Sample construction
167,907	Initial sample after all merges.
(2,695)	CAD currency excluded.
(2,489)	Negative stockholders' equity excluded.
(757)	Financial institutions excluded.
161,966	**Final sample**
67	**Countries**

We have excluded observations whose currency (Compustat item: curcd) was different from the US dollar (2,695 observations in Canadian dollars were excluded). Since Demerjian, Lev and McVay's database excludes financial institutions, our final sample does not have data from these institutions (757 obs excluded). Finally, we also excluded 2,489 firms with negative stockholder equity (Compustat item: teq). Brown, Lajbcygier and Li (2008) assert that negative book equity is difficult to interpret (in addition to the high default risk). For this reason, several empirical studies in accounting and finance exclude negative book equity stocks from their analyses (e.g. Vassalou & Xing, 2004; Khan & Watts, 2009; Kim & Zhang, 2016). The final sample totalled an unbalanced panel, with 161,966 firm-year observations from 1980 to 2020, covering 67 countries. A complete list of countries is given in Appendix A.

Since the comprehensive income variable computed by the CCM database has values only from 2009 onwards, we chose to manually construct this variable. To do this, we followed Black (2016), calculating comprehensive income as the sum of Compustat items: *cibegni*, *cisecgl*, *cidergl*, *cipen*, *cicurr*, and *ciother*; if missing, comprehensive income is the sum of Compustat items: *ni*, *cisecgl*, *cidergl*, *cipen*, *cicurr*, and *ciother*; if still missing, comprehensive income is the sum of Compustat items: *citotal* and *cimii*.

Table 4.2 depicts a summary of the variables. Average comprehensive income of the sample is -2.6%. The mean value of managerial ability is .0014 and the median is -.0157 (the values range from -.282 to .697). For comparison purposes, Demerjian, Lev and McVay (2012) found a mean value of -.004 and a median of -.013 (the values ranged from -.415 to .557). Net property, plant and equipment represented on average 28.6% of total assets, and goodwill represented on average 0.5% of total shares outstanding. Despite the extreme values for some variables, for example in the maximum of compincat, gdwlshrout and leverage, we

chose neither to exclude outliers nor to winsorise our sample. The average leverage of the

companies was about 50% and the compensation paid to executives represented an average of

1.1% of the firms' total assets.

Table 4.2

Summary Statistics

	N	mean	st.dev.	min	p1	p25	median	p75	p99	max
compincat	51,974	-0.0263	0.2842	-12.4602	-0.9836	-0.0427	0.0298	0.0762	0.2957	24.5863
mascore	161,966	0.0014	0.1249	-0.2822	-0.2168	-0.0698	-0.0157	0.0410	0.4931	0.6970
ppenet	161,915	0.2863	0.2335	0	0.0064	0.0988	0.2198	0.4154	0.9018	1.0000
gdwlshrout	117,892	0.0046	0.3784	0	0	0	0	0.0019	0.0311	75.9160
size	161,966	5.2405	2.3200	-5.8091	0.5805	3.5630	5.0948	6.8091	10.8850	13.5896
leverage	161,650	0.5003	0.3477	0	0.0551	0.3093	0.4903	0.6503	1.2459	63.6667
compensat	39,818	0.0109	0.0218	0	0.0003	0.0027	0.0058	0.0119	0.0826	1.9106
resquot	43,179	0.1141	0.0585	-0.5767	0.0108	0.0810	0.1062	0.1375	0.2939	1.9373
spglobeq	121,683	0.0973	0.1868	-0.8423	-0.3849	-0.0154	0.1139	0.2631	0.4789	2.8400
rintrate	155,093	0.0479	0.0260	-0.3531	0.0018	0.0298	0.0492	0.0654	0.0859	0.7762
gdpgrowth	160,894	0.0280	0.0219	-0.2149	-0.0349	0.0188	0.0300	0.0413	0.0786	0.2663

Table 4.3 shows correlation between the main variables included in the model as well as the variation inflation factor (VIF). The starting points that we call attention to are (i) the positive and statistically significant relationship between comprehensive income (compincat) and the managerial ability variable (mascore) and (ii) the negative and statistically significant relationship between mascore and net property, plant and equipment (ppenet). Overall, the variables have low correlation as well as low VIF values, indicating that the problem of multicollinearity is unlikely to be a concern for our results. We also conducted a Hausman test that indicated that the fixed effects model is most appropriate. It is also important to emphasise that all results of the regressions performed are based on White's (1980) adjustments (standard errors adjusted for heteroscedasticity).

Table 4.3

VIF Test and Correlation Matrix

Variables	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) compincat	---	1										
(2) mascore	1.20	0.121***	1									
(3) ppenet	1.22	0.080***	-0.202***	1								
(4) gdwlshrout	1.40	0.090***	-0.00	-0.00	1							
(5) size	1.76	0.301***	0.077***	0.158***	0.008***	1						
(6) leverage	1.30	-0.099***	-0.060***	0.125***	0.008***	0.111***	1					
(7) compensat	1.16	-0.033***	0.078***	-0.147***	-0.138***	-0.363***	-0.196***	1				
(8) resquot	1.08	0.100***	0.137***	-0.027***	-0.068***	-0.106***	-0.024***	0.078***	1			
(9) spglobeq	1.05	0.045***	0.00	0.009***	-0.00	-0.035***	-0.011***	-0.009*	0.069***	1		
(10) rintrate	1.05	-0.008*	0.010***	0.094***	0.00	-0.248***	0.031***	0.021***	0.167***	0.134***	1	
(11) gdpgrowth	1.01	0.046***	0.014***	-0.005**	0.00	-0.113***	-0.016***	0.020***	0.01	0.139***	0.185***	1

Note(s): ** and *** represent significance at 5% and 1% levels, respectively.

4.7. Results

First of all, it is worth noting that the exploratory nature of this study makes dialogue and comparison with previous studies somewhat difficult. In this sense, the results obtained are interpreted based essentially on the theoretical support presented in sections 4.3 and 4.4. Table 4.4 shows the results of stepwise multiple regression. Our first results indicate the strength of association between intangible capital, represented by managerial ability, and physical capital (an average of 28%). The last two columns show the full regression with and without year and country controls. The results remain robust even after controlling for firm factors, macroeconomic factors and country-year-specific factors. Our results show that a 1% increase in managerial ability score is associated with a 14.4% increase in physical capital as a proportion of total assets (final column of Table 4.4). These first findings suggest that our proposition about the relationship between intangible capital and physical capital (H1) appears to be true. It should be noted that all macroeconomic control variables were statistically significant.

Our empirical findings depict that, on average, the positive relationship between intangible capital and physical capital prevails. We argue that the positive relationship denotes that intangible capital is renewed at a speed greater than it is converted – that is, intangible capital is converted into physical capital and is renewed for future conversions. This finding suggests that, on average, companies seek to maintain strong intangible capital – that is, they invest in innovative managerial ability and in transforming this knowledge and expertise into physical capital, regardless of the sector. A possible negative relationship would indicate that physical capital absorbs more intangible capital than this (the intangible capital) can renew itself. This would represent a scenario in which firms in a given sector have low intangible capital intensity.

Table 4.4

Stepwise Regression Results for the Association Between Physical Capital and Intangible

Capital

compincat	Model (5)						
mascore	0.287***	0.283***	0.284***	0.295***	0.274***	0.281***	0.144***
	(19.75)	(19.55)	(19.37)	(19.41)	(18.72)	(18.40)	(18.82)
ppenet		-0.330**	-0.333**	-0.347**	-0.250*	-0.173***	0.0494***
		(-3.10)	(-3.07)	(-3.25)	(-2.40)	(-7.24)	(9.88)
gdwlshrout			-0.193	-1.911***	-1.435***	-1.633***	0.237
			(-1.15)	(-4.29)	(-4.50)	(-5.23)	(1.85)
size				0.0506***	0.0567***	0.0682***	0.0515***
				(4.84)	(5.56)	(15.59)	(80.42)
leverage					-0.378***	-0.359***	-0.241***
					(-22.53)	(-25.61)	(-50.88)
spglobeq						0.0596***	0.0133
						(11.77)	(0.81)
rintrate						0.182**	-0.272*
						(2.82)	(-2.12)
gdpgrowth						0.599***	0.528***
						(12.81)	(3.29)
_cons	-0.0261***	0.0570*	0.0582*	-0.259**	-0.141	-0.264***	-0.233
	(-2703.64)	(2.12)	(2.09)	(-2.85)	(-1.52)	(-9.86)	(-0.00)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	51,974	51,966	51,630	51,630	51,491	48,532	48,532
R^2	0.02	0.03	0.03	0.04	0.09	0.13	0.19

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

We also draw attention to the goodwill (gdwlshrout) and fixed assets (ppenet) coefficients. Note that both present negative associations with physical capital in almost all steps. However, when we include country-year-fixed factors, ppenet becomes positive and statistically significant whereas gdwlshrout ceases to be statistically significant (these changes may be related to year and country controls). Finally, firm size has a positive association with physical capital (probably due to scale gains), whereas leverage has a negative association.

We expand our analysis to examine whether changes in intangible capital explain changes in physical capital. Examining whether the association verified in the initial model (Equation (5)) remains in the variation model (Equation (6)) allows us to make more inferences about the cause-and-effect relationship between physical capital and intangible capital. The results in Table 4.5 show that it does – that is, the association between changes in managerial ability and changes in physical capital is positive and statistically significant in every step.

Table 4.5

Stepwise Regression Results for the Association Between Changes in Physical Capital and Changes in Intangible Capital

dcompincat	Model (6)						
dmascore	0.262***	0.264***	0.266***	0.280***	0.262***	0.255***	0.277***
	(9.96)	(9.65)	(9.57)	(7.23)	(7.23)	(11.73)	(26.77)
dppenet		-0.909	-0.910	-0.977	-0.844	-0.250***	-0.242***
		(-1.45)	(-1.43)	(-1.40)	(-1.25)	(-4.60)	(-10.95)
dgdwlshrout			1.112	3.398	3.794	1.728	1.543***
			(1.14)	(1.32)	(1.31)	(1.40)	(5.53)
dsize				-0.141	-0.144	0.00969	-0.00395
				(-0.88)	(-0.90)	(0.43)	(-0.95)
dleverage					-0.554***	-0.446***	-0.392***
					(-6.22)	(-13.13)	(-38.08)
spglobeq						0.105***	0.00462
						(14.48)	(0.26)
rintrate						-0.0245	-0.239
						(-0.33)	(-1.69)
dpgrowth						0.212**	-0.0904
						(2.95)	(-0.51)
_cons	0.00474***	0.00692***	0.00675***	0.0163	0.0225	-0.00434	-0.142
	(74.31)	(4.52)	(3.82)	(1.30)	(1.68)	(-1.89)	(-0.55)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	44,926	44,916	44,558	44,558	44,382	41,807	41,807
R^2	0.00	0.02	0.02	0.02	0.04	0.07	0.07

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

More specifically, a 1% increase/decrease in managerial ability is associated with an increase/decrease in physical capital (as a proportion of total assets) of about 27.7% (final column). These results seem to confirm hypothesis H1, and suggest that intangible capital is the cause of organisations' physical capital. Interestingly, contrary to the findings in Table 4.4, changes in ppenet (dppenet) are negatively related to changes in physical capital. Changes in goodwill (dgdwlshrout) are now positively associated with changes in physical capital. This change is probably due to the influence of year and country controls, and not of gdwlshrout itself. Changes in firm size have no statistically significant association with changes in physical capital, whereas changes in leverage have a negative association with physical capital.

We proceed with the analysis since we are interested in showing not a separate relationship between physical and intangible capital, but an entangled relationship between them. Based on the Equation (7) model, we now examine the entanglement effect. The results from Table 4.6 show that the coefficient of the interaction – that is, the joint effect – is positive and statistically significant, supporting our proposition (H2) about the entanglement effect. Note that the entanglement coefficient (20.7%) is about 50% as high as the mascore coefficient (see Table 4.4) even using ppenet as a control for the individual action of physical capital. Thus, a 1% increase in the entanglement effect is associated with an approximately 21% increase in physical capital (as a proportion of total assets). We believe that this represents a true physical–intangible symbiosis that is present in every single organisation and is the source of generation not only of ordinary earnings but also of residual earnings.

Table 4.6

Stepwise Regression Results for the Association Between the Entanglement Effect and

Physical Capital

compincat	Model (7)						
entang	0.617***	0.589***	0.589***	0.598***	0.558***	0.570***	0.207***
	(15.74)	(17.15)	(17.25)	(17.48)	(17.42)	(17.66)	(9.64)
ppenet		-0.320**	-0.323**	-0.337**	-0.239*	-0.161***	0.0415***
		(-3.01)	(-2.99)	(-3.17)	(-2.31)	(-6.70)	(8.31)
gdwlshrout			-0.289	-1.939***	-1.454***	-1.660***	0.0485
			(-1.91)	(-4.15)	(-4.43)	(-4.98)	(0.38)
size				0.0484***	0.0547***	0.0662***	0.0526***
				(4.64)	(5.39)	(14.91)	(82.19)
leverage					-0.382***	-0.364***	-0.245***
					(-22.89)	(-25.74)	(-51.41)
spglobeq						0.0617***	0.0140
						(12.10)	(0.85)
rintrate						0.174**	-0.304*
						(2.65)	(-2.36)
gdpgrowth						0.580***	0.545***
						(12.29)	(3.39)
_cons	-0.0244***	0.0561*	0.0577*	-0.246**	-0.128	-0.250***	-0.238
	(-199.48)	(2.10)	(2.08)	(-2.71)	(-1.39)	(-9.18)	(-0.00)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	51,966	51,966	51,630	51,630	51,491	48,532	48,532
R^2	0.01	0.02	0.02	0.03	0.09	0.12	0.18

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

Interestingly, ppenet alone shows a negative relationship with compincat in most of the stepwise regression, showing a positive association only when we insert year and country fixed effects (last column). Also in Table 4.6, goodwill (gdwlshrout) presents a negative association with physical capital (without year and country fixed effects). In the model with country-year fixed effects, there is no statistically significant relationship. As Table 4.6 shows aggregated results for all companies in the sample, we next examine the behaviour of the entanglement effect by economic sector.

Table 4.7 reports the entanglement effect across different economic sectors following the classification of the GICS. For this analysis, we consider again the Equation (7) model. The results were statistically significant for almost all sectors, with the exception of Communication Services (GICS 50). This suggests that entanglement is a real force in organisations regardless of the economic sector investigated.

Although the Utilities (GICS 55) and Real Estate (GICS 60) sectors showed the highest coefficients, the low number of observations for these two sectors should be highlighted. Thus, we draw attention to the coefficients of the Materials (GICS 15), Health Care (GICS 35) and Information Technology (GICS 45) sectors. Non-tabulated results showed that these three sectors also presented the highest coefficients in regressions without control for country and year fixed effects. These findings suggest that in these three sectors, intangible capital is renewed at a higher rate than it is converted into physical capital.

For illustrative purposes only, the Materials sector (GICS 15) is represented by the Chemical Industries, Construction Materials, Paper & Forest Products, Metals & Mining and Containers & Packaging industries. The Health Care sector (GICS 35) is represented by the Pharmaceuticals, Biotechnology & Life Sciences industry group. Finally, the Information Technology sector (GICS 45) is represented by companies from Software & Services, Technology Hardware & Equipment and Semiconductors & Semiconductor Equipment.

Table 4.7

Regression Results for the Association Between the Entanglement Effect and Physical Capital by Economic Sector

compincat	GIC-10 Energy	GIC-15 Materials	GIC-20 Industrials	GIC-25 Cons. Discr.	GIC-30 Cons. Staples	GIC-35 Health Care	GIC-45 Inform. Tech.	GIC-50 Comm. Serv.	GIC-55 Utilities	GIC-60 Real Estate
entang	0.396***	0.644***	0.180***	0.236***	0.310***	0.656***	0.578***	0.0746	0.805*	0.897***
	(15.37)	(11.67)	(4.52)	(5.05)	(3.89)	(4.37)	(4.08)	(0.94)	(2.50)	(4.04)
ppenet	-0.0501***	-0.0127	-0.0136	0.0507***	0.0289	0.327***	-0.0802***	0.0282	-0.154*	-0.0898
	(-3.74)	(-0.73)	(-1.46)	(5.06)	(1.49)	(11.35)	(-3.30)	(1.46)	(-2.12)	(-1.63)
gdwlshrout	-0.606	-0.112	-0.864***	-0.261	-1.113**	-0.685	-0.831	0.220	5.138*	0.185
	(-0.70)	(-0.22)	(-4.01)	(-1.71)	(-2.63)	(-1.40)	(-1.68)	(0.59)	(2.61)	(0.03)
size	0.0219***	0.0306***	0.0423***	0.0349***	0.0329***	0.0984***	0.0558***	0.0299***	0.0360**	-0.00760
	(12.72)	(14.77)	(34.26)	(27.63)	(17.25)	(44.74)	(35.03)	(15.23)	(2.81)	(-0.95)
leverage	-0.167***	-0.210***	-0.249***	-0.189***	-0.234***	-0.454***	-0.235***	-0.106***	-0.0677	0.0301
	(-11.17)	(-12.90)	(-29.42)	(-21.12)	(-13.24)	(-31.83)	(-21.63)	(-6.56)	(-0.60)	(0.79)
spglobeq	-0.0229	0.0916**	-0.0115	-0.0311	0.0196	0.0185	-0.00311	0.0162	-0.394	-0.0325
	(-0.51)	(2.88)	(-0.33)	(-0.93)	(0.47)	(0.22)	(-0.07)	(0.49)	(-0.51)	(-0.45)
rintrate	0.334	-0.362	-0.678*	-0.507*	-0.212	-1.442*	-0.524	-0.161	2.017	-0.631
	(1.00)	(-1.53)	(-2.48)	(-2.03)	(-0.75)	(-1.97)	(-1.43)	(-0.59)	(0.41)	(-1.25)
gdpgrowth	0.0873	0.327	0.664*	0.891**	0.116	1.163	0.480	1.139**	3.432	0.335
	(0.19)	(1.02)	(2.24)	(2.77)	(0.28)	(1.39)	(1.20)	(3.10)	(0.71)	(0.45)
_cons	-0.299	0.0687	-0.0000294	-0.184	-0.243	-0.429	-0.117	-0.124	-0.202	0.172*
	(-1.30)	(0.36)	(-0.00)	(-1.10)	(-1.36)	(-1.15)	(-0.38)	(-0.67)	(-1.51)	(2.23)
Year Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,076	3,453	8,567	8,012	2,668	8,105	10,926	2,541	76	106
R^2	0.22	0.16	0.19	0.14	0.16	0.32	0.16	0.17	0.43	0.42

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

Note that the relationship between ppenet (in isolation) and physical capital is mixed. In some sectors the association is positive (Consumer Discretionary and Health Care), whereas in other sectors the association is negative (Energy, Information Technology and Utilities) or not significant (Materials, Industrials, Consumer Staples, Communication Services and Real Estate). Goodwill has no significant association with physical capital for most sectors, with the exception of Consumer Staples and Industrials (negative) and Utilities (positive).

Once again, we examine the change model. We now are interested in verifying whether changes in the entanglement effect are associated with changes in physical capital (Equation (8)). The results are reported in Table 4.8 and show that a one-unit change in entanglement is positively associated with a 53% (without year and country fixed effects) and 55% (with year and country fixed effects) change in physical capital. It is important to note that we also performed this analysis by sector with and without country-year fixed effects (untabulated). Our findings remain quite similar to those found in Table 4.7. The results in Table 4.8 also show that changes in leverage and fixed assets are negatively related to changes in physical capital. In turn, changes in firm size have no statistically significant relationship with changes in physical capital.

Table 4.8

Regression Results for the Association Between Changes in the Entanglement Effect and

Changes in Physical Capital

dcompincat	**Model (8)**	
dentang	0.527***	0.553***
	(12.90)	(19.28)
dppenet	-0.231***	-0.228***
	(-4.28)	(-10.27)
dgdwlshrout	1.827	1.621***
	(1.45)	(5.79)
dsize	0.0101	-0.00343
	(0.45)	(-0.82)
dleverage	-0.448***	-0.394***
	(-13.11)	(-38.12)
spglobeq	0.105***	0.00383
	(14.37)	(0.21)
rintrate	-0.00112	-0.281*
	(-0.02)	(-1.98)
gdpgrowth	0.201**	-0.124
	(2.79)	(-0.70)
_cons	-0.00511*	-0.143
	(-2.20)	(-0.55)
Year Control	No	Yes
Country Control	No	Yes
N	41,807	41,807
R^2	0.07	0.06

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels,

respectively.

Although the entanglement effect suggests that both forces (physical and intangible)

act together in generating economic outcomes, the findings suggest a dominant resultant

force of intangible capital impacting physical capital. It may be that our findings are

influenced by the tools used in this research (linear regressions). This is one of the limitations

of our investigation. We do not use the tools of quantum mechanics. The tools of statistical

physics or quantum-statistical mechanics turned out to be extremely useful when applied to

complex systems (Chakraborti et al., 2011) – and organisations can be characterised as

complex systems (Dooley & Van de Ven, 1999; Schneider & Somers, 2006; Scott & Davis, 2007). "Strategy making [...] is probably much closer to a quantum probability wave that changes its shape each time we observe it than it is to a linear and predictable Newtonian equation" (O'Donnell et al., 2003, p. 86).

We next examine whether the entanglement effect has a statistically significant relationship with market variables. First, we examine the association between the entanglement effect and firms' market value according to the specifications of Equation (9). The results are reported in Table 4.9. We found that the entanglement effect is positive and statistically significant whatever the regression model (columns 1 and 2).

Regardless of the market value measure (mkvalt or mkvaltprc) the association remains significant even after controlling for firm factors, macroeconomic factors and country-year-specific factors. We call attention to the high R-squared observed in the columns with year and country fixed effects (column number 2). The findings observed in Table 4.9 seem to confirm Oliveira and Lustosa's (2022) proposal that intangible capital and physical capital are entangled, and this entanglement forms the firm's economic value. Furthermore, our findings suggest that investors also incorporate the entanglement effect in their analysis.

Table 4.9

Regression Results for the Association Between the Entanglement Effect and a Firm's Market Value

| | mkvalt | | mkvaltprc | |
	(1)	(2)	(1)	(2)
entang	2.323***	2.877***	2.271***	2.715***
	(18.29)	(38.70)	(20.92)	(44.10)
ppenet	-0.901***	-0.900***	-0.727***	-0.721***
	(-11.31)	(-56.97)	(-12.23)	(-54.33)
gdwlshrout	-5.745***	-12.52***	-4.685***	-11.13***
	(-4.33)	(-26.52)	(-4.82)	(-26.10)
size	0.863***	0.981***	0.843***	0.963***
	(89.00)	(497.62)	(120.46)	(603.62)
leverage	-0.531***	-0.758***	-0.566***	-0.833***
	(-4.93)	(-68.79)	(-6.52)	(-93.26)
spglobeq	0.779***	0.688***	0.718***	0.378***
	(54.17)	(8.79)	(55.33)	(8.72)
rintrate	0.192	-3.103***	-1.628***	-1.233***
	(0.79)	(-5.26)	(-8.63)	(-4.15)
gdpgrowth	3.641***	5.177***	4.121***	4.435***
	(22.65)	(6.98)	(28.31)	(9.54)
_cons	1.188***	0.787	1.248***	0.866
	(15.97)	(0.00)	(24.61)	(0.00)
Year Control	No	Yes	No	Yes
Country Control	No	Yes	No	Yes
N	68,853	68,853	104,549	104,549
R^2	0.49	0.84	0.54	0.85

Note(s): t statistics in parentheses. *** represent significance at 0.1% level.

Finally, we investigate whether market return is also associated with the entanglement effect. To do this, we follow the Equation (10) model. The results are reported in Table 4.10 and show a positive and significant association for most return measures. Our findings suggest that a variation in the entanglement effect is positively associated with a variation in market return (a mean of 2.7%). It should be noted that as our main objective is to examine entanglement (rather than to make predictions), the low value of R-squared does not change our findings. Once again, our findings suggest that investors also incorporate the entanglement effect when making decisions.

Table 4.10

Regression Results for the Association Between the Entanglement Effect and a Firm's Market

Return

	Eq. (11)	Eq. (12)	Eq. (13)	Eq. (14)	Eq. (15)	Eq. (16)
	ret1	*ret2*	*ret3*	*ret4*	*ret5*	*ret6*
dentang	1.092	1.240	2.952***	2.953***	2.367***	2.378***
	(0.14)	(0.43)	(6.80)	(6.80)	(7.29)	(7.32)
ppenet	0.634	-0.500	-0.0667	-0.0552	-0.183***	-0.173***
	(0.47)	(-1.09)	(-0.96)	(-0.80)	(-3.52)	(-3.35)
gdwlshrout	-12.17	-8.343	0.0371	0.515	-2.856	-2.873
	(-0.30)	(-0.56)	(0.02)	(0.23)	(-1.70)	(-1.71)
size	-0.0504	-0.0174	-0.0765***	-0.0754***	0.00198	0.00571
	(-0.30)	(-0.31)	(-9.04)	(-8.91)	(0.31)	(0.90)
leverage	-0.564	-0.410	0.0861	0.0852	-0.0989**	-0.102**
	(-0.56)	(-1.29)	(1.80)	(1.78)	(-2.76)	(-2.84)
spglobeq	-0.0111	0.382	0.564*	0.563*	0.514**	0.530**
	(-0.00)	(0.24)	(2.34)	(2.33)	(2.85)	(2.93)
rintrate	-0.409	-0.192	-0.721	-0.691	0.0883	0.469
	(-0.01)	(-0.02)	(-0.43)	(-0.42)	(0.07)	(0.38)
gdpgrowth	-9.091	-1.637	-2.967	-2.955	-0.377	-0.330
	(-0.13)	(-0.10)	(-1.15)	(-1.15)	(-0.20)	(-0.17)
_cons	1.064	-0.903	0.200	0.193	-0.309	-0.347
	(0.01)	(-0.04)	(0.06)	(0.06)	(-0.12)	(-0.14)
Year Control	Yes	Yes	Yes	Yes	Yes	Yes
Country Control	Yes	Yes	Yes	Yes	Yes	Yes
N	61,118	96,581	96,614	96,614	96,614	96,614
R^2	0.00	0.00	0.01	0.01	0.01	0.01

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels,

respectively.

