UNIVERSITAT DE BARCELONA

Historical cost versus fair value of biological assets: Relevance of accounting information

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PhD in Business

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This thesis is dedicated to my teacher and also director, who guided and advised me during all the process. I also dedicate this work to my parents and partner; without their support, I wouldn't have finished it.

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CHAPTER 1. INTRODUCTION

1.1. Presentation, motivation and research objectives

This study is motivated by the existence of an ongoing and unresolved debate, both in the academic and practitioner accounting domains, over the convenience of the use of fair value (FV) versus historical cost (HC). I adopt the Financial Accounting Standards Board (FASB) conceptual framework, which specifies that the objective of financial reporting is to provide decision-useful information, which means that the predictive value includes information about the amounts, timing, and uncertainty of future cash flows (FASB, 2010).

On the one hand, the most important institutions and regulators in accounting, such as the International Accounting Standards Board (IASB) and the United States of America (USA) FASB have taken positions to converge to unified accounting standards, based on the valuation at FV, as they believe that it allows a better assessment of assets and liabilities (IASB, 2006). For example, the Statements of Financial Accounting Standards (SFAS) 105 issued in 1990 disclosures of information about financial instruments and SFAS 107 in 1991 extends existing FV disclosure for some instruments. The International Financial Reporting Standards (IFRS) have also incorporated the FV measurement, to different assets and value changes to be recognised in profit and loss statement, in order to improve on disclosure of financial instruments (Van Greuning et al., 2011). One of the most well-known and analysed international standards were the International Accounting Standards (IAS) 32 on disclosure and presentation of financial instruments, issued in 1995 and revised in 1998, by IAS 39. Moreover, the IAS 41 on Agriculture, issued in 2000, introduces a FV model to agriculture accounting. The IASB and the FASB has also committed themselves to a joint approach to dealing with reporting issues arising from the global crisis. They set up the Financial Crisis Advisory Group (FCAG) in December 2008, to advice the two boards about standard-setting implications of the global financial crisis and potential changes to the global regulatory environment. FV accounting was one of the subjects discussed.

On a conceptual level, standard-setters must balance relevance and reliability (Laux and Leuz, 2009), the two primary qualitative characteristics of financial information. Relevant accounting information helps shareholders in predicting future trends of the business or confirming and correcting any past predictions they have made. However, reliability requires that accounting information to be independently verifiable, unbiased, and faithfully represented. In this vein, the evolution towards FV reflects the needs of users of financial accounting and efforts of accounting-setting bodies to reverse the pattern of declining relevance and reliability of financial information (Barlev and Haddad, 2003). Under FV accounting assets and liabilities in balance sheet draws the attention of shareholders to the value of their equity and periodic changes,

as is reflected by current market conditions and hence provide timely information. FV measurement reflects changes in assets and liabilities values that will be realized in subsequent operations. In the recognition of unrealized gains and losses, shareholders should make decisions regarding the future of the business entity as realised gains only when they have an impact on cash flow. Additionally, the rapid expansion and integration of world financial markets, and improved knowledge about market and economic conditions around the world, shareholders and stakeholders need to improve the accuracy of financial information to make more informed decisions regarding their investments. FV gives them a more accurate representation of the true value of the firm's financial health at the present date (Barth, Beaver and Landsman, 2001; Landsman, 2007).

On the other hand, over the last decades there has been a scholarly debate around the advantages and disadvantages of using FV and HC valuations. Proponents of HC argue that FV is not as objective or reliable as HC, and can be subject to manipulation (i.e. Liang and Wen, 2007; Ronen, 2008). It requires more subjective judgments, bringing inaccuracy and uncertainty of the accounting information (Plantin and Sapra, 2008), and it contributed pro-cyclically to the 2007 financial crisis (Laux and Leuz, 2009). In contrast, proponents of FV criticise the questionable benefits of HC, arguing that it increases volatility (Bleck and Liu, 2007), that FV provides more relevant information to investors (Khurana and Kim, 2003; and Ryan, 2008), and that it offers a more appropriate platform to forecast future earnings and cash flows (Bratten, Causholli and Khan, 2012). However, some research found empirical evidence under certain conditions. FV is informative to investors, but the level of informativeness is affected by the amount of measurement error and source of the estimates (Landsman, 2007), and the implementation has its own problems (Penman, 2007). At a conceptual level, although the FV accounting debate is far to be over, both sides generally agree that the central issue is achieving a balance between relevance and reliability.

Most previous empirical studies on the convenience of FV versus HC refer mainly to financial instruments and focus on its relevance, usually analysing the association between accounting amounts and market values (e.g. Barth, 1994; Barth and Clinch, 1998; Hitz, 2007). While results support the incremental value relevance of FV disclosures held by banks and insurances companies (Barth, 1994; Barth, 1996; Bernard, Merton and Palepu, 1995; Danboldt and Rees, 2008), Nelson (1996) and Hann et al. (2007) do not. Barth and Clinch (1998), and Eccher, Ramesh and Thiagajaran (1996) do find FV relevance, but under certain conditions. However, fewer studies examine the relevance from the point of view of the predictability of accounting information (e.g. Chen, Cooper and Gardner, 2006; Evans, Hodder and Hopkins, 2014; Hail, 2013) and, in particular, of the predictability of future earnings

and future cash flows (e.g. Bratten, Causholli and Khan, 2012; Laswad and Baskerville, 2007).

The International Accounting Standards Committee (IASC) originally issued the IAS 41 in December 2000, and it was first applied to annual periods beginning on or after 1 January 2003. This standard requires biological assets to be measured at FV costs to sell, and valuation changes to be recognised in the net profit or loss for that period. In this vein, the valuation of biological assets at FV allows a more precise assessment of future economic benefits embodied in biological assets than their valuation at HC (Bohušová, Svoboda and Nerudová, 2012). The debate on the convenience of FV versus HC has also been extended to agriculture since then, again with controversial stances and findings. I pay special attention to this unresolved debate on the convenience of applying FV versus HC measuring biological assets in the agricultural sector. To the best of my knowledge, only two studies analyse the predictive power of biological assets measured at FV. One, the unpublished paper by He, Wright and Evans (2011), compared different methods of FV measurement, but it did not examine a direct comparison of the predictive power of FV versus HC estimates. The other one, Argilés, Garcia and Monllau (2011) used a sample of non-audited accounts of small Spanish agricultural holdings, with very few of them applying FV, which results are subject to the limitations of both the quality of the accounting information disclosed by small firms and the low number of farms using FV in this sample.

The main purpose of this study is to provide empirical evidence on the existing academic discussion of HC versus FV accounting information for biological assets. First, this study presents a bibliometric analysis of accounting research. This research aims to review the existing accounting literature that examines the usefulness of FV accounting information to investors in academic research. Specifically, I research published articles obtained by searching for keywords "value relevance" and "fair value" over the period 1994-2016. The data is collected from the Social Science Citation Index (SSCI) in the Institute for Scientific Information (ISI) Web of Science (WoS) database, resulting in 129 articles that have been analysed to obtain the most cited authors, journals and publications. Research in value relevance of FV has been more productive during the last decade. The most significant topic areas and research methods in this area are discussed, as are the main Journal Citation Reports (JCR) categories. On the other hand, this study conducts an empirical analysis that examines whether the ability of accounting data to predict future cash flows is affected by the use of FV versus HC in measuring biological assets. I use a sample comprising 794 firm-year observations for the period 1992–2013. The observations correspond to 84 companies from 21 different countries. I find that in itself a fair valuation of biological assets does not affect the ability of accounting data to predict future cash flows. Lastly, this study tests the appropriateness of the recent amendment of the IAS 41, which indicates that bearer plants should be accounted in the same way as property, plant

and equipment in IAS 16, and therefore HC must be applied for bearer plants. Results show that FV has a moderating effect on the unpredictable nature of biological assets with the subsample of firms owing bearer plants, either with companies farming forests and crops or with only forest companies.

1.2. Structure of the thesis

The current chapter is an introduction to the subject of study, which is to provide theoretical and empirical evidence on the existing academic discussion of the relevance of accounting information of biological assets. It explores why this subject has been chosen, the two objectives in which is this study is focused, and explains the research structure and contributions of the thesis.

Chapter two presents a bibliometric analysis. The aim of this chapter is to provide a quantitative analysis of academic literature, focusing on citation rates and other characteristics. This study uses a bibliometric analysis to explore and present an overview of accounting research related to the value relevance of FV accounting, by searching simultaneously for keywords "value relevance" and "fair value" in the WoS. More specifically, I attempt to demonstrate the importance and the impact of current and emerging research. Also, I identify top performing journals and researchers in my keywords search.

The third chapter presents the literature review and hypothesis of the empirical study on the accounting relevance. More precisely, it focuses on the relevance of FV versus HC accounting. This chapter identifies empirical accounting research analysing the influence of FV on predicting future cash flows, and especially the usefulness of FV versus HC. This chapter also describes and summarises the theoretical framework related to agricultural accounting, including background information as well as empirical studies related to the relevance of FV accounting for biological assets. The importance of the agriculture sector for both developing and developed countries, and the consistent transition from the HC principle towards a FV accounting justifies this research. Lastly, it presents the two alternative hypotheses based on previous literature review.

The fourth chapter presents the methodology of the empirical study, including the empirical model, and describes the sample and descriptive statistics. Where previous research has traditionally focused on earnings and earnings components (Dechow, Kothari and Watts, 1998; Barth, Beaver and Landsman, 2001; Kim and Kross, 2005),

this study does an empirical research on the predictive power of FV with respect to HC on agricultural accounting. More precisely, on the comparative ability of valuing biological assets by FV versus HC, to predict future cash flows. In this vein, with respect to previous research, our study uses a larger sample of bigger firms dealing with biological assets and producing audited financial statements. Additionally, it performs a direct comparison between FV and HC using an elaborated multivariate analysis.

Chapter five presents a summary of the main results and discussion of the thesis. I find evidence that biological assets influence unpredictability when they are measured at HC. In this case, the ability of accounting data to predict future cash flows diminishes as the proportion of biological assets on total assets increases. The valuation at FV switches this negative influence of biological assets to a positive one, thus turning biological assets from a confusing magnitude to a relevant source of information. I find that when they are measured at FV, the prediction accuracy of future cash flows improves as the ratio of biological assets to total assets increases. This evidence of different measures of prediction accuracy is robust, as is the improvement of accounting standards, regardless of FV, over time. The evidence is weaker for the measurement of bearer plants at FV. Moreover, results do not suggest that the IAS 41 amendment to shift from FV to HC is going to improve the ability of accounting data to predict future cash flows. Additionally, I do not find significant evidence that the measurement of biological assets at FV would influence the ability of the information on revenue volatility, corporate size or the crisis period, for predicting future cash flows.

Chapter six presents an additional analysis: bearer plants. The focus of this chapter is to test the appropriateness of the recent amendment of the IAS 41, which indicates that bearer plants should be accounted in the same way as property, plant and equipment in IAS 16, and therefore HC must be applied for bearer plants. To the authors' knowledge, there is no previous published empirical research on the relevance of FV versus HC in valuing bearer plants. Results show useful evidence of the recent debate concerning the reform of the IAS 41. According to the results, FV has a moderating effect on the unpredictable nature of biological assets with the subsample of firms owing bearer plants, either with companies farming forests and crops or with only forest companies.

The last chapter presents the conclusions of the study, together with the implications, limitations and lines of future research. This study provides insights for regulators, as well as for researchers and practitioners, in relation to the adoption of FV for biological assets and bearer plants.

CHAPTER 2. BIBLIOMETRIC ANALYSIS

2.1. Introduction and overview of the bibliometric analysis

In this chapter, I perform a bibliometric analysis on the relevance of accounting information when it is measured at FV by connecting searches using keywords "value relevance" and "fair value" in WoS database over the period 1994-2016. The bibliometric analysis will show the trend of the research on the subject from the final number of articles found in my keywords search and will display the most common JCR categories. It will provide an overview of authors that published articles found in my keywords search. It will give the reader a comprehensive understanding of the types of research methods and topic areas used in each article. It will also determine the impact of a journal. Furthermore, it will identify core articles that influence the literature on this subject.

Nowadays there is a lot of research about the relevance of accounting information focused on the accounting valuation methods. Although research on value relevance has developed over the years and established itself as a well-regarded scientific field in the scholarly community (Barth, Beaver and Landsman, 2001), the literature examining the relevance of the accounting valuation methods has only expanded since the 1990s due to academic researchers and a non-academic audience (i.e., standard setters, firm managers, financial statement users, policymakers and regulators of financial institutions) interested in understanding how accounting information affects investors' decisions. Therefore, I intend to make a quantitative analysis of articles using my keywords in their title or abstract, and published in the WoS.

However, previous research shows that there is no fixed methodology for establishing the productivity and the impact of a group of publications, authors or journals in my keywords search. The main contribution of this chapter is to develop a bibliometric analysis that considers the most influential factors for producing these results and taking into account different tools that are currently used in the literature. This research may be relevant because some publications, authors or journals may have a high impact according to a given set of measures, but a different impact under another. In this analysis, a combination of several measures has been used to assess the quality of the bibliometric material: total number of citations, total number of articles published, impact factor, and h-index among others. In addition, articles have been classified according to their research method, topic area and JCR category.

Overall, I find that the subject of my keywords search is currently of interest in accounting and business literature. A large number of articles published including the keywords of my search during the last years of the period included in the search shows that the interest of the accounting community in this subject has not declined. The most common research method employed is archival. The highest number of articles

found in my search are published in journals usually dealing with financial accounting journals. "Business, finance" is the main JCR category. Journal Accounting and Economics (JAE) is the most influential journal and North American authors are the main leaders publishing articles in my keywords search. The most cited article of my keyword search is Holthausen and Watts (2001). Nevertheless, the most productive and cited author is Mary E. Barth.

The remainder of the chapter is organised as follows. First, I review the literature on bibliometric analysis. Second, I describe the methodology used in the bibliometric analysis. Third, I present the results of the bibliometric analysis. Finally, I present the conclusions and discussion of the bibliometric analysis.

2.2. Literature review of the bibliometric analysis

Bibliometrics is defined as the application of mathematical and statistical analysis to assess bibliographic material. Its purpose is to measure the output of researchers, institutions, and countries, to identify national and international networks, and to map the development of new (multi-disciplinary) fields of science (Organisation for Economic Co-operation and Development, sixth edition, 2002). Additionally, the increase of data availability and computational advances in the last decades has increased the necessity to evaluate a specific research area using a range of bibliometric measures and indicators.

Bibliometric studies have been developed in many fields. In management, Podsakoff et al. (2008) examined 30 management journals to identify the most influential universities and authors from 1981 to 2004, using citation analysis and number of publications. Other authors examine the impact of specific universities (Kirkpatrick and Locke, 1992; Trieschmann et al., 2000) and identify influential researchers in management (Morrison and Inkpen, 1991; Shane, 1997). Merigó and Yang (2017) present a bibliometric analysis of articles published in operations research and management science. Gaviria-Marin, Merigó, and Popa (2018) analyse articles published between 1997 and 2016 in the Journal of Knowledge Management, using bibliometric indicators such as h-index, number of publications and citations.

Econometrics is another field that has attracted attention from bibliometric researchers. Baltagi (2007) presents different rankings of academic institutions by article over the period 1989-2005, and list the top 150 authors. This study is based on 16 leading international journals that publish articles in econometrics, which updates

his previous research (Baltagi, 1998). His analysis takes into account the number of citations, number of articles published in a journal, use different time intervals (2000-2005, 1995-2005, and 1989-2005), and show rankings for both institutions and authors by journal. A similar study, Hall (1990) analyse articles published during the period 1980-1988.

Some studies develop bibliometric analysis in economics. Laband and Piette (1994) analyse the influence of economic journals for the period 1970-1990. Their results show that the most influential journals are the American Economic Review, Econometrics and the Journal of Political Economy. Card and DellaVigna (2013) develop a similar study, but using the top five economics journals[1] between 1970 to 2012. More recently, Wei (2018) presents a bibliometric analysis of the top five economics journals during the period 2012-2016 to identify the main characteristics (authors, institutions, countries and collaboration), and to determine the research interests. Laband (2013) presents different information about the level of citations per articles published in 248 economics journals during the period 2001-2005. Stern (2013) illustrates in his study the uncertainty associated with the citation-based ranking of journals, institutions and authors. He calculates the standard error of the impact factor for all economics journals with a five-year impact factor in the 2011 JCR and finds that the top two journals are the most relevant by all the measures used. Further studies analyse the influence of authors and institutions in top journals (Kocher and Sutter, 2001; Süssmuthetal, 2006). There is a vast relevant literature using economics departments rakings in the US since main journals are from there. However, some authors provide rankings of journals, institutions, and authors, focusing on the European region (Coupé, 2003; Lubrano et al., 2003). Also, other specific regions receive additional attention, like Canada (Davies, Kocher, and Sutter, 2008), China (Du and Teixeira, 2012), Germany (Sternberg and Litzenberger, 2005), Spain (Rodríguez, 2006), and Latin America (Bonicall, Merigó and Torres-Abad, 2015). Additionally, Wagstaff and Culyer (2012) develop a bibliometric analysis of articles in health economics for over 40 years. They list the 300 most cited articles. They also report the most influential authors, countries, institutions and journals through a variety of measures (e.g., the h-index).

Entrepreneurship is also of interest in bibliometrics. Ratnatunga and Romano (1997) study the most influential research in contemporary small enterprise research[2]. Dos Santos, Holsapple, and Ye (2011) analyse journals that publish entrepreneurship

[1] Card and DellaVigna (2013) analyzed the following five journals: the American Economic Review, Econometrica, the Journal of Political Economy, the Quarterly Journal of Economics, and the Review of Economic Studies.

[2] Contemporary small enterprises research is defined as all main articles published during 1986–1992 in the Journal of Small Business Management, International Small Business Journal, Entrepreneurship: Theory and Practice, Journal of Business Venturing, Small Business Economics, and the Asia Pacific International Management Forum.

articles, using a citation-based model. Landström, Harirchi, and Aström (2012) provide a complete overview of entrepreneurship research since the 1980s until the 2000s. Other authors develop similar studies, focusing on family business research (Casillas and Acedo, 2007; Benavides-Velasco, Quintana-García, and GuzmánParra, 2013).

Production and operations management is analysed in numerous bibliometric studies. Pilkington and Liston-Heyes (1999) use co-citation analysis to find the main topics in operations management. Later, Pilkington and Fitzgerald (2006) identify changes and emerging topics in operations management. Hsieh and Chang (2009) provide an overview of the research in this field based on articles published in the 20 main journals. They show the most productive and influential authors, institutions and countries. Pilkington and Meredith (2009) analyse the three major operations management journals between 1980 and 2006 by using citation and co-citation analysis. They illustrate the most relevant authors, journals, topic areas, and research methods in the field, and how these evolve over time. Shang, Saladina and Fry (2015) investigate the research contributions of academic institutions and authors that published articles in the eleven top operations management journals during the period 1985-2010.

Numerous bibliometric studies focus on marketing. Tellis et al. (1999) compare the publications find in the major journals in order to establish a ranking between them. Baumgartner and Pieters (2003) analyse the influence of marketing journals by using citation analysis. Other authors emphasise the influence of marketing researchers, institutions and countries (Chan, Lai, and Liano, 2012b; Stremersch and Verhoef, 2005). Specific topics of marketing are analysed, for instance, advertising research (Kim and McMillan, 2008), public policy (Sprott and Miyazaki, 2002) and pricing research (Leone et al., 2012). Valenzuela-Fernandez, Merigo, and Lichtenthal (2019) present an overview of the Journal of Business-to-Business Marketing through a bibliometric analysis from 1992 to 2016, focusing on the most cited articles and authors, h-index, publications per year, among other measures.

In finance research, several studies have also provided a wide overview of the research published over the years by using bibliometric indicators to assess the general state of the art. For example, Alexander and Mabry (1994) present rankings of the most influential authors and institutions. Borokhovich et al. (1995) analysed the most influential institutions in finance, while Kim et al. (2009) considered the competitive advantage of the top institutions and the trends for the future. Some other studies focus on the quality and influence of financial journals (Borokhovich, Bricker and Simkins, 2000; Olheten, Theoharakis and Travlos, 2005; Currie and Pandher, 2011). Calma (2017) examine the ten highly ranked journals in finance and identify the most published authors, most cited articles, top publishing countries, top publishing

universities, top publication years and the most discussed topics using keywords search from WoS.

Several studies have used bibliometric analysis to provide an overview of the research published in business, being citation and co-citation analysis the most common types of analysis (i.e. Stremersch, Verniers, and Verhoef, 2007; Uysal, 2009; Leone et al., 2012; and Zhao, Zhang, and Kwon, 2018). Baker, Groenewegen, and Den Hond (2005) explore the evolution of the literature in corporate social responsibility and corporate social performance during a period of 30 years. Uysal (2009) uses a co-citation analysis to analyse scholarly communication patterns that exist on business ethics published in a wide range of accounting journals over the period 1988-2007. Merigó et al. (2015) analyse all the publications in the Journal of Business Research between 1973 and 2014. This study concluded that the USA is the leading region in the journal, although a considerable dispersion exists, especially during the last decades when European and Asian universities are taking a more signification position. Zhao, Zhang, and Kwon (2018) describe the development of research on corporate social responsibility in international business journals, using an author co-citation analysis of articles published in twelve leading journals over three decades (1996-2015).

Numerous authors use bibliometric analysis to assess over the years the state of the art in accounting research. McRae (1974) is one of the first citation analyses in accounting. This article examines the relationship between accounting systems and information systems based on the analysis of citations in 17 accounting journals during 1968-1969. Similarly, Hoftstedt (1976) evaluates the connection between accounting and other disciplines for behavioural accounting and contributes to the discussion of citation analysis in this accounting research. Brown and Gardner (1985) apply citation analysis to assess the research contributions of accounting faculties, doctoral programs, and researchers that published accounting research articles on what these authors label as contemporary accounting research[3]. They find that authors and institutions from the USA are the most influential in contemporary accounting research. Brown (1996) also analyses the most influential articles, authors and institutions on contemporary accounting research by using a citation analysis and finds similar results. Brown, Gardner and Vasarhelyi (1987) evaluate the research contributions in AOS during 1976-1984, which showed that the journal had successfully achieved its research objectives and had a great impact on the social sciences. Bricker (1988) investigates how accounting researchers accumulate and retain knowledge within the period 1983-1986, and reveal a strong tendency to cite more recent articles. Bricker (1989) investigates the structure of accounting research by performing a co-citation analysis. He identifies various lines of research and

[3] Brown and Gardner (1985) define contemporary accounting research as articles published in TAR, JAR, JAE, and AOS between 1976 and 1982.

examines the degree of fragmentation for the period 1983-1986. Meyer and Rigsby (2001) analyse the topic areas and research methods used in the journal Behavioural Research in accounting for 1989 to 1998 and examine the impact of the journal on the accounting literature. Reiter and Williams (2002) show that accounting research cites articles published in journals classified in economics and finance categories more often than vice versa, showing a direct transfer of knowledge from economics and finance to accounting. Solomon and Trotman (2003) analyse the impact of articles about auditing judgement and decision experiments published in AOS during the period 1976-2000. They also compare these results with other leading research journals. Other authors rank accounting journals, PhD programs or institutions with respect to their impact on accounting research (Milne, 2001; Brown, 2003; Brown and Laksmana, 2004; Beattie and Goodacre, 2006; Reinstein and Calderon, 2006; Chan et al., 2009; Coyne et al., 2010). Some other studies determine the rankings of the accounting journals by survey and citation techniques (Bonner et al., 2006, 2012). In order to examine the quality of accounting journals, Lowe and Locke (2005) establish different rankings of accounting journals based on a survey to professors in accounting and finance departments in the UK. Other articles use citation analysis to develop several rankings classifying accounting journals by topic areas and research methods (Coyne et al., 2010; Pickerd et al., 2011). Another interesting issue is the regional classification of accounting research. Qu, Ding, and Lukasewich (2009) examines the authorship distribution in the CAR journal. It provides empirical evidence that USA elites influence the research of a non-USA research community. Chan, Tong, and Zhang (2012a) assess the research productivity in Australian and New Zealand institutions during 1991-2010, using 48 accounting and finance journals. Accounting research has also been compared with other related disciplines. Lukka and Kasanen (1996) and Williams and Rodgers (1995) are interdisciplinary studies of accounting research since their citation analysis draws from accounting, economics and finance research. These authors analyse the institutional barriers in the knowledge production process of accounting research using Bourdieu's concept of elites (Bourdieu, 1996). Both similarly conclude that journals TAR, JAR and JAE (also called US elite) has its strengths in quantitative empirical and analytical research methods, while journal AOS (also known as European elite) specialises in organizational and social issues using qualitative methods. Swanson (2004) compares authors publishing articles in accounting, finance, management and marketing research. Mensah et al. (2004) focus on the influence of managerial accounting research in other related disciplines (economics, operations research, psychology, sociology, organisational behaviour, and strategic management).

Finally, bibliometric analysis is commonly used to provide an overview of the published research in a given academic field, and more precisely in accounting research. Accordingly, in my bibliometric analysis, I use some of the bibliometric measures and indicators employed in accounting literature and related fields.

2.3. Methodology of the bibliometric analysis

In this section, I describe the methodology used in my bibliometric analysis, which is presented as follows. First, I present the methodology used for the article selection. Second, I describe the methodology for the article classification. Third, I outline the methodology for the journal: number of articles published and citations. Forth, I define the methodology used for the author: number of articles published and citations. Finally, I present the methodology for the article citation analysis.

