The Influence of Deflators on Valuation

ABSTRACT

This paper deals with the analysis of the scale effect in the value-relevance of accounting numbers. We examine different deflators that have been widely used to mitigate such effect. We demonstrate from both theoretical and empirical viewpoints that most of the usual deflators employed in the literature generate endogeneity problems. In this paper we propose a new solution for the scale effect problem in the context of the Ohlson model and based on the use of exogenous deflators. This alternative produces, at least for the USA and Canada, better statistical results than endogenous deflators such as the market value, the book value of equity or the total assets. We claim in the paper that, using the number of employees (size of workforce of a firm) as deflator, the original relationship in the regression model is not altered, allowing us to correctly interpret the coefficients associated to book value and earnings.

Keywords: Scale effect, deflator, employees, value-relevance.

JEL Classification: M41.

* *The first named author gratefully acknowledges financial support from the Ministerio de Ciencia y Tecnologia (SEC2005-07657, Spain).*

1. INTRODUCTION

This study examines issues related to scale effects in value-relevance empirical models. Following the Ohlson (1995) framework, numerous studies have investigated the relation between the market value of equity and accounting variables, basically book value and earnings. In cross-sectional regressions, variables are affected by differences between sample firms, so that large (small) firms often have large (small) values of the relevant variables but these differences are not of research interest. Following Easton and Sommers (2003, p. 25-26), "*the overwhelming influence of large firms in these regressions is referred to as the scale effect. (…) Therefore the results of the regressions are driven by a relatively small subset of the very largest firms in the sample*". These scale differences can affect the regression results, causing heteroscedasticity, coefficient bias and an upwardly biased R-squared.

Previous studies have proposed different solutions to scale problems, essentially to deflate regression equations by a proxy of the scale or to include a scale proxy as an independent variable. However, there is no unique solution to this problem, as different studies propose different methods. Barth and Kallapur (1996) find that including a scale proxy as an independent variable is more effective than deflation at mitigating coefficient bias, since deflation can worsen coefficient bias and reduce estimation efficiency. However, a drawback of this approach is that their findings are sensitive to the scale proxy chosen.

Concerning the use of deflation, common deflators employed in previous studies are total assets, book value, earnings, number of shares and market value. Christie (1987) argues that opening market value is the natural deflator. Easton (1998) suggests book value as a more suitable deflator. Brown *et al.* (1999) show that the number of shares is not a good deflator, as it is an arbitrary choice made by the firm that reveals new size differences. They assert, however, that the opening market value can reduce scale effect. Lo and Lys (2000) discuss past applications of the Ohlson's (1995) model and, specifically, they draw attention to the possibility that the proposal solutions may change the nature of the relation, although they also suggest opening market value as a suitable deflator. Equally, Easton and Sommers (2003) identify scale with market capitalization and support the use of this variable as a deflator. Akbar and Stark (2003) find that market value is not a superior deflator in valuation equations on UK data, as different deflators appear to have similar effects; while Livnat (2000) states that other variables could be equally good or even better in reducing scale effects. In this line, Barth and Clinch (2005) find that the number of shares outstanding is generally more effective at mitigating scale effects, though they recognise that it is difficult to identify which type of scale effect is present in the data.

Consequently, there seems to be no agreement about the methodology to be adopted to reduce scale effect problems. Moreover, several studies with the same research objective arrive at contradictory conclusions.

On the other hand, Brown *et al.* (1999) find evidence that the increasing value relevance of accounting over time showed in Collins *et. al*. (1997) and Francis and Schipper (1999) are attributable to scale. After controlling its effect, however, value relevance declines. Also Lo and Lys (2000) assert that most valuation studies draw inappropriate conclusions due to scale effects. Barth and Clinch (2005) find that scale effects do not simply result from size differences across firms, as they are unobservable and can be manifest in several ways.

Therefore, new evidence is necessary in order to reduce the pervasive effect of scale and to draw correct inference in the relation between market value of equity and accounting variables. The aim of this study is to show if the use of those commonly proposed deflators is appropriate for reducing the scale effect or if, alternatively, a better deflator for the Ohlson's (1995) model exists. In particular, we look at a pool of candidates of deflators and then, select the "best" one according to various statistical criteria.

Our study provides theoretical and empirical evidence of the superiority of using an exogenous deflator such as the number of employees, that is, the size of the workforce of a firm. It provides better results in statistical terms than other deflators because this variable is related to scale and is exogenous in the Ohlson model, so that it avoids the endogeneity problems associated with other deflators.

The remainder of the paper is structured as follows. In Section 2, we discuss from a theoretical viewpoint the influence on valuation of different deflators proposed in previous research. Section 3 is devoted to the sample used in the empirical work. Section 4 presents the results of the empirical analysis, and finally Section 5 concludes the paper.

2. INFLUENCE OF DIFFERENT DEFLATORS ON VALUATION

In the empirical literature concerning the value-relevance of accounting numbers, most studies are based in Ohlson's (1995) framework, and use regression models of the market value of equity on accounting variables:

$$V_t = \alpha_0 + \alpha_1 bv_t + \alpha_2 x_t + \varepsilon_t, \qquad t = 1, 2, ..., \tag{1}$$

where V_t is the market value of a given firm at period of time t; bv_t is the book value of equity at period t, and x_t represents accounting earnings from period t-1 to t.

One of the important issues in the above regression is to identify and mitigate the so-called "scale effect", which arises through the cross-sectional scale differences between sample firms. Note that the nature of the data we usually encounter in market valuation is such that the results of regression (1) are generally driven by a relatively small subset of the very largest firms in the sample. Previous studies have showed that the scale effect produces biases in the estimated coefficients and heteroscedasticity, leading to model inefficiency. Barth and Kallapur (1996), Barth and Clinch (2005), Brown et al. (1999), Lo and Lys (2000) and Easton and Sommers (2003) are some of the studies pointing out scale effects in accounting research.

