USEFULNESS OF FAIR VALUE FOR CASH FLOW PREDICTION: EVIDENCE FROM BIOLOGICAL ASSETS

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USEFULNESS OF FAIR VALUATION OF BIOLOGICAL ASSETS FOR CASH FLOW PREDICTION

ABSTRACT

This study develops an empirical analysis of the relevance of accounting information when biological assets are measured at fair value. We use an international sample of firms with biological assets. We find that biological assets influence unpredictability when they are measured at historical cost (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 fair value (FV) switches this negative influence of biological assets to a positive one. We 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 is robust to different measures of prediction accuracy, as well as to the improvement of accounting standards, regardless of FV, over time. The evidence is weaker for bearer plants.

KEYWORDS

Biological assets, cash flow prediction, fair value, historical cost, prediction accuracy, prediction inaccuracy, agricultural accounting

1. Introduction

Our 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 FV versus HC. We adopt the FASB (2010) conceptual framework which specifies that the objective of financial reporting is to provide decision-useful information, which includes information that would be relevant by its predictive value of the amounts, timing, and uncertainty of the prospects for future cash flows. Important institutions and regulators in accounting, such as the International Accounting Standards Board (IASB) and the Financial Accounting Standards Board (FASB) have taken positions to converge to unified accounting standards, based on the valuation at FV, considering that it allows a better assessment of assets and liabilities (IASB, 2006). However, there is 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 (i.e. Liang & Wen, 2007; and Ronen, 2008), that it requires more subjective judgments, bringing inaccuracy and uncertainty of the accounting information (Plantin & Sapra, 2008), and that it contributed pro-cyclically to the 2007 financial crisis (Laux & Leuz, 2009). In contrast, proponents of FV criticise the questionable benefits of HC, arguing that it increases volatility (Bleck & Liu, 2007), that FV provides more relevant information to investors (Khurana & Kim, 2003; Ryan, 2008), and that it offers a more appropriate platform to forecast future earnings and cash flows (Bratten et al., 2012).

Most previous empirical studies on the convenience of FV versus HC refer to financial instruments and focus on its relevance, usually analysing the association between accounting values and market values (e.g. Barth, 1994; Barth & Clinch, 1998; Hitz, 2007). However, fewer studies examine the relevance from the point of view of the predictability of accounting information (e.g. Chen et al., 2006; Hail, 2013, Evans et al., 2014) and, in particular, of the predictability of future earnings and future cash flows (e.g. Laswad & Baskerville, 2007; Bratten et al. 2012).

The International Accounting Standards Committee (IASC) 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 less costs to sell, and valuation changes to be recognised in the net profit or loss for the period in which they arise. 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 (Bohusova et al., 2012). The debate on the convenience of FV versus HC has also been extended to agriculture since then, again with controversial stances and findings. We 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 our knowledge, only two studies analyze the predictive power of biological assets measured at FV. On the one hand, the unpublished paper by He et al. (2011) compared different methods of FV measurement, but it did not perform direct comparison of the predictive power of FV versus HC estimates. On the other hand, Argilés et al. (2011) used a sample of non-audited accounts of Spanish small agricultural holdings, with very few of them applying FV, which results are subject to limitations of both, the quality of the accounting information disclosed by small firms, and the low number of farms using FV in this sample.

This study extends prior literature by examining whether the ability of accounting data to predict future cash flows is affected by the use of FV versus HC in measuring biological assets. We use a sample comprising 794 firm-year observations for the period 1992-2013. The observations correspond to 84 companies from 21 different countries. We find that in itself fair valuation of biological assets does not affect the ability of accounting data to predict future cash flows.

We 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. We 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 is robust to different measures of prediction accuracy, as well as to 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, we 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.

This paper makes three main contributions. First, we contribute extending the scarce extant empirical research on the predictive power of FV with respect to HC. Second, we contribute with an empirical research on agricultural accounting, more precisely on the comparative ability of valuing biological assets at 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 multivariate analysis. Third, we contribute testing the appropriateness of the recent amendment of the IAS 41 with respect to bearer plants.