2.3.1. Search procedure

For the purpose of the analysis, the data were collected from journals in the WoS Core Collection databases produced by the ISI, later maintained by Clarivate Analytics (previously Thomson Reuters). The WoS provides comprehensive citation search published in 33,000 journals from more than 250 disciplines with over 100 years of coverage. More precisely, I used the SSCI, one of the six multidisciplinary citation indexes in the WoS databases, which covers over 3,000 journals across 55 social science disciplines from 1988 to the present. According to Merigó and Yang (2017), it is the most common database used for its international coverage of high-quality journals focused on accounting research.

I define the search procedure followed to identify the final article selection. I perform the bibliometric analysis using the SSCI, which I accessed on 21-10-2017 through WoS Core Collection database. I use the keywords "value relevance" and "fair value" to perform my search. Therefore, I start my search adding these two previous keywords simultaneously using the combining option AND in the WoS, and within the timespan 1900-2016. I perform the search during the second half of 2017. I filter the results by article within document types refining option. From this search, I take all articles that include the previous keywords in their titles, abstracts, and keywords of the source articles. From these results, I examine each article's title and content in the abstract. Then, I eliminate articles not related to the subject of my keywords search. Articles of the final search are ordered alphabetically by author's surname (see Annex 1). I retrieve authors' surnames, journal, abstract, total number of citations, average of citations per year, impact factor, five-year impact factor, and h-index. According to Hirsch (2005) and Merigó and Yang (2017), these variables provide general information to assess the quality of the bibliometric material.

Articles found in my keywords search have been classified according to the JCR categories in Clarivate Analytics (previously Thomson Reuters), which allows to evaluate and compare articles from journals in the SSCI using citation data. Currently, JCR does not include a specific section for accounting. The category "Business, Finance" includes journals mainly dedicated to research related to financial and accounting. The search provides articles from journals classified in different JCR categories: Agricultural, Economics and Policy; Business; Business, Finance; Communication; Economics; Ethics; Management; Medical Ethics; Political Science; Psychology; Public Administration; and Social Science, Biomedical. These categories allow the evaluation and comparison of articles and journals using citation data. It is important to mention that some journals belong to more than one category. For example, JAE belongs to "Business, Finance" and "Economics" categories. As a result, this classification also allows for multiple categories per article. According to the Scope Notes in Clarivate Analytics[4], the description of the main JCR categories of articles in my keywords search is:

> **Agricultural, Economics & Policy:** covers resources concerned with production, distribution, and consumption of agricultural commodities as well as the managerial and policy decisions concerning these commodities.
>
> **Business:** covers resources concerned with all aspects of business and the business world. These include marketing and advertising, forecasting, planning, administration, organizational studies, compensation, strategy, retailing, consumer research, and management. Also covered are resources relating to business history and business ethics.
>
> **Business, Finance:** covers resources concerned with financial and economic correlations, accounting, financial management, investment strategies, the international monetary system, insurance, taxation, and banking.
>
> **Communication:** covers resources on the study of the verbal and non-verbal exchange of ideas and information. These include communication theory, practice and policy, media studies (journalism, broadcasting, advertising, etc.), mass communication, public opinion, speech, business and technical writing as well as public relations.
>
> **Economics:** covers resources concerned with all aspects, both theoretical and applied, of the production, distribution, and consumption of goods and services. These include generalist as well as specialist resources, such as

[4] Scope Notes 2017 in Science Citation Index, Science Citation Index Expanded, and in the SSCI.

political economy, agricultural economics, macroeconomics, microeconomics, econometrics, trade, and planning.

Ethics: covers resources concerned with normative ethics, including all aspects of the evaluation of human conduct and social relations, such as business ethics, medical ethics, environmental ethics, etc. Descriptive ethics is covered extensively in the Arts & Humanities Citation Index, Philosophy.

Management: covers resources concerned with management science, organization studies, strategic planning and decision-making methods, leadership studies, and total quality management.

Medical Ethics: covers resources concerned with all aspects of ethics in health care and medicine.

Political Science: covers resources concerned with political studies, military studies, the electoral and legislative processes, political theory, history of political science, comparative studies of political systems, and the interaction of politics and other areas of science and social science.

Psychology, Multidisciplinary: covers resources concerned with a general or interdisciplinary approach to the field. Resources related to philosophical psychology, psychobiology, and the history of psychology are included in this category.

Public Administration: covers resources concerned with the management of public enterprises, implementation of governmental decisions, the relationship between public and private sectors, public finance policy, and state bureaucracy studies.

Social Science, Biomedical: covers resources concerned with the political and social effects of biomedical research. These also include family planning, healthcare ethics, psycho-oncology, and sexual health.

It should be pointed out that the search is not limited to this category of journals. Other categories have been considered in the analysis since articles are related to the subject of my keywords search.

Finally, I classify articles found in my keywords search by types of research methods and topic areas in the subsection 2.3.2. In the subsections 2.3.3. and 2.3.4., I analyse journal and author characteristics, respectively, by number of articles published and citations. In the subsection 2.3.5., I describe the methodology of the article citation analysis.

2.3.2. Article classification

With respect to article classification, I classify the articles obtained by connecting searches using keywords "value relevance" and "fair value" in WoS over the period 1994-2016 by types of research methods and topic areas. These classification schemes are similar to those developed by Brown and Gardner (1985), and Shields (1997), which were followed by Coyne et al. (2010) and Pickerd et al. (2011).

To classify all articles by research method, I examine each article in my keywords search. I review in more detail the abstract and the methodology section. Similar to Coyne' et al. classification (2010), I use the following types of research methods: Analytical, Archival, Case study, Experimental, Framework, Simulation, Survey, and Theoretical. The meanings of these types of research methods are the following:

Analytical: studies basing analysis and conclusions on theories or substantiated ideas in mathematical terms. Researchers use maths to predict, explain, or give substance to theory.

Archival: studies basing analysis and conclusions on objective data (based on objective amounts, as for example net income, sales, fees, etc.) and on historical documents (like texts, journal articles, corporate annual reports, company disclosures, etc.) collected from third parties. Research mainly applies statistical techniques to data drawn from commercial databases.

Case study: studies basing analysis and conclusions on research on phenomena, including people, processes and structures, a system, a unit, a process, or an organization.

Experimental: studies basing analysis and conclusions on data gathered by administering treatments to subjects. The researcher manipulates one or more variables with subjects who are assigned randomly to various groups.

Framework: studies basing analysis and conclusions on the development of a new concept or new perspectives.

Simulation: studies which involve computer-based simulation articles and random numbers.

Survey: studies which analysis and conclusions are based on a group of people and is often conducted through a questionnaire and/or interview approach asking for facts or opinions about certain issues.

Theoretical: studies which involve researcher to examine theories, formulate research questions, recognise categories, and patterns from data.

The different types of research methods are not mutually exclusive. For example, Boone (2002) employs a case study, as well as hypotheses tests using archival data. The research method of this article is classified into Archival and Case study categories.

As mentioned previously, I also classify articles by topic area. In order to classify articles by topic area, I examine the article's title and abstract. Adapted from Coyne' et al. (2010), I use the same definitions of topic area excluding Accounting Information Systems (AIS) research, which examines issues related to accounting information system, such as system security and design science, because I consider that this topic area is not related to the subject of my keywords search. Similar to Coyne et al. (2010), I classify articles by Auditing, Financial, Managerial, Taxation, and Other. The meanings of these types of topic areas are:

Auditing: studies related to audit. These studies include the study of the external and internal audit environment, auditor decision-making, auditor independence, the effects of auditing on the financial reporting process, and auditor fees.

Financial: studies that examine financial accounting, financial markets, and focuses on the relationship between accounting information and the decision making of external users of the accounting information in the capital markets.

Managerial: studies that focus on the relationship between accounting information and internal users of the accounting information, for example examining budgeting, compensation, decision-making within an enterprise, incentives, and the allocation of resources within an enterprise.

Taxation: studies that examine issues related to taxpayer decision-making, market reactions to tax disclosures, and the relationship between accounting information and tax authorities.

Other: studies that do not fit into one of the above-mentioned topic areas. The topic areas in these studies vary significantly and include such categories as ethics, policies, public administration, methodologies, and psychology.

Similar to the previous research method classification, the categorization by topic area also allows for multiple categories per article. If an article is related to multiple contexts, it is categorised as providing a contribution to each area. Song and Thomas (2010) examine the relevance of fair value measurements under FAS 157 FV (Financial) and its impact on corporate governance mechanisms (Managerial).

2.3.3. Journal characteristics: number of articles published and citations

In this subsection, I intend to analyse the characteristics of journals publishing articles connecting searches using keywords "value relevance" and "fair value" in WoS over the period 1994-2016. From the 129 articles obtained in my keywords search, I rank all the journals by number of articles with the objective to identify the journals with more articles published.

For this analysis, I study several variables, which assess the impact of a journal, allowing for a comparison of journals: total number of articles published, impact factor and five-years impact factor. Lastly, I mention the JCR category for each journal. The total number of articles published indicates the productivity in my keywords search. The impact factor of a journal is commonly accepted as a relevant indicator to reflect the relative importance of a journal within a field. It is a measure that considers the number of citations received in year n to items published in this journal in years n-1 and n-2 divided by number of citable items published in this journal in years n-1 and n-2. However, the calculation process is widely criticised because it can be easily manipulated by using self-citation techniques (Merigó and Yang, 2017). Due to the criticism received, citations over the last five years are considered. Although it is still possible to manipulate the five-year impact factor under this framework, it is at least possible to reduce this limitation by more than 50 % and it seems to provide a more accurate result (Merigó and Yang, 2017). The impact factor and the five-year impact factor take into consideration to all articles published in a journal, despite these articles appear or not in my keywords search. The JCR category presents quantifiable statistical data that helps to measure the relative importance of journals within their subject categories and shows the relationships between citing and cited journals.

In addition, I analyse the total amount of citations received by a journal, with the aim to examine in more detail the most influential journals that publish articles in my keywords search. Following Merigó and Yang (2017), I examine the total number of citations, journals with articles in the search with 50-100 citations, with 100-200

citations and with more than 200 citations, h-index, and the year when the journal was included in the WoS database. In order to assess the importance or influence of a journal, I collect the number of citations from articles published in my keywords search. The h-index is a good indicator of both author's productivity (total number of publications) and the impact of his or her work (number of published articles receiving citations). This index can also be applied to the productivity and impact of a scholarly journal, as well as a group of authors, a department or a university. In this case, this index is used to measure both productivity and impact of a journal on the selected timespan and type of document, allowing the comparison between journals in the same field. In order to highlight the most influential publications and given the number of citations in the sample, the articles in a journal above 50, 100 and 200 citations are considered separately. The first year of a journal in the WoS database allows a comparison of the temporal coverage of a journal with the other journals in my ranking. The prior information is retrieved, from all journals that publish articles related to my keywords search, from the information provided by clicking "View Journal Impact" in WoS website, which uses data from the 2016[5] edition of JCR.

2.3.4. Author characteristics: number of articles published and citations

From the articles found connecting searches using keywords "value relevance" and "fair value" in WoS over the period 1994-2016, I intend to collect data on author productivity and analyse their impact. Accordingly, I present a list of articles by author and show authors receiving over 100 citations. To know the degree of involvement of an author, I also classify authors according to the number of times that an author published an article related to my keywords search.

More precisely, I count the number of authors by the number of articles authored in my keywords search, where each author is counted as a contributor without taking into consideration the order of authorship. In addition, I aim to detect those authors who publish the highest number of articles, whether these articles are single-authored or not. Thus, the results will show the influence of researchers publishing articles in my keywords search and gives a general view of researcher total production. Given the amount of citations received by the articles found in my keywords search, I also list the authors receiving over 100 citations and their affiliation. Additionally, I record data on the number authors by article, which provides a preliminary indication of

[5] The SSCI impact factor measures the number of citations received by the average article in a journal two years after articles' publication.

authors' collaboration on the subject of my keywords search. Again, I count the number of authors for all articles included in the search.

2.3.5. Article citation analysis

In this subsection, I describe the methodology of the article citation analysis with the main presumption that the number of citations an article receives is considered to be an indicator of its impact or influence (Brown and Gardener, 1985), and it will reflect some notion of relevance of the author, as well as of the articles included in the search (Milne, 2001). Tahai and Rigsby (1998) argue that citation analysis allows the creation of research patterns that reveal a network between disciplines and tracks the value or durability of research by evaluating the extent and usage of previous literature in current literature. From the articles obtained connecting searches using keywords "value relevance" and "fair value" in WoS over the period 1994-2016, I record data on the citations received by articles, as well as those received by authors.

To examine the impact or influence of an article on the subject of my keywords search, I analyse the number of citations an article received. Following Merigó and Yang's (2017), the number of citations has been analysed for the whole period of my study, and for two different subperiods. According to my timespan, I analyse the number of citations by the whole period of time (1994-2016), the first decade (1994-2005) and the second decade (2006-2016), separately. Moreover, I select and examine the most cited articles as being considered the most influential articles and authors in my keywords search. Taking into consideration the frequency of citations that an article received in my keywords search, I consider the threshold of 100 citations an acceptable amount to outline the most influential articles. I also take into consideration authors' name, year of publication, journal, total amount of citations and average citations per year. The average number of citations per year is calculated by dividing the total number of citations by the number of years the author or journal has been publishing articles. This metric can be a very useful measure to assess the yearly impact for a journal or an author.

2.4. Article selection

In this subsection, I explain the article selection for my bibliometric analysis. A set of 178 preliminary items are identified searching simultaneously by "value relevance" AND "fair value" keywords in the WoS Core Collection databases, within the time frame from the beginning of 1994 until the end of 2016. AND is the combining option in the WoS database. According to the search procedure, I select articles including the two keywords introduced at the same time in different fields (title, abstract and keywords of the source articles).

As can be seen in Panel A of Table 1, from the 178 preliminary results, I exclude 9 publications, of which 8 are book reviews in academic journals and 1 is an editorial material. After refining results by articles, my search shows 169 articles, of which 14 articles are also classified as proceedings papers (13) and book chapters (1) in the document type. From these 169 articles, I exclude 40 articles because they were not associated with the keywords of my search. Therefore, I perform my analysis with a final selection of 129 articles from a wide range of accounting and non-accounting journals.

Panel B of Table 1 shows that 111 out of 169 articles belong to Business, Finance JCR category. Articles are also associated with other areas of research: Economics (26), Business (14), Management (12), Public Administration (6), Ethics (4), Law (4), Nursing (4), Psychology Applied (3), Psychology Social (3), Social Issues (3), Agricultural Economics Policy (2), Education Educational Research (2), Environmental Sciences (2), Environmental Studies (2), Health Policy Services (2), Medical Ethics (2), Philosophy (2), Psychology Multidisciplinary (2), Social Sciences Biomedical (2), Social Sciences Mathematical Methods (2), Sociology (2), and among other JCR categories. It is important to mention that some articles are multidisciplinary since belong to more than one category.

After reviewing the title and the information in the abstract of all articles, 40 articles (see Panel C of Table 1) that belong to Economics (16); Business (5); Management (5); Law (4); Nursing (4); Ethics (3); Psychology Applied (3); Psychology (3); Social Issues (2); Education & Educational Research (2); Environment Sciences (2), Environmental Studies (2), Environmental Studies (2), Heath Policy Services (2); Philosophy (2); Social Sciences, Mathematical Methods (2); Sociology (2); and among other JCR categories, are deleted from the analysis in order to exclude publications not related to the subject of my keywords search. Also, in this case, it is important to mention that some articles are multidisciplinary since belong to more than one category. Regarding the Finance and Business categories, no articles are deleted from the search since they are all related to the keywords of my search.

Table 1. Article selection: Results obtained by searching for "value relevance" AND "fair value" in WoS over the period 1994-2016.

Panel A. Preliminary results and final article selection in my keywords search.

	Number of items
Preliminary results	178
- Book reviews	-8
- Editorial material	-1
Total number of articles obtained in my keywords search (Panel B)	169
- Number of articles delated from my keywords search (Panel C)	-40
Final number of articles in my keywords search (Panel D)	129

Panel B. JCR categories of 169 articles obtained in my keywords search.

JCR category	**Number of articles**
Business, Finance	111
Economics	26
Business	14
Management	12
Public Administration	6
Ethics	4
Law	4
Nursing	4
Psychology Applied	3
Psychology Social	3
Social Issues	3
Agricultural Economics & Policy	2
Education & Educational Research	2
Environmental Sciences	2
Environmental Studies	2
Health Policy & Services	2
Medical Ethics	2
Philosophy	2
Psychology, Multidisciplinary	2
Social Sciences, Mathematical Methods	2
Sociology	2
Anthropology	1
Area Studies	1
Behavioural Sciences	1
Biodiversity Conservation	1
Communication	1
Energy & Fuels	1
Geography	1
History & Philosophy of Science	1
Information Science & Library Science	1
Nutrition & Dietetics	1
Operations Research & Management Science	1
Orthopaedics	1
Planning & Development	1
Political Science	1
Psychiatry	1
Social Sciences, Biomedical	1
Surgery	1
Number of articles belonging in each JCR category	227

Panel C. JCR categories of 40 articles deleted from my keywords search.

JCR Category	Number of articles
- Economics	-16
- Business	-5
- Management	-5
- Law	-4
- Nursing	-4
- Ethics	-3
- Psychology Applied	-3
- Psychology Social	-3
- Social Issues	-2
- Education & Educational Research	-2
- Environmental Sciences	-2
- Environmental Studies	-2
- Health Policy & Services	-2
- Philosophy	-2
- Social Sciences, Mathematical Methods	-2
- Sociology	-2
- Anthropology	-1
- Area Studies	-1
- Behavioural Sciences	-1
- Biodiversity Conservation	-1
- Communication	-1
- Energy Fuels	-1
- Geography	-1
- History & Philosophy Science	-1
- Information Science & Library Science	-1
- Medical Ethics	-1
- Nutrition & Dietetics	-1
- Operations Research & Management Science	-1
- Orthopaedics	-1
- Planning & Development	-1
- Psychiatry	-1
- Psychology, Multidisciplinary	-1
- Surgery	-1
Number of articles deleted belonging in each JCR category	76

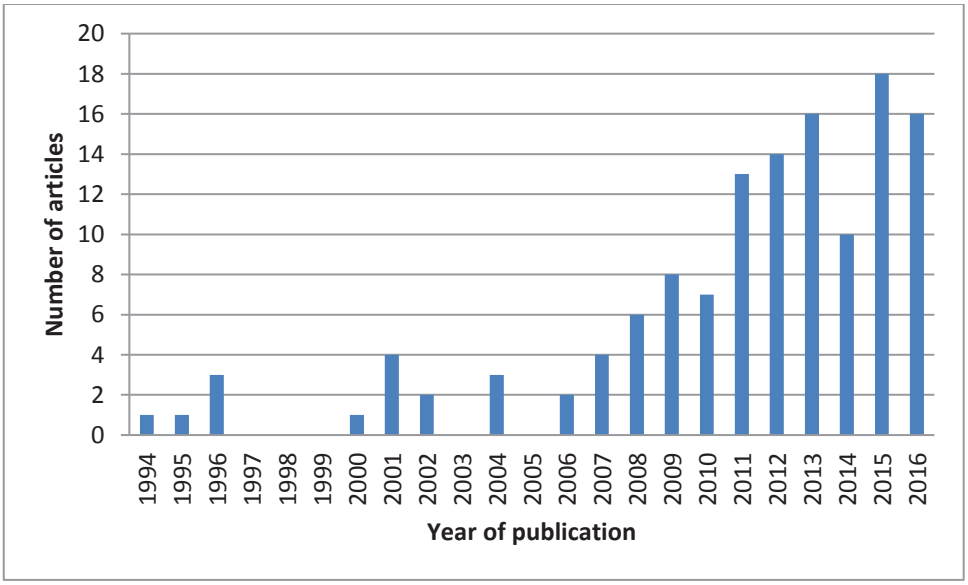
Panel D. JCR categories of 129 articles in my keywords search.

JCR category	Number of articles
Business, Finance	111
Business	10
Economics	9
Management	7
Public Administration	6
Agricultural, Economics & Policy	2
Communication	1
Ethics	1
Medical Ethics	1
Political Science	1
Psychology, Multidisciplinary	1
Social Science, Biomedical	1
Number of articles belonging in each JCR category	151

Panel D of Table 1 shows that the main JCR category in the final number of articles in my keywords search is Business, Finance; with 111 articles published. A plausible explanation for the predominance of this JCR category is that the keywords of my search belong to well-established subjects of research in the accounting field. This category typically contains accounting journals. The number of articles published in journals classified in the remaining categories is comparatively scarce. The next are Business, with 10 articles; and Economics with 9 articles, being the categories more related to accounting. Management and Public Administration categories present 7 and 6 articles, respectively. The number of articles in the remaining categories is very scarce in comparison with the already described JCR categories.

Graph 1 displays the trend of the 129 articles considered in the study. As shown in this graphic, the number of publications between 1994 and 2007 is lower with respect to the following period 2007-2016. During five different years, no article related to the search is published (1997, 1998, 1999, 2003 and 2005). The number of articles per year is up to four publications in the period 1994-2007, steadily increasing after this year to the maximum number of 18 articles published in 2015, combined with a slight decrease in 2010 and a sharp decrease in 2014. Despite a few exceptions (2010, 2014 and 2016), the number of articles per year found in my keywords search increase from 2005 and after 2007 is always above 4 articles.

Graphic 1. Number of articles published per year searching for "value relevance" AND "fair value" in WoS from 1994 until 2016.



Overall, Graph 1 shows a sharp increase of the number of articles published from the first year of study (1 article published in 1994) to the last year (16 articles published in 2016), suggesting that an increase in the interest on the subject of my keywords search. It should also be pointed out that an increasing number of journals have been indexed in the JCR during the period of our study.

2.5. Results of the bibliometric analysis

In this subsection, I present the results of the bibliometric analysis as follows. First, I describe the results of the article classification. Second, I present the results of the journals publishing articles found in my keywords search, by number of articles and citations. Third, I display the results of author by number of articles published and citations. Finally, the results of article citation analysis are presented.

2.5.1. Results by article classification

In this subsection, I present the results of the number of articles found in my keywords search and classified by two different criteria: research method and topic area. Table 2 presents results of article classification, ranking by number of articles connecting searches using keywords "value relevance" and "fair value" in WoS from 1994 until 2016. Moreover, it is relevant to mention that some of the 129 articles in my keywords search belong to journals that are classified in more than one research method and topic area. Consequently, the total amount of articles displayed in each panel of Table 2 are higher than the initial 129 articles of my keywords search.

Panel A of Table 2 shows that archival is the dominant research method for the articles included in my keyword search with 68 articles published (48.92% of my search). Analytical is the second-highest research method with 19 articles (13.67%), followed by theoretical with 15 articles (10.79%). The next group of research methods are survey, with 10 articles (7.19%); framework, with 9 articles (6.47%); case study, with 8 articles (5.76%); and experimental, with 6 articles (4.32%). The smallest group is simulation, with 2 articles (1.44%).

Table 2. Number of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016 by research method and topic area.

Panel A. Number of articles and percentage by research method.

Research method	Number of articles	Percent
Archival	68	48.92%
Analytical	19	13.67%
Theoretical	17	12.23%
Survey	10	7.19%
Framework	9	6.47%
Case study	8	5.76%
Experimental	6	4.32%
Simulation	2	1.44%
Total number of articles	139	100.00%

Panel B. Number of articles and percentage by topic area.

Topic area	Number of articles	Percent
Financial	122	81.88%
Managerial	18	12.08%
Auditing	4	2.68%
Other	3	2.01%
Taxation	2	1.34%
Total number of articles	149	100,00%

Panel B of Table 2 displays data on articles classified by topic area. Financial, with 122 articles, is the main topic in our field (81.88% of the search), which is in accordance with the subject of my keywords research. Managerial is the second, with only 12.08% of my search. The number of articles in the remaining topic areas is very scarce in comparison with the two previous ones.

2.5.2. Results by journal: number of articles published and citations

The following subsection presents the results of the analysis by journal. Table 3 shows a list of journals ranked by number of articles published in my keywords search. As can be seen, the 129 articles in my keywords search are published in 39 different scientific journals. TAR is the journal with the highest number of articles in my keywords search with 19 articles published (14.73% of my search). JAE comes next with 12 articles (9.30%). ABR is in the third position with 11 articles (8.53%), RAS in the fourth position with 10 (7.75%), followed by AH in fifth position with 9 articles

(6.98%) and AOS in the sixth position with 8 (6.20%). JAR is seventh with 6 articles (4.65%), JBFA comes eighth with 5 articles (3.88%), followed by AF and CAR both with 4 articles (3.10%). The remaining journals published less than 4 articles related to my keywords search. Additionally, JAE is the journal with the highest impact factor and 5-year impact factor in 2016 (IF = 3.839 and 5Y-IF = 6.016), followed by JAR (IF = 3.0 and 5Y-IF = 4.8) and TAR (IF = 2.304 and 5Y-IF = 4.396).

Out of the 39 journals, 25 belong to "business, finance" category, of which 18 journals are considered accounting journals[6] and 7 finance journals (see column G). The remaining journals (14) belong to other JCR categories: economics (10); business (7); management (5); public administration (4); agricultural, economics & policy (1); biomedical (1); communication (1); ethics (1); medical ethics (1); political science (1); psychology (1); social issues (1); and social science (1). It should be pointed out that 13 of 39 journals belong to 2 different JCR categories, 2 journals belong to 3 JCR categories and 1 journal belong to five JCR categories. These journals have been considered in the analysis since the articles are related to the subject of my keywords search.