4.8. Robustness Check

4.8.1. Sensitivity Analysis

To assess the sensitivity of our results, we included in the model some variables with

the potential to impact our findings. We use (i) total compensation paid to executives

(compensat), (ii) total intangible assets (intangat) and (iii) other intangible assets (intanoat).

We believe that these variables could influence physical capital or market variables. We

replaced gdwlshrout sometimes with intangat and sometimes with intanoat. We also replaced

net property, plant and equipment (ppenet) with gross property, plant and equipment (ppegross). Non-tabulated results indicate that our findings remain very consistent.[15]

We also examine the persistence of the relationship between the entanglement effect and firm value creation. We analyse entang lagged by one year, considering the specifications of Equation (7). Untabulated results show that the positive and statistically significant relationship remains even with entang lagged by one year. We believe that this finding is due to the autocorrelation in earnings (or earnings persistence) between two consecutive years (Lev, 1983; Lipe, 1990; Schipper & Vincent, 2003).

4.8.2. Alternative Measurement

In order to verify whether the results obtained for the variable of interest (entang) remain unchanged, we performed another robustness test by using an alternative variable for intangible capital. We replaced mascore with another measure of intangible capital named research quotient (Knott, 2008). Research quotient (RQ) is a measure of a firm's R&D productivity (Cummings & Knott, 2018; Knott & Vieregger, 2020). It is a novel firm-level measure of innovation efficiency (Ongsakul, Chatjuthamard & Jiraporn, 2021). In short, RQ indicates the percentage increase in revenue from a 1% increase in R&D.

RQ relies on the premise that R&D spending "per se is not a core skill unless the firm has the human capital required to employ the spending to good effect" (Bettis, 1981, p. 381). R&D generates new information in the organisational environment as well as enhancing the company's ability to assimilate and exploit outside information (Cohen & Levinthal, 1989; 1990). Knott's (2008) approach is partially similar to Demerjian, Lev and McVay's approach. She starts from the firm's final goods production function:

$$Y = K^{\alpha}.L^{\beta}.R^{\gamma}.S^{\delta}, \tag{17}$$

---

[15] Keeping these variables in our model would significantly impact the number of observations from our sample, which is why we chose to use them only for robustness-testing purposes.

where Y is output (sales), K is capital (net property, plant and equipment), L is labour, R is R&D, and S is spillovers.

From Equation (17), the author derives a random-coefficients model (Hildreth & Houck, 1968; Amemiya, 1978) for all inputs (as well as the intercept) to detect the firm's ability to convert inputs to outputs. As in Demerjian, Lev and McVay (2012), the measure of RQ captures the ability of R&D spending to generate revenue. This is what Knott (2008) calls heterogeneity in firms' R&D elasticities. Knott asserts that firms have their own innate abilities (organisational IQ) and for this, they differ in their R&D elasticities. Those with higher innate ability (IQ) invest more in R&D. Therefore, according to the author, it is not that higher R&D investment increases return; it is that having higher returns (higher organisational IQ) increases R&D investment.

Recent studies link RQ measure with issues such as corporate innovation (Cummings & Knott, 2018; Ongsakul, Chatjuthamard & Jiraporn, 2021), economic growth (Knott & Vieregger, 2019), firm value (Cooper, Knott & Yang, 2020) and stock returns (Santi, 2020). We argue that, by measuring the productivity of spending on R&D, RQ becomes a good proxy for a firm's intangible capital.[16] For this reason, we advocate RQ as a good alternative variable for our purpose.

We followed the Equation (5) model to perform the regressions. The results are depicted in Table 4.11. They indicate that our findings remain robust even for alternative measures of intangible capital. First, RQ (resquot) shows a positive association with physical capital (columns 1 and 2), reinforcing our proposition about the conversion from intangible capital (now as resquot) into physical capital (in addition to its renewal for future

---

[16] Knott (2008) named the measurement "organizational IQ". "Organizational IQ, like individual IQ, is highly complex, but both terms refer to the capability to make use of new information" (p. 2054).

conversions). Next, similarly to what we proposed for entanglement in Equation (7), we created an alternative proxy of the entanglement effect by interacting RQ with property, plant and equipment (entangrq = resquot*ppenet). Although the results are significant only for the case without country-year controls (column 3), we consider that the results shown in Table 4.11 reinforce that the entanglement effect is present in organisations' economic reality.

Table 4.11

Robustness Test: Regression Results for an Alternative Measurement of Entanglement

compincat	(1)	(2)	(3)	(4)
resquot	0.337***	0.235***		
	(5.39)	(8.28)		
entangrq			0.730**	0.0145
			(2.62)	(0.11)
ppenet	-0.274***	0.0456***	-0.355***	0.0307
	(-6.03)	(4.34)	(-7.41)	(1.90)
gdwlshrout	-1.994***	0.324	-2.095***	0.247
	(-5.26)	(1.56)	(-5.42)	(1.19)
size	0.0501***	0.0363***	0.0478***	0.0367***
	(7.16)	(43.19)	(6.91)	(43.66)
leverage	-0.301***	-0.193***	-0.307***	-0.193***
	(-14.24)	(-30.11)	(-14.38)	(-30.02)
spglobeq	0.0692***	-0.00244	0.0705***	-0.00403
	(9.95)	(-0.12)	(10.14)	(-0.20)
rintrate	0.337***	-0.217	0.319***	-0.215
	(3.73)	(-1.35)	(3.53)	(-1.33)
gdpgrowth	0.781***	0.723***	0.804***	0.742***
	(11.01)	(3.84)	(11.32)	(3.93)
_cons	-0.205***	-0.263	-0.150***	-0.225
	(-4.41)	(-1.21)	(-3.54)	(-1.03)
Year Control	No	Yes	No	Yes
Country Control	No	Yes	No	Yes
N	17,038	17,038	17,038	17,038
R^2	0.13	0.18	0.12	0.18

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

4.9. Summary and Conclusion

The existing literature has suggested that accounting goodwill is made up of different components acting as generators of residual earnings. Another stream of studies has suggested that intangible assets need to be combined with other assets to create value. However, no previous study has examined a simultaneous or entangled relationship between intangible capital and physical capital as an explanatory factor for value creation. Supported by quantum theory foundations and using a large sample of companies in different countries and over a long period of time, this study has examined this issue.

Our findings confirm our two hypotheses. First, our findings show that intangible capital is associated with physical capital. In addition, this association is positive, suggesting a conversion of the first into the second. The positive association also reveals that intangible capital is renewed at a speed greater than its conversion. Second, more importantly, our findings suggest that the entanglement effect is real. We found a positive association between the entanglement effect and physical capital and firm value creation. In other words, when we entangle property, plant and equipment with intangible capital, we find that this "new force" has a statistically significant association with several measures of a firm's economic outcome, such as physical capital, market value and market return.

It has to be considered that we did not investigate whether entanglement creates residual earnings. We consider this a limitation of this study, as well as a suggestion for further research (another limitation, discussed at the end of Section 6, concerns the use of the tools from statistical physics). Nevertheless, this study opens a wide path for further studies that aim to investigate the role of goodwill as a value driver that acts entangled with other assets.

We also draw attention to the growth of quantum physics as a driving factor for new discoveries in the field of social and economic sciences. Using concepts and methods from

quantum physics seems to be bearing fruit in several other areas of knowledge. Thus, we consider that accounting science has quite a way to progress if it is also to enter this subatomic universe, which remains poorly explored.

The entanglement effect theoretically proposed by Oliveira and Lustosa (2022) and empirically found in this study gives rise to a challenging scenario for accounting measurement. It is challenging because one of the most significant properties of accounting is binary classification (Pinnuck & Shekhar, 2013). Existing studies in different areas of knowledge have suggested the abandonment of the Cartesian view in favour of the entanglement of things. This study joins this literature. However, we are not trying to propose a new form of measurement, but merely to show, based on physics and economics concepts, that the process of generating value can be better understood if we relax the binary premise.

Reflecting on our findings, we ask: what then is the goodwill paid on a business-combination transaction? We consider it to be the prospect of future profitability of the acquired business. A wealth that is only potential at the present time. This is not an asset, as it is not an acquired right by the entity – and this is even more true in a scenario where most M&A deals are highly unprofitable. As highlighted in the literature review, some scholars still question whether the company has control of these virtues. For all the above, we conclude that goodwill should be considered a value driver that acts intertwined with a firm's physical capital, rather than an asset in isolation.

5. Discussing the Nature of Accounting Goodwill in the Banking Industry

5.1. Abstract

A strand of recent literature in economics and the social sciences has been using concepts from quantum physics to investigate economic and social phenomena. We expand this approach to accounting, and discuss the nature of accounting goodwill in the banking industry. Supported by quantum mechanics, we argue that goodwill alone cannot generate superior profits. Rather, it is the elements that make up goodwill, entangled with a bank's physical capital, that generate superior performance. In this article, we empirically examine the entanglement between intangible capital (goodwill) and physical capital. We call this the "entanglement effect". First, we develop a measure for intangible capital, based on the skills of bank managers, which in this study we name "bank managerial ability". We examine this measure and find a positive and significant association with a bank's physical capital, suggesting that there is a conversion of intangible capital into physical capital. Interestingly, we find that managerial ability in banking has a negative association with accounting goodwill. Then, we build a proxy for the entanglement effect by interacting a measure for a bank's physical capital (earning assets) with a measure for intangible capital (bank managerial ability). Consistent with theoretical concepts from quantum mechanics, our findings indicate that the entanglement effect is statistically significant for a series of tests performed. For example, entanglement is positively related to a bank's physical capital, market value and profitability. The findings suggest that the entanglement effect is a real force in the banking industry. Our findings remain robust for alternative measures for both bank managerial ability and the entanglement effect.

Key words: Goodwill; Managerial Ability; Quantum Entanglement; Banking Industry

5.2. Introduction

A univocal definition of the very nature of goodwill remains an open issue (Garzella et al., 2020). The controversial nature of goodwill has puzzled the accounting community for over a century (Baboukardos & Rimmel, 2014) and still remains in evidence (Wen & Moehrle, 2016; Rubio, Martínez & Mazón, 2021; Iatridis, Pappas & Walker, 2021). Especially in the banking sector, this controversy reaches even greater proportions. This is because, although goodwill is an asset, for prudential purposes of regulatory capital requirements, banks are not permitted to include goodwill in their Tier 1 capital (Valkanov & Kleimeier, 2007; Nwogugu, 2015; Chircop & Novotny-Farkas, 2016).

Our purpose in this paper is to shed new light on the nature of goodwill. We hold that rather than being solely an accounting item capable of generating residual income, goodwill should be considered intangible capital that acts entangled with the bank's physical capital. It is this entangled action, in turn, that is capable of generating normal and abnormal earnings. By that, we mean that goodwill alone cannot create abnormal profits. In other words, we propose that the intangible elements that make up goodwill (managerial ability, creativity, organisational IQ, employee motivation, reputation, personal skills, etc.) are intrinsically "entangled" with the organisation's present (equity) and future (decisions not yet implemented) physical capital. We examine this proposition in the banking context.

Our empirical strategy starts with the creation of a measure of intangible capital. Our intention is to build an external measure to avoid the endogeneity problem. As value creation involves the numerous decisions made in everyday banking activities – the "economic events" addressed in Oliveira and Lustosa (2022) – we build a measure that involves the ability of bank managers. In this study, we call this measure "bank managerial ability" (bankma). To build such a measure, we follow the approach adopted by Demerjian, Lev and

McVay (2012), who developed a measure for managerial ability using a database that excluded financial firms.

We obtained the data from the Bureau van Dijk (BvD) Orbis Bank Focus database. We merged financial information with monthly stock price data for each base date. Next, we merged it with indicators from the World Bank database. The final sample comprises 28,161 bank-year observations from 2002 to 2020, covering 122 countries. We start building the bankma score with the nonparametric data envelopment analysis (DEA) to estimate banks' relative efficiency. Following the income-based approach, we select five stock and flow variables as inputs (deposits, loans, interest expenses, fixed assets and operating expenses), which contribute to the generation of outputs (interest income and non-interest income).

Since such a measure captures both firm- and manager-specific efficiency factors, we then regress bank efficiency using the tobit model on the firm characteristics that affect bank efficiency (e.g. size, leverage, market share and systemic importance). The residual term derived from the tobit regression is the element reflecting the bankma score, which captures the ability of a bank's managers to generate income.

After creating the bankma score, we examined this measure as a cause of physical capital and found a positive and statistically significant association between these variables. We hold that this positive relationship suggests: (i) conversion of intangible capital into physical capital; and (ii) renewal of intangible capital for future conversions. Next, we examine the relationship between bankma and reported goodwill. Interestingly, we found a negative and statistically significant association between these variables. This finding suggests that more able managers, on average, carry out fewer mergers and acquisitions (M&As) than less able managers.

After that step, we create a variable representing the entanglement effect – the core point of our investigation. We interact bankma score (our measure for intangible capital) with

earning assets, which are assets that generate interest or dividends (our measure for physical capital). Our objective is to examine, in banking, the entanglement effect proposed by Oliveira and Lustosa (2022). These authors argue that intangible capital and physical capital are entangled, and this entanglement forms the economic value of the company. They use concepts from quantum theory, in particular from agential realism (Barad, 2007; 2010; 2014), to provide a new theoretical discussion about the nature of goodwill.

After controlling for economic and country-year-fixed factors, our findings depict that the entanglement effect (entang) is statistically significant for a series of tests performed. For example, entang is positively related to a bank's physical capital, market value and profitability. Our findings suggest that the entanglement effect is a real force in the banking industry. Our findings remain robust for other measures of both bankma (e.g. using an intermediation approach rather than an income-based approach) and entang (interaction with other variables).

This paper makes some contributions for scholars, investors and regulators. First, by deepening the discussion on the nature of goodwill we can advance a consensus on this highly controversial subject. Second, comprehending what drives performance is top of mind for bank managers and policy-makers alike, as the first step in understanding superior performance (Soteriou & Zenios, 1999). Third, by providing a complementary approach to the measurement of managerial ability, we contribute to this growing literature, especially for the banking sector. The quality of management teams is of particular importance for supervisory purposes. For example, according to the CAMELS (capital, assets, management, earnings, liquidity and sensitivity to market risk) methodology – widely used by bank supervisory authorities – management is, indeed, important to the successful operation of a bank (Barr, Seiford & Siems, 1994). Curi and Lozano-Vivas (2020) suggest that managerial ability could be a useful quantitative tool for regulators and supervisors towards achieving

effective management oversight and to maintain stability. Furthermore, differences in managerial ability can have important effects on shareholder wealth (Hayes & Schaefer, 1999).

Following this introduction, the paper is organised as follows. Section 2 provides a background on the paper. Section 3 reviews the theoretical framework and presents our research hypothesis. In Section 4 we outline our research methodology. This section includes (i) sample selection and data description, (ii) the building of the bank's managerial ability score and (iii) our model specification. Section 5 reports the descriptive statistics. Section 6 presents and discusses our empirical findings. Section 7 highlights the robustness test performed. The final section outlines our conclusions.

5.3. Background

Examining goodwill in banking is important for several reasons. First, because the impact of ASC 805/350 and IFRS 3R on compliance with capital requirements for banking firms can be significant (Nwogugu, 2015). Second, because of the systemic risk that a significant goodwill write-off may cause for banks. The most highly publicised write-downs of goodwill have been in the banking industry (Gore & Zimmerman, 2010). Third, because internally generated goodwill (left unrecorded) exerts a strong influence on banks' wealth generation and needs to be investigated further. According to Kohlbeck and Warfield (2007), unrecorded intangible assets are important in understanding the persistence and valuation of abnormal earnings in the banking industry.

Sanchidrián, García and Gonzalo-Angulo (2021) assert that, due to its high degree of uncertainty, the Basel Committee on Banking Supervision (BCBS) has never considered goodwill as a prudential asset. For this reason, goodwill valuation is seemingly not a matter of concern for the banking supervisor, since its impact on solvency is neutral. However, a discretionary implementation of the impairment approach could hide real losses and move

them to later periods. For example, if there is a cyclical behaviour of banks to recognise impairment losses in periods of crisis, when the income statement per se is weaker, this can "compromise the continuity of the entity spreading doubts to the financial statements users and triggering the dreaded systemic risk" (p. 34).

Additionally, goodwill in the banking sector has some specificities that differ from other sectors of the economy. For this reason, some authors have tried to build a specific model for this sector. For example, Begley, Chamberlain and Li (2006) provide a model of goodwill for banks by using the residual income valuation technique. They found that banks create value more from deposit-taking activities and fee income than from lending activities. The authors suggest extending the model to encompass other banking activities in order to improve the model of bank valuation. However, by considering only isolated banking activities (e.g. deposit-taking, credit card services, mortgage-servicing rights and trust activities), they fall short of envisioning that entanglement between intangible capital and physical capital can also be a driver of value creation in banks.

In another example, Isidro and Grilo (2012) provide an accounting-based valuation model that considers a relationship between the stream of future cash flows from fee income and value that depends on lending, borrowing and off-balance-sheet business. They found that unrealised expected cash flows from fee income are the most importance source of unrecorded goodwill. We extend this approach by providing evidence of a driver of value creation in the banking sector that goes beyond traditional accounting variables.

The financial industry, led mainly by the major global bank conglomerates, has sought increasingly innovative solutions in supplying financial services as well as fundraising. Such a strategy requires the development of firms' internal skills, especially from the top management team. This is because managers have a broad vision of their company and know the company's strengths and weaknesses. Despite the relevance of

literature on managerial ability, most previous studies have ignored their consequences for financial companies (García-Meca & García-Sánchez, 2018). In a recent article, Demerjian and Lev (2021) carry out a retrospective and review of the literature on managerial ability and call for research that develops scores incorporating the distinct features of firms into specific industries such as banking.

This study holds that goodwill (or intangible capital) "becomes" physical capital and is renewed (or not) as new ideas, plans and strategies arise to feed the decision-making process. This statement suggests a kind of epistemological (or even ontological) inseparability between intangible capital and physical capital. This is like saying that the inspiration of brilliant minds like Nikola Tesla or Leonardo da Vinci would be of no (or little) value if their ideas had not become physical capital in the forms of the transmission of alternating currents or the *Mona Lisa* (Oliveira, Lustosa & Gonçalves, 2021).

From this background, we propose that what accounting standards argue to be the generator of residual earnings (goodwill) acquired in a business combination should be considered a driver of such residual earnings. We hold that this "driving element" exists neither physically nor economically separate from the company's physical capital. Therefore, the core proposition of this paper is that the entanglement effect is the true generator of both normal and superior profits. In other words, we consider that the entanglement effect is the very nature of goodwill. It happens in the daily life of organisations through the numerous decisions that are taken. This is because management actions or decisions add or destroy organisational value (Lang & Stulz 1994); that is, they generate an economic residual that can be positive (surplus) or negative (loss). These residuals occur from intangible capital acting not alone, but in entanglement with physical capital.

Prior literature on economics and strategy has suggested the complementarity of tangible and intangible assets (e.g., Teece, 1986; Helfat, 1997; Radhakrishnan et al., 2017).

This study differs from that literature by proposing an original inseparability between such assets. Our approach finds support in theoretical quantum physics, especially in the literature on agential realism[17]. In short, agential realism is a holistic approach that uses insights from quantum theory to propose a new understanding of how discursive practices relate to the material world (Oliveira & Lustosa, 2022). For Schatzki (2010), agential realism helps us to understand materiality "as an ingredient of social phenomena" (p. 134).

> Agential for the conceptualization that everything does something, that everything is performative and has agency—nothing is delimited, everything is always in intra-activity with something else, and Realism as the concept for the fact that the agentiality has real effects. (Højgaard & Søndergaard, 2011, pp. 345–346)

Importantly, we point out that our approach is also based on the concept of economic measurement, as we consider that this has the ability to capture the entanglement effect. The economic measurement theory, centred on the concept of opportunity cost (Coase, 1937; 1990), helps to provide insights into the nature of the formation of economic residuals (positive or negative) in every managerial decision (Oliveira & Lustosa, 2022).

5.4. Literature Review and Hypothesis Development

5.4.1. Managerial Ability

Managerial ability reflects a manager's efficiency, relative to their industry peers, in transforming corporate resources (e.g. general and administrative expenses, fixed assets, research and development (R&D) expenditures) to revenues (Demerjian, Lev & McVay, 2012). It derives from experience and is tacit, making it rare and difficult to imitate (Holcomb, Holmes & Connelly, 2009). Managerial ability can help sustain a company's value or be decisive in its long-term success (Curi & Lozano-Vivas, 2020). The existing literature provides several methodologies to measure managerial ability. We focus on the

---

[17] For reviews, see Barad (2007; 2010).

approach adopted by Demerjian, Lev and McVay (2012), which is based on a manager's efficiency in generating revenues.

The authors adopt a two-step procedure to measure managerial ability. First, they use the DEA approach to model firm efficiency. Based on seven inputs and one output, they create a total firm-efficiency score that captures both firm- and manager-specific efficiency factors. Second, to isolate manager-specific effects, they regress this firm-efficiency score on various firm characteristics to disentangle managerial performance from firm performance. The residual from this stage – the total firm efficiency unexplained by the firm's characteristics – is the measure of managerial ability (Baik, Farber & Lee, 2011; Francis et al., 2016; Sun, 2016; Andreou et al., 2017; Bonsall IV, Holzman & Miller, 2017). This approach effectively separates the managerial effect from the firm effect, as well as capturing the overall ability of the management team (Hasan, 2020; Doukas & Zhang, 2020).

Previous research has linked managerial ability to the banking industry while exploring some research questions – for example, the impact of managerial ability on banks' liquidity creation and risk-taking behaviour (Andreou, Philip & Robejsek, 2016); the role of managerial ability in the quality of financial reporting in banks (García-Meca & García-Sánchez, 2018); the impact of managerial ability on bank risk-taking (Curi & Lozano-Vivas, 2020); the role of managerial ability on bank lending behaviour (Vo et al., 2021); and the impact of managerial ability on bank failure (Luu, Doan & Anh, 2021).

We expand this stream of research and examine the relationship between intangible capital and physical capital: our goal is to look into the cause-and-effect relationship between them. We expect to find a positive relationship, as the banking industry stands out for its increasingly advanced technology and sophisticated services, which demand an increasingly skilled workforce (e.g. see Kirov & Thill (2018)). The positive relationship indicates that, on average, managerial ability in the banking industry is strong enough to convert itself into

physical capital and still maintain its growth (or renewal). This is an expected behaviour in those sectors that demand high innovative capacity, such as the banking industry. From this context we develop our first hypothesis:

H1. Intangible capital (bankma) is positively associated with physical capital in the banking industry.

It should be highlighted that this study contributes to the growing literature on managerial ability in the banking sector by providing an original approach to the building of a measurement of managerial ability. Even based on prior literature to select the variables, our approach differs from all those mentioned above. Thus, we hope to add new knowledge to this field of research.

5.4.2. Quantum Approach in Social Sciences

By proposing an entangled relationship between physical capital and intangible capital, we make room for a growing literature in the field of social sciences: the literature around quantum physics. Sociophysics and econophysics (will "accountphysics" one day exist?) are approaches which use ideas, models and conceptual methods of quantum mechanics applied to socio-economic phenomena (Kutner et al., 2019). Quantum social science is making significant progress as an emerging field in the social sciences (for reviews, see Haven & Khrennikov, 2013; Wendt, 2015).

Since accounting science uses statistical tools to investigate patrimonial phenomena, it is quite surprising that little accounting research has used the concepts and methods of statistical physics. We find few examples in the accounting literature addressing such a topic. Demski et al. (2006) explore a connection between quantum information and conceptual applications to accounting. Fellingham and Schroeder (2006) discuss the relationship between quantum information and double entry accounting. In another interesting study, Abreu (2016) documents the relevance of physics to accounting by developing a firm value

model based on econophysics concepts. Finally, we highlight Moore's (2017) study, in which the author theoretically addresses the reality of organisations as intertwined, unbounded and not easily sorted into disjointed categories.

In any case, there is a large avenue of opportunities for research relating accounting and quantum physics. Haven and Khrennikov (2013) indicate several potential research fields relating quantum mechanics to areas such as finance, decision making and economics. We believe that it is only a matter of time before we see a profusion of these studies in the accounting field.

We follow the quantum approach to test the entanglement effect suggested by Oliveira and Lustosa (2022). The authors explain the economic nature of goodwill, supported by the theoretical concept of quantum entanglement. They abandon the Cartesian dualistic approach (Burrel & Morgan, 1979; Hopper & Powell, 1985) to explain the entangled nature of physical capital and intangible capital. According to the authors, intangible capital (goodwill) and physical capital are "entangled", and this entanglement forms the economic value of the firm.

From this perspective, we build a proxy for entanglement by considering the interaction between a measure of a bank's physical capital and a measure of its intangible capital (detailed in the methodology section below). We expect the entanglement effect to be capable of generating physical capital (e.g. financial instruments, deposits and loans), which in turn results in value creation for banks. Therefore, we expect to find a positive value in the coefficient of the variable of interest (entang) to confirm our proposal. Thus, we create the second research hypothesis that considers the entanglement effect proposed by Oliveira and Lustosa (2022):

H2. There is a positive entanglement effect in the banking industry which is capable of creating physical capital and generating value for banks.

5.5. Research Methodology

5.5.1. Sample Selection and Data Description

We focus on banks for several reasons. First, to answer a call from Demerjian and Lev (2021) to develop managerial ability scores incorporating the distinct features of companies in specific industries, such as the banking sector. Second, to reduce heterogeneity issues. Banks have larger informational asymmetries and a different capital structure from non-financial firms (García-Meca & García-Sánchez, 2018). Thus, only analysing the banking sector reduces the possibility of cross-sectional variations, since banks exhibit a relatively high degree of homogeneity in their operations and their capital structures (Beaver et al., 1989; Beaver, McAnally & Stinson, 1997; Kohlbeck & Warfield, 2007).

