RESEARCH ARTICLE

Valuation of agrifood SMEs. Lessons to be learnt from the stock market

Raül Vidal [1] and Javier Ribal [2]

[1] Institut Els Alfacs, Dept. Administration and Management. San Carles de la Ràpita (Tarragona) Spain. [2] Universitat Politècnica de València, Dept. Economic and Social Sciences. Camino de Vera s/n, 46022 Valencia, Spain.

Abstract

The European agrifood industry is mostly characterized by small and medium enterprises (SMEs); as in 2013, SMEs represented 99.13% of the total number of companies. The valuation of SMEs not listed in any stock market is a complex task since there is not enough information on comparable transactions. When applying discounted cash flow (DCF) models to value private agrifood companies, the capital structure and the cost of equity are two key parameters to be determined. The implications of these parameters in the value of the enterprise are not clear inasmuch as it is not possible to carry out a contrast due, precisely, to the lack of comparables. The main goal of this study is to determine the biases that those two parameters can introduce into the valuation process of an agrifood company. We have used the stock market as a framework wherein to apply a simple fundamental model to the companies of the European food industry in order to obtain three valuation multiples. By means of two bootstrap approaches, the bias induced in the multiples has been assessed for every year from 2002-2013. Results show that the use of the return on equity as cost of equity tends to undervaluation; the use of capital asset pricing model (CAPM) tends to a slight overvaluation, whereas using the total beta induces an undervaluation bias. Moreover, the capital structure shows little influence on the valuation multiples. The conclusions drawn from this paper can be useful for managers and shareholders of privately-held agrifood companies.

Introduction

The European agrifood industry is mostly characterized by small and medium enterprises (SMEs); as in 2013, SMEs represented 99.13% of the total number of companies (Eurostat, 2016). Koller *et al.* (2010) stated that the SMEs not listed in any stock market is a complex task. Plenborg & Pimentel (2016) stated that smaller firms are often characterized by a lower information environment when compared with larger firms, which makes the valuation of such firms more challenging.

In the case of listed companies, discounted cash flow (DCF) models and multiples are widely adopted (Demirakos *et al.*, 2004; Dukes *et al.*, 2006). In a study into mergers and acquisitions in the food industry, Declerk (2016) states that the use of multiples is inevitable. The transparency and high volume of the stock market make it possible to ascertain the valuation multiples. Unfortunately, this is only true for listed companies. In the case of privately-held companies, valuation multiples are scarce and barely representative (Ribal *et al.*, 2010). When pricing SMEs practitioners tend to rely on accounting methods, namely net

asset valuation, or on fundamental methods, namely discounted cash flows, DCF (Rojo & García, 2006).

Imam *et al.* (2008) stated that most analysts prefer sophisticated valuation models, such as DCF. Demirakos *et al.* (2010) report that analysts in the UK use DCF models more frequently than Price-Earnings models to value small firms, loss-making firms, and firms with a limited number of industry peers.

A DCF valuation of privately-held companies implies a series of key decisions regarding capital structure and cost of equity (Petersen *et al.*, 2006). These decisions can influence the final value of the company, and that is, precisely, the main goal of this study: to determine the biases that those decisions can introduce into the valuation process of an agrifood company. Specifically, the study focuses on the following research questions, whose answers should be useful to value privately-held firms: (1) how does the choice of capital structure influence the value of agrifood SMEs?; (2) how does the method used to obtain the cost of equity influence the value of agrifood SMEs?

To answer these questions, we need to compare the estimated value with the real value. Since there is no real value available for agrifood SMEs, we have taken a group of listed agrifood companies as a benchmark to check the influence of those valuation decisions on the value. Instead of comparing values we have compared multiples. Broadly speaking, the procedure works this way: first, all the agrifood companies listed in the European stock markets are valued by means of DCF obtaining the fundamental enterprise value (EV_F) for each company. Second, accounting variables are used to compute several valuation multiples, which are termed fundamental multiples. Third, these fundamental multiples are bootstrapped and compared with the corresponding bootstrapped stock multiples in order to contrast the existence of statistical significant differences in each multiple mean. Using multiples instead of values so as to contrast the models has some apparent advantages, such as the better interpretation of relative measures and the possibility of allowing a greater number of contrasts (one 'enterprise value' versus several multiples). By introducing different ways of fixing capital structure and cost of equity, the influence on the valuation multiple can be studied. From a practitioner's point of view, the answers to these questions can help to make valuation decisions and improve the accuracy of valuation multiples with greater insight or at least to know which kind of bias can be introduced by those decisions (Chullen *et al.*, 2015).

Material and methods

Data source

In order to answer these paper questions listed European agrifood companies have been used. Accounting and market data of those companies from 2002 to 2013 have been gathered from the Damodaran website (www.damodaran.com). Specifically, EVs, EBIT, DA, NET CAPEX, CWC, BV, E, D, FE, NI and t. The number of initial observations (companies) for each year is shown in Table 1, together with the exploratory statistics for each multiple and year. The analysis of the whole sample shows that 53% of the companies are classified as miscellaneous, 13% as dairy products, 10% meat products, 7% confectionery, 7% baking, 5% flour and grain; the rest of the sub-industries show smaller percentages. As regards to sales figures, companies from the stock markets in UK, France, Switzerland, Germany and The Netherlands weight more than 75% of the overall sales figure of the sample. Taking into account the number of companies, those companies from the stock markets in UK, France, Greece, Norway, Germany Switzerland, Finland, Italy and Belgium are more than 75% of the number of companies in the sample.

Selection of multiples

According to Frykman & Tolleryd (2003), there are two basic types of multiple: equity and enterprise value. Equity multiples express the value of shareholders' claims on the company relative to a variable only relevant to shareholders. Typical equity multiples include price/earnings and price/book value. Enterprise multiples express the value of the entire enterprise relative to a variable that relates to the entire enterprise, such as EBIT or EBITDA or Sales. Having reviewed accounting and finance literature, Bhojraj & Lee (2002) stated that there is little evidence to support the selection of specific multiples. In this study, we have used enterprise valuation multiples since they are both more comprehensive and are more closely related to the DCF valuation than the price multiples. Moreover, as regards SMEs, a valuation based on EV can be seamlessly converted to equity price by adjusting the current net debt whereas a valuation based on equity price is rapidly outdated. Specifically, it is EV/EBIT, EV/EBITDA and EV/Sales that have been selected since they are the multiples that are most commonly used in the reviewed literature.

Table 1. Exploratory statistics of stock multiples.

