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The Role of Assumptions in Ohlson Model Performance: Lessons for Improving Equity-Value Modeling

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Abstract: In this paper, we test whether the short-run econometric conditions for the basic assumptions of the Ohlson valuation model hold, and then we relate these results with the fulfillment of the short-run econometric conditions for this model to be effective. Better future modeling motivated us to analyze to what extent the assumptions involved in this seminal model are not good enough approximations to solve the firm valuation problem, causing poor model performance. The model is based on the well-known dividend discount model and the residual income valuation model, and it adds a linear information model, which is a time series model by nature. Therefore, we adopt the time series approach. In the presence of non-stationary variables, we focus our research on US-listed firms for which more than forty years of data with the required cointegration properties to use error correction models are available. The results show that the clean surplus relation assumption has no impact on model performance, while the unbiased accounting property assumption has an important effect on it. The results also emphasize the uselessness of forcing valuation models to match the value displacement property of dividends.

Keywords: clean surplus relation; conservatism correction; displacement property; discount dividends model (DDM); error correction model (ECM); Ohlson valuation model; information dynamics model (LIM); residual income valuation model (RIM)

JEL Classification: C32; C58; G32; G35; M41



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1. Introduction

The Ohlson valuation model (OVM) [1] constitutes a starting point of accounting-based theoretical modeling of the firms' value. In the literature previous to OVM, empirical research from an informative perspective focused on how financial data reported by companies being reflected by stock prices was usual. Surprisingly, this purely empiricist research, far from being displaced by empirical works based on the emerging theoretical models since OVM, has continued to this day, sometimes misusing theoretical models to justify it.

The OVM is based on two well-known models: the dividend discount model (DDM) [2] and the residual income valuation model (RIM) [3]. It also adds the linear information model (LIM) [4], which links future abnormal earnings with current accounting variables. We can say without hesitation that the OVM has influenced all subsequent modeling of the intrinsic firms' value and continues to do so.

Concerning aforementioned, the analysis of its building blocks and their relationship with the OVM usefulness becomes more and more relevant for guiding future research in

this area. In this context, the main objective of this work is to test whether the short-run econometric conditions of the basic assumptions of the OVM hold, and relate it with the fulfillment of the short-run econometric conditions for the OVM to be effective.

We are not interested in validating the OVM through testing the realism of its assumptions. On the contrary, in this context we are “friedmanists”, in the sense that we agree that model validation should be done only with its predictions. However, when model validation offers poor results, as OVM validation does, testing the plausibility of its assumptions and their relations with these poor predictions becomes crucial for future modeling. We are interested in knowing, for better future modeling, to what extent the assumptions involved in the OVM are not good enough approximations to solve the firm valuation problem, causing poor OVM results.

Several papers have examined the OVM usefulness in predicting cross-sectional stock returns, among others, [5–15]. As Lo and Lys claimed [16], the OVM is a time series model by nature; hence, papers developed in the time series framework better capture the OVM’s essence [17–26]. For this fact, we adopted the time series approach to conduct our analyses. However, as Qi, Wu and Xiang highlighted [26], economic and accounting variables involved in the OVM and in the related hypotheses derived from it, such as market value and book value, usually exhibit non-stationary behavior and, following Biddle, Chen and Zhang [8], a previous analysis of cointegration properties is required to achieve non-spurious regression results.

In this context, our final sample is constituted the listed US firms with available time series data for more than forty years, in which the variables involved in the OVM have a cointegration relationship (i.e., the long-run relationship implicit in the OVM holds). Following Biddle, Chen and Zhang [8] we propose an error correction model (ECM) of the econometric model derived from the OVM to verify whether the short-run conditions implicit in the OVM hold for each firm. This result permits us, by conditioning the analysis for OVM short-run conditions fulfillment, to check the impact of assumptions on the OVM’s performance. To do this, we also test the short-run conditions implicit in the main OVM assumptions for each firm using the ECM when the time series properties of the involved variables require it.

Our results confirm the previous evidence in the literature of poor OVM efficacy, the OVM’s tendency to undervalue firms, and the low value relevance of the book value of equity. With respect to our main objective, the results show that while the clean surplus relation (CSR) assumption had no impact on OVM performance, the unbiased accounting property (UAP) assumption had an important effect on it. Finally, the results highlighted the little sense in forcing valuation models to comply with the value displacement property (VDP) of dividends.

The rest of this paper is structured as follows. The next section is dedicated to presenting the OVM and its building blocks, which are further analyzed. In Section 3, we lay out the materials and methods used to achieve our objective, including the sample design, the econometric models used, and the short-run conditions implicit in the OVM and its assumptions. Section 4 is dedicated to showing and discussing the test results. Finally, in Section 5 we summarize the conclusions.