Table 5.1 depicts the operationalisation of all variables used in the study, as well as the sample construction. We obtained the data from BvD's BankFocus database by Wharton Research Data Services (WRDS). The initial sample comprised all banks listed from 1990 to 2020 and totalled 527,870 observations. In addition to the "31dec" base date, we kept the observations whose base date had a significant number (greater than 1,000) of observations. As such, we kept observations whose base dates were 31 March, 30 June, 30 September, 31 October and 31 December (524,465 obs). Then, we merged financial information with monthly stock price data for each base date. This new sample totalled 48,708 observations. After that, we excluded data whose unit of measure was different from thousands (3,708 obs) and duplicate data points (16,020 obs). Finally, we merged the data set with World Bank indicators.[18] Due to the low number of observations from 2001 (4 obs), we excluded that year. After all these steps, the final sample totalled 28,161 firm-year observations from 31 October 2002 to 30 June 2020, covering 122 countries. A complete list of countries is given in Appendix B.

---

[18] Available at https://data.worldbank.org/indicator

Table 5.1

Definitions of the Main Variables and Sample Construction

Acronym	Operationalisation	Data source
DEA input/output variables		
depshtfund	Total deposits and short-term funding	BvD BankFocus
feeinc	Total fee and commission income	BvD BankFocus
fixassets	Book value of fixed assets (property, plant and equipment)	BvD BankFocus
gloans	Total gross loans	BvD BankFocus
intexp	Total interest expenses	BvD BankFocus
intinc	Total interest income	BvD BankFocus
nonintinc	Total non-interest income	BvD BankFocus
operatexp	Total operating expenses	BvD BankFocus
totcustdep	Total customer deposits (current + savings + term)	BvD BankFocus
Tobit regression variables		
bank_efficiency	Bank efficiency score (from DEA analysis)	---
size	Natural logarithm of the bank's total assets	BvD BankFocus
age	Natural logarithm of time in BvD database in years of the bank	BvD BankFocus
leverage	Total of liabilities scaled by total assets	BvD BankFocus
labor	Cost of salary scaled by total assets	BvD BankFocus
mktshr	Share of the bank's total assets in relation to the country's banking assets	BvD BankFocus
cr5	Concentration ratio of the five largest banks by assets	BvD BankFocus
sifi	Bank's systemic importance. This is a dummy variable equal to one if the bank is considered a systemically important financial institution and equal to 0 otherwise	BvD BankFocus
Linear regression variables		
bankma	Bank managerial ability score (residual from tobit regression)	---
ciat	Total comprehensive income scaled by total assets	BvD BankFocus
custdepat	Total customer deposits (current + savings + term) scaled by total assets	BvD BankFocus
earnasset	Total earning assets scaled by total assets	BvD BankFocus
entang	Proxy for entanglement. It is the interaction between bankma and earnasset	---
entang_fa	Alternative proxy for entanglement (for robustness purposes). It is the interaction between bankma and finasset	---
entang_dep	Alternative proxy for entanglement (for robustness purposes). It is the interaction between bankma and custdepat	---
entang_alt	Alternative proxy for entanglement (for robustness purposes). It is the interaction between earnasset and an alternative measure for bankma	---
entang_fa_alt	Alternative proxy for entanglement (for robustness purposes). It is the interaction between finasset and an alternative measure for bankma	---
entang_dep_alt	Alternative proxy for entanglement (for robustness purposes). It is the interaction between custdepat and an alternative measure for bankma	---
finasset	Financial assets (trading and at fair value through P/L + available for sale + held to maturity) scaled by total assets	BvD BankFocus
gdwlyes	Dummy variable indicating whether the bank has goodwill balance	BvD BankFocus
gdwlshrout	Book value of goodwill scaled by total shares outstanding	BvD BankFocus
gdpgrowth	GDP growth by country	World Bank website
intang	Total intangible assets scaled by total assets	BvD BankFocus
mkvalt	Bank's market value	BvD BankFocus
ppeat	The ratio of property, plant and equipment (PPE) to total assets	BvD BankFocus
perfloans	Performing loans (there is no impairment) scaled by total assets	BvD BankFocus
ret	Bank's market return	BvD BankFocus

Acronym	Operationalisation	Data source
Linear regression variables (continuation)		
rintrate	Real interest rate by country	World Bank website
roa	Net income scaled by total assets	BvD BankFocus
spglobeq	Standard & Poor's global equity indices by country	World Bank website
firm-year obs.	**Sample Construction**	
524,465	Initial sample (base dates: 31 Mar, 30 Jun, 30 Sep, 31 Oct and 31 Dec)	
48,708	Sample after merge with stock price	
(3,708)	Statement unit not in thousands	
(16,020)	Duplicates based on index and base dates	
(426)	Not matched with World Bank database	
(4)	Data from year 2001	
(389)	Duplicates based on index and year (to run DEA)	
28,161	**Final sample**	
122	**Countries**	

5.5.2. *Building the Bank's Managerial Ability Score*

Following Demerjian, Lev and McVay (2012), we build a measure of bankma based on managers' efficiency in generating revenues. First, we calculate bank efficiency based on this approach. In the banking literature, such a model is known as the operating approach or income-based approach, and perceives a bank as a business unit generating income from total cost and expenses incurred (Leightner & Lovell, 1998; Das & Ghosh, 2006).

The first step was to split the sample by year in order to run a DEA to estimate the banks' relative efficiency. In summary, DEA is a nonparametric method that has been used to measure the relative efficiency of a set of decision-making units (DMUs) with common crisp inputs and outputs (Bowlin, 1998; Guo & Tanaka, 2001). Based on linear programming, DEA creates an efficient frontier of observed production points to maximise a ratio of outputs to inputs (Yue, 1992; Baik, Choi & Farber, 2020). DMUs – in our case, banks – operating on the frontier are fully efficient, with a score of 1, while DMUs below the frontier are considered less efficient, with a score below 1 ($0 < $ efficiency $ < 1$).

Traditional measures of efficiency, such as return on assets (ROA) or return on equity (ROE), are constrained to a single input and output. On the other hand, frontier efficiency

methods, such as DEA, form a best practice frontier function for each firm that provides the maximum output for any given combination of inputs (Leverty & Grace, 2012). It is also important to emphasise that DEA is a leading approach for performance analysis in the banking industry literature (Wu, Yang & Liang, 2006).

Based on previous studies (Charnes, Cooper & Huang, 1990; Yue, 1992; Leightner & Lovell, 1998; Das & Ghosh, 2006; Lema, 2017; Kumar, Anand & Batra, 2020; Zhu et al., 2021), we use five stock and flow variables as inputs, which contribute to maximisation of the output (revenue). Our DEA model solves the following optimisation problem:

$$\max{}_v \theta = \frac{\text{intinc} + \text{nonintinc}}{v1\text{depshtfund} + v2\text{gloans} + v3\text{intexp} + v4\text{fixassets} + v5\text{operatexp}} \tag{1}$$

where intinc is the total of interest income; nonintinc is the total of non-interest income; depshtfund is total deposits and short-term funding; gloans is total gross loans; intexp is total interest expenses; fixassets is the book value of fixed assets (total property, plant and equipment (PPE)); and operatexp is total operating expenses.

We used the Open Source DEA (OSDEA®)[19] software to evaluate each bank's efficiency by using the slacks-based measure (SBM) super efficiency (Tone, 2001; 2002) with an input-oriented model. Such an approach has been used in several studies examining efficiency in banks (e.g. Chiu, Chen & Bai, 2011; Puri & Yadav, 2013; Zimková, 2014; Li et al., 2019; Jamshidi et al., 2021). Most DEA analyses in the banking sector have focused on input-oriented analyses, especially because bank managers have more control over the management of inputs than over outputs (Ouenniche & Carrales, 2018).

---

[19] OSDEA is a free open source data envelopment analysis solver. More information on OSDEA can be found at http://www.opensourcedea.org.

Since the DEA measure captures both firm- and manager-specific efficiency factors, we move to the second step. We regress the total bank efficiency measure using a tobit model on the bank characteristics that affect its efficiency. Based on previous studies (Cantrell, 2013; Andreou, Philip & Robejsek, 2016; García-Meca & García-Sánchez, 2018; Banna et al., 2019; Curi & Lozano-Vivas, 2020; Vo et al., 2021; Safiullah, Hassan & Kabir, 2020), our model adopts the following specification:

$$\text{bank\_efficiency}_{it} = \beta_0 + \beta_1 \text{size}_{it} + \beta_2 \text{age}_{it} + \beta_3 \text{leverage}_{it} + \beta_4 \text{labor}_{it} + \beta_5 \text{mktshr}_{ict} +$$
$$\beta_6 \text{cr5}_{ct} + \beta_7 \text{sifi}_{it} + \text{year fixed effects} + \text{country fixed effects} + \varepsilon_{it} \quad (2)$$

where size is the natural logarithm of the bank's total assets; age is the natural logarithm of the number of years bank i has in the BvD database; leverage is the total of liabilities scaled by total assets; and labor is the cost of salary scaled by total assets. As the database has no data on salary, we used the overheads (BvD item: DATA 99255) or costs of running the bank, the major element of which is normally salaries; mktshr is the bank's market share measured by the total assets of bank i in relation to total banking assets in country c in year t.

Based on the aforementioned literature, we expect larger banks, younger banks, more leveraged banks, banks with lower labour costs and banks with greater market share to be more efficient. We did not find, in the existing literature on managerial ability, any studies that used the cr5 and sifi variables in the tobit regression. However, we consider it important to use these variables, in view of their importance in the literature on efficiency in the banking sector.

The cr5 variable is the concentration ratio of the five largest banks by assets in country c in year t. The literature on this topic is mixed. On the one hand, some authors suggest that an increased concentration is expected to hinder both competition and efficiency

(e.g. Casu & Girardone, 2006) – that is, a more efficient financial system facilitates the entry of competitors (Rajan & Zingales, 2003). On the other hand, other authors suggest that concentration would increase the overall efficiency of the sector (e.g. Corvoisier & Gropp, 2002). Notwithstanding, concentration ratios are often used in structural models explaining competitive performance in the banking sector (Bikker & Haaf, 2002). The sifi variable represents the bank's global systemic importance. It is a dummy variable indicating whether bank i is considered a SIFI (systemically important financial institution) in year t. SIFI banks outperform others in terms of both cost and profit without needing to take more risks (Tabak, Fazio & Cajueiro, 2013).

The residual term (ε_{it}) derived from this second step is the element reflecting bank managerial ability (bankma). Bankma captures the ability of managers to generate income "through efficient exploration of resources through decisions and choices encompassing capital, labor, investment, and other revenue-generating practices" (Andreou et al., 2017, p. 110). According to Demerjian, Lev and McVay (2012), more able managers better foresee business opportunities, better understand technology and industry trends, reliably predict product demand, invest in higher-value projects and manage their employees more efficiently. For this reason, we choose bankma as a proxy for intangible capital (or goodwill). Finally, it is important to emphasise that, as this approach cannot discriminate between the contributions of individual managers, our bankma score therefore refers to the entire management team (not only the CEO).

5.5.3. Model Specification

After creating the bankma score, we examine the relationship between intangible capital and physical capital. As stated in Section 3, our objective is to examine the cause-and-effect relationship between them. To do this, we follow the specification from Equation (3) below. We expect to find a positive and statistically significant association, suggesting a

conversion of intangible into physical capital (in addition to the renewal of intangible capital) – that is, suggesting that the cause of physical capital (physcap) is intangible capital (intcap):

$$\text{physcap}_t = f(\text{intcap}; \Delta\text{intcap})_t + \sum_a \beta_a \text{ Firm Factors}_{it} + \sum_b \beta_b \text{ Economic Factors}_{it} +$$

$$\text{Year Fixed Effects}_{it} + \text{ Country Fixed Effects}_{it} + \varepsilon_{it} \qquad (3)$$

Oliveira and Lustosa (2022) hold that physical capital represents management decisions already implemented – that is, ideas, plans and strategies made material in assets and liabilities. Thus, we consider that changes in a bank's physical capital can be represented by its comprehensive income. Aggregate comprehensive income is theoretically defined as a measure of all changes in the value of net assets (equity) of an entity that result from recognised transactions and other economic events of the period, except for transactions with owners (Hodgson & Russell, 2014; Black, 2016).

We included two variables in the regression model that could capture the isolated influence of both physical and intangible capital. We then selected intangible assets (intang) – which include goodwill – and financial assets (finasset). We include size and leverage to control for the presence of unobserved heterogeneity at the firm level. We also control for macroeconomic factors. Finally, we control for the presence of unobservable heterogeneity both across countries and over time in our panel data by including year and country fixed effects. Equation (3) can be rewritten to:

$$\text{ciat}_{it} = \beta_0 + \beta_1\text{bankma}_{it} + \beta_2\text{intang}_{it} + \beta_3\text{finasset}_{it} + \beta_4\text{size}_{it} + \beta_5\text{leverage}_{it} +$$

$$\beta_6\text{spglobeq}_t + \beta_7\text{rintrate}_t + \beta_8\text{gdpgrowth}_t + \text{year\_FE} + \text{country\_FE} + \varepsilon_{it} \qquad (4)$$

where ciat is the comprehensive income of bank *i* in year *t* scaled by total assets, bankma is the bank's managerial ability score, intang is the ratio of intangible assets (including goodwill) to total assets, finasset is total financial assets scaled by total assets; size is the natural logarithm of the bank's total assets, leverage is total liabilities scaled by total assets, spglobeq is the Standard & Poor's global equity index for each country, rintrate is the real interest rate for each country, and gdpgrowth is the gross domestic product (GDP) growth for each country.

To complement our first analysis, we also employed a "variation", or "change" version of the Equation (4) model. This model allows us to examine whether changes in intangible capital cause changes in physical capital. Thus, we rearrange Equation (4) to present the variables as changes (except for economic factors):

$$\Delta ciat_{it} = \beta_0 + \beta_1 \Delta bankma_{it} + \beta_2 \Delta intang_{it} + \beta_3 \Delta finasset_{it} + \beta_4 \Delta size_{it} + \beta_5 \Delta leverage_{it} + \beta_6 spglobeq_t + \beta_7 rintrate_t + \beta_8 gdpgrowth_t + year\_FE + country\_FE + \varepsilon_{it} \qquad (5)$$

where Δ means changes in the variables already specified in the Equation (4) model.

Since we are adopting bankma score as our proxy for intangible capital (goodwill), we consider it important to examine the relationship between these variables. We follow the specification of Equation (6) (below) to examine such an association, and expect to find a positive sign in coefficient β_1, as the literature has suggested that managerial ability is one of the elements that make up accounting goodwill (Paton, 1922; Gynther, 1969; Falk & Gordon, 1977; Chauvin & Hirschey, 1994; Wiese, 2005; Lustosa, 2017).

$$\text{bankma}_{it} = \beta_0 + \beta_1 \text{gdwlshrout}_{it} + \beta_2 \text{ppeat}_{it} + \beta_3 \text{finasset}_{it} + \beta_4 \text{custdep}_{it} +$$

$$\beta_5 \text{size}_{it} + \beta_6 \text{leverage}_{it} + \beta_7 \text{spglobeq}_t + \beta_8 \text{rintrate}_t + \beta_9 \text{gdpgrowth}_t + \text{year\_FE} +$$

$$\text{country\_FE} + \varepsilon_{it} \tag{6}$$

where gdwlshrout is the book value of goodwill scaled by total shares outstanding. We chose to scale goodwill by shares outstanding to avoid a possible autocorrelation with the other RHS variables (which are scaled by total assets); ppeat is total PPE scaled by total assets; finasset is total financial assets scaled by total assets; and custdep is total customer deposits scaled by total assets.

We also carried out another analysis which examines the relationship between a bank manager's ability and the probability of their carrying out M&A agreements (with premium payment). Our intention is to examine whether the association (positive or negative) observed in Equation (6) remains regardless of the magnitude of goodwill. We perform this investigation because prior studies have suggested that most M&A deals fail to achieve their economic and strategic objectives (Cartwright & Cooper, 1990, 1993; Marks & Mirvis, 2000, 2001; Cartwright & Schoenberg, 2006; Calipha, Tarba & Brock, 2010). We run a logistic regression according to the specifications of Equation (7) (below):

$$\text{Log P(gdwlyes)} = \beta_0 + \beta_1 \text{bankma}_{it} + \beta_2 \text{ppeat}_{it} + \beta_3 \text{finasset}_{it} + \beta_4 \text{custdep}_{it} +$$

$$\beta_5 \text{size}_{it} + \beta_6 \text{leverage}_{it} + \beta_7 \text{spglobeq}_t + \beta_8 \text{rintrate}_t + \beta_9 \text{gdpgrowth}_t + \text{year\_FE} +$$

$$\text{country\_FE} \tag{7}$$

where gdwlyes is the binary dependent variable representing the probability (P) of the bank entering into an M&A agreement with a premium payment. Gdwlyes is equal to 1 if bank *i* has a goodwill balance in year *t* and is equal to 0 otherwise.

After this investigation, we build a proxy of entanglement to examine whether there is a positive and statistically significant association between entanglement and banks' physical capital and value creation. We interact bankma score with earning assets: entang = bankma × earnasset. To examine the role of the entanglement effect in a bank's physical capital, we follow the models (8) and (9) below, which are similar to those already proposed in Equations (4) and (5):

$$\text{ciat}_{it} = \beta_0 + \beta_1 \text{entang}_{it} + \beta_2 \text{intang}_{it} + \beta_3 \text{finasset}_{it} + \beta_4 \text{size}_{it} + \beta_5 \text{leverage}_{it} +$$
$$\beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_FE} + \text{country\_FE} + \varepsilon_{it} \qquad (8)$$

$$\Delta \text{ciat}_{it} = \beta_0 + \beta_1 \Delta \text{entang}_{it} + \beta_2 \Delta \text{intang}_{it} + \beta_3 \Delta \text{finasset}_{it} + \beta_4 \Delta \text{size}_{it} +$$
$$\beta_5 \Delta \text{leverage}_{it} + \beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_FE} +$$
$$\text{country\_FE} + \varepsilon_{it} \qquad (9)$$

Finally, we examine the relationship between the entanglement effect and the economic value of the bank. We first examine the bank's ROA to verify whether entang has positive association with ROA (Equation 10). Then, we follow the accounting-based valuation model developed by Ohlson (1995) to examine the relationship between entang and the bank's market value (Equation 11). We consider the following specifications:

$$\text{roa}_{it} = \beta_0 + \beta_1 \text{entang}_{it} + \beta_2 \text{intang}_{it} + \beta_3 \text{finasset}_{it} + \beta_4 \text{size}_{it} + \beta_5 \text{leverage}_{it} +$$
$$\beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_FE} + \text{country\_FE} + \varepsilon_{it} \qquad (10)$$

$$\text{mkvalt}_{it} = \beta_0 + \beta_1 \text{entang}_{it} + \beta_2 \text{intang}_{it} + \beta_3 \text{finasset}_{it} + \beta_4 \text{size}_{it} + \beta_5 \text{leverage}_{it} +$$
$$\beta_6 \text{spglobeq}_t + \beta_7 \text{rintrate}_t + \beta_8 \text{gdpgrowth}_t + \text{year\_FE} + \text{country\_FE} + \varepsilon_{it} \qquad (11)$$

where mkvalt is the natural logarithm of the market value of the bank.

5.6. Data and Descriptive Statistics

Table 5.2 shows summary statistics of the main variables used in this study. The mean of bank efficiency reported in panel A is 0.429. Demerjian, Lev and McVay (2012) examined 43 industries and found a mean efficiency of 0.567. Previous studies on banking have found values between 0.60 and 0.75. A total of 8.9% (1,922/21,632) of observations are on the frontier (not tabulated). Taking into account the bank's specialisation (panel B), it is observed that saving banks (29%) and cooperative banks (33%) are the least efficient financial institutions in our sample.

Table 5.2

Summary Statistics

Panel A								
	N	mean	std. dev.	min	p25	median	p75	max
bank_efficiency	21,632	.429	0.242	.025	.261	.342	.526	1

Panel B								
bank_efficiency by specialisation	N	mean	std. dev.	min	p25	median	p75	max
Bank holdings & Holding Co.	8,733	.397	0.225	.034	.249	.311	.455	1
Central banks	5	1	0.000	1	1	1	1	1
Commercial banks	8,951	.44	0.230	.057	.279	.37	.54	1
Cooperative banks	255	.331	0.208	.055	.215	.249	.356	1
Finance companies	1,058	.583	0.295	.042	.349	.506	1	1
Group finance companies	10	.529	0.329	.252	.281	.369	1	1
Investment & Trust corporations	76	.53	0.294	.179	.308	.398	.779	1
Investment banks	773	.501	0.302	.031	.262	.413	.707	1
Islamic banks	471	.374	0.224	.025	.238	.325	.394	1
Micro-financing institutions	67	.464	0.286	.107	.246	.402	.54	1
Other non-banking credit Inst.	30	.554	0.289	.054	.365	.521	.753	1
Private banking / Asset Manag. Co.	120	.36	0.245	.074	.19	.293	.392	1
Real Estate & Mortgage banks	196	.487	0.298	.075	.268	.361	.693	1
Savings banks	343	.291	0.101	.071	.22	.285	.34	1
Securities firms	351	.596	0.299	.078	.343	.521	1	1
Specialised governmental credit inst.	193	.415	0.277	.143	.224	.279	.506	1

Panel C

	N	mean	std. dev.	min	p25	median	p75	max
size	28,153	14.98	3.778	2.079	12.67	14.395	16.67	29.26
age	24,782	1.446	0.785	0	.693	1.609	2.08	2.83
leverage	28,148	.748	0.515	-.005	.765	.886	.917	48
labor	28,090	.062	1.193	-.257	.014	.025	.035	163.58
mktshrasset	28,154	.05	0.140	0	0	.001	.023	1
cr5asset	28,160	.684	0.174	.255	.561	.612	.83	1
sifi	28,161	.014	0.119	0	0	0	0	1
ciat	23,089	.063	8.141	-47.69	.004	.01	.02	1,232.48
bankma	19,132	-.008	0.189	-6.614	-.092	-.031	.043	1.48
intang	20,608	.016	0.052	-.003	.001	.003	.014	.92
gdwlyes	28,161	.382	0.486	0	0	0	1	1
gdwlshrout	12,898	0	0.001	0	0	0	0	.04
earnasset	28,121	.87	0.148	0	.854	.914	.948	1.38
entang	19,132	-.006	0.156	-5.229	-.081	-.027	.037	.93
finasset	28,153	.142	0.159	-.265	.003	.108	.216	.998
ppeat	27,488	.018	0.041	-.011	.004	.01	.019	.89
custdep	21,552	.674	0.223	0	.607	.743	.822	4.97
perfloans	12,308	.591	0.204	0	.512	.634	.72	4.12
roa	28,100	.05	7.371	-48	.004	.01	.019	1,231.98
mkvalt	26,476	3.148	15.401	0	.043	.207	1.15	1,278.9
return	22,767	.242	16.902	-1	-.156	.026	.225	1,832.11
spglobeq	26,906	.063	0.220	-.822	-.061	.09	.194	1.301
rintrate	23,453	.034	0.053	-.742	.015	.024	.04	.609
gdpgrowth	28,030	.025	0.027	-.24	.016	.023	.035	.262

Panel C shows that, on average, cost of labour represents around 6% of total assets.

Banks have on average 5% of market share by total assets. The five largest banks hold around

68% of the banking assets in their respective countries. About 1.4% of banks (29 banks) are

classified as SIFI. The mean bank managerial ability (bankma) score is -0.008. Demerjian,

Lev and McVay (2012) found -0.004. Previous studies on banking have come up with mixed

findings. For instance, Banna et al. (2019) found -0.002, Curi and Lozano-Vivas (2020)

found -0.021 and Safiullah, Hassan and Kabir (2020) found 0.0026 for conventional banks

and 0.0021 for Islamic banks. About 38% of banks reported goodwill balance (gdwlyes).

Earning assets represent on average 87% of total assets while financial assets represent

around 14% of total assets. Finally, fixed assets (ppeat) and intangible assets (intang)

represent around 2% of total assets, and customer deposits (custdep) represent 67% of total assets. The average market value of banks was around US$3.15 billion.

Table 5.3 depicts correlation between the main independent variables included in the model as well as the variation inflation factor (VIF). Overall, the variables have low correlation as well as low VIF values, indicating that the problem of multicollinearity is unlikely to be a concern for our results. The starting point to which we call attention is the negative and statistically significant relationship between bankma and size, labour and fixed assets, suggesting that more able managers are associated with smaller banks, lower costs of labour and less PPE.

Table 5.3

Correlation Matrix and VIF Test

Variables	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) size	1.14	1														
(2) age	1.05	0.14***	1													
(3) leverage	1.06	0.27***	0.04***	1												
(4) labor	1.02	-0.03***	-0.02***	0.13***	1											
(5) mktshr	1.35	0.21***	-0.01*	0.09***	-0.01	1										
(6) cr5	1.37	0.21***	-0.12***	0.07***	0.01*	0.46***	1									
(7) sifi	1.06	0.20***	0.05***	0.03***	0.00	0.14***	0.07***	1								
(8) bankma	1.06	-0.03***	0.02**	0.04***	-0.41***	0.00	-0.01	-0.01	1							
(9) intang	1.20	-0.08***	-0.04***	-0.14***	0.08***	-0.05***	0.02**	-0.01**	-0.01	1						
(10) gdwlshrout	1.02	0.21***	-0.01	0.02*	0.00	0.03***	0.05***	0.01	0.01	0.01	1					
(11) earnasset	2.18	-0.05***	0.10***	-0.01	-0.07***	-0.07***	-0.17***	0.00	0.04***	-0.48***	-0.03***	1				
(12) finasset	1.99	0.14***	-0.04***	0.11***	0.00	0.01**	0.09***	0.03***	0.03***	-0.03***	-0.01	0.07***	1			
(13) ppeat	1.26	-0.03***	-0.06***	0.02***	0.03***	0.00	0.05***	-0.03***	-0.13***	0.09***	0.01	-0.44***	-0.03***	1		
(14) custdep	1.24	-0.05***	0.13***	0.34***	-0.20***	-0.09***	-0.30***	-0.13***	-0.03***	-0.14***	-0.06***	0.23***	0.02***	-0.14***	1	
(15) perfloans	2.42	-0.11***	0.02*	0.09***	-0.08***	-0.16***	-0.27***	-0.11***	-0.01	-0.11***	-0.03***	0.46***	-0.33***	-0.18***	0.28***	1

Note(s): *, ** and *** represent significance at 10%, 5% and 1% levels, respectively.

