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Investment funds and underpricing of shares

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Abstract

Purpose – The purpose of this paper is to assess whether greater participation of venture capital/private equity (VC/PE) funds in the companies' capital structure at the moment of initial public offering (IPO) contributes to the reduction in the underpricing of their shares.

Design/methodology/approach – Descriptive statistics, correlation analysis, mean difference test and cross-sectional regression were used. The final sample consisted of 89 companies making IPO in Brasil Bolsa Balcão between 2007 and 2017.

Findings – The participation of VC/PE funds was shown to mitigate the effect of information asymmetry on managers and shareholders, thus reducing the underpricing of companies at the moment of IPO (*H1*). However, the expectation that a greater participation of these funds promotes further reduction in a potential underpricing (*H2*) was not confirmed.

Research limitations/implications – One can highlight the small amount of IPOs during the sampling period due to the occurrence of international and national economic crises, as well as the difficulty in obtaining information on the participation of VC/PE funds in the companies' capital structure.

Practical implications – It was observed that information asymmetry had a mitigating effect from the presence of these funds in the companies, which can improve the pricing of their shares, decrease the costs and make volume captions viable for investments, in addition to giving credibility to the market information effectiveness.

Originality/value – This study differs from others in that it assesses not only the influence of VC/PE funds on the reduction of the underpricing of IPO shares, but also the participation of these funds in the capital of these companies.

Keywords Underpricing, Initial public offering, Brasil Bolsa Balcão, Cross-sectional regression, Mean differences, Venture capital and private equity funds

Paper type Research paper

1. Introduction

Between 2007 and 2017, the Brazilian economy underwent periods of oscillation with increase and decrease in the gross national product, thus directly affecting the basic interest rates (SELIC rate) and hampering the access to credit (Bacen, 2018a, b). In periods of crisis, one can highlight the role played by funds of venture capital (VC) and private equity (PE). These funds work as a financial alternative for ventures with high potential of growth and risk. In fact, investments made by these funds were R\$13.3bn in 2014, R\$18.5bn in 2015 and R\$11.3bn in 2016 (ABVCAP, 2018).

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Initial public offering (IPO) is among the most common forms of VC/PE investment funds and whose life cycle lasts, on average, from two to seven years. According to Cumming and Johan (2008), the presence of VC/PE investment funds in companies contributes to reducing the information asymmetry in the market. In order to do so, fund managers submit the prospective companies to due diligence processes and other analyses for assessment of risks and opportunities. Therefore, companies receiving such investments are viewed as more reliable by non-fund investors, thus creating a quality stamp to their IPO.

According to Miller and Reilly (1987), underpricing is a way for market operators to compensate for the lack of information at the moment of IPO. Also, Sonoda (2008) materialises this concept by stating that underpricing is an under-estimation of or discount in share prices in relation to the actual market price. As for IPO, specifically, this occurs when its offering price is lower than that on the first day of negotiation. Therefore, underpricing can be understood as the difference between closing price and offering price of IPO share on the first day of negotiation. For Ribeiro (2005), Gioielli (2013) and Sonoda (2008), the presence of VC/PE funds decreases the information asymmetry between owners and investors so that the effect of underpricing on IPOs can be mitigated in companies relying on the participation of these funds.

According to Belghitar and Dixon (2012), companies with prior participation of VC/PE funds are considered to be of low risk. Therefore, emitters do not need to under-price their IPO shares in order to attract investors. It is also thought that VC/PE funds regularly include IPO companies in their portfolios so that they have a strong incentive to establish a reliable reputation. This enables them to access the IPO market in the future under favourable conditions. Finally, the reputation of credibility helps these funds to establish a strong relationship with all offering participants, namely, auditors, insurers, pension fund managers and institutional investors.

In view of the above, the objective of this study is to assess whether the presence of VC/P funds in invested companies contributes to reducing the underpricing of their shares at the moment of IPO. The resulting hypotheses are:

- H1.* Companies with prior participation of VC/PE funds have less underpricing of IPO shares compared to those without such participation.
- H2.* The greater the prior participation of VC/PE funds in these companies' capital, the less the underpricing of IPO shares.