[6] In 2016, there are 18 journals considered in the accounting category in JCR (i.e.: journals containing the word accounting and/or auditing in the journal's title) in WoS that published articles on the subject of my keywords search: Abacus (ABA), Accounting & Business Research (ABR), Accounting & Finance (AF), Accounting Auditing & Accountability Journal (etc.), Accounting Horizons, Accounting Review, Accounting Organizations & Society, Asia-Pacific Journal of Accounting & Economics, Auditing – A Journal of Accounting & Economics, Australian Accounting Review, Contemporary Accounting Research, Critical Perspectives on Accounting, European Accounting Review, Journal of Accounting & Economics, Journal of Accounting And Public Policy, Journal of Accounting Research, Journal of Business Finance & Accounting, and Review of Accounting Studies.

Table 3. List of journals ranked by number of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016.

(A) Ranking	(B) Journals	(C) Number of articles	(D) Percent	(E) Impact factor	(F) 5-year impact factor	(G) JCR Category
1	TAR	19	14.73%	2.304	4.396	Business, Finance
2	JAE	12	9.30%	3.839	6.016	Business, Finance Economics
3	ABR	11	8.53%	0.911	1.565	Business, Finance
4	RAS	10	7.75%	1.756	2.565	Business, Finance
5	AH	9	6.98%	1.218	1.564	Business, Finance
6	AOS	8	6.20%	2.158	3.628	Business, Finance
7	JAR	6	4.65%	3.0	4.8	Business, Finance
8	JBFA	5	3.88%	1.276	1.724	Business, Finance
9	AF	4	3.10%	1.396	1.654	Business, Finance
10	CAR	4	3.10%	2.269	3.358	Business, Finance
11	ABA	3	2.33%	1.119	1.321	Business, Finance
12	AAR	3	2.33%	0.576	1.046	Business, Finance
13	BFP	3	2.33%	0.215	0.207	Business Management
14	EAR	3	2.33%	2.107	2.462	Business, Finance
15	CAL	2	1.55%	0.162	0.255	Agricultural, Economics & Policy Business Economics
16	GPRIP	2	1.55%	0.303	0.573	Business, Finance
17	IRAS	2	1.55%	1.35	1.471	Public Administration
18	JAPP	2	1.55%	1.333	2.57	Business, Finance Public Administration
19	AAAJ	1	0.78%	2.732	2.991	Business, Finance
20	ARFE	1	0.78%	1.415	1.989	Business, Finance Economics
21	APJAE	1	0.78%	0.279	0.271	Business, Finance Economics
22	AUD	1	0.78%	1.937	2.281	Business, Finance
23	BIO	1	0.78%	1.562	1.676	Ethics Medical ethics Social issues Social Sciences Biomedical
24	CMC	1	0.78%	1.585	1.745	Business
25	CPA	1	0.78%	1.5	-	Business, Finance
26	INN	1	0.78%	0.058 (2012)	-	Business Management Public Administration
27	IRFA	1	0.78%	1.457	1.652	Business, Finance
28	JBF	1	0.78%	1.776	2.57	Business, Finance Economics
29	JBEF	1	0.78%	0.576	0.794	Business, Finance Economics
30	JBIM	1	0.78%	1.371	2.017	Business

31	JCF	1	0.78%	1.579	2.37	Business, Finance
32	JEIC	1	0.78%	0.931	0.953	Economics
33	JEP	1	0.78%	1.275	2.222	Economics Psychology
34	JME	1	0.78%	0.217	0.617	Communication Economics
35	JRI	1	0.78%	1.343	1.882	Business, Finance Economics
36	MSMR	1	0.78%	2.705	4.225	Business Management
37	RBGN	1	0.78%	0.153	0.518	Business Management
38	RCRD	1	0.78%	0.17	0.188	Political Science Public Administration
39	SJM	1	0.78%	1.45	2.054	Management
	Total	129	100%			

Abbreviations: Impact Factor = Impact factor of year 2016; AAAJ = Accounting Auditing and Accountability Journal; AAR = Australia Accounting Review; ABA = Abacus: A Journal of Accounting and Business Studies; ABR = Accounting and Business Research; AF = Accounting and Finance; AH = Accounting Horizons; AOS = Accounting, Organizations and Society; APJAE = Asia-Pacific Journal of Accounting & Economics; ARFE = Annual Review of Financial Economics; AUD = Auditing-A Journal of Practice & Theory; BFP = Betriebswirtschaftliche Forschung und Praxis; BIO = Bioethics; CAL = Custos e Agronegocio on Line; CAR = Contemporary Accounting Research; CMC = Consumption Markets and Culture; CPA = Critical Perspectives on Accounting; EAR = European Accounting Review; GPRIP = Geneva Papers on Risk and Insurance-Issues and Practice; INN = Innovar-Revista de Ciencias Administrativas y Sociales; IRAS = International Review of Administrative Sciences; IRFA = International Review of Financial Analysis; JAE = Journal of Accounting and Economics; JAPP = Journal of Accounting and Public Policy; JAR = Journal of Accounting Research; JBEF = Journal of Behavioral Finance; JBF = Journal of Banking & Finance; JBFA = Journal of Business Finance and Accounting; JBIM = Journal of Business & Industrial Marketing; JCF = Journal of Corporate Finance; JEIC = Journal of Economic Interaction and Coordination; JEP = Journal of Economic Psychology; JME = Journal of Media Economics; JRI = Journal of Risk and Insurance; MSMR = Mit Sloan Management Review; RAS = Review of Accounting Studies; RBGN = RBGN-Revista Brasileira de Gestao de Negocios; RCRD = Revista del Clad Reforma y Democracia; SJM = Scandinavian Journal of Management; and TAR = The Accounting Review.

Table 4 presents a list of journals with more than 50 citations ranked by number of citations. These citations are referred to the articles included in my keywords search and for the period 1994-2016. Apart from being between the journals publishing more articles and with the highest impact factor, JAE, TAR and JAR received the largest number of citations. Therefore, they also show the highest h-index, which reflects both productivity and impact of the journals in my keywords search. JAE is the journal presenting the highest number of citations with 1095 citations, the highest h-index with 125 and the 2 most cited articles in my keywords search, with both articles having more than 200 citations. Also, 4 other articles in this journal have between 50

and 100 citations. A likely explanation for the large impact of articles found in my keywords search and published in the JAE is that it is also included in the JCR category Economics, and likely read and referenced by economists. The second journal in this ranking is TAR with 882 citations and h-index with 119. In this journal, there are 3 articles that have between 100 and 200 citations, and 4 articles between 50 and 100 citations. JAR is the third journal with 284 citations, h-index with 116 and includes the third most cited article of the search with more than 200 citations. The next group of influential journals are RAS, AOS and EAR, followed by ABR and JBFA. RAS is found in the fourth position with 284 citations (h-index = 40) and AOS in the fifth position with 190 citations (h-index = 96). Both journals present one article with between 100 and 200 citations. Next is EAR with 114 citations (h-index = 29), which contains one article with between 50 and 100 citations. ABR is in seventh position with 90 citations (h-index = 23). Lastly, JBFA presents 50 citations (h-index = 33).

It should be pointed out that in this ranking half of the journals have been included in WoS database during the last fifteen years. RAS is included in WoS in 2004, JABFA in 2005, EAR in 2006 and ABR in 2007. Therefore, a likely reason for the low level of citations by some of the journals displayed in this panel is that WoS does not contain many journals that publish articles related to the subject of my keywords search. However, RAS and EAR have received a high number of citations despite the fact that they were first included in WoS during the period analysed (2004 and 2006, respectively).

Table 4. List of journals with more than 50 citations ranked by citations of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016.

Ranking	Journals	Citations	Citations≥200	200<Citations≤100	100<Citations≥50	H-index	First year in WoS
1	JAE	1095	2	0	4	125	1982
2	TAR	882	0	3	4	119	1926
3	JAR	284	1	0	0	116	1963
4	RAS	203	0	1	0	40	2004
5	AOS	190	0	1	0	96	1981
6	EAR	114	0	0	1	29	2006
7	ABR	90	0	0	0	23	2007
8	JBFA	50	0	0	0	33	2005

Abbreviations: ABR = Accounting and Business Research; AOS = Accounting, Organizations and Society; EAR = European Accounting Review; JAE = Journal of Accounting and Economics; JAR = Journal of Accounting Research; JBFA = Journal of Business Finance and Accounting; RAS = Review of Accounting Studies; and TAR = The Accounting Review.

2.5.3. Results by author: number of articles published and citations

This subsection presents the information on authors of articles found in my keywords search. Table 5 presents a list of the authors publishing articles in my keywords search and receiving more than 100 citations ranked by number of citations. These citations are referred to the articles included in my keywords search and for the period analysed. Results show that 16 authors received more than 100 citations, being Barth the first author with 949 citations (12.60% of my search), followed by Landsman with 506 (6.72%) and Beaver with 482 (6.40%). Additionally, the majority of authors with more than 100 citations in my keywords search are affiliated to North American institutions (15 authors), with the exception of Laux who is currently affiliated to an Austrian institution.

Table 5. List of authors receiving more than 100 citations ranked by citations of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016.

Authors	Citations	Percent	Institution
Barth, M	949	12.60%	Stanford University, USA
Landsman, WR	506	6.72%	University of North Carolina, USA
Beaver, WH	482	6.40%	Stanford University, USA
Holthausen, RW	374	4.97%	University of Pennsylvania, USA
Watts, RL	374	4.97%	Sloan School of Management Massachusetts Institute of Technology (MIT), USA
McNichols, M	231	3.07%	Stanford University, USA
Kasznik, R	225	2.99%	Stanford University, USA
Subramanayam, KR	173	2.30%	University of Southern California, USA
Laux, C	155	2.06%	Vienna University of Economics, Austria
Leuz, C	144	1.91%	University of Chicago, USA
Wahlen, JM	138	1.83%	Indiana University Bloomington, USA
Hung, M	134	1.78%	University of Southern California, USA
Ryan, S	122	1.62%	New York University, USA
Ramanna, K	111	1.47%	Harvard Business School, USA
Hopkins, PE	110	1.46%	Indiana University, USA
Hodder, L	105	1.39%	Indiana University, USA
Subtotal	4333	57.54%	
Other authors	3198	42.46%	
Total amount of citations	7531	100%	

Table 6 shows the number of articles by authors publishing articles in my keywords search. The maximum number of articles published by an author is 8 (0.41% of my search). No author published between 5 and 7 articles. Only 5 authors published 3 and 4 articles, representing 2.05% of my search, respectively. Another 20 authors

published 2 articles (8.20%). The vast majority of the authors (213) published only one article, which means that 87.30% of the authors who publish articles on the subject of my keywords search is occasional.

Table 6. Number of authors publishing articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016.

Number of articles by author	Number of authors	Percent	Authors
8	1	0.41%	Barth, ME
7	0	0%	
6	0	0%	
5	0	0%	
4	5	2.05%	Bolivar, MPR Galera, AN Hodder, LD Hopkins, PE Ryan, SG
3	5	2.05%	Beaver, WH Landsman, WR Linsmeier, TJ Pelger, C Wahlen, JM
2	20	8.20%	Bratten, B Dichev, ID Kadous, K Koonce, L Kothari, SP Laux, C Livne, G Magnan, M McNichols, MF Palea, V Petroni, KR Ramanna, K Riedl, EJ Shakespeare, CM Shivakumar, L Sloan, RG Subramanayam, KR Watts, RL Zhang, Y
1	213	87.30%	Not displayed for simplicity
Total number of authors	244	100%	

As previously mentioned, the most productive author has written 8 articles found in my keywords search (see Table 6) and is also the author with more articles cited (see Table 5). This author is the professor Mary E. Barth. Her research focuses on financial accounting and reporting issues, particularly subjects of interest to accounting

standard setters. These accounting subjects include using fair value in financial reporting, recognition versus disclosure, the information roles of accruals and cash flows, issues related to global financial reporting and convergence, among others.

Finally, Table 7 shows information on the number of researchers authoring an article found in my keywords search. Most articles are authored by two or three authors (31.01% and 41.86% of authors in my search, respectively), while 22.48% are single-authored, and only 4.65% are authored by four co-authors. There are no articles published with more than four authors.

Table 7. Number of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016 by number of researchers authoring an article.

Number of authors by article	Number of articles	Percent
1	29	22.48%
2	40	31.01%
3	54	41.86%
4	6	4.65%
Total number of articles	129	100.00%

2.5.4. Results on article citation

The following subsection presents the results on an additional article citation analysis of my keywords search. Panel A of Table 8 presents the number of articles by number of citations received in my search for the whole period of time (1994-2016), the first period (1994-2005) and the second period (2006-2016). Only 11.63% of the articles found in my search are published in the first half of the period studied (1994-2005). This period includes three of the most cited articles: one article received between 301 and 400 citations (0.78% of my search), and two articles received between 201 and 300 citations (1.55%). Also, 3 articles are amongst the highest number of articles published during this period, receiving between 51 and 100 citations, and another 3 between 31 and 40 citations (2.33% of my search, respectively). 88.37% of the articles found in my keywords search are published in the second half of the period (2006-2016). Most articles published during 2006-2016 receive between 0 and 20 citations. More precisely, 40 articles receive between 1 and 5 citations (31.01%), followed by 22 articles receive between 11 and 20 citations (17.05%), and 21 articles receive between 6 and 10 citations (16.28%). Lastly, 13 articles receive 0 citations (10.08%). The total number of citations by articles for the whole period (1994-2016) shows that 41 articles

received between 1 and 5 citations (31.78%), followed by 22 articles receiving between 11 and 20 citations, and another 22 between 6 and 10 citations (17.05% of my search, respectively). Next, are 14 articles receiving 0 citations. The rest of articles receive between 21 and 400 citations, but they present a lower number of articles (between 0 and 8 articles).

Table 8. Number of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016 by total number of citations received.

Panel A. Total number of articles by citations.

Citations	1994-2005		2006-2016		1994-2016	
	Number of articles	Percent	Number of articles	Percent	Number of articles	Percent
300 < citations ≤ 400	1	0.78%	0	0.00%	1	0.78%
200 < citations ≤ 300	2	1.55%	0	0.00%	2	1.55%
100 < citations ≤ 200	2	1.55%	3	2.33%	5	3.88%
50 < citations ≤ 100	3	2.33%	5	3.88%	8	6.20%
40 < citations ≤ 50	1	0.78%	3	2.33%	4	3.10%
30 < citations ≤ 40	3	2.33%	2	1.55%	5	3.88%
20 < citations ≤ 30	0	0.00%	5	3.88%	5	3.88%
10 < citations ≤ 20	0	0.00%	22	17.05%	22	17.05%
5 < citations ≤ 10	1	0.78%	21	16.28%	22	17.05%
0 < citations ≤ 5	1	0.78%	40	31.01%	41	31.78%
0 citations	1	0.78%	13	10.08%	14	10.85%
Total	15	11.63%	114	88.37%	129	100.00%

Panel B. Total number of articles with from 1 to 5 citations.

Citations	1994-2005		2006-2016		1994-2016	
	Number of articles	Percent	Number of articles	Percent	Number of articles	Percent
5 citations	1	0.78%	4	3.10%	5	3.88%
4 citations	0	0.00%	6	4.65%	6	4.65%
3 citations	0	0.00%	5	3.88%	5	3.88%
2 citations	0	0.00%	10	7.75%	10	7.75%
1 citation	0	0.00%	15	11.63%	15	11.63%
Total	1	0.78%	40	31.01%	41	31.78%

Since the highest number of articles received between 1 and 5 citations in Panel A of Table 8, Panel B displays articles receiving this number of citations in more detail. From 1994 to 2005, only 1 article is cited, receiving 5 citations (0.78% of my search). From 2006 to 2016, 40 articles are cited (31.01%). The main group, with 15 articles, receive 1 citation (11.63%).

Table 9 displays information on the eight articles receiving above 100 citations connecting searches using keywords "value relevance" and "fair value" in WoS over the period 1994-2016. The article with more citations is Holthausen and Watts (2001), with 374 citations and published in the JAE. In this article authors critically assess that the value relevance literature has had little impact on financial accounting standard setting, since the literature does not seek to develop a descriptive theory of accounting and standard setting.

The second article by number of citations is Barth, Beaver and Landsman (2001), with 291 citations, also published in the JAE. This paper, in contrast to Houlthausen and Watts (2001), concludes that value relevance research provides insights into questions of interest to financial accounting standard setters and summarizes a subset of value relevance research related to FV accounting. In particular, they clarify several misconceptions. First, value relevance research provides insights into questions of interest for standard setters and other non-academic constituents. Second, the FASB and other standard setters focus on equity valuation. Although financial statements have a variety of applications beyond equity valuation, the uses of financial statements do not diminish the importance of value relevance research. Third, empirical implementations of extant valuation models can be used to address questions of value relevance despite their simplifying assumptions. Fourth, value relevance research can accommodate conservatism and can be used to study its implications for the relation between accounting amounts and equity values. Fifth, value relevance studies are designed to assess whether particular accounting amounts reflect information that is used by investors in valuing firms' equity, not to estimate firm value. Sixth, value relevance research employs well-established techniques for mitigating the effects of various econometric issues that arise in value relevance studies.

The third article is Barth, Kasznik and McNichols (2001), with 225 citations and published in the JAR. This study examines the relation between analysts' incentives to cover firms and the extent of their intangible assets, because intangible assets are typically unrecognized and estimates of their fair values are not disclosed. As predicted, they find that analyst coverage is significantly greater for firms with larger research and development and advertising expenses relative to their industry, and for firms in industries with larger research and development expense. They also predict and find that analyst coverage increases with firm size, growth, trading volume, equity issuance, and perceived mispricing, and decreases with the number of analysts employed by the brokerage houses. These findings indicate that analyst coverage depends on private benefits and costs of covering a firm.

Table 9. The eight articles receiving more than 100 citations ranked by citations of articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016.

Author/s	Year	Title	Journal	Citations	Average citation/year
Holthausen, RW Watts, RL	2001	The relevance of the value-relevance literature for financial accounting standard setting	JAE	374	22
Barth, ME Beaver, WH Landsman, WR	2001	The relevance of the value relevance literature for financial accounting standard setting: Another view	JAE	291	17.12
Barth, ME Kasznik, R McNichols, MF	2001	Analyst coverage and intangible assets	JAR	225	13.24
Barth, ME	1994	Fair value Accounting: Evidence from investment securities and the market valuation of banks	TAR	148	6.17
Laux, C Leuz, C	2009	The crisis of fair-value accounting: Making sense of the recent debate	AOS	144	16
Hung, M Subramanayam, KR	2007	Financial statement effects of adopting international accounting standards: the case of Germany	RAS	134	12.18
Barth, ME Beaver, WH Landsman, WR	1996	Value-relevance of banks' fair value disclosures under SFAS No 107	TAR	129	5.95
Ryan, SG	2008	Accounting in and for the Subprime Crisis	TAR	106	10.7

Abbreviations: AOS = Accounting, Organizations and Society; JAE = Journal of Accounting and Economics; JAR = Journal of Accounting Research; RAS = Review of Accounting Studies; and TAR = The Accounting Review.

The fourth article in citations and the oldest article appearing in my keywords search is Barth (1994), with 148 citations and published in the TAR. This study investigates how disclosed FV estimates of bank's investment securities and securities gains and losses are reflected in share prices in comparison with HC, to determine which is more relevant and reliable to investors for valuing bank's equity. This research finds that FV estimates of investment securities provide significant explanatory power beyond that provided by historical costs. Using a measurement error model, investment securities' fair values are found to have less measurement error than historical costs regarding the amount reflected in share prices. The findings for securities gains and losses are different. The significance of any incremental explanatory power for fair values beyond historical costs depends on the specification of the estimating equation. In some conditions, FV securities gains and losses have no significant incremental explanatory power, but historical costs always provide incremental explanatory power to fair values. The findings based on a measurement error model indicate that fair value securities gains and losses also have more measurement error than historical costs. Thus, although FV estimates of investment securities appear reliable and relevant to investors in valuing bank equity, FV securities gains and losses do not.

The fifth article with more citations is Laux and Leuz (2009), with 144 citations, and published in the AOS, which focuses on the debate about pros and cons of FV accounting after the recent financial crisis, also takes into consideration the trade-off between relevance and reliability. They highlight four issues. First, much of the controversy results from confusion about what is new and different about FV accounting. Second, while there are legitimate concerns about marking to market (or pure FV accounting) in times of financial crisis, it is less clear that these problems apply to FV accounting as stipulated by the accounting standards. Third, HC accounting is unlikely to be the remedy. The concerns about HC accounting could be larger than those with FV accounting. Fourth, accounting standards interact with other elements of the institutional framework (e.g. managers' concerns about litigation). Therefore, the implementation of FV accounting could bring problems in practice.

The sixth article is Hung and Subramanyam (2007), with 134 citations. Using a sample of German firms, they investigate the financial statement effects of adopting IAS from 1998 to 2002. They find that total assets and book value of equity, as well as variability of book value and income, are significantly higher under IAS than under German GAAP. In addition, book value and income are no more value relevant under IAS than under German GAAP, showing that IFRS has not led to a rise in the market value relevance of consolidated financial statements.

The following article is written by Barth, Beaver and Landsman, with 129 citations and published in the TAR. This study provides evidence that investors perceive FV estimates of loans, equity securities and long-term debt disclosed under SFAS 107 provide significant explanatory power for bank share prices beyond that provided by related book values.

Lastly, the eighth article by total number of citations is Ryan (2008), with 106 citations and published in the TAR, provides a detailed description of the causes and evolution of the subprime crisis for accounting. First, it overviews the institutional and market aspects of subprime mortgages, focusing on accounting relevance. Second, it discusses the critical aspects of FAS 157's FV definition and measurement guidance. It also explains the practical difficulties that have arisen in applying this definition and guidance to subprime positions during the crisis. He also raises a potential issue regarding the application of FAS 159's fair value option. Third, discusses issues that have arisen regarding sale accounting for subprime mortgage securitizations under FAS 140 and consolidation of securitization entities under FIN 46 (R) associated with mortgage foreclosures and modifications. Fourth, indicates ways that accounting academics can address the implications of the subprime crisis in their research and teaching.

2.6. Conclusions and discussion of the bibliometric analysis

This chapter performs a bibliometric analysis of articles published in academic journals by connecting searches using keywords "value relevance" and "fair value" in WoS over the period 1994-2016. Given that to my knowledge no previous study has published a bibliometric analysis in this issue, it can be considered a contribution to the academic accounting community for examining articles published in a wide range of journals and presenting the results by considering different indicators or tools that are used in current research.

This study reveals that the subject of the search is currently of interest in the literature, as shown by the high number of articles published during the last years of the search. The number of articles published has increased over the years studied, which suggests that interest in the subject of my keywords search has increased in the last years. The most common method employed is archival (48% of my search), the financial accounting is the topic area with more publications (82%), and "business, finance" is the main JCR category (73%). The journals with the most articles published in my keywords search are TAR (19 articles), JAE (12), ABR (11) and RAS (10). However,

JAE (1095 citations) and TAR (882), presents the most cited articles in my keywords search, followed by JAR (284) and RAS (203). Among this group, JAE becomes the most influential journal and gets the best results likely due to belonging to the Economics and "Business, Finance" JCR category. In 2016, there are 18 journals considered in the JCR accounting category that published articles on the subject of my keywords search. Considering that only 23 were considered accounting journals in 2016 in WoS, the accounting field is scarcely represented. Consequently, this low number of journals implies a low number of citations of accounting articles. Only one article out of the 129 found in my keywords search has received more than 300 citations and two articles more than 200 citations, while compared to other related fields, usually several articles have more than 1000 citations and many are above the 500 citations. The eight articles receiving over 100 citations in my keywords search, ordered by the number of citations received, are: Holthausen and Watts (2001); Barth, Beaver and Landsman (2001); Barth, Kasznik and McNichols (2001); Barth (1994); Laux and Leuz (2009); Hung and Subramanayam (2007); Barth, Beaver and Landsman (1996); and Ryan (2008). The author with the highest number of articles found in my keywords search is Mary E, with 8 articles. She is also the most cited authors, with 949 citations. It is worth highlighting that her main line of research is close to the subject studied. Further, authors with two or more articles published represent 13% of authors in my keywords search, and by contrast, more than 87% of the authors published only one article. Lastly, 42% of the articles found in my keywords search was written by three authors.

The findings of my bibliometric analysis are useful and helpful to both academics and practitioners for obtaining a general overview of the state of the art in accounting research according to some key indicators that are currently used in the literature. It is through my keywords search that I find the most relevant articles, authors and journals. Nevertheless, my study has some limitations. First, the objective of the analysis is to identify important articles found in my keywords search. However, articles that are not collected in WoS are not included in this study. There are possibly some journals that published articles related to the subject of my keywords search during the period studied, but they were not included in WoS. Another example would be that not many publications in non-English languages are included in WoS. Consequently, some authors do not receive many citations due to the subject of my keywords research being highly specific and/or they do not publish many articles related to the keywords of my search. Secondly, it was necessary to chart the field and analyse the community, so different information was presented by several rankings. However, these are not conclusive results. They are simply being informative based on bibliometric data found in my keywords search and for a specific period. Third, other relevant information in the evaluation of research is difficult to quantify, including the author's work in journals, conferences, promotion of specific research worldwide and numerous other related issues.