Year	EV/EBIT						EV/EBITDA						EV/Sales					
	n	Mean	Sd	Median	Min	Max	n	Mean	Sd	Median	Min	Max	n	Mean	Sd	Median	Min	Max
2002	96	14.83	7.38	13.27	1.64	50.69	101	24.22	158.56	7.66	1.25	1601.27	130	0.92	0.84	0.65	0.10	5.90
2003	105	12.74	13.47	9.69	0.15	91.37	111	8.06	9.18	5.76	0.10	87.63	113	0.61	0.46	0.46	0.01	3.01
2004	114	12.63	11.97	10.06	0.15	105.66	118	8.58	11.19	6.14	0.10	105.66	124	0.70	0.58	0.48	0.01	3.81
2005	109	15.89	14.13	11.45	0.76	83.02	113	10.63	11.03	7.60	0.45	69.47	115	1.48	6.97	0.59	0.03	75.09
2006	111	34.14	90.07	15.21	1.17	842.28	115	21.71	79.79	10.15	0.69	842.28	118	1.71	4.92	0.79	0.04	51.27
2007	102	21.01	21.60	18.33	1.09	182.17	108	13.49	11.03	11.22	0.67	64.94	112	1.67	5.58	0.88	0.05	59.37
2008	83	10.09	14.43	7.34	2.93	125.56	83	10.09	14.43	7.34	2.93	125.56	87	1.14	2.94	0.64	0.07	27.37
2009	85	11.67	12.89	8.43	1.37	105.46	91	10.13	16.67	5.96	1.08	120.40	101	0.88	1.88	0.41	0.04	18.28
2010	93	13.26	37.90	8.22	1.32	370.87	98	6.90	7.53	5.26	0.93	68.99	108	0.73	0.89	0.42	0.03	6.91
2011	96	12.70	32.35	7.09	0.72	302.70	99	4.98	3.18	4.15	0.47	19.33	109	0.60	0.67	0.34	0.02	4.52
2012	123	42.35	199.93	9.98	0.14	1923.91	136	59.89	395.07	5.59	0.14	4113.79	155	0.73	0.83	0.44	0.01	5.19
2013	125	12.94	25.97	9.34	0.66	290.76	129	9.14	16.48	6.33	0.34	182.00	149	1.00	3.23	0.51	0.02	39.27
Global	124	18.50	71.54	10.35	0.14	1923.91	1302	16.71	137.97	6.83	0.10	4113.79	1421	1.00	3.26	0.57	0.01	75.09

Calculation of the EV_F

The EV_F is estimated by assuming that an asset, a company, is worth the discounted value of all the future cash flows it can generate. The cash flows are measured as FCFF following Damodaran's (2006) definition. Among the members of the discount family, the discounted cash flow model has traditionally been the dominant one in practice (Jennergren, 2008). The results obtained by Imam *et al.* (2013) indicate that European investment analysts prefer to use cash flow based models in conjunction with non-book value based accrual models.

We will assume that the EV_F will be determined by the previous year's FCFF, taking perpetuity into account, as Eq. (1) shows.

$$EV_F = \frac{FCFF}{WACC} \quad (1)$$

The choice of this valuation model is influenced by the need to carry out an automatic mass valuation. The main advantage is that the amount of data to be collected is relatively small while the main drawback is the model's simplicity. Eq. (1) is also used as a way of estimating the continuing value in two-stage DCF models (Jennergren, 2008).

The FCFF are calculated as shown in Eq. (2):

$$FCFF = EBIT * (1 - t) + DA - CAPEX - CWC \quad (2)$$

The capital expenditures are obtained by following Eq. (3).

$$CAPEX = NETCAPEX + DA \quad (3)$$

The FCFF are discounted by using the WACC, Eq. (4).

$$WACC = K_e * \frac{E}{(E + D)} + K_d * (1 - t) * \frac{D}{(E + D)} \quad (4)$$

Marques-Perez *et al.* (2017) stated that the discount rate in agro-industrial firms is an essential tool for appropriate corporate management.

The cost of debt is calculated as an approximation using the financial expenses and the current debt of the company, Eq. (5).

$$K_d = \frac{FE}{D} \quad (5)$$

As Petersen *et al.* (2006) state, the estimation of a target capital structure is a non-trivial issue since market prices on equity and debt are not observable for equity privately-held firms. According to both literature and practitioners, the capital structure in Eq. (4) will take different values which are dependent on three different options.

The first option: the capital structure is taken from the company's books; this option is sometimes used when pricing privately-held companies. Woolley (2009) stated that there are many studies that use the book value of debt and equity. For McLaney *et al.* (2004), book value weights may be more objective yet less sensitive to economic reality than market values. However, Damodaran (2006) is not convinced by the arguments of those analysts who continue to use book value weights.

The second option: the capital structure is fixed as the average capital structure of the industry stock market. Since there is no available capital structure

of the market for privately-held companies, this is similar to considering the debt ratio when financing investments and it could represent the company's target capital structure. Vinturella & Erickson (2003), among others, state that the weights in the cost of capital should represent the firm's target capital structure. Koller *et al.* (2010) consider that the industry peer group is a good starting point from which to set the capital structure. McLaney *et al.* (2004) point out that, given fluctuations in share prices, the weighted average cost of capital (WACC) based on market values can change daily.

The third option: the capital structure is fixed by iterative calculation. This option addresses the so-called circularity problem, which means we cannot know the post-tax WACC without knowing the value of equity, and we cannot know the value of equity without knowing the post-tax WACC. Koller *et al.* (2010) recommend determining the equity value (for the cost of capital) of privately-held companies either using a multiples approach or through iterative DCF iteratively. Larkin (2011) states that analysts should use the iterative method with the WACC when valuing passive investments. According to Turner (2008), the circularity problem is important, since a small error in the post-tax WACC calculation can lead to a large error in the FCFF model's valuation.

Furthermore, the cost of equity (k_e) will also be obtained in two different ways. The first way is to take the average Return on Equity (ROE) of the agrifood industry as the cost of equity to be used in the WACC formula. For each sample company, the ROE was computed as the NI divided by the book value (BV). Breuer *et al.* (2014) suggested that one may rely on historical return moments. For Rojo (2014), ROE based on accounting data seems to be a good instrument with which to analyse the value of an investment project and may be a landmark in the study of the discount rate. Feenstra & Wang (2000) stated that the accounting rate of return, based on accrual concepts and defined as net income divided by book value of equity, is not only a central feature of any basic text on financial statement analysis, but it also figures commonly in the evaluation, by investment analysts, of the financial performance of firms.