2. The Valuation Model of Ohlson (1995)

The OVM is based on the residual income valuation model (RIM) [3]. According to the RIM, the firm value at the end of period t (V_t) follows this expression:

$$V_t = B_t + \sum_{\tau=1}^{\infty} (1+r)^{-\tau} \cdot E_t[X_{t+\tau}^a] \quad (1)$$

where B_t is the book value at the end of period t , $X_{t+\tau}^a$ is the residual income or abnormal earnings in the $(t + \tau)$ period, r is the long-run average of the cost of capital, and $E_t[\cdot]$ is the expected value operator conditioned on information available at the t -period’s end.

As it is well known in the accounting literature [27–29], the RIM’s expression results from the combination of three building blocks. The first is the dividend discount valuation model (DDM), popularized by Gordon and Shapiro [2], which defines the firm value at the end of period t (V_t) as

$$V_t = \sum_{\tau=1}^{\infty} (1+r)^{-\tau} \cdot E_t[D_{t+\tau}] \tag{2}$$

where $D_{t+\tau}$ is the dividend paid in period $(t + \tau)$.

Second, there is the clean surplus relation. In other words,

$$B_t = B_{t-1} + X_t - D_t \tag{3}$$

where X_t is the earnings in period t and D_t is the dividend paid in period t , which is independent of X_t .

Third is the definition of abnormal earnings as

$$X_t^a \equiv X_t - rB_{t-1} \tag{4}$$

As Qi, Wu and Xiang highlighted [26], one way to achieve a close-form solution of the RIM that does not depend on an explicit forecast of future residual income is by making assumptions to connect future residual income with realized accounting information. In this sense, Ohlson [1] added to the RIM an information dynamics model (the LIM), which captured the time series behavior of the abnormal earnings as follows:

$$X_{t+1}^a = \omega X_t^a + v_t + \varepsilon_{t+1} \tag{5}$$

$$v_{t+1} = \gamma v_t + \eta_{t+1} \tag{6}$$

where ω is the parameter of the persistence of abnormal earnings, restricted to be non-negative and less than one, a condition that implies that the unconditional mean of abnormal earnings is zero; v_t is the variable other information at the end of period t , available by the market but not (yet) incorporated into the current accounting information; γ is the parameter of persistence of the other information variable, also restricted to be non-negative and less than one, implying that the unconditional mean of the other information variable is zero; and ε_{t+1} and η_{t+1} are error terms with means of zero.

Then, the OVM becomes

$$V_t = B_t + \alpha_1 X_t^a + \alpha_2 v_t \tag{7}$$

where $\alpha_1 = \omega / (1 + r - \omega)$ and $\alpha_2 = (1 + r) / (1 + r - \omega)(1 + r - \gamma)$.

To recapitulate, the OVM builds on two short-run basic assumptions, on which our research focuses:

1. The CSR, introduced by Equation (3);
2. The UAP, in the sense that in the long-run, the firm’s value average equals the book value average, as can be deduced from Equations (5)–(7), ignoring conservative or aggressive accounting (it is noted that in the firms’ financial information, accounting conservatism/aggressiveness implies the systematic and independent persistence to underestimate/overestimate, the net assets of the company through policies and methods that are conservative/aggressive [30]).

Additionally, a necessary and sufficient condition is required for aligning the OVM properties to the Miller and Modigliani irrelevance dividend policy theorem [31]:

3. Dividends reduce the current book value on a dollar-for-dollar basis, but they do not contemporarily affect earnings (i.e., $\partial B_t / \partial d_t = -1$ and $\partial X_t / \partial d_t = 0$). Under this condition, the firm value is also reduced by dividends on a dollar-for-dollar basis, and thus the fundamental VDP holds. Although this condition was initially introduced

by Ohlson as an assumption, he later emphasized that “the valuation function does not depend on . . . this assumption.”

3. Materials and Methods

3.1. Data

We performed our analysis by using annual data from the Compustat database of US non-financial listed companies from 1974. Since our analysis required a long enough time series, we retained only firms that had consecutive data for more than 40 years. A total of 385 listed firms met this requirement, and 15,400 firm-year observations constituted our initial data sample. Surely, this condition made the survivorship bias unavoidable in our sample.

For each firm-year, we had data related to the net income or loss total (X), share equity total (s), price close (P), dividend income total (D), and total equity (B). To avoid the scale effect, we related all the variables to the number of shares for each firm. Table 1 shows the main descriptive statistics for these variables for the total sample and for three selected years around the beginning, the middle, and the end of the sample period. In Table 1, we observe two key characteristics that influence our analysis: the high dispersion among companies and the increase in the magnitudes over time.

Table 1. Descriptive statistics.