Therefore, the population of companies making IPO in the Brasil Bolsa Balcão (B3) between 2007 and 2017 were considered. The hypotheses were verified by using descriptive statistics, correlation analysis, mean difference tests and cross-sectional regression, including their assumptions. Differently from other studies, this one is concerned with capturing the sensibility regarding the participation of VC/PE funds in the companies' capital structure before their IPO. Either high or low level of property has different impacts on the underpricing of these companies. From the market's perspective, this fact suggests that the simple presence of these funds cannot have the expected effect on the mitigation of a potential asymmetry between managers and owners, in addition to other conflicts regarding the market information effectiveness. Also, the recent crisis in the country's economy might shed light on the relevance of these funds as alternative development sources in the Brazilian market.

2. Literature review

Underpricing can be identified by means of abnormal positive returns from shares in the initial negotiations. This fact means that the company is evaluated for a value lower than the potential one, thus enabling profitability for investors in the first days of negotiation.

Therefore, underpricing is regarded as an indirect cost for the company because part of the offer is not collected. This phenomenon is termed in the finance literature as “leaving cash on the table” and can be measured by the number of shares multiplied by the difference between closing price in the first day of negotiation and the initially offered one (Ibbotson, 1975; Miller & Reilly, 1987; Tiniç, 1988; Leal & Lemgruber, 2000; Loughran & Ritter, 2002).

There is still no definitive explanation on underpricing. A view on this theme supports that underpricing occurs due to market imperfections regarding the IPO process, that is, the existence of information asymmetry among investors. For Benveniste and Spindt (1989) and Spatt and Srivastava (1991), the book building acts as a mechanism for data extraction so that adverse selection among investors can be reduced. These data are useful in the pricing of shares and set accuracy to the value being determined. The book-building practice enables the underwriters to obtain more information from better-informed investors (Cornelli & Goldreich, 2003). For Drake and Vetsuypens (1993), on the other hand, underpricing occurs due to legal liability. Underwriters use the book-building process in order to avoid legal problems in case of lack of clarification on something relevant in the IPO prospects. According to Taranto (2002), in turn, underpricing occurs due to the fact that executives who possess stock options can have fiscal benefit with the reduction of share prices in the first day of negotiation.

With regard to the concept of VC/PE funds, Takahashi (2006) states that VC funds are those invested in companies operating in new markets (NM), preferably the ones with a bold and entrepreneurial stance. In addition, VC funds enable companies to position themselves in a competitive market environment despite their difficulties to obtain credit lines due to their low level of net equity (Engel, 2002; Leite & Souza, 2001). On the other hand, investments of PE funds are aimed at large-sized companies with high growth potential. This investment is directly negotiated between funds and managers by means of a private placement. The financing of companies by means of VC/PE funds is aimed at providing capital for them and aggregating value through administrative participation (Barry, 1994; Takahashi, 2006; Sonoda, 2008).

In Brazil, VC funds are regulated under the normative instruction number 209/94 (CVM, 1994), whereas PE funds are regulated under the normative instruction number 391/03 (CVM, 2003). According to Carvalho, Furtado and Ribeiro (2006), the participation of VC/PE funds in the Brazilian market began in the 1990s due to the country’s economic stability resulting from the Real Plan. The second cycle of this industry occurred in the 2000s when 71 VC/PE funds invested in 306 companies. Today, there are 157 VC/PE funds in Brazil (ABVCAP, 2018).

VC/PE funds have the reputation of being involved in the control of the company’s activities. Wruck (2008) states that these funds add new management methodologies to the market, which, in turn, are applied to the invested companies. The VC/VE funds make investments in target companies, that is, those with management problems or inefficiency. According to Williamson (1967) and Jensen (1986), these funds understand that excess of free cash flow and high capitalisation are signs of poor management by the company.