On the other hand, the positive values suggest that more able managers are associated with higher-earning assets. It is necessary to point out that, due to high correlation (.96) between goodwill (gdwlat) and intangible assets (intang), we choose to use intang in the linear regressions due to the greater number of observations. The highest correlation observed (-0.48) was between earning assets (earnasset) and intangible assets (intang). In this case, we emphasise that earnasset is not used alone – that is, this variable is used only in interaction with bankma, and intangibles are used only as a firm-level control variable.

5.7. Empirical Findings and Discussion

First, it is important to emphasise that all results of the regressions performed are based on White's (1980) adjustments (standard errors adjusted for heteroscedasticity). In addition, the exploratory nature of this study makes dialogue and comparison with previous studies somewhat difficult. Thus, the results obtained are interpreted based essentially on the theoretical support discussed in previous sections, especially sections 5.3 and 5.4.

Table 5.4 depicts the result of the stepwise regression involving physical capital (comprehensive income scaled by total assets) and intangible capital (bankma) according to Equation (4). Our finding indicates the strength of association between them. The last two columns show that our findings remain robust even after controlling for firm factors, macroeconomic factors and country-specific factors. They show that a 1% increase in bankma is associated with a 1.6% (last column) increase in physical capital. These first findings are our basis for suggesting a cause-and-effect relationship between these two variables.

This first finding suggests that our proposition about the association between intangible capital and physical capital (H1) appears to be true. The positive value in the β_1 coefficient, supporting our hypothesis H1, suggests that in addition to the conversion of intangible capital into physical capital, there is a renewal of the intangible capital. In other

words, our findings suggest that intangible capital is renewed at a greater speed than it is converted.

We argue that a possible negative value would indicate that physical capital "absorbs" more intangible capital than this intangible capital manages to renew on its own. This would represent a scenario in which firms in a given sector have low intangible capital intensity – which seems not to be the case in banking. It should be noted that intangible assets (intang) and financial assets (finasset) in isolation do not show a statistically significant relationship with physical capital (only presenting a statistically significant relationship in the presence of other variables). Table 5.4 also shows that bank size is positively related to physical capital, while bank leverage is negatively related to physical capital.

Table 5.4

Stepwise Regression Results for the Association Between Physical Capital and Intangible

Capital

ciat	Model (4)						
bankma	0.0144***	0.0139***	0.0139***	0.0137***	0.0158***	0.0165***	0.0157***
	(4.96)	(5.05)	(5.07)	(5.04)	(5.79)	(8.06)	(15.78)
intang		0.0628	0.0650	0.0574	-0.0140	0.0333	-0.0856***
		(1.32)	(1.35)	(1.16)	(-0.36)	(0.80)	(-11.92)
finasset			0.00427	0.00496	0.00463	-0.00384	0.00540***
			(1.09)	(1.25)	(1.22)	(-1.31)	(4.29)
size				0.00112	0.00190**	0.0000755	0.00216***
				(1.72)	(2.67)	(0.13)	(21.48)
leverage					-0.123***	-0.0948***	-0.0833***
					(-3.91)	(-3.73)	(-37.14)
spglobeq						0.00403***	0.00466**
						(4.90)	(3.00)
rintrate						0.00237	0.00140
						(0.37)	(0.20)
gdpgrowth						0.130***	0.0415*
						(9.15)	(2.54)
_cons	0.00899***	0.00795***	0.00719***	-0.0104	0.0865***	0.0875***	0.0929***
	(342.62)	(13.22)	(7.36)	(-1.02)	(3.57)	(3.89)	(8.42)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	15,601	14,043	14,043	14,043	14,043	11,742	11,742
R^2	0.01	0.01	0.01	0.01	0.08	0.11	0.25

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels,

respectively.

Now, we examine whether changes in intangible capital explain changes in physical

capital (Equation 5). The results are shown in Table 5.5 and seem to confirm our initial

proposition that intangible capital is the cause of banks' physical capital. A 1% increase /

decrease in intangible capital (dbankma) is associated with an increase / decrease of about 1%

in physical capital (dciat). Note that changes in intangible assets (dintang) and changes in

financial assets (dfinasset) did not present a statistically significant relationship with changes

in physical capital. Notwithstanding, we continue our analysis since we are interested in

examining not a separate relationship between physical and intangible capital, but an

entangled relationship between them.

Table 5.5

Regression Results for the Association Between Changes in Physical Capital and Changes in

Intangible Capital

dciat	Model (5)						
dbankma	0.0117** (2.98)	0.0113* (2.35)	0.0113* (2.35)	0.0113* (2.34)	0.0115* (2.36)	0.00908** (3.19)	0.00966*** (6.98)
dintang		-0.0422 (-1.24)	-0.0425 (-1.24)	-0.0402 (-1.07)	-0.0533 (-1.35)	0.00778 (0.26)	-0.00103 (-0.08)
dfinasset			-0.000440 (-0.19)	-0.000593 (-0.26)	-0.000674 (-0.30)	-0.00276 (-1.14)	-0.00295 (-1.66)
dsize				-0.000237 (-0.47)	-0.000140 (-0.27)	-0.000572 (-1.37)	-0.000942** (-2.65)
dleverage					-0.0158 (-1.11)	-0.00368 (-0.38)	-0.00517 (-1.70)
spglobeq						0.00778*** (5.44)	0.00540** (3.10)
rintrate						-0.0197 (-1.89)	-0.0121 (-1.50)
gdpgrowth						0.0740*** (4.55)	-0.00550 (-0.28)
_cons	-0.000280*** (-49.55)	-0.000129*** (-9.52)	-0.000131*** (-7.56)	-0.000108 (-1.87)	-0.0000922 (-1.58)	-0.00185*** (-3.47)	0.0234 (1.43)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	13,010	10,001	10,001	10,001	10,001	8,405	8,405
R^2	0.01	0.01	0.01	0.01	0.01	0.02	0.06

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

Next, we performed two regressions to examine the relationship between bank managerial ability and goodwill. The first one was based on the Equation (6) model, and its results are reported in Table 5.6. Interestingly, they show a negative and statistically significant association between goodwill and managerial ability. This finding suggests that an increase in goodwill balance is associated with a decrease in bankma score. After controlling for year-country-fixed factors (last column) the association is non-significant. After finding this intriguing association, we ran the second regression to confirm this negative relationship. It is also worth noting that financial assets are positively related to bankma score, suggesting that these assets boost a manager's ability to maximise their bank's results. On the other hand, bank leverage is negatively related to managerial ability, suggesting that more leveraged banks reduce the ability of managers to act.

Table 5.6

Stepwise Regression Results for the Association Between Bank Managerial Ability and Goodwill

bankma	Model (6)							
gdwlshrout	-5.324***	-5.189***	-4.606***	-4.633***	-5.399***	-5.541***	-6.216***	0.863
	(-7.90)	(-6.63)	(-5.27)	(-5.71)	(-6.47)	(-5.85)	(-8.93)	(0.38)
ppeat		-0.677	-0.648	-0.554	-0.487	-0.480	-0.432	-1.278***
		(-1.51)	(-1.50)	(-1.42)	(-1.39)	(-1.38)	(-1.35)	(-15.15)
finasset			0.125**	0.143***	0.157***	0.158***	0.113**	0.101***
			(3.01)	(3.40)	(3.70)	(3.76)	(3.01)	(7.88)
custdep				-0.0135	-0.0225	0.00486	0.0547	0.0338*
				(-0.26)	(-0.42)	(0.10)	(1.01)	(2.38)
size					0.0155*	0.0150*	0.0194**	-0.0000198
					(2.46)	(2.42)	(3.15)	(-0.02)
leverage						-0.253*	-0.305*	-0.345***
						(-2.02)	(-2.15)	(-11.92)
spglobeq							-0.0160*	-0.000789
							(-2.53)	(-0.05)
rintrate							-0.0786	0.0429
							(-1.35)	(0.59)
gdpgrowth							-0.0661	-0.529***
							(-0.77)	(-3.42)
_cons	-0.00709***	0.00345	-0.0196	-0.0138	-0.251*	-0.0364	-0.0778	0.258***
	(-166.81)	(0.49)	(-1.89)	(-0.36)	(-2.28)	(-0.22)	(-0.42)	(4.09)
Year Control	No	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	No	Yes
N	10,816	10,816	10,816	10,434	10,434	10,434	9,111	9,111
R^2	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.08

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

We performed a stepwise logistic regression following the Equation (7) model, and its results are reported in Table 5.7. They show that the inverse relationship remains regardless of the magnitude of goodwill – that is, they show an inverse relationship between managerial ability and the probability of a firm entering into an M&A agreement with a premium payment.

This finding suggests that with increasing managerial ability in the bank's management team (including CEOs), there is a decreasing likelihood that the bank will enter into an M&A process. This is a very intriguing finding, since the prevailing literature has

argued that managerial ability is one of the intangible elements that make up goodwill. However, our findings are in line with the M&A literature, which has suggested that most M&A deals are unsuccessful. Table 5.7 also shows that bank size is positively related to a bank's probability of having a goodwill balance, suggesting that larger banks are more likely to pay an acquisition premium in a business combination. On the other hand, banks with more customer deposits (custdep) and more leveraged banks are less likely to enter into a business combination with payment for goodwill.

Table 5.7

Stepwise Regression Results for the Likelihood of the Bank Having a Goodwill Balance

gdwlyes	Model (7)							
bankma	-1.414***	-1.493***	-1.479***	-1.989***	-1.679***	-2.193***	-2.171***	-2.382***
	(-10.06)	(-10.51)	(-10.39)	(-11.30)	(-7.36)	(-9.38)	(-8.67)	(-8.80)
ppeat		-3.997***	-4.074***	-10.54***	5.444	4.600	6.711*	6.583
		(-3.78)	(-3.84)	(-7.83)	(1.91)	(1.59)	(2.06)	(1.92)
finasset			-0.218	-0.164	-0.531*	-0.392	-0.254	-0.0931
			(-1.21)	(-0.78)	(-2.24)	(-1.65)	(-1.01)	(-0.34)
custdep				-7.542***	-3.488***	-1.462***	-1.119**	-0.549
				(-26.33)	(-13.46)	(-4.89)	(-3.26)	(-1.40)
size					0.981***	1.050***	1.098***	1.161***
					(36.00)	(36.25)	(34.41)	(32.62)
leverage						-8.917***	-8.582***	-7.950***
						(-10.87)	(-9.61)	(-8.40)
spglobeq							-0.259	-2.707**
							(-1.42)	(-3.12)
rintrate							13.61***	6.697
							(6.29)	(1.01)
gdpgrowth							11.36***	7.474
							(6.30)	(0.74)
_cons	1.390***	1.453***	1.494***	7.259***	-9.893***	-4.450***	-6.280***	-16.97***
	(58.27)	(49.46)	(33.14)	(31.02)	(-22.56)	(-5.97)	(-7.75)	(-10.42)
Year Control	No	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	No	Yes
N	11,157	11,157	11,157	10,769	10,769	10,769	9,399	8,098
pseudo R^2	0.01	0.01	0.01	0.12	0.33	0.34	0.35	0.33

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

Our next analysis is based on the Equation (8) model, in which we examine the entanglement between physical capital and intangible capital. Table 5.8 reports the results. Note that the entanglement coefficient is positive and significant in every step. The coefficient of the interaction, i.e., the joint effect, seems to support our hypothesis H2 on the entanglement effect – that is, it seems that the entanglement effect produces the bank's physical capital.

Table 5.8

Stepwise Regression Results for the Association Between the Entanglement Effect and Physical Capital

ciat	**Model (8)**						
entang	0.0150***	0.0149***	0.0148***	0.0147***	0.0166***	0.0172***	0.0172***
	(4.62)	(4.63)	(4.65)	(4.62)	(5.10)	(7.29)	(14.98)
intang		0.0611	0.0633	0.0557	-0.0155	0.0329	-0.0840***
		(1.29)	(1.32)	(1.13)	(-0.39)	(0.80)	(-11.69)
finasset			0.00433	0.00502	0.00472	-0.00378	0.00528***
			(1.11)	(1.26)	(1.24)	(-1.29)	(4.19)
size				0.00112	0.00190**	0.0000871	0.00215***
				(1.73)	(2.65)	(0.14)	(21.40)
leverage					-0.122***	-0.0936***	-0.0826***
					(-3.82)	(-3.60)	(-36.81)
spglobeq						0.00404***	0.00470**
						(4.90)	(3.02)
rintrate						0.00242	0.00147
						(0.38)	(0.21)
gdpgrowth						0.130***	0.0414*
						(9.11)	(2.54)
_cons	0.00897***	0.00796***	0.00719***	-0.0105	0.0855***	0.0863***	0.0924***
	(378.48)	(13.27)	(7.37)	(-1.03)	(3.47)	(3.76)	(8.37)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	15,601	14,043	14,043	14,043	14,043	11,742	11,742
R^2	0.01	0.01	0.01	0.01	0.08	0.10	0.24

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

In other words, our findings suggests that bankma acting while entangled with earning assets adds more value to the bank. A one-unit increase in entanglement is associated with a 1.7% increase in the bank's physical capital. Although the magnitude of the entang coefficient is low, it must be considered that earning assets represent on average 87% of total assets. This makes the magnitude of the entanglement effect quite representative. Still on Table 5.8, either intangible assets (intang) alone have no statistically significant association with physical capital (columns 2–6), or that association is negative (column 7). Finally, bank size has a positive association with physical capital (probably due to scale gains) whereas leverage has a negative association.

It should be noted that non-tabulated results showed that earning assets alone did not show a statistically significant relationship with physical capital in the first steps of the stepwise regression. Only after the inclusion of control variables did the relationship become significant and positive (coefficient of 0.011 and t statistic of 5.02). Furthermore, when some variables are changed (sensitivity), the earning assets alone become non-significant (sometimes with a negative coefficient).

Once again, we investigate the change model. We now are interested in examining whether changes in entanglement are associated with changes in a bank's physical capital. The results are reported in Table 5.9, and show that a change of one unit in entanglement (dentang) is positively associated with a 0.9% change (with year and country fixed effects) in physical capital (dciat). The positive value, now in the variation of the entanglement effect, seems to confirm our proposition about the entanglement effect (H2).

Additionally, Table 5.9 demonstrates that changes in both intangible assets (dintang) and financial assets (dfinasset) have no statistically significant association with changes in physical capital. Interestingly, contrary to the findings in Table 5.8, changes in bank size have

a negative association with changes in physical capital – that is, an increase (decrease) in the

bank's size causes a negative (positive) change in its physical capital. Changes in leverage

have no statistically significant association with physical capital.

Table 5.9

Regression Results for the Association Between Changes in the Entanglement Effect and

Changes in Physical Capital

dciat	Model (9)	
dentang	0.0113	0.00881***
	(1.41)	(5.23)
dintang	0.0176	-0.0167
	(0.48)	(-0.85)
dfinasset	-0.00490	-0.00496
	(-1.95)	(-1.96)
dsize	-0.000751	-0.00119*
	(-1.34)	(-2.30)
dleverage	0.0145	0.00458
	(1.03)	(0.97)
spglobeq	0.00923***	0.00961***
	(5.49)	(4.07)
rintrate	-0.0246	-0.00587
	(-1.80)	(-0.50)
gdpgrowth	0.0599**	-0.0589*
	(2.71)	(-2.15)
_cons	-0.00153*	-0.00279
	(-2.31)	(-0.29)
Year Control	No	Yes
Country Control	No	Yes
N	8,302	8,302
R^2	0.02	0.04

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels,

respectively.

We next examine whether entanglement has a statistically significant relationship with profitability and market variables. This analysis can indicate whether investors perceive the entanglement effect. First, we investigate the association between entanglement and a bank's ROA. Since we have verified a positive association between entang and banks' physical capital, we are interested now in examining whether the entanglement effect also has an association with a bank's profitability. Table 5.10 reports the results following the specifications of Equation (10). Stepwise regression confirms the positive association between entanglement and a bank's profitability, indicating the importance of the entanglement effect when examining a bank's profitability. Table 5.10 also shows that the larger the bank, the more profitable it is, while the higher the bank's leverage, the lower its profitability. Once again – in the same way as observed in Table 5.4 – intangible assets (intang) and financial assets (finasset) in isolation were not statistically significant in the regression, only presenting a statistically significant relationship with ROA in the presence of other variables.

Table 5.10

Regression Results for the Association Between the Entanglement Effect and Banks'

Profitability

roa	Model (10)						
entang	0.0123*** (4.10)	0.0134*** (4.86)	0.0134*** (4.85)	0.0133*** (4.84)	0.0147*** (5.41)	0.0156*** (6.79)	0.0144*** (13.47)
intang		0.0178 (0.39)	0.0182 (0.40)	0.0100 (0.21)	-0.0498 (-1.24)	0.0191 (0.50)	-0.0497*** (-7.57)
finasset			0.00105 (0.43)	0.00173 (0.69)	0.00167 (0.67)	-0.00323 (-1.28)	0.00689*** (5.69)
size				0.00128 (1.92)	0.00232** (3.05)	-0.000377 (-0.65)	0.00171*** (17.83)
leverage					-0.114*** (-4.58)	-0.0880*** (-4.18)	-0.0636*** (-32.99)
spglobeq						0.00216*** (3.54)	0.00373** (3.05)
rintrate						-0.00144 (-0.17)	-0.00288 (-0.46)
gdpgrowth						0.127*** (10.56)	0.0790*** (6.09)
_cons	0.00904*** (486.21)	0.00857*** (15.69)	0.00839*** (11.27)	-0.0121 (-1.14)	0.0723*** (3.80)	0.0890*** (4.78)	0.0398*** (5.25)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	19,132	16,630	16,630	16,630	16,630	13,328	13,328
R^2	0.01	0.01	0.01	0.01	0.06	0.10	0.20

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels,

respectively.

Table 5.11 reports the relationship between entang and a bank's market value

according to the specifications of Equation (11). The results show a positive and statistically

significant association between the two factors, even after controlling for firm factors,

macroeconomic factors and year-country-specific factors. We call attention to the high

magnitude of both β_1 coefficient and R-squared observed in the column with year and

country fixed effects (the final column). The findings observed in Table 5.11 seem to confirm

Oliveira and Lustosa's (2022) proposal that intangible capital and physical capital are

entangled, and this entanglement forms the firm's economic value. The findings from Table 5.11 suggest that investors also incorporate the entanglement effect.

Although entanglement suggests that both forces (physical and intangible) act together in generating the economic result, the results of this regression suggest a dominant resultant force of intangible capital impacting physical capital. It may be that our findings are influenced by the tool used in this research (linear regressions). This is one of the limitations of our investigation. We do not use the tools of quantum mechanics. The tools of statistical physics or quantum-statistical mechanics turned out to be extremely useful when applied to complex systems (Chakraborti et al., 2011) – and organisations can be characterised as complex systems (Dooley & Van de Ven, 1999; Schneider & Somers, 2006; Scott & Davis, 2007). "Strategy making [...] is probably much closer to a quantum probability wave that changes its shape each time we observe it than it is to a linear and predictable Newtonian equation" (O'Donnell et al., 2003, p. 86).

Table 5.11

Regression Results for the Association Between the Entanglement Effect and a Bank's Market Value

mkvalt	Model (11)						
entang	0.396*** (6.09)	0.501*** (6.98)	0.504*** (7.04)	0.414*** (7.10)	0.407*** (7.31)	0.508*** (7.98)	0.791*** (16.87)
intang		11.24*** (6.20)	11.16*** (6.16)	5.304*** (4.22)	3.020*** (3.31)	2.699** (2.85)	0.451 (1.57)
finasset			-0.158 (-1.20)	0.305** (2.88)	0.316** (3.14)	0.153 (1.30)	0.606*** (11.59)
size				0.879*** (32.64)	0.939*** (39.60)	0.947*** (38.43)	1.056*** (251.55)
leverage					-5.333*** (-12.17)	-6.484*** (-12.38)	-5.052*** (-57.65)
spglobeq						0.282*** (11.36)	0.436*** (8.11)
rintrate						1.236*** (6.14)	0.0854 (0.31)
gdpgrowth						7.179*** (17.61)	5.151*** (8.85)
_cons	-0.989*** (-2079.58)	-1.112*** (-51.06)	-1.085*** (-33.05)	-15.28*** (-35.14)	-11.53*** (-22.41)	-10.79*** (-18.17)	-18.83*** (-58.41)
Year Control	No	No	No	No	No	No	Yes
Country Control	No	No	No	No	No	No	Yes
N	18,140	15,867	15,867	15,867	15,867	12,820	12,820
R^2	0.01	0.04	0.04	0.26	0.32	0.42	0.89

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

5.8. Robustness Test

5.8.1. Sensitivity Analysis

To assess the sensitivity of our results, we performed some tests by switching variables for others with the potential to impact our findings. We believe that these variables could influence banks' physical capital, profitability or market value. We replaced (i) intang with goodwill scaled by shares outstanding (gdwlshrout) and (ii) financial assets (finasset) – in Equations (4), (8), (10) and (11) – either with PPE (ppeat) or with customer deposits

(custdep). Besides this, we inserted performing loans (perfloans) into the model. Non-tabulated results indicate that our findings remain very consistent.[20]

When building bankma score (subsection 4.2), we performed sensitivity tests by including some variables in the Equation (2) model. Based on previous literature, we inserted the following variables into the tobit regression: (i) "free cash flow indicator" (Cantrell, 2013; García-Meca & García-Sánchez, 2018; Safiullah, Hassan & Kabir, 2020); (ii) "growth in assets" (Curi & Lozano-Vivas, 2020); and (iii) "legal status" (Banna et al., 2019). Once again, non-tabulated results indicate that our findings remain very consistent.

5.8.2. *Alternative Measurements*

In order to check whether our findings for the variable of interest remain unchanged, we performed additional robustness tests by using alternative measures for entang. First, we interact bankma with other measures of physical capital. We then select: (i) financial assets (finasset), considering that they would be a good replacement for earning assets, and (ii) customer deposits (custdep), following the approach suggest by Martins and Martins (2015), and Martins and Santos (2017). For the authors, bank deposits (demand and term) are accounts that generate gains for their holders. Banks create value from deposit-taking, both by virtue of their paying interest at below-market rates and by cross-selling fee-based services (Begley, Chamberlain & Li, 2006).

The results are reported in Table 5.12. The first two columns show the entanglement effect between bankma and finasset. The last two columns show the entanglement effect between bankma and custdep. Regardless of how we measure entanglement, our findings remain unchanged. With or without the influence of year and country controls, our findings

---

[20] Keeping these variables in our model would significantly impact the number of observations from our sample, which is why we chose to use them only for robustness-testing purposes.

remain very robust. The findings suggest that the entanglement effect proposed in this study remains robust regardless of the form of interaction of the chosen variables.

Table 5.12

Robustness Test: Regression Results for Alternative Measurements of Entanglement

ciat	Model (6)			
entang_fa	0.0271***	0.0417***		
	(4.96)	(11.55)		
entang_dep			0.0193***	0.0170***
			(8.03)	(13.48)
intang	0.0312	-0.0854***	0.0238	0.00691
	(0.75)	(-11.84)	(0.58)	(0.95)
finasset	-0.00382	0.00387**	-0.00165	0.00729***
	(-1.27)	(3.02)	(-0.62)	(6.47)
size	0.000249	0.00215***	0.000225	0.00134***
	(0.42)	(21.29)	(0.40)	(14.93)
leverage	-0.0921***	-0.0832***	-0.0939***	-0.0746***
	(-3.40)	(-36.86)	(-3.84)	(-33.15)
spglobeq	0.00370***	0.00402*	0.00349***	0.00358**
	(4.53)	(2.57)	(4.34)	(2.64)
rintrate	0.00206	0.00275	0.00578	0.00679
	(0.31)	(0.39)	(1.00)	(1.09)
gdpgrowth	0.127***	0.0348*	0.129***	0.0207
	(8.85)	(2.12)	(9.02)	(1.46)
_cons	0.0825***	0.0939***	0.0846***	0.0597***
	(3.46)	(8.47)	(3.63)	(12.96)
Year Control	No	Yes	No	Yes
Country Control	No	Yes	No	Yes
N	11,742	11,742	11,335	11,335
R^2	0.09	0.24	0.10	0.27

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

Finally, we change the approach used when running DEA to build an alternative banking efficiency score. To do this, we again split the database by year to run DEA using the intermediation approach proposed by Sealey and Lindley (1977). The intermediation approach assumes that financial firms act as intermediaries between savers and borrowers borrowing funds from depositors and lending those funds to others for profit (Yue, 1992; Favero & Papi, 1995; Sufian, 2009). With this approach, our measure of bankma will be based on the bank's efficiency in maximising the financial intermediation. Andreou, Philip and Robejsek (2016) document that more able bank managers have the capacity to facilitate greater intermediation.

"The intermediation approach considers various types of costs as the inputs, and those are combined to support the largest possible number of revenue generating accounts" (Soteriou & Zenios, 1999, p. 1224). According to this approach, deposits and the various costs of obtaining funds (e.g. interest expenses, labour, capital and operating costs) should be treated as inputs of a bank. Loans and fees are treated as outputs from the primary business activities of banks (Sealey and Lindley, 1977; Yue, 1992; Fukuyama, 1993; Sufian, 2009; Holod & Lewis, 2011; Sharma, Sharma & Barua, 2013; Karray & Chichti, 2013). Thus, our DEA alternative model solves the following optimisation problem:

$$\max v\theta = \frac{\text{feeinc} + \text{gloans}}{v1\text{totcustdep} + v2\text{intexp} + v3\text{fixassets} + v4\text{operatexp}} \tag{12}$$

where feeinc is the total of fee and commission income; gloans is total gross loans; totcustdep is the total of customer deposits; intexp is total interest expenses; fixassets is the book value of fixed assets (total PPE); and operatexp is total operating expenses. After running DEA, we ran a tobit regression following the specifications of Equation (2) and collected the residual term, which is now our alternative measure of bankma. The results are depicted in Table 5.13.