From an econometric viewpoint, let us first consider the cross-sectional counterpart of equation (1),

$$V_i = \beta_0 + \beta_1 bv_i + \beta_2 x_i + \varepsilon_i, \tag{2}$$

where V_i, bv_i and x_i correspond to the same variables as in equation (1) for a given firm, and are in fact unobservable, and ε_i has zero mean and constant variance, σ^2. As in Barth and Kallapur (1996), we suppose that the observable variables are V_i^*, bv_i^* and x_i^*, which are related to the unobservable ones in (2) throughout the unknown scale factor S_i, which has a multiplicative effect on the observable variables. That is,

$$V_i^* = S_i V_i,$$

$$bv_i^* = S_i bv_i$$

and

$$x_i^* = S_i x_i.$$

Multiplying both sides in equation (2) by the scale factor S_i, we get,

$$V_i^* = \beta_0 S_i + \beta_1 bv_i^* + \beta_2 x_i^* + \varepsilon_i^*, \tag{3}$$

with $\varepsilon_i^* = \varepsilon_i S_i$, which is a feasible regression, though with heteroscedastic residuals since the variance of the error term is proportional to the square of the scale factor S_i, i.e., $\mathrm{Var}(\varepsilon_i^*) = \sigma^2 S_i^2$. Barth and Kallapur (1996) also point out that the estimation of the β-coefficients if no scale factor is taken into account leads to a coefficient bias problem, with the magnitude of the bias depending on S_i. When the true scale factor S_i is known, the scale effect is clearly removed by deflating (3) by S_i and thus, getting back to equation (2). However, in practice, the scale factor is unknown and a proxy has to be found and used to deflate the model. Note, however, that if we use an incorrect deflator (say Z_i) in (3), the error term will still present heteroscedasticity problems unless the deflator is directly proportional to the true one, i.e., Z_i

$= \alpha S_i$, for a given α. In such a case, the variance of the error term remains constant ($V(\varepsilon_i^*/Z_i) = \sigma^2 S_i^2/Z_i^2 = \sigma^2/\alpha^2$) and then standard regression techniques can be applied. In the Ohlson's (1995) framework, the deflators usually employed are the number of shares, the market value, the book value of equity, and the total assets. In most of the empirical papers, authors use lagged deflators so that the dependent variable is set in terms of market profitability.

2.1. Deflator's choice

Accounting literature has showed the importance of accounting information for equity valuation.[1] Investors take into account earning information for equity valuation and this fact generates endogeneity problems if researchers use market value as a deflator in Ohlson's (1995) model.

We develop a simple model that is useful to analyze the relationship between the price of a firm and accounting numbers, specifically earnings. Consider a firm that finances its investments with retained earnings. Dividends (D_t) are equal to earnings (X_t) plus depreciation (DP_t) minus investment outlays (I_t), i.e., $D_t = X_t + DP_t - I_t$, where X_t is properly defined as earnings after depreciation, interest, taxes and preferred dividends but before extraordinary items.

Suppose that at time t, expected depreciation and investment at time t + k are proportional to expected future earnings, that is,

$$E_t\left[D_{t+k}\right] = E_t\left[X_{t+k} + DP_{t+k} - I_{t+k}\right] = E_t\left[X_{t+k}\left(1 + a_1 - a_2\right)\right],$$

where a_1 and a_2 are the proportionality factors. If we assume a constant discount rate (r) for expected dividends, the market value of equity[2] at time t is:

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[1] Collins and Kothari (1989) and Collins *et al.* (1997) are two of most cited studies showing the importance of earnings on equity valuation.
[2] Fama and French (1995) used this simple model to establish the relation between book-to-market-equity and expected stock return, and between book-to-market-equity and earnings on book equity.

$$V_t = \left(1 + a_1 - a_2\right) \sum_{k=1}^{\infty} \frac{E_t\left[X_{t+k}\right]}{\left(1+r\right)^k}.$$

This model is very convenient if we want to show the influence of accounting numbers on the market value of a firm. Let the estimated flows of earnings be formed in such a way that they grow at the inflation rate g. Then, the market value of firm A is:

$$V_0(A) = (1 + a_1 - a_2) \sum_{k=1}^{\infty} \frac{x\left(1+g\right)^{k-1}}{\left(1+r\right)^k} = \frac{(1 + a_1 - a_2)x}{r - g} \quad if \;\; r > g \,,$$

and the share price is equal to:

$$P_0(A) = \frac{(1 + a_1 - a_2)x}{\left(r - g\right)N},$$

where N is the number of shares.

We observe from the above framework that the market value depends on earnings and, if we use it as a deflator, it would alter the information contained in earnings and book value. We need a cross-sectional constant to maintain the proportionality relation between market value and earnings; however market value is not a constant term, as it depends on earnings. So this deflator would not be a good solution for the scale effect because it would not maintain the original relationship between market value and earnings. Coming back to the Ohlson's (1995) model, which is described through the relationship,

$$V_t = \alpha_0 + \alpha_1 bv_t + \alpha_2 x_t \,, \tag{4}$$

and supposing that in period 1, $V_1 = V_0(1+k)$, if we deflate the model in period 1 by market value in period 0, we obtain:

$$\frac{V_1}{V_0} = \alpha_0^{'} + \alpha_1^{'} \frac{bv_1}{V_0} + \alpha_2^{'} \frac{x_1}{V_0}.$$

Noting that $x_1 = x$, $d_1 = d$, and $bv_1 = C + x - d$, where C is the initial and unique contribution, then,

$$\frac{V_0(1+k)}{V_0} = \alpha_0^{'} + \alpha_1^{'} \frac{C+x-d}{\frac{(1+a_1-a_2)x}{(r-g)}} + \alpha_2^{'} \frac{x}{\frac{(1+a_1-a_2)x}{(r-g)}}$$

$$(1+k) = \alpha_0^{'} + \alpha_1^{'} \frac{(C+x-d)(r-g)}{(1+a_1-a_2)x} + \alpha_2^{'} \frac{(r-g)}{(1+a_1-a_2)}$$

$$(1+k) = \alpha_0^{'} + \frac{(r-g)}{(1+a_1-a_2)} \left[\alpha_1^{'} \frac{(C+x-d)}{x} + \alpha_2^{'} \right]$$

$$(1+k) = \alpha_0^{'} + \frac{(r-g)}{(1+a_1-a_2)} \left[\alpha_1^{'} + \alpha_2^{'} + \alpha_1^{'} \frac{(C-d)}{x} \right] = \alpha_0^{''} + \alpha_1^{'} \frac{(C-d)}{x} \frac{(r-g)}{(1+a_1-a_2)} \qquad (5)$$

being $\alpha_0^{''} = \alpha_0^{'} + \frac{(r-g)}{(1+a_1-a_2)} \left[\alpha_1^{'} + \alpha_2^{'} \right]$.

We clearly see that the final relationship in (5) is not the original one, because this deflator has altered the relation between accounting numbers and the return.

On the other hand, the number of shares is neither a good solution for the scale effect because it is arbitrary and sometimes has no relation with the size of a firm. Let us consider the case of two firms with the same accounting numbers and market value but where one of the firms has one share and the other has a large number of shares. Then, we would clearly have a scale effect problem in the regression model (1).