As a result, this chapter only provides general and useful information that helps to understand the specific subject of accounting, but other concerns should be considered in order to get a complete picture. Therefore, an interesting avenue for future researches would be to extend the bibliometric analysis with other databases to provide a more complete picture of the relevant research using the keywords in my search. Most bibliometric analyses are performed using WoS as a data source. However, there is an increasing trend of bibliometric analyses expanding their corresponding data analysis to other recognised scientific data sources, such as SCOPUS and Google Scholar. For example, Rosenstreich and Wooliscroft (2009) used the Google Scholar database to measure the impact of accounting journals. Martínez-Blasco et al. (2016) examine factors that could contribute to explain the citation impact of articles published in the Spanish Journal of Finance and Accounting during 2008–2013 using WoS, Scopus and Google Scholar database. In this vein, an interesting avenue for future research would be to expand the bibliometric analyses using the keywords of my search to SCOPUS and/or Google Scholar. Scopus is a larger interdisciplinary database from Elsevier that covers a wider range of accounting journals and contains more recent articles. The Google Scholar database has interdisciplinary coverage and allows users to search for a wider variety of materials.

CHAPTER 3. LITERATURE REVIEW AND HYPOTHESES OF THE EMPIRICAL ANALYSIS ON THE PREDICTIVE ABILITY OF BIOLOGICAL ASSETS MEASURED AT FAIR VALUE

3.1. Literature review of the empirical analysis on the predictive ability of biological assets measured at fair value

In this chapter I present the literature review on the relevance of the accounting information measured at FV. The reform of the accounting standard towards FV accounting has created intense debate in the last few decades. The most important accounting setters and institutions, such as the IASB and the FASB have encouraged the convergence of international accounting towards standards based on market prices. In spite of this trend towards FV, there is a lack of agreement between academics and practitioners about the advantages and disadvantages of moving from HC to FV accounting. This controversy shows the need to provide empirical evidence on the existing academic discussion about the value relevance of FV accounting.

The remainder of this chapter is organised as follows. First, I examine previous empirical studies on the value relevance of accounting information measured at FV, focusing on the predictive power of FV and especially on predicting future cash flows. Most of the empirical studies on the value relevance of accounting information analyse the statistical association between the accounting numbers and firms' market values, focusing on the valuation of financial instruments and using samples of firms in the financial industry (i.e. Barth, 1994; Barth, Beaver, and Landsman, 1996; Eccher, Ramesh and Thiagajaran, 1996; Nelson, 1996). However, few previous studies directly or indirectly tested the predictive ability of FV accounting information for predicting future cash flows (Chen, Cooper and Gardner, 2006; Argilés, García-Bladón and Monllau, 2011). Second, I study the standardization in agricultural accounting, describing relevant regulations on international accounting standards and particularly focusing on the IAS 41 *Agriculture*. The agriculture sector historically received little attention from the international accounting standard setters. The standard setters considered the agricultural activity different from other activities performed. The specific methodical treatments of the recognition and reporting biological assets, biological transformation and agricultural produce, reflected the particularity. The standardisation of the agricultural reporting practices within and between countries facilitated the comparison between agricultural firms. As a result, the IAS 41 *Agriculture,* issued in 2000 by the IASB, required biological assets and agricultural produce valued at FV. The aim of this standard was to be the guidance for the application of specific accounting methods, enabling accounting users the practical implementation of the standard, and finally improve comparability of agricultural companies' financial statement. Third, I analyse previous academic research on the IAS 41 with the objective to identify the impact and areas of concern of its application for European and non-European agricultural entities (e.g. Argilés and Slof, 2001; Elad, 2004; Herbohn and Herbohn, 2006). The overall perception of previous

empirical research on the benefits of IAS 41 is somewhat inconsistent. On one hand, there is a lack of agreement about the benefits and weaknesses of moving from HC towards the fair valuation for biological assets. On the other hand, regarding the implementation guidance of this standard previous literature shows several problems, including the revenue recognition, income measurement, accounting relevance, earnings manipulation, and international comparability. Fourth, I examine the scarce prior research on the value relevance of accounting information measured at FV for biological assets, and particularly on studies analysing the value relevance of FV for biological assets to predict future cash flows (He, Wright and Evans, 2011; Argilés, Garcia and Monllau, 2011). Lastly, supported by prior research, I present the two alternatives hypotheses of the empirical analysis on the predictive ability of biological assets measured at FV.

3.1.1. Value relevance of accounting information measured at fair value

Previous empirical studies on the value relevance of accounting information analyse the statistical association between the accounting numbers and firms' market values (i.e. Barth, 1994; Barth, Beaver and Landsman, 1996; Eccher, Ramesh and Thiagajaran, 1996; Nelson, 1996). They usually analyse the valuation of financial instruments and use samples of firms in the financial industry. The empirical evidence gathered by prior literature does not always support the higher relevance of FV over HC in valuing financial instruments or banks' assets and liabilities. For instance, Barth (1994) and Barth, Beaver, and Landsman (1996) found evidence that FV estimates of banks' investment securities, loans and long-term debts provide significant explanatory power for bank share prices beyond that provide by HC values, while in a similar study Nelson (1996) noticed no reliable evidence of incremental explanatory power for the FV disclosures of bank loans, deposits, long-term debt or net off-balance-sheet financial instruments with respect to HC. Eccher, Ramesh and Thiagajaran (1996) reported that FV of investment securities are value-relevant. However, they found mixed evidence for other financial instruments such as net loans, deposits and off-balance-sheet financial instruments. On the other hand, Barth and Landsman (1995) concluded that when assets are trade in a market that is perfect and complete, FV is relevant, but when FV is not clearly defined by an unambiguous market, neither the balance sheet nor income statements fully reflect all value-relevant information and management discretion can detract from its relevance. Danbolt and Rees (2008) found that FV income is considerably more value relevant than HC income, but once the model is extended from an earnings-only model to one that

controls the change in the equity, the differences in the explanatory power of the models based on HC and FV accounting are not significant. That is, according to their findings, the FV is consistently more value relevant than HC, although this value can be convey via asset values (more precisely via the revaluation element which adjusts HC to FV) and need not be incorporated into income computations.

Empirical accounting research analysing the predictive power of FV estimates is scarce. Related to this issue, Liang and Riedl (2014), comparing a sample of UK and US real-estate firms which applied FV and HC valuations respectively, found that FV enhanced analysts' ability to forecast net asset value, but it reduced their ability to forecast net income. Evans, Hodder and Hopkins (2014), with a sample of US financial institutions found that FV adjustments for investment securities have predictive ability for subsequent realise income, as well as for bank's share prices. Campbell (2015) found a negative relationship between unrealised cash flow hedge gains/losses and future gross profit with a sample of non-financial US firms, thus suggesting that FV impairs the predictability of future performance.

The empirical research analysing the influence of FV on predicting future cash flows is also scarce. Aboody, Barth and Kasznik (1999) examined the performance prediction and pricing implications of fixed asset revaluations for a sample of UK firms for the period 1983-1995. Their findings show that upward revaluations are significantly positively related to changes in future operating income and cash flows from operations. Using a sample of New Zealand benefit pension plans, Laswad and Baskerville (2007) found that while current cash flows from operations are significantly and positively correlated with realised earnings, they are not associated with unrealised earnings disclosed under FV, but these authors do not analyse the influence of FV on future cash flows. Moreover, they merely perform a univariate analysis. Bratten, Causholli and Kahn (2012) found that current period pre-tax earnings of US banks that report a greater proportion of their assets and liabilities at FV have a stronger positive association with next period cash flows, as well as two-years and three-years future cash flows. They did not find enhanced association between current period pre-tax earnings and one-year future pre-tax income for banks that report a greater proportion of their assets and liabilities valued at FV, but they found this enhanced association with respect to two-year and three-year future pre-tax earnings. Chen, Cooper and Gardner (2006) found that the predictive ability of accounting data for future cash flows has not increased for US firms from 1984 to 2003, despite the standards move towards FV accounting. They also found that the correlation between market data and future cash flows is significantly lower than the correlation between current accounting data and future cash flows. They concluded that FV accounting may have reduced the predictive ability of financial reporting for future cash flows over this period.

3.1.2. Standardization in agricultural accounting

The objective of financial reporting is to provide financial information about the reporting entity that is useful to existing and potential investors, lenders and other creditors in making economic decisions (IASB, 2015). The content and form of these financial reports is regulated by accounting standards, and accounting standards have been the domain of national governments and accounting organizations within a particular country. The complexity of conducting international business operations across national borders started in the 1960s and 1970s, where each nation with a different set of business regulations and different accounting methods, presented a challenge for accountants and professional bodies that establish accounting and auditing standards. In addition, a diversity of applicable accounting, auditing and tax standards and regulations showed a negative impact on enterprises' abilities to prepare reliable financial information necessary for both reporting and their stakeholders.

As a result of the globalisation of capital markets, the financial reporting practices were harmonised and internationalised (Henderson, Peirson and Herbohn, 2006). The fundamental argument was that a common set of standards would increase the comparability of reports based in different countries but traded in the same market (Whittington, 2005). This would also increase the global investment, as users of financial reports would have the same understanding of the financial information presented. In response, the IASC, which was formed in 1973, and replaced in 2001 by the IASB, developed a set of IAS, which will produce high-quality financial information to help participants in the world's capital markets to make economic decisions.

In the agricultural sector, the attempts to find an accounting model for the sector were diverse at both national and international levels. Previous guidance for agricultural accounting could be found from the American Institute of Certified Public Accountants (AICPA, 1995) and the Canadian Institute of Chartered Accountants (CICA, 1986). Both standard setters considered HC as the main reference for asset valuation except in rare circumstances where realisable value may be considered as an alternative. In Europe, the Farm Accountancy Data Network (FADN) established by the European Commission in 1965 developed general procedures and detailed guidelines for farm accounting. Also, the French 'Plan Comptable Général Agricole' (PCGA) since 1986 set up standards for certain agricultural assets and gave detailed guidelines for the accounting of agricultural transactions and the presentation of financial statements. In Australia, the accounting for biological assets was undertaken in accordance with Australian Accounting Standards Board (AASB) 1037 'Self-generating and Regenerating Assets' since June 2001. However, the first important and broad international standard was issued by

the IASB. In 1996, the Draft Statement of Principles settled out the issues, forms and alternatives to this standardization. In July 1999, the Exposure Draft E65, named as *Agriculture*, was published and submitted to financial information user appreciation until 31 January 2000. The IAS 41 *Agriculture* finally appeared in February 2001. The release of the standard changed agricultural accounting from a domestic issue to a global one. This standard was necessary due to the lack of accounting guidelines in the field of agriculture, the growing demand for financial information by the financial institutions that provided resources to agricultural enterprises, the increase of agriculture at international level, and the big importance of agricultural activities in the economy of many countries (Vera, 2004). In July 2003, the European Commission approved the requirement for the use of IAS's from 2005 in the group accounts of all companies listed on European stock exchanges. This regulation also applied to members of the European Economic Area, and Member States were given discretion to apply this requirement to a wider group of companies and their accounts (Whittington, 2005).

Other standards are based on the IAS 41 after its application. The AASB 141 *Agriculture* applies since 1 July 2009 with the objective to prescribe the accounting treatment and disclosures related to agricultural activity. This standard incorporated IAS 41 issued by the IASB, including some Australian-specific paragraphs (which are not included in IAS 41). The International Public Sector Accounting Standards (IPSAS) 27 *Agriculture*, issued by the International Public Sector Accounting Standards Board (IPSASB) and effective since 1 April 2011, also prescribes the accounting treatment and disclosures related to agricultural activity. IPSAS 27 is primarily based on the IASB's IAS 41 with limited changes dealing with public sector financial reporting issues.

3.1.2.1. International Accounting Standard 41 *Agriculture*

IAS 41 prescribes a set of rules for the registration and measurement of biological assets and agricultural produce. This standard applies to:

- ✓ biological assets with the exception of bearer plants;
- ✓ agricultural produce at the point of harvest;
- ✓ government grants related to these biological assets; and
- ✓ produce growing on bearer plants.

IAS 41 does not apply to the following elements:

- ✓ land related to agricultural activity (see IAS 16 *Property, Plants and Equipment* and IAS 40 *Investment Property*);
- ✓ bearer plants related to agricultural activity (see IAS 16);
- ✓ government grants related to bearer plants (see IAS 20 *Accounting for Government Grants and Disclosure of Government Assistance*);
- ✓ intangible assets related to the agricultural activity (see IAS 38 *Intangible Assets*).

The objective of IAS 41 is to regulate accounting treatment, representation in financial statements and the disclosure of agricultural activities. Specifically, IAS 41 defines agricultural activity as the management of an entity of the biological assets for sale, into agricultural produce, or into other biological assets.

Agricultural activity is distinguished by the management of biological transformation. The biological transformation comprises the processes of growth, degeneration, production, and procreation that cause qualitative or quantitative changes in a biological asset. While the biological assets represent living animals or plants, the agricultural produce represents the harvested product of these assets, such as milk, wool, meat, fruits or cereals. It is important to note IAS 41 applies to the harvested products, obtained during the agricultural activity from the biological assets, only at the point of harvest. After harvest, agricultural produce becomes inventory (prescribes the application of IAS 2 *Inventory*). IAS 41 does not deal with the accounting for bearer plants, which are in accordance with IAS 16 *Property, Plant and Equipment*.

IAS 41 defines special criteria for the recognition of the biological assets and of agricultural production. An entity shall recognise in assets if and only if:

- ✓ the asset is controlled by the entity as a result of past events;
- ✓ it is probable that future economic benefits associated to the asset will flow into the entity; and
- ✓ the FV or cost of the asset can be measured reliably.

The measurement of the biological assets at their initial recognition and at each balance date will be made at FV less costs to sell at the point of harvest, except for the case when the FV cannot be measured reliably.

In determining FV, the entity uses the quoted price in the most relevant active market. If the value is not available, the entity uses one or more of the following, when available, in determining FV:

- ✓ the most recent market prices of some similar assets, proving that since then there has not been a significant change of economic circumstances;
- ✓ market prices for similar assets, the difference being treated through adjustments; and
- ✓ sector benchmark, where the value is determined through recalculated production measures.

This standard clearly states that the FV used should be the most reliable value. When an entity has to use estimations, it will determine the most reliable estimation from a small interval of reliable estimations. However, if FV cannot be measured and there are no comparable prices, the FV minus the estimated point-of-sale costs is determined by the discounted value of the cash flows.

3.1.3. Academic research on IAS 41 *Agriculture*

Since its issuance the IAS 41 has been subject to academic interest that tried to evaluate the impact of its implementation. Some researchers published articles criticising fair valuation for biological assets and indicated some areas of concern in the application of the IAS 41. Elad (2004) complained that the lack of active markets for most biological assets makes its application difficult, and that even with active markets, its application may be excessively costly, particularly in less developed countries. Despite these active markets, Arimany, Farreras and Rabaseda (2013) stated that Spanish agricultural enterprises do not apply FV of biological assets because they are unable to determine a reliable value or estimation. Fisher, Mortensen and Webber (2010) analysed the adoption of IAS 41 in New Zealand (classified as a common law country) and concluded that the absence of an active market can lead to the use of discounted cash flow models that generate results of questionable quality due to the diversity of premises. However, proponents of FV for the biological assets argue that

it is easy for users of accounting information to understand financial statements, when there are active markets (Azevedo, 2007).

The requirement of the inclusion in the income statement of any unrealised gains or losses arising from changes in FV of biological assets measured at reporting period is an additional criticism to IAS 41. Penttinen et al. (2004) claimed that fair valuation would cause unrealistic fluctuations in the net profits of forest enterprises. Moreover, any change in FV recognised immediately in the profit or loss leads to higher volatility of annual results, and consequently higher risk of income prediction for the users of the financial statement (Lefter and Roman, 2007). However, Elad (2004) argued that the inclusion of these gains and losses reflect the efforts of managements' stewardship of biological assets over the period. Azevedo (2007) empirical study concluded that the adoption of FV would result in a positive impact on earnings in the Portuguese accounting system, particularly in the wine-growing sector. This will lead to a rise in the companies' gains, since standardization establishes that FV's fluctuations shall be included on the result of operations over the period in which it arises. Lefter and Roman (2007) concluded that recognising in the income statement the changes in value due to the transformation process will improve relevance of the agricultural financial statements for decision-making process. In this vein, the valuation of biological assets at FV allows a more precise assessment of future economic benefits embodied in biological assets than their valuation at HC (Bohušová, Svoboda and Nerudová, 2012).

The variety of methods of measurement of FV in conformity with the IAS 41 is an impediment to the comparability of financial information across the countries and sectors. Elad and Herbohn (2011) found that companies that operate in the same region use fundamentally different methods of measurement of FV for valuing the same type of biological asset. This concern is shared by George (2007), who deems FV of biological assets rely on too many estimates and opinions that impacts accounting information, auditing opinion, and creates confusion. In contrast, PricewaterhouseCoopers (2009) study highlighted similarities in the application of FV accounting to forest owning companies within and across regions, but it has shown that many judgments are necessary to arrive at FV.

Furthermore, Gabriel and Stefea (2013) argued that IAS 41 must be carefully analysed according to the impact of production forecast in accounting, to the impact of FV measurement over cash flows, and also to the possibility for firms to use accounting in their own interests. Firstly, crop production depends on climatic conditions, where relevant FV that is achieved today given specific assumptions could not be the same on another day. Secondly, FV changes along different periods could imply recognition of gains, and overall, it could determine a loss at the point of harvest. Finally, with

regard to the diversity of fair valuation models, managers could choose a specific measurement in order to serve their own interests.

In Australia, Herbohn and Herbohn (2006) evaluated the impact of IAS 41 in the forestry sector of the Australian Accounting Standard Board (AASB) 1037 (requiring FV for biological assets). They identified some negative effects: the subjectivity of FV measurement reduces the reliability of reported information, increases volatility of reported income, and the inclusion of unrealised gains in net annual profit make available the possibility of manipulation. Dowling and Godfrey (2001) also found that firms utilise the net market value method due to the non-existence of active and liquid markets, or firms simply prefer not to use this method of measurement. Booth and Walker (2003) concluded that the application of AASB 1037 has resulted in misleading financial statements and a reduction in the presentation of relevant financial information. Specifically, they described practical difficulties associated with separating the value of biological assets from related assets. The unpublished paper by He, Wright and Evans (2011) dealt with three different FV approaches: level 1 (unadjusted quoted market prices in active markets for identical items), level 2 (adjusted quoted market prices in active markets for similar items or in inactive markets for identical items) and level 3 (firm-supplied estimates, using a discounted cash flow method for example). Using a sample of Australian firms holding biological assets from 2001 to 2009, they only found predictive power for FV under level 3, but not under levels 1 and 2. They concluded that FV accounting for agricultural assets does not provide useful information to investors for decision-making. Standard setters should reconsider the implementation of FV for biological assets, or additional disclosure requirements should be considered to improve the quality of financial reporting.

Other relevant empirical studies show a positive impact of IAS 41 and advantages of FV recognition in international agricultural reporting. Argilés and Slof (2001) argued that its application brings simplicity for the predominant small family farms, as it defines clear and simple valuations for agricultural assets, and suggest that the Farm Accountancy Data Network (FADN) procedures could be a guideline to implement IAS 41. Athanasios, Stergios and Laskaridou (2010) also stated that the FADN is an experienced data network, which procedures could be key elements to provide an informative frame for farm development policy. They concluded that the main contribution of IAS 41 is to provide a strong conceptual framework in agricultural accounting practice. Furthermore, none of the suspected drawbacks of FV were empirically confirmed. Argilés, Garcia and Monllay (2011) concluded that FV does not imply gain volatility, and assures a higher predictive power of future earnings. Consequently, FV allows anticipating financial problems and the improvement in the precision of results mitigates agency problems, as managers are more perceived as specialised accountants. They analysed the impact of using FV of biological assets,

considering a sample of approximately 500 Spanish agricultural firms. However, results are subject to limitations including the quality of the accounting information disclosed by small firms, and the small subsample of farms using fair valuation.

3.1.4. Value relevance of accounting information measured at fair value for biological assets

Prior research on the usefulness and convenience of FV for biological assets and agriculture is also scarce and controversial. Argilés and Slof (2001) observed that general accounting rules did not adapt to the particularities of farming. Suggesting that with further instruments and using the FADN procedures, the implementation of IAS 41 could improve the use of accounting in European farms. This standard defines clear and simple valuations for agricultural assets and the presentation of the financial statements is less complicated than HC. They found that the FV is a better measure for the valuation of biological assets and agricultural produce since it brings simplicity for the predominant small family farms in Europe, with no resources and skills to perform accounting procedures and HC cost calculations for biological assets. In contrast, opponents have focused on practical difficulties, particularly when an active market does not exist. According to Elad (2004) IAS 41 is very controversial. FV accounting can be simpler and more appropriate than HC accounting where an active market for a biological asset exists and, in some contexts, HC may be difficult to apply. However, there are other debatable reasons and some of these problems are likely to impact farm accounting practices. First, FV of a biological asset cannot always be determined reliably. The use of subjective judgement by practitioners might result in different treatments that impede comparability and harmonization. Second, the notion of FV into French PCG model and its variants in Francophone Africa will disrupt its philosophy and conceptual framework. Showing that in a wide international context the application of IAS 41 is difficult in different national settings. Third, the annual revaluation of biological assets at FV might be difficult and expensive, particularly in developing countries. Fourth, there are some inconsistencies between the EU Fourth Directive and the provisions of IAS 41. Fifth, the limited use of net market value measurement by firms reflected the lack of information systems capable of detecting reliable net market values. This was identified as an impediment to the implementation of the AASB 1037 and for this reason its application was delayed. Sixth, it would be difficult to apply IAS 41 in the forestry industry in many tropical countries where forest companies secure rights to operate over an agreed period. The IAS 41 requirement that changes in FV of biological assets to be taken

to income could lead a company to record huge profits arising from substantial unrealised holding gains on initial recognition of the FV of assets within its concession.

Other studies did not analyse the value relevance of FV accounting for biological assets, but they associated accounting information with the performance of the farm. Argilés and Slog (2003) provided empirical evidence on the relationship between the use of financial reports and financial performance. They concluded that the financial performance of farmers using the financial reports for decision-making purposes was significantly better than those ones who did not use the reports. Suggesting that managers will benefit from using the financial reports, if the expected gain in performance is larger than the costs of obtaining the reports. Using a sample containing viable and non-viable Catalan farms, Argilés (2001) found that accounting information added significant information to predict the viability of a farm. Findings of these two prior articles suggest that the quality accounting information affects the management and future predictability of agricultural businesses. According to Argilés, Sabata-Aliberch and García-Blandón (2012), farmers and accountants operating in the agricultural sector in Spain have more difficulties in understanding and using HC accounting than in FV accounting. They also compared the reliability of the two valuation methods in the decision-making process. Given the complexities of cost calculation for biological assets and the predominance of small family business, they conclude that accounting in the agricultural sector can be more easily applied and more accurately reflect the real situation of a farm under FV accounting.

To our knowledge, there are only two empirical articles testing the ability of accounting data, when biological assets are measured at FV, to predict future cash flows. He, Wright and Evans (2011) investigated whether the use of FV accounting in the agricultural sector is consistent with the objective of general purpose financial reporting, by assessing the ability of fair values to explain and to forecast future cash flows. As mentioned previously, using a sample of Australian firms holding biological assets from 2001 until 2009, they only found predictive power for FV under level 3, but not under levels 1 and 2. Accordingly, FV accounting for biological assets have the ability to explain but do not provide useful information in relation to forecast future cash flows. The results suggest the need for accounting standard setter to reconsider the continued implementation of FV accounting in the agricultural sector. However, they did not compare the predictive power of FV accounting for biological assets with respect to HC. They also recognised that given that the AASB 141 requires FV in Australia from 2004 onward, the global financial crisis and the subsequent volatility of market prices may have affected their results on the predictive power of FV over their sample period. Using a sample of Spanish farms valuing biological assets at HC and another sample applying FV, Argilés, Garcia and Monllau (2011) developed an empirical study comparing the predictive power of FV versus HC

valuation with respect to income and future cash flow. They found no significant differences between both valuation methods in relation to assessing future cash flows. Consequently, there is no difference in the relevance of accounting information. In contrast, their results show higher predictive power of future earnings under fair valuation of biological assets. There are no significant differences in earnings, revenues and profitability volatility that could influence any difference in predictive power. None of the alleged drawbacks of FV have been empirically confirmed by this research. They also found evidence that FV has the advantage of simplicity, when market values are available, considering the complexities of cost calculations in the predominant small business in the agricultural sector. Their empirical research supported that FV requires a no less consistent valuation method with respect to HC, as well as reliable and comparable sources of information. However, the small subsample of farms applying FV is a limitation of this study. Further research with wider samples, segmented by small and big agricultural business, and different countries is needed.

3.2. Hypotheses of the empirical analysis on the predictive ability of biological assets measured at fair value

While the empirical research on accounting relevance is inconclusive, most arguments support the greater predictive ability of FV. Proponents of FV argued that it is relevant for decision-making as it provides the most up-to-date assessments, and not simply report the past (Damant, 2001). They also argued that market efficiency would be enhanced when decisions are taken upon information reported at FV (CFA 2007, p. 8). While cost-based measures reflect only the effects of conditions that existed when the transactions took place, and under HC the effects of price changes are reflected only when the assets or liabilities are realised or settled, FV provides more updated information. In this vein, FV embodies the market's expectation with respect to a specific asset or liability, thus conveying a more appropriate assessment to forecast future cash-flows than HC. If an investor or stakeholder knows the FV of a specific asset or liability, he or she has the basics for evaluating the market's expectations.