Our findings show that entang remains positive and statistically significant for both the main entang measure and the alternative measures highlighted in Table 5.12 (entang_fa and entang_dep). In summary, the robustness tests show that our findings remain very consistent regardless of how we: (i) measure the bank's efficiency score (bank_efficiency), (ii) measure the bank's managerial ability score (bankma), or (iii) construct the variable that captures the entanglement effect (entang).

Table 5.13

Robustness Test: Regression Results for Alternative Measurements of Bank Managerial Ability

ciat	Model (6)					
entang_alt	0.0139***	0.00727***				
	(5.25)	(5.63)				
entang_fa_alt			0.0136**	0.0257***		
			(2.64)	(6.24)		
entang_dep_alt					0.0180***	0.00969***
					(5.64)	(5.74)
intang	-0.0292	-0.00304	-0.0245	-0.00745	-0.0296	-0.00169
	(-0.50)	(-0.34)	(-0.42)	(-0.84)	(-0.52)	(-0.19)
finasset	0.00858*	0.0118***	0.00623	0.0121***	0.00872**	0.0117***
	(2.58)	(8.60)	(1.94)	(8.83)	(2.83)	(8.59)
size	0.00121	0.00164***	0.00110	0.00164***	0.00123	0.00164***
	(1.49)	(15.39)	(1.37)	(15.36)	(1.54)	(15.35)
leverage	-0.167	-0.0866***	-0.168	-0.0883***	-0.166	-0.0867***
	(-1.85)	(-33.07)	(-1.86)	(-33.97)	(-1.84)	(-33.15)
spglobeq	0.00483***	0.00703***	0.00470***	0.00679***	0.00483***	0.00701***
	(3.90)	(4.39)	(3.82)	(4.24)	(3.93)	(4.38)
rintrate	0.0152	0.00602	0.0132	0.00529	0.0150	0.00625
	(1.75)	(0.82)	(1.56)	(0.72)	(1.77)	(0.85)
gdpgrowth	0.122***	0.0137	0.124***	0.0141	0.122***	0.0126
	(6.60)	(0.82)	(6.73)	(0.84)	(6.68)	(0.75)
_cons	0.132	0.0688***	0.136	0.0706***	0.131	0.0689***
	(1.82)	(8.13)	(1.86)	(8.34)	(1.80)	(8.14)
Year Control	No	Yes	No	Yes	No	Yes
Country Control	No	Yes	No	Yes	No	Yes
N	11,452	11,452	11,452	11,452	11,452	11,452
R^2	0.14	0.24	0.14	0.24	0.14	0.24

Note(s): t statistics in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1% levels, respectively.

5.9. Summary and Conclusion

Banks have been increasingly limited by regulators as to the accounting assets that can be used as regulatory capital. For this reason, it is important to understand the nature of goodwill in the banking industry. Existing literature has suggested that accounting goodwill is made up of different components acting as a generator of residual earnings. On the other hand, supported by quantum theory foundations, this study has explored an alternative approach to the nature of goodwill. We consider the entanglement effect between intangible capital and physical capital as an explanatory factor for value creation in banking. To the best of our knowledge, no previous study has examined such an approach.

Our findings are as follows. First, we find that, in banking, intangible capital is directly associated with physical capital, suggesting the conversion of the first into the second. Not least, this positive relationship suggests that intangible capital is renewed at a speed greater than it is converted. Second, and more importantly, we find a positive association between the entanglement effect and both a bank's physical capital and its value creation, suggesting that the entanglement effect is a real force in banking. When we entangle bankma score with the bank's earning assets, we find that this effect has a statistically significant association with several measures of a bank's economic outcomes. Robustness tests show that our findings remain very consistent.

In the final paragraph of Section 6, we highlighted a limitation of this study, which concerns the use of statistical physics tools. Here we highlight another (which can also be considered a suggestion for future research): we have not investigated whether the entanglement effect creates residual income. Notwithstanding, this study opens a wide avenue for further studies aiming to investigate goodwill in the banking industry.

Based on our findings, we can suggest goodwill not as an accounting asset (in isolation), but as a perspective on future profitability of the acquired business – a measure of

intangible capital or intangible wealth that is only potential at the present time. An intangible capital that creates value (positive residuals) for banks through its joint, or entangled, action with physical capital. These findings may be of special importance to scholars, investors and regulators.

Finally, we draw attention to the growth of quantum physics as a field of knowledge to be triangulated with accounting. Although econophysics and sociophysics are already consolidated as fields of knowledge, we find very few studies linking accounting and quantum physics. Accounting is still in the first steps of this journey. We argue that accounting, while a science, has quite a way to progress if it is also to enter this subatomic world, which remains poorly explored.

6. Concluding Remarks

In this doctoral dissertation, I develop a new approach to the nature of goodwill. Through a tetralogy of essays, I provide: (i) an alternative theoretical underpinning – supported by quantum theory, economics and general systems theory – which explains the nature of goodwill, taking into account the entanglement effect between intangible capital and physical capital; and (ii) empirical evidence of the entanglement effect. Additionally, I provide new empirical evidence relating to core goodwill, indicating that it represents only 15% of reported goodwill. I also provide theoretical support, grounded in psychology, for this issue.

The main conclusions of this dissertation are: (i) goodwill does not act in isolation as a generator of residual income. The qualities and virtues of human actions (e.g. techniques and skills) are value drivers that culminate in physical capital. The actions of both (physical and intangible) are entangled in the process of generating superior gains; (ii) the entanglement effect represents the very nature of goodwill; (iii) the highest share of reported goodwill does not represent economic substance. The findings suggest that this large share of goodwill may be the result of decisions influenced by cognitive biases; (iv) there is a positive association between intangible capital (proxied by managerial ability) and physical, suggesting that, on average, intangible capital is renewed at a greater speed than its conversion; and (v) the data confirms that the entanglement effect is a real force in organisations – that is, there is a positive association between the entanglement effect and firms' value creation, regardless of the sector.

As highlighted in the second essay, I conclude that the economic nature of goodwill is "agential". It builds up ("mattering" – as in Barad, 2007; 2014) dynamically, in an intra-active process, according to the "quality" of its entanglement with intangible capital (and other assets) and in each specific context. The entanglement effect I propose means that there

is no "spooky action at a distance" (Albert Einstein's famous phrase) linking goodwill to physical capital, but rather a real symbiotic relationship in which one depends on the other to generate value.

This thesis has some limitations, which are highlighted in each of the four articles and summarised here. First, regarding the issue of cognitive biases, I do not develop any measure for a specific bias. The empirical tests I run consider the premise that one (or some) of them are significantly present in less able managers. It should be noted that the psychology literature, in general, uses experimental studies to address this issue. Second, I assume that decisions about premium payments are made rationally and in good faith by executives (for example, I do not consider cases of opportunism); third, although I make use of quantum theory to address the entanglement effect, I do not use the tools of quantum mechanics to perform empirical tests; last but not least, I do not investigate whether the entanglement effect creates residual income for firms.

This thesis not only expands the literature on the nature of goodwill but also points to a large separation between core goodwill and reported goodwill. By borrowing concepts from other fields of knowledge, I provide a solid basis which may be of great value for scholars, investors and regulators. From this thesis, an avenue for future research opens, and here I provide some paths that can be followed.

Regarding cognitive biases, further research can perform experimental studies to examine the influence of a specific bias in decision making. Previous research in the psychology literature (as considered in the first essay) provides several insights for performing this kind of research. Those interested in the dialogue between quantum theory and accounting can make use of other concepts from the quantum field, such as quantum tunnelling. Or they could dialogue the concepts dealt with in this thesis with elements from the conceptual framework of accounting. In the empirical field, future research may use the

tools of statistical mechanics (exemplified in the second article) to perform cause-and-effect tests, rather than multiple regressions. Finally, there is also ample room for further research to use some measure of residual earnings in order to test its relationship to entanglement.

I end this thesis by calling attention to the importance of quantum theory in the field of social sciences. From quantum theory, we can expand our Cartesian view of things. Perhaps the accounting classification of accounts into tangibles and intangibles is also a mere Cartesian habit of mind. According to Barad's agential realism, everything is entangled. We just apply the agential "cuts" to produce determinate boundaries and properties of "entities" within phenomena. Therefore, "different agential cuts produce different phenomena" (Barad, 2007, p. 175). Even in religion, we have examples of quantum entanglement. For example, in the biblical Book of Genesis (1:4) it is written: "And God saw the light, that it was good: and God ***divided*** the light from the darkness" (my emphasis). Does not this sentence suggest that before that event, light and darkness were entangled?

References

Abrahamson, E., & Rosenkopf, L. (1993). Institutional and competitive bandwagons: Using mathematical modeling as a tool to explore innovation diffusion. *Academy of Management Review*, 18(3), 487–517. https://doi.org/10.5465/amr.1993.9309035148

Abreu, R. (2016). From Accounting to Firm Value. *Procedia Economics and Finance*, 39, 685–692. https://doi.org/10.1016/S2212-5671(16)30290-8

Agarwal, N. S. (2012). New Quantum Theory. *Indian Journal of Science and Technology*, 5(11), 3612–3617. https://doi.org/10.17485/ijst/2012/v5i11.5

Agarwal, N., & Zeephongsekul, P. (2013). Psychological pricing in mergers & acquisitions using prospect theory. *Studies in Economics and Finance*, 30(1), 22–30. https://doi.org/10.1108/10867371311300937

Aguilera, R. V., & Dencker, J. C. (2004). The role of human resource management in cross-border mergers and acquisitions. *International Journal of Human Resource Management*, 15(8), 1355–1370. https://doi.org/10.1080/0958519042000257977

Ahern, K. R., & Harford, J. (2013). The Importance of Industry Links in Merger Waves. *The Journal of Finance*, 69(2), 527–576. https://doi.org/10.1111/jofi.12122

Al Jifri, K., & Citron, D. (2009). The value-relevance of financial statement recognition versus note disclosure: Evidence from Goodwill Accounting. *European Accounting Review*, 18(1), 123–140. https://doi.org/10.1080/09638180802324351

Alexandridis, G., Petmezas, D., & Travlos, N. G. (2010). Gains from mergers and acquisitions around the world: New evidence. *Financial Management*, 39(4), 1671-1695. https://doi.org/10.1111/j.1755-053X.2010.01126.x

Allee, V. (2008). Value network analysis and value conversion of tangible and intangible assets. *Journal of Intellectual Capital*, 9(1), 5–24. https://doi.org/10.1108/14691930810845777

Amemiya, T. (1978). A Note on a Random Coefficients Model. International Economic

    Review, 19(3), 793–796. https://doi.org/10.2307/2526342

Amir, E., Harris, T. S., & Venuti, E. K. (1993). A Comparison of the Value-Relevance of

    U.S. versus non-U.S. GAAP Accounting Measures Using Form 20-F Reconciliations.

    Journal of Accounting Research, 31 (Suppl.), 230–264.

    https://doi.org/10.2307/2491172

Andrade, G., Mitchell, M., & Stafford, E. (2001). New Evidence and Perspectives on

    Mergers. *Journal of Economic Perspectives*, 15(2), 103–120.

    https://doi.org/10.1257/jep.15.2.103

Andreou, P. C., Karasamani, I., Louca, C., & Ehrlich, D. (2017). The impact of managerial

    ability on crisis-period corporate investment. *Journal of Business Research*, 79, 107–

    122. https://doi.org/10.1016/j.jbusres.2017.05.022

Andreou,P. C., Philip, D., & Robejsek, P. (2016). Bank liquidity creation and risk-taking:

    Does managerial ability matter? *Journal of Business Finance & Accounting*, 43(1–2),

    226–259. https://doi.org/10.1111/jbfa.12169

Angwin, D. (2007). Motive Archetypes in Mergers and Acquisitions (M&A): The

    Implications of a Configurational Approach to Performance. In Cooper, C.

    L. and Finkelstein, S. (Eds.), *Advances in Mergers and Acquisitions* (pp. 77–105).

    Stamford, CT: JAI Press New York. https://doi.org/10.1016/S1479-361X(07)06004-8

Angwin, D. N., Mellahi, K., Gomes, E., & Peter, E. (2016). How communication approaches

    impact mergers and acquisitions outcomes. *The International Journal of Human

    Resource Management*, 27(20), 2370–2397.

    https://doi.org/10.1080/09585192.2014.985330

Ayton, P., & Fischer, I. (2004). The hot hand fallacy and the gambler's fallacy: Two faces of subjective randomness? *Memory & Cognition*, 32(8), 1369–1378. https://doi.org/10.3758/BF03206327

Baboukardos, D., & Rimmel, G. (2014). Goodwill under IFRS: Relevance and Disclosures in an Unfavorable Environment. *Accounting Forum*, 38(1), 1–17. https://doi.org/10.1016/j.accfor.2013.11.001

Baik, B., Choi, S., & Farber, D. B. (2020). Managerial ability and income smoothing. *The Account Review*, 95(4), 1–22. https://doi.org/10.2308/accr-52600

Baik, B., Farber, D. B., & Lee, S. (2011). CEO ability and management earnings forecasts. *Contemporary Accounting Research*, 28(5) 1645–1668. https://doi.org/10.1111/j.1911-3846.2011.01091.x

Balasubramanian, N., Black, B. S., & Khanna, V. (2010). The relation between firm-level corporate governance and market value: a case study of India. Emerging Markets Review, 11(4), 319–340. https://doi.org/10.1016/j.ememar.2010.05.001

Banker, R. D., Darrough, M. N., Huang, R., & Plehn-Dujowich, J. M. (2013). The relation between CEO compensation and past performance. *The Accounting Review*, 88(1), 1–30. https://doi.org/10.2308/accr-50274

Banna, H., Rana, M. S., Ismail, I., & Ismail, N. (2019). Quantifying the managerial ability of microfinance institutions: Evidence from Latin America. *Journal of International Development*, 31(7), 578–600. https://doi.org/10.1002/jid.3419

Bao, J., & Edmans, A. (2011). Do Investment Banks Matter for M&A Returns? *The Review of Financial Studies*, 24(7), 2286–2315. https://doi.org/10.1093/rfs/hhr014

Barad, K. M. (2003). Posthumanist performativity: toward an understanding of how matter comes to matter. *Signs: Journal of Women in Culture and Society*, 28(3), 801–831. https://doi.org/10.1086/345321

Barad, K. M. (2007). *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duham & London: Duke University Press. https://doi.org/10.1215/9780822388128

Barad, K. M. (2010). Quantum Entanglements and Hauntological Relations of Inheritance: Dis/continuities, SpaceTime Enfoldings, and Justice-to-Come. *Derrida Today*, 3(2), 240–268. https://doi.org/10.3366/drt.2010.0206

Barad, K. M. (2014). Diffracting Diffraction: Cutting Together-Apart. *Parallax*, 20(3), 168–187. https://doi.org/10.1080/13534645.2014.927623

Barker, R., & Schulte, S. (2017). Representing the market perspective: Fair value measurement for non-financial assets. *Accounting, Organizations and Society*, 56, 55–67. https://doi.org/10.1016/j.aos.2014.12.004

Baron, J. (2008). *Thinking and deciding* (4th ed.). Cambridge, MA: Cambridge University Press.

Baron, J., & Hershey, J. C. (1988). Outcome Bias in Decision Evaluation. *Journal of Personality and Social Psychology*, 54(4), 569–579. https://doi.org/10.1037/0022-3514.54.4.569

Barr, R. S., Seiford, L. M., & Siems, T. F. (1994). Forecasting Bank Failure: A Non-Parametric Frontier Estimation Approach. *Recherches Économiques de Louvain (Louvain Economic Review)*, 60(4), 417–429. https://doi.org/10.1017/S0770451800004590

Bawden, D., Robinson, L., & Siddiqui, T. (2015). "Potentialities or Possibilities": Towards Quantum Information Science? *Journal of the Association for Information Science and Technology*, 66, 437–449. https://doi.org/10.1002/asi.23192

Beatty, A., & Weber, J. (2006). Accounting discretion in fair value estimates: An examination of SFAS 142 goodwill impairments. *Journal of Accounting Research*, 44(2), 257–288. https://doi.org/10.1111/j.1475-679X.2006.00200.x

Beaver, W. H., McAnally, M. L., & Stinson, C. H. (1997). The information content of earnings and prices: a simultaneous equations approach. *Journal of Accounting and Economics*, 23(1), 53–81. https://doi.org/10.1016/S0165-4101(96)00424-7

Beaver, W., Eger, C., Ryan, S., & Wolfson, M. (1989). Financial reporting, supplemental disclosures and bank share prices. *Journal of Accounting Research*, 27(2): 157–178. https://doi.org/10.2307/2491230

Becker, G. S. (1962). Irrational Behavior and Economic Theory. *The Journal of Political Economy*, 70(1), 1–13. https://doi.org/10.1086/258584

Begley, J., Chamberlain, S. L., & Li, Y. (2006). Modeling goodwill for banks: A residual income approach with empirical tests. *Contemporary Accounting Research*, 23(1), 31–68. https://doi.org/10.1506/DVWU-BWTW-B018-LMTA

Bell, J. S. (1964). On the Einstein-Podolsky-Rosen paradox, *Physics*, 1(3), 195–200.

Bepari, M. K., & Mollik, A. T. (2017). Regime change in the accounting for goodwill: goodwill write-offs and the value relevance of older goodwill. *International Journal of Accounting & Information Management*, 25(1), 43–69. https://doi.org/10.1108/IJAIM-02-2016-0018

Bertrand, E. (2015). From the Firm to Economic Policy: The Problem of Coase's Cost. *History of Political Economy*, 47(3), 481–510. https://doi.org/10.1215/00182702-3153152

Bertrand, M., & Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *Quarterly Journal of Economics*, 118(4), 1169–1208. https://doi.org/10.1162/003355303322552775

Betancourt, L., & Irving, J. H. (2019). The Challenge of Accounting for Goodwill: Impact of

    a Possible Return to Amortization. *The CPA Journal*. Retrieved in 04/07/2020 in

    https://www.cpajournal.com/2019/11/27/the-challengeof-accounting-for-goodwill/.

Bettis R. A. (1981). Performance differences in related and unrelated diversified firms.

    Strategic Management Journal, 2(4): 379–393.

    https://doi.org/10.1002/smj.4250020406

Bikker, J. A., & Haaf, K. (2002). Measures of competition and concentration in the banking

    industry: a review of the literature. *Economic & Financial Modelling*, 9, 53–98.

Billett, M. T., & Qian, Y. (2008). Are Overconfident CEOs Born or Made? Evidence of Self-

    Attribution Bias from Frequent Acquirers. *Management Science*, 54(6), 1037–1051.

    https://doi.org/10.1287/mnsc.1070.0830

Birnberg, J. G. (2011). A Proposed Framework for Behavioral Accounting Research.

    Behavioral Research in Accounting, 23(1), 1–43.

    https://doi.org/10.2308/bria.2011.23.1.1

Birnberg, J. G., & Ganguly, A. R. (2012). Is neuroaccounting waiting in the wings? An essay.

    Accounting, Organizations and Society, 37(1), 1–13.

    https://doi.org/10.1016/j.aos.2011.11.004

Black, D. E. (2016). Other comprehensive income: a review and directions for future

    research. *Accounting & Finance*, 52(1), 9–45. https://doi.org/10.1111/acfi.12186

Bonsall IV, S. B., Holzman, E. R., & Miller, B. P. (2017). Managerial ability and credit risk

    assessment. *Management Science*, 63(5), 1425–1449.

    https://doi.org/10.1287/mnsc.2015.2403

Boone, A. L. & Mulherin, H. (2007). How are firms sold? *Journal of Finance*, 62(2), 847–

    875. https://doi.org/10.1111/j.1540-6261.2007.01225.x

Booth, B. (2003). The Conceptual Framework as a Coherent System for the Development of Accounting Standards. *Abacus*, 39(3), 310–324. https://doi.org/10.1111/j.1467-6281.2003.00135.x

Bourdieu, P., Chamboredon J-C., & Passeron J-C. (1991). *The Craft of Sociology: Epistemological Preliminaries*. Translated by Richard Nice. Berlin; New York: de Gruyter.

Bowlin, W. F. (1998). Measuring performance: An introduction to data envelopment analysis (DEA). *Journal of Cost Analysis*, 15(2), 3–27. https://doi.org/10.1080/08823871.1998.10462318

Bozalek, V., & Zembylas, M. (2017). Diffraction or reflection? Sketching the contours of two methodologies in educational research. *International Journal of Qualitative Studies in Education*, 30(2), 111–127. https://doi.org/10.1080/09518398.2016.1201166

Bracha, A., & Brown, D. J. (2012). Affective Decision Making: A Theory of Optimism Bias. *Games and Economic Behavior*, 75(1), 67–80. https://doi.org/10.1016/j.geb.2011.11.004

Brouwer, A., Hoogendoorn, M., & Naarding, E. (2015). Will the changes proposed to the conceptual framework's definitions and recognition criteria provide a better basis for IASB standard setting? *Accounting and Business Research*, 45(5), 547–571. https://doi.org/10.1080/00014788.2015.1048769

Brown, A. B., Davis-Friday, P. Y., Guler, L., & Marquardt, C. (2015). M&A Decisions and U.S. Firms' Voluntary Adoption of Clawback Provisions in Executive Compensation Contracts. *Journal of Business Finance & Accounting*, 42(1–2), 237–271. https://doi.org/10.1111/jbfa.12111

Brown, S. J., Lajbcygier, P., & Li, B. (2008). Going Negative: What to Do with Negative Book Equity Stocks. *Journal of Portfolio Management*, 35(1), 95–102. https://doi.org/10.3905/JPM.2008.35.1.95

Bruner, R. F. (2004). *Applied Mergers and Acquisitions*. John Wiley & Sons, New Jersey.

Brütting, M. (2011). *Goodwill impairment: causes and impact* [Unpublished doctoral dissertation]. City University London, United Kingdom.

Bruza, P., Busemeyer, J. R., & Gabora, L. (2009). Introduction to the special issue on quantum cognition. *Journal of Mathematical Psychology*, 53(5), 303–305. https://doi.org/10.1016/j.jmp.2009.06.002

Buehler, R., Griffin, D., & Ross, M. (1994). Exploring the "Planning Fallacy": Why People Underestimate Their Task Completion Times. *Journal of Personality and Social Psychology*, 67(3), 366–381. https://doi.org/10.1037/0022-3514.67.3.366

Buehler, R., Griffin, D., & Ross, M. (2002). Inside the Planning Fallacy: The Causes and Consequences of Optimistic Time Predictions. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The Psychology of Intuitive Judgment* (pp. 250–270). Cambridge University Press.

Bugeja, M., & Gallery, N. (2006). Is older goodwill value relevant? *Accounting and Finance*, 46, 519–535. https://doi.org/10.1111/j.1467-629X.2006.00181.x

Bui, D. G., Chen, Y-S., Hasan, I., & Lin, C. Y. (2018). Can lenders discern managerial ability from luck? Evidence from bank loan contracts. *Journal of Banking and Finance*, 87, 187–201. https://doi.org/10.1016/j.jbankfin.2017.09.023

Burger, M., & Wen, H. (2021). The relative and incremental value relevance of goodwill before and after SFAS No. 142. *Journal of Accounting and Public Policy*, 40(6), 106906. https://doi.org/10.1016/j.jaccpubpol.2021.106906

Burrell, G., & Morgan, G. (1979). *Sociological Paradigms and Organisational Analysis: elements of the sociology of corporate life*. Heinemann, London.

Büscher, M., & Veloso, L. (2018). Métodos Móveis. *Tempo Social: Revista de Sociologia da USP*, 30(2), 133–151. https://doi.org/10.11606/0103-2070.ts.2018.142258

Busco, C., & Quattrone, P. (2018). In search of the "perfect one": How accounting as a maieutic machine sustains inventions through generative 'in-tensions'. *Management Accounting Research*, 39, 1–16. https://doi.org/10.1016/j.mar.2017.02.002

Busemeyer, J. R., & Bruza, P. (2012). *Quantum Models of Cognition and Decision*. Cambridge University Press: Cambridge, UK.

Busemeyer, J. R., Wang, Z., & Townsend, J. T. (2006). Quantum dynamics of human decision- making. *Journal of Mathematical Psychology*, 50, 220–241. https://doi.org/10.1016/j.jmp.2006.01.003

Cabrita, M. R., & Vaz, J. L. (2005). Intellectual Capital and Value Creation: Evidence from the Portuguese Banking Industry. *Electronic Journal of Knowledge Management*, 4(1), 11–20. https://www.academic-publishing.org/index.php/ejkm/article/view/731

Calipha, R., Tarba, S., & Brock, D. (2010). Mergers and Acquisitions: A Review of Phases, Motives and Success Factors. In C. L. Cooper & S. Finkelstein (Eds.), *Advances in Mergers and Acquisitions* (pp. 1–24). Emerald Group Publishing Limited, Bingley. https://doi.org/10.1108/S1479-361X(2010)0000009004

Callon, M. (1998). An essay on framing and overflowing: economic externalities revisited by sociology. In M. Callon (ed.), *The Laws of the Markets* (pp. 244–269). Blackwell, Oxford. https://doi.org/10.1111/j.1467-954X.1998.tb03477.x

Canning, J. B. (1929). *The Economics of Accountancy: A Critical Analysis of Accounting Theory*. The Ronald Press Company.

Cantrell, B. W. (2013). Bank managerial ability and accounting: Do Better Managers Report Higher Quality Loan Loss Reserves and Fair Values? Doctoral Dissertation. The University of Texas at Austin. https://repositories.lib.utexas.edu/handle/2152/21752. (downloaded on March, 24th, 2022).