Next, we analyze the book value of equity as a potential deflator. We consider a firm that finances its investments with retained earnings. In this context, we define the book value of equity at period t as

$$bv_t(A) = C + \sum_{k=1}^{t} X_k - \sum_{k=1}^{t} D_k \,,$$

where C is the initial contribution of shareholders, X_k earnings in period k and D_k is all the pay-out in period k. We define $D_k = X_k + DP_k - I_k$. Therefore the book value is:

$$bv_t(A) = C + \sum_{k=1}^{t} X_k - \sum_{k=1}^{t} (X_k + DP_k - I_k) = C + \sum_{k=1}^{t} (I_k - DP_k) \,.$$

Noting that $bv_0 = C$ and $x_1 = x$, if we deflate equation (4) by the book value in period 0, we obtain:

$$\frac{V_1}{bv_0} = \alpha_0^{'} + \alpha_1^{'} \frac{bv_1}{bv_0} + \alpha_2^{'} \frac{x_1}{bv_0}$$

$$\frac{V_1}{C} = \alpha_0^{'} + \alpha_1^{'} \frac{(C + I_1 - DP_1)}{C} + \alpha_2^{'} \frac{x}{C}$$

$$\frac{V_1}{C} = \alpha_0^{'} + \alpha_1^{'} + \alpha_1^{'} \frac{(I_1 - DP_1)}{C} + \alpha_2^{'} \frac{x}{C}. \qquad (6)$$

As in the previous case, the relation in (6) is different from the original one, and thus, the book value of equity is neither a good deflator because it also alters the original relationship.

Finally, the level of total net assets of a firm has also been used in the literature as a potential deflator. We can calculate the total net assets of a firm in year t as follows:

$$TA_t = \sum_{k=0}^{t} I_k - \sum_{k=1}^{t} DP_k = C + \sum_{k=1}^{t} \left(I_k - DP_k\right) = bv_t\left(A\right),$$

where $C = I_0$. We observe that the total net assets are exactly the same as the book value of equity if the firm finances its investments with retained earnings. Thus, this deflator would not be a good solution either.

As mentioned in previous pages, from an econometric viewpoint, two additional issues still arise in the scale effect problems. On the one hand, cross-sectional scale differences between sample firms may result in biased coefficient estimates. On the other hand, the scale differences also produce heteroscedastic regression errors that can cause biased standard error estimates and inefficient results. These two issues are crucial for the interpretation of the beta-coefficients in the regression model (1).

In this paper we argue that the number of employees may be a better deflator than the ones mentioned above since this variable does not affect the original relationship (4), because it is a cross-sectional constant that maintains the proportionality relation between market value and earnings. Lo and Lys (2000) draw attention to the possibility that solutions proposed by accounting literature may change the nature of the studied relation. Moreover, number of employees is a good proxy for the scale, since the number of employees is usually related to the size of accounting numbers. Actually, it is the size of workforce of a firm. Also, in other lines of accounting research, this variable has been widely used as a scale proxy. (See, e.g., Subramanyam and Zhang, 2001, and Hann *et al.,* 2006). Moreover, by using an exogenous variable in the Ohlson's (1995) model, as is the case with the number of employees, we should expect to get more efficient results in the estimation of the coefficients in the (deflated) regression model.

3. DATA

Our sample consists of annual accounting data over the period 1995-2004. The accounting information comes from the Global Vantage database. From this source we take into account data at the end of each fiscal year.

We extract the following data for each firm: common shares outstanding (shares), number of employees (Emp.), market value (V), common equity (book value –bv-), total assets (ta), common stock (cs), common stock plus capital surplus (contributions), and earnings before extraordinary items (earnings-x-). Moreover, as is usual in value-relevance literature, we only consider non-financial companies, and firms with positive common equity. That gives a maximum of 21,134 observations for the US capital market and 3,310 for the Canadian capital market.

3.1. Descriptive statistics

Table 1 shows descriptive statistics of the variables in our sample. We observe that all variables in the USA and Canada move in a very similar way. All selected variables (number of shares, book value, total assets, common stock and contributions) increase across the sample in both countries. Market value grows until 2000, then it declines in 2001 and 2002, and it increases again over 2003 and 2004. This pattern holds for the two analyzed countries, the USA and Canada.

(Insert Table 1 about here)

For the book-to-market ratio the behavior is slightly different from one country to another. Thus, for the US, we observe a value of about 0.31. In Canada this ratio is around 0.49. The behavior in the USA and Canada in terms of earnings is practically the same. We observe that earnings decline in both countries in 1998 and 2001, the only difference is that, in Canada, in 2001 the earnings mean is negative. We see that for the number of employees the behavior is very similar too. The only observed difference is that, for the USA in 2000, the number of employees grows at around 550 employees per firm, while in Canada it diminishes by around 200 employees per firm.

To sum up, the behavior of all the variables is practically the same in the two financial markets. This is not at all surprising if we note for instance that Mittoo (1992) found that both interlisted and non-interlisted Canadian securities are integrated with the US market.

4. EMPIRICAL RESULTS

Which deflator is the best to solve the scale effect problems in accounting numbers is still an open question. The literature on this topic suggests different methods to solve the scale problem. Barth and Kallapur (1996) identified the econometric problem created by scale effects, resulting in biased coefficient estimates and heteroscedastic regression errors. They consider scale as an omitted variable, and state that in the special case that the scale factor is known, deflation cures coefficient bias and heteroscedasticity, and it would thus be the best remedy for it. They establish two alternatives for the scale effect problems: to deflate by a scale proxy, and to include a proxy of the scale as an additional independent variable. They list total assets, sales, book value, net income, number of shares outstanding and share prices as proxies for this unknown scale factor. In this line of research, Collins et al. (1997) and Francis and Schipper (1999) use book value and net income as independent variables for explaining market capitalization.

Other studies have also showed the benefits of deflating. Christie (1987) concludes that the correct deflator in return studies is the market value of equity at the beginning of the year. Easton (1998) proposes book value as deflator. Notwithstanding, Barth and Clinch (2005) affirm that the number of shares is an effective general proxy of scale and that share-deflated specifications perform best for data with scale effects. Lo and Lys (2000) use opening market value and Easton and Sommers (2003) argue that the best deflator is the market value at the end of fiscal year. However, Akbar and Stark (2003) argue that the deflator proposed by Easton and Sommers (2003) is not the best deflator when UK data are used.

