Inventory Valuation, Company Value, and the Uncertainty Principle

I Introduction

One of the key elements to the operation of capital markets is information efficiency (Ball and Brown 1968). Both the IASB and the FASB frameworks emphasize decision usefulness, particularly to investors in capital markets, as the primary focus of general purpose financial statements. While theoretically, market values are determined by estimating discounted cash flows (Copeland, Weston et al. 2005; Brealey 2007), practical observations suggest a role for accounting information in the valuation process. Market information suggests that practitioners use the accounting performance measure "earnings" for firm valuation and determination of share prices.

Because corporations report accounting earnings and more recently cash flows, investors appear to use earnings for the valuation of firms and calculation of share prices. Using earnings as a surrogate for expected future cash flows in calculating enterprise value is appropriate according to empirical findings. Earnings have a higher correlation with cash flow forecasts than current cash flows (Watts and Leftwich 1977). Cash flow forecasts are better reflected by earnings (Dechow 1994), and earnings are a better predictor of future cash flows than current cash flows (Dechow, Kothari et al. 1998). This importance of earnings is predicated on the income statement as the primary vehicle for conveying information about shareholder value. It reports the "*value added buying inputs at one price, transforming them according to the business model, and selling them at another price*" (Penman 2007). The income statement provides an input to the process of estimating future cash flows.

However, there is a growing emphasis on fair value accounting (Whittington 2008). From the "fair value" perspective, the balance sheet becomes the primary vehicle for conveying information to shareholders. Fair value accounting seeks to convey information about equity value and managements' stewardship by stating all assets and liabilities on the balance sheet at their value to shareholders. The balance sheet satisfies the valuation objective and the income statement provides information about risk exposure and management performance (Penman 2007).

The measurement issues flowing from these competing approaches are analogous to the Heisenberg's Uncertainty Principle in physics. Heisenberg showed that an object's time path cannot be measured with arbitrarily high precision. The trajectory is constructed from the object's position and velocity; but these two variables never come into exact focus at the same time, so the observations are subject to an unavoidable random error (Heisenberg 1930). Similarly, the nature of the accounting model is such that when one attempts to measure the balance sheet as a surrogate for shareholder value, the income statement makes an inaccurate assessment of the change is shareholder wealth. The corollary is that the when we measure the income statement as accurately as possible, the balance sheet does not reflect the market value of the firm. In Heisenberg's terms, we can measure the wealth position of a firm (balance sheet) or the momentum of wealth (income statement) but we cannot measure both at the same time.

Penman (2009) provides a list of situations where fair value accounting is appropriate. Biological or agricultural inventories are not on the list and yet IAS 41 states that biological assets should be measured on initial recognition and at subsequent reporting dates at fair value less estimated costs to sell, unless fair value cannot be reliably measured. This research focuses on the relevance of IAS 41 in providing relevant information to the market. The specific problem is whether valuation of inventory at its market value has relevance to the valuation of an enterprise. The corollary is that the income statement does not have additional explanatory power with respect to a firm's value in capital markets when inventory is measured at its market value and other assets are also measured at their market value.

Our theoretical analysis adapts Hotelling's theory of exhaustible resources (Hotelling 1931) predicting that valuing agricultural inventory at its market price is justified when that inventory is sold in a competitive market. The theory is tested using 114 agricultural company observations that use market values for inventory valuations over the period 2003 to 2008. This panel data was analysed with market price and adjusted market price (market price less other assets) as the dependent variables and agricultural inventory, other assets, and earnings as the independent variables. The results support the propositions that the share price of an agricultural firm moves linearly with the net value of assets. Furthermore, accounting earnings have a minimal but significant influence on the stock market value of the firm.

The remainder of this paper proceeds as follows. The next section provides a theoretical basis for the valuation of agricultural inventory by adapting the theory of natural resources. Section III details the research design. Section IV details the results followed by the conclusions and implications.

II. Theoretical Model

The IASB objective is "*To develop a single set of high quality, understandable and enforceable accounting standards to help participants in the world's capital markets and other users to make economic decisions*". Despite the objective, accounting still suffers from measurement errors as the following quote emphasizes.

"... a financial community which at present does not surely know when or whether to hold its breath-for fear of unheralded and unsuspected but no longer concealable discrepancies between what is so and what is reported to be so from time to time" (Chambers 1999).

Because balance sheet valuations presented by accountants make use of different valuation methods and these different valuations are added together to give an asset total, some argue they cannot make sense (Canning 1929). Chambers (1998, p36) argues that accounting suffers from fundamental measurement problems, because there are five different methods for valuation (attributes), as set by the FASB, and the use of these methods is expected to continue. One of these different valuation methods is IAS 41 where agricultural inventory is valued differently from all other inventory and still those values are added together to represent total inventory.