The market’s positive perception of the presence of VC/PE funds in companies is related to the theory of agency. According to Jensen and Meckling (1976), financing decisions are affected by the fact that the companies’ owners delegate the management to fund agents. In this way, it is not possible to ensure that the fund agent will always make a great financial decision under the company managers’ point of view. Mechanisms of control, corporate management, variable remuneration for managers, indebtedness, among others, are established in order to conciliate the interests of managers with those of shareholders. This set of measures is termed agency costs. The theory of agency points to the existence of information asymmetry between managers and owners.

Barry, Muscarella and Peavy (1990) found that companies with VC/PE fund investment are better positioned in the financing market before IPO compared to those with no

participation of these funds in their capital structure. It is believed that companies belonging to the portfolio of these funds provide superior quality in the moment of IPO as a result of the reduced agency conflicts. For Saito and Silveira (2008), this occurs because of the concentration of functions as the same person plays the roles of manager and owner, which condenses the efforts for maximisation of the shareholders' wealth.

Another positive aspect highlighted in the literature regarding the presence of VC/PE funds in the company's capital structure is the mitigation of information asymmetry. This occurs when two or more fund agents make an economic transaction in which one of the parts involved holds more information than the others. Information asymmetry is one of the main market failures occurring when it is difficult or very expensive to obtain relevant and precise data on the quality of traded goods. This fact alters the market balance and resource allocation (Akerlof, 1970; Lambert, Leuz, & Verrecchia, 2011).

Rock (1986) identified that non-informed investors are more inclined to invest in IPO shares with underpricing as they can wait longer until the shares become well valued. In turn, Megginson and Weiss (1991) pointed to the decrease in the information asymmetry when companies have participation of VC/PE funds in their capital structure. Therefore, one expects that these companies' IPO shares suffer less underpricing than those without participation of these funds.

Another aspect affecting the underpricing of shares is their negotiation in the differentiated segment of the NM of B3 (2017). Companies issuing shares in this segment are subject to more rigid rules of corporate management and transparency, thus reducing the information asymmetry between the parts. Fernandes (2007) associated the performance of companies in this segment to the reduction of underpricing, since the market provides reliability and protection to the company's minority shareholders. In addition, companies with better earnings margin before interest and taxes (EBIT) are more likely to better perform during the IPO period, which reduces potential noises on the entity and mitigates information asymmetry-related problems (Fernandes, 2007).

The issue of information asymmetry still points to the occurrence of two types of problems, namely, adverse selection and moral hazard (Akerlof, 1970; Spence, 1973; Stiglitz, 1985). According to Lima, Rodrigues, Silva, and Silva (2012), adverse selection occurs because the manager has information unknown by the investors, whereas moral hazard refers to the likelihood of an economic agent changing his or her behaviour depending on the context in which the economic transaction occurs. In turn, Galozzi (2014) states that managers have information on the company which is unknown to the market. Therefore, in the IPO period, shares are negotiated with higher price because of the optimism on partial information. This may lead to underpricing, but the presence of VC/PE funds can mitigate these types of problems in order to decrease the information asymmetry and consequently both adverse selection and moral hazard.

As for the signalling impact of VC/PE funds on the market, it should be clarified that the theory of signalling evidences the existence of indicators, which enable to decrease the problem of information asymmetry (Spence, 1973). Megginson and Weiss (1991) pointed out that the presence of VC/PE funds provides signals to the market about the quality of the company, thus reducing information asymmetry and allowing investors to attest the quality of a possible IPO. According to the authors, this occurs due to factors such as: commitment of the VC/PE funds to the invested companies; relationship of fund agents with auditors, underwriters and investment managers; and reputation of the VC/PE funds.

Minardi, Ferrari, and Tavares (2013) stated that the presence of VC/PE funds can provide signals of good future performance as these fund models have a short lifetime and need resources to keep their business. In this way, they need to identify promising companies and good managers in order to develop and expand their business. Moreover, it is important to ensure that these companies have a good performance over time as they are always making IPOs and ensuring the quality of the next ones.

For Galozzi (2014), there are both well- and ill-informed investors about the company. In order to attract those with low-quality information and ensure successful IPOs, the shares are offered at prices systematically lower than the expected value. This fact implies greater underpricing or high cost of placement. As a way of mitigating this undesired effect, the founder should have a high level of property in the company following the offer in order to signal to the market that he or she believes in the company's success in the future. Another way of avoiding such high costs is to have VC/PE funds in the company's capital structure, thus mitigating noises and ensuring the veracity of the share values.