The argument we employ in this paper is that the deflators used in the above-mentioned works could partly solve the scale effect problems, but they also generate endogeneity if we are in the context of the Ohlson's (1995) model. In that respect, we propose the use of the number of employees as a proxy to solve the scale effect problem, keeping the original interpretation of the beta-coefficients in the regression model (1). Moreover, in other lines of accounting research the number of employees has been widely employed as a proxy since it is the size of workforce of a firm. Therefore, we expect that using such an exogenous regressor would also produce more efficient results in the estimated coefficients from the regression model.

4.1. Coefficients

First we evaluate the Ohlson model with different deflators to see if there are differences between the two countries in the estimated coefficients. The equation, estimated by Ordinary Least Squares (OLS), is:

$$\frac{V_{it}}{S_{it}} = \beta_0 + \beta_1 \frac{bv_{it}}{S_{it}} + \beta_2 \frac{x_{it}}{S_{it}} + \varepsilon_{it} \qquad (7)$$

where V_{it} is market value of firm i at the end of fiscal year t, bv_{it} is common equity of company i in year t, x_{it} are earnings before extraordinary items of firm i in year t, ε_{it} is residual error on firm i in year t, and S_{it} is the deflator used in the regression to solve the scale effect problem.

Table 2 shows the estimated coefficients in the regressions, first with no deflation and then including a variety of them. The most interesting feature observed in this table is that these coefficients are different depending on the deflator used. This is obvious because the interpretation is not exactly the same and it clearly depends on the deflator used. We observe that the coefficients corresponding to book value (β_1) and earnings (β_2) are closer in the two countries than the other deflators when the number of employees is used as deflator. Thus, it seems that this deflator is not strongly influenced by differences across countries.

(Insert Tables 2 and 3 about here)

We also observe several differences in the estimated coefficients across different deflators. The coefficients corresponding to book value (β_1) in the USA vary between 0.30 and 3.76 and they are between 0.29 and 3.20 for Canada. In the case of earnings (β_2) the coefficients vary between 0.94 and 7.65 for the US market and between -0.88 and 3.36 for Canada. Next, we want to examine if there are scale effect problems in our sample and if, as Easton and Sommers (2003) postulate, the origin of these problems comes from market value differences across firms. For this purpose we divide our sample, based on the size of the workforce (number of employees), into 60 groups in the US market and 10 groups in Canada, maintaining the proportion observed in our sample size. In Table 3 we display the Spearman correlation coefficients between the variables in the Ohlson model. It can be seen that the portfolio with the highest number of employees has the highest correlations. Also, if we observe the correlation taking into account all observations in the sample pool, we see that this correlation is highly influenced by the portfolio with the highest number of employees, P60 for the US firms and P10 for the Canadian ones. This is clear in the case of the correlation between market value-earnings and earnings-book value. Also noticeable is the fact that the mean value of all portfolios is always lower than in the pool of observations, indicating thereby that there is a scale effect problem. We observe that the portfolio with the largest firms (in workforce terms) has a number of employees three times higher than the preceding portfolio.[3] Also, we observe that the difference in size between the portfolio with the largest and the smallest size is similar in the two countries. Therefore, the large difference between size portfolios is the origin of the scale effect problem, and the US market seems to present similar scale-related problems to the Canadian market.

The follow-up step in this direction is to compare the results using different deflators to resolve the scale effects, taking into account that some deflators might be related to the variables in the Ohlson model, and thereby, as showed in Section 2, possibly generating severe endogeneity problems.

4.3. Residuals

In line with the results displayed in the preceding section, we next show that the scale effect problems do not simply result from market value differences between firms since scale may have several other dimensions. We form 60 portfolios for the USA and 10 for Canada, within

[3] Similar results are obtained when we construct portfolios by market value.

each set of annual observations based on the magnitude of number of employees.[4] The mean of the studentized residuals and the mean of the absolute values of studentized residuals are calculated for each portfolio within each year. Means across 9 years of data are computed for each of the 60 portfolios for the USA and the 10 portfolios for Canada.[5] On the other hand we use the same pool of deflators as before to evaluate the results. We also use square roots of these deflators since the variances of the error terms could be directly proportional to the unknown scale factor.[6] Table 4 displays the mean of annual means of the studentized residuals for each portfolio. We observe that in the model with no deflation there is no significant influence on the regression because the means are in all cases lower than 1.96. Therefore the scale does not generate a problem of influence on the regression in our sample, and size differences do not result in coefficient bias associated with the scale. Surprisingly the inclusion of some deflators produces even higher residuals than in the case of no deflation in the US capital market. Thus, for example, for the highest portfolio in the USA (P60), we see that all deflators produce higher residuals than with no deflation. With respect to Canada, this does not happen for any deflator. We also note that the use of the square root of the deflators does not produce any significant improvement in the results.

(Insert Tables 4 and 5 about here)

Table 5 reports the mean of annual means of the absolute values of the studentized residuals. The results in this table suggest that the model without deflator has heteroscedasticity caused by the largest firms (in terms of the number of employees), and this happens for the two analyzed countries, the USA and Canada. Using the number of employees as a deflator produces good results in heteroscedasticity terms. For both countries, it presents a similar pattern to market value, because it has higher residuals in the smallest portfolios and

[4] Similar results are obtained in market value portfolios.
[5] We also computed the mean values of the entire pool of (absolute) studentized residuals and the results remain unaltered.

lower residuals in the largest ones. The square root version of this deflator produces slightly better results than the version without any transformation.

So far we have seen that our proposed deflator (and its square root version) corrects the heteroscedasticity generated by the scale. This solution is recommended by Lo (2005), among others, who affirms that researchers should generally deflate their models when scale differences exist in the data. On the other hand, we have been able to show that scale may not only be due to market capitalization, as Easton and Sommers (2003) affirm, because constructing portfolios according to the workforce size produces the same scale effects problems as when forming market value portfolios.

In the following sub-section we consider if the use of the number of employees as deflator produces smaller prediction errors than those based on models without deflation or with the other deflators.

4.4. Prediction Errors

We analyze the behavior of the different deflators in terms of their prediction ability. For this purpose, predictions are obtained from equation (1), then relative prediction errors are calculated for each observation from the equation:

$$RPE_{it} = \frac{\left(\frac{V_{it}}{S_{it}} - \hat{\beta}_0 - \hat{\beta}_1 \frac{bv_{it}}{S_{it}} - \hat{\beta}_2 \frac{x_{it}}{S_{it}} \right)}{\frac{V_{it}}{S_{it}}} , \qquad (8)$$

where variables are defined as in equation (7).