The second way is to use the capital asset pricing model (CAPM) model. The cost of equity (k_e) is typically calculated via the CAPM in both listed companies (Breuer *et al.*, 2014) and unlisted companies (Rojo & García, 2006; Rojo, 2013). By eliciting responses from the finance directors of 193 UK quoted firms, McLaney *et al.* (2004) found a significant association between the use of the WACC and the use of the CAPM. For Koller *et al.* (2010), asset-pricing models that translate risk into expected return are used since the expected rates of return are unobservable. The CAPM is the most common asset-pricing model (Eq. 6) and postulates that the expected rate of return equals the plus the company's beta times the RP_m. RP_m is obtained as the difference between the $E(R_m)$ and the R_f following Eq. (7).

$$K_e = R_f + \beta_l * RP_m \tag{6}$$

$$RP_m = E(R_m) - R_f \tag{7}$$

The individual beta of each company is obtained by unlevering each food firm beta using the Modigliani & Miller's (1958) beta formula. Petersen *et al.* (2006) also report the use of this formula in the valuation of privately-held firms, Eq. (8).

$$\beta_u = \frac{\beta_l}{\left[1 + (1-t) * \frac{D}{E}\right]} \tag{8}$$

Then, the unlevered average beta of the food industry is computed, as shown in Eq. (9). Koller *et al.* (2010) recommend using industry rather than company-specific beta.

$$\beta_{u(Industry)} = Mean\ \beta_u = \overline{\beta_u} \tag{9}$$

Finally, the food industry beta is levered by using the capital structure of the individual company, following Eq. (10).

$$\beta_l = \left[1 + (1-t) * \frac{D}{E}\right] * \overline{\beta_u} \tag{10}$$

In order to estimate the market risk premium, we have used annual return realizations from the French *Cotation Assistée en Continu* (CAC), since the company betas are also computed using the CAC as the market index. Based on these data, we have calculated the differences between the total historical CAC returns and the historical 10-year French bonds as risk-free rate to determine historical excess returns. The time series covers the period from 1987 (base year) until the corresponding year of the study. The geometric average of the annual market risk premium has been used (Koller *et al.*, 2010).

When using the beta for unlisted companies, Damodaran (2006) suggests adjusting it to reflect the total risk rather than the market risk. That implies the assumption that the marginal investor is not a well-diversified investor. The total beta can be obtained by dividing the market beta by the correlation coefficient between each stock and the market index. This operation yields a higher industry beta. Petersen *et al.* (2006) report that Danish practitioners do not follow the Damodaran approach, but they add an additional 1-3 percentage points to the cost of equity in order to compensate for

unsystematic risk. Since our study focuses on the valuation of unlisted companies, we have deemed that the total beta approach should be included as a third option with which to work out the k_e. Unfortunately, we only had enough data from 2009 to 2013; therefore, this option will only cover those years. Moreover, the total beta can be used to ascertain the relative difference in value of the same company for a diversified investor and a non-diversified investor. The existence of the non-diversified investor in unlisted companies is well known (Damodaran, 2006). Petersen *et al.* (2006) also reported that the valuation of privately-held firms often involves investors who are not well-diversified. Assuming that the owner of an unlisted company is a non-diversified investor, the discount to be used when pricing unlisted companies could be estimated.

The combination of the different options regarding capital structure and cost of equity leads to nine variants of the fundamental valuation model. As the literature shows, each of these nine combinations is deemed to be of possible use by a practitioner when valuing an unlisted agrifood company.

Bootstrapping of valuation multiples

In order to test the difference between fundamental and stock multiples, a bootstrap technique has been used. Bootstrapping is a technique that resamples from the original data set (Efron, 1979; Davison & Hinkley, 1997) and allows any lack of normality issues to be avoided. Bootstrap methods have many applications for certain kinds of computations, such as biases, standard errors and confidence limits (Hesterberg *et al.*, 2005; Chernick & LaBudde, 2014). The references to valuation models that include the use of the bootstrap as a basic tool are scarce. Cruz (2012) used bootstrapping and Monte Carlo simulation for decision-making purposes in the assessment of investment projects. Breuer *et al.* (2014) estimated the discount rate for firm valuation by way of a bootstrap approach.

We have used two different bootstrap approaches: the first one consists of determining the valuation multiples and then bootstrapping them; we have termed it 'first valuation then bootstrapping'. In the second approach, the bootstrapping of the fundamental variables comes first and, after that, the fundamental valuation is carried out, we have named it 'first bootstrapping then valuation'.

In the first approach, we have used case resampling to derive the distribution of the mean from a distribution of an n multiple sample. First, we have resampled the data to obtain a bootstrap resample. An example of the first EV/EBIT resample might look like Eq. (11).

$$EV/EBIT_1^* = \{m_1, m_2, m_2, m_3, m_4, m_1, ..., m_n, ...\} \quad (11)$$

EV/EBIT1* is the distribution of the fundamental multiples for each year, while "mi" is the EV/EBIT for company "i". Note that there are some duplicates, since a bootstrap resample comes from sampling with replacement from the data. The size of the bootstrap resample is equal to the number of observations in the original data set. Then we have computed the mean of this resample and obtained the first bootstrap mean: μ1*. In the same way, a second resample EV/EBIT2* can be obtained, and a second bootstrap mean: μ2* can be computed. This procedure has been repeated 10,000 times to obtain a series of 10,000 bootstrap means; this series is called the empirical bootstrap distribution.

The empirical bootstrap distribution of EV/EBITF would be as shown in Eq. (12). The very same procedure has been carried out for every year for all of the fundamental multiples and stock multiples.

$$\{\mu_1^*, \ \mu_2^*, \ \mu_3^*, \ \mu_4^*, ... \mu_{10000}^*\} \quad (12)$$

In the second approach, the procedure is slightly different. Each variable of the fundamental model is resampled, the bootstrap mean is obtained and the procedure is repeated 10,000 times. At the same time, the accounting variables (EBIT, EBITDA and Sales) are also bootstrapped. A matrix is obtained, made up of the valuation parameters and the accounting variables as columns and the 10,000 bootstrap means as rows. For each row, the fundamental value is worked out. Using those 10,000 fundamental values and the corresponding accounting variables, the empirical bootstrap distribution for each multiple is built. In the same way, the empirical bootstrap distribution for stock multiples has been determined by bootstrapping stock enterprise value (EVs) and the corresponding accounting variable.

The first approach will provide the empirical distribution of the average multiple, while the second one will provide the multiple distribution of the average company. In the first approach, all the companies are considered to be of equal importance in the industry (in the company group), whereas in the second, the companies with greater value and greater accounting variables (EBIT, EBITDA or Sales) will have a greater pull on the bootstrap empirical distribution of the multiple.

The bootstrap allows the distribution of each multiple mean to be estimated and confidence intervals built. Table 2 summarizes both bootstrap approaches.