There is still a need for accurate measurement of objects, specifications about the correct measurement scales, and equal characteristics within classes of objects in accounting (Dean 2008). Accounting may be considered to be measuring income and wealth; however in the current form it is not fulfilling this purpose. Costs of assets are mistakenly seen as measurement of wealth and if these representations of wealth follow each other for multiple years, the income (change in wealth) will not be represented accurately (Chambers 1998, p42). Careful consideration of the balance sheet and income statement is essential to understand accounting.

<u>Balance Sheet and Income Statement</u>

Accounting has the ability to deal with an array of aspects of financial affairs; it is multipurpose in nature. However, the balance sheet and income statement are by definition called the

statement of financial position and the measure of periodic income respectively. Where the first is a statement of wealth, the second is a statement of periodical change in wealth. This accounting reporting system represents two closely related aspects: "the money equivalents of items of property, and the extents of monetary interests, ownership and debt, in the aggregate" (Chambers 1999, p.125). In other words, it represents a sequence of firm and personal financial affairs expressed in monetary equivalents at a certain point in time. A firm cannot accurately present the two financial statements at any specific point in time. That is, the firm can only represent the balance sheet or the income statement correctly (Chambers 1999, p124).

The measurement paradox between the balance sheet and income statement is analogous to a phenomena first observed in physics, called the Heisenberg uncertainty principle. The Heisenberg uncertainty principle states that it is impossible to know both the exact position and the exact velocity of an object at the same time, so the observations are subject to an unavoidable random error (Blankmeyer 1999). In other words, when the position of object is exactly known, one cannot know the rate of change of its speed. Other analogies are found between finance and thermo dynamics, economics, and statistical interference (Blankmeyer 1999). However, here the analogy between accounting and the uncertainty principle from physics is stronger. In accounting terms, either the wealth of a firm or the change in wealth can be represented accurately. This is exactly the point Chambers makes in related articles (Chambers 1998; Chambers 1999). In physics, the parameters connecting the variables are conjoint variables. The more accurately one is measured, the greater the inaccuracy in the measurement of the other variable. That is, if we get the measurement of wealth more accurate, then we will get the measurement of change in wealth more inaccurate. The end point is that 100% accuracy in one leads to complete inaccuracy in the other.

The following example highlights the issue. Table 1 represents key data from the annual report of BRL Hardy Limited, a wine producer.

Table 1, Panel A shows the differences between the net profit as disclosed in the accounts and the cash flow from operations. While we normally expect a difference between cash flows and profits, the magnitude of the difference, 100% of the profits for the year would be regarded as a measure of questionable earnings (Dechow, Sloan et al. 1995; Dechow 2000).

Table 1: BRL Hardy Limited – Application of IAS 41/AASB 141

PANEL A		2002	2001	
		$'000	$'000	
Profit before tax	G	119,529	101,911	
Tax		-35191	-29699	
Profit after tax		84,338	72,212	
Cash flow from operations		-45,147	21,842	
ESTIMATED ACCRUALS		**129,485**	**50,370**	
PANEL B				**Change**
Estimate accruals				
Creditors - current		140,122	125,883	14,239
Creditors - non current		10,338	43,617	-33,279
Debtors - current		215,271	181,043	34,228
Debtors - non current		10,366	44,542	-34,176
PANEL C				
Inventories Current				**Change**
Raw materials and stores		12,778	11,125	
Wine and spirit stocks		419,718	314,667	
Borrowing expenses capitalised		5,861	3,005	
		438,357	**328,797**	109,560
Inventories Non-current				
Wine and spirit stocks		111,448	106,955	
Borrowing expenses capitalised		8,381	7,318	
		119,829	**114,273**	5,556
				115,116

Accruals can result from a number of causes including the booking of unearned revenue. Panel B shows the differences in debtors over the two periods. The debtors have not changed significantly and thus are not the cause of the substantial accrual in the accounts. Similarly, Panel B shows that there has been no significant change in the level of creditors that would account for the level of accruals. However, an examination of the notes to the accounts shows that the company applied IAS41 (AASB 141) to its inventory valuation. In a year where there was no significant change in sales, the change in inventory valuation as per Panel C accounts for the bulk of the company's accruals.

An implication of this finding is that investors have to be careful with the interpretation of information from either the balance sheet or income statement. Standards such as IAS 41 focus on the accurate measurement of the balance sheet by providing the market value of inventory. However, the nature of double entry accounting is such that the accurate measurement of the balance sheet will provide an inaccurate measurement of income. Since investors use accounting information for firm valuation purposes, primarily through the prediction of future cash flows using the income statement, the application of IAS 41 can be misleading.

A seminal paper by Hotelling (1931) suggests a valuation method for exhaustible resources, whereby the total value of a resource (in and above the ground) is valued at market value less the costs to sell. Hotelling's method focuses on policy, but it was implemented by industry analysts, and academic researchers used it for the valuation of national oil reserve stocks by US National Income accountants and the Bureau of Economic Analysis (Davis and Moore 1998). The Hotelling method is reworked by Miller and Upton (1985) into the Hotelling Valuation Principle (HVP) to value natural resource stocks. The HVP has been used to value oil and gas properties (Harris and Ohlson 1987), assessment of the natural gas export policy in Canada (Watkins 1992) and gold mines in Australia (Kelly 1998).