On the contrary, cost-based measures only enable extending the effects of past costs to the future. As argued by Liang and Riedl (2014), reporting of accounting numbers at FV improves the information environment by revealing managers' expectations of firms' ability to generate future cash flows. According to them, FV reporting should

reveal management private information regarding estimates of the underlying firms' value and increase the precision of forecasts. In the same vein, Barlev and Haddad (2003) argued that, because of giving priority to reliability and conservatism, HC accounting is a source of irrelevance that obscures the true performance of the firm, while FV accounting figures provide information allowing the assessment of potential payments and risks of default. By definition, FV refers to what could have been earned in the market, including the expected future income caused as result of holding an asset or liability (Evans, Hodder and Hopkins, 2014).

As for biological assets, HC fails to appropriately assess the economic value of biological transformations. While it does not report revenue and current values until the maturing, harvest and sale of biological assets, FV reflects any current biological transformations in accounting figures, thus providing updated and advantageous information for predicting future cash flows with respect to HC. Argilés, Sabata-Aliberch and García-Blandón (2012) found that FV encourages better judgements and more accurate income calculations among accountants operating in the agricultural sector. The interviews with students, farmers and accountants exposed flawed accounting practices in the agricultural sector in Spain in order to meet HC accounting requirements. On the contrary, critics of FV claimed that it bears little association with future cash flows because the recognition of gains and losses is driven by short-term market influences rather than by reliable income incurrence (Chisnall, 2001). The resulting information provided by fair values would not give a better insight into the management of the business, as large commercial banks could not realise directly the difference between the carrying value and the FV of its loan book. Plantin and Sapra (2008) warned that FV may degrade its informative content by incorporating purely speculative price fluctuations. Their parsimonious model shows that FV overcomes short-term price movements causing inefficiency, and also distorts this information for illiquid assets such as loans and insurance liabilities. Consequently, accounting numbers at FV are more volatile, and volatility is a source of confusion and forecast error. The fact that FV may be subject to more measurement noise and managerial manipulation add disadvantages to the efficient use of accounting information in investment efficiency and forecasting (Liang and Wen, 2007). In this vein, Liang and Rield (2014) empirical results confirmed that FV changes are inherently unpredictable due to their low serial correlation. Therefore, full FV reporting will reduce the accuracy of analysts' income statement-based forecasts, owing to increase the difficulty of forecasting firm's net income when it incorporates unrealised gains and losses. This may be particularly important in the agricultural industry, characterised by a volatile environment due to special and increasing unpredictable climate and market conditions (European Parliament, 2016; FAO et al, 2011). Subsequently, the valuation of biological assets at FV is a source of confusion for the prediction of cash flow.

Few empirical studies analysed the predictive power comparing FV and HC accounting valuation methods. Chen, Sommers and Taylor (2006) tested the predictive power of FV, finding that it reduces the ability to predict future cash flows. However, they study this relation indirectly, comparing the association between accounting numbers and future cash flows over time, assuming that accounting has been evolving to FV. Kim and Kross (2005) found an increasing relationship between earnings and one-year-ahead operating cash flows over time, but they attribute it to the increasing conservatism in accounting rather than to the influence of fair valuation. Related to these issues, Beaver, Mchnichols and Rhie (2005) found a small decline in the ability of financial ratios to predict bankruptcy from 1962 to 2002, and an incremental explanatory power of market-related variables over this period. They explained that the deterioration in predictive ability of financial ratios in terms of an insufficient improvement of FASB standards.

Given that there are no conclusive arguments and that the empirical research on the relative ability of FV and HC valuation to predict future cash flows is also inconclusive, I have no defined stance on this issue and formulate the following two alternative hypotheses:

Hypothesis 1. Measurement of biological assets at FV is associated with lower cash flow prediction accuracy (i.e. with higher prediction inaccuracy) than measurement at HC.

Hypothesis 2. Measurement of biological assets at FV is associated with higher cash flow prediction accuracy (i.e. with lower prediction inaccuracy) than measurement at HC.

CHAPTER 4. METHODOLOGY OF THE EMPIRICAL ANALYSIS ON THE PREDICTIVE ABILITY OF BIOLOGICAL ASSETS MEASURED AT FAIR VALUE

4.1. Empirical model

The main purpose of this study is to examine the influence exerted by biological assets measured at FV, as compared to HC, on the ability of accounting data to predict future cash flows. We focus on cash flows from operations (CFO). We use Equation 1, where the dependent variable prediction inaccuracy (*PI)* is a proxy for the (in)ability to predict future CFO: the difference between the real operating cash flow figure and its prediction based on accounting information. It depends on the use of FV versus HC, in valuing the biological assets (*FVB*), but also on additional control variables, such as the valuation method for financial instruments (*FVF*), the importance of biological assets in total assets (*BIOTA*), revenue volatility (*CREV*), size (log*TA*), the specific context of the financial crisis (*CRISIS*), the institutional context (*ZONE*), and type of farming (*TYPE*). I also include interaction terms with *FVB* in order to analyse the likely existence of opposite influences (moderating or stressing effects) on these control variables, thus formulating the following equation:

$$PI_{j,t} = \beta_0 + \beta_1 \cdot FVB_{j,t-1} + \beta_2 \cdot FVF_{j,t-1} + \beta_3 \cdot BIOTA_{j,t-1} + \beta_4 \cdot CREV_{j,t-1} + \beta_5 \cdot \log TA_{j,t-1} + \beta_6 \cdot CRISIS_{j,t-1} + \beta_7 \cdot FVB_{j,t-1} \cdot BIOTA_{j,t-1} + \beta_8 \cdot FVB_{j,t-1} \cdot CREV_{j,t-1} + \beta_9 \cdot FVB_{j,t-1} \cdot \log TA_{j,t-1} + \beta_{10} \cdot FVB_{j,t-1} \cdot CRISIS_{j,t-1} + \sum_z \beta_z \cdot ZONE_{j,t-1} + \sum_k \beta_k \cdot TYPE_{j,t-1} + \varepsilon_{j,t} \quad (1)$$

where each variable refers to a given firm *j* and year *t*, *z* and *k* are the number of dummies for geographical areas and types of farming (3 and 5), respectively. For simplicity I use the same variable indicating the error term in all equations used in this paper.

I replicate different methodologies for the examination of the dependent variable. I build it with the residuals from several prediction models. I first start from Altamuro and Beatty's (2010) model assessing earnings' ability to predict future CFO, and make it suitable for our specific characteristics. Bratten, Causholli and Khan (2012) also used a similar model. Accordingly, I formulate the following model for predicting future *CFO*:

$$CFO_{j,t} = \alpha_0 + \alpha_1 \cdot ROA_{j,t-1} + \alpha_2 \cdot \log TA_{j,t-1} + \alpha_3 \left(ROA_{j,t-1} \cdot \log TA_{j,t-1}\right) + \varepsilon_{j,t} \quad (2)$$

where return on assets (*ROA)* at a given period *t* is pre-tax income (*INC*) during year *t* scaled by total assets (*TA)* of year *t*-1. To investigate the efficiency of cash flows, I also use a variant of this model scaling *CFO* during year *t* scaled by *TA* of year *t*-1:

$$\frac{CFO_{j,t}}{TA_{j,t-1}} = \gamma_0 + \gamma_1 \cdot ROA_{j,t-1} + \gamma_2 \cdot \log TA_{j,t-1} + \gamma_3 \cdot \left(ROA_{j,t-1} \cdot \log TA_{j,t-1}\right) + \varepsilon_{j,t} \quad (3)$$

Additionally, I examine whether asset measurement linked to asset use influences the ability of a mechanical forecasting model of firm's future CFO. Similarly to Huffman (2013), I use the following adaptation from Barth, Landsman and Lang's (2012) model:

$$\frac{CFO_{j,t}}{TA_{j,t-1}} = \theta_0 + \theta_1 \cdot \frac{CFO_{j,t-1}}{TA_{j,t-2}} + \theta_2 \cdot \frac{NIURB_{j,t-1}}{TA_{j,t-2}} + \theta_3 \cdot \frac{URB_{j,t-1}}{TA_{j,t-2}} + \varepsilon_{j,t} \quad (4)$$

where *NIURB* is pre-tax net income less the unrealized gains and losses related to the change in biological assets (*URB*). This latter variable is the difference between the amounts of current and previous year biological assets. All variables are deflated by TA of prior year.

I finally use Kim and Kross's (2005) model, where CFO at *t* depends on income and cash flows at *t*-1, and I additionally include changes in efficiency forecasted for *t* (*RCHAT*), which significantly improves prediction accuracy over time:

$$CFO_{j,t} = \varphi_0 + \varphi_1 \cdot INC_{j,t-1} + \varphi_2 \cdot CFO_{j,t-1} + \varphi_3 \cdot RCHAT_{j,t} + \varepsilon_{j,t} \quad (5)$$

Forecasted changes in firm efficiency are approached through relative change in assets turnover with respect to previous year. It summarises management decisions that managers forecast to introduce, and that should be added to previous data when predicting future cash flows. More precisely, I approach and calculate it through the following equation:

$$RCHAT_{j,t} = \frac{\left(\frac{REV_{j,t}}{TA_{j,t}} - \frac{\mathrm{REV}_{j,t-1}}{TA_{j,t-1}}\right)}{\left(\frac{REV_{j,t-1}}{TA_{j,t-1}}\right)} \quad (6)$$

where *REV* is firms' revenue. *RCHAT* was included in Argilés et al. (2014) and Forteza et al. (2017), as a more precise measure of firm efficiency, commonly used in business by practitioners and academics (e.g. Fairfield and Yohn, 2001; Singh and

Davidson, 2003). It consistently contributed with significant explanatory power of firm current profitability depending on previous profitability.

I regress Equations (2-5) for the subsamples of firms applying HC and FV, in order to compare the prediction inaccuracy of both valuation methods, and measure it through the residuals from these equations. More precisely, following Carnes et al. (2003) I define the dependent variable in Equation (1) as:

$$PI = \left| \frac{CFO_{j,t} - PRCFO_{j,t}}{CFO_{j,t}} \right| \quad (7)$$

where *PRCFO* is the predicted *CFO* from Equations (2-5).

With respect to our independent variables, *FVB* and *FVF* are dummies indicating that a firm uses FV (HC) for biological assets and financial instruments, respectively, when the value for the variable is 1 (0). *FVB* is the variable of interest for our study. A positive sign for this variable would provide support for H1, while a negative sign would provide support for H2. Similarly, I do not expect a definite sign for this variable, as well as for *FVF*.

BIOTA is the ratio of biological assets to total assets (*TA*). The nature of agricultural activity makes biological assets and agricultural produce valuation certainly difficult, due to biological assets typically changes over time (i.e. fatten, mature, strengthen, etc.) and quantity depends on buying, selling and is determined by other processes such as growth, aging, production and procreation. Thus, many assets owned by a farm at a certain time can be substantially different from how they were when acquired Also the biological assets used in agriculture are affected by random climate and market conditions bringing about unexpected changes and variability in revenue and income (Allen and Lueck, 1998; Cordts, Deerberg and Hanf, 1984). In this vein, the higher the importance of biological assets, the more the firm would be affected by natural changes and random shocks, and therefore the more unpredictable would be their cash flows. I therefore expect a positive sign for this variable.

I also use a measure of firm revenue volatility relative to its mean revenue: the coefficient of variation of revenue (*CREV*). Revenue volatility has been widely used in business and economic research to approach volatility or risk (e.g.: Azzimonti and Talbert, 2014; Bekkers and François, 2012; Callen, Morel and Fader, 2003). Given that instability entails lower predictability, I expect a positive sign for this variable.

TA proxies firm size assessed through total assets, as it is usual in empirical research on business and accounting (e.g. Bratten, Causholli and Khan, 2012; Evans, Hodder and Hopkins, 2014). Given the non-normal distribution of size, as there are usually few big firms competing with a large number of small firms, I use the logarithmic

transformation for this variable. Some characteristics of bigger firms are, for example, that they are more complex and have slower response times and decision taking (Jensen and Meckling, 1976; Knight and Cavusgil, 1996), making them less flexible (You, 1995), more vulnerable to changing circumstances (Nor et al., 2007) and exposed to sudden reductions in CFO. From this point of view, their businesses, and more precisely their CFO generation, are less predictable. On the other hand, they are usually better prepared in organizational terms and control systems (Busenitz and Barney, 1997), their staff and employees are more skilled (Brown and Medoff, 1989), they have greater access to resource endowment (Beck and Demirguc-Kunt, 2006), and have more control over market conditions with respect to smaller firms, thus allowing more accurate and reliable forecasts. Bratten et al. (2012) found that FV enhances the predictive accuracy of future cash flows and earnings in larger banks, but not in smaller ones. Given both opposite effects, I do not expect a definite sign for this variable.

I also allow for the unstable and uncertain context driven by the global financial crisis since 2007, using an additional dummy (CRISIS) taking the value of 1 when a given observation belongs to the period 2007-2013, and zero otherwise, similarly to previous empirical accounting and financial studies on the financial crisis (e.g. Erkens, Hung and Matos, 2012; Liang and Riedl, 2014). I consider that the financial crisis began in 2007 with the subprime mortgage liquidity crisis in the USA (Jin, Kanagaretnam and Lobo, 2011; Ryan, 2008). Bratten, Causholli and Khan (2012) and Liang and Riedl's (2014) findings, documenting an attenuation in the predictive power of fair valuation during the financial crisis, support the inclusion of this variable in our model. Accordingly, I expect a positive sign for this variable.

ZONE indicates three different dummy variables controlling for the geographical area where the parent company is located. The predictability of firm cash flow is also influenced by the institutional setting within which accounting is prepared and disclosed, decisions are taken, action occurs, and interactions between accountants and users of accounting information develop. Sound accounting and business practices improve the transparency, comparability and assessment of financial reports (Alford et al., 1993; Leuz, Nanda and Wysocki, 2003). More transparent disclosures and reporting rules, as well as accounting and business practices, should facilitate benchmarking, reliability and also the prediction of future cash flows. To proxy for the context in which the firm operates, I use dummies indicating (with value 1 and zero otherwise) that the firm headquarter is located in a given geographical area. For simplicity, given the large number of countries, as well as the limited number of firms included in our sample, I use the following big geographical areas with similar agricultural policies and geographical proximity: Europe (*EU*), East Asia Developed countries (*EAST*) and North America (*AMERICA*). The default geographical area is for firms located in developing countries. Given their more unstable economic

context and poorer institutional setting, I expect lower predictability for firms located in developing countries, and therefore a negative sign for the geographical dummy variables used in our study. In their meta-analysis of agricultural studies, Bravo-Ureta et al. (2007) used similar classification distinguishing between North America, Europe and Oceania and less developed countries.

TYPE refers to a set of five dummy variables indicating the predominant type of farming, with value 1, and 0 otherwise. I follow the International Standard Industrial Classification (ISIC) of all economic activities (UN Department of Statistics and Social Affairs, 2008), distinguishing for our purposes between manufacturing activities, forestry, fishing and agriculture, which in its turn includes crops, animal production, and mixed farming. More specific agricultural productions such as perennial, non-perennial, plant propagation, or support activities included in the ISIC cannot be ascertained, nor does it exist, in our sample. Accordingly, I distinguish between agricultural crops (*CROP*), fishing (*FISHING*), forest (*FOREST*), livestock (*LIVESTOCK*) and mixed (*MIXED*). Manufacture (*MANUFACTURE)* is the default category: firms with biological assets but performing manufacturing activity. I consider that the type of farming is predominant when it is indicated in the firm's website or in the OSIRIS database, or otherwise, following the European Farm Accountancy Data Network definitions and criteria: when a given type of farming is over 75% of farm's total output. Given that manufacturing activities have lower exposure to climate and market shocks, I expect a positive sign for these dummy variables.

4.2. Data sources and sample

The test of our hypotheses requires financial data of firms measuring biological assets at FV and HC. Given that most farms operating in the agricultural sector are small family households, which are not required to disclose financial information, and that there are usually few farms disclosing audited accounting information in a single country, I use a sample of international firms with available information about biological assets in their financial statements. In this vein, I begin with a list of international firms from OSIRIS database in the agricultural, forestry and fishing sector. OSIRIS has information on audited financial information of listed and major unlisted/delisted companies around the world, which allows mitigating concerns regarding the quality of the accounting information disclosed by small firms. From this list, I select firms that in their websites or stock markets include their notes to financial statements disclosing the corresponding information about valuation of

biological assets and financial instruments, thus providing data on our variable of interest (*FVB*), as well as on the similar dummy variable *FVF*. I enlarge the sample with all firms listed in the Spanish and Australian stock markets, in the above-mentioned sectors, as well as in the manufacture of food products. I select both countries because their accounting standards indicate HC and FV for biological assets, respectively. Data for CFO are also collected from notes to financial statements; while for the remaining variables are collected from their profit and loss statements and balance sheets, available in OSIRIS or firms' websites. Considering the year 2000, when the IAS 41 was issued, I tried to collect all available data before this data.

As can be seen in Table 10, the sample consists of 84 firms with necessary data for the study, 48 of them measuring biological assets at FV and 51 at HC, with 15 firms using both valuation methods over the years under study, and with a total number of 794 year-data observations, 380 of them using FV valuation (48%) for biological assets and 414 using HC (52%). The number of observations with biological assets measured at FV and HC are unevenly distributed by country, given the different requirements of their accounting standards on this issue. Australia (with 196 year-data observations), Malaysia (42 observations), Spain (32 observations) and Germany (22 observations) are the countries with more firm-year observations measuring biological assets at FV in our sample (displayed in panel B of Table 10). Most firm-year observations measuring biological assets at HC belong to farms in Canada (153 observations), followed by Spain (62 observations), Malaysia (52 observations) and Australia (38 observations). In Australia (234 observations), Malaysia (94 observations) and Spain (94 observations), there are a considerable number of observations in both FV and HC categories. For Australia, this is naturally explained by the AASB 141 issued on 2004 (to be applied on 2005), which required a change in the valuation of biological assets from HC to FV. Moreover, for the other countries, as well as for Australia also, it seems that some firms decided to apply different measurement methods to those required in their national accounting standards. Due to the great diversity of our sample, we convert all monetary values into dollars using the year end exchange rate reported by the Federal Reserve of USA. Moreover, as some variables in our equations are in absolute values, I convert them into 31 December 2013 values employing the annual change of the Consumer Price Index reported by the US Bureau of Labor Statistics (a unit of the US Department of Labor).

Table 10. Sample characteristics.

	Total	HC	FV
Panel A: Number of firms and observations			
Total number of firms	84	51	48
Firm-year observations	794	414	380
Panel B: Firm-year observations by countries			
European Union:	**227**	**101**	**126**
Belgium	23	8	15
Denmark	3	1	2
France	9	0	9
Germany	22	0	22
Ireland	13	13	0
Italy	8	2	6
Luxemburg	16	0	16
Netherlands	14	0	16
Norway	13	13	0
Spain	94	62	32
United Kingdom	10	2	8
East Asia Developed:	**253**	**50**	**203**
Australia	234	38	196
Japan	12	12	0
Singapore	7	0	7
North America:	**165**	**165**	**0**
Canada	153	153	0
USA	12	12	0
Developing Countries:	**149**	**98**	**51**
Brazil	14	14	0
India	13	13	0
Indonesia	16	16	0
Malaysia	94	52	42
Mauritius	12	3	9
Panel C: Firm-year observations by type of farming			
CROP	389	221	168
FISHING	55	16	39
FOREST	115	42	73
LIVESTOCK	32	23	9
MIXED	78	41	37
MANUFACTURE	125	71	54
Panel D: Firm-year observations by year			
1992	1	1	0
1993	1	1	0
1994	2	2	0
1995	2	2	0
1996	6	5	1
1997	13	12	1
1998	14	12	2
1999	16	14	2
2000	20	16	4
2001	31	21	10
2002	35	24	11
2003	41	30	11

2004	70	40	30
2005	68	31	37
2006	74	31	43
2007	71	27	44
2008	73	30	43
2009	68	29	39
2010	62	28	34
2011	57	27	30
2012	51	24	27
2013	18	7	11

As can be seen in panel C of Table 10, the most frequent type of farming in the sample is *CROP* (with 389 year-data observations), followed by MANUFACTURE (125 observations), *FOREST* (115 observations), *MIXED* (78 observations), *FISHING* (55 observations) and *LIVESTOCK* (32 observations). *CROP* is also the type of farming with more firm-year observations for both FV and HC, with 168 year-data observations of firms using FV for bearer biological assets and 221 using FV. Most firm-year observations in the first years in our sample belong to farms using HC for biological assets, while FV is more frequently used since 2005 (see panel D of Table 10). This data is in accordance with trends in the reform of accounting standards, as well as the implementation of IAS 41.

As is common in business and accounting empirical studies to reduce the influence of outliers (e.g. Dichev and Tang, 2009; Huffman, 2013), I winsorise all continuous variables at the 1st and 99th percentiles of their respective distribution.

4.3. Descriptive statistics

Table 11 displays descriptive statistics for our sample. Firms valuing at FV have significantly higher income, assets, revenues and cash flow (but non-significant median differences for this latter variable), but they generate significantly less cash flow in relative terms. There are no significant differences in profitability and the share of biological assets, as well as on the coefficients of variations of income, assets and revenues, which do not support the commonly accepted hypothesis on greater volatility under FV versus HC for the agricultural sector (e.g. Plantin and Sapra, 2008; Dowling and Godfrey, 2001). Eight firms with few observations do not allow the

calculation of standard deviation and therefore they are excluded from the analysis of volatility and the multivariate analysis.

Table 11. Sample: descriptive statistics.

	Historical Cost			Fair Value				
	Number of observations	Mean	Median	Number of observations	Mean	Median	Mann-Whitney	t-test
INC (000 $)	414	56,944	12,872	380	102,130	21,392	***	***
TA (000 $)	414	921,981	294,390	380	1,407,583	570,789	***	***
REV (000 $)	411	851,456	181,615	380	1,318,684	318,955	**	***
ROA	367	0.0551	0.0557	346	0.0492	0.0552		
BIOTA	411	0.1830	0.1514	378	0.1865	0.1139		
CFO (000 $)	414	59,180	14,341	380	76,875	19,655		**
CFO_t/TA_{t-1}	367	0.0638	0.0705	346	0.0249	0.0451	***	***
CVINC	43	1.5668	0.5920	48	-0.1996	0.4325		
CVTA	43	0.3409	0.3813	48	0.3453	0.2973		
CREV	43	0.3964	0.3182	48	0.3753	0.3470		

Significant differences at: * p<0.1, ** p<0.05 and *** p<0.01.
Abbreviations: *INC* = pre-tax income; *TA* = total assets; *REV* = revenue; *ROA* = return on assets; *BIOTA* = ratio of biological assets to total assets; *CFO* = cash flows from operations; *CVINC* = coefficient of variation of pre-tax income; *CVTA* = coefficient of variation of total assets; and *CREV* = coefficient of variation of revenues.

As can be seen in Table 12, all Pearson correlations between the independent variables in Equation (1) are low. The interaction variables are excluded from this table. The highest value (-0.4768, significant with p<0.01) is between the dummy variables for *FVB* and *AMERICA*. Therefore, collinearity is unlikely to affect estimations. The correlation between *FVB* and *FVF* is positive (0.3097) and significant with p<0.01, thus suggesting that firms tend to apply FV simultaneously for biological assets and for financial instruments.

Given the necessary delays for some variables in our equations, as well as a minimum number of four observations that I require for the calculation of revenue volatility, the number of available observations for any subsequent specific regression is lower than those displayed in Tables 11 and 12.

Table 12. Pearson correlations between independent variables in Equation 1.

	FVB	*FVF*	*BIOTA*	*CREV*	log*TA*	*CRISIS*	*EU*	*EAST*	*AMERICA*	*CROP*	*LIVESTOCK*	*FOREST*	*FISHING*	*MIXED*
FVB	1.000													
FVF	0.3097***	1.0000												
BIOTA	0.0498	0.0899**	1.0000											
CREV	0.0022	-0.0856**	0.0284	1.0000**										
log*TA*	0.1572***	-0.0862**	-0.1648***	-0.0807	1.0000									
CRISIS	0.2513***	0.2908***	0.0699**	0.0173***	0.1331***	1.0000								
EU	0.0264	-0.1894***	-0.1932***	-0.2331	0.1626***	-0.0346	1.0000							
EAST	0.4389***	0.1337***	-0.1715***	0.0202***	-0.0772**	0.0410	-0.4385	1.0000						
AMERICA	-0.4768***	0.2635***	0.1930***	-0.0927***	-0.3535***	-0.0961***	-0.3528***	-0.2646***	1.0000					
CROPS	-0.0381	0.1967***	0.1726***	0.2686***	0.0862**	0.0798**	-0.2663***	-0.1942***	0.2457***	1.0000				
LIVESTOCK	-0.0710*	0.0487	-0.0403	-0.1280***	-0.0749**	0.0438	0.0411	0.1298***	-0.1054***	-0.1907***	1.0000			
FOREST	0.1143***	-0.1038***	0.1052***	-0.1647***	0.0622*	-0.0388	0.1206***	-0.0905***	-0.1092***	-0.3935***	-0.0833**	1.0000		
FISHING	0.7460**	-0.0910**	0.0451	0.2116***	-0.1360***	0.0135	0.1162***	0.1360***	-0.1559***	-0.2822***	-0.0597*	-0.1233***	1.0000	
MIXED	0.0052	0.1072***	0.0161	-0.1573**	-0.1692***	0.0181	-0.2174***	0.1426***	0.2233***	-0.3067***	-0.0649*	-0.1340***	-0.0961***	1.0000

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01

Abbreviations: FVB = a dummy variable indicating FV for biological assets; FVF = a dummy variable indicating FV for financial instruments; BIOTA = the ratio of biological assets to total assets; CREV = the coefficient of variation of revenues; TA = total assets; CRISIS = a dummy variable indicating that a given observation is in a period of economic downturn (2007–2013); EU, EAST and AMERICA = dummy variables indicating geographical areas; and CROP, LIVESTOCK, FOREST, FISHING and MIXED = dummy variables indicating types of farming.