Panel A. Full Period							
	Mean	Median	SD	Min	Max	Q1	Q3
Earnings	6.1	2.0	131.9	−75.5	8535.5	1.0	3.2
Price	116.0	27.3	2590.5	0.0	141,600.0	16.9	42.4
Dividend	1.5	1.0	2.5	0.0	147.9	0.4	1.9
Book	344.9	15.4	34,134.1	0.0	4,231,100.0	9.8	23.4
Panel B. Year 1974							
	Mean	Median	SD	Min	Max	Q1	Q3
Earnings	2.5	2.1	2.3	−4.6	14.4	1.1	3.2
Price	16.8	11.8	18.4	0.4	168.0	6.0	21.0
Dividend	1.0	0.6	1.1	0.0	12.5	0.2	1.5
Book	18.8	15.8	14.4	0.3	93.6	9.2	23.7
Panel C. Year 1994							
	Mean	Median	SD	Min	Max	Q1	Q3
Earnings	3.2	1.9	21.4	−8.8	420.0	1.2	2.8
Price	84.8	27.3	1038.3	0.3	20,400.0	18.5	40.9
Dividend	1.3	1.0	1.4	0.0	12.1	0.4	1.8
Book	43.2	13.9	513.2	0.5	10,080.5	9.2	20.9
Panel D. Year 2013							
	Mean	Median	SD	Min	Max	Q1	Q3
Earnings	3.3	2.2	9.3	−4.6	172.6	1.1	3.8
Price	61.2	43.9	148.9	0.0	2795.0	26.8	69.0
Dividend	2.0	1.3	2.5	0.0	19.8	0.4	2.8
Book	11,017.9	17.5	215,635.4	0.0	4,231,100.0	10.9	30.5

Earnings (X) is the net income or loss total divided by the share equity total (s). Price (P) is the adjusted share price closed. Dividend (D) is the dividend income total divided by the share equity total (s). Book (B) is the total equity divided by the share equity total (s).

As usual in time series analyses, first of all, we checked the stationary qualities of the firm-specific variables using the well-known augmented Dickey–Fuller (ADF) unit root test. Table 2 shows the results. Besides a constant, we introduced in the ADF test a trend to capture the time evolution data observed above in the statistical data analysis. The null hypothesis of the presence of a unit root in the time series data was not rejected in any case. This result was usually observed in the literature [32,33] and generally led to spurious results in the ordinary least squares (OLS) regressions [34,35]. This may produce large coefficients of determination and significant slope parameters, even when no meaningful

relationship exists between the target variable and regressors (it is noted that previous to Qi, Wu and Xiang [26], only the Callen and Morel [21] and Morel [36] time series empirical analyses on the OVM, explicitly considered the effects of a non-stationary state on the empirical results).

Table 2. Unit roots augmented Dickey–Fuller (ADF) tests.

	Mean	Median	SD	Min	Max	Q1	Q3
Earnings	−1.966	−2.128	0.781	−2.995	1.319	−2.496	−1.606
Price	−1.879	−2.096	0.865	−2.997	2.702	−2.409	−1.618
Dividend	−1.929	−2.181	0.912	−2.998	2.674	−2.502	−1.582
Book	−1.505	−1.715	1.001	−2.98	2.909	−2.151	−1.135

For the ADF tests, the null hypothesis was that the variables had a unit root, and the critical values with the constant and trend were −4.15 and −3.80 at 1% and 5%, respectively. The variable definitions are above in Table 1.

However, Engle and Granger [37] proved that OLS estimates are inconsistent only in the absence of cointegration. When cointegration occurs (i.e., when the error term is stationary, even though the target variable and some of the regressors are not), there is some long-run equilibrium relation tying them together. Therefore, we next checked whether the book value and other independent variables were cointegrated with the market value in order to test the long-run relationship implicit in the OVM as a necessary condition for OVM validity.

Using the trace test, we checked for the existence of cointegration relationships among firm-specific variables. Of the 385 companies retained in the initial sample, the results showed that for only 247 (64.16%) of them, a cointegration relationship among their variables existed, while in the other 138 (35.84%), no cointegration relationship was found (despite this, it may exist and be overshadowed by structural changes or be of a non-integer order). Therefore, we only retained 247 firms of the initial sample to perform our short-run analyses.

3.2. Econometric Models

3.2.1. Econometric Model to Test the OVM

To test the short-run restrictions implicit in the OVM, we combined Equations (3), (4) and (7) and expressed the OVM as follows:

$$V_t = B_t + \alpha_1[X_t - r(B_t + D_t - X_t)] + \alpha_2v_t \tag{8}$$

By rearranging Equation (8), we got

$$V_t = (1 - r\alpha_1)B_t + (\alpha_1 + r\alpha_1)X_t - r\alpha_1D_t + \alpha_2v_t \tag{9}$$

where the firm value was contemporarily related to the accounting numbers and the other information. Note that as the restrictions that ensure the PDV were not added, α_1 empirically collected the informative effect of the dividends.

From Equation (9), and taking into account that the unconditional mean of the other information was zero by the LIM construction, we made use of the following firm-specific econometric model to test the OVM:

$$P_t = \beta_0 + \beta_1B_t + \beta_2X_t + \beta_3D_t + \varepsilon_t \tag{10}$$

where P_t is the firm market value at the end of period t , β_0 is a constant that shows OVM undervaluation (overvaluation) with respect to the firm market value (P_t) when it is positive (negative) and significant, $\beta_1 = 1 - r\alpha_1$, $\beta_2 = \alpha_1 + r\alpha_1$, and $\beta_3 = -r\alpha_1 = \beta_1 - 1$.