Cartwright, S., & Cooper, C. L. (1990). The Impact of Mergers and Acquisitions on People at Work: Existing Research and Issues. *British Journal of Management*, 1(2), 65–76. https://doi.org/10.1111/j.1467-8551.1990.tb00163.x

Cartwright, S., & Cooper, C. L. (1993). The role of cultural compatibility in successful organizational marriage. *Academy of Management Executive*, 7(2), 57–70. https://doi.org/10.5465/ame.1993.9411302324

Cartwright, S., & Schoenberg, R. (2006). Thirty Years of Mergers and Acquisitions Research: Recent Advances and Future Opportunities. *British Journal of Management*, 17, S1–S5. https://doi.org/10.1111/j.1467-8551.2006.00475.x

Casu, B., & Girardone, C. (2006). Bank Competition, Concentration and Efficiency in the Single European Market. *The Manchester School*, 74(4), 441–468. https://doi.org/10.1111/j.1467-9957.2006.00503.x

Cecez-Kecmanovic, D., Galliers, B., Henfridsson, O., Newell, S., & Vidgen, R. (2010). On sociomateriality of information systems and organizing. *MIS Quarterly*, Call for Papers MISQ.

Chakraborti, A., Toke, I. M., Patriarca, M., & Abergel, F. (2011). Econophysics: Empirical facts and agent-based models. Quantitative Finance, 11(7), 991–1012. https://doi.org/10.48550/arXiv.0909.1974

Charnes, A., Cooper, W. W., Huang, Z. M., & Sun, D. B. (1990). Polyhedral cone–ratio DEA models with an illustrative application to large commercial banks. *Journal of Econometrics*, 46(1–2), 73–91. https://doi.org/10.1016/0304-4076(90)90048-X

Chauvin, K. W., & Hirschey, M. (1994). Goodwill, profitability and the market value of the firm. *Journal of Accounting and Public Policy*, 13(2), 159–180. https://doi.org/10.1016/0278-4254(94)90018-3

Chen, S., & Lin, C. (2018). Managerial ability and acquirer returns. The Quarterly Review of Economics and Finance, 68, 171–182. https://doi.org/10.1016/j.qref.2017.09.004

Chircop, J., & Novotny-Farkas, Z. (2016). The economic consequences of extending the use of fair value accounting in regulatory capital calculations. Journal of Accounting and Economics, 62(2), 183–203. https://doi.org/10.1016/j.jacceco.2016.10.004

Chiu, P., Teoh, S., & Tian, F. (2013). Board interlocks and earnings management contagion. *The Accounting Review*, 88(3), 915–944. https://doi.org/10.2308/accr-50369

Chiu, Y-H., Chen, Y-C., & Bai, X-J. (2011). Efficiency and risk in Taiwan banking: SBM super-DEA estimation. *Applied Economics*, 43(5), 587–602. https://doi.org/10.1080/00036840802599750

Churyk, N. T. (2005). Reporting goodwill: Are the new accounting standards consistent with market valuations? *Journal of Business Research*, 58, 1353–1361. https://doi.org/10.1016/j.jbusres.2004.05.006

Coase, R. H. (1937). The Nature of the Firm. *Economica*, New Series, 4(16), 386–405. https://doi.org/10.2307/2626876

Coase, R. H. (1990). Accounting and the theory of the firm. *Journal of Accounting and Economics*, 12(1–3), 3–13. https://doi.org/10.1016/0165-4101(90)90038-6

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and Learning: The Two Faces of R&D. *The Economic Journal*, 99(397), 569–596. https://doi.org/10.2307/2233763

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128–152. https://doi.org/10.2307/2393553

Colley, J. R., & Volkan, A. G. (1988). Accounting for Goodwill. *Accounting Horizons*, 2(1), 35–41. https://www.proquest.com/openview/687ccd2d6d3d4a3a2fb545aca71bb0ad/1?pq-origsite=gscholar&cbl=3330

Colville, I. (1981). Reconstructing "Behavioural Accounting". *Accounting, Organizations and Society*, 6(2), 119–132. https://doi.org/10.1016/0361-3682(81)90002-7

Cooper, J. (2007). Debating Accounting Principles and Policies: the Case of Goodwill, 1880-1921. *Accounting, Business & Financial History*, 17(2), 241–64. https://doi.org/10.1080/09585200701376568

Cooper, M., Knott, A. M., & Yang, W. (2019). RQ innovative efficiency and firm value. *SSRN Working paper*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2631655

Cordazzo, M., & Rossi, P. (2020). The influence of IFRS mandatory adoption on value relevance of intangible assets in Italy. *Journal of Applied Accounting Research*, 21(3), 415–436. https://doi.org/10.1108/JAAR-05-2018-0069

Corvoisier, S., & Gropp, R. (2002). Bank concentration and retail interest rates. *Journal of Banking & Finance*, 26(11), 2155–2189. https://doi.org/10.1016/S0378-4266(02)00204-2

Courtis, J. K. (1983). Business Goodwill: Conceptual Clarification Via Accounting, Legal and Etymological Perspectives. *The Accounting Historians Journal*, 10(2), 1–38. https://doi.org/10.2308/0148-4184.10.2.1

Cozza, M. (2021). Elderliness: The Agential Inseparability of Ageing and Assistive Technologies. In A. Peine, B. L. Marshall, W. Martin, & L. Neven (Eds.), *Socio-Gerontechnology – Interdisciplinary Critical Studies of Ageing and Technology* (pp. 70-84). London: Routledge. https://doi.org/10.4324/9780429278266-6

Cummings, T., & Knott, A. M. (2018). Outside CEOs and innovation. *Strategic Management Journal*, 39(8), 2095–2119. https://doi.org/10.1002/smj.2792

Curi, C., & Lozano-Vivas, A. (2020). Managerial ability as a tool for prudential regulation. *Journal of Economic Behavior & Organization*, 174, 87–107. https://doi.org/10.1016/j.jebo.2020.03.023

Custódio, C., & Metzger, D. (2013). How do CEOs matter? The effect of industry expertise on acquisition returns. *The Review of Financial Studies*, 26(8), 2008–2047. https://doi.org/10.1093/rfs/hht032

d'Espagnat, B. (1979). The Quantum Theory and Reality. *Scientific American*, 241(5), 158–181.

Dahmash, F. N., Durand, R. B., & Watson, J. (2009). Th e value relevance and reliability of reported goodwill and identifiable intangible assets. *British Accounting Review*, 41(2), 120–137. https://doi.org/10.1016/j.bar.2009.03.002

Das, A., & Ghosh, S. (2006). Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. *Review of Financial Economics*, 15(3), 193–221. https://doi.org/10.1016/j.rfe.2005.06.002Get

Das, T. K., & Teng, B.-S. (1999). Cognitive biases and strategic decision processes: An integrative perspective. *Journal of Management Studies*, 36(6), 757–778. https://doi.org/10.1111/1467-6486.00157

Davenport, T. H. (2020). How to Make Better Decisions About Coronavirus. *MIT Sloan Management Review*. https://sloanreview.mit.edu/ article/how-to-make-better-decisions-about-coronavirus/

De Franco, G., Hope, O-K., & Lu, H. (2017). Managerial ability and bank-loan pricing. *Journal of Business Finance & Accounting*, 44(9–10), 1315–1337. https://doi.org/10.1111/jbfa.12267

Demerjian, P., & Lev. B. (2021). Measuring Managerial Ability: A Retrospective and Review of the Literature. *Data Envelopment Analysis Journal*, 5(1), 1–25. http://dx.doi.org/10.1561/103.00000037

Demerjian, P., Lev. B., & McVay, S. (2012). Quantifying managerial ability: A new measure and validity tests. *Management Science*, 58(7), 1229–1248. https://doi.org/10.1287/mnsc.1110.1487

Demsetz, H. (1973). Industry Structure, Market Rivalry, and Public Policy. *Journal of Law and Economics*, 16(1), 1–9.

Demski, J. S., FitzGerald, S. A., Ijiri, Y., Ijiri, Y., & Haijin, L. (2006). Quantum information and accounting information: Their salient features and conceptual applications. *Journal of Accounting and Public Policy*, 25(4), 435–464. https://doi.org/10.1016/j.jaccpubpol.2006.05.004

Dhir, S., & Mital, A. (2012). Decision-Making for Mergers and Acquisitions: The Role of Agency Issues and Behavioural Biases. *Strategic Change*, 21(1–2), 59–69. https://doi.org/10.1002/jsc.1895

Dicksee, L. R. (1897). Goodwill and its treatment in accounts. *The Accountant*, 23, 9 January, 40–48.

Dicksee, L. R., & Tillyard, F. (1906). *Goodwill and Its Treatment in Accounts*. 3rd ed. London: Gee & Co.

Dooley, K. J., & Van de Ven, A. H. (1999). Explaining Complex Organizational Dynamics. *Organization Science*, 10(3), 358–372. https://doi.org/10.1287/orsc.10.3.358

Doukas, J.A., & Zhang, R. (2020). Corporate managerial ability, earnings smoothing, and acquisitions. *Journal of Corporate Finance*, 65, 101756. https://doi.org/10.1016/j.jcorpfin.2020.101756

Doukas, J.A., & Zhang, R. (2021). Managerial ability, corporate social culture, and M&As. *Journal of Corporate Finance*, 68, 101942. https://doi.org/10.1016/j.jcorpfin.2021.101942

Dunning, D. (2011). The Dunning-Kruger effect: On being ignorant of one's own ignorance. *Advances in experimental social psychology*, 44, 247–296. https://doi.org/10.1016/B978-0-12-385522-0.00005-6

Dye, R. A. (2002). Classifications Manipulation and Nash Accounting Standards. *Journal of Accounting Research*, 40(4), 1125–1162. https://doi.org/10.1111/1475-679X.00084

Eckstein, C. (2004). The measurement and recognition of intangible assets: then and now. *Accounting Forum*, 28(2), 139–158. https://doi.org/10.1016/j.accfor.2004.02.001

Edwards, E. O. & Bell, P. W. (1961). *The theory and measurement of business income*. University of California Press. https://doi.org/10.1525/9780520340626

Egger, D. J., Gutiérrez, R. G., Mestre, J. C. & Woerner, S. (2020). Credit Risk Analysis using Quantum Computers. *IEEE Transactions on Computers*, 70(12), 2136–2145. https://doi.org/10.1109/TC.2020.3038063

Ehrlinger, J., Johnson, K., Banner, M., Dunning, D., & Kruger, J. (2008). Why the unskilled are unaware: Further explorations of (absent) self–insight among the incompetent. *Organizational Behavior and Human Decision Processes*, 105(1), 98–121. https://doi.org/10.1016/j.obhdp.2007.05.002

Einhorn, H. J. (1976). A synthesis: Accounting and behavioral science. *Journal of Accounting Research*, 14, 196–206. https://doi.org/10.2307/2490452

Einstein, A., Podolsky, B., & Rosen, N. (1935). Can quantum–mechanical description of physical reality be considered complete. *Physical Review*, 47, 777–780. https://doi.org/10.1103/PhysRev.47.777

El-Tawy, N., & Tollington, T. (2013). Some thoughts on the recognition of assets, notably in respect of intangible assets. *Accounting Forum*, 37(1), 67–80. https://doi.org/10.1016/j.accfor.2012.10.001

Falk, H., & Gordon, L. A. (1977). Imperfect Markets and the Nature of Goodwill. *Journal of Business Finance and Accounting*, 4(4), 443–462. https://doi.org/10.1111/j.1468-5957.1977.tb00727.x

Favero, C., & Papi, L. (1995). Technical efficiency and scale efficiency in the Italian banking sector: a non-parametric approach. *Applied Economics*, 27(4), 385–395. https://doi.org/10.1080/00036849500000123

Fellingham, J., & Schroeder, D. (2006). Quantum Information and Accounting. *Journal of Engineering and Technology Management*, 23(1–2), 33–53. https://doi.org/10.1016/j.jengtecman.2006.02.004

Ferramosca, S., & Allegrini, M. (2021). Impairment or amortization of goodwill? an analysis of CFO perceptions of goodwill accounting. *European Management Journal*, 39(6), 816–828. https://doi.org/10.1016/j.emj.2021.03.001

Ficek, Z., & Tanas, R. (2002). Entangled states and collective nonclassical effects in two-atom systems. *Physics Reports*, 372(5), 369–443. https://doi.org/10.1016/S0370-1573(02)00368-X

Filip, A., Jeanjean, T., & Paugam, L. (2015). Using Real Activities to Avoid Goodwill Impairment Losses: Evidence and Effect on Future Performance. *Journal of Business Finance & Accounting*, 42(3–4), 515–554. https://doi.org/10.1111/jbfa.12107

Fisher, I. (1906). *The nature of capital and income*. The Macmillan Company.

Fonseca, J. S. D. (2018). Vulnerabilidade pós-humana, crítica e a agência da matéria. *Natureza Humana*, 20(1), 58–68.

Francis, B., Hasan, I., Mani, S., & Ye, P. (2016). Relative peer quality and firm performance. *Journal of Financial Economics*, 122(1), 196–219. https://doi.org/10.1016/j.jfineco.2016.06.002

Francis, B., Hasan, I., Siraj, I., & Wu, Q. (2019). Managerial Ability and Value Relevance of Earnings. *China Accounting and Finance Review*, 21(4), 147–191.

French, A. P., & Taylor, E. F. (1978). *An introduction to quantum physics*. NY: Norton.

Frésard, L., Hege, U., & Phillips, G. (2017). Extending industry specialization through crossborder acquisitions. *Review of Financial Studies*, 30(5), 1539–1582. https://doi.org/10.1093/rfs/hhx008

Fukuyama, W. (1993). Technical and scale efficiency of Japanese commercial banks: A non-parametric approach. *Applied Economics*, 25(8), 1101–1112. https://doi.org/10.1080/00036849300000090

Garcia, C., Katsuo, Y., & van Mourik, C. (2018). Goodwill accounting standards in the United Kingdom, the United States, France, and Japan. *Accounting History*, 23(3), 314–337. https://doi.org/10.1177/1032373217748672

García-Meca, E., & García-Sánchez, I.-M. (2018). Does managerial ability influence the quality of financial reporting? *European Management Journal*, 36(4), 544–557. https://doi.org/10.1016/j.emj.2017.07.010

Garcia-Pont, C., & Nohria, N. (2002). Local versus global mimetism: the dynamics of alliance formation in the automobile industry. *Strategic Management Journal*, 23(4), 307–321. https://doi.org/10.1002/smj.225

Garzella, S., Ferri, S., Fiorentino, R., & Paolone, F. (2020). The (in)coherence in accounting for goodwill: Implications for a revision of international accounting standards. *Meditari Accountancy Research*, 28(2), 311–325. https://doi.org/10.1108/MEDAR-11-2018-0398

Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology*, 17(3), 295–314. https://doi.org/10.1016/0010-0285(85)90010-6

Godfrey, J. M., & Koh, P. (2009). Goodwill Impairment as a Reflection of Investment Opportunities. *Accounting and Finance*, 49(1), 117–140. https://doi.org/10.1111/j.1467-629X.2008.00272.x

Gomes, E., Angwin, D., Weber, Y., & Tarba, S. Y. (2013). Critical success factors through the mergers and acquisitions process: Revealing pre- and post-M&A connections for improved performance. *Thunderbird International Business Review*, 55(1), pp. 13–35. https://doi.org/10.1002/tie.21521

Gore, R., & Zimmerman, D. (2010). Is goodwill an asset? *The CPA Journal*, 80(6), 46–48.

Grable, J., Lytton, R., & O'Neill, B. (2004). Projection bias and financial risk tolerance. *The Journal of Behavioral Finance*, 5(3), 142–147. https://doi.org/10.1207/s15427579jpfm0503_2

Griffin, D., & Buehler, R. (1999). Frequency, Probability, and Prediction: Easy Solutions to Cognitive Illusions? *Cognitive Psychology*, 38(1), 48–78. https://doi.org/10.1006/cogp.1998.0707

Gröblacher, S., Paterek, T., Kaltenbaek, R., Brukner, C., Żukowski, M., et al. (2007). An experimental test of non-local realism. *Nature*, 446, 871–875. https://doi.org/10.1038/nature05677

Gu, F., & Lev, B. (2011). Overpriced shares, ill-advised acquisitions, and goodwill impairment. *The Accounting Review*, 86(6), 1995–2022. https://doi.org/10.2308/accr-10131

Guerreiro, R. (1989*). Modelo Conceitual de Sistema de Informação de Gestão Econômica: Uma Contribuição à Teoria de Comunicação da Contabilidade*. São Paulo: Doctoral

Dissertation, FEA/USP. https://www.teses.usp.br/teses/disponiveis/12/12136/tde-03062020-155114/pt-br.php

Guo, P., & Tanaka, H. (2001). Fuzzy DEA: a perceptual evaluation method. *Fuzzy Sets and Systems*, 119(1), 149–160. https://doi.org/10.1016/S0165-0114(99)00106-2

Gynther, R. S. (1969). Some "Conceptualizing" on Goodwill. *The Accounting Review*, 44(2), 247–255. https://www.jstor.org/stable/243799

Hamberg, M., & Beisland, L-A. (2014). Changes in the value relevance of goodwill accounting following the adoption of IFRS 3. *Journal of International Accounting, Auditing and Taxation*, 23(2), 59–73. https://doi.org/10.1016/j.intaccaudtax.2014.07.002

Hammond, J. S., Keeney, R. L., & Raiffa, H. (1998). The Hidden Traps in Decision Making. *Harvard Business Review*, September-October, 47–58. http://www.fannyhavas.fr/wp-content/uploads/2020/12/TheHiddenTrapsinDecisionMakingHBR1998.pdf

Haraway, D. (1992). The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others. In L. Grossberg, C. Nelson, & P. Treichler, *Cultural Studies* (pp. 295–337). New York: Routledge.

Hardy, L. (1998). Spooky action at a distance in quantum mechanics. *Contemporary Physics*, 39(6), 419–429. https://doi.org/10.1080/001075198181757

Harford, J. (2005). What drives merger waves? *Journal of Financial Economics*, 77(3), 529–560. https://doi.org/10.1016/j.jfineco.2004.05.004

Harris, A. J. L., & Hahn, U. (2011). Unrealistic Optimism About Future Life Events: A Cautionary Note. *Psychological Review*, 118(1), 135–154. https://doi.org/10.1037/a0020997

Hasan, M. M. (2020). Readability of narrative disclosures in 10-K reports: Does managerial ability matter? *European Accounting Review*, 29(1), 147–168. https://doi.org/10.1080/09638180.2018.1528169

Haselton, M. G., Nettle, D., & Andrews, P. (2005). The evolution of cognitive bias. In D. M. Buss (Ed.), *Handbook of evolutionary psychology* (pp. 968–987). New York: Wiley. https://doi.org/10.1002/9781119125563.evpsych241

Haspeslagh, P. C., & Jemison, D. B. (1991). *Managing Acquisitions: Creating Value Through Corporate Renewal*. Free Press: New York.

Haven, E., & Khrennikov, A. (2013). *Quantum Social Science*. Cambridge: Cambridge Press.

Hayes, R. M., & Schaefer, S. (1999). How much are differences in managerial ability worth? *Journal of Accounting and Economics*, 27(2) 125–148. https://doi.org/10.1016/S0165-4101(99)00007-5

Hayn, C., & Hughes, J. P. (2006). Leading indicators of goodwill impairment. *Journal of Accounting, Auditing and Finance*, 21(3), 223–265. https://doi.org/10.1177/0148558X0602100303

Hayward, M. L. A., & Hambrick, D. C. (1997). Explaining the Premiums Paid for Large Acquisitions: Evidence of CEO hubris. *Administrative Science Quarterly*, 42(1), 103–127. https://doi.org/10.2307/2393810

Hayward, M. L. A., & Shimizu, K. (2006). De-commitment to losing strategic action: Evidence from the divestiture of poorly performing acquisitions. *Strategic Management Journal*, 27(6), 541–557. https://doi.org/10.1002/smj.526

Helfat, C. E. (1997). Know-how and asset complementarity and dynamic capability accumulation: the case of R&D. *Strategic Management Journal*, 18(5), 339–360. https://doi.org/10.1002/(SICI)1097-0266(199705)18:5<339::AID-SMJ883>3.0.CO;2-7

Henning, S. L., Lewis, B. L. & Shaw, W. H. (2000). Valuation of the Components of Purchased Goodwill. *Journal of Accounting Research*, 38(2), 375–386. https://doi.org/10.2307/2672938

Henningsson, S., Yetton, P. W., & Wynne, P. J. (2018). A review of information system integration in mergers and acquisitions. *Journal of information Technology*, 33, 255–303. https://doi.org/10.1057/s41265-017-0051-9

Hetherington, L., Hardman, M., Noakes, J., & Wegerif, R. (2018). Making the case for a material-dialogic approach to science education. *Studies in Science Education*, 54(2), 141–176. https://doi.org/10.1080/03057267.2019.1598036

Hilbert, M. (2012). Toward a Synthesis of Cognitive Biases: How Noisy Information Processing Can Bias Human Decision Making. *Psychological Bulletin*, 138(2), 211–237. https://doi.org/10.1037/a0025940

Hildreth, C., & Houck, J. P. (1968). Some Estimators for a Linear Model with Random Coefficients. *Journal of the American Statistical Association*, 63(322), 584–595. https://doi.org/10.1080/01621459.1968.11009277

Hodgson, A., & Russell, M. (2014). Comprehending Comprehensive Income. *Australian Accounting Review*, 69(24), 100–110. https://doi.org/10.1111/auar.12022

Hofman, M. A. (2014). Evolution of the human brain: when bigger is better. *Frontiers in Neuroanatomy*, 8(15), 1–12. https://doi.org/10.3389/fnana.2014.00015

Højgaard, L., & Søndergaard, D. M. (2011). Theorizing the complexities of discursive and material subjectivity: Agential realism and poststructural analyses. *Theory & Psychology*, 21(3), 338–354. https://doi.org/10.1177/0959354309359965

Holcomb, T. R., Holmes, R. M., & Connelly, B. L. (2009). Making the Most of What You Have: Managerial Ability as a Source of Resource Value Creation. *Strategic Management Journal*, 30(5), 457–485. https://doi.org/10.1002/smj.747

Holford, W. D. (2018). An agential realist perspective on the construction and flow of knowledge: the case of dynamic entanglement and "cuts" within an aircraft engine manufacturing workplace. *Journal of Knowledge Management*, 22(7), 1442–1470. https://doi.org/10.1108/JKM-08-2017-0342

Holod, D., & Lewis, H. F. (2011). Resolving the deposit dilemma: A new DEA bank efficiency model, *Journal of Banking and Finance*, 35(11), 2801–2810. https://doi.org/10.1016/j.jbankfin.2011.03.007

Höne, K. E. (2017). *Quantum social Science*. Oxford Bibliographies Online. https://doi.org/10.1093/OBO/9780199743292-0203

Hopper, T., & Powell, A. (1985). Making sense of research into the organizational and social aspects of management accounting: a review of its underlying assumptions. *Journal of Management Studies*, 22(5), 429–465. https://doi.org/10.1111/j.1467-6486.1985.tb00007.x

Horodecki, R., Horodecki, P., Horodecki, M., & Horodecki, K. (2009). Quantum entanglement. *Reviews of Modern Physics*, 81(2), 865-942. https://doi.org/10.1103/RevModPhys.81.865

Huang, S. (2013). When peers are not peers and don't know it: The Dunning-Kruger effect and self-fulfilling prophecy in peer-review. *BioEssays*, 35(5), 414–416. https://doi.org/10.1002/bies.201200182

Huang, X., & Sun, L. (2017). Managerial ability and real earnings management. *Advances in Accounting*, 39, 91–104. https://doi.org/10.1016/j.adiac.2017.08.003

Hughes, H. P. (1972). *A History of the Issues and Problems Surrounding Goodwill in Accounting*, Doctoral Dissertation, the University of Alabama. https://www.proquest.com/openview/069f9dbd7bf3f94ff701fd020adf93c3/1.pdf?pq-origsite=gscholar&cbl=18750&diss=y

Huikku, J., Mouritsen, J., & Silvola, H. (2017). Relative reliability and the recognisable firm: Calculating goodwill impairment value. *Accounting, Organizations and Society*, 56(1), 68–83. https://doi.org/10.1016/j.aos.2016.03.005

Iatridis, G. E., Pappas, K., & Walker, M. (2021). Narrative disclosure quality and the timeliness of goodwill impairments. *British Accounting Review*, 54(2), 100978. https://doi.org/10.1016/j.bar.2021.100978

Isidro, H., & Grilo, D. (2012). Value-Driving activities in Euro-zone banks. *European Accounting Review*, 21(2), 297–341. https://doi.org/10.1080/09638180.2011.585790

Iudícibus, S. (2015). *Teoria da Contabilidade*. 11ª ed. Atlas, São Paulo.

Iverson, G. L., Brooks, B. L., & Holdnack, J. A. (2008). Misdiagnosis of cognitive impairment in forensic neuropsychology. In R. L. Heilbronner (Ed.), *Neuropsychology in the courtroom: Expert analysis of reports and testimony* (pp. 243–266). New York: Guilford Press.

Jahmani, Y., Dowling, W. A., & Torres, P. D. (2010). Goodwill impairment: a new window for earnings management? *Journal of Business & Economics Research*, 8(2), 19–23. https://doi.org/10.19030/jber.v8i2.669

Jamshidi, M., Sanei, M., Mahmoodirad, A., Lotfi, F. H., & Tohidi, G. (2021). Uncertain SBM data envelopment analysis model: A case study in Iranian banks. *International Journal of Finance and Economics*, 26(2), 2674–2689. https://doi.org/10.1002/ijfe.1927

Jennings, R., Robinson, J., Thompson, R. B., & Duvall, L. (1996). The relation between accounting good will numbers and equity values. *Journal of Business Finance and Accounting*, 23(4), 513–533. https://doi.org/10.1111/j.1468-5957.1996.tb01024.x

Jimenez, E., & Moya, D. (2005). Econophysics: from game theory and information theory to quantum mechanics. *Physica A: Statistical Mechanics and its Applications*, 348, 505–543. https://doi.org/10.1016/j.physa.2004.09.029

Johnson, L., & Petrone, K. (1998). Is goodwill an asset? *Accounting Horizons*, 12(3), 293–303.