We believe that our study provides insights for regulators, as well as for researchers and practitioners, in relation to the adoption of FV for biological assets.

The remainder of the paper is organised as follows: we first review previous literature and raise hypotheses, then outline the methodology applied, present sample selection and descriptive statistics, explain results and additional analysis on bearer plants, and finally present conclusions, limitations and orientations for future research.

2. Literature review and hypotheses

As mentioned, previous empirical studies on the relevance of accounting information analyse the statistical association between the accounting numbers and market values of equity. 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 et al. (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 provided by HC values, while in a similar study Nelson (1996) found no reliable evidence of incremental explanatory power for the FV disclosures of loans, deposits, long-term debt or net off-balance sheet financial instruments with respect to HC. On the other hand, Barth & Landsman (1995) concluded that when assets are traded 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 & 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 for 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 conveyed 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 sparse. 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 et al. (2014), with a sample of US financial institutions found that FV adjustments for investment securities have predictive ability for subsequent realized income, as well as for bank's share prices. Campbell (2015) found a negative relationship between unrealized 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, providing also similar mixed and incomplete evidence. Aboody et al. (1999) evidenced that fixed assets revaluations by UK firms are positively related to changes in future operating income and cash flows. Using a sample of New Zealand benefit pension plans, Laswad & 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 did not analyse the influence of FV on future cash flows. Moreover, they merely performed a univariate analysis. Bratten et al. (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 to two and three years ahead cash flows. They did not find enhanced association between current period pre-tax earnings and one-year ahead 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- and three-year ahead pre-tax earnings. Chen et al. (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 toward 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.

The research on the usefulness and convenience of FV for biological assets and agriculture is also scarce and controversial. Argilés & Slof (2001) argued that the implementation of FV brings simplicity for the predominant small family farms in the EU, with no resources and skills to perform accounting procedures and HC cost calculations for biological assets. They suggested that the Farm Accountancy Data Network procedures could be a guideline for implementing IAS 41. In contrast, opponents have focused on practical difficulties, particularly when an active market does not exist. Elad (2004) complained that the lack of active markets for most biological assets make difficult the application of the IAS 41, and that even with active markets, its application may be excessively costly, particularly in developing countries. Herbohn & Herbohn (2006) and Dowling & Godfrey (2001) identified some negative effects in the implementation of the Australian Accounting Standard Board 1037 (requiring FV for biological assets): subjectivity in FV measurement, the inclusion of unrealised gains in net annual profit, and increased income volatility.

To our knowledge there are only two empirical papers testing the ability of accounting data, when biological assets are measured at FV, to predict future cash flows. The unpublished paper by He et al. (2011) deals 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. However, they did not compare the predictive power of FV with respect to HC. Additionally, they recognise 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. Argilés et al. (2011) found significant higher predictive power of FV versus HC for future earnings, but not for cash flows. They used a sample of non-audited financial statements of small Spanish agricultural households, in which they found evidence of the existence of flawed and unskilled HC valuation practices for biological assets. Moreover, their subsample of farms using FV was very small.

While the empirical research is inconclusive, most arguments support the greater predictive ability of FV. Proponents of FV argue 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 argue that market efficiency would be enhanced when decisions are taken upon information reported at FV (CFA 2007: 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) argue that, as a consequence 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 et al., 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.

On the contrary, critics of FV claim 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). Plantin and Sapra (2008) warn that FV may degrade its informative content by incorporating purely speculative price fluctuations. 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) argue that fair value changes are inherently unpredictable, and consequently, a full FV reporting model incorporating unrealized gains and losses into firm income hinders predictability. This may be particularly important in the agricultural industry, characterized by a volatile environment due to especial and increasing unpredictable climate and market conditions (FAO et al, 2011; European Parliament, 2016). Subsequently, the valuation of biological assets at FV is a source of confusion for the prediction of cash flow.