Calculation of the multiples

The valuation multiples are computed each year and the analysis is first carried out on an annual basis and then by considering a unique time window from 2002 to 2013. The way of working out the valuation multiples is

Table 2. Description of empirical approaches

First Valuation then Bootstrapping (Average Multiple)	First Bootstrapping then Valuation (Average Company Multiple)
1. Individual company valuation	1. Bootstrapping the mean of the valuation model parameters (10,000 times)
2. Calculation of the fundamental multiples.	2. Calculation of the distribution of the mean value (10,000 values)
3. Bootstrapping the mean of the fundamental multiples and the stock multiples (10,000 multiples)	3. Calculation of the distribution of the mean for each fundamental and stock multiple (10,000 multiples)
4. Contrasting statistical differences in the mean	4. Contrasting statistical differences in the mean

different according to the bootstrap approach. If the 'first valuation then bootstrap' approach is taken, the EV_F is estimated and three valuation multiples are calculated, EV/EBIT, EV/EBITDA and EV/Sales, and the corresponding stock valuation multiples are simultaneously obtained. It must be ensured that the observations and the sampling for each valuation multiple and year are the same in terms of stock and fundamental multiples in order to carry out a correct comparison. After applying the nine valuation variants and computing the three valuation multiples, the normality Shapiro-Wilk test (Shapiro & Wilk, 1965) shows that the normality hypothesis is rejected in 82% of the stock multiple cases and 77% of the fundamental multiple cases. Damodaran (2006) also points out that valuation multiples do not follow a normal distribution. Liu *et al.* (2002) stated that while the skewness is less noticeable for multiples based on forward earnings, it is quite prominent for multiples based on sales and cash flows. The normality test cannot be carried out on the second bootstrap approach, since the variables of the valuation model are bootstrapped first and then the average EV_F and EV_S are computed.

One outlier detection technique has been applied in order to identify those multiples with anomalous measurements. Table 1 shows the maximum for every year and multiple, some of which are extremely high and exert a great influence on the mean. As Vakili & Schmitt (2014) pointed out, a few outliers, if left unchecked, will exert a disproportionate pull on estimated parameters. Removing outliers is a delicate issue but, in the case of valuation multiples, large multiples can greatly affect the average. In this mass valuation process, the application of an automatic criterion for the purposes of detecting and then removing outliers has been deemed unavoidable. In particular, a technique has been used for detecting univariate outliers, specifically the absolute deviation around the median, MAD. Researchers are quite used to detecting the presence of outliers by observing an interval spanning over the mean plus (minus) two or three standard deviations. Leys *et al.* (2013) relate the problems of using the mean as the central tendency indicator: first,

normality is assumed; second, the mean and the standard deviation are greatly affected by outliers and third, there are some issues related to small samples. In this case, the computation of the MAD has been carried out considering a lognormal distribution. The threshold value has been set at ± 3 times MAD. In the first approach, the MAD criterion has been applied on each set of valuation multiples. In the second approach, the MAD has been applied on the variables needed to obtain EV.

Since we have chosen three multiples (EV/EBIT, EV/EBITDA and EV/Sales), built nine valuation variants, taken two bootstrap approaches and the study was carried out over 12 years, we should have 648 bootstrap distributions of the valuation multiples. However, as we had no information on the total beta for 7 years, the total beta model was only applied for 5 years; hence the number of bootstrap distributions and contrasts adds up to 522. Table 3 summarizes the different options on capital structure and cost of equity, and the two approaches used to estimate the fundamental valuation multiples. The models are named "Model x.y.z". The "x" reference explains the bootstrap approach, the "y" reference the capital structure and, finally, the "z" reference specifies the cost of equity. Fig. 1 displays the general outline of all the empirical models.

Iterative procedure to determine the capital structure

The application of the valuation options regarding capital structure and cost of equity is quite straightforward. Nevertheless, computing the capital structure for each company by solving the circularity problem requires some iterative calculations (Turner, 2008). Larkin (2011) details the calculations to be carried out and says that it is extremely simple to execute the iterative method in an Excel spreadsheet. Vélez-Pareja & Tham (2009) also recommend using the spreadsheet to handle circularity.

In our study, taking into account the number of companies and models, two R scripts (R Core Team,

Table 3. Valuation models regarding capital structure and cost of equity.

Capital structure	Cost of equity	Approach 1 First Valuation then Bootstrap (Average Multiple)	Approach 2 First Bootstrap then Valuation (Average Company Multiple)
Books	ROE	Model 1.1.1	Model 2.1.1
Books	CAPM (Industry Beta)	Model 1.1.2	Model 2.1.2
Books	CAPM (Total Beta)	Model 1.1.3	Model 2.1.3
Market	ROE	Model 1.2.1	Model 2.2.1
Market	CAPM (Industry Beta)	Model 1.2.2	Model 2.2.2
Market	CAPM (Total Beta)	Model 1.2.3	Model 2.2.3
Circularity	ROE	Model 1.3.1	Model 2.3.1
Circularity	CAPM (Industry Beta)	Model 1.3.2	Model 2.3.2
Circularity	CAPM (Total Beta)	Model 1.3.3	Model 2.3.3

2016) have been written using the secant method and the Newton-Raphson method (Kaw *et al.*, 2011). Only the solutions of Equity greater than zero are deemed to be right, which implies the removal of some companies with negative solution for the Equity.

Data loss

There are several sources of data loss. Some of them are common to all models, while others are model-specific.

As far as common sources are concerned, companies with no available data have been removed in the corresponding year. Moreover, before computing valuation multiples, any observation with negative FCFF,

negative EBIT or negative EBITDA has been removed. This is consistent with other research on multiples (Gavious & Parmet, 2010). Therefore, those companies that show a bad performance are not included in the corresponding year. This implies the removal of about 24% of the companies in the period 2002-2008 and about 76% in the period 2009-2013. The number of companies that show negative results increased substantially in the years of economic crisis, reducing the sample size in those years.

As regards the specific sources, those companies with a negative beta have been removed in the corresponding year; the outlier detection procedure helped to remove some observations (between 2% and 8%) and also the iterative procedure used to fix the capital structure led
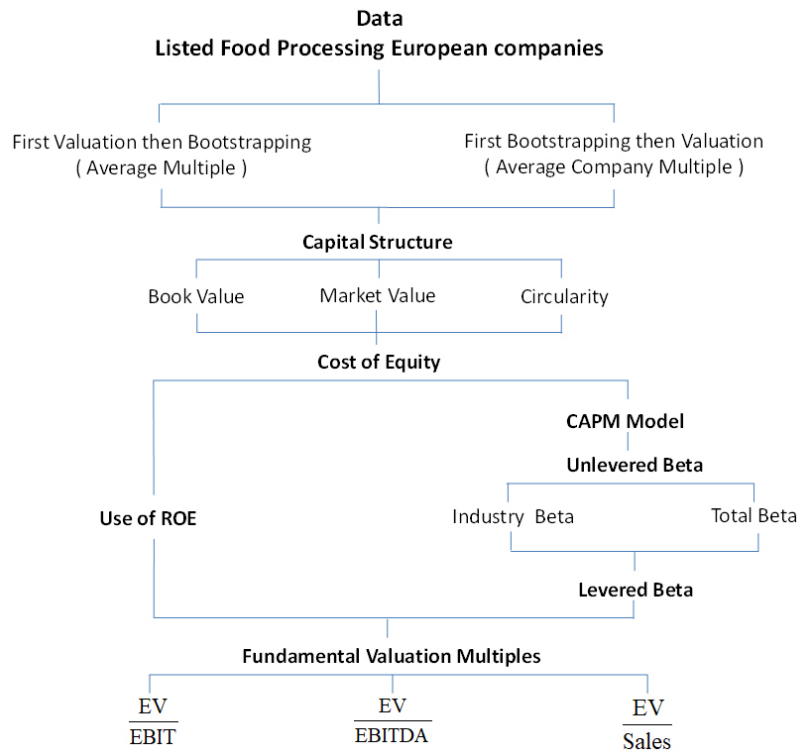