However, since the variables involved in Equation (9) were non-stationary even though a cointegration relationship existed in the sample design, following the Engle and Granger methodology [37], we transformed Equation (10) into an ECM as follows:

$$\Delta P_{t+1} = \sum_{i=0}^{T-1} \lambda_i^P \Delta P_{t-i} + \sum_{i=0}^{T-1} \lambda_i^B B_{t-i} + \sum_{i=0}^{T-1} \lambda_i^X X_{t-i} + \sum_{i=0}^{T-1} \lambda_i^D D_{t-i} + \alpha(P_t - \beta_0 - \beta_1 B_t - \beta_2 X_t - \beta_3 D_t) + v_t \quad (11)$$

This was composed of two parts: the T-lags of the endogenous and the exogenous variables in the differences, which corrected possible econometric estimation problems as an autocorrelation due to the residuals in Equation (10), and the equation of the long-run equilibrium, which showed a reversion of the OVM firm value to the market price with a speed fixed by α .

Under Equations (10) and (11), the four empirical conditions for OVM validation were the following:

1. $\beta_0 = 0$;
2. $\beta_1 = 1 - r\alpha_1 > 0$;
3. $\beta_2 = \alpha_1 + r\alpha_1 > 0$;
4. $\beta_3 = -r\alpha_1 = \beta_1 - 1$.

3.2.2. Econometric Model to Test the CSR

The CSR in Equation (3) can be re-expressed in incremental form as

$$\Delta B_t = B_t - B_{t-1} = X_t - D_t \quad (12)$$

In addition, from Equation (12), the following econometric model is derived:

$$\Delta B_t = \omega_0 + \omega_1(X_t - D_t) + u_t \quad (13)$$

This model can be estimated directly by OLS because the two variables involved are differences and are stationary, as usual. The conditions for CSR fulfillment are that the independent term (ω_0) is statistically zero and the slope coefficient (ω_1) is statistically equal to one.

3.2.3. Testing the UAP

Following Choi, Myers, Zang and Ziebart [38], who extended the work of Feltham and Ohlson [39] to better capture conservatism accounting in the LIM, we expected that in the presence of conservative (aggressive) accounting, the slope parameter (β_1) of the ECM in Equation (11) would be higher (smaller) than under the UAP, since the conservatism correction term that they added to the OVM was also a function of the book value and rectified it upward (downward) in the presence of accounting conservatism (aggressiveness). Therefore, if under the assumption of UAP, the slope parameter (β_1) in Equation (11) equaled the slope parameter (β_3) plus one, then in the presence of accounting conservatism (aggressiveness), the slope parameter (β_1) must have been distinct from the slope parameter (β_3) plus one.

In our time series framework, this bias correction difference can be seen as a mean of the annual slope coefficient of the Choi correction term [38]. Obviously, this mean was conditioned by the generally accepted accounting principles (GAAP) or the international financial reporting standards (IFRS) evolution along the sample period. In this sense, when we tested the short-run necessary conditions for OVM validation using the ECM in Equation (11), we were explicitly testing through the fourth condition that the UAP held.

3.2.4. Econometric Model to Test the VDP

Our starting point to achieve an econometric model to check whether the VDP held was the definition of the firm earnings in the t-period (X_t) as a function of the firm market value at the beginning of this period (P_{t-1}):

$$X_t = r^{acc} P_{t-1} + \zeta_t \quad (14)$$

where r^{acc} is the average cost of capital and ζ_{t+1} is an error term with zero mean that arises from the deviation of the t-year-specific cost of capital with respect to the long-run average. At the same time, we considered the following relationship between the shareholders' dividends and the firm market value when the VDP held:

$$P_t = P_{t-1} (1 + r^{mkt}) - D_t + \zeta_t \quad (15)$$

where r^{mkt} is the average stock market return and ζ_{t+1} is an error term with zero mean that arises from the deviation of the t-year-specific stock market return with respect to the long-run average. Equation (15) introduces the dividend value irrelevance by fixing the slope coefficient of D_t at -1 .

By substituting the market values in Equation (15) for their relation with earnings using Equation (14), we obtained the following recursive equation for the firm earnings:

$$X_{t+1} = (1 + r^{mkt}) X_t - r^{acc} D_t + \zeta_{t+1} \quad (16)$$

Alternatively, this can be expressed as

$$\Delta X_t = X_t - X_{t-1} = r^{mkt} X_t - r^{acc} D_t + \zeta_t \quad (17)$$

where ζ_t is an error term with zero mean.

From Equation (17), it is straightforward to deduce the following econometric model:

$$\Delta X_t = \gamma_0 + \gamma_1 (\hat{r}^{mkt} X_{t-1} - \hat{r}^{acc} D_{t-1}) + \zeta_t \quad (18)$$

where \hat{r}^{mkt} and \hat{r}^{acc} are estimated from Equations (14) and (15), respectively, and ζ_t is an error term with zero mean. Once again, this model could be estimated directly by OLS because the two variables involved in the regression were differences that, as usual, were stationary. The conditions for VPD fulfillment were that the independent term (γ_0) was null statistically and the slope coefficient (γ_1) was statistically equal to one.