(Insert Table 6 about here)

In Table 6 we display the average values of the relative prediction errors across deflators. All deflators, except the USA Common Stock, improve the results compared with

[6] Note that the use of the original variable as a deflator is based upon the assumption that the variance of the error

the model with no deflation. The best deflator according to the relative prediction errors is market value, followed by earnings. The number of employees does also produce good results in the two analyzed countries. The square root versions of the deflators do not improve the original deflators in the majority of cases, and thus, they will not be employed in the forthcoming pages.

4.5. Residual Variance

The variances of the error terms are related to the unknown scale factor. For this reason we calculate the proportion of the residual variance explained by each deflator. We estimate the following equation by OLS:

$$\sigma_{R_t} = \beta_0 + \beta_1 \overline{S_t} + \varepsilon_t \, , \tag{9}$$

where σ_{R_t} is the mean residual variance in year t for the model without deflator, $\overline{S_t}$ is the mean of the deflator in year t, and ε_t is residual error in year t.

(Insert Table 7 about here)

The regression results were obtained using bootstrap with 9,999 observations in each regression, repeating this procedure 1,000 times. Table 7 displays the results of the estimated regression (9), and we observe that the number of employees explains a large proportion of the variation of the residual variance in the two countries (around 19%). This is consistent with previous results presented across this paper, verifying that this deflator produces similar results in the two countries. This is clearly of interest in the sense that we are looking for a deflator that may not only solve the scale effect problems, but that at the same time, be valid for global studies. As we observe in Table 7, market value explains around 46% in the USA but only 1.17% in Canada, implying that this deflator is no good for the latter country. An

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term is proportional to the squared variable. (See equation (3)).

explanation for that may be related with the standard deviation of market value. It is 66% higher in the USA than in Canada.

4.6. Endogeneity

We have seen in section 2 that some of the deflators usually employed in the literature produce serious endogeneity problems. We have also demonstrated that the number of employees is a good deflator to be used in the context of the Ohlson's (1995) model, since it verifies all the conditions for using it properly. Now, we want to prove empirically that the others deflators used in this paper generate endogeneity as we have previously claimed. For this reason, we apply Hausman tests comparing equation (1), with a certain deflator, with the one using the number of employees. In the Hausman test, the null hypothesis postulates exogeneity while the alternative implies endogeneity of the regressors in the models.

(Insert Table 8 about here)

Table 8 shows the results comparing all the deflators with the number of employees. We see that all null hypotheses are rejected, showing endogeneity problems with the variables usually employed in the literature. The number of employees seems to be the best deflator, first because this variable is exogenous, and, as we have demonstrated above, it is also a useful instrument to solve the scale effect problems in the Ohlson model. Another advantage of the number of employees is related to the stability of the results obtained with this deflator. It produces good results in both the US and the Canadian capital markets. Thus it suggests that this deflator may also be used in other international studies. On the other hand, the Hausman statistic related to market value is the largest one, implying that although this deflator is good for correcting heteroscedasticy and for generating estimations in the model, it also generates a serious problem of endogeneity.

5. CONCLUSIONS

In this paper we have examined a number of deflators that have been widely employed in the empirical literature on value-relevance of accounting numbers to solve the scale effect. We show that scale effect problems do not simply arise from market value differences across firms as is claimed for instance by Easton and Sommers (2003). In fact, we have obtained the same scale effect problems when constructing portfolios according to the number of employees and by market capitalization, concluding then that the scale has several dimensions. Moreover, we have shown theoretically, (with a simple model of dividends supported by accounting and financial literature), and empirically that the deflators most widely used such as market value, book value of equity or total assets are endogenous in the context of the Ohlson's (1995) model, leading thus to erroneous interpretations of the coefficients in the regression model.

In this article we have proposed the use of exogenous deflators in the Ohlson's (1995) model. Number of employees seems to be a good deflator as far as this variable, which is exogenous to the model, does not affect the original relationship between market value of equity and the accounting variables. Lo and Lys (2000) draw attention to the possibility that solutions proposed by accounting literature may change the nature of the studied relation. Number of employees is cross-sectionally constant; therefore it maintains the proportionality relation between market value and earnings. It is a good proxy for the scale since the number of employees is usually related with the size of a firm and accounting numbers because it is the size of workforce. Moreover, it has been widely used in the other lines of accounting research for controlling by size.

We examined the US and the Canadian markets, and the results, deflated by the number of employees (and its square root version), outperform the others in the majority of the cases. Furthermore, it produces the closest results between the two markets implying that it might be more suitable than the others for global studies.

This article can be extended in several directions. First, the number of employees could be used as a deflator in other empirical studies for other countries, and researchers could find other deflators to be applied in the Ohlson's (1995) model, which may also be exogenous to the model. This is the main contribution of the paper since most widely used deflators in other works employ variables which are endogenous to the model in the context of value-relevance accounting numbers.

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Table 1. Descriptive statistics based on the sample.

The results in this table are mean values calculated at the end of each fiscal year. Accounting numbers are in US million dollars for the USA and in Canadian million dollars for Canada. T: Year; Shares: Number of shares by company (in millions); V: Market value; bv: book value; ta: total assets; Emp.: Number of employees (in thousands); cs: Common stock; Contrib: Common stock plus capital surplus; Earnings: Earnings before extraordinary items; Pool: mean value taking into account all observations; N: number of observations.

USA								
T	Shares	V	bv	ta	Emp.	cs	Contrib	Earnings
1996	140.09	2,696.04	899.27	4,614.47	11.35	93.11	381.81	143.02
1997	135.18	3,423.70	947.57	4,968.60	11.45	99.58	414.96	148.91
1998	138.74	4,131.56	1,061.00	5,667.59	11.91	109.99	503.68	144.95
1999	142.95	4,945.80	1,206.76	6,379.40	12.35	113.42	594.92	180.40
2000	147.70	5,414.50	1,443.58	7,290.00	12.90	121.07	802.08	189.58
2001	145.89	4,498.97	1,463.30	7,709.80	12.19	118.64	866.88	104.00
2002	152.20	3,770.39	1,501.31	8,404.92	12.69	121.24	992.26	131.19
2003	155.77	4,699.27	1,695.43	9,211.37	12.51	122.86	1,085.53	205.71
2004	198.80	6,630.52	2,494.63	12,827.95	14.55	169.41	1,625.79	328.96
Pool	149.13	4,267.67	1,347.62	7,116.00	12.33	115.36	757.49	167.28
N	21,298	21,193	21,298	21,298	20,846	21,184	21,263	21,286