CHAPTER 5. RESULTS OF THE EMPIRICAL ANALYSIS ON THE PREDICTIVE ABILITY OF BIOLOGICAL ASSETS MEASURED AT FAIR VALUE

5.1. Main results of the empirical analysis on the predictive ability of biological assets measured at fair value

I first estimate Equations (2-5) in order to get the different measurements for the dependent variable in Equation (1). As mentioned, I regress these equations for the subsamples of farms applying HC and FV. Given the autocorrelation pattern of our sample, I perform panel data estimations. The commonly used Hausman test did not reject the null hypothesis of no correlation between individual effects and the explanatory variables for Equations (2, 5) in both subsamples of farms applying HC and FV. As the individual effects are uncorrelated with the regressors in all estimations, the random effects estimator is consistent and efficient, for these equations. On the contrary, the Hausman test rejects the null hypothesis of no correlation between individual effects and the explanatory variables in Equations (3, 4), where the individual effects are correlated with the regressors. A random effects estimator is inconsistent, while a fixed effects estimator is consistent and efficient in these equations in both subsamples of farms applying HC and FV. Therefore, I perform panel data estimations with random effects for Equations (2, 5) and with fixed-effects estimations for Equations (3, 4).

I then calculate PI for any of these Equations (2, 5). As I do with the independent variables, I also winsorise PI at the 1st and 99th percentiles of its respective distribution. Moreover, as is common in time-series research, we truncate PI values at 100% in order to reduce the effects of outliers (Carnes et al., 2003). Comparisons of the truncated PI values for the subsamples of farms using HC and FV (displayed in Table 13) provide inconclusive results. While CFO prediction accuracy is significantly lower for FV when I calculate PI from Equations (3, 4), it is higher for calculations from Equations (2, 5). More accurate results require multivariate analysis.

Table 13. Comparison for CFO prediction inaccuracy between subsamples of firm-year observations valuing at FV and HC.

	Number of observations		Mean		
	HC	**FV**	**HC**	**FV**	
Equation (2)	324	310	0.8067	0.6980	***[1]
Equation (3)	324	310	0.5767	0.7863	***[1]
Equation (4)	321	307	0.5687	0.6797	***[1]
Equation (5)	357	344	0.7053	0.6568	**[2]

Significant differences at: * p<0.1, ** p<0.05 and *** p<0.01.
1. Significant differences with p<0.01 with t and Mann-Whitney tests.
2. Significant at p<0.05 with t-test (there are no violations for normality and variance homogeneity) and at p < 0.1 with Mann-Whitney test.

Table 14. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses).

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		2.1965***	0.9702***	1.1264***	2.0703***
		0.3590)	(0.3112)	(0.3141)	(0.3941)
FVB	?	-0.0212	0.3096	-0.2338	0.2398
		(0.4628)	(0.5775)	(0.5138)	(0.4915)
FVF	?	-0.0250	-0.0160	-0.0025	-0.0563
		(0.04384)	(0.0484)	(0.0638)	(0.0479)
BIOTA	+	0.2661	0.3218**	0.4072***	0.2643*
		(0.1799)	(0.1441)	(0.1450)	(0.1437)
CREV	+	0.0236	-0.0138	0.0159	0.2488
		(0.1373)	(0.1491)	(0.1598)	(0.1563)
logTA	?	-0.1670***	-0.0431	-0.0810**	-0.1795***
		(0.0358)	(0.0312)	(0.0334)	(0.0393)
CRISIS	+	-0.0435	0.0909**	0.0657*	0.0498*
		(0.0386)	(0.0360)	(0.0362)	(0.0294)
FVB·BIOTA	?	-0.3824*	-0.6517***	-0.4451***	-0.3696**
		(0.1974)	(0.2053)	(0.1702)	(0.1626)
FVB·CREV	?	0.0796	-0.0593	0.1862	-0.0670
		(0.1566)	(0.2410)	(0.2024)	(0.1707)
FVB·logTA	?	-0.0046	0.0064	0.0322	-0.0125
		(0.0500)	(0.0606)	(0.0541)	(0.0566)
FVB·CRISIS	?	0.0788	-0.1359***	0.0173	-0.0264
		(0.0571)	(0.0494)	(0.0477)	(0.0400)
EU	-	0.0081	0.0002	0.0864	0.0244
		(0.0771)	(0.0831)	(0.0845)	(0.0859)
EAST	-	0.0638	0.0204	0.1254	0.0490
		(0.0828)	(0.0822)	(0.0846)	(0.0797)
AMERICA	-	0.0243	-0.1799***	-0.0499	0.0692
		(0.0838)	(0.0627)	(0.0872)	(0.0886)
CROP	+	-0.0633	-0.0298	0.0199	-0.0637
		(0.0635)	(0.0767)	(0.0739)	(0.0840)
LIVESTOCK	+	0.1854**	0.0703	0.06711	0.2659***
		(0.0753)	(0.1020)	(0.1168)	(0.0935)
FOREST	+	-0.0609	-0.1042	0.0231	-0.0011
		(0.0871)	(0.0764)	(0.0767)	(0.0937)
FISHING	+	-0.0275	-0.0468	-0.0572	-0.0643
		(0.0731)	(0.1006)	(0.1143)	(0.1113)
MIXED	+	0.0769	-0.0324	-0.0679	0.0442
		(0.0582)	(0.0763)	(0.0845)	(0.0793)
Fitness of the model					
R2		0.2716	0.1937	0.1347	0.2738
χ^2		194.88***	146.64***	57.46***	154.94***
Number of firms		78	78	78	80
N of observations		629	629	624	694

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Abbreviations: FVB = a dummy variable indicating FV for biological assets; FVF = a dummy variable indicating FV for financial instruments; BIOTA = the ratio of biological assets to total assets; CREV = the coefficient of variation of revenues; TA = total assets; CRISIS = a dummy variable indicating that a given observation is in a period of economic downturn (2007–2013); EU, EAST and AMERICA = dummy variables indicating geographical areas; and CROP, LIVESTOCK, FOREST, FISHING and MIXED = dummy variables indicating types of farming.

Next, I estimate Equation (1) for the different dependent variables used in this study and calculated through Equations (2, 5). In all cases, the Hausman test indicates that the random effects estimator is consistent and efficient. Given that the Cook-Weisberg's test reveals the existence of heteroscedasticity, I perform robust variance estimates. All robust random effects estimations shown in Table 14 present significant goodness-of-fit. R-squared overall ranges from 0.13 to 0.27. Despite results are differing according to the several dependent variables used in the study, there are some similarities. Most controled variables are not significant at $p < 0.1$. The share of biological assets in total assets (BIOTA) present the expected sign in all columns, significant at $p < 0.05$, $p < 0.01$ and $p < 0.1$ for columns B, C and D, respectively, thus providing support for our expectation on the unpredictable nature of biological assets. The negative sign for logTA (significant at $p < 0.01$ in columns A and D, and at $p < 0.05$ in column C) provides support for the argument of greater prediction accuracy associated with size. The significant (at $p < 0.05$ in column B and at $p < 0.1$ in columns C and D) positive signs of CRISIS provide support for the expectation of uncertainty under the financial crisis. The geographical area does not influence prediction accuracy, in most cases, but the negative coefficient of the dummy variable AMERICA in column B indicates that the predictive ability of accounting data in US and Canada is higher than in the developing countries. However, this result is not robust to alternative calculations of the dependent variable with Equations (2), (4) and (5). LIVESTOCK is the only type of farming with significant influence on the dependent variable. Its significant positive sign (at $p < 0.5$ and $p < 0.01$ for columns A and B, respectively) is in accordance with expectations on the lower predictability with respect to the manufacturing activity.

As for the variables of interest, FV by itself does not influence CFO prediction (neither for biological assets, nor for financial instruments), but FVB has a significant effect on the unpredictable nature of biological assets: the coefficient of FVB·BIOTA is negative and significant in all cases (at $p < 0.01$ in columns B and C, at $p < 0.05$ in column D and at $p < 0.1$ in column A). It is interesting to point out that the significant positive sign of BIOTA (with the exception of column A, which is non-significant at $p < 0.1$) reveals that it influences lower prediction accuracy, when biological assets are valued at HC. In this vein, future cash flows predictability diminishes as the ratio

of biological assets to total assets increases. This evidence is consistent with the difficulties in predicting future cash flows when biological assets are an important proportion of a firm's assets. But this expectation is only supported when biological assets are measured at HC. When they are measured at FV, the ability of accounting data to predict future cash flows increases as the proportion of biological assets increases, as can be ascertained by the overall negative sign of both coefficients (BIOTA+FVB·BIOTA). Hence, the association between BIOTA and PI is positive and negative for HC and FV, respectively. These findings suggest that HC is unable to assess the economic value of the biological transformations of these biological assets. The outdated costs of past purchased inputs, and the discretionary allocations and complexities related to cost calculation of biological assets are potential sources of irrelevance. Moreover, HC valuation does not accurately and currently reflect the common random climate and market conditions which often affect biological assets. The potential misleading information provided by this valuation method obscures the true performance of agricultural firms, thus providing an irrelevant basis for assessing the potential of these assets to generate future cash flows. The higher the proportion of biological assets in total assets, the greater the importance of these outdated and irrelevant information, and consequently the lower the prediction accuracy. On the contrary, FV reports economic values of biological transformations, as well as climate and market influences on the current condition of the biological assets, thus providing a more appropriate assessment of the future income caused by continuing to hold these assets. Our results suggest that accounting figures of biological assets not only improve their predictability when they are measured at FV with respect to HC, they also suggest that while their measurement at HC is a source of irrelevance, the figures become relevant when they are measured at FV. Therefore, there is a change from irrelevance to relevance, when the measurement of biological assets moves from HC to FV. Hence, an important implication of our study is that FV allows a true and fair assessment of potential future income conveyed by firms' biological assets. Therefore, the greater the proportion of biological assets in total assets, the greater the content of relevant information included in the financial statements and the greater the prediction accuracy of future cash flows. The most important point with respect to the purpose of our study is that the predictability of accounting data improves when biological assets are measured at FV with respect to HC, thus supporting our hypothesis H2.

I do not find evidence of significant interactions between FVB and revenue volatility, corporate size or the crisis period. All coefficients of these interaction terms are insignificant with the exception of the interaction with the variable CRISIS in column B.

It should be noted that I find a greater relevance of FV versus HC despite the preponderance of observations at HC (FV) prior to (during) the financial crisis, when

the prediction accuracy of FV is substantially reduced, according to Bratten, Causholli and Khan (2012) and Liang and Riedl (2014). This fact provides an interesting robustness check for our results, as the superiority of FV over HC is observed even under a context which is less favourable for FV than for HC.

Overall, I find empirical support for the hypothesis H2 on the greater relevance of FV with respect to HC. More precisely, I find that FV has a beneficial effect on the unpredictable nature of biological assets. It switches the sign of the association between biological assets intensity and the ability of accounting data to predict future cash flows. While biological assets intensity negatively influences prediction accuracy when they are measured at HC, its influence is positive when they are measured at FV. However, I do not find significant robust effects of FV in the influences of revenue variability, size and the recent financial crisis on the prediction of future cash flows. Lastly, these results are robust to different measures of prediction accuracy and to a likely improvement in the relevance of accounting regardless of FV.

5.2. Additional analyses

Given the wide span of years included in the sample, that many firms have been increasingly adopting FV over latter years, and that most firm-year observations valuing at FV in our sample are in the latter years, the results could be biased by a likely improved relevance of accounting, regardless of FV. Thus, the main analysis is re-estimated for a group of countries sharing the same accounting standards for a certain period of time, in order to measure if the adoption of the standard improved the quality of accounting information. The application of IAS 41 starting after the beginning of 2003 represented the starting point of the transition from the measurement of biological assets and agricultural produce from HC to FV accounting. To analyse this change, I rerun estimations restricting our sample to observations from 2003 (the implementation year of IAS 41) up until 2013. Results displayed in Table 15 are similar to those of Table 14. FVB·BIOTA is significantly negative at $p < 0.05$ with the dependent variable PI calculated with Equations 2-4, and at $p < 0.1$ with Equation 5.

Table 15. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), subsample of observations from 2003 to 2013.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		2.3856***	1.3756***	1.110***	2.1721**
		(0.3668)	(0.3331)	(0.2867)	(0.4029)
FVB	?	-0.29339	-0.1332	-0.0895	0.2421
		(0.4572)	(0.6287)	(0.4481)	(0.5023)
FVF	?	0.04363	-0.0621	-0.0394	-0.0457
		(0.0459)	(0.0758)	(0.0621)	(0.0406)
BIOTA	+	0.2587	0.2418	0.3220**	0.1507
		(0.1903)	(0.1631)	(0.1478)	(0.1544)
CREV	+	0.0107	-0.0440	0.0077	0.1617
		(0.1460)	(0.1381)	(0.1421)	(0.1478)
logTA	?	-0.1914***	-0.0900***	-0.0737**	-0.1847***
		(0.0373)	(0.0323)	(0.0312)	(0.0393)
CRISIS	+	-0.0270	0.0465	0.0590	0.0630**
		(0.0412)	(0.0410)	(0.0370)	(0.0260)
FVB·BIOTA	?	-0.4744**	-0.5943**	-0.4141**	-0.2915*
		(0.2097)	(0.2378)	(0.1665)	(0.1694)
FVB·CREV	?	0.0901	-0.0184	0.1614	0.0443
		(0.1633)	(0.2558)	(0.1638)	(0.1512)
FVB·logTA	?	0.0294	0.0623	0.0188	-0.0178
		(0.0512)	(0.0639)	(0.0483)	(0.0560)
FVB·CRISIS	?	0.0600	-0.0628	0.0171	-0.0410
		(0.0561)	(0.0568)	(0.0483)	(0.0382)
EU	-	-0.0179	-0.0145	0.0828	-0.0088
		(0.0828)	(0.0861)	(0.0810)	(0.0819)
EAST	-	0.0407	0.0074	0.11429	0.0049
		(0.0896)	(0.0842)	(0.0786)	(0.0820)
AMERICA	-	-0.0381	-0.0315	-0.0270	0.0761
		(0.0881)	(0.0769)	(0.0715)	(0.0887)
CROP	+	-0.0775	-0.0205	0.0215	-0.0527
		(0.0725)	(0.0759)	(0.0692)	(0.0835)
LIVESTOCK	+	0.1611*	0.0815	0.0966	0.2772***
		(0.0847)	(0.1060)	(0.1063)	(0.0940)
FOREST	+	-0.0765	-0.0787	0.0320	0.0085
		(0.0977)	(0.0782)	(0.0742)	(0.1041)
FISHING	+	-0.0294	-0.0325	-0.0428	-0.0550
		(0.0811)	(0.1092)	(0.1197)	(0.1138)
MIXED	+	0.0487	-0.0619	-0.0767	0.0748
		(0.0731)	(0.0738)	(0.0780)	(0.0807)
Fitness of the model					
R2		0.2664	0.1896	0.1289	0.2988
χ^2		167.70***	96.85***	81.71***	148.91***
Number of firms		78	78	78	80
N of observations		557	557	554	594

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

IAS 41 was issued by the IASC in February 2001. In order to analyse the introduction of this standard, I rerun estimations restricting the sample to observations from 2001 (the immediate year after the issue of IAS 41) up until 2013. Results, displayed in Table 16, are again comparable for FVB·BIOTA, and similarly to those of the full sample, the coefficient of FVB·CRISIS is significantly negative at $p < 0.05$ when the dependent variable is calculated with Equation 3. Therefore, our results in Table 16 are robust due to a likely influence of additional factors improving the relevance of accounting information over the last years.

Since IFRS are considered high-quality accounting standards, I rerun estimations restricting the sample to European firms with observations from 2005 (the implementation year of IFRS) until 2013, with the main objective to analyse the benefits of IFRS on the quality of accounting information. The comparability and transparency should increase after the IFRS adoption. Results displayed in Table 17 show that there is significant goodness-of-fit for three different measures of PI (Equations 2, 3 and 5), while the model does not present significant goodness-of-fit when the dependent variable is built with Equation 4 (see column C of Table 17). The variables of interest FVB and FVF are not significant. FVB and FVB·BIOTA are only significantly positive at $p < 0.1$ with the dependent variable PI calculated with Equation 2 and Equation 3, respectively. The variable CRISIS is only significantly positive at $p < 0.1$ when the dependent variable is calculated with Equation 2 (see column A of Table 17). FV does not influence the unpredictable nature of biological assets. These findings suggest that previous results are not confirmed with the subsample of European firms after the adoption of IFRS in 2005. These results could be attributed either to the higher relevance of IFRS, to the smaller sample size, or to the detrimental effect of the financial crisis on the prediction accuracy.

The effect of the financial crisis on the accuracy of predicting cash flows is also analysed in more detail. The Equation (1) was estimated again using a subsample of European firms for the period 2005-2006 and 2005-2007. Table 18 shows results for the period 2005-2006, years after the IFRS adoption and excluding when the crisis began. The FVB and FV·BIOTA do not influence prediction accuracy in any case. FVF has a significant and positive effect on the prediction accuracy (at $p < 0.01$ in columns B and C of Table 18). These findings suggest that the results of the main analysis are not confirmed with the subsample of European firms after the adoption of IFRS and excluding the financial crisis period. The low number of observations (33 to 39 firm-year observations from 19 and 20 different firms) does not provide goodness-of-fit for the estimations of Equation (1) with any of the four different measures of *PI*.

Table 16. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), subsample of observations from 2001 to 2013.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		2.2742***	0.6383**	1.1528***	2.16129***
		(0.3560)	(0.3344)	(0.3053)	(0.3768)
FVB	?	-0.1113	0.6725	-0.1769	0.1874
		(0.4555)	(0.5735)	(0.4933)	(0.4841)
FVF	?	0.0049	-0.0150	-0.0372	-0.0453
		(0.0387)	(0.0463)	(0.0638)	(0.0445)
BIOTA	+	0.2795	0.2170	0.2981**	0.2094
		(0.1854)	(0.1561)	(0.1472)	(0.1487)
CREV	+	0.0188	0.0114	0.0149	0.1961
		(0.1379)	(0.1370)	(0.1593)	(0.1492)
logTA	?	-0.1779***	-0.00005	-0.0772**	-0.1861***
		(0.0364)	(0.0327)	(0.0328)	(0.0366)
CRISIS	+	-0.0327	0.0774**	0.0589	0.0601***
		(0.0392)	(0.0385)	(0.0384)	(0.0305)
FVB·BIOTA	?	-0.0327**	-0.5151**	-0.3398**	-0.2991*
		(0.0392)	(0.2032)	(0.1682)	(0.1641)
FVB·CREV	?	0.0926	-0.0856	0.1714	-0.0081
		(0.1544)	(0.2197)	(0.1987)	(0.1580)
FVB·logTA	?	0.0073	-0.0432	0.0247	-0.0134
		(0.0503)	(0.0594)	(0.0522)	(0.0537)
FVB·CRISIS	?	0.0684	-0.1115**	0.0279	-0.0341
		(0.0554)	(0.0510)	(0.0483)	(0.0414)
EU	-	-0.0013	0.0219	0.0791	0.0220
		(0.0784)	(0.0851)	(0.0839)	(0.0854)
EAST	-	0.0515	0.0461	0.1141	0.0533
		(0.0845)	(0.0874)	(0.0832)	(0.0823)
AMERICA	-	0.0020	-0.1326**	-0.0344	0.0644
		(0.0849)	(0.0676)	(0.0828)	(0.0887)
CROP	+	-0.0699	-0.0422	0.0131	-0.0590
		(0.0668)	(0.0769)	(0.0732)	(0.0831)
LIVESTOCK	+	0.1779**	0.0569	0.0734	0.2449**
		(0.0781)	(0.1050)	(0.1103)	(0.0955)
FOREST	+	-0.0681	-0.1229	0.0162	0.0053
		(0.0847)	(0.0845)	(0.0775)	(0.0982)
FISHING	+	-0.0346	-0.0713	-0.0625	-.0706
		(0.0784)	(0.1013)	(0.1157)	(0.1107)
MIXED	+	0.0684	-0.0524	-0.0702	0.0447
		(0.0616)	(0.0780)	(0.0819)	(0.0787)
Fitness of the model					
R^2		0.2805	0.1570	0.1161	0.2785
χ^2		178.86***	104.09***	59.05***	155.59***
Number of firms		78	78	78	80
N of observations		592	592	589	644

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Table 17. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), with subsample of European firms (including Norway) for years 2005-2013.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		1.3497***	-1.4634**	0.0925	4.4786***
		(0.4486)	(0.6954)	(1.2362)	(1.6043)
FVB	?	2.2438*	1.5038	2.0278	-1.4128
		(1.3037)	(1.2595)	(1.8142)	(1.6089)
FVF	?	-0.1091	0.0370	-0.0443	0.0201
		(0.0678)	(0.1416)	(0.2282)	(0.1725)
BIOTA	+	-0.1265	0.5321	0.7375	0.3352
		(0.4160)	(0.5284)	(1.0784)	(0.8015)
CREV	+	-0.3038	0.4498	0.3106	-0.0626
		(0.2142)	(0.3008)	(0.3591)	(0.3974)
log*TA*	?	-0.0315	0.2513***	0.0655	-0.4586**
		(0.0559)	(0.0755)	(0.1479)	(0.1783)
CRISIS	+	0.0637*	0.0889	-0.0819	-0.0321
		(0.0348)	(0.1099)	(0.1493)	(0.1307)
FVB·BIOTA	?	-0.0557	-1.0220*	-0.7618	-0.6592
		(0.4351)	(0.5905)	(1.1363)	(0.8395)
FVB·CREV	?	0.7192**	-0.1276	0.0540	0.4850
		(0.3393)	(0.4000)	(0.4451)	(0.3732)
FVB·log*TA*	?	-0.2930**	-0.1805	-0.2253	0.1813
		(0.1365)	(0.1379)	(0.2040)	(0.1866)
FVB·CRISIS	?	-0.0232	-0.1602	0.0150	-0.0087
		(0.1324)	(0.1242)	(0.1635)	(0.1520)
CROP	+	-0.1572	-0.0483	-0.1861	-0.1371
		(0.1285)	(0.1620)	(0.1535)	(0.1492)
LIVESTOCK	+	-0.1201***	-0.0758***	0.1320	0.0058
		(0.0284)	(0.0262)	(0.0852)	(0.1484)
FOREST	+	-0.1972	-0.0123	-0.2173	-0.1387
		(0.1559)	(0.1801)	(0.1814)	(0.1796)
FISHING	+	0.1865*	-0.0969	0.1074	0.0403
		(0.1096)	(0.1628)	(0.1650)	(0.1580)
MIXED	+	-	-	-	-
Fitness of the model					
R^2		0.4070	0.2278	0.1708	0.2297
χ^2		197.56***	228.16***	·	90.56***
Number of firms		21	21	21	23
N of observations		144	144	136	154

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Table 18. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), with subsample of European firms (including Norway) for years 2005-2006.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		2.6607	0.1774	1.7832	4.6381**
		(2.2306)	(1.6435)	(1.4983)	(1.9668)
FVB	?	1.9062	-3.1350	-2.0314	1.3927
		(1.7898)	(2.8514)	(1.5436)	(1.4274)
FVF	?	0.0845	0.6708***	0.6425***	-0.0625
		(0.3858)	(0.2298)	(0.2243)	(0.3388)
BIOTA	+	0.7642	-1.3216	-0.1539	-0.3373
		(0.9037)	(1.4457)	(0.6169)	(1.4732)
CREV	+	0.5688	1.5098***	1.9098***	0.2377
		(0.8444)	(0.5767)	(0.5616)	(0.5329)
logTA	?	-0.2475	-0.0236	-0.2364	-0.4555**
		(0.2261)	(0.1952)	(0.1689)	(0.2269)
FVB·BIOTA	?	-0.6819	1.0590	-0.3107	-0.1736
		(1.0547)	(1.5618)	(0.6516)	(1.5285)
FVB·CREV	?	0.7603	1.3549	-1.3362***	-1.4442*
		(1.1292)	(1.1944)	(0.4613)	(0.7829)
FVB·logTA	?	-0.2358	0.2250	0.2403	-0.0775
		(0.1791)	(0.3167)	(0.1539)	(0.1617)
CROP	+	-0.0713	0.6000	-0.0591	-0.2428
		(0.3993)	(0.3693)	(0.2007)	(0.2730)
LIVESTOCK	+	0.1405	-0.8816***	-0.7319***	0.0844
		(0.1660)	(0.2476)	(0.2195)	(0.2996)
FOREST	+	-0.3901	0.2647	0.3580	-0.2361
		(0.4173)	(0.3117)	(0.2223)	(0.2823)
FISHING	+	-0.0644	-0.0737	-0.4077*	0.0368
		(0.2160)	(0.2174)	(0.2084)	(0.3542)
MIXED	+	-		-	-
Fitness of the model					
R^2		0.6036	0.5194	0.7057	0.3766
χ^2		.	.	.	.
Number of firms		19	19	19	20
N of observations		33	33	33	39

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Table 19 shows results using a subsample of European firms for years 2005-2007. This analysis includes 2007, taking in consideration that the crisis did not begin until September. The variables of interest FVB and FVF are not significant. FVB·BIOTA is not significantly negative with the dependent variable PI calculated in any case. The results of the main analysis are not confirmed with the subsample of European companies for the period 2005-2007, which could be attributed to higher relevance of IFRS or to the small subsample.