4. Empirical Results

For the 247 listed firms that constituted our final sample, we estimated the ECM in Equation (11) to verify whether the necessary short-run conditions to validate the OVM were fulfilled. In Table 3 Panel A, we show the main results of this analysis. We can see that for 155 firms, the estimated independent term ($\hat{\beta}_0$) was not null statistically, and that it always had a positive sign. This result indicates underestimation of the OVM, as was usual in the literature.

The slope parameters β_1 and β_2 were both positive and statistically significant in 93 and 219 firms, respectively. This result highlights the scarce relevance that the book value had in firm valuation; it was only significant in 38% of the cases, which contrasted with the prominent role that it had in the OVM, not only as the base of the valuation process from the RIM in Equation (1), but also in the abnormal earnings definition in Equation (4). We note that this result is consistent with that shown previously for β_0 .

Related to the relationship between the slope coefficients β_1 and β_3 , the OVM imposition only occurred in 49% (121) of the firms analyzed, perhaps due to the poor result reported for β_1 . The severity of this result was increased by the fact that we previously removed from the sample the firms in which the necessary long-run condition between the firm market price and the book value did not hold. In summation, when we put together the four short-run conditions required to accredit a reasonable performance of the OVM, only 23 of the 247 firms in the sample—almost 10%—complied with them jointly.

Table 3. Test results.

Panel A. Ohlson Valuation Model (OVM)									
	#	%	Mean	Median	SD	Min	Max	Q1	Q3
$\hat{\beta}_0$	155	62.753	4.748	1.245	24.061	0.021	50.148	0.911	1.928
$\hat{\beta}_1$	93	37.652	5.903	3.614	5.587	0.805	17.699	2.613	6.222
$\hat{\beta}_2$	219	88.664	1.353	1.211	0.642	0.165	4.866	0.953	1.643
$\hat{\beta}_3$	135	54.656	2.148	2.532	8.639	0.036	16.294	0.602	3.552
$\hat{\beta}_3 = \hat{\beta}_1 - 1$	121	48.988							
Panel B. Clean Surplus Relation (CSR)									
	#	%	Mean	Median	SD	Min	Max	Q1	Q3
$\hat{\omega}_0$	18	7.287	−0.641	−0.410	1.247	−2.001	0.864	−0.902	0.170
$\hat{\omega}_1$	229	92.713	0.859	0.835	0.231	0.376	1.858	0.709	0.962
$\hat{\omega}_0 = 0; \hat{\omega}_1 = 1$	161	65.182							
Panel C. Unbiased Accounting Property (UAP)									
	#	%	Mean	Median	SD	Min	Max	Q1	Q3
$\hat{\beta}_3 = \hat{\beta}_1 - 1$	121	48.988							
Panel D. Value Displacement Property (VDP)									
	#	%	Mean	Median	SD	Min	Max	Q1	Q3
$\hat{\gamma}_0$	230	93.117	−0.536	−0.486	0.241	−1.271	−0.149	−0.705	−0.345
$\hat{\gamma}_1 = 1$	152	61.538							

Panel A shows the main results of OVM short-run conditions analysis (Equation (11)). Panel B shows the results of CSR short-run conditions analysis (Equation (13)). Panel C shows the results of testing the relation between the slope coefficients β_1 and β_3 in Equation (11) related with UAP. Panel D reports the results of testing the short-run conditions for the VDP in Equation (18). Columns 2–3 show, at least 5% significance level, the number and percentage of firms in which the tested short-run hypotheses held. Columns 4–10 show the main statistic of the estimated parameters.

In Table 3 Panel B, we show the results from the estimates of Equation (13) to test the conditions for the CSR. Of the 247 firms analyzed, in 229 cases, the independent term was not significant, but only 161 of these cases had a slope parameter statistically equal to one. These 161 firms represented around 65% of the final sample of firms, and only about 35% of the firms showed a dirty surplus relation.

With respect to the UAP, we reproduced in Table 3 Panel C the results of testing the relation between the slope coefficients β_1 and β_3 in Equation (11) that the OVM imposed, showing that for more than 51% of the firms, we could not confirm that this property held. However, although empirical, this result was model-dependent in the sense that we argued that the conservatism correction term could be expressed as a function of the firm book value following [14].

Finally, in Table 3 Panel D, we reported the results of testing the conditions for the VDP holds. The independent term (γ_0) in Equation (18) was not significant for 105 firms, while in only 22 firms, the slope coefficient (γ_1) was statistically equal to one. In fact, in these 22 firms, both conditions jointly held. This poor result is in line with the evidence showed by the literature, where several theories have been developed to explain it, such as those by Frankfurter and Wood [40] and Al-Malkawi, Rafferty and Pillai [24].