Agricultural inventory valuation under IFRS satisfies the tenets of the HVP normally applied to natural resources. The generalisation of the HVP to commodities in general and agricultural inventory in particular, provides a basis for empirically testing the relevance of IAS 41.

When inventory is measured at any certain point in time, for example financial year end, it is as an exhaustible resource at that certain point. The HVP argues that valuing those assets at their market value (less the costs to market) represents the present value of all future cash flows. If one assumes that the other assets (in particular non-current assets) are valued at their market value, then the book value of the firm should equal the market value of the firm. The income statement shows the income from selling the biological assets and the profit/loss that occurred from the changing market price of the biological assets. The income statement becomes a balancing entry for reflecting the change in inventory values, making earnings a meaningless figure for firm valuation purposes. That is, it does not accurately reflect the change in value and therefore it does not provide an estimate of future cash flows.

For the formal development of the theory, consider a wealth maximizing cattle producer operating in a competitively efficient commodity market. As a participant in a competitive market, the producer is a price taker with no supplier or buyer able to be able to influence the price in the market. The producer has a property with a maximum carrying capacity of cattle (M) and a normal carrying capacity of saleable cattle (S). The difference between M and S reflects that some of the farm's capacity may be dedicated to the replacement of the existing exhaustible inventory of cattle or that climatic conditions require a reduction in the saleable number of cattle. The cattle are mature and may be sold in the current period or any of the next N periods. Let the cash expenses of getting the cattle to market at time t be:

$$C_t = C_t(s_t, S_t) \qquad (1)$$

Where;

$s_t =$ Current period sales of cattle, and

$S_t = \sum_{t=0}^{N} s_t =$ The cumulative level of cattle sold.

As to the restrictions of the cash expense of bringing cattle to the market C_t must behave such that $\frac{\partial C_t}{\partial s_t}$ is positive, since costs of sales of existing stock of cattle will rise with the amount of cattle sold in period t. $\frac{\partial C_t}{\partial S_t} \geq 0$ if additional cattle sold is increasingly expensive to bring to and sell at the market.

The discounted present value of profits will then be:

$$V_0 = \sum_{t=0}^{N} p_t s_t - C(s_t, S_t) R^{-qt} \qquad (2)$$

Where;

$V_0 =$ Discounted present value of profits

$p_t =$ Exogeneously determined market price of cattle at time t which is assumed to be known with certainty by all participants in the market

$R =$ One plus the rate of interest, assumed to be known with certainty and constant over time

$N =$ The date by which current stock of cattle Q will be sold

Maximization of V_0operates under the following constraint:

$$\sum_{t=0}^{N} s_t \leq M_0 \qquad (3)$$

Where;

$M_0 =$ The maximum carrying capacity of cattle.

The first order solution for wealth maximization in any period is:

$$(p_t - c_t)R^{-t} - \sum_{t=n}^{N} \frac{\partial C_t}{\partial S_t} R^{-t} = \lambda, \;\; t = 0, \dots, N \qquad (4)$$

Where;

$c_t = \frac{\partial C_t}{\partial s_t}$, is the marginal cost of production in period t and,
$\lambda =$ the Lagrangian multiplier on constraint (Equation 3)

By simplifying to a special case with the assumption that the cost of bringing cattle to the market is independent of the prior cattle sales such that: $\frac{\partial C_t}{\partial S_t} = 0$, then the first order condition (Equation 4) can be written as:

$$(p_t - c_t)R^{-t} = \lambda, \;\; t = 0, \dots, N \qquad (5)$$

With the assumed cost structure and under an optimal sales regimen, the present value of a unit of produce must be the same regardless of when it is brought to the market. Solving for the system of equations in (Equation 5) the same solution as Hotelling's (1931) model for natural resources appears:

$$(p_t - c_t) = (p_0 - c_0)R^t, \;\; t = 0, \dots, N \qquad (6)$$

Implication of Equation 6 is that the rate of growth in the real interest rate is equal to the growth rate in the real price of the inventory, net of marginal costs of sales. In other words, the growth in the interest rate and growth in the real price are assumed equal and cancel each other out in the equation, so that the current net price is the same as for any future net price.