Given that the sample data covers a range of 24 years and corresponds to very different countries, with their corresponding different currencies and environments, I additionally perform the main analysis with all the observations at local currency, without transforming the data. While in the Equation 1 there is only one variable expressed in absolute values, in the Equations 2, 3 and 5 there are several of them, and therefore very heterogeneous data is mixed. Table 20 displays that BIOTA is significantly positive at $p < 0.01$ and FVB·BIOTA is significantly negative at $p < 0.05$ with the dependent variable PI estimated only with the Equation 4, whose variables are defined in relative terms, provides similar results to the main analysis. One of the models, Equation 2 does not even present a significant adjustment (see column A of Table 20). As expected the results lose the consistency and stability obtained with the transformed data, approving the need to convert all monetary values into the same type of currency. We believe that not having done the transformation would be a serious objection to the work.

Finally, the Equation (1) was estimated with the previous four different measures of PI but excluding the coefficients of interaction between FVB and biological assets (FVB·BIOTA), revenue volatility (FVB·CREV), corporate size (FVB·logTA) and the crisis period (FVB·CRISIS). Results displayed in Table 21 shows FVB is significantly positive with the dependent variable PI calculated with Equation 3. The variable logTA is significantly positive at $p < 0.01$ when the dependent variable is calculated with Equation 2, 4 and 5, and at $p < 0.1$ when is calculated with Equation 3. The variable CRISIS is significantly positive at $p < 0.01$ and $p < 0.05$, when the dependent variable is calculated with Equation 4 and Equation 5, respectively. Compared to our previous results, these results suggest the need to include the four iterative variables in the estimation of Equation (1).

Table 19. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), with subsample of European firms (including Norway) for years 2005-2007.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		3.5945**	0.1220	-0.0297	1.6572
		(1.6394)	(1.0672)	(0.9371)	(1.0206)
FVB	?	-2.2314	1.3470	-0.5394	-2.3168
		(2.4733)	(2.2055)	(2.4880)	(1.5142)
FVF	?	0.0541	0.0650	0.3010	0.0968
		(0.2433)	(0.1985)	(0.1860)	(0.1302)
BIOTA	+	-1.3191	-0.4509	-1.0391	-0.2355
		(1.6468)	(0.5909)	(0.9825)	(0.9410)
CREV	+	0.1420	0.9756**	0.8064**	0.0303
		(0.6454)	(0.3990)	(0.3874)	(0.3357)
logTA	?	-0.3267	0.0336	0.0619	-0.1052
		(0.1992)	(0.1253)	(0.1175)	(0.1162)
CRISIS	+	0.0263	-0.0299	0.0058	0.1320
		(0.0831)	(0.2581)	(0.1323)	(0.1093)
FVB·BIOTA	?	1.8601	-0.5466	0.8531	0.7787
		(1.7240)	(0.5586)	(1.1155)	(0.9560)
FVB·CREV	?	0.8823	-1.8832**	0.6378	1.5349**
		(0.8406)	(0.7844)	(0.6107)	(0.6034)
FVB·logTA	?	0.1798	-0.0940	-0.0151	0.1479
		(0.2541)	(0.2219)	(0.2628)	(0.1548)
FVB·CRISIS	?	0.0368	-0.0177	-0.1193	-0.2838**
		(0.1519)	(0.2849)	(0.1739)	(0.1324)
CROP	+	-0.0043	0.1789	0.1817	0.2028
		(0.3081)	(0.2578)	(0.2729)	(0.1522)
LIVESTOCK	+	-0.2135	-0.2576***	-0.2148**	-0.3396**
		(0.2310)	(0.0793)	(0.1078)	(0.1438)
FOREST	+	-0.2227	0.2371	0.2267	-0.0744
		(0.3165)	(0.1754)	(0.2091)	(0.1435)
FISHING	+	0.0720	0.2683**	-0.1427	0.0460
		(0.3343)	(0.1343)	(0.1781)	(0.1501)
MIXED	+	-	-	-	-
Fitness of the model					
R^2		0.3559	0.3527	0.3193	0.5249
χ^2		173.95***	563.77	108.61***	576.70***
Number of firms		19	19	19	21
N of observations		52	52	52	59

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Table 20. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), with not transformed data.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		1.036287***	1.060014***	0.8217**	1.5252***
		.03257	.2918805	(0.3195)	(0.1424)
FVB	?	.0431894	-.3042864	0.1245	0.0014
		.061446	.3835146	(0.3903)	(0.3302)
FVF	?	-.0001241	-.0705942	-0.0684	0.0602***
		.0013776	.059625	(0.0575)	(0.0191)
BIOTA	+	.0065892	.1817855	0.3865***	0.0526
		.0074973	.1473967	(0.1227)	(0.0567)
CREV	+	-.0022711	-.0049631	-0.0053	-0.0009
		.0021429	.0542121	(0.0559)	(0.0198)
log*TA*	?	-.0019655	-.0234346**	-0.0149	-0.0304***
		.0015487	.0112233	(0.0124)	(0.0064)
CRISIS	+	-.0030497	.0226578	0.0532	-0.0158
		.0027998	.0279083	(0.0379)	(0.0151)
FVB·BIOTA	?	-.0098009	-.3044198	-0.3254**	-0.0834
		.0078734	.1976253	(0.1426)	(0.0647)
FVB·CREV	?	.0011196	-.1329582	0.1184*	0.0019
		.0015862	.1049725	(0.0703)	(0.0271)
FVB·log*TA*	?	-.0021599	.0322177*	-0.0054	0.0007
		.0030223	.0169391	(0.0164)	(0.0166)
FVB·CRISIS	?	-.0021599	-.027139	0.0361	-0.0024
		.0030223	.0327715	(0.0505)	(0.0208)
EU	-	.0067389	.0276785	0.0507	0.0107
		.0041464	.0735026	(0.0987)	(0.0274)
EAST	-	.0033016	.029108	0.0940	-0.0146
		.0042054	.0849126	(0.1035)	(0.0281)
AMERICA	-	.0016016	-.1075937	-0.0588	-0.0706*
		.0049758	.0794432	(0.0967)	(0.0378)
CROP	+	-.0010997	.0753803	0.0386	0.0180
		.0025871	.078306	(0.0753)	(0.0194)
LIVESTOCK	+	-.0005123	.0347167	0.0849	0.0121
		.0046287	.113011	(0.1341)	(0.0333)
FOREST	+	.0010354	-.0360811	-0.0067	0.0351*
		.0028296	.0826024	(0.0816)	(0.0208)
FISHING	+	-.0050319	.0091319	-0.0534	0.0062
		.0043246	.1139721	(0.1193)	(0.0300)
MIXED	+	-.0024075	.0382	-0.0332	0.0386
		.003297	.0829876	(0.0900)	(0.0331)
Fitness of the model					
R^2		0.2166	0.2082	0.0937	0.2958
χ^2		5.76	97.04***	83.39***	80.12***
Number of firms		77	77	77	79
N of observations		620	620	617	683

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Table 21. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of biological assets (standard deviations in parentheses), excluding iterative variables.

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		2.2387***	1.1779***	1.0154***	2.2559***
		(0.2730)	(0.2964)	(0.2729)	(0.2689)
FVB	?	-0.0439	0.1702***	0.0715	0.0323
		(0.0475)	(0.0555)	(0.0757)	(0.0560)
FVF	?	-0.0243	0.0071	0.0050	-0.0451
		(0.0436)	(0.0496)	(0.0655)	(0.0475)
BIOTA	+	0.0412	-0.1140	0.1531	0.0035
		(0.1004)	(0.1310)	(0.1267)	(0.0879)
CREV	+	0.0442	-0.0936	0.0849	0.1907
		(0.1006)	(0.1262)	(0.1201)	(0.1195)
log*TA*	?	-0.1723***	-0.0501*	-0.0691***	-0.1918***
		(0.0245)	(0.0283)	(0.0266)	(0.0256)
CRISIS	+	-0.0092	0.0253	0.0717***	0.0350*
		(0.0289)	(0.0268)	(0.0265)	(0.0205)
EU	-	0.0095	-0.0607	0.0834	-0.0070
		(0.0776)	(0.0803)	(0.0868)	(0.0856)
EAST	-	0.0714	-0.0266	0.1219	0.0272
		(0.0812)	(0.0741)	(0.0772)	(0.0702)
AMERICA	-	0.0396	-0.1834***	-0.0147	0.0600
		(0.0786)	(0.0663)	(0.0800)	(0.0807)
CROP	+	-0.0543	-0.0366	0.0188	-0.0639
		(0.0629)	(0.0761)	(0.0717)	(0.0825)
LIVESTOCK	+	0.1647**	0.0357	0.0613	0.2367***
		(0.0746)	(0.0966)	(0.1064)	(0.0866)
FOREST	+	-0.0520	-0.1149	0.0155	0.0014
		(0.0885)	(0.0782)	(0.0752)	(0.0933)
FISHING	+	-0.0217	-0.0731	-0.0644	-0.0695
		(0.0740)	(0.1176)	(0.1143)	(0.1130)
MIXED	+	0.0976*	-0.0170	-0.0533	0.0564
		(0.0550)	(0.0809)	(0.0799)	(0.0795)
Fitness of the model					
R^2		0.2626	0.1499	0.1159	0.2672
χ^2		159.72***	101.62***	43.13***	126.58***
Number of firms		78	78	78	80
N of observations		629	629	624	694

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

CHAPTER 6. AMENDMENT OF IAS 41 *AGRICULTURE* AND EMPIRICAL ANALYSIS ON THE PREDICTIVE ABILITY OF BEARER PLANTS

6.1. Proposed amendments to IAS 41 *Agriculture*

Prior to the amendments the accounting for bearer plants was within the scope of IAS 41 *Agriculture*, which required all biological assets to be measured at FV less estimated costs to sell at an initial recognition and at a subsequent reporting date, based on the principle that biological transformation is best reflected by FV measurement for both bearer and consumable biological assets.

In 2012, the IASB decided to give priority to developing a proposal to amend IAS 41 in response to comments received on the IASB's Agenda Consultation. The IASB received feedback from stakeholders expressing concerns about the relevance and usefulness of information provided to users regarding certain biological assets valued at FV. Especially mature bearer biological assets (such as trees from which firewood is harvested while the tree remains), which no longer undergo significant biological transformation and are used solely to grow produce. These assets were perceived to be more similar to fixed assets (property, plant and equipment), and thus it would be appropriated to follow a depreciated cost model similar to that set out in IAS 16 *Property, Plant and Equipment*.

Moreover, IASB had to review the IAS 41 due to various previous studies showing practical and theoretical limitations, which significantly affected the quality of financial report and misrepresent information (i.e. Elad and Herbon, 2011; Aryanto, 2011). FV measurement of biological assets was viewed by some respondents as being complex, costly and difficult to apply. Furthermore, volatility arises from recognising changes in the FV less costs to sell in profit or loss. Due to the absence of active market for these types of assets, many investors, analysts and other users of financial statements adjusted the reported profit or loss numbers to eliminate the effects of changes in FV of theses bearer biological assets. On the other hand, the treatment of biological assets needed to be differentiated based on the nature and usefulness of information presented. All biological assets cannot receive the same treatment, when not all of these assets owned by an entity are designated for capital appreciation or to be sold.

Consequently, the IASB published an Exposure Draft on 26 June 2013 proposing amendments to IAS 41 to include bearer plants within the scope of IAS 16. In June 2014, the IASB issued *Agriculture: Bearer Plants (Amendments to IAS 16 and IAS 41)* with amendments that change the financial reporting for bearer plants, such as grape vines, rubber trees and oil palms. The IASB (2014) decided that bearer plants should be accounted in the same way as property, plant and equipment in IAS 16, and therefore HC must be applied when initially valuing bearer plants, for annual periods beginning on or after 1 January 2016. The amendments include them within the scope of IAS

16, instead of IAS 41, while produce growing on bearer plants will remain in accordance with the requirements in IAS 41. However, one of the sixteen IASB members abstained and two voted against the publication of the exposure draft, because they believe that these amendments lower the quality of the information available in the financial statements (IASB, 2013).

In order to provide a more comprehensive result in the study of FV accounting and agriculture, this section performs an additional analysis testing the influence of FV for bearer biological assets on the predictability of future cash flows.

6.1.1. Amendments to IAS 41 *Agriculture*

A bearer plant is, as defined in IAS 41, a living plant that is:

- ✓ used in the production process of agricultural produce;
- ✓ expected to bear produce for more than one period; and
- ✓ not intended to be sold as agricultural produce, except for incidental scrap sales.

The following are not bearer plants:

- ✓ plants cultivated to be harvested as agricultural produce.
- ✓ plants cultivated to grow agricultural produce, when are intended to be harvested as agricultural produce or sold as living plants, other than as part of incidental scrap sales.
- ✓ plants cultivated for sale only.
- ✓ annual crops; and
- ✓ produce growing on a bearer plants.

When bearer plants are no longer capable of bearing produce they may be cut down and sold as scrap. Such incidental scrap sales would not prevent the plant from satisfying the definition of a bearer plant.

The agricultural produce of bearer plants remains within the scope of IAS 41. Consequently, references to 'biological assets' in this Standard apply equally to the produce.

6.2. Subsample

I repeat previous analysis with a subsample of firms dealing with bearer plants, and valuing these bearer plants in their balance sheet. Given that the sample does not have precise information on the amount and the importance of bearer plants within the biological assets, this study includes a subsample of 504 year-data observations, from 54 crops and forest farms that in the notes of financial statements identify biological assets only in their fixed assets. The biological assets in the inventories were not included in the subsample.

Panel A of Table 22 displays basic data on the subsample of firms with bearer plants in their balance sheet. We have 504 firm-year observations, 263 of them using HC valuation (52% of the subsample) for bearer biological assets and 241 using FV valuation (48% of the subsample), from 54 crops and forest farms, 30 of the farms measuring bearer biological assets at FV and 34 at HC, with 10 firms using both valuation methods over the years under study.

Table 22. Subsample of observations and firms dealing with bearer plants.

Panel A. Number of firms and observations

	Total	**HC**	**FV**
Total number of firms	54	30	34
Firm-year observations	504	263	241

Panel B. Firm-year observations by type of farming

	Total	**HC**	**FV**
CROP	389	221	168
FOREST	115	42	73

Panel B of Table 22 shows firm-year observations of bearer biological assets by type of farming. The subsample consists of 389 year-data observations of crop firms, with 221 of them using HC valuation for bearer biological assets and 380 using FV, and 115 year-data observations of forest firms, with 42 of them using HC valuation for bearer biological assets and 73 using FV.

6.3. Results and discussion of the empirical analysis of the predictive ability of bearer plants

Table 23 shows the results of estimations for this subsample of farms. The Hausman test indicates that the random effects estimator is consistent and efficient. The Cook and Weisberg's test reveal the existence of heteroscedasticity, thus I perform robust random effects estimations. As for our main explanatory variable, FVB is not significant at $p < 0.1$, but the variable FVB·BIOTA reveals an interaction effect of FV on PI, but the coefficients of this latter variable are significant (at $p < 0.05$) only in columns B and C. These results suggest that HC valuation for bearer plants does not influence prediction inaccuracy, but in two out of four measures of PI, FV increases the ability of accounting data to predict future cash flows as the proportion of biological assets increases. Hence, the main finding of this paper does not robustly hold for forest and crop firms whose biological assets are only fixed assets. These results also suggest that the shift from FV to HC in measuring bearer plants, included in the amendment of IAS 41, is not likely to improve the ability of accounting data to predict future cash flows.

Given that there are doubts on the appropriateness of this subsample for analysing the effect of measuring bearer plants at FV on prediction accuracy, I perform an additional analysis with the subsample of forest firms, where the biological assets can be more undoubtedly identified as bearer plants. Table 24 displays that FVB·BIOTA is significantly negative at $p < 0.01$ and at $p < 0.1$ with the dependent variable PI calculated with Equation 3 and 4, respectively. These results are similar to those of Table 23. Also, CRISIS is significantly negative at $p < 0.01$ with the dependent variable PI calculated with Equation 2. However, the low number of observations (97 to 105 firm-year observations from 10 firms) does not provide significant goodness-of-fit for the estimations of Equation (1) with none of the four different measures of PI.

Table 23. Random effects robust estimations for CFO prediction inaccuracy (truncated at 100%) depending on FV valuation of fixed biological assets including only forest and crop companies (standard deviations in parentheses).

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		2.1138***	0.8831	0.6839	1.1505
		(0.8173)	(0.5783)	(0.6596)	(0.7455)
FVB	?	0.8974	1.2915	1.1975	1.2963
		(0.8809)	(0.7905)	(0.7780)	(1.0000)
FVF	?	-0.08317*	-0.0660	0.0901*	-0.0920
		(0.0441)	(0.0684)	(0.0511)	(0.0669)
BIOTA	+	-0.0250	0.1997	0.1680	-0.0973
		(0.2320)	(0.1824)	(0.1606)	(0.1717)
CREV	+	0.4110	0.5004	0.0864	0.5796
		(0.3167)	(0.3065)	(0.2249)	(0.3551)
log*TA*	?	-0.1777*	-0.0714	-0.0428	-0.1009
		(0.0918)	(0.0644)	(0.0730)	(0.0717)
CRISIS	+	-0.1423	0.0762	0.0963*	0.0420
		(0.0924)	(0.0583)	(0.0503)	(0.0433)
FVB·BIOTA	?	-0.1426	-0.4968**	-0.3991**	-0.0587
		(0.2585)	(0.2175)	(0.1970)	(0.2598)
FVB·CREV	?	-0.2594	-0.0630	0.1422	-0.3989
		(0.2990)	(0.4011)	(0.2256)	(0.3827)
*FVB·*log*TA*	?	-0.0852	-0.0906	-0.1189	-0.1087
		(0.0948)	(0.1006)	(0.0866)	(0.1215)
FVB·CRISIS	?	0.1749	-0.0869	0.0135	-0.0514
		(0.1160)	(0.0774)	(0.0630)	(0.0622)
EU	-	-0.0589	-0.0474	0.0257	0.0310
		(0.0902)	(0.0745)	(0.0813)	(0.1205)
EAST	-	80.0482	0.0872	0.0622	0.0993
		(0.1067)	(0.0913)	(0.0992)	(0.1402)
AMERICA	-	0.1103	-0.0102	0.1178	0.4726***
		(0.1590)	(0.1431)	(0.1803)	(0.1528)
Fitness of the model					
R^2		0.2899	0.2620	0.2389	0.2932
χ^2		133.13***	145.31***	215.43***	132.94***
Number of firms		30	30	30	33
N of observations		244	244	244	273

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Abbreviations: FVB = a dummy variable indicating FV for biological assets; FVF = a dummy variable indicating FV for financial instruments; BIOTA = the ratio of biological assets to total assets; CREV = the coefficient of variation of revenues; TA = total assets; CRISIS = a dummy variable indicating that a given observation is in a period of economic downturn (2007–2013), EU, EAST and AMERICA = dummy variables indicating geographical areas.

Table 24. Random effects robust estimations for prediction inaccuracy (truncated at 100%) depending on FV valuation of fixed biological assets including only forest companies (standard deviations in parentheses).

Variables	Expected sign	(A) Equation 2	(B) Equation 3	(C) Equation 4	(D) Equation 5
Intercept		8.298***	1.9485*	1.9883***	4.9099***
		(2.4667)	(1.0628)	(0.7672)	(1.3211)
FVB	?	-4.0931	0.3446	0.1138	-0.7561
		(3.5628)	(1.8672)	(0.8826)	(2.4942)
FVF	?	0.3881**	-0.4903***	0.5003***	-0.1273
		(0.1871)	(0.1475)	(0.0363)	(0.1554)
BIOTA	+	-0.1151	0.0772	0.1381	-0.1531
		(0.2542)	(0.2183)	(0.2790)	(0.2050)
CREV	+	0.9789	-0.9349***	-0.3626	-0.1860
		(1.2270)	(0.3298)	(0.2936)	(0.9011)
log*TA*	?	-0.9042***	-0.1114	-0.1602*	-0.4796***
		(0.2415)	(0.1209)	(0.0863)	(0.1500)
CRISIS	+	-0.1510***	-0.0081	0.0570	0.0542
		(0.0446)	(0.0513)	(0.0391)	(0.0766)
FVB·BIOTA	?	0.0587	-0.7147***	-0.5281*	-0.2142
		(0.4590)	(0.2705)	(0.2963)	(0.3160)
FVB·CREV	?	-1.5566	1.2263***	-0.5001	-0.9261
		(1.6901)	(0.4042)	(0.3904)	(1.3169)
FVB·log*TA*	?	0.4538	0.0020	-0.0097	0.1333
		(0.3409)	(0.2044)	(0.0945)	(0.2535)
FVB·CRISIS	?	0.3572***	0.1232	-0.0403	-0.00001
		(0.1162)	(0.1038)	(0.0803)	(0.0942)
EU	-	-0.0689	-0.1603**	-0.0123	-0.0378
		(0.3051)	(0.0705)	(0.0475)	(0.2470)
EAST	-	0.3484	-0.0146	-0.0352	0.2426
		(0.2964)	(0.1203)	(0.0724)	(0.2633)
AMERICA	-	-1.0690 ***	-0.0217	-0.7934 ***	0.0629
		(0.3778)	(0.2596)	(0.1061)	(0.2801)
Fitness of the model					
R^2		0.4788	0.6046	0.4615	0.4604
χ^2		.	.	.	.
Number of firms		10	10	10	10
Number of observations		97	97	97	105

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01.

Abbreviations: FVB = a dummy variable indicating FV for biological assets; FVF = a dummy variable indicating FV for financial instruments; BIOTA = the ratio of biological assets to total assets; CREV = the coefficient of variation of revenues; TA = total assets; CRISIS = a dummy variable indicating that a given observation is in a period of economic downturn (2007–2013), EU, EAST and AMERICA = dummy variables indicating geographical areas.

CHAPTER 7. CONCLUSIONS, DISCUSION, IMPLICATIONS AND FUTURE RESEARCH LINES OF THE EMPIRICAL ANALYSIS ON THE PREDICTIVE ABILITY OF BIOLOGICAL ASSETS MEASURED AT FAIR VALUE

7.1. Conclusions

Most of the current discussion on FV focuses on the relevance and reliability of reported values for financial instruments. There is no general consensus on the conceptual merits of FV valuation method. On the one hand, proponents of FV argue that the relevance of the financial statements for the decision-making process would be better under FV. This can be explained by the fact that the users of the financial statements can appreciate the management's performance in each period, in association to changes in the market. On the other hand, opponents contend that the reliability of financial reporting would decrease because of the immediate recognition in the profit or loss account of any change in the FV leads to higher volatility of the annual result and higher prediction risk for users of financial statements. Academics and accounting standard setters point out that there are neither clear benefits nor empirical evidence on whether relevance, volatility or earnings management are improved or worsened when applying FV valuation.

Accounting for biological assets and in particular bearer biological assets has deserved less attention with respect to this discussion and empirical research on the subject. Moreover, the relevance of financial information in terms of its predictive power has been scarcely studied. In this study, I present a bibliometric analysis of accounting research searching by the keywords "value relevance" and "fair value". Research shows that the subject of the search is currently of interest in the literature, as shown by the high number of articles published during the last years of the search. The most significant topic of the search is Financial Accounting, the most relevant method in this area is Archival, and the main source discipline is Business, Finance. Being JAE the most important journal with the most cited articles and the second with more articles published in the search. The vast majority of authors published just one article and there is collaboration between researchers. This information should be useful to decision-makers in multiple settings that consult and produce research publications to related accounting literature (e.g. PhD. students, accounting departments, business schools, universities). Second, I perform an empirical analysis of the relevance of FV for the prediction of future CFO, employing an international sample of agricultural firms with biological assets. I find that, in itself FV valuation of biological assets does not influence the relevance of accounting information, but changes the unpredictable nature of biological assets into a positive influence to predict future cash flows. The share of biological assets to total assets is positively related with prediction inaccuracy when biological assets are measured at HC, while the relationship becomes negative when FV is the measurement criterion. These results are robust to different measures of prediction inaccuracy, as well as to a likely improvement in the relevance of accounting information regardless of FV, but they are inconclusive when we consider

the subsample of European countries after the adoption of the IFRS. There is neither moderating nor stressing effect through sales variability, size or the context of the recent financial crisis. These final results provide limited evidence on the positive effect of measuring bearer plants at FV on the prediction of future cash flows. However, after the application of the recent Amendment to IAS 41, issued in 2014 and effective from 2016, the accounting treatment for biological assets in the form of bearer biological assets and held more than one year allows entities the use of a cost or revaluation model for mature bearer plants, instead of fair valuation model. Given the results obtained, this study concludes that there is partial evidence on the positive impact of FV for bearer biological assets on the prediction of future cash flows, and therefore there is no empirical support for the amendments to IAS 41 requiring the shift from FV to HC measurement for bearer plants.

Overall, this research provides some clarity concerning standards that have recently been amended. These findings are of potential interest to regulators, because I assess the effects of the implementation of IAS 41, as well as its amendment with respect to bearer plants. They are also interesting to analysts, as I provide empirical evidence of the influence of FV for biological assets on the prediction of future cash flows. Lastly, this study will help stakeholders to better understand measurement practices and statement preparers become more aware of the valuation implications of biological assets and bearer plants.