Figure 1. Outline of empirical models

to a great deal of companies (around 20% more) being removed. The iteration option introduces some bias, favouring companies with a relatively low debt. Those companies, which do not generate enough value to pay their debt, will have a negative equity and will be removed from the analysis in that option; consequently, the size of the sample will be reduced.

Results

In the previous section, several valuation choices have been introduced. The analysis has been carried out on two levels: an annual level (working with annual observations) and a whole period level (working with firm year observations).

The focus of annual level analysis is on determining the number of times there is a statistically significant difference between stock and fundamental multiples. A contrast ratio, made up of the fundamental multiple divided by the stock multiple, has been computed for each type of multiple, model and year. The null hypothesis (H_0) is that the contrast ratio is equal to one. If the contrast ratio is statistically different from one, then there is a significant difference between the fundamental multiple and the stock multiple. The level of significance was set at 95%; this means that if the contrast ratio is outside the 2.5%-97.5% range of the empirical bootstrap distribution, then the average of the multiples is considered to be statistically different, which is to say the null hypothesis is rejected. On the whole, the fundamental multiples are not statistically different from the stock multiples in half of the cases, and when there is a statistical difference, the fundamental models are more likely to undervalue than to overvalue (Table 4). A better insight can be gained by examining the results of the different models.

Influence of the cost of equity and the capital structure on the annual level analysis

Table 5 has been built for bootstrap approach 1 (measuring the results of the average multiple) by grouping the model results according to the cost of equity and capital structure. When the cost of equity is fixed as the average agrifood industry ROE an undervaluing bias is introduced in the valuation of agrifood companies. When the industry beta is used to fix the cost of equity by means of the CAPM, the null hypothesis is not rejected in 33% of the cases; in the remaining 67%, fundamental multiples are more likely to be greater than the stock ones, there is an overvaluation bias. When considering that the investor is not diversifying in the Markowitz sense (total beta models), higher stock multiples could be expected since a higher cost of equity is used in the fundamental models. In 71% of the cases, the null hypothesis cannot be rejected and, in the rest of the cases, there is an undervaluation bias.

Likewise, Table 6 gathers the results for bootstrap approach 2, which measures the results of the average company multiple. The results are quite similar to Table 5, the use of the industry ROE or the total Beta tend to cause some undervaluation while the use of the industry beta creates a slight overvaluation.

The different ways of considering the capital structure do not show any clear effect on the value and consequently on the valuation multiples. The selection of the cost of equity seems to be much more influential.

Whole period level analysis (2002-2013)

The large number of combinations, 522, can hinder a global vision; for that reason, two graphical analyses have been carried out considering the period 2002-2013.

Figure 2 has been built in order to show the biases introduced by the valuation choices in both approaches. Since we had no data on the total beta for the period 2002-2008, the models that use the total beta have been left out; which is, all the x.y.3 models are not considered. The remaining six valuation models and the two bootstrap approaches have been applied so as to obtain the valuation multiples. Figure 2 is made up of six squared panels. In each panel, a scatterplot

Table 4. Annual models. Contrast of the null hypothesis

Bootstrap approach	$H_0^{1,2}$ rejection				H_0 fail to reject	
	$M_S^3 > M_F^4$		$M_S < M_F$		$M_S = M_F$	
	Number	%	Number	%	Number	%
Average multiple	85	33%	56	21%	120	46%
Average company multiple	103	39%	13	5%	145	56%

[1] Null hypothesis (H_0): There is no significant difference in the average of the valuation multiple. [2] Null hypothesis (H_0): There is no significant difference in the multiple of the average company. [3] Ms: Stock multiples. [4] M_F: Fundamental multiples.

Table 5. Bootstrap approach 1. Contrast of the null hypothesis. Average multiple

Capital structure	$H_0{}^1$: $M_S{}^2 = M_F{}^3$	Industry ROE		CAPM (Industry Beta)		CAPM (Total Beta)	
		Number	%	Number	%	Number	%
All	Fail to reject H_0	52	48%	36	33%	32	71%
	Reject H_0 ($M_S > M_F$)	54	96%	18	25%	13	100%
	Reject H_0 ($M_S < M_F$)	2	4%	54	75%	0	0%
Books	Fail to reject H_0	18	50%	15	42%	10	67%
	Reject H_0 ($M_S > M_F$)	18	100%	6	29%	5	100%
	Reject H_0 ($M_S < M_F$)	0	0%	15	71%	0	0%
Market	Fail to reject H_0	16	44%	16	44%	10	67%
	Reject H_0 ($M_S > M_F$)	20	100%	6	30%	5	100%
	Reject H_0 ($M_S < M_F$)	0	0%	14	70%	0	0%
Circularity	Fail to reject H_0	18	50%	5	14%	12	80%
	Reject H_0 ($M_S > M_F$)	16	89%	6	19%	3	100%
	Reject H_0 ($M_S < M_F$)	2	11%	25	81%	0	0%

[1] Null hypothesis (H_0): There is no significant difference in the average of the valuation multiple. [2] Ms: Stock multiples. [3] M_F: Fundamental multiples.