Once we verified the statistical fulfillment (at a significance level of 5%) of the necessary short-term conditions for the correct performance of the model and its assumptions, we analyzed in Table 4 the interaction between the results discussed above. In this way, among the 161 firms where the conditions for CSR fulfillment held, we only found conditions for OVM validation holding in 15 of the 23 firms, or around 65%, the same percentage of firms that the conditions for CSR fulfillment held over the 247 sample firms. This result shows that CSR fulfillment did not have a relevant impact on the OVM performance.

Table 4. Short-run conditions fulfillment

	OVM Short-Run Conditions					
	Total	(%)	Hold	%	Not Hold	%
Total	247	100%	23	100%	224	100%
CSR	161	65%	15	65%	146	65%
UAP	121	49%	23	100%	98	44%
CSR + UAP	77	31%	15	65%	62	28%
VDP	22	9%	2	9%	20	9%

OVM = Ohlson valuation model, CSR = clean surplus relation, UAP = unbiased accounting property, and VDP = value displacement property.

In contrast, in all 23 firms where the conditions for OVM validation held, as was implicit in the test design, the UAP short-term conditions held. However, in only around 44% of the firms where the conditions for OVM validation did not hold did the UAP short-term conditions hold. In this case, the UAP yielded a stronger constraint on OVM performance.

Obviously, we could see a similar pattern when we considered the two OVM assumptions, CSR and the UAP, jointly. The percentage of firms in the conditions imposed by CSR and the UAP were jointly held was 66% lower among those firms where the conditions for OVM validation did not hold. Concretely, the percentage went from 65%, shown among firms where the conditions for OVM validation held, to 28%.

Finally, and with respect to the VDP, from the bottom row of Table 4, we can infer that the poor result shown by testing the condition for its fulfillment did not influence the OVM performance at all. This was an expected result, because as we highlighted in Section 2, the VDP is not really an assumption of the OVM. Moreover, if we conditioned the OVM effectiveness to the hold of the short-run VPD conditions as Ohlson suggested [1], the number of firms in which we found that the OVM short-run conditions held would have been reduced by more than 90%, going from 22 to just 2 firms out of the 247 that conformed to our final sample.

5. Conclusions

Even though the objective of this work was not to test the OVM, throughout it we verified to what extent the short-term restrictions implicit in the model were statistically fulfilled, since we needed this information to condition the results of the analyses conducted to their (non) compliance. This auxiliary analysis showed evidence that confirmed the previous one found extensively in the literature related to the poor performance of the OVM. Only 23 of the 247 US listed firms that conformed to our final sample statistically met the short-run conditions that the OVM imposed.

With respect to the building blocks analyzed, the results show that in 65% of firms (161 of 247) the conditions from the CSR were in place, while the conditions from the UAP were in 49% of the companies (121 of 247). However, the conditions for these two assumptions being jointly fulfilled were only present in 77 of the 247 sample firms (31%).

When we conditioned these results to the compliance or not of the short-run conditions implicit in the OVM, we found that: While the fulfillment conditions from the CSR affected these two groups of firms equally, the fulfillment conditions for the UAP had effects on these two groups of firms sharply different. The UAP's short-run conditions were met in all of the firms where the short-run conditions implicit in the OVM were also met, but in only 44% of the firms where the short-run conditions implicit in the OVM were not met.

These results show that, whereas the UAP assumption became an effective restriction to OVM performance, the CSR assumption did not. They also augured that attempts by researchers to correct for the effect of accounting conservatism in the valuation models, as in Choi, Myers, Zang and Ziebart [38], would be more effective than attempts to circumvent the CSR in these models. This condition occurs despite the widespread belief that models,

such as abnormal earnings growth valuation models (AEG) [41], bypassing the CSR should allow for a more robust modeling framework, as Ho, Lee, Yu and Lin [42] and Anesten, Möler, Skogsvik and Skogsvik [43] argued. In fact, Juettner-Nauroth himself introduced the CSR in his AEG model [44], curiously focused on accommodating biased accounting in both the RIM and AEG valuation models.

Finally, with respect to the condition added in the OVM to align it with the dividend irrelevance theory developed in Miller and Modigliani [31], the results showed that in only 9% of the companies in the sample, the conditions that allowed the VDP held. This was an expected result, since both empirical evidence and theoretical works, much of them predating [1], showed evidence against this dividend property. Moreover, if we conditioned the OVM effectiveness on the VDP conditions, only 2 firms of the 247 in the sample met the conditions to be correctly valued with the OVM. However, our conditional analysis showed that the fulfillment of the VDP did not affect at all the OVM performance as expected, since the VDP was not an assumption of the OVM. In this context, it is surprising to find more recent research that advocates the need to align the valuation models with the displacement property of dividends, such as that by Rees and Valentincic [45], Clubb [46], and Gao, Ohlson and Ostaszewski [47].