In conclusion, opponents to FV state that there are many difficulties for the practical implementation of IAS 41. Moreover, there is little research on the valuation problems of accounting for biological assets at FV in developing countries. However, agriculture could be considered a specialised industry with its own drawbacks, where FV accounting would be beneficial.

7.2. Limitations

These results should be interpreted with caution since they are based on the specific characteristics of the employed sample. This sample includes big and audited companies, but small and medium-size entities that can be particularly representative in this sector were excluded. Also, there is a heterogeneous group of farms with respect to countries and geographical contexts. Given our sample characteristics, it was assumed that biological assets included in the subsample are predominantly bearer plants, taking into consideration only biological assets in their fixed assets.

As previously mentioned, our findings are not robust enough for the setting of homogeneous and quality accounting standards, such as the results for the subsample of firms located in EU and data since the implementation of IFRS. Results are not conclusive with respect to bearer plants either. Moreover, these results could also be biased because we convert all currencies into US $ and 2013 values.

7.3. Suggestion for future research

Further research on this area could replicate this analysis with larger samples and more precise, larger samples with firms explicitly growing and harvesting fruits from bearer plants. Also, more research is needed including more homogeneous samples. For example, using larger samples with observations limited to firms located in EU and data after the implementation of IFRS in 2005.

The recent Amendment to IAS 41 generates the need of future research related to the effect on the comparability of financial statements, whether they improve financial reporting and consequently decision-making process. The reclassification of some biological assets to the property, plant and equipment, the new identification of the bearer plants, the valuation and the effect of such classification on the usefulness of financial reports can be further explored. Significant clarifications remain necessary on accounting before supporting HC accounting for bearer plants. The impact of the amendment on the agricultural sector deserves future research, particularly to determine whether its implementation increases the ability to predict future cash flows.

Altogether, as it was said by Laux and Leuz (2009, p. 833) 'the fair-value debate is far from over and much remains to be done'.

APPENDICES

Appendix 1. Articles found searching for "value relevance" AND "fair value" in WoS over the period 1994-2016 ranked alphabetically by authors' name.

Authors	Title	Journal	Citations	Year	Citations/ Year
Agarwal, V; Taffler, RJ; Bellotti, X; Nash, EA	Investor relations, information asymmetry and market value	ABR	4	2016	2
Ahmed, AS; Kilic, E; Lobo, GJ	Does recognition versus disclosure matter? Evidence from value-relevance of banks' recognized and disclosed derivative financial instruments	TAR	75	2006	6.33
Allen, A; Ramanna, K	Towards an understanding of the role of standard setters in standard setting	JAE	14	2013	2.8
Anand, P	Procedural fairness in economic and social choice: Evidence from a survey of voters	JEP	31	2001	1.82
Arora, N; Richardson, S; Tuna, I	Asset reliability and security prices: evidence from credit markets	RAS	7	2014	1.75
Badenhorst, WM; Brummer, LM; de Wet, JHV	The value-relevance of equity accounted carrying amounts and disclosed fair values of listed associates	AAR	0	2016	0
Ball, R	IFRS - 10 years later	ABR	0	2016	0
Barker, R; Mcgeachin, A	Why is there inconsistency in accounting for liabilities in IFRS? An analysis of recognition, measurement, estimation and conservatism	ABR	9	2013	1.8
Barth, M; Taylor, D	In defence of fair value: Weighing the evidence on earnings management and asset securitizations	JAE	14	2010	2.12
Barth, ME	Measurement in financial reporting: The need for concepts	AH	8	2014	2
Barth, ME	Fair value accounting - evidence from investment securities and the market valuation of banks	TAR	145	1994	6.17
Barth, ME; Beaver, WH; Landsman, WR	The relevance of the value relevance literature for financial accounting standard setting: another view	JAE	288	2001	17.12
Barth, ME; Beaver, WH; Landsman, WR	Value-relevance of banks' fair value disclosures under SFAS No 107	TAR	129	1996	5.95
Barth, ME; Hodder, LD; Stubben, SR	Fair value accounting for liabilities and own credit risk	TAR	45	2008	4.5
Barth, ME; Kasznik, R; McNichols, MF	Analyst coverage and intangible assets	JAR	224	2001	13.24
Barth, ME; Landsman, WR	How did financial reporting contribute to the financial crisis?	EAR	81	2010	10.5
Beaver, WH	Perspectives on recent capital market research	TAR	60	2002	3.75

Bens, DA; Cheng, M; Neamtiu, M	The impact of sec disclosure monitoring on the uncertainty of fair value estimates	TAR	1	2016	0.5
Bhat, G; Ryan, SG	The impact of risk modeling on the market perception of banks' estimated fair value gains and losses for financial instruments(star)	AOS	1	2015	0.33
Biondi, Y; Giannoccolo, P	Share price formation, market exuberance and financial stability under alternative accounting regimes	JEIC	2	2015	0.67
Bischof, J; Daske, H; Sextroh, C	Fair value-related information in analysts' decision processes: Evidence from the financial crisis	JBFA	7	2014	1.75
Bissessur, S; Hodgson, A	Stock market synchronicity - an alternative approach to assessing the information impact of Australian IFRS	AF	6	2012	1
Blankespoor, E; Linsmeier, TJ; Petroni, KR; Shakespeare, C	Fair value accounting for financial instruments: Does it improve the association between bank leverage and credit risk?	TAR	16	2013	3.2
Bloomfield, R; Nelson, MW; Soltes, E	Gathering data for archival, field, survey, and experimental accounting research	JAR	8	2016	4
Bolivar, MPR; Galera, AN	The role of fair value accounting in promoting government accountability	ABA	2	2012	0.33
Bolivar, MPR; Galera, AN	Could fair value accounting be useful, under NPM models, for users of financial information?	IRAS	8	2007	0.73
Bolivar, MPR; Galera, AN; Quiles, FA	The improvement of financial accountability for modernization of public sector in emerging countries of Latin America	RCLAD	0	2014	0
Boone, JP	Revisiting the reportedly weak value relevance of oil and gas asset present values: The roles of measurement error, model misspecification, and time-period idiosyncrasy	TAR	9	2002	0.56
Botosan, CA; Huffman, AA	Decision-useful asset measurement from a business valuation perspective	AH	2	2015	0.67
Bratten, B; Causholli, M; Khan, U	Usefulness of fair values for predicting banks' future earnings: evidence from other comprehensive income and its components	RAS	1	2016	0.5
Bratten, B; Jennings, R; Schwab, CM	The accuracy of disclosures for complex estimates: Evidence from reported stock option fair values	AOS	1	2016	0.5
Brousseau, C; Gendron, M; Belanger, P; Coupland, J	Does fair value accounting contribute to market price volatility? An experimental approach	AF	2	2014	0.5
Brown, LD; Lee, YJ	Changes in option-based compensation around the issuance of SFAS 123R	JBFA	11	2011	1.57
Campbell, JL	The fair value of cash flow hedges, future profitability, and stock returns	CAR	5	2015	1.67
Cardao-Pito, T; Barros, J	The application of "fair value" accounting standards to the income statements of companies listed in the Portuguese Stock Index-20 (PSI-20)	RBGN	1	2016	0.5

Chalmers, K; Godfrey, JM	Reputation costs: the impetus for voluntary derivative financial instrument reporting	AOS	33	2004	2.43
Chen, W; Tan, HT; Wang, EY	Fair value accounting and managers' hedging decisions	JAR	5	2013	1
Cheng, K	Accounting discretion and fair value reporting: A study of us banks' fair value reporting of mortgage-backed-securities	JBFA	3	2012	0.5
Choudhary, P	Evidence on differences between recognition and disclosure: A comparison of inputs to estimate fair values of employee stock options	JAE	20	2011	2.86
Christensen, BE; Glover, SM; Wood, DA	Extreme estimation uncertainty in fair value estimates: Implications for audit assurance	AUD	29	2012	4.83
Christensen, HB; Nikolaev, VV	Does fair value accounting for non-financial assets pass the market test?	RAS	17	2013	3.4
Cormier, D; Lapointe-Antunes, P; Magnan, M	Revisiting the relevance and reliability of Non-GAAP reporting: The case of the income trusts	CAR	2	2011	1
da Silva, FN; Ribeiro, AM; do Carmo, CHS	Is fair value accounting effect relevant to earnings? A study of companies within biological assets segment between 2010 and 2013.	CAO	0	2015	0
Danbolt, J; Rees, W	An experiment in fair value accounting: UK investment vehicles	EAR	16	2008	1.8
De George, ET; Li, X; Shivakumar, L	A review of the IFRS adoption literature	RAS	4	2016	2
Dechow, PM; Sloan, RG; Zha, J	Stock prices and earnings: A history of research	ARFE	2	2014	0.5
Demerjian, PR; Donovan, J; Larson, CR	Fair value accounting and debt contracting: Evidence from adoption of SFAS 159	JAR	1	2016	0.5
Dichev, ID; Graham, JR; Harvey, CR; Rajgopal, S	Earnings quality: Evidence from the field	JAE	81	2013	16.4
Dichev, ID; Tang, VW	Matching and the changing properties of accounting earnings over the last 40 years	TAR	49	2008	4.9
Dong, MY; Ryan, S; Zhang, XJ	Preserving amortized costs within a fair-value-accounting framework: reclassification of gains and losses on available-for-sale securities upon realization	RAS	6	2014	1.5
D'Souza, J; Jacob, J; Soderstrom, NS	Nuclear decommissioning costs: The impact of recoverability risk on valuation	JAE	5	2000	0.28
Durocher, S; Gendron, Y	Epistemic commitment and cognitive disunity toward fair-value accounting	ABR	9	2014	2.25
Eccher, EA; Ramesh, K; Thiagarajan, SR	Fair value disclosures by bank holding companies	JAE	72	1996	3.32
Eng, LL; Saudagaran, S; Yoon, S	A note on value relevance of mark-to-market values of energy contracts under EITF Issue No. 98-10	JAPP	2	2009	0.22

Erb, C; Pelger, C	Twisting words? A study of the construction and reconstruction of reliability in financial reporting standard-setting	AOS	0	2015	0
Evans, ME; Hodder, L; Hopkins, PE	The predictive ability of fair values for future financial performance of commercial banks and the relation of predictive ability to banks' share prices	CAR	7	2014	1.75
Friedman, A	Beyond accountability for reasonableness	BIO	29	2008	2.9
Galera, AN; Bolivar, MPR	Modernizing governments in transitional and emerging economies through financial reporting based on international standards	IRAS	1	2011	0.14
Gebhardt, G	Financial instruments in non-financial firms: what do we know?	ABR	11	2012	1.83
Gjerde, O; Knivsfla, K; Saettem, F	The value relevance of financial reporting in Norway 1965-2004	SJM	8	2011	1.14
Guthrie, K; Irving, JH; Sokolowsky, J	Accounting choice and the fair value option	AH	8	2011	1.14
Hail, L	Financial reporting and firm valuation: relevance lost or relevance regained?	ABR	14	2013	2.8
Hann, RN; Heflin, F; Subramanayam, KR	Fair-value pension accounting	JAE	39	2007	3.55
Hirst, DE; Hopkins, PE; Wahlen, JM	Fair values, income measurement, and bank analysts' risk and valuation judgments	TAR	49	2004	3.57
Hirsto, H	Everyday discourses of stock market investing: Searching for investor power and responsibility	CMC	7	2011	1
Hodder, LD; Hopkins, PE	Agency problems, accounting slack, and banks' response to proposed reporting of loan fair values*	AOS	5	2014	1.25
Hodder, LD; Hopkins, PE; Wahlen, JM	Risk-relevance of fair-value income measures for commercial banks	TAR	47	2006	4
Holthausen, RW; Watts, RL	The relevance of the value-relevance literature for financial accounting standard setting	JAE	371	2001	22
Huang, HW; Lin, S; Raghunandan, K	The volatility of other comprehensive income and audit fees	AH	0	2016	0
Hung, M; Subramanayam, KR	Financial statement effects of adopting international accounting standards: the case of Germany	RAS	132	2007	12.18
Israeli, D	Recognition versus disclosure: evidence from fair value of investment property	RAS	3	2015	1
Jarva, H	Do firms manage fair value estimates? An examination of SFAS 142 goodwill impairments	JBFA	23	2009	2.56
Jung, BC; Shane, PB; Yang, YS	Do financial analysts' long-term growth forecasts matter? Evidence from stock recommendations and career outcomes	JAE	8	2012	1.33

Kadous, K; Koonce, L; Thayer, JM	Do financial statement users judge relevance based on properties of reliability?	TAR	8	2012	1.5
Kadous, K; Leiby, J; Peecher, ME	How do auditors' weight informal contrary advice? The joint influence of advisor social bond and advice justifiability	TAR	11	2013	2.2
Kanagaretnam, K; Mathieu, R; Shehata, M	Usefulness of comprehensive income reporting in Canada	JAPP	32	2009	3.56
Kimbrough, MD	The influences of financial statement recognition and analyst coverage on the market's valuation of R&D capital	TAR	17	2007	1.55
Kirsch, HJ; Dettenrieder, D; Ewelt-Knauer, C; Kohling, K	Extent of fair value accounting - A Descriptive analysis of listed companies of DAX 30	BFP	0	2015	0
Koonce, L; Nelson, KK; Shakespeare, CM	Judging the relevance of fair value for financial instruments	TAR	13	2011	1.86
Kothari, SP; Lester, R	The role of accounting in the financial crisis: lessons for the future	AH	18	2012	3
Kothari, SP; Ramanna, K; Skinner, DJ	Implications for GAAP from an analysis of positive research in accounting	JAE	97	2010	12.12
Kuhner, C; Pelger, C	On the relationship of stewardship and valuation an analytical viewpoint	ABA	1	2015	0.33
Lachmann, M; Stefani, U; Wohrmann, A	Fair value accounting for liabilities: Presentation format of credit risk changes and individual information processing	AOS	2	2015	0.67
Laux, C	Financial instruments, financial reporting, and financial stability	ABR	11	2012	1.83
Laux, C; Leuz, C	The crisis of fair-value accounting: Making sense of the recent debate	AOS	142	2009	16
Lawrence, A; Siriviriyakul, S; Sloan, RG	Who's the fairest of them all? Evidence from closed-end funds	TAR	1	2016	0.5
Lev, B; Li, SY; Sougiannis, T	The usefulness of accounting estimates for predicting cash flows and earnings	RAS	23	2010	2.88
Linsmeier, TJ	Revised model for presentation in statement(s) of financial performance: potential implications for measurement in the conceptual framework	AH	0	2016	0
Linsmeier, TJ	A Standard setter's framework for selecting between fair value and historical cost measurement attributes: a basis for discussion of "Does fair value accounting for nonfinancial assets pass the market test?"	RAS	4	2013	0.8
Livne, G; Markarian, G; Milne, A	Bankers' compensation and fair value accounting	JCF	10	2011	1.43
Livne, G; McNichols, M	An empirical investigation of the true and fair override in the United Kingdom	JBFA	6	2009	0.67
Magnan, M; Menini, A; Parbonetti, A	Fair value accounting: information or confusion for financial markets?	RAS	4	2015	1.33
Mala, R; Chand, P	Effect of the global financial crisis on accounting convergence	AF	12	2012	2

Malone, L; Tarca, A; Wee, M	IFRS non-GAAP earnings disclosures and fair value measurement	AF	1	2016	0.5
Mazza, CR; Hunton, JE; McEwen, RA	Fair value (US GAAP) and entity-specific (IFRS) measurements for performance Obligations: The potential mitigating effect of benchmarks on earnings management	JBF	1	2011	0.14
McAnally, ML; McGuire, ST; Weaver, CD	Assessing the financial reporting consequences of conversion to IFRS: The case of equity-based compensation	AH	8	2010	1
Muller, MA; Riedl, EJ; Sellhorn, T	Recognition versus disclosure of fair values	TAR	5	2015	1.67
Munchen, WB; Saarbrucken, KK; Passau, TS	Fair value - Worthy valuation objective in reform of the business accounting	BFP	0	2004	
Nguyen, T; Molinari, P	Accounting for "insurance contracts" according to IASB Exposure Draft - Is the information useful?	GPRIP	1	2013	0.2
Niu, F; Xu, BX	Does recognition versus disclosure really matter? Evidence from the market valuation of recognition of employee stock option expenses	AJAE	9	2009	1
Nobes, CW; Stadler, C	The qualitative characteristics of financial information, and managers' accounting decisions: evidence from IFRS policy changes	ABR	0	2015	0
Palea, V	The politics economy of fair value reporting and the governance of the standards-setting process: Critical issues and pitfalls from a European perspective	CPA	4	2015	1.33
Palea, V; Maino, R	Private equity fair value measurement: A critical perspective on IFRS 13	AAR	14	2013	0.8
Papadamou, S; Tzivinikos, T	The risk relevance of International Financial Reporting Standards: Evidence from Greek banks	IRFA	4	2013	0.8
Pelger, C	Practices of standard-setting - An analysis of the IASB's and FASB's process of identifying the objective of financial reporting	AOS	3	2016	1.5
Petroni, KR; Wahlen, JM	Fair values of equity and debt securities and share prices of property-liability insurers	JRI	40	1995	1.74
Pinnuck, M	A review of the role of financial reporting in the global financial crisis	AAR	11	2012	1.83
Pirson, M; Malhotra, D	Unconventional insights for managing stakeholder trust	MSMR	18	2008	1.8
Quagli, A; Avallone, F	Fair value or cost model? Drivers of choice for IAS 40 in the real estate industry	EAR	11	2010	1.5
Riedl, EJ; Serafeim, G	Information risk and fair values: An examination of equity betas	JAR	28	2011	4
Roggi, O; Giannozzi, A	Fair value disclosure, liquidity risk and stock returns	JBF	1	2015	0.33

Ryan, SG	Risk reporting quality: implications of academic research for financial reporting policy	ABR	8	2012	1.33
Ryan, SG	Accounting in and for the Subprime Crisis	TAR	106	2008	10.7
Sarmento, ML; Farhangmehr, M; Simoes, C	A relationship marketing perspective to trade fairs: insights from participants	JBIM	2	2015	0.67
Shalev, R; Zhang, IX; Zhang, Y	CEO compensation and fair value accounting: Evidence from purchase price allocation	JAR	17	2013	3.4
Shivakumar, L	The role of financial reporting in debt contracting and in stewardship	ABR	15	2013	3.2
Silva, ACDE; Machado, MAV; Machado, MR	Historical cost X fair value: which information is more relevant on the measurement of biological assets?	CAO	1	2013	0.2
So, S; Smith, M	Value-relevance of presenting changes in fair value of investment properties in the income statement: evidence from Hong Kong	ABR	8	2009	0.89
Song, CJ; Thomas, WB; Yi, H	Value relevance of FAS No. 157 fair value hierarchy information and the impact of corporate governance mechanisms	TAR	85	2010	10.75
Sutton, DB; Cordery, CJ; van Zijl, T	The purpose of financial reporting: The case for coherence in the conceptual framework and standards	ABA	0	2015	0
Tirado-Beltran, JM	Accounting value and the financial crisis: Spanish credit entities	INN	0	2011	0
Valencia, A; Smith, TJ; Ang, J	The effect of noisy fair value measures on bank capital adequacy ratios	AH	2	2013	0.4
Venkatachalam, M	Value-relevance of banks' derivatives disclosures	JAE	74	1996	3.41
Watts, RL; Zuo, L	Understanding practice and institutions: A historical perspective	AH	0	2016	0
Wier, HA	Fair value or conservatism: The case of the gold industry	CAR	3	2009	0.44
Wu, RCF; Hsu, AWH	Value Relevance of Embedded Value and IFRS 4 Insurance Contracts	GPRIP	3	2011	0.43
Y Zhang, J Andrew, K Rudkin	Accounting as an instrument of neoliberalisation? Exploring the adoption of fair value accounting in China	AAAJ	13	2012	2.17
Yoo, C; Yang, D; Kim, H; Heo, E	Key Value Drivers of Startup Companies in the New Media Industry-The Case of Online Games in Korea	JME	1	2012	0.17
Zulch, H; Wersborg, TSG; Detzen, D	Plausiblity Checks of a Purchase Price Allocation according to IFRS 3-Theoretical Background and Illustrative Example	BFP	0	2015	0
Wu, RCF; Hsu, AWH	Value Relevance of Embedded Value and IFRS 4 Insurance Contracts	GPRIP	3	2011	0.43
Y Zhang, J Andrew, K Rudkin	Accounting as an instrument of neoliberalisation? Exploring the adoption of fair value accounting in China	AAAJ	13	2012	2.17

Yoo, C; Yang, D; Kim, H; Heo, E	Key Value Drivers of Startup Companies in the New Media Industry-The Case of Online Games in Korea	JME	1	2012	0.17
Zulch, H; Wersborg, TSG; Detzen, D	Plausiblity Checks of a Purchase Price Allocation according to IFRS 3-Theoretical Background and Illustrative Example	BFP	0	2015	0

Abbreviations: Citations = Total number of citations received by articles in the search according to WoS (accessed 21-10-2017); Year = Year of article publication; Citations/Year = Total amount of citations per year; AAAJ = Accounting Auditing and Accountability Journal; AAR = Australia Accounting Review; ABA = Abacus: A Journal of Accounting and Business Studies; ABR = Accounting and Business Research; AF = Accounting and Finance; AH = Accounting Horizons; AOS = Accounting, Organizations and Society; APJAE = Asia-Pacific Journal of Accounting & Economics; ARFE = Annual Review of Financial Economics; AUD = Auditing-A Journal of Practice & Theory; BFP = Betriebswirtschaftliche Forschung und Praxis; BIO = Bioethics; CAL = Custos e Agronegocio on Line; CAR = Contemporary Accounting Research; CMC = Consumption Markets and Culture; CPA = Critical Perspectives on Accounting; EAR = European Accounting Review; GPRIP = Geneva Papers on Risk and Insurance-Issues and Practice; INN = Innovar-Revista de Ciencias Administrativas y Sociales; IRAS = International Review of Administrative Sciences; IRFA = International Review of Financial Analysis; JAE = Journal of Accounting and Economics; JAPP = Journal of Accounting and Public Policy; JAR = Journal of Accounting Research; JBEF = Journal of Behavioral Finance; JBF = Journal of Banking & Finance; JBFA = Journal of Business Finance and Accounting; JBIM = Journal of Business & Industrial Marketing; JCF = Journal of Corporate Finance; JEIC = Journal of Economic Interaction and Coordination; JEP = Journal of Economic Psychology; JME = Journal of Media Economics; JRI = Journal of Risk and Insurance; MSMR = Mit Sloan Management Review; RAS = Review of Accounting Studies; RBGN = RBGN-Revista Brasileira de Gestao de Negocios; RCRD = Revista del Clad Reforma y Democracia; SJM = Scandinavian Journal of Management; and TAR = The Accounting Review.

Appendix 2. Abbreviations

AAAJ	Accounting Auditing and Accountability Journal
AAR	Australia Accounting Review
AASB	Australian Accounting Standards Board
ABA	Abacus: A Journal of Accounting and Business Studies
ABR	Accounting and Business Research
AF	Accounting and Finance
AH	Accounting Horizons
AIS	Accounting Information Systems
AOS	Accounting, Organizations and Society
APJAE	Asia-Pacific Journal of Accounting & Economics
ARFE	Annual Review of Financial Economics
AUD	Auditing-A Journal of Practice & Theory
BFP	Betriebswirtschaftliche Forschung und Praxis
BIO	Bioethics
CAL	Custos e Agronegocio on Lin
CAR	Contemporary Accounting Research
CAR	Contemporary Accounting Research
CFO	Cash Flows from Operations
CMC	Consumption Markets and Culture
CPA	Critical Perspectives on Accounting
EAR	European Accounting Review
FADN	Farm Accountancy Data Network
FASB	Financial Accounting Standards Board
SFAS	Statements of Financial Accounting Standards
FCAG	Financial Crisis Advisory Group
FV	Fair Value
GPRIP	Geneva Papers on Risk and Insurance-Issues and Practice
HC	Historical Cost
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IASC	International Accounting Standards Committee
INN	Innovar-Revista de Ciencias Administrativas y Sociales
IPSASB	International Public Sector Accounting Standards Board
IRAS	International Review of Administrative Sciences
IRFA	International Review of Financial Analysis
ISI	Institute for Scientific Information
JAE	Journal Accounting and Economics
JAPP	Journal of Accounting and Public Policy
JAR	Journal of Accounting Research
JBEF	Journal of Behavioral Finance
JBF	Journal of Banking & Finance
JBFA	Journal of Business Finance and Accounting
JBIM	Journal of Business & Industrial Marketing
JCF	Journal of Corporate Finance

JCR	Journal Citation Reports
JEIC	Journal of Economic Interaction and Coordination
JEP	Journal of Economic Psychology
JME	Journal of Media Economics
JRI	Journal of Risk and Insurance
MSMR	Mit Sloan Management Review
PCGA	French 'Plan Comptable Général Agricole'
PI	Prediction Inacuracy
RAS	Review of Accounting Studies
RBGN	RBGN-Revista Brasileira de Gestao de Negocios
RCRD	Revista del Clad Reforma y Democracia
SJM	Scandinavian Journal of Management
SSCI	Social Science Citation Index
TAR	The Accounting Review
TAR	The Accounting Review
USA	United States of America
WoS	Web of Science

Appendix 3. Outcomes of the Ph.D. dissertation

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