CANADA								
	Shares	V	bv	ta	Emp.	cs	Contrib	Earnings
1996	85.92	1,231.61	659.05	4,304.07	8.37	331.66	358.03	68.43
1997	83.03	1,534.93	694.65	4,805.03	9.38	351.05	367.62	75.02
1998	82.46	1,494.85	755.90	4,981.87	9.62	408.20	426.45	60.13
1999	81.46	2,039.25	783.90	4,834.13	9.85	426.82	442.61	78.01
2000	86.79	2,011.35	947.41	5,743.70	9.65	564.08	595.74	84.46
2001	90.82	1,819.33	918.22	6,399.63	9.49	621.08	657.58	-19.65
2002	103.16	1,647.78	1,020.58	6,977.42	9.81	735.97	771.43	59.97
2003	115.67	2,259.00	1,087.73	7,231.95	8.76	739.71	778.60	121.43
2004	123.82	3,317.28	1,488.45	9,652.35	9.57	807.77	871.16	195.65
Pool	92.38	1,800.19	880.62	5,791.44	9.28	528.56	558.75	72.07
N	3,385	3,325	3,385	3,385	1,539	3,375	3,349	3,373

Table 2. Regression results based on different deflators.
This equation is estimated by OLS:

$$\frac{V_{it}}{S_{it}} = \beta_0 + \beta_1 \frac{bv_{it}}{S_{it}} + \beta_2 \frac{x_{it}}{S_{it}} + \varepsilon_{it}$$

where V_{it} is market value of firm i at the end of fiscal year t, bv_{it} is book value of firm i in year t, x_{it} are earnings before extraordinary items of firm i in year t, ε_{it} is residual error on firm i in year t and S_{it} is deflator used in the regression for solving scale effect problem. Deflator column shows deflator used in the regression. NO: Regression without deflator; Shares: Number of shares outstanding in year t; V: Market value in year $t-1$; bv: book value in year $t-1$; ta: Total assets in year $t-1$; Employees: Number of employees in year t; cs: Common stock in year $t-1$; Contrib: Common stock plus capital surplus in year $t-1$; Earnings: Earnings before extraordinary items in year $t-1$. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

	USA					CANADA				
Deflator	β_0	β_1	β_2	$R^2_{adj.}$	**N**	β_0	β_1	β_2	$R^2_{adj.}$	**N**
NO	147.50***	1.82***	4.66***	0.82	19,394	82.94***	1.46***	1.75***	0.83	3,034
Shares	9.78***	0.85***	3.04***	0.41	21,134	4.72***	0.97***	1.66***	0.54	3,310
V	0.99***	0.30***	1.12***	0.11	17,943	0.99***	0.29***	0.68***	0.14	2,779
bv	-1.12***	3.76***	1.56***	0.22	18,049	-1.11***	3.20***	-0.88***	0.24	2,832
ta	-0.12***	2.91***	2.16***	0.43	18,049	-0.08**	2.30***	-0.36**	0.43	2,832
Employees	84.18***	2.17***	0.94***	0.60	20,710	1.08	2.09***	1.29***	0.76	1,525
cs	183.85***	2.06***	1.47***	0.78	17,956	0.83***	1.31***	3.32***	0.66	2,824
Contrib	1.27***	1.30***	7.65***	0.72	18,019	0.88***	1.25***	3.36***	0.64	2,799
Earnings	0.18	1.88***	2.61***	0.68	18,041	-0.63*	1.50***	1.13***	0.77	2,822

Table 3. Correlations by employees portfolios.

This table shows the Spearman coefficient correlation in portfolios classified by size of workforce (number of employees). P1 is the portfolio with the smallest firms and P20 is the one with the largest assets in number of employees terms. Pool: Correlation taking into account all observations; Mean: Mean value of portfolios; V-bv: Correlation between market value and book value; V-X: Correlation between market value and earnings; X-bv: Correlation between earnings and book value; Size: Mean number of employees by firm taking into account all observations.

USA

	Pool	P1	P2	P3	P4	P5	P6	P7	P8	P9	…	P51	P52	P53	P54	P55	P56	P57	P58	P59	P60	Mean
V-bv	0.90	0.69	0.59	0.69	0.75	0.73	0.75	0.77	0.80	0.79	…	0.86	0.85	0.85	0.84	0.86	0.79	0.84	0.87	0.84	0.86	0.80
V-X	0.73	0.11	-0.22	0.04	0.01	0.29	0.11	0.23	0.23	0.23	…	0.78	0.70	0.76	0.83	0.86	0.78	0.86	0.84	0.84	0.87	0.57
X-bv	0.70	0.24	-0.04	0.14	0.10	0.33	0.15	0.25	0.31	0.21	…	0.73	0.67	0.68	0.76	0.78	0.60	0.77	0.72	0.73	0.79	0.52
Size	12.33	0.02	0.05	0.09	0.11	0.14	0.18	0.21	0.25	0.29	…	15.54	17.78	20.82	24.44	29.37	37.15	46.76	61.84	93.33	243.75	12.43

CANADA

	Pool	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Mean
V-bv	0.88	0.75	0.73	0.85	0.74	0.81	0.83	0.94	0.82	0.86	0.90	0.82
V-X	0.64	0.36	0.53	0.63	0.43	0.53	0.65	0.72	0.59	0.65	0.65	0.57
X-bv	0.65	0.46	0.41	0.55	0.41	0.49	0.51	0.68	0.52	0.68	0.66	0.54
Size	9.28	0.06	0.27	0.64	1.22	1.89	2.80	4.41	7.71	18.85	56.46	9.43

Table 4. Studentized residuals by employees portfolios.

This table shows the mean of annual means of the studentized residuals for each portfolio. P1 is the portfolio with the smallest firms, in number of employees terms, and P60 and P10 contains the largest ones for the US and Canadian markets respectively. The residuals are obtained from the estimated equation:

$$\frac{V_{it}}{S_{it}} = \beta_0 + \beta_1 \frac{bv_{it}}{S_{it}} + \beta_2 \frac{x_{it}}{S_{it}} + \varepsilon_{it} ,$$

where V_{it} is market value of firm i at the end of fiscal year t, bv_{it} is common equity of company i in year t, x_{it} are earnings before extraordinary items of firm i in year t, ε_{it} is residual error on firm i in year t and S_{it} is the deflator used in the regression for solving scale effect problems. Deflator column shows the deflator used in the regression. NO: Regression without deflator; Shares: Number of shares outstanding in year t; V: Market value in year $t-1$; bv: Common equity in year $t-1$; ta: Total assets in year $t-1$; Employees: Number of employees in year t; cs: Common stock in year $t-1$; Contrib: Common stock plus capital surplus in year $t-1$; Earnings: Earnings before extraordinary items in year $t-1$. This table shows the results obtained with the square root version of these deflators too.