Jordan, C. E., & Clark, S. J. (2004). Big Bath Earnings Management: The Case of Goodwill Impairment under SFAS Nº142. *Journal of Applied Business Research*, 20(2), 63–70. https://doi.org/10.19030/jabr.v20i2.2206

Jordan, S., & Messner, M. (2012). Enabling control and the problem of incomplete performance indicators. *Accounting, Organizations and Society*, 37(8), 544–564. https://doi.org/10.1016/j.aos.2012.08.002

Jorgenson, L. A., Newsome, W. T., Anderson, D. J., Bargmann, C. I., Brown, E. N., Deisseroth, K., Donoghue, J. P., Hudson, K. L., Ling, G. S. F., MacLeish, P. R., Marder, E., Normann, R. A., Sanes, J. R., Schnitzer, M. J., Sejnowski, T. J., Tank, D. W., Tsien, R. Y., Ugurbil, K., & Wingfield, J. C. (2015). The BRAIN Initiative: developing technology to catalyse neuroscience discovery. *Philosophical Transactions Royal Society B*, 370(1668), 1–12. https://doi.org/10.1098/rstb.2014.0164

Justesen, L., & Mouritsen, J. (2011). Effects of actor-network theory in accounting research. *Accounting, Auditing & Accountability Journal*, 24(2), 161–193. https://doi.org/10.1108/09513571111100672

Kahneman, D., & Riepe, M. W. (1998). Aspects of Investor Psychology. *Journal of Portfolio Management*, 24(4), 52–65. https://doi.org/10.3905/jpm.1998.409643

Kahneman, D., & Tversky, A. (1982). Intuitive prediction: Biases and corrective procedures. In D. Kahneman, P. Slovic, & A. Tversky, (eds.), *Judgment Under Uncertainty: Heuristics and Biases* (pp. 414–421). London: Cambridge University Press.

Kahneman, D., & Tversky, A. (1984). Choice, Values, and Frames. *American Psychologist*, 39(4), 341–350. https://doi.org/10.1037/0003-066X.39.4.341

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias. *Journal of Economic Perspectives*, 5(1), 193–206. https://doi.org/10.1257/jep.5.1.193

Kaiser, B. M., & Thiele, K. (2014). Diffraction: Onto-epistemology, Quantum Physics and the Critical Humanities. *Parallax*, 20(3), 165–167. https://doi.org/10.1080/13534645.2014.927621

Kaplan, R. S., & Norton D. P., (2004). Measuring the Strategic Readiness of Intangible Assets. *Harvard Business Review*, 82(2), 52–63. https://hbr.org/2004/02/measuring-the-strategic-readiness-of-intangible-assets

Karray, S. C., & Chichti, J. E. (2013). Bank size and efficiency in developing countries: intermediation approach versus value added approach and impact of non-traditional activities. *Asian Economic and Financial Review*, 3(5), 593–613. https://archive.aessweb.com/index.php/5002/article/view/1034

Keh, H. T., Foo, M. D., & Lim, B. C. (2002). Opportunity Evaluation under Risky Conditions: The Cognitive Processes of Entrepreneurs. *Entrepreneurship Theory and Practice*, 27(2), 125–148. https://doi.org/10.1111/1540-8520.00003

Khan, M., & Watts, R. L. (2009). Estimation and empirical properties of a firm-year measure of accounting conservatism. *Journal of Accounting and Economics*, 48(2–3): 132–150. https://doi.org/10.1016/j.jacceco.2009.08.002

Kianto, A., Ritala, P., Vanhala, M., & Hussinki, H. (2020). Reflections on the criteria for the sound measurement of intellectual capital: A knowledge-based perspective. *Critical Perspectives on Accounting*, 70, 1–15. https://doi.org/10.1016/j.cpa.2018.05.002

Kim, J. B., & Zhang, L. (2016). Accounting Conservatism and Stock Price Crash Risk: Firm-level Evidence. *Contemporary Accounting Research*, 33(1), 412–441. https://doi.org/10.1111/1911-3846.12112

Kim, S., & Bay, D. (2017). Cognitive Dissonance as an Explanation of Goodwill Write-Offs. *Journal of Behavioral Finance*, 18(1), 14–28. https://doi.org/10.1080/15427560.2017.1274755

King, D. R., Dalton, D. R., Daily, C. M., & Covin, J. G. (2004). Meta-Analyses of Post-Acquisition Performance: Indications of Unidentified Moderators. *Strategic Management Journal*, 25(2), 187–200. https://doi.org/10.1002/smj.371

Kinsey, M. J., Gwynne, S. M. V., Kuligowski, E. D., & Kinateder, M. (2019). Cognitive Biases Within Decision Making During Fire Evacuations. *Fire Technology*, 55(2), 465–485. https://doi.org/10.1007/s10694-018-0708-0

Kirov, V. N., & Thill, P. (2018). The impact of crisis and restructuring on employment relations in banking: The cases of France, Luxembourg and Romania. *European Journal of Industrial Relations*, 24(3), 1–17. https://doi.org/10.1177/0959680117752047

Kliestik, T., Kovacova, M., Podhorska, I., & Kliestikova, J. (2018). Searching for key sources of goodwill creation as new global managerial challenge. *Polish Journal of Management Studies*, 17(1), 144–154. https://doi.org/10.17512/pjms.2018.17.1.12

Kliger, D., & Levy, O. (2008). Projection bias by investors: A market approach. *Journal of Economic Behavior & Organization*, 66(3–4), 657–668. https://doi.org/10.1016/j.jebo.2003.11.018

Knott, A. M. (2008). R&D/returns causality: absorptive capacity or organizational IQ.

    Management Science, 54(12), 2054–2067. https://doi.org/10.1287/mnsc.1080.0933

Knott, A. M., & Vieregger, C. (2019). Does R&D drive growth, *SSRN Working paper*,

    https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382885.

Knott, A. M., & Vieregger, C. (2020). Reconciling the firm size and innovation puzzle.

    Organization Science, 31(2), 477–488. https://doi.org/10.1287/orsc.2019.1310

Koester, A., Shevlin, T., & Wangerin, D. (2016). The role of managerial ability in corporate

    tax avoidance. *Management Science*, 63(10), 3285–3310.

    https://doi.org/10.1287/mnsc.2016.2510

Kohlbeck, M., & Warfield, T. D. (2007). Unrecorded Intangible Assets: Abnormal Earnings

    and Valuation. *Accounting Horizons*, 21(1), 23–31.

    https://doi.org/10.2308/acch.2007.21.1.23

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: how difficulties in

    recognizing one's own incompetence lead to inflated self-assessments. *Journal of

    Personality and Social Psychology*, 77(6), 1121–1134. https://doi.org/10.1037/0022-

    3514.77.6.1121

Kruger, J., & Evans, M. (2004). If you don't want to be late, enumerate: Unpacking reduces

    the planning fallacy. *Journal of Experimental Social Psychology*, 40(5), 586–598.

    https://doi.org/10.1016/j.jesp.2003.11.001

Kumar, A., Anand, N., & Batra, V. (2020). Trends in Indian private sector bank efficiency:

    non-stochastic frontier DEA window analysis approach. *Journal of Asian Finance,

    Economics, and Business*, 7(10), 729–740.

    https://doi.org/10.13106/jafeb.2020.vol7.n10.729

Kutner, R., Ausloos, M., Grech, D., Di Matteo, T., Schinckus, C., & Stanley, H. E. (2019).

    Econophysics and sociophysics: Their milestones & challenges. *Physica A: Statistical*

Mechanics and its Applications, 516, 240–253.

https://doi.org/10.1016/j.physa.2018.10.019

Lang, L. H. P., & Stulz, R. M. (1994). Tobin's q, Corporate Diversification, and Firm

Performance. *Journal of Political Economy*, 102(6), 1248–1280.

https://doi.org/10.1086/261970

Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*,

32(2), 311–328. https://doi.org/10.1037/0022-3514.32.2.311

Larsson, R., & Finkelstein, S. (1999). Integrating Strategic, Organizational, and Human

Resource Perspectives on Mergers and Acquisitions: A Case Survey of Synergy

Realization. *Organization Science*, 10(1), 1–26. https://doi.org/10.1287/orsc.10.1.1

Latour, B. (1987). *Science in action*. Cambridge, MA: Harvard University Press.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network theory*. Oxford:

Oxford University Press.

Lau, R. Y. K., Liao, S. Y. S., Wong, K. F., & Chiu, D. K. W. (2012). Web 2.0 Environmental

Scanning and Adaptive Decision Support for Business Mergers and Acquisitions. *MIS

Quarterly*, 36(4), 1239–1268. https://doi.org/10.2307/41703506

Leake, P. D. (1914). *Goodwill: Its Nature and How to Value It*. London: Gee & Co.

Leake, P. D. (1921). *Commercial Goodwill – Its History, Value and Treatment in Accounts*.

London: Sir Isaac Pitman and Sons, Ltd.

Lee, T. A. (1971). Goodwill: An Example of Will-o'-the-Wisp Accounting. *Accounting and

Business Research*, 1(4), 318–328. https://doi.org/10.1080/00014788.1971.9728985

Lee, J. S., Keil, M., & Wong, K. F. E. (2018). Does a Tired Mind Help Avoid a Decision

Bias? The Effect of Ego Depletion on Escalation of Commitment. *Applied

Psychology*, 67(1), 171–185. https://doi.org/10.1111/apps.12109

Leibenstein, H. (1950). Bandwagon, Snob, and Veblen Effects in the Theory of Consumers' Demand. *Quarterly Journal of Economics*, 64(2), 183–207. https://doi.org/10.2307/1882692

Leightner, J. E., & Knox Lovell, C. A. (1998). The impact of financial liberalization on the performance of Thai banks. *Journal of Economics and Business*, 50(2), 115–131. https://doi.org/10.1016/S0148-6195(97)00073-8

Lema, T. Z. (2017). Determinants of bank technical efficiency: evidence from commercial banks in Ethiopia. *Cogent Business & Management*, 4(1), 1–13. https://doi.org/10.1080/23311975.2016.1268356

Leonardi, P. M. (2013). Theoretical Foundations for the Study of Sociomateriality. *Information and Organization*, 23(2), 59–76. https://doi.org/10.1016/j.infoandorg.2013.02.002

Lev, B. (1983). Some economic determinants of time-series properties of earnings. *Journal of Accounting and Economics*, 5, 31–48. https://doi.org/10.1016/0165-4101(83)90004-6

Lev, B. (2001). *Intangibles: Management, measurement, and reporting*. Washington, DC: The Brookings Institution.

Lev, B. (2004). Sharpening the intangibles edge, *Harvard Business Review*, June:109–116.

Leverty, J. T., & Grace, M. F. (2012). Dupes or Incompetents? An Examination of Management's Impact on Firm Distress. *Journal of Risk & Insurance*, 79(3), 751–783. https://doi.org/10.1111/j.1539-6975.2011.01443.x

Levinson, H. (1973). The psychological roots of merger failure. In H. Levinson (Ed.): *The great jackass fallacy*. Boston: Harvard Graduate School of Business Administration, Division of Research.

Lewis, M. W., & Grimes, A. J. (1999). Metatriangulations: Building Theory from Multiple Paradigms. *Academy of Management Review*, 24(4), 672–690. https://doi.org/10.5465/amr.1999.2553247

Li, K. K., & Sloan, R. G. (2017). Has goodwill accounting gone bad? *Review of Accounting Studies*, 22(2), 964–1003. https://doi.org/10.1007/s11142-017-9401-7

Li, Y., Chiu, Y-H., Lin, T-Y., & Huang, Y. Y. (2019). Market share and performance in Taiwanese banks: min/max SBM DEA. *TOP*, 27, 233–252. https://doi.org/10.1007/s11750-019-00504-6

Li, Z., Shroff, P. K., Venkataraman, R., & Zhang, I. X. (2011). Causes and consequences of goodwill impairment losses. *Review of Accounting Studies*, 16, 745–778. https://doi.org/10.1007/s11142-011-9167-2

Liao, P.-C., & Radhakrishnan, S. (2020). Auditors' liability to Lenders and Auditor Conservatism. *Management Science*, 66(8), 3788–3798. https://doi.org/10.1287/mnsc.2019.3302

Lieder, F., & Griffiths, T. L. (2020). Resource-rational analysis: Understanding human cognition as the optimal use of limited computational resources. *Behavioral and Brain Sciences*, 43, 1–60. https://doi.org/10.1017/S0140525X1900061X

Lieder, F., Griffiths, T. L., Huys, Q. J. M., & Goodman, N. D. (2018). The anchoring bias reflects rational use of cognitive resources. *Psychonomic Bulletin & Review*, 25(1), 322–349. https://doi.org/10.3758/s13423-017-1286-8

Lima, E. M., Espejo, M. B., Pereira, C. A., & Frezatti, F. (2011). As Respostas do GECON às Críticas do Relevance Lost. *Contabilidade Vista & Revista*, 22(1), 177–200. https://revistas.face.ufmg.br/index.php/contabilidadevistaerevista/article/view/832

Lipe, R. (1990). The relation between stock returns and accounting earnings given alternative information. *The Accounting Review*, 65(1), 49–71. https://www.jstor.org/stable/247876

Loewenstein, G., O'Donoghue, T., & Rabin, M. (2003). Projection Bias in Predicting Future Utility. *Quarterly Journal of Economics*, 118(4), 1209–1248. https://doi.org/10.1162/003355303322552784

Lustosa, P. R. B. (2017). A New Approach to Accounting Goodwill (and Other Identified Intangibles with Indefinite Useful Lives): Theory and Empirical Evidence, *SSRN Working Paper*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3023311

Ma, R., & Hopkins, R. (1988). Goodwill – An Example of Puzzle-Solving in Accounting. *Abacus*, 24(1), 75–85. https://doi.org/10.1111/j.1467-6281.1988.tb00204.x

Madan, C. R., Ludvig, E. A., & Spetch, M. L. (2014). Remembering the best and worst of times: Memories for extreme outcomes bias risky decisions. *Psychonomic Bulletin & Review*, 21(3), 629–636. https://doi.org/10.3758/s13423-013-0542-9

Malhotra, S., Zhu, P., & Reus, T. R. (2015). Anchoring on the acquisition premium decisions of others. *Strategic Management Journal*, 36(12), 1866–1876. https://doi.org/10.1002/smj.2314

Malmendier, U., & Tate, G. (2008). Who makes acquisitions? CEO overconfidence and the market's reaction. *Journal of Financial Economics*, 89(1), 20–43. https://doi.org/10.1016/j.jfineco.2007.07.002

Marks, M. L., & Mirvis, P. H. (2000). Managing Mergers, Acquisitions, and Alliances: Creating an Effective Transition Structure. *Organizational Dynamics*, 28(3), 35–47. https://doi.org/10.1016/S0090-2616(00)88448-X

Marks, M. L., & Mirvis, P. H. (2001). Making mergers and acquisitions work: Strategic and psychological preparation. *Academy of Management Perspective*, 15(2), 80–92. https://doi.org/10.5465/ame.2001.4614947

Marks, M. L., & Mirvis, P. H. (2011). Merge Ahead: A Research Agenda to Increase Merger and Acquisition Success. *Journal of Business and Psychology*, 26(2), 161–168. https://doi.org/10.1007/s10869-011-9219-4

Marshall, G. W., & Mowen, J. C. (1993). An Experimental Investigation of the Outcome Bias in Salesperson Performance Evaluations. *Journal of Personal Selling and Sales Management*, 13(3), 31–47. https://www.tandfonline.com/doi/abs/10.1080/08853134.1993.10753956

Martins, E. (1972). *Contribuição à Avaliação do Ativo Intangível*. [Unpublished doctoral dissertation]. Faculdade de Economia, Administração e Contabilidade. Universidade de São Paulo, USP.

Martins, E. (2020). Goodwill: baixa, amortização ou impairment? E quando originado do passivo? *Revista Fipecafi de Contabilidade, Controladoria e Finanças*, 1(1), 5–19. https://ojs.fipecafi.org/index.php/RevFipecafiCCF/article/view/3

Martins, E., & Martins, V. A. (2015). Contabilidade e finanças: a temerária utilização do WACC. *Revista Universo Contábil*, 11(1), 25–46. https://doi.org/10.4270/ruc.2015102

Martins, E., & Santos, A. (2017). Goodwill from Debt. *Revista de Educação e Pesquisa em Contabilidade – REPeC*, 11, 8–20. https://doi.org/10.17524/repec.v11i0.1718

Martynova, M., & Renneboog, L. (2008). A century of corporate takeovers: What have we learned and where do we stand? *Journal of Banking and Finance*, 32(10), 2148–2177. https://doi.org/10.1016/j.jbankfin.2007.12.038

Mazzi, F., André, P., Dionysiou, D., & Tsalavoutas, I. (2017). Compliance with Goodwill-Related Mandatory Disclosure Requirements and the Cost of Equity Capital. *Accounting and Business Research*, 47(3), 268–312. https://doi.org/10.1080/00014788.2016.1254593

Mazzocco, P. J., Alicke, M. D., & Davis, T. L. (2004). On the robustness of outcome bias: No constraint by prior culpability. *Basic and Applied Social Psychology*, 26(2–3), 131–146. https://doi.org/10.1080/01973533.2004.9646401

McCarthy, A. M., Schoorman, F. D., & Cooper, A. C. (1993). Reinvestment decisions by entrepreneurs: Rational decision-making or escalation of commitment? *Journal of Business Venturing*, 8(1), 9–24. https://doi.org/10.1016/0883-9026(93)90008-S

McCarthy, M. G., & Schneider, D. K. (1995). Market Perception of goodwill: Some Empirical Evidence. *Accounting and Business Research*, 26(1), 69–81. https://doi.org/10.1080/00014788.1995.9729499

Mehra, R., & Sah, R. (2002). Mood Fluctuations, Projection Bias, and Volatility of Equity Prices. *Journal of Economic Dynamics and Control*, 26(5), 869–887. https://doi.org/10.1016/S0165-1889(01)00035-5

Mennicken, A., & Miller, P. (2012). Accounting, territorialization and power. *Foucault Studies*, 13, 4–24. https://doi.org/10.22439/fs.v0i13.3503

Miles, R. E., Snow, C. C., Meyer, A. D., & Coleman, H. J. (1978). Organizational Strategy, Structure, and Process. *Academy of Management Review*, 3(3), 546–562. https://doi.org/10.5465/amr.1978.4305755

Miller, P., & Power, M. (2013). Accounting, Organizing and Economizing: Connecting Accounting Research and Organization Theory. *Academy of Management Annals*, 7(1), 555– 603. https://doi.org/10.5465/19416520.2013.783668

Mirvis, P. H., & Marks, M. L. (1992). The human side of merger planning: Assessing and Analyzing "Fit". *Human Resource Planning*, 15(3), 69–93. https://www.researchgate.net/profile/Philip-Mirvis/publication/292279886_The_human_side_of_merger_planning_Assessing_and_analyzing_fit/links/56b4ac9b08ae38193f6c9e1d/The-human-side-of-merger-planning-Assessing-and-analyzing-fit.pdf

Moeller, S. B., Schlingemann, F. P, & Stulz, R. M. (2005). Wealth destruction on a massive scale? A study of acquiring–firm returns in the recent merger wave. *Journal of Finance*, 60(2), 757–782. https://doi.org/10.1111/j.1540-6261.2005.00745.x

Moore, L. (2017). Carving nature at its joints: the entity concept in an entangled society. *Accounting Historians Journal*, 44(2), 125–138. https://doi.org/10.2308/aahj-10556

Morgan, G. (1998). *Images of Organization*: The Executive Edition. Los Angeles, CA: SAGE.

Mouritsen, J. (2003). Intellectual capital and the capital market: the circulability of intellectual capital. *Accounting, Auditing & Accountability Journal*, 16(1), 18–30. https://doi.org/10.1108/09513570310464246

Murata, A., Nakamura, T., & Karwowski, W. (2015). Influence of cognitive biases in distorting decision making and leading to critical unfavorable incidents. *Safety*, 1(1), 44–58. https://doi.org/10.3390/safety1010044

Myers, S. C. (1977). Determinants of Corporate Borrowing. *Journal of Financial Economics*, 5(2), 147–175. https://doi.org/10.1016/0304-405X(77)90015-0

Nagata, K., Laskowski, W., Wieśniak, M., & Żukowski, M. (2004). Rotational Invariance as an Additional Constraint on Local Realism. *Physical Review Letters*, 93 (230403), 1–4. https://doi.org/10.1103/PhysRevLett.93.230403

Nahavandi, A., & Malekzadeh, A. R. (1988). Acculturation in Mergers and Acquisitions. *Academy of Management Review*, 13(1), 79–90. https://doi.org/10.5465/amr.1988.4306790

Napier, N. K. (1989). Mergers and acquisitions, human resource issues and outcomes: A review and suggested typology. *Journal of Management Studies*, 26(3), 271–289. https://doi.org/10.1111/j.1467-6486.1989.tb00728.x

Nicolescu, B. (1999). *O manifesto da transdisciplinaridade*. Translation into Portuguese by Lúcia Pereira de Souza. São Paulo: Triom.

Nwogugu, M. (2015). Real options, enforcement of goodwill/intangibles rules and associated behavioral issues. *Journal of Money Laundering Control*, 18(3), 330–351. https://doi.org/10.1108/JMLC-02-2014-0008

O'Donnell, D., O'Regan, P., Coates, B., Kennedy, T., Keary, B., & Berkery, G. (2003). Human interaction: the critical source of intangible value. *Journal of Intellectual Capital*, 4(1), 82–99. https://doi.org/10.1108/14691930310455405

O'Hanlon, J., & Peasnell, K.V. (2002). Residual income and value creation: The 'missing link'. *Review of Accounting Studies*, 7 (2–3), 229–245. https://doi.org/10.1023/A:1020230203952

Ohlson, J. A. (1995). Earnings, Book Values and Dividends in Equity Valuation. *Contemporary Accounting Research*, 11(2), 661–687. https://doi.org/10.1111/j.1911-3846.1995.tb00461.x

Olante, M. E. (2013). Overpaid acquisitions and goodwill impairment losses – Evidence from the US. *Advances in Accounting*, 29(2), 243–254. https://doi.org/10.1016/j.adiac.2013.09.010

Oliveira, K. V., & Lustosa, P. R. B. (2022). The entanglement of accounting goodwill: Einstein's "spooky action at a distance". *Accounting Forum* (forthcoming). http://dx.doi.org/10.1080/01559982.2022.2089319

Oliveira, K. V., Lustosa, P. R. B., & Gonçalves, A. O. (2021). Goodwill from the appreciative inquiry (AI) perspective: innovation transforming intangible capital. *Revista Contemporânea de Contabilidade*, 18(47), 3–17. https://doi.org/10.5007/2175-8069.2021.e75538

Oliveira, L., Rodrigues, L. L., & Craig, R. (2010). Intangible assets and value relevance: Evidence from the Portuguese stock exchange. *British Accounting Review*, 42(4), 241–252. https://doi.org/10.1016/j.bar.2010.08.001

Omer, H., & Alon, N. (1994). The Continuity Principle: A Unified Approach to Disaster and Trauma. *American Journal of Community Psychology*, 22(2), 273–287. https://doi.org/10.1007/BF02506866

Ongsakul, V., Chatjuthamard, P., & Jiraporn, P. (2021). Does the market for corporate control impede or promote corporate innovation efficiency? Evidence from research quotient. *Finance Research Letters*, 46(part A), 102212. https://doi.org/10.1016/j.frl.2021.102212

Orlikowski, W. J. (2007). Sociomaterial practices: exploring technology at work. *Organization Studies*, 28(9), 1435–1448. https://doi.org/10.1177/0170840607081138

Orlikowski, W. J. (2010). The sociomateriality of organisational life: considering technology in management research. *Cambridge Journal of Economics*, 34(1), 125–141. https://doi.org/10.1093/cje/bep058

Orlikowski, W. J., & Scott, S. V. (2008). Sociomateriality: challenging the separation of technology, work and organization. *Academy of Management Annals*, 2(1), 433–474. https://doi.org/10.5465/19416520802211644

Orrell, D. (2018). Quantum economics. *Economic Thought*, 7(2), 63–81.

http://et.worldeconomicsassociation.org/files/2018/11/WEA-ET-7-2.pdf#page=65

Ouenniche J., & Carrales S. (2018). Assessing efficiency profiles of UK commercial banks: a DEA analysis with regression-based feedback. *Annals of Operations Research*, 266, 551–587. https://doi.org/10.1007/s10479-018-2797-z

Papadakis, V. M. (2005). The role of broader context and the communication program in merger and acquisition implementation success. *Management Decision*, 43(2), 236–255. https://doi.org/10.1108/00251740510581948

Paton, W. A. (1922). *Accounting Theory - With Special Reference to the Corporate Enterprise*. New York: The Ronald Press Company.

Pereira, C. A. (2001). Ambiente, Empresa, Gestão e Eficácia in: Catelli, A. (Ed.). *Controladoria: uma abordagem da gestão econômica – GECON* (pp. 35–80). 2ª. Ed. São Paulo: Atlas.

Pinnuck, M., & Shekhar, C. (2013). The profit versus loss heuristic and firm financing decisions. *Accounting, Organizations and Society*, 38(6–7), 420–439. https://doi.org/10.1016/j.aos.2013.09.003

Pothos, E. M., & Busemeyer, J. R. (2009). A quantum probability explanation for violations of 'rational' decision theory. *Proceedings of the Royal Society, B*, 276, 2171–2178. https://doi.org/10.1098/rspb.2009.0121

Puri, J., & Yadav, S. P. (2013). A concept of fuzzy input mix-efficiency in fuzzy DEA and its application in banking sector. *Expert Systems with Applications*, 40(5), 1437–1450. https://doi.org/10.1016/j.eswa.2012.08.047

Radhakrishnan, S., Wang, H., Wang, K., & Zhu, Z. (2017). R&D investment and firm growth: the role of tangible asset complementarity. *SSRN working paper*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3096806.