Miller and Upton (1985) adapted the original Hotelling Principle into a model for firm valuation. Assuming constant returns to scale in current and cumulative sales of cattle, the Hotelling Valuation Principle (HVP) takes a simple form. Marginal costs equal average costs and thus Equation 2 can be substituted into Equation 6 (the present value of the inventory):

$$V_0 = (p_0 - c_0) \sum_{t=0}^{N} s_t = (p_0 - c_0)S_0 \qquad (7)$$

S_0 is the total saleable stock cattle of cattle carried on the farm at a point in time, assuming the rational farmer will stock the optimum cattle for the current and expected climatic conditions. Thus, when cattle inventory is valued at its fair market value $(p_0 - c_0)$, it represents the present value of all future cash flows. The implication of Equation 7 can be tested by converting it into a

regression. Regress observed market values per unit of cattle in the inventory of particular entities at a given point in time on current cattle prices net of costs:

$$V_0^{it} = \alpha + \beta\left(p_0^{it} - c_0^{it}\right)S_0^{it} \qquad (8)$$

Where;

i = An index of firms
t = Calender time
0 = Current values according to sample date *t*

With constant returns to scale, the HVP is expected to display a $\alpha = 0\ and\ \beta = 1$. Under these assumptions changes in other variables, like expected future cattle prices and interest rates should not affect firm value. This assumption is critical regarding the link to IAS 41. Based on the conceptual framework and the argument that the balance sheet would be a better indicator of firm value for firms with biological assets and agricultural produce, the following two propositions are derived.

> *Proposition 1: When agricultural inventory is valued at market value, valuing inventory at its fair value will reflect the present value of all future sales of agricultural products.*

The introduction of accounting standards for the impairment of assets suggests that assets other than inventory will be valued at a value no greater than the present value of their future cash flows. For a company that is subject to IAS 41, where their other assets are valued at their current market value, the net assets as shown in the balance sheet (other assets plus agricultural inventory) will represent the present value of all expected future cash flows of the firm.

> *Proposition 2: Where other assets are valued at their market value and IAS 141 is used for inventory valuation, the balance sheet should represent the present value of future cash flows to the entity.*

As argued before, when corrected for other assets, the value of agricultural inventory is represented directly in market value, because of the nature of the accounting model.

> *Proposition 3: Earnings or changes in earnings resulting from price changes in agricultural inventory do not have influence on the market value of the firm.*

III Research Design

The initial sample included all firms listed on the Australian Stock Exchange (ASX) that used IAS 41 (AASB 141). Stock prices and financial data were obtained from the Aspect databases. Due to the limited number of firms using IAS 41, the sample period was 2003 to 2008.

This research uses panel data Ordinary Least Square (OLS) models to estimate the coefficients. The data consists of 19 firms over 6 years, with at least three years of agricultural inventory data present per firm. In estimating the models there was a need to control for size. Appropriate tests on the validity of the models are performed. OLS regression is used to determine whether the balance sheet explains the stock price of listed firms using IAS 41, whether agricultural inventory represents the present value of future agricultural sales, and whether the earnings number from the income statement has additional explanatory power with respect to stock prices.

The HVP suggest the following formula for the valuation of a firm:

$$V_A = (p_0 - c_0)S_0 \qquad (9)$$

This model assumes that the entire value of the firm is captured in the goods held for resale. No recognition is given to the fact that the firm may hold other assets that have value in their own right. These assets might include land, buildings, investments and cash. Firms are valued according to their inventory and other assets can be represented as per Equation 10.

$$V_A = (p_0 - c_0)S_0 + BV_{OA} \qquad (10)$$

Where;

$\mathrm{BV_{OA}} =$ Book value of other assets on the balance sheet

This can be rewritten into a general model suitable for analysis:

$$V_A = \alpha + \beta_1(p_0 - c_0)S_0 + \beta_2 BV_{OA} \qquad (11)$$

Replacing the HVP value with the balance sheet value of agricultural inventory leads to a general equation:

$$V_A = \alpha + \beta_1 BV_{INV} + \beta_2 BV_{OA} \qquad (12)$$

Where;

$BV_{INV} =$ Value of agricultural inventory under IAS 41

Panel data model

The specific model for panel data regression analysis is:

$$V_{jt} = \alpha_0 + \beta_1 INV_{jt} + \beta_2 OA_{jt} + \epsilon_{jt} \qquad (13)$$

Where;

$V_{jt} =$	Value of the jth firm at time t
$\alpha_0 =$	Intercept term
$INV_{jt} =$	Value of agricultural inventory for j^{th} firm at time t
$OA_{jt} =$	Book value of other assets for j^{th} firm at time t
$\epsilon_{jt} =$	Error term for j^{th} firm at time t
$t =$	Year

Hypothesis 1 [H1]: The value of agricultural inventory will be directly represented in firm value and together with other assets the combined beta coefficients will not be significantly different from one.

This leads to the following hypotheses from Equation 12 in regression terminology:

$$H1_0: \beta_1 + \beta_2 = 1$$
$$H1_1: \beta_1 + \beta_2 \neq 1$$

The model specified in (Equation 13) tests the explanatory power of agricultural inventory and other assets towards market value. It is expected that both variables will have a positive coefficient and that other assets have more explanatory power since they represent a larger portion of total assets.