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

H1. Measurement of biological assets at FV is associated with lower cash flow prediction accuracy (i.e.: with higher prediction inaccuracy) than measurement at HC.

H2. Measurement of biological assets at FV is associated with higher cash flow prediction accuracy (i.e.: with lower prediction inaccuracy) than measurement at HC.

3. Empirical Model

As explained, 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, as compared to HC, in valuing the biological assets (*FVB*), but also on additional control variables, such as the use of FV in valuing 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*). We 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 we use the same variable indicating the error term in all equations used in this paper.

We use different measures for our dependent variable. We build it with the residuals from several prediction models. We 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 et al. (2012) also used similar model. Accordingly, we formulate the following model for predicting future *CFO*:

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

where *ROA* at a given period *t* is pre-tax income (*INC*) at *t* to *TA* at *t*-1. We also use a variant of this model scaling *CFO* at *t* by *TA* at *t*-1:

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

Additionally, similarly to Huffman (2013), we use the following adaptation from Barth et al.'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.

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

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

Forecasted changes in firm efficiency are approached through relative change in assets turnover with respect to previous year. It summarizes management decisions that managers forecast to introduce, and that should be added to previous data when predicting future cash flows. More precisely, we 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 firm 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 & Yohn, 2001; Singh & Davidson III, 2003).

We regress Equations (2) to (5) for the subsamples of firms applying HC and FV with panel data, 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) we 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) to (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, we do not expect a definite sign for *FVF*.

BIOTA is the ratio of biological assets to total assets (*TA*). The biological assets used in agriculture are affected by random climate and markets conditions bringing about unexpected changes and variability in revenue and income (Cordts et al., 1984; Allen & Lueck, 1998). In this vein, the higher the importance of biological assets, the more the firm would be affected by these random shocks, and therefore the more unpredictable would be their cash flows. We therefore expect a positive sign for this variable.

We 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.: Callen et al., 2003; Bekkers & François, 2012; Azzimonti & Talbert, 2014). Given that instability entails lower predictability, we 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 et al., 2012; Evans et al., 2014). Given the non-normal distribution of size, as there are few big firms competing with a large number of small firms, we use the logarithmic transformation of this variable. Some characteristics of bigger firms, for example that they are more complex and have slower response time and decision taking (Jensen & Meckling, 1976; Knight & Cavusgil, 1996), make 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 business, 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 & Barney, 1997), their staff and employees are more skilled (Brown & Medoff, 1989), have greater access to resource endowment (Beck & 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, we do not expect a definite sign for this variable.

We also control 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 0 otherwise, similarly to previous empirical accounting and financial studies on the financial crisis (e.g. Erkens et al., 2012; Liang & Riedl, 2014). We take into account that the financial crisis began in 2007 with the subprime mortgage liquidity crisis in the USA (Ryan, 2008; Jin et al., 2011). Findings form Bratten et al. (2012) and

Liang & Riedl (2014), documenting an attenuation in the predictive power of fair valuation during the financial crisis, support the inclusion of this variable in our model. Accordingly, we 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 et al., 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 we use dummies indicating (with value 1 and 0 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, we use the following large 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 instable economic context and poorer institutional setting, we 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 a 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 zero otherwise. We 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, or does not exist, in our sample. Accordingly, we 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. We consider that the type of farming is predominant when it is so indicated in the firm's website or in the OSIRIS data base, or otherwise, following the European Farm Accountancy Data Network definitions and criteria: when a given type of farming is over 75% of the farm's total output. Given that manufacturing activities have lower exposure to climate and market shocks, we expect a positive sign for these dummy variables.

4. Sample and descriptive statistics

The tests of our hypotheses require 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, we use an international sample of firms with available information about biological assets in their financial statements. In this vein, we begin with a list of firms from different countries from the OSIRIS data base 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 we 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*. We enlarge the sample with all firms listed in the Spanish and Australian stock markets in the manufacture of food products. We select both countries because their accounting standards require measuring biological assets at HC and FV 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, we tried to collect all available data before this data.