Finally, another aspect influencing the IPO decision is the market moment. In a study conducted by Baker and Wurgler (2002), they found that companies tend to issue shares during windows of opportunity in which the own capital cost is relatively lower than that of other sources of capital. Therefore, North-American companies tend to issue more shares than debt securities when the stock market value is higher than its patrimonial value. This moment is defined as market timing.

Lucas and McDonald (1990) showed that companies opt to make IPOs at periods of heated market, which adds value to negotiated shares. The prediction of the market timing is associated with the ability to analyse the share price movement in the market based on the macro-economic view of exchange and taxation policies (Fama, 1970). For Baker and Wurgler (2002), the theory of market timing shows that the company's capital structure is the result of past attempts by managers to take advantage of favourable conditions of the stock market, in which new shares are issued when they are perceived as over-valued by the market and re-purchased when perceived as under-valued. The performance of IPO shares is related to the current market moment. A lower underpricing is expected in periods of high appreciation (Oliveira & Kayo, 2015).

This can be evidenced by the existing negative relationship between market-to-book value rate and leverage of the company. As the market value of the company surpasses its book value, new shares are issued to the detriment of debts. The opposite occurs when the market value is lower than the book value. Underpricing of shares in the IPO period is equally affected by the ideal market moment. When there is a large (or small) number of IPOs, this period is termed as hot (or cold) market. The hot market usually occurs when companies are well evaluated, resulting in a high number of IPOs. According to Rossi and Marotta (2010), 83 per cent of the Brazilian companies made IPOs in hot market periods and 17 per cent of them opened their capital in cold market periods between 2004 and 2007. The total volume of resources obtained in hot market periods was higher by 17 per cent than that in the cold market periods. Ritter (1984) adds by stating that there is a higher incidence of underpricing in the periods of hot market.

Table I shows a synthesis of these studies in which underpricing is the dependent variable. The expected signals of independent and control variables are supported by the above-cited theories. In sum, one can observe that there are divergent results on the prior participation of VC/PE funds in the reduction of underpricing of shares following the IPO period (*H1*). Foreign studies showed a great number of significantly negative results, as expected, whereas national studies reported no statistically significant results. With regard to control variables, Megginson and Weiss (1991) found more consistent results for market share, IPO lead co-ordinator and company age before IPO. Most of the other studies had no statistical significance and this fact corroborates the need for new studies on the theme.

3. Methodology

The population of interest consists of all companies opening their capital (IPO) in B3 between January 2007 and December 2017. The final sample comprised 89 companies, with 58 having participation of VC/PE funds in their capital structure before IPO and 31 having no type of investment. Evolution of these companies is presented in Table II. Capital IQ is

Table I.
Synthesis of
the results of
empirical studies

Variables	Type	Theory	Expected sign	International			National								
				Sig. (%)	Sign	Sig. (%)	Sig. (%)	Sign	Sig. (%)	Sign	Sig. (%)				
Presence of VC/PE funds before IPO	I	TA & IA	-	Megginson and Weiss (1991)	-	1	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	1	Altyrnikova and Sarannasina (2017)	-	1	Sonoda (2008)	+	ns
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						
Logarithm of IPO volume captured	C	MT	-	Megginson and Weiss (1991)	+	ns	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	ns	Altyrnikova and Sarannasina (2017)	+	1	Sonoda (2008)	+	1
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						
Market share of the IPO lead coordinator	C	TS	-	Megginson and Weiss (1991)	-	1	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	ns	Altyrnikova and Sarannasina (2017)	+	10	Sonoda (2008)	-	ns
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						
Company's age before IPO	C	AS	-	Megginson and Weiss (1991)	-	1	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	ns	Altyrnikova and Sarannasina (2017)	-	ns	Sonoda (2008)	+	1
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						
Market return rate in the IPO period	C	MT	+	Megginson and Weiss (1991)	+	ns	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	ns	Altyrnikova and Sarannasina (2017)	-	ns	Sonoda (2008)	+	ns
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						
EBIT margin in the year before IPO	C	IA	-	Megginson and Weiss (1991)	-	1	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	ns	Altyrnikova and Sarannasina (2017)	-	10	Sonoda (2008)	-	10
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						
New market dummy for IPO	C	IA	-	Megginson and Weiss (1991)	-	1	Bruton, Mogilevsky and Chahine and Filatochev (2009)	-	ns	Altyrnikova and Sarannasina (2017)	-	5	Sonoda (2008)	-	5
				Galozzi (2014)	-	1	Fernandes (2007)	-	ns						