A firm's asset structure can be divided into agricultural inventory, other inventory, and other assets. This example can be written as a ratio between agricultural inventory and total assets, and allows comparison with the regression coefficient. This is shown in Equation 14.

$$V'_{jt} = \alpha_0 + \beta_1 INV_{jt} + \epsilon_{jt} \qquad (14)$$

Where;

$$V'_{jt} = \text{Adjusted market value:} \frac{INV_{jt}}{(INV_{jt} + OA_{jt})} * V_{jt}$$

Hypothesis 2 [H2]: The relation between adjusted market value and agricultural inventory is not significantly different from one (Equation 14).

Based on Equation 14 the following hypotheses can be constructed:

$$H2_0: \beta_1 = 1$$
$$H2_1: \beta_1 \neq 1$$

<u>Model for income statement testing</u>

The HVP suggests that earnings do not play a role in the valuation of agricultural equity for commodities. The explanatory power of earnings is tested by a modified version of Ohlson (1995). The model is displayed as Equation 15. Value relevance literature indicates that earnings have explanatory power regarding market value; however, the result is expected to be insignificant for earnings of firms with agricultural inventory.

$$V_{jt} = \alpha_0 + \gamma_1 E_{jt} + \gamma_2 BV_{jt} + \varepsilon_{jt} \qquad (15)$$

Where;

$E_{jt} =$ Earnings per share for j^{th} firm at time t

γ_1 & $\gamma_2 =$ Regression coefficients

$BV_{jt} =$ Book value of other assets + inventory per share for j^{th} firm at time t

The HVP argues that earnings should have no effect on market value of the firm if the firm only has agricultural inventory. It can be expected that the earnings coefficient does not have significant influence on firm valuation. The hypotheses based on Equation 15 are:

Hypothesis 3 [H3]: Earnings do not have a significant influence on market value.

$$H3_0: \gamma_1 = 0$$
$$H3_1: \gamma_1 \neq 0$$

Hypothesis 4 [H4]: Book Value does not have a significant influence on market value.

$$H4_0: \gamma_2 = 0$$
$$H4_1: \gamma_2 \neq 0$$

Hypotheses [H1] and [H2] are tested with unadjusted data and then in the logarithmic form to take care of scale issues. Hypotheses [H3] and [H4] are tested using per share data and Wald tests are performed on the individual coefficients. Table 2 presents the operational definitions of the regression variables.

Pooled OLS regression will be used to estimate the coefficients. The assumptions underlying pooled OLS regression suggest no relationship within or between each cross-section. If some relationship does exist and is not specified in the model, then the misspecification is captured in the error and may contaminate the coefficient estimates. This issue can be addressed through the use of fixed or random effects models which require the inclusion of a dummy variable for each cross section. However, for the sample used in this study, this would result in a large number of parameters relative to the number of observations. Thus the power of the model would be diminished due to the loss of degrees of freedom. Consequently, the models will be estimated assuming no fixed effects.

The pooling of firm observations may lead to bias in the t-statistics due to a lack of independence of the observations. This issue is addressed in two ways. The results will be reported on an annual basis as well as for the pooled data. Although this reduces the power of the test due to the smaller sample size, it does overcome the estimation bias. Furthermore, to control for heteroscedasticity in the residuals, the significance of the coefficients will be also be tested using White's (1980) heteroscedasticity-consistent standard errors. The White test is a more generally applied test than the similar Breusch-Pagan test (1979), as it is less sensitive to violations of the assumption of normality and does npt assume prior knowledge of the heteroscedasticity source.

Table 2: Definition of Variables

Symbol	Variable	Definition
V_{jt}	Firm Market Value	Stock price for firm j at financial year end of year t
INV_{jt}	Agricultural Inventory	Current and Non-Current agricultural inventory for firm j at financial year end of year t
OA_{jt}	Book value other assets	Value of other assets for firm j at financial year end of year t
V'_{jt}	Adjusted Firm Market Value	Firm market value adjusted by the ratio agricultural inventory versus other assets for firm j at financial year end of year t
E_{jt}	Earnings	Earnings per share for firm j at financial year end of year t
BV_{jt}	Equity book value	Value of other assets plus the value of agricultural inventory for firm j at financial year end of year t

IV Results

Basic analysis of balance sheet data

Table 3 presents the descriptive statistics for the sample firms. Not all firms had agricultural inventory in the selected years; this is reflected in the number of observations for Adjusted Market Value (AMV) and Agricultural Inventory (INV) shown in Table 3.