As can be seen in Table 1, our sample consists of 84 firms with the necessary data for our study, 51 of them measuring biological assets at HC and 48 at FV, with 15 firms using both valuation methods over the years under study, and with a total number of 794 year-data observations, 414 of them using HC valuation (53%) for biological assets and 380 FV (48%). 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, Malaysia, Spain and Germany are the countries with more firm-year observations measuring biological assets at FV in our sample (displayed in panel B of Table 1). Most firm-year observations measuring biological assets at HC belong to farms in Canada, followed by Spain, Malaysia and Australia. In Australia, Malaysia and Spain there is 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, we convert them into 31st 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).

(Insert Table 1 approximately here)

The most frequent type of farming in our sample is *CROP*, followed by MANUFACTURE, *FOREST*, *MIXED*, *FISHING* and *LIVESTOCK* (see panel C in Table 1). *CROP* is also the type of farming with more firm-year observations for both FV and HC. Most firm-year observations in the first years in our sample belong to farms using HC, while FV is more frequently used since 2005 (see panel D). These data are in accordance with the trend in the reform of the accounting standards, as well as with the implementation of IAS 41.

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

Table 2 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 of greater volatility under FV versus HC (e.g. Plantin & Sapra, 2008; and Dowling & 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.

(Insert Table 2 approximately here)

As it can be seen in Table 3, 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.

(Insert Table 3 approximately here)

Given the necessary lagged variables in our equations, as well as a minimum number of four observations that we require for the calculation of revenue volatility, the number of available observations for any subsequent specific regression is lower than those displayed in Tables 1 and 2.

5. Results

We first estimate Equations (2) to (5) in order to get the different measures for the dependent variable in Equation (1). As mentioned, we regress these equations for the subsamples of farms applying HC and FV. Given the autocorrelation pattern of our sample, we 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) and (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) and (4), where the individual effects are correlated with the regressors. Random effects estimator is inconsistent, while fixed effects estimator is consistent and efficient in these equations in both subsamples of farms applying HC and FV. Therefore, we perform panel data estimations with random effects for Equations (2) and (5) and with fixed effects estimations for Equations (3) and (4).

We then calculate *PI* for any of these Equations (2) to (5). As we do with the independent variables, we also winsorize *PI* at the 1^{st} and 99^{th} percentiles of its respective distribution. Moreover, as is common in time-series research, we truncate *PI* values at 100 percent 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 4) provide inconclusive results. While CFO prediction accuracy is significantly lower for FV when we calculate *PI* from Equations (3) and (4), it is higher for calculations from Equations (2) and (5). More accurate results require multivariate analysis.

(Insert Table 4 approximately here)

Next we estimate Equation (1) for the different dependent variables used in this study and calculated through Equations (2) to (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, we perform robust variance estimates. All robust random effects estimations shown in Table 5 present significant goodness-of-fit. R-squared overall ranges from 0.13 to 0.27. Despite results are different according to the several dependent variables used in the study, there are some similarities. Most control 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 log*TA* (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* provides 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.

(Insert Table 5 approximately here)

As for our 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. In this vein, 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.

We 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 panel B.

It should be noted that we 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 et al (2012) and Liang & 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.

Given the wide span of years included in our 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, our results could be biased by a likely improved relevance of accounting, regardless of FV. We rerun estimations restricting our sample to observations from 2003 (the implementation year of IAS 41) up until 2013. Results (not displayed for simplicity) are similar to those of Table 5. *FVB·BIOTA* is significantly negative at $p<0.05$ with the dependent variable *PI* calculated with Equations 2 to 4, and at $p<0.1$ with Equation 5. Results restricting the sample to observations from 2001 (the immediate year after the issue of IAS 41) up until 2013 are again similar 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 5 are robust to a likely influence of additional factors improving the relevance of accounting information over the last years.