Table 6. Bootstrap approach 2. Contrast of the null hypothesis. Average company multiple

Capital structure	$H_0{}^1$: $M_S{}^2 = M_F{}^3$	Industry ROE		CAPM (Industry Beta)		CAPM (Total Beta)	
		Number	%	Number	%	Number	%
All	Fail to reject H_0	42	39%	85	79%	18	40%
	Reject H_0 ($M_S > M_F$)	66	100%	10	43%	27	100%
	Reject H_0 ($M_S < M_F$)	0	0%	13	57%	0	0%
Books	Fail to reject H_0	12	33%	27	75%	3	20%
	Reject H_0 ($M_S > M_F$)	24	100%	6	67%	12	100%
	Reject H_0 ($M_S < M_F$)	0	0%	3	33%	0	0%
Market	Fail to reject H_0	12	33%	29	81%	3	20%
	Reject H_0 ($M_S > M_F$)	24	100%	1	14%	12	100%
	Reject H_0 ($M_S < M_F$)	0	0%	6	86%	0	0%
Circularity	Fail to reject H_0	18	50%	29	81%	12	80%
	Reject H_0 ($M_S > M_F$)	18	100%	3	43%	3	100%
	Reject H_0 ($M_S < M_F$)	0	0%	4	57%	0	0%

[1] Null hypothesis (H_0): There is no significant difference in the multiple of the average company. [2] Ms: Stock multiples. [3] M_F: Fundamental multiples.

of one multiple has been plotted by applying the six valuation models and one of the bootstrap approaches. Each model is represented by a coloured cloud made up of 10,000 dots. The x-coordinate of each panel measures the bootstrap mean of the stock multiple, while the y-coordinate is the bootstrap mean of the fundamental multiple for the very same resampling. A bisector line has been traced to visually ascertain the bias. If a dot cloud is above the bisector line, the fundamental model is overvaluing; on the contrary, if a dot cloud is under the bisector line, the fundamental model is undervaluing. The distance from the cloud to the bisector line displays the strength of the bias. The relative difference between models can be checked as well, since we have used squared panels. Some of the results of the annual analysis are confirmed: using the ROE as the cost of equity induces undervaluation, whereas using the CAPM to fix the cost of equity tends to a slight overvaluation. The method of fixing the capital structure is not very influential, although the clouds from models with circularity structure (1.3.z) are placed slightly higher on the fundamental multiple axis.

The approach 2 models that use the CAPM (models 2.y.2) are clearly the least biased regardless of the method of fixing the capital structure. In this case, the model is much less sensitive and the effect of the circularity selection does not show.

Additionally, the average multiple and the multiple of the average company have been traced as vertical lines in panels 1.y.z and 2.y.z, respectively. Both averages have been calculated taking the company years with positive multiples in the first case, or positive EV_S and positive accounting variables in the second case. Outliers have been removed in both cases.

The variability of the multiples can also be compared in Fig. 2. If the cloud is longer in the direction of one axis than in the other it shows a greater variability in the former. It can be seen that x.y.2 models (the ones that use the CAPM) show greater variability in the fundamental multiples than in the stock multiples, except in the case of EV/Sales. On the contrary, x.y.1 models (the ones that use the ROE to fix the cost of equity) exhibit a similar variability for both kinds of multiples.

With regard to both bootstrap approaches, the first approach shows less variability. In the first approach, only the variability of the numerator and the denominator of the fundamental multiples are considered, whereas in the second one the variability of several parameters of EV are taken into account; the greater number of variables has induced greater variability.

The bootstrap estimates of each multiple are analogous to the idea of the density estimation of the mean. An estimation of the shape of the density function can be obtained by plotting a histogram. As an example, Figs. 3 and 4 show the results of the EV/Sales models for the period 2002-2013; fundamental and stock histograms are plotted together. With these kinds of plots, the variability and the difference between stock and fundamental multiples can be clearly appreciated for each multiple, model and approach. The results match those from Fig. 2. Figs. 3 and 4 also include models x.y.3 (circularity structure); interestingly, the variability in the fundamental multiples of the x.y.3 models is much greater than in the rest.

Assuming that the stock multiple is the true one, a measure of the bias with respect to the stock multiple has been calculated as M_F/M_S -1. If this bias ratio is statistically greater than zero, the fundamental multiples tend to overvalue; on the contrary, if the bias ratio is less than zero, the fundamental multiples tend to undervalue. The average results are shown in Table 7.

The bias ratio confirms the results of the H_0 contrast in the annual level analysis. The use of ROE as cost of equity introduces a negative bias, that is, an undervaluation of between 25% and 58%. Similarly, when using the total beta to fix the cost of equity, the undervaluation is in the range of 12-52%. When using the industry beta, the bias is slightly positive in almost all the cases.

Discussion

The bootstrap technique is applied to take into account the variability of the valuation process and, hence, the variability induced on the valuation multiples. Depending on when the bootstrap is used in the calculation process, the empirical distribution of the mean multiples or the empirical distribution of the multiples of the average company can be obtained. The sign of the bias introduced by the valuation process is essentially the same between the average multiple (approach 1) or the average company multiple (approach 2). Nevertheless the average company ratio is much more robust to outlier's presence. Morningstar (2005), a financial data provider, also uses the average company ratio to compute valuation multiples and state that outliers can easily skew the results of the arithmetic method. In order to check the effect produced by eliminating the outliers, all of the calculations have been repeated without removing any outlier. Over the whole period, the relative position of the dot clouds is very similar to Fig. 2, but the variability in both axes is greater in approach 1; the average multiple is much higher if the outliers have not been removed. This is consistent with Chullen *et al.* (2015), who warns that "arithmetic mean aggregation still being the most common aggregation in practice produces significantly upwards biased results".

Table 7. Average bias between stock exchange and fundamental multiples (2002-2013).

Approaches[1,2]	Books			Market			Circularity		
	ROE	CAPM Industry Beta	CAPM Total Beta	ROE	CAPM Industry Beta	CAPM Total Beta	ROE	CAPM Industry Beta	CAPM Total Beta
Average Multiple	-32.24*	10.26	-23.39*	-40.31*	10.73	-25.37*	-25.29*	19.19*	-12.89
Average Company Multiple	-43.18*	-2.28	-51.38*	-57.85*	11.99	-49.38*	-33.78*	8.36	-39.59*