Notes: I, independent; C, control; IA, information asymmetry; TA, theory of agency; AS, adverse selection; TS, theory of signalling; MT, market timing

the main database, being produced by the Standard & Poor's. However, Economatica and Comdinheiro databases were also used for complementing the missing data.

Data were assessed by using descriptive statistics, correlation analysis, cross-sectional regression and mean difference test. The variables assessed and their descriptions are presented, respectively, in the regression model of the first equation and Table III. Initially, the descriptive statistics of the data are presented in order to understand populations and samples. According to Fávero, Belfiore, Silva and Chan (2009), descriptive statistical measures are aimed at studying central position measurements (i.e. mean, median, mode and dispersion), standard deviation, variance, amplitude, asymmetry and kurtosis.

Table II.
Sample evolution

Description	Total
Initial sample	112
(-) Companies with EBIT margin greater than 100%	1
(-) Companies without information on their capital structure before IPO	12
(-) Companies without EBIT margin	10
(=) Final sample	89

Table III.
Description
of the variables

Code	Description	Type	Expected sign	Formula	Components
UND	Underpricing	Dependent	na	$UND = (P_1 - P_0) / P_0$	P_1 = closing price on the first selling day P_0 = offer price on the day of IPO
PFUN	Prior participation of VC/PE funds before IPO	Independent	-	$PFUN = NAF / NTA$	NAF = number of shares belonging to VC/PE funds before IPO NTA = total number of circulating shares after IPO
VOL	Volume of IPO shares sold	Control	-	$VOL = Ln(VV)$	Ln = Naperian logarithm VV = Volume of IPO shared sold
MKC	Market share of IPO lead co-ordinator	Control	-	$MKC = NOC / NTO$	NOC = number of share offers managed by the lead co-ordinate NTO = total number of share offers in the market
IDA	Company's age before IPO	Control	-	$IDA = Ln(AE)$	Ln = Naperian logarithm AE = Years of the company's existence before IPO
RM	Market return rate in the IPO period	Control	+	$RM = (IBOV_1 - IBOV_0) / IBOV_0$	$IBOV_0$ = Ibovespa points on the day before IPO $IBOV_1$ = Ibovespa points on the day of IPO
ME	EBIT margin in the year before IPO	Control	-	$ME = EBIT / Revenues$	EBIT before IPO Revenues = net sales income in the year before IPO
DNM	New market dummy for IPO	Control	-	Dummy for differentiated listing segment of new market in the stock exchange	1 = If the company belongs to the new market on the day of IPO 0 = If the company does not belong to the new market on the day of IPO

Next, one has verified signal, value and statistical significance of the correlation. Correlation analysis consists in assessing two variables and how they related to each other in order to quantify the power and direction of the existing relationship between them (Dinardo & Johnston, 2001; Fávero *et al.*, 2009). In the present study, correlation analysis had two objectives: to verify the existence of a potentially high correlation between dependent and independent/control variables and to identify a potentially high multicollinearity between independent/control variables. If it exists, then the regression model should confirm it.

Next, the regression model (see the first equation) is applied to test the hypothetical assumptions with normality and homoscedasticity of residuals, linearity of parameters and absence of high multicollinearity between explicative variables (Corrar, Paulo, & Dias Filho, 2006; Sweeney, Williams and Anderson, 2013). The application of the cross-sectional regression was aimed at verifying *H1*: companies with prior participation of VC/PE funds have less under-priced shares during the IPO period compared to those without such participations. As a robustness test, a non-parametric mean difference test using independent samples was performed:

$$UND_i = \beta_0 + \beta_1 PFUN_i + \beta_2 VOL_i + \beta_3 MKC_i + \beta_4 IDA_i + \beta_5 RM_i + \beta_6 ME_i + \beta_7 DNM_i + u_i, \quad (1)$$

where β_0 is the linear coefficient; β_{1-7} the angle coefficients; i the companies; u the error term.