Overall, we find empirical support for our hypothesis H2 on the greater relevance of FV with respect to HC. More precisely, we 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. We 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. Our results are robust to different measures of prediction accuracy and to a likely improvement in the relevance of accounting regardless of FV.

6. Additional analysis: Bearer Plants

In the last few years, 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, which no longer undergo significant biological transformation and are used solely to grow produce, were perceived to be more akin to property, plant and equipment, and their operation similar to that of manufacturing. As a result the IASB issued 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 published 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. 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 this vein, trying to cast light on the debate of the specific suitability of FV versus HC valuation for bearer plants, we perform additional analysis testing the influence of FV for bearer plants. Given that we do not have precise information on the amount and importance of bearer plants within the biological assets in our sample, we rerun Equation (1) for the subsample of crop and forest farms that in their notes to financial statements identify biological assets only in their fixed assets, and not in their inventories. We thus assume that the biological assets included in this subsample are predominantly bearer plants. Table 6 shows the results of estimations for this subsample of farms. The Hausman test indicates that the random effects estimator is consistent and efficient, and the Cook and Weisberg's test reveals the existence of heteroscedasticity, thus we 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.

(insert Table 6 approximately here)

Given that there are doubts on the appropriateness of this subsample for analysing the effect of measuring bearer plants at FV on prediction accuracy, we perform additional analysis with the subsample of forest firms, where the biological assets can be more undoubtedly identified as bearer plants, but the low number of observations (97 to 105 firm-year observations from 10 different firms) does not provide significant goodness-of-fit for the estimations of Equation (1) with none of the four different measures of *PI*.

7. Conclusions

Most of the current discussion on FV versus HC accounting focuses on the relevance and reliability of reported values for financial instruments. There is no general consensus on the conceptual merits of both valuation methods. Proponents of FV argue that the relevance of financial reporting would increase under FV, while opponents contend that the reliability of financial reporting would decrease. Academics and accounting standard setters also 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 or HC valuation. The agricultural sector, as well as the biological assets, have deserved less attention with respect to the 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 we 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. We 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, over time. Our results provide limited evidence on the positive effect of measuring bearer plants at FV on the prediction of future cash flows, and they provide no empirical support for the amendment of IAS 41 on 2014 requiring the shift from FV to HC measurement for bearer plants.

Our findings are of potential interest to regulators, because we 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 we provide empirical evidence of the influence of FV for biological assets on the prediction of future cash flows.

We believe that our results should be interpreted with caution since they are based on the specific characteristics of our sample. As mentioned, our results are not conclusive with respect to bearer plants either. Our results could also be biased because we convert all currencies into US $ and 2013 values. More research is needed on this issue, with bigger and homogeneous samples, as well as with more detailed analysis with respect to the valuation of specific biological assets.

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”.

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TABLE 1
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

TABLE 2
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
INC is pre-tax income, *TA* is total assets, *REV* is revenue, *ROA* is return on assets, *BIOTA* is the ratio of biological assets to total assets, *CFO* is cash flows from operations, *CVINC* is the coefficient of variation of pre-tax income, *CVTA* is the coefficient of variation of total assets and *CREV* is the coefficient of variation of revenues.

TABLE 3

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.

TABLE 4

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 5
Random effects robust estimations for cash flow prediction inaccuracy (standard errors in parentheses).

VARIABLES	Expected sign	(A) Eq. 2	(B) Eq. 3	(C) Eq. 4	(D) Eq. 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)
log*TA*	?	-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·log*TA*	?	-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					
R^2		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 y *** p<0.01.

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

Table 6

Random effects robust estimations for cash flow prediction inaccuracy with the subsample of forest and crop companies with biological assets only in fixed assets (standard errors in parentheses).

VARIABLES	Expected sign	(A) Eq. 2	(B) Eq. 3	(C) Eq. 4	(D) Eq. 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
Number of observations		244	244	244	273

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

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