	USA									CANADA				
Deflator	**P1**	**P2**	**P3**	**P4**	**…**	**P57**	**P58**	**P59**	**P60**	**P1**	**P2**	**…**	**P9**	**P10**
NO	-0.03	-0.02	-0.01	-0.01	…	0.31	0.18	0.19	-0.01	0.10	0.09	…	-0.44	0.74
Shares	-0.35	-0.33	-0.27	-0.11	…	0.68	0.76	0.65	0.89	-0.11	0.03	…	0.19	0.42
V	0.17	0.39	0.23	0.34	…	-0.06	-0.05	-0.10	-0.08	0.36	0.13	…	-0.06	-0.06
bv	0.37	0.73	0.50	0.56	…	0.20	0.22	0.16	0.38	0.62	0.42	…	-0.19	-0.01
ta	0.19	0.63	0.45	0.57	…	0.22	0.22	0.20	0.30	0.54	0.29	…	-0.14	0.03
Employees	0.73	0.67	0.39	0.57	…	0.07	0.13	0.07	-0.02	0.39	0.38	…	-0.15	0.02
cs	0.00	0.41	0.22	0.36	…	-0.06	0.02	-0.15	0.11	0.40	0.37	…	-0.24	0.06
Contrib	-0.07	0.11	0.04	0.12	…	0.27	0.26	0.31	0.45	0.36	0.37	…	-0.25	0.06
Earnings	-0.35	-0.50	-0.35	-0.35	…	0.21	0.31	0.23	0.36	-0.20	0.07	…	-0.07	0.07
$\sqrt{Shares}$	-0.27	-0.14	-0.13	-0.03	…	0.71	0.73	0.71	0.89	-0.06	0.06	…	0.07	0.18
$\sqrt{V}$	-0.33	-0.11	-0.10	-0.02	…	0.79	0.87	0.94	1.15	-0.02	0.03	…	-0.03	0.44
$\sqrt{bv}$	-0.04	0.29	0.20	0.22	…	0.28	0.31	0.34	0.53	0.24	0.31	…	-0.22	0.08
$\sqrt{ta}$	0.02	0.36	0.31	0.33	…	0.13	0.15	0.16	0.35	0.36	0.36	…	-0.29	0.04
$\sqrt{Employees}$	0.05	0.34	0.19	0.30	…	0.29	0.37	0.29	0.57	0.51	0.25	…	-0.31	0.01
$\sqrt{cs}$	-0.08	0.09	0.11	0.22	…	0.10	0.13	0.26	0.46	0.09	0.36	…	-0.16	0.01
$\sqrt{Contrib}$	-0.17	-0.03	-0.03	0.02	…	0.30	0.25	0.31	0.39	0.07	0.37	…	-0.17	0.00
$\sqrt{Earnings}$	-0.26	-0.20	-0.08	0.01	…	0.37	0.49	0.48	0.62	0.30	0.11	…	-0.16	0.22

Table 5. Average absolute values of studentized residuals by employees portfolios.
This table shows the mean of annual means of the absolute values of the studentized residuals for each portfolio. P1 is the portfolio with the smallest firms, in number of employees terms, and P60 and P10 contains the largest ones for the US and Canadian markets respectively. The residuals are obtained from the estimated equation:

$$\frac{V_{it}}{S_{it}} = \beta_0 + \beta_1 \frac{bv_{it}}{S_{it}} + \beta_2 \frac{x_{it}}{S_{it}} + \varepsilon_{it},$$

where V_{it} is market value of firm i at the end of fiscal year t, bv_{it} is common equity of company i in year t, x_{it} is earnings before extraordinary items of firm i in year t, ε_{it} is residual error on firm i in year t and S_{it} is the deflator used in the regression for solving scale effect problems. Deflator column shows the deflator used in the regression. NO: Regression without deflator; Shares: Number of shares outstanding in year t; V: Market value in year $t-1$; bv: Common equity in year $t-1$; ta: Total assets in year $t-1$; Employees: Number of employees in year t; cs: Common stock in year $t-1$; Contrib: Common stock plus capital surplus in year $t-1$; Earnings: Earnings before extraordinary items in year $t-1$. This table shows the results obtained with the square root version of these deflators too.

	USA									CANADA				
Deflator	**P1**	**P2**	**P3**	**P4**	**…**	**P57**	**P58**	**P59**	**P60**	**P1**	**P2**	**…**	**P9**	**P10**
NO	0.05	0.04	0.05	0.05	…	1.22	1.12	1.68	2.71	0.13	0.18	…	0.83	2.34
Shares	0.84	0.68	0.62	0.63	…	1.01	1.07	1.03	1.15	0.57	0.62	…	0.84	1.04
V	0.96	1.09	0.98	1.00	…	0.55	0.51	0.57	0.51	1.09	0.86	…	0.57	0.55
bv	1.10	1.24	1.03	1.02	…	0.76	0.70	0.69	0.81	1.14	1.11	…	0.61	0.60
ta	1.22	1.34	1.11	1.18	…	0.61	0.60	0.55	0.58	1.28	1.20	…	0.48	0.42
Employees	1.40	1.42	1.21	1.17	…	0.49	0.53	0.47	0.32	1.25	1.15	…	0.29	0.26
cs	0.59	0.78	0.62	0.72	…	0.40	0.48	0.48	0.46	0.67	0.75	…	0.69	0.92
Contrib	0.48	0.51	0.40	0.43	…	0.79	0.73	0.80	0.88	0.62	0.75	…	0.69	0.93
Earnings	0.81	0.80	0.77	0.75	…	0.77	0.68	0.67	0.73	0.83	0.92	…	0.45	0.55
$\sqrt{Shares}$	0.38	0.31	0.29	0.34	…	1.18	1.16	1.29	1.21	0.29	0.43	…	0.99	1.09
$\sqrt{V}$	0.44	0.39	0.39	0.42	…	1.26	1.25	1.44	1.41	0.34	0.49	…	0.90	1.28
$\sqrt{bv}$	0.52	0.60	0.51	0.52	…	1.04	0.92	1.13	1.05	0.45	0.70	…	0.93	1.08
$\sqrt{ta}$	0.54	0.65	0.60	0.61	…	1.02	0.88	1.11	1.08	0.57	0.78	…	0.84	0.99
$\sqrt{Employees}$	0.87	0.73	0.56	0.65	…	0.88	0.86	0.93	1.03	0.89	0.80	…	0.63	0.78
$\sqrt{cs}$	0.49	0.40	0.40	0.53	…	0.71	0.67	0.82	0.94	0.35	0.71	…	0.93	1.04
$\sqrt{Contrib}$	0.29	0.25	0.25	0.30	…	1.01	0.89	1.12	0.97	0.35	0.73	…	0.94	1.03
$\sqrt{Earnings}$	0.39	0.37	0.36	0.38	…	1.13	1.13	1.21	1.13	0.63	0.45	…	0.81	1.18