Finally, the *H2*, in which the higher the participation of VC/PE funds in these companies the less the underpricing of their shares during the IPO period, was tested by using the Wilcoxon's sign test for companies with participation of VC/PE funds in their capital structure before IPO. In this test, the numerical values of the difference between each pair were calculated, resulting in three possible conditions: increase (+), decrease (−) or equality (=). Once all differences between the values obtained for each pair of data have been calculated, the differences were ordered by their absolute value (i.e. without sign) so that the original values could be replaced by their respective position in the ordered scale. The test of the hypothesis of equality between the groups is based on the sum of positions of negative and positive differences. The null hypothesis states that mean values are equal, whereas the alternative hypothesis states that the mean values are not equal (Wilcoxon, 1945; Siegel & Castellan, 2006).

Of the companies with participation of VC/PE funds in their capital structure before IPO, one can identify those with positive underpricing. Next, these companies were distributed in quartiles in which the first (Q1) and fourth (Q4) quartiles were those with less and greater participation of VC/PE funds, respectively. After this classification, the mean difference test is applied to underpricing of the companies (Q4–Q1).

4. Analysis of the results

Tables AI and AII present the main characteristics of the companies making IPOs, which were grouped depending on having or not having VC/PE funds, respectively. In turn, Table IV briefly lists other overall characteristics of the IPOs in our sample. One can observe that lead co-ordinating banks UBS Pactual, Itaú BBA and Credit Suisse are those extensively operating in the IPO market. However, by analysing the quality of these positions and considering IPOs with participation of VC/PE funds, it is noted that Merrill Lynch is the most highlighted. Another interesting aspect is the concentration of positions in the years of 2007 and 2011, which were the periods preceding the systemic crises initiated in the USA and Europe by contagion effect. From 2014 on, there was a low incidence of IPOs in Brazil as a result of economic problems, which recovered in 2017. One can also highlight that the majority of IPOs occur in the differentiated segment of corporate management of the NM. At last, about 60 per cent of the IPOs occur in companies older 20 years – a fact explaining one of the reasons for the reduction of information asymmetry.