Rajan, R. G., & Zingales, L. (2003). The Great Reversals: The Politics of Financial Development in the 20th Century. *Journal of Financial Economics*, 69(1), 5-50. https://doi.org/10.1016/S0304-405X(03)00125-9

Ramanna, K., & Watts, R. L. (2012). Evidence on the use of unverifiable estimates in required goodwill impairment. *Review of Accounting Studies*, 17, 749–780. https://doi.org/10.1007/s11142-012-9188-5

Rapoport, A. (1986). *General System Theory. Essential Concepts and Applications*. Abacus Press: Turnbridge Wells, Kent/Cambridge, MA.

Rebentrost, P., Gupt, B., & Bromley, T. R. (2018). Quantum computational finance: Monte Carlo pricing of financial derivatives. *Physical Review A*, 98(2), 1–15. https://doi.org/10.1103/PhysRevA.98.022321

Rhodes-Kropf, M., & Viswanathan, S. (2004). Market Valuation and Merger Waves. *Journal of Finance*, 59(6), 2685–2718. https://doi.org/10.1111/j.1540-6261.2004.00713.x

Ricci, R. G., & Magni, C. A. (2014). Axiomatization of residual income and generation of financial securities. *Quantitative Finance*, 14(7), 1257–1271. https://doi.org/10.1080/14697688.2012.717415

Robson, K. (1992). Accounting numbers as 'inscription': action at a distance and the development of accounting. *Accounting, Organizations and Society*, 17(7), 685-708. https://doi.org/10.1016/0361-3682(92)90019-O

Roll, R. (1986). The Hubris Hypothesis of Corporate Takeovers. *Journal of Business*, 59(2), 197–216. https://www.jstor.org/stable/2353017

Rubio, J. A. C., Martínez, A. A., & Mazón, A. C. (2021). Economic effects of goodwill accounting practices: systematic amortisation versus impairment test. *Spanish Journal of Finance and Accounting*, 50(2), 224–245. https://doi.org/10.1080/02102412.2020.1778376

Safiullah, M., Hassan, M. K., & Kabir, M. N. (2020). Corporate governance and liquidity creation nexus in Islamic banks – Is managerial ability a channel? *Global Finance Journal*, 51, 100543. https://doi.org/10.1016/j.gfj.2020.100543

Samuelson, W., & Zeckhauser, R. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty*, 1, 7–59. https://doi.org/10.1007/BF00055564

Sanchidrián, J. P., García, J. P., & Gonzalo-Angulo, J. A. (2021). (IR) Relevance of goodwill impairment: the case of European banking (2005–2015). *Journal of Banking Regulation*, 22(1), 24–38. https://doi.org/10.1057/s41261-020-00126-0

Santi, C. (2020). Research Quotient, Optimal R&D and Stock Returns. *SSRN Working paper*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3170754

Sanz, A. F., Borondo, F., & Miret-Artes, S. (2002). Particle diffraction studied using quantum trajectories. *Journal of Physics: Condensed Matter*, 14(24), 6109–6145. https://doi.org/10.1088/0953-8984/14/24/312

Sarala, R. M., Vaara, E., & Junni, P. (2019). Beyond merger syndrome and cultural differences: New avenues for research on the "human side" of global mergers and acquisitions (M&As). *Journal of World Business*, 54(4), 307–321. https://doi.org/10.1016/j.jwb.2017.10.001

Schatzki, T. R. (2010). Materiality and social life. *Nature and Culture*, 5(2), 123–149. https://doi.org/10.3167/nc.2010.050202

Schipper, K., & Vincent, L. (2003). Earnings quality. *Accounting Horizons*, 17(Supplement), 97–110.

Schleich, W. P., Ranade, K. S., Anton, C. et al. (2016). Quantum Technology: From Research to Application. *Applied Physics B*, 122(130), 1–31. https://doi.org/10.1007/s00340-016-6353-8

Schlösser, T., Dunning, D., Johnson, K. L., & Kruger, J. (2013). How unaware are the unskilled? Empirical tests of the "signal extraction" counterexplanation for the Dunning-Kruger effect in self-evaluations of performance. *Journal of Economic Psychology*, 39, 85–100. https://doi.org/10.1016/j.joep.2013.07.004

Schneider, M., & Somers, M. (2006). Organizations as complex adaptive systems: Implications of complexity theory for leadership research. *The Leadership Quarterly*, 17(4), 351–365. https://doi.org/10.1016/j.leaqua.2006.04.006

Schuler, R., & Jackson, S. (2001). HR Issues and Activities in Mergers and Acquisitions. *European Management Journal*, 19(3), 239–253. https://doi.org/10.1016/S0263-2373(01)00021-4

Schweiger, D. M., & DeNisi, A. S. (1991). Communication with employees following a merger: A longitudinal field experiment. *Academy of Management Journal*, 34(1), 110–135. https://doi.org/10.5465/256304

Scott, S. V., & Orlikowski, W. J. (2009). "Getting the truth": exploring the material grounds of institutional dynamics in social media. *Working Paper Series - London School of Economics and Political Science*, 177. http://eprints.lse.ac.uk/26699/1/WP_177.pdf

Scott, W. R., & Davis, G. F. (2007). *Organizations and Organizing: Rational, Natural, and Open Systems Perspectives*. Englewood Cliffs, NJ: Prentice-Hall.

Sealey Jr, C. W., & Lindley, J. T. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *Journal of Finance*, 32(4), 1251–1266. https://doi.org/10.1111/j.1540-6261.1977.tb03324.x

Sehgal, M. (2014). Diffractive Propositions: Reading Alfred North Whitehead with Donna Haraway and Karen Barad. *Parallax*, 20(3), 188–201. https://doi.org/10.1080/13534645.2014.927625

Seo, M., & Hill, N. S. (2005). Understanding the human side of merger and acquisition: An integrative framework. *Journal of Applied Behavioral Science*, 41(4), 422–443. https://doi.org/10.1177/0021886305281902

Seth, A., Song, K., & Pettit, R. (2000). Synergy, Managerialism or Hubris? An Empirical Examination of Motives for Foreign Acquisitions of U.S. Firms. *Journal of International Business Studies*, 31(3), 387–405. https://doi.org/10.1057/palgrave.jibs.8490913

Shahwan, Y. (2004). The Australian market perception of goodwill and identifiable intangibles. *Journal of Applied Business Research*, 20(4), 45–64. https://doi.org/10.19030/jabr.v20i4.2224

Shalm, L. K., Meyer-Scott, E., Christensen, B. G., Bierhorst, P., Wayne, M. A., et al. (2015). Strong Loophole-Free Test of Local Realism. *Physical Review Letters*, 115 (25), 1–10. https://doi.org/10.1103/PhysRevLett.115.250402

Sharma, D., Sharma, A. K., & Barua, M. K. (2013). Efficiency and productivity of banking sector: A critical analysis of literature and design of conceptual model. *Qualitative Research in Financial Markets*, 5(2), 195–224. https://doi.org/10.1108/QRFM-10-2011-0025

Shimizu, K., Hitt, M. A., Vaidyanath, D., & Pisano, V. (2004). Theoretical foundations of cross-border mergers and acquisitions: A review of current research and recommendations for the future. *Journal of International Management*, 10(3), 307–353. https://doi.org/10.1016/j.intman.2004.05.005

Soteriou, A., & Zenios, S. A. (1999). Operations, quality and profitability in the provision of banking services. *Management Science*, 45(9), 1221–1238. https://doi.org/10.1287/mnsc.45.9.1221

Souza, A. M. (2008). *Um Estudo de Emaranhamento e Desigualdades de Bell em Sistemas Térmicos Magnéticos*. Doctoral Dissertation, Centro Brasileiro de Pesquisas Físicas. http://cbpfindex.cbpf.br/publication_pdfs/tese.2008_03_06_15_28_14.pdf.

Souza, M. M., & Borba, J. A. (2017). Value relevance vis-à-vis disclosure on business combinations and goodwill recognized by publicly traded Brazilian companies. *Revista Contabilidade & Finanças*, 28(73), 77–92. https://doi.org/10.1590/1808-057x201703240

Stahl, G. K., & Voigt, A. (2008). Do Cultural Differences Matter in Mergers and Acquisitions? A Tentative Model and Examination. *Organization Science*, 19(1), 160–176. https://doi.org/10.1287/orsc.1070.0270

Stamatopoulos, N., Egger, D. J., Sun, Y., Zoufal, C., Iten, R., et al. (2020). Option pricing using quantum computers. *Quantum*, 4(291), 1–20. https://doi.org/10.22331/q-2020-07-06-291

Stauffer, D. (2013). A Biased Review of Sociophysics. *Journal of Statistical Physics*, 151, 9–20. https://doi.org/10.1007/s10955-012-0604-9

Staw, B. M. (1981). The Escalation of Commitment to a Course of Action. *Academy of Management Review*, 6(4), 577–587. https://doi.org/10.5465/amr.1981.4285694

Staw, B. M. (1997). The Escalation of Commitment: an Update and Appraisal. In Shapira, Z. (ed). *Organizational Decision Making* (pp. 191–215). Cambridge University Press: New York.

Sufian, F. (2009). Determinants of bank efficiency during unstable macroeconomic environment: empirical evidence from Malaysia. *Research in International Business and Finance*, 23(1), 54–77. https://doi.org/10.1016/j.ribaf.2008.07.002

Sun, L. (2016). Managerial ability and goodwill impairment. *Advances in Accounting*, 32, 42–51. https://doi.org/10.1016/j.adiac.2016.02.002

Sunstein, C. R. (2002). Probability Neglect: Emotions, Worst Cases, and Law. *Yale Law Journal*, 112(1), 61–107.

https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=12421&context=journal_articles

Tabak, B. M., Fazio, D. M., & Cajueiro, D. O. (2013). Systemically important banks and financial stability: The case of Latin America. *Journal of Banking & Finance*, 37(10), 3855–3866. https://doi.org/10.1016/j.jbankfin.2013.06.003

Tearney, M. G. (1973). Accounting for Goodwill: A Realistic Approach. *Journal of Accountancy*, 136(1), 41–45.

https://www.proquest.com/openview/f08cef3d6644b4d069250adbb70ce6fb/1.pdf?pq-origsite=gscholar&cbl=41064

Teece, D. J. (1986). Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. *Research Policy*, 15(6), 285–305. https://doi.org/10.1016/0048-7333(86)90027-2

Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior and Organization*, 1(1), 39–60. https://doi.org/10.1016/0167-2681(80)90051-7

Thompson, S. C. (1999). Illusion of Control: How We Overestimate Our Personal Influence. *Current Directions in Psychological Science*, 8(6), 187–190. https://doi.org/10.1111/1467-8721.00044

Tobias-Renstrøm, S., & Køppe, S. (2020). Karen Barad, psychology, and subject models: Why we need to take experience seriously. *Theory & Psychology*, 30(5), 638–656. https://doi.org/10.1177/0959354320903089

Tone, K. (2001). A slacks-based measure of efficiency in data envelopment analysis. *European Journal of Operational Research*, 130(3), 498–509. https://doi.org/10.1016/S0377-2217(99)00407-5

Tone, K. (2002). A slacks-based measure of super-efficiency in data envelopment analysis. *European Journal of Operational Research*, 143(1), 32–41. https://doi.org/10.1016/S0377-2217(01)00324-1

Trueblood, J. S., & Busemeyer, J. R. (2011). A Quantum Probability Account of Order Effects in Inference. *Cognitive Science*, 35(8), 1518–1552. https://doi.org/10.1111/j.1551-6709.2011.01197.x

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases: Biases in judgments reveal some heuristics of thinking under uncertainty. *Science*, 185(4157), 1124–1131. https://doi.org/10.1126/science.185.4157.1124

Valkanov, E. & Kleimeier, S. (2007). The role of regulatory capital in international bank mergers and acquisitions. *Research in International Business and Finance*, 21(1), 50–68. https://doi.org/10.1016/j.ribaf.2005.12.001

Vassalou, M., & Xing, Y. (2004). Default risk in equity returns. *Journal of Finance*, 59(2), 831–868. https://doi.org/10.1111/j.1540-6261.2004.00650.x

Very, P., & Schweiger, D. M. (2001). The acquisition process as a learning process: evidence from a study of critical problems and solutions in domestic and cross-border deals. *Journal of World Business*, 36 (1), 11–31. https://doi.org/10.1016/S1090-9516(00)00052-3

Vo, X. V., Pham, T. H. A., Doan, T. N., & Luu, H. N. (2021). Managerial ability and bank lending behavior. *Finance Research Letters*, 39(101585), 1–7. https://doi.org/10.1016/j.frl.2020.101585

von Bertalanffy, L. (1968). *General System Theory: Foundations, Development, Applications*. New York: George Braziller.

von Bertalanffy, L. (1972). The History and Status of General Systems Theory. *Academy of Management Journal*, 15(4), 407–426. https://doi.org/10.5465/255139

Wang, Z., Busemeyer, J. R., Atmanspacher, H., & Pothos, E. M. (2013). The Potential of Using Quantum Theory to Build Models of Cognition. *Topics in Cognitive Science*, 5(4), 672–688. https://doi.org/10.1111/tops.12043

Weber, Y., Shenkar, O., & Raveh, A. (1996). National and Corporate Cultural Fit in Mergers/Acquisitions: An Exploratory Study. *Management Science*, 42(8), 1215–1227. https://doi.org/10.1287/mnsc.42.8.1215

Weinstein, N. D. (1980). Unrealistic Optimism about Future Life Events. *Journal of Personality and Social Psychology*, 39(5), 806–820. https://doi.org/10.1037/0022-3514.39.5.806

Wen, H., & Moehrle, S. R. (2016). Accounting for goodwill: An academic literature review and analysis to inform the debate. *Research in Accounting Regulation*, 28(1), 11–21. https://doi.org/10.1016/j.racreg.2016.03.002

Wendt, A. (2015). *Quantum Mind and Social Science: Unifying Physical and Social Ontology*. Cambridge: Cambridge University Press.

Wheatley, M. (2006). *Leadership and the New Science: Discovering Order in a Chaotic World* (3rd ed.). San Francisco: Berrett-Koehler.

White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48(4), 817–838. https://doi.org/10.2307/1912934

Whyte, G., & Sebenius, J. K. (1997). The effect of multiple anchors on anchoring in individual and group judgment. *Organizational Behavior and Human Decision Processes*, 69(1), 75–85. https://doi.org/10.1006/obhd.1996.2674

Wiese, A. (2005). Accounting for goodwill: the transition from amortisation to impairment – an impact assessment. *Meditari Accountancy Research*, 13(1), 105–120. https://hdl.handle.net/10520/EJC72488

Williams, P. F. (2009). Reshaping accounting research: Living in the world in which we live. *Accounting Forum*, 33(4), 274–279. https://doi.org/10.1016/j.accfor.2009.01.001

Williams, P. F., Jenkins, J. G., & Ingraham, L. (2006). The winnowing away of behavioral accounting research in the US: The process for anointing academic elites. *Accounting, Organizations and Society*, 31(8), 783–818. https://doi.org/10.1016/j.aos.2006.07.003

Wittmann, B., Ramelow, S., Steinlechner, F., Langford, N. K., Brunner, N., Wiseman, H. M., Ursin, R., & Zeilinger, A. (2012). Loophole-free Einstein–Podolsky–Rosen experiment via quantum steering. *New Journal of Physics*, 14(053030), 1–12. https://doi.org/10.1088/1367-2630/14/5/053030

Woerner., S., & Egger, D. J. (2019). Quantum risk analysis. *npj Quantum Information*, 5(15), 1–8. https://doi.org/10.1038/s41534-019-0130-6

Wu, D., Yang, Z., & Liang, L. (2006). Efficiency analysis of cross-region bank branches using fuzzy data envelopment analysis. *Applied Mathematics and Computation*, 181(1), 271–281. https://doi.org/10.1016/j.amc.2006.01.037

Xia, J., Tan, J., & Tan, D. (2008). Mimetic entry and bandwagon effect: the rise and decline of international equity joint venture in China. *Strategic Management Journal*, 29(2), 195–217. https://doi.org/10.1002/smj.648

Xu, E. Q. (2017). Cross-border merger waves. *Journal of Corporate Finance*, 46, 207–231. https://doi.org/10.1016/j.jcorpfin.2017.07.004

Xu, W., Anandarajan, A., & Curatola, A. (2011). The value relevance of goodwill impairment. *Research in Accounting Regulation*, 23(2), 145–148. https://doi.org/10.1016/j.racreg.2011.06.007

Yehuda, N., Vincent, L., & Lys, T. (2017). The nature and implications of acquisition goodwill. *Asia-Pacific Journal of Accounting and Economics*, 26(6), 709–730. https://doi.org/10.1080/16081625.2017.1414615

Yue, P. (1992). Data Envelopment Analysis and Commercial Bank Performance: A Primer with Applications to Missouri Banks. *Federal Reserve Bank of St. Louis Review*, 74(1), 31–45. https://repositories.lib.utexas.edu/handle/2152/46390

Yukalov, V. I., & Sornette, D. (2011). Decision theory with prospect interference and entanglement. *Theory and Decision*, 70, 283–328. https://doi.org/10.1007/s11238-010-9202-y

Zang, Y. (2008). Discretionary behaviour with respect to the adoption of SFAS no. 142 and the behaviour of security prices. *Review of Accounting and Finance*, 7(1), 38–68. https://doi.org/10.1108/14757700810853842

Zeitun, R., & Tian, G. G. (2007). Capital structure and corporate performance: evidence from Jordan. *Australasian Accounting, Business and Finance Journal*, 1(4), 40–61. http://dx.doi.org/10.14453/aabfj.v1i4.3

Zhang, Y., Lewis, M., Pellon, M., & Coleman, P. (2007). A Preliminary Research on Modeling Cognitive Agents for Social Environments in Multi-Agent Systems. *Trinity University Working paper – Department of Computer Sciences*, 116–123. https://www.aaai.org/Papers/Symposia/Fall/2007/FS-07-04/FS07-04-017.pdf

Zhu, N., Shah, W. U. H., Kamal, M. A., & Yasmeen, R. (2021). Efficiency and productivity analysis of Pakistan's banking industry: A DEA approach. *International Journal of Finance and Economics*, 26(4), 6362–6374. https://doi.org/10.1002/ijfe.2123

Zimková, E. (2014). Technical efficiency and super efficiency of the banking sector in

    Slovakia. *Procedia Economics and Finance*, 12, 780–787.

    https://doi.org/10.1016/S2212-5671(14)00405-5

Zollo, M., & Meier, D. (2008). What Is M&A Performance? *Academy of Management*

    Perspectives, 22(3), 55–77. https://doi.org/10.5465/amp.2008.34587995

Appendix A

Countries that make up the sample of chapter 4 – Empirical Evidence on the Nature of

Accounting Goodwill: An Interdisciplinary Approach

Country Name	Freq.	Percent	Cum.
Argentina	139	0.09	0.09
Australia	257	0.16	0.24
Austria	7	0.00	0.25
Bahamas	42	0.03	0.27
Bahrain	3	0.00	0.28
Bangladesh	1	0.00	0.28
Belgium	84	0.05	0.33
Bermuda	592	0.37	0.69
Brazil	242	0.15	0.84
British Virgin Islands	6	0.00	0.85
Canada	2,386	1.47	2.32
Cayman Islands	121	0.07	2.40
Chile	233	0.14	2.54
China	2,136	1.32	3.86
Colombia	21	0.01	3.87
Costa Rica	7	0.00	3.88
Cyprus	11	0.01	3.88
Denmark	77	0.05	3.93
Dominican Republic	6	0.00	3.93
Finland	80	0.05	3.98
France	456	0.28	4.26
Germany	260	0.16	4.43
Ghana	7	0.00	4.43
Greece	306	0.19	4.62
Hong Kong SAR, China	650	0.40	5.02
Hungary	27	0.02	5.04
Iceland	9	0.01	5.04
India	189	0.12	5.16
Indonesia	67	0.04	5.20
Ireland	742	0.46	5.66
Israel	1860	1.15	6.81
Italy	192	0.12	6.92
Japan	770	0.48	7.40
Jordan	4	0.00	7.40
Korea, Rep.	146	0.09	7.49
Luxembourg	203	0.13	7.62
Macao SAR, China	32	0.02	7.64
Malaysia	3	0.00	7.64
Marshall Islands	13	0.01	7.65
Mexico	459	0.28	7.93
Monaco	72	0.04	7.98
Netherlands	643	0.40	8.37
New Zealand	56	0.03	8.41
Nicaragua	1	0.00	8.41
Norway	102	0.06	8.47
Panama	42	0.03	8.50
Papua New Guinea	13	0.01	8.50
Peru	49	0.03	8.54
Philippines	103	0.06	8.60
Poland	3	0.00	8.60

Country Name	Freq.	Percent	Cum.
Portugal	19	0.01	8.61
Russian Federation	91	0.06	8.67
Singapore	191	0.12	8.79
South Africa	278	0.17	8.96
Spain	117	0.07	9.03
Sweden	216	0.13	9.16
Switzerland	281	0.17	9.34
Thailand	6	0.00	9.34
Turkey	21	0.01	9.35
United Arab Emirates	10	0.01	9.36
United Kingdom	1,880	1.16	10.52
United States	144,894	89.46	99.98
Uruguay	10	0.01	99.99
Venezuela	22	0.01	100.00
Total	**161,966**	**100.00**	

Appendix B

Countries that make up the sample of chapter 5 – Discussing the Nature of Accounting

Goodwill in the Banking Industry

Country Name	Freq.	Percent	Cum.
Argentina	86	0.31	0.31
Armenia	8	0.03	0.33
Australia	204	0.72	1.06
Austria	117	0.42	1.47
Bahamas, The	20	0.07	1.54
Bahrain	161	0.57	2.12
Bangladesh	369	1.31	3.43
Barbados	15	0.05	3.48
Belgium	60	0.21	3.69
Belize	8	0.03	3.72
Benin	9	0.03	3.75
Bermuda	167	0.59	4.35
Bolivia	36	0.13	4.47
Bosnia and Herzegovina	20	0.07	4.55
Botswana	38	0.13	4.68
Brazil	270	0.96	5.64
British Virgin Islands	6	0.02	5.66
Bulgaria	52	0.18	5.84
Burkina Faso	7	0.02	5.87
Cabo Verde	12	0.04	5.91
Canada	243	0.86	6.78
Cayman Islands	93	0.33	7.11
Chile	93	0.33	7.44
China	505	1.79	9.23
Colombia	105	0.37	9.60
Costa Rica	1	0.00	9.61
Cote d'Ivoire	13	0.05	9.65
Croatia	108	0.38	10.04
Cyprus	32	0.11	10.15
Czech Republic	24	0.09	10.23
Denmark	263	0.93	11.17
Ecuador	43	0.15	11.32
Egypt, Arab Rep.	271	0.96	12.28
El Salvador	6	0.02	12.30
Estonia	4	0.01	12.32
Finland	41	0.15	12.46
France	303	1.08	13.54
Gambia, The	9	0.03	13.57
Georgia	16	0.06	13.63
Germany	337	1.20	14.83
Ghana	69	0.25	15.07
Greece	83	0.29	15.37
Guyana	20	0.07	15.44
Hong Kong SAR, China	216	0.77	16.20
Hungary	29	0.10	16.31
Iceland	4	0.01	16.32
India	783	2.78	19.10
Indonesia	534	1.90	21.00
Iraq	167	0.59	21.59
Ireland	49	0.17	21.76

Country Name	Freq.	Percent	Cum.
Israel	111	0.39	22.16
Italy	316	1.12	23.28
Jamaica	49	0.17	23.45
Japan	1,610	5.72	29.17
Jordan	212	0.75	29.92
Kazakhstan	111	0.39	30.32
Kenya	95	0.34	30.66
Korea, Rep.	339	1.20	31.86
Kuwait	277	0.98	32.84
Lao PDR	8	0.03	32.87
Lebanon	61	0.22	33.09
Libya	2	0.01	33.10
Liechtenstein	7	0.02	33.12
Lithuania	12	0.04	33.16
Luxembourg	24	0.09	33.25
Malawi	25	0.09	33.34
Malaysia	141	0.50	33.84
Mali	4	0.01	33.85
Malta	56	0.20	34.05
Mauritius	40	0.14	34.19
Mexico	132	0.47	34.66
Moldova	25	0.09	34.75
Monaco	7	0.02	34.78
Montenegro	12	0.04	34.82
Morocco	122	0.43	35.25
Namibia	16	0.06	35.31
Netherlands	105	0.37	35.68
New Zealand	22	0.08	35.76
Niger	3	0.01	35.77
Nigeria	172	0.61	36.38
North Macedonia	70	0.25	36.63
Norway	217	0.77	37.40
Oman	198	0.70	38.10
Pakistan	378	1.34	39.44
Panama	64	0.23	39.67
Papua New Guinea	5	0.02	39.69
Peru	90	0.32	40.01
Philippines	180	0.64	40.65
Poland	171	0.61	41.26
Portugal	29	0.10	41.36
Qatar	126	0.45	41.81
Romania	45	0.16	41.97
Russian Federation	159	0.56	42.53
Rwanda	9	0.03	42.56
Saudi Arabia	148	0.53	43.09
Senegal	6	0.02	43.11
Serbia	17	0.06	43.17
Singapore	98	0.35	43.52
Slovak Republic	53	0.19	43.71
Slovenia	18	0.06	43.77
South Africa	108	0.38	44.15
Spain	112	0.40	44.55
Sri Lanka	270	0.96	45.51
Sudan	4	0.01	45.52
Sweden	101	0.36	45.88
Switzerland	348	1.24	47.12
Syrian Arab Republic	110	0.39	47.51
Tanzania	33	0.12	47.63

Country Name	Freq.	Percent	Cum.
Thailand	297	1.05	48.68
Togo	10	0.04	48.72
Trinidad and Tobago	39	0.14	48.85
Tunisia	173	0.61	49.47
Turkey	443	1.57	51.04
Uganda	27	0.10	51.14
Ukraine	120	0.43	51.56
United Arab Emirates	248	0.88	52.44
United Kingdom	413	1.47	53.91
United States	12,723	45.18	99.09
Vietnam	126	0.45	99.54
West Bank and Gaza	53	0.19	99.73
Zambia	28	0.10	99.83
Zimbabwe	49	0.17	100.00
Total	**28,161**	**100.00**	