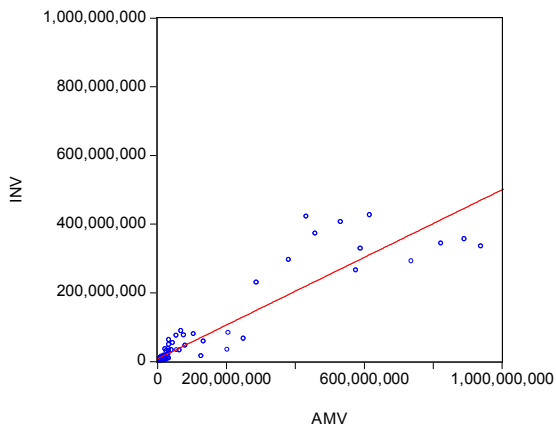
Table 3: Summary Statistics Data

	MV	AMV	INV	OA
Observations	**110**	**94**	**94**	**110**
In Millions				
Mean	988	100	58	556
Median	75.436	15.724	9.000	68.134
Maximum	15,700	939	427	6,550
Minimum	2.053	0.016	0.299	1.085

There are significant differences in the size of the sample firms with biological assets. The smallest firm has a market value of A$2 million and the highest market value is A$15,700 million. Firm size contributes to the large differences in the market value observed between these firms. The ASX does not have sufficient companies available to make subsamples without creating econometrical problems.

A simple scatter plot with regression line between agricultural inventory and adjusted market value shows that regression line is quite flat and around a 0.5 coefficient (Figure 1).

Figure 1: Scatter plot Agricultural Inventory vs Adjusted Market Value



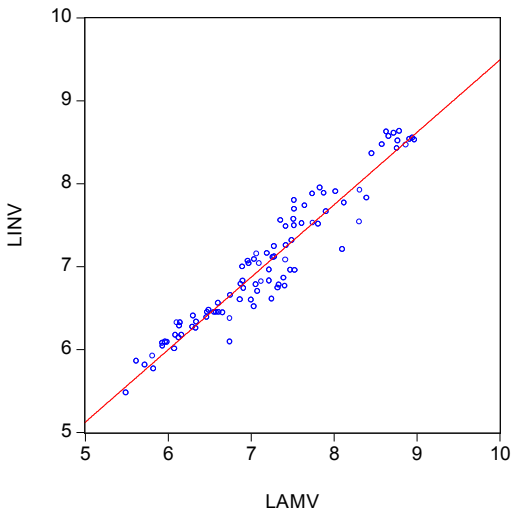
This coefficient of 0.5 might be caused by the influence of larger observations. A common way in econometrics to solve this issue is the use of a logarithmic scale (log10) to adjust for nonlinear relationships between explained and explanatory variables (Wooldridge 2003). The Summary Statistics of the variables in logarithmic form are shown in Table 4. Another explanation for the coefficient might be that the current value of the agricultural inventory is determined by price whilst investors recognize the flow of profits generated by the biological assets and value it accordingly.

Table 4: Summary Statistics Log of Data

	LMV	LAMV	LINV	LOA
Observations	110	95	94	110
Mean	7.968	7.170	7.050	7.819
Median	7.877	7.197	6.955	7.833
Maximum	10.195	8.972	8.630	9.816
Minimum	6.312	4.203	5.476	6.036

As a result of the use of a logarithmic function the variables are more normally distributed. Figure 2 plots the regression line between the log of agricultural inventory and log of adjusted market value.

Figure 2: Scatter plot Log of Agricultural Inventory vs Log of Adjusted Market Value



The result displayed in Table 5 shows a regression line with a coefficient between 0.9 and 1.

Correlation coefficients

Correlations between variables are shown in Table 5 and Table 6.

Table 5: Pearson Correlation of Market value with biological asset and other assets

	INV	OA
MV	0.658***	0.948***
AMV	0.923***	
Notes: * = significant at 1%**		

The correlation coefficients show that there is a moderately strong correlation between agricultural inventory and market value and a very strong correlation between market value and other assets. This can be explained by the fact that other assets make up the largest part of the firm's market value and as a consequence the correlation between those values is large as well. The adjusted market value is corrected for the proportion of the biological assets compared to the other assets. The correlation between AMV and INV is nearly one. Size is still playing a role in the sample so the correlation coefficients for the log variables are shown in Table 7.

Table 6: Pearson Correlation - log market value, log biological assets, and log other assets

	LINV	LOA
LMV	0.820***	0.955***
LAMV	0.960***	
Notes: * = significant at 1%**		

The logarithmic results show a strong correlation between market value and agricultural inventory. Regression analysis is performed to provide further evidence of the relationship.

Hotelling Regression valuation model

Hypothesis [H1]: The value of agricultural inventory will be directly represented in firm value and together with other assets the combined Beta coefficient will not be significantly different from one.

Table 7 shows that the coefficients on both agricultural inventory and other assets are significant. The explanatory power of the model is high with an adjusted R^2 of 92.5% for the pooled sample. The coefficients and adjusted R^2 are similar for each of the yearly samples. A Wald-test (

Table 8) for the pooled sample indicates that we cannot reject the hypothesis that the sum of the coefficients is equal to one (5% level). Thus, H1 is supported.