[1] Bias defined as $M_F/M_S - 1$ (%). [2] CAPM Total Beta model for the 2009-2013 period. * $p \leq 0.01$.
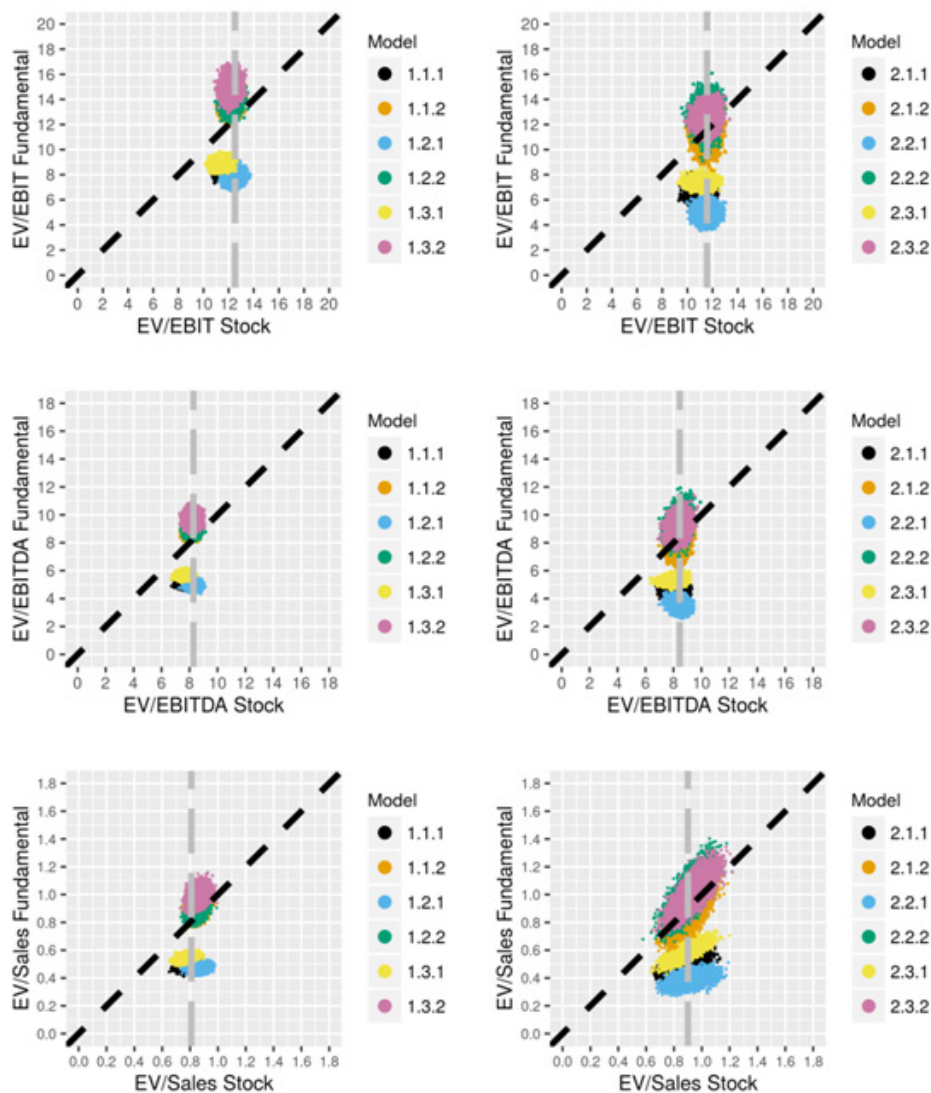
Figure 2. Bias analysis of bootstrapped fundamental and stock multiples (2002-2013). Left column, Approach 1 models (1.1.1, Book structure + ROE; 1.1.2, Book structure + CAPM; 1.2.1, Market structure + ROE; 1.2.2, Market structure + CAPM; 1.3.1, Circularity structure + ROE; 1.3.2, Circularity structure + CAPM). Right column. Approach 2 models (2.1.1, Book structure + ROE; 2.1.2, Book structure + CAPM; 2.2.1, Market structure + ROE; 2.2.2, Market structure + CAPM; 2.3.1, Circularity structure + ROE; 2.3.2, Circularity structure + CAPM)

On the contrary, approach 2 is much more robust and there is no clear change in variability; moreover, the average company multiple does not suffer any noticeable change when computed without removing outliers.

Statistical contrasts have been carried out to determine the existence of statistical differences between fundamental and stock multiples. Around 50% of the fundamental multiples are not statistically different from the stock multiples. When pricing privately-held agrifood companies, using the return on equity or the total beta causes undervaluation, whereas using the industry beta causes a slight overvaluation.

The quantification of the bias shows that the use of the total beta decreases the value by around 10-50%. The ROE decreases the value by around 25%-58%. These figures could be read as a discount for the lack of diversification, which is a regular case in unlisted companies and SMEs. Rojo (2014) worked out a discount of 27.63% using 96 non-financial companies quoted in Spain and a discount of 49.26% when using the total beta to calculate the ke from a sample of 286 privately-held companies. Using historical studies of restricted stock transactions involving public securities, Mercer (2003) reported that the appropriate marketability discount is approximately 35%.
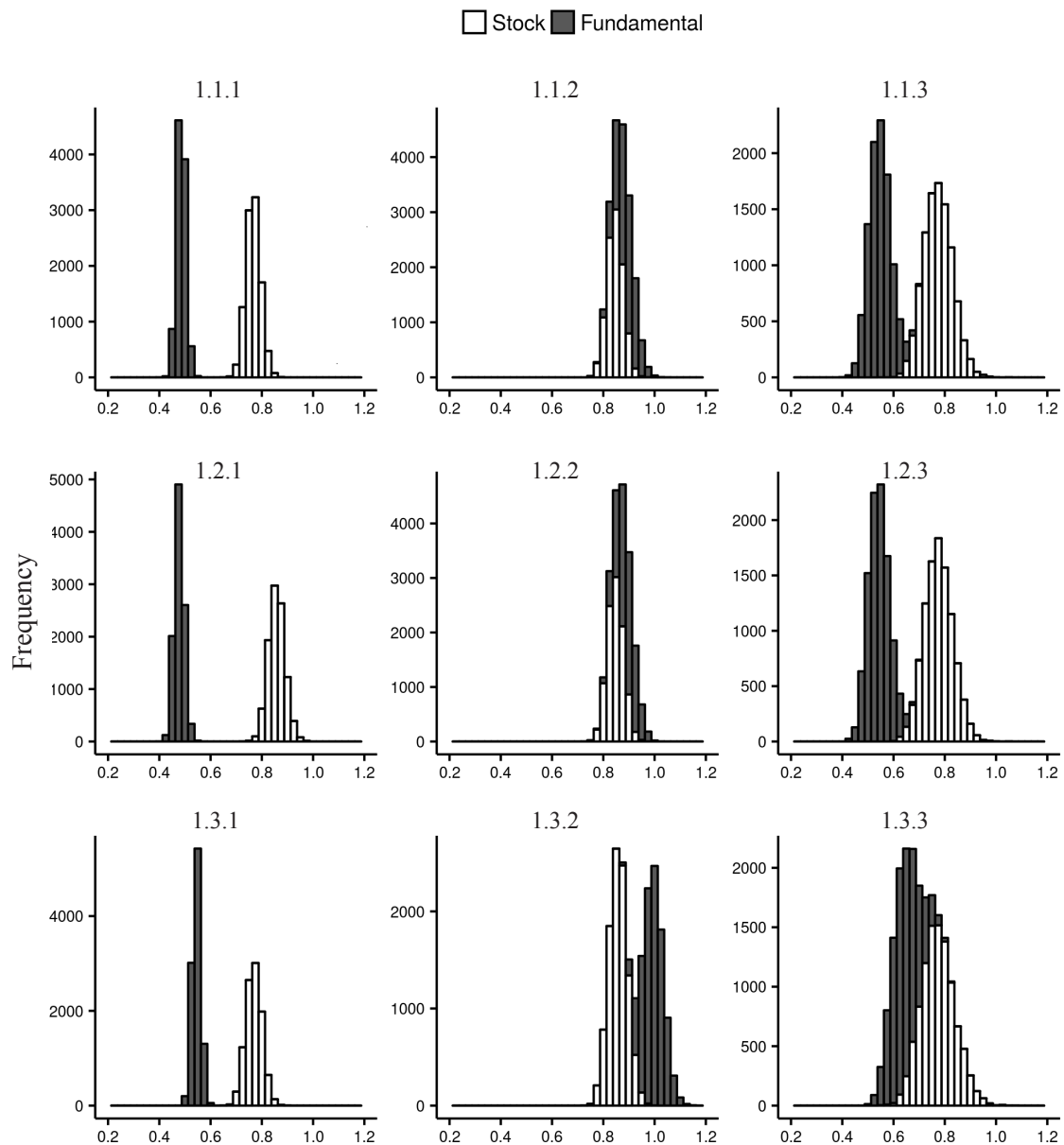
Figure 3. Empirical distributions of the average EV/Sales multiple (2002-2013). Approach 1 models: 1.1.1, Book structure + ROE; 1.1.2, Book structure + CAPM; 1.1.3, Book structure + Total beta; 1.2.1, Market structure + ROE; 1.2.2, Market structure + CAPM; 1.2.3, Market structure + Total beta; 1.3.1, Circularity structure + ROE; 1.3.2, Circularity structure + CAPM; 1.3.3, Circularity structure + Total beta