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References

1. Ohlson, J.A. Earnings, Book Values, and Dividends in Equity Valuation. *Contemp. Account. Res.* **1995**, *11*, 661–687. [[CrossRef](#)]
2. Gordon, M.J.; Shapiro, E. Capital Equipment Analysis: The Required Rate of Profit. *Manag. Sci.* **1956**, *3*, 102–110. [[CrossRef](#)]
3. Preinreich, G.A.D. Annual Survey of Economic Theory: The Theory of Depreciation. *Econometrica* **1938**, *6*, 219. [[CrossRef](#)]
4. Myers, J.N. Implementing Residual Income Valuation with Linear Information Dynamics. *Account. Rev.* **1999**, *74*, 1–28. [[CrossRef](#)]
5. Abarbanell, J.; Bernard, V. Is the U.S. Stock Market Myopic? *J. Account. Res.* **2000**, *38*, 221–242. [[CrossRef](#)]
6. Barth, M.E.; Beaver, W.H.; Hand, J.R.M.; Landsman, W.R. Accruals, Cash Flow, and Equity Values. *Rev. Account. Stud.* **1999**, *4*, 205–229. [[CrossRef](#)]
7. Barth, M.E.; Beaver, W.H.; Hand, J.R.M.; Landsman, W.R. Accruals, Accounting-Based Valuation Models, and the Prediction of Equity Values. *J. Account. Audit. Financ.* **2005**, *20*, 311–345. [[CrossRef](#)]
8. Biddle, G.C.; Chen, P.; Zhang, G. When Capital Follows Profitability. Non-linear Residual Income Dynamics. *Rev. Account. Stud.* **2001**, *6*, 229–265. [[CrossRef](#)]
9. Choi, Y.-S.; O’Hanlon, J.F.; Pope, P.F. Conservative Accounting and Linear Information Valuation Models. *Contemp. Account. Res.* **2006**, *23*, 73–101. [[CrossRef](#)]
10. Dechow, P.M.; Hutton, A.P.; Sloan, R.G. An empirical assessment of the residual income valuation model. *J. Account. Econ.* **1999**, *26*, 1–34. [[CrossRef](#)]
11. Francis, J.; Olsson, P.; Oswald, D.R. Comparing the Accuracy and Explainability of Dividend, Free Cash Flow, and Abnormal Earnings Equity Value Estimates. *J. Account. Res.* **2000**, *38*, 45. [[CrossRef](#)]
12. Frankel, R.; Lee, C.M. Accounting valuation, market expectation, and cross-sectional stock returns. *J. Account. Econ.* **1998**, *25*, 283–319. [[CrossRef](#)]
13. Hand, J.; Landsman, W. The Pricing of Dividends in Equity Valuation. *J. Bus. Financ. Account.* **2005**, *32*, 435–469. [[CrossRef](#)]
14. McCrae, M.; Nilsson, H. The explanatory and predictive power of different specifications of the Ohlson (1995) valuation models. *Eur. Account. Rev.* **2001**, *10*, 315–341. [[CrossRef](#)]