Table 7: [H1] Regression Results

$$log^{10}(V_{jt}) = \alpha_0 + \beta_1 log^{10}(INV_{jt}) + \beta_2 log^{10}(OA_{jt}) + \epsilon_{jt}$$

Sample	$Adj\ R^2$	α_0	β_1	β_2	N
Pooled	0.925	0.196	0.203	0.815	94
		(1.96)*	(7.73)***	(32.50)***	
2003	0.959	-0.082***	0.163***	0.876***	15
2004	0.936	-0.040***	0.185***	0.855***	16
2005	0.916	0.208***	0.112***	0.892***	16
2006	0.923	0.148***	0.210***	0.816***	18
2007	0.902	0.752***	0.181***	0.783***	15
2008	0.917	0.133***	0.320***	0.715***	14

Notes: *, **, *** Significant at 10%, 5%, 1% respectively; Pooled DW: 0.329 Panel: 2003-2008, with no fixed effects

Table 8: [H1] Wald test on combined coefficients for pooled sample

$$Normalised\ restriction\ (= 0)$$

$H_0: -1 + \beta_1 + \beta_2 = 0$
$H_1: -1 + \beta_1 + \beta_2 \neq 0$

	Value	d.f.
Chi-square	3.552*	1

Notes: *, **, *** Significant at 10%, 5%, 1% respectively

<u>Hotelling Valuation Model, Adjusted Market Value</u>

Hypothesis [H2]: The relation between adjusted market value and agricultural inventory is not significantly different from one.

Table 9: [H2] Regression Results

$$log^{10}(V'_{jt}) = \alpha_0 + \beta_1 log^{10}(INV_{jt}) + \epsilon_{jt}$$

Sample	R^2	α_0	β_1	N
Pooled	0.921	-0.239	1.055	94
		(-3.03)***	(109.38)***	
2003	0.949	-0.284***	1.052***	15
2004	0.930	-0.304***	1.059***	16
2005	0.919	-0.006***	1.020***	16
2006	0.920	-0.235***	1.057***	18

2007	0.914	-0.008***	1.043***	15
2008	0.908	-0.684***	1.112***	14

Notes: *, **, *** Significant at 10%, 5%, 1% respectively
Pooled DW: 0.255; Panel: 2003-2008, with no fixed effects

The results of the regression (Table 9) show a high R^2 and this should tell that almost all the movement of the adjusted firm value can be explained by the movement of agricultural inventory. The constant in the regression is statistically significant and coefficient on agricultural inventory is statistically significant at the 1% level for the pooled sample and each of the yearly samples. To test whether the relation is one or not an additional Wald test is performed (Table 10). The null is rejected and thus it cannot be assumed that agricultural inventory is equal to its proportion of market value. It can be concluded that the proportion of inventory as a scaling factor fully explains market value.

Table 10: [H2] Individual Wald Test on the $\boldsymbol{\beta_1}$ coefficient for the pooled sample

	$Normalised\ restriction\ (= 0)$	
$H_0: -1 + \beta_1 = 0$		
$H_1: -1 + \beta_1 \neq 0$		
	Value	d.f.
Chi-square	33.000***	1

Notes: *, **, *** Significant at 10%, 5%, 1% respectively

It can be concluded that the model has a good fit and for adjusted firm market value and agricultural inventory a relation of one cannot be rejected. This result is confirming the expectations from the theoretical framework.

<u>Basic analysis of income statement data</u>

This section includes the test of the income statement and examines the relevance of earnings from agricultural inventory on the firm market value. The data used is on a per share basis to correct for company size. In order to measure the inventory effect correctly, the adjusted market value is used corrected to a per share basis.

Table 11: Per Share Summary Statistics

	EPS	BVPS	AMVPS	MVPS
Observations	105	110	95	110
Mean	1.702	1.742	0.389	2.404
Median	0.9	0.846	0.191	1.323
Maximum	126.8	12.068	2.4	13.053

Minimum	-190.4	0.003	0.0001	0.009

Table 11 indicates no negative market values, but the earnings number per share can be negative. Table 12 reports the correlation statistics for each of the variables.

Table 12: Correlation Statistics for Per Share Variables

	EPS	BVPS	INVPS
MVPS	0.25**	0.742***	0.256**
AMVPS	0.167	0.136	0.883***
Notes: *, **, * Significant at 10%, 5%, 1% respectively**			

The correlation coefficients show a significant relationship between earnings per share and market value per share, and book value per share and market value per share. Agricultural inventory per share is correlated with both market value variables.