The method of fixing the capital structure does not exhibit a clear influence on the valuation multiples. Woolley (2009) thinks that "the use of book structure will almost underestimate the cost of capital because the market value of equity should be above the book value and, hence, using book value gives too low a weighting to the more expensive equity component of the WACC". This statement is not confirmed either when the cost of equity is obtained from the return on equity, or when the CAPM is involved. If the beta is first unlevered and then

levered, the influence of the capital structure is minor and the changes in the capital structure do not change the WACC sharply.

Fixing the cost of equity by means of the CAPM appears to be the less biased method to value agrifood companies with discounted cash flows; this is consistent with the reviewed literature.

All of these conclusions can be useful for managers and shareholders of privately-held companies when applying for a valuation report or analysing and
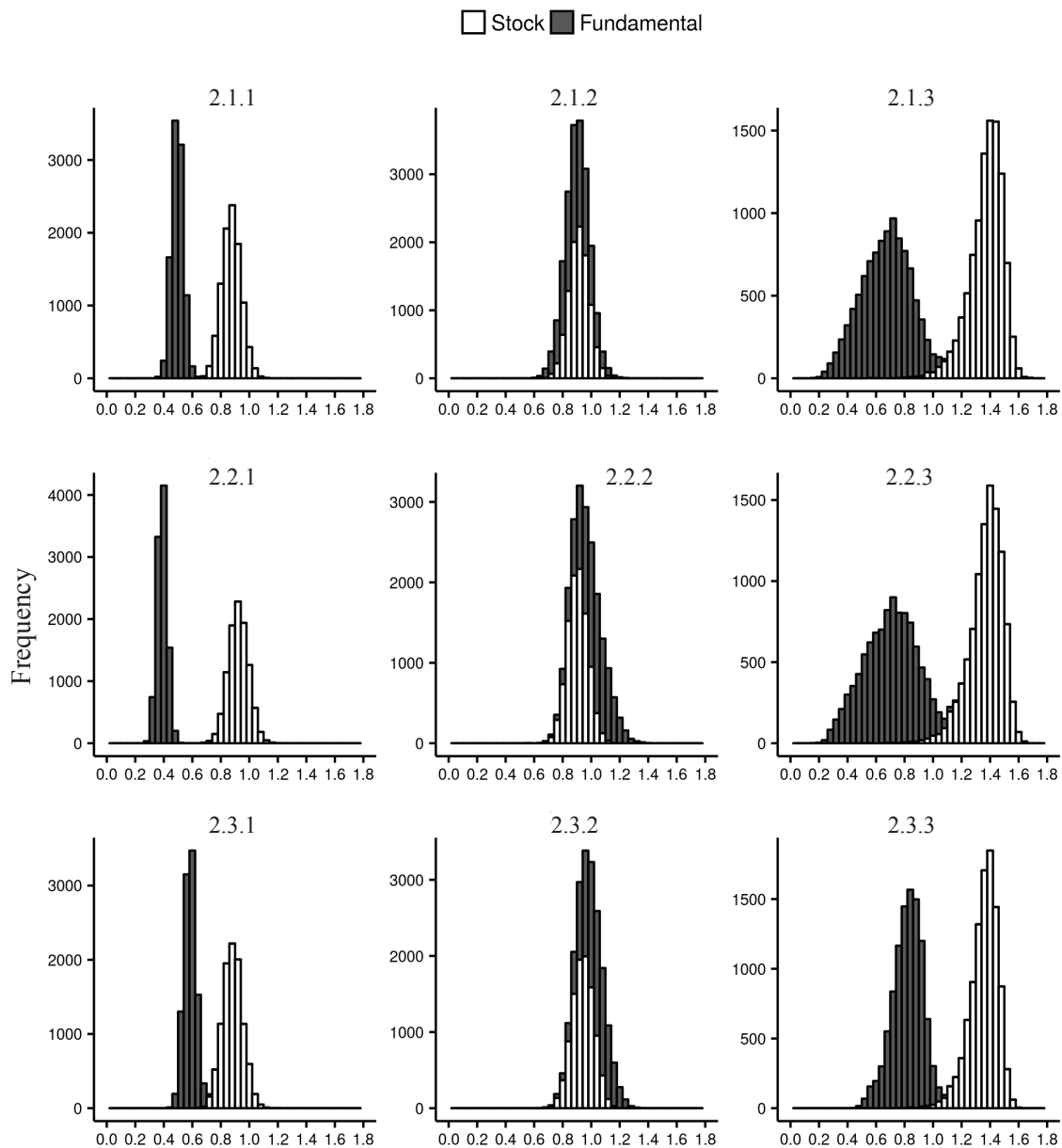
Figure 4. Empirical distributions of the average company's. EV/Sales Multiple (2002-2013). Approach 2 models: 2.1.1, Book structure + ROE; 2.1.2, Book structure + CAPM; 2.1.3, Book structure + Total beta; 2.2.1, Market structure + ROE; 2.2.2, Market structure + CAPM; 2.2.3, Market structure + Total beta; 2.3.1, Circularity structure + ROE; 2.3.2, Circularity structure + CAPM; 2.3.3, Circularity structure + Total beta

discussing one. Building empirical distributions of multiples can help to increase the amount of industry information on SMEs and privately-held companies, which would increase the transparency in their valuation process.

Besides the specific conclusions, the main contribution of this paper is the use of the stock market as a framework wherein to apply fundamental valuation together with bootstrapping in order to determine the bias introduced by the choice of some parameters in the DCF valuation model.

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