Table 6. Relative prediction errors

This table shows relative predictions errors in absolute terms for each deflator used. Predictions are obtained from the estimated equation:

$$\frac{V_{it}}{S_{it}} = \beta_0 + \beta_1 \frac{bv_{it}}{S_{it}} + \beta_2 \frac{x_{it}}{S_{it}} + \varepsilon_{it},$$

where V_{it} is market value of firm i at the end of fiscal year t, bv_{it} is common equity of company i in year t, x_{it} is earnings before extraordinary items of firm i in year t, ε_{it} is residual error on firm i in year t and S_{it} is the deflator used in the regression for solving scale effect problems. Deflator column shows deflator used in the regression. NO: Regression without deflator; Shares: Number of shares outstanding in year t; V: Market value in year $t-1$; bv: Common equity in year $t-1$; ta: Total assets in year $t-1$; Employees: Number of employees in year t; cs: Common stock in year $t-1$; Contrib: Common stock plus capital surplus in year $t-1$; Earnings: Earnings before extraordinary items in year $t-1$. This table shows the results obtained with the square root version of these deflators too. Therefore, relative prediction errors for each observation are calculated from the equation:

$$RPE_{it} = \frac{\left(\frac{V_{it}}{S_{it}} - \hat{\beta}_0 - \hat{\beta}_1 \frac{bv_{it}}{S_{it}} - \hat{\beta}_2 \frac{x_{it}}{S_{it}}\right)}{\frac{V_{it}}{S_{it}}}$$

Relative prediction errors are average values.

Deflator	USA	CANADA	Deflator	USA	CANADA
NO	5.23	3.95	$\sqrt{Shares}$	1.83	1.59
Shares	1.52	1.90	$\sqrt{V}$	0.94	0.85
V	0.43	0.45	$\sqrt{bv}$	1.16	1.05
bv	1.01	1.03	$\sqrt{ta}$	1.14	1.12
ta	0.98	1.05	$\sqrt{Employees}$	1.71	1.00
Employees	1.80	0.93	$\sqrt{cs}$	2.50	1.17
Cs	12.16	1.16	$\sqrt{Contrib}$	1.25	1.21
Contrib	1.15	1.18	$\sqrt{Earnings}$	0.86	0.80
Earnings	0.67	0.71			

Table 7. Residual variance explained by deflator using bootstrap.
This table shows beta coefficients and adjusted R-Square for the following regression:

$$\sigma_{R_t} = \beta_0 + \beta_1 \overline{S_t} + \varepsilon_t ,$$

where σ_{R_t} is mean residual variance in year t for the model without deflator, $\overline{S_t}$ is mean of deflator in year t and ε_t is residual error in year t. Deflator column shows deflator used in the regression. Shares: Number of shares outstanding in year t; V: Market value in year $t-1$; bv: Common equity in year $t-1$; ta: Total assets in year $t-1$; Employees: Number of employees in year t; cs: Common stock in year $t-1$; Contrib: Common stock plus capital surplus in year $t-1$; Earnings: Earnings before extraordinary items in year $t-1$. This regression results have been obtained using bootstrap with 9,999 observations in each regression, repeating this procedure 1,000 times. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

	USA			CANADA		
Deflator	β_0	β_1	$R^2_{adj.}$	β_0	β_1	$R^2_{adj.}$
Shares	5,865.78***	19.33***	1.39%	5,815.98***	-37.70***	10.14%
V	545.61***	1.84***	45.89%	1,605.66***	0.33***	1.17%
bv	6,271.77***	1.78***	7.61%	3,426.48***	-1.27***	3.09%
ta	6,484.86***	0.30***	6.20%	3,974.83***	-0.28***	6.56%
Employees	-9,149.72***	1,442.37***	19.06%	-12,823.6***	1,604.64***	18.45%
cs	2,750.83***	50,74***	12.13%	3,464.88***	-2.20***	4.64%
Contrib	7,277.94***	1.86***	5.53%	3,525.38***	-2.19***	5.28%
Earnings	7,463.77***	7,53***	2.47%	2,278.96***	-0.44	0.01%

Table 8. Hausman Test

This table shows the results of applying Hausman test to the following equations:

$$\frac{V_{it}}{S_{it}} = \beta_1 \frac{bv_{it}}{S_{it}} + \beta_2 \frac{x_{it}}{S_{it}} + \varepsilon_{it} ,$$

$$\frac{V_{it}}{Employees_{it}} = \beta_1 \frac{bv_{it}}{Employees_{it}} + \beta_2 \frac{x_{it}}{Employees_{it}} + \varepsilon_{it} ,$$

where V_{it} is market value of firm i at the end of fiscal year t, bv_{it} is common equity of company i in year t, x_{it} is earning before extraordinary items of firm i in year t, ε_{it} is residual error on firm i in year t and S_{it} is the deflator used in the regression for solving scale effect problems. Shares: Number of shares outstanding in year t; V: Market value in year $t-1$; bv: Common equity in year $t-1$; ta: Total assets in year $t-1$; Employees: Number of employees in year t; cs: Common stock in year $t-1$; Contrib: Common stock plus capital surplus in year $t-1$; Earning: Earning before extraordinary items in year $t-1$. In Hausman test, the null hypotheses postulates exogeneity while the alternative implies then endogeneity.

	USA		**CANADA**	
Comparison (Deflator – Employees)	χ^2	p-value	χ^2	p-value
Shares - Employees	2,947.62	.0000	705.17	.0000
V - Employees	10,803.30	.0000	3,526.34	.0000
bv - Employees	504.78	.0000	158.45	.0000
ta - Employees	780.40	.0000	36.28	.0000
cs - Employees	37.06	.0000	197.20	.0000
Contrib - Employees	868.71	.0000	222.28	.0000
Earnings - Employees	266.60	.0000	331.68	.0000