<u>Ohlson's valuation model</u>

Hypothesis [H3]: The earnings per share has no influence on the market value of firms with agricultural inventory.

$$H3_0: \gamma_1 = 0$$
$$H3_1: \gamma_1 \neq 0$$

Hypothesis [H4]: Book Value does not have a significant influence on market value.

$$H4_0: \gamma_2 = 0$$
$$H4_1: \gamma_2 \neq 0$$

Table 13: [H3] & [H4] Regression Results

$$V_{jt} = \alpha_0 + \gamma_1 E_{jt} + \gamma_2 BV_{jt} + \varepsilon_{jt}$$

Sample	R^2	α_0	γ_1	γ_2	N
Pooled	0.690	0.781	0.0004	1.045	98
		(3.116)***	(0.0002)**	(0.066)***	
2003	0.918	0.154***	0.034***	1.739***	15
2004	0.921	0.099***	0.029***	1.916***	16
2005	0.589	0.980***	0.018***	0.131***	17
2006	0.620	1.673***	0.045***	0.632***	18
2007	0.970	0.682***	0.103***	1.191***	15
2008	0.774	0.025***	0.064***	1.595***	17

Notes: *, **, *** Significant at 10%, 5%, 1% respectively

Panel: 2003-2008, with no fixed effects; Pooled DW: 1.943

The reported R^2 is typical of an Ohlson model at 69%. The earnings and book value variables are statistically significant at the 1% level (Table 13). The constant is also significant at the 1% level. The individual Wald test for the hypothesis (Table 14) indicates that at the 1% level the null hypothesis is rejected and thus the coefficient on the earnings per share variable is significantly different from zero. However, the coefficient is considerably small, so it can be said the influence is minimal.

Table 14: [H3] Individual Wald Test on the γ_1 coefficient

	$Normalised\ restriction\ (= 0)$	
$H_0: \gamma_1 = 0$ $H_1: \gamma_1 \neq 0$		
	Value	d.f.
Chi-square	4.926**	1

Notes: *, **, *** Significant at 10%, 5%, 1% respectively

The regression results show that γ_2 is significantly different from zero. Furthermore, an individual Wald test (Table 15) shows that the γ_2 coefficient is significantly different from one at the 5% level. In other words, Other Assets explains the variation in market value.

Table 15: [H4] Individual Wald Test on the γ_2 coefficient

	$Normalised\ restriction\ (= 0)$	
$H_0: -1 + \gamma_2 = 0$ $H_1: -1 + \gamma_2 \neq 0$		
	Value	d.f.
Chi-square	5.668**	1

Notes: *, **, *** Significant at 10%, 5%, 1% respectively

It can be concluded that in the first two hypotheses agricultural inventory is a significant part of firm market value. In a modified Ohlson model, it is shown that the earnings variable is significant but the coefficient is very small and therefore it can be said there is minimal influence. These findings are in line with the uncertainty principle and the accounting model.

V Conclusions and Implications

The adjusted R^2 in all three models is high. The result of Durbin-Watson statistic is indeterminate in the first estimation, the 2nd and 3rd estimation do not suffer from positive serial

correlation according to the Durbin-Watson test statistic. The Jarque-Berra statistic for all three estimates states that the null hypothesis can't be rejected and thus normality of the error has to be assumed.

The results of the panel data regression provide support for all four of the hypotheses dealing with the explanatory power of the balance sheet. H1 shows that balance sheet net asset values have significant explanatory power with respect to stock market values. Since the asset values used in the regression included agricultural inventory and other assets this supports the proposition that the balance sheet reflects the present value of the firm's future cash flows. The R^2 of 92.5% suggests a strong relationship with the sum of the betas equal to one. This was supported by the Wald test.

H2 shows a significant relationship between agricultural inventory and adjusted market value of the firm. The results support the proposition that valuing agricultural inventory at its fair market value represents the present value of future expected cash flows for the sale of those commodities. This suggests the balance sheet item, agricultural inventory, is directly associated with the firm's stock market value as suggested by the HVP. H3 shows that earnings have significant explanatory power with respect to the market price of the firm. However, Ohlson's theory argues that the value of the coefficient should be a function of the risk free rate. The earnings coefficient for Model 3 has a value of 0.023 which is well below the range of 6 to 12 as predicated by Ohlson and found in prior research (Kothari and Sloan 1992). This minimal coefficient may arise because of the correlation between the adjustment to earnings and the adjustment to inventory required by IAS 41. The test of H3 and H4 supports the superiority of the balance sheets variables over the income statement variables for firm valuation purposes.

The most important practical implication is that accounting standards should be formulated on the foundation of the market where the inventory is sold and not on the basis of the nature of the product. The accounting standard is about biological assets, while the Hotelling theory only applies to commodities traded in efficient markets, but not all biological assets are traded in an efficient market and as a consequence application of fair value accounting would violate the underpinnings of the HVP. The theory suggests that the basis for the application of fair value accounting is the nature of the market in which the product is traded and not the physical nature of the product itself.

Findings of this research offer a key insight to analysts, market participants including investors, and accounting and auditing professionals. This concerns the usage of information for firm valuation purposes. Earnings from agricultural inventory cannot be used for firm valuation purposes; instead the balance sheet value of agricultural inventory should be used. An important separation of firm valuation calculation methods will arise between firms with and without agricultural inventory.

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