15. Penman, S.H.; Sougiannis, T. The dividend displacement property and the substitution of anticipated earnings for dividends in equity valuation. *Account. Rev.* **1997**, *72*, 1–21.
16. Lo, K.; Lys, T.Z. The Ohlson Model: Contribution to Valuation Theory, Limitations, and Empirical Applications. *J. Account. Audit. Financ.* **2000**, *15*, 337–367. [[CrossRef](#)]
17. Ahmed, A.S.; Morton, R.M.; Schaefer, T.F. Accounting Conservatism and the Valuation of Accounting Numbers: Evidence on the Feltham-Ohlson (1996) Model. *J. Account. Audit. Financ.* **2000**, *15*, 271–300. [[CrossRef](#)]
18. Ballester, M.; Livnat, J.; Sinha, N. Tracks. *J. Account. Audit. Financ.* **2002**, *17*, 351–373. [[CrossRef](#)]
19. Bar-Yosef, S.; Callen, J.L.; Livnat, J. Modeling dividends, earnings, and book value equity: An empirical investigation of the ohlson valuation dynamics. *Rev. Account. Stud.* **1996**, *1*, 207–224. [[CrossRef](#)]
20. Bauman, M.P. An empirical investigation of conservatism in book value measurement. *Manag. Financ.* **1999**, *25*, 42–57. [[CrossRef](#)]
21. Callen, J.L.; Morel, M. A Lintnerian Linear Accounting Valuation Model. *J. Account. Audit. Financ.* **2000**, *15*, 301–314. [[CrossRef](#)]
22. Callen, J.L.; Segal, D. Empirical Tests of the Feltham-Ohlson (1995) Model. *Rev. Account. Stud.* **2005**, *10*, 409–429. [[CrossRef](#)]
23. Lee, C.M.; Myers, J.; Swaminathan, B. What is the Intrinsic Value of the Dow? *J. Financ.* **1999**, *54*, 1693–1741. [[CrossRef](#)]
24. Al-Malkawi, H.A.N.; Rafferty, M.; Pillai, R. Dividend policy: A review of theories and empirical evidence. *Int. Bull. Bus. Adm.* **2010**, *9*, 171–200.
25. Ota, K. A test of the Ohlson (1995) Model. Empirical Evidence from Japan. *Int. J. Account.* **2002**, *37*, 157–182. [[CrossRef](#)]
26. Qi, D.D.; Wu, Y.W.; Xiang, B. Stationarity and Cointegration Tests of the Ohlson Model. *J. Account. Audit. Financ.* **2000**, *15*, 141–160. [[CrossRef](#)]
27. Edwards, E.O.; Bell, P.W. *The Theory and Measurement of Business Income*; University of California Press: Berkeley, CA, USA, 1961.
28. Peasnell, K.V. On Capital Budgeting and Income Measurement. *Abacus* **1981**, *17*, 52–67. [[CrossRef](#)]
29. Peasnell, K.V. Some Formal Connections between Economic Values and Yields and Accounting Numbers. *J. Bus. Financ. Account.* **1982**, *9*, 361–381. [[CrossRef](#)]
30. Fullana, O.; Gonzalez-Sanchez, M.; Toscano, D. IFRS Adoption and Unconditional Conservatism: An Accruals-Based Analysis. 2020. Available online: <https://ssrn.com/abstract=3141625> (accessed on 18 December 2020).
31. Miller, M.H.; Modigliani, F. Dividend Policy, Growth, and the Valuation of Shares. *J. Bus.* **1961**, *34*, 411. [[CrossRef](#)]
32. Fama, E.F.; French, K.R. The cross-section of expected stock returns. *J. Financ.* **1992**, *47*, 427–465. [[CrossRef](#)]
33. Wu, C.; Kao, C.; Lee, C.F. Time-Series Properties of Financial Series and Implications for Modeling. *J. Account. Audit. Financ.* **1996**, *11*, 277–303. [[CrossRef](#)]
34. Granger, C.; Newbold, P. Spurious regressions in econometrics. *J. Econ.* **1974**, *2*, 111–120. [[CrossRef](#)]
35. Phillips, P. Understanding spurious regressions in econometrics. *J. Econ.* **1986**, *33*, 311–340. [[CrossRef](#)]
36. Morel, M. Multi-Lagged Specification of the Ohlson Model. *J. Account. Audit. Financ.* **1999**, *14*, 147–161. [[CrossRef](#)]
37. Engle, R.F.; Granger, C.W.J. Co-Integration and Error-Correction: Representation, Estimation, and Testing. *Essays Econom.* **2010**, *251–276*, 145–172.
38. Choi, J.-H.; Myers, L.A.; Zang, Y.; Ziebart, D.A. The Roles that Forecast Surprise and Forecast Error Play in Determining Management Forecast Precision. *Account. Horiz.* **2010**, *24*, 165–188. [[CrossRef](#)]
39. Feltham, G.A.; Ohlson, J.A. Valuation and Clean Surplus Accounting for Operating and Financial Activities. *Contemp. Account. Res.* **1995**, *11*, 689–731. [[CrossRef](#)]
40. Frankfurter, G.M.; Wood, B.G., Jr. Dividend policy theories and their empirical tests. *Int. Rev. Financ. Anal.* **2002**, *11*, 111–138. [[CrossRef](#)]
41. Ohlson, J.A.; Juettner-Nauroth, B.E. Expected EPS and EPS Growth as Determinants of Value. *Rev. Account. Stud.* **2005**, *10*, 349–365. [[CrossRef](#)]
42. Ho, K.-C.; Lee, S.-C.; Yu, M.-T.; Lin, C.-T. A Comparative Analysis of Accounting-Based Valuation Models. *J. Account. Audit. Financ.* **2016**, *32*, 561–575. [[CrossRef](#)]
43. Anesten, S.; Möller, N.; Skogsvik, K.; Skogsvik, S. The pricing accuracy of alternative equity valuation models: Scandinavian evidence. *J. Int. Financ. Manag. Account.* **2019**, *31*, 5–34. [[CrossRef](#)]
44. Skogsvik, K.; Juettner-Nauroth, B.E. A note on accounting conservatism in residual income and abnormal earnings growth equity valuation. *Br. Account. Rev.* **2013**, *45*, 70–80. [[CrossRef](#)]
45. Rees, W.; Valentincic, A. Dividend Irrelevance and Accounting Models of Value. *J. Bus. Financ. Account.* **2013**, *40*, 646–672. [[CrossRef](#)]
46. Clubb, C.D.B. Information dynamics, dividend displacement, conservatism, and earnings measurement: A development of the Ohlson (1995) valuation framework. *Rev. Account. Stud.* **2012**, *18*, 360–385. [[CrossRef](#)]
47. Gao, Z.; Ohlson, J.A.; Ostaszewski, A.J. Dividend policy irrelevancy and the construct of earnings. *J. Bus. Financ. Account.* **2013**, *40*, 673–694. [[CrossRef](#)]