General characteristics	Total sample			With prior participation of VC/PE funds			No prior participation of VC/PE funds			
	No. of firms	Total (%)	Rank	No. of firms	Total (%)	Participation (%)	Rank	No. of firms	Total (%)	Rank
Lead co-ordinator										
UBS Pactual	24	27.0	1st	14	24.1	7.404	6th	10	32.3	1st
Itaú BBA	21	23.6	2nd	18	31.0	10.444	5th	3	9.7	3rd
Credit Suisse	17	19.1	3rd	9	15.5	12.220	3rd	8	25.8	2nd
Merrill Lynch	6	6.7	4th	5	8.6	25.909	1st	1	3.2	5th
Bradesco BBI	5	5.6	5th	4	6.9	5.621	7th	1	3.2	5th
JP Morgan	5	5.6	5th	3	5.2	17.197	2nd	2	6.5	4th
Santander	4	4.5	6th	1	1.7	0.010	9th	3	9.7	3rd
Unibanco	3	3.4	7th	1	1.7	0.002	11th	2	6.5	4th
Citibank	2	2.2	8th	1	1.7	0.012	10th	1	3.2	5th
BB Investimento	1	1.1	9th	1	1.7	0.018	8th	0	na	na
Morgan Stanley	1	1.1	9th	1	1.7	11.568	4th	0	na	na
Total	89	100	na	58	100	na	na	31	100	
General characteristics	Total sample			With prior participation of VC/PE funds			No prior participation of VC/PE funds			
	No. of firms	Total (%)	Rank	No. of firms	Total (%)	Rank	No. of firms	Total (%)	Rank	
IPO year										
2007	42	47	1st	21	36	1st	21	68	1st	
2008	2	2	6th	2	3	6th	0			
2009	5	6	5th	3	5	5th	2	6	3rd	
2010	7	8	4th	4	7	4th	3	10	2nd	
2011	11	12	2nd	9	16	2nd	2	6	3rd	
2012	2	2	6th	1	2	7th	1	3	4th	
2013	9	10	3rd	8	14	3rd	1	3	4th	
2014	1	1	7th	1	2	7th	0	na	na	
2015	0	na	na	0	na	na	0	na	na	
2016	1	1	7th	1	2	7th	0	na	na	
2017	9	10	3rd	8	14	3rd	1	3	4th	
Total	89	100	na	58	100	na	31	100	n/a	
General characteristics	Total sample			With prior participation of VC/PE funds			No prior participation of VC/PE funds			
	No. of firms	Total (%)	Rank	IPO year	No. of firms	Total (%)	No. of firms	IPO year	Rank	
Listing segment										
NM	71	80	1st	50	86	1st	21	68	1st	
N1	9	10	2nd	5	9	2nd	4	13	3rd	
N2	9	10	3rd	3	5	3rd	6	19	2nd	
Total	89	100		58	100		31	100		
General characteristics	Total sample			With prior participation of VC/PE funds			No prior participation of VC/PE funds			
	Company's age before IPO (in years)	No. of firms	Total (%)	No. of firms	Total (%)	No. of firms	Total (%)			
< 5	11	12		8	14	3	10			
5–9	12	13		10	17	2	6			
10–20	13	15		6	10	7	23			
> 20	53	60		34	59	19	61			
Total	89	100		58	100	31	100			

Table IV.
General characteristics
of IPOs

With regard to the descriptive statistics of the variables composing the Equation (1), one can see in Table V that the mean underpricing is 2.3 per cent in the period, with minimum and maximum values of –37 and 43 per cent, respectively. The participation of VC/PE funds has a mean value of 7.1 per cent in the total sample. Minimum value of 0 represents the 31 companies without participation of these investment funds before IPO. In addition,

lead co-ordinators represent a mean value of 18.2 per cent of the total number of offers in the market. At last, it is worth highlighting that the mean EBIT margin was 22 per cent in the year before IPO of the companies.

Table VI shows the correlation analysis of the variables in the econometric model in Equation (1). One can see that the greater the participation of VC/PE funds in the companies' capital structure, the less their underpricing in the IPO period. This result is in accordance with *H1*. In addition, contrary to the expected, there is a significantly positive relationship between volume of IPO shares and underpricing. At last, no significantly high positive correlation was identified between explicative variables, which should point to a lack of high multicollinearity in the tests of assumptions in the cross-sectional regression model.

For analysis of the results in the cross-sectional regression model, it is necessary, before all, to test their assumptions. Although normality of the residuals was not identified, the Gauss–Markov theorem showed that estimators of ordinary least squares are still the best linear unbiased estimators as they have minimum variance (Gujarati, 2006). Moreover, the value of the variance inflation factor is 1.06, being lower than 10. This fact indicates lack of high multicollinearity between explicative variables. Furthermore, the Breusch–Pagan test indicates the presence of heteroscedasticity of the residuals, which was corrected by means of robust standard errors. The linearity of coefficients was verified by considering a significant econometric model as a whole, with *F*-test having a value of 2.26 per cent.

Table VII shows that there is a significantly negative relationship between prior participation of VC/PE funds in the capital structure and underpricing of companies in the IPO period. This fact confirms the theories of agency and information asymmetry. According to them, the presence of VC/PE funds in the company's capital structure reduces the information asymmetry, thus mitigating potential conflicts between managers and shareholders. This occurs when the roles of manager and owner are played by the same person, which, in turn, condensates his or her efforts to maximise the shareholders' wealth. It is worth highlighting that for each 1 per cent increase in the participation of VC/PE funds in the capital structure, there is a reduction of 0.10 per cent in the underpricing of the companies. Furthermore, this result is in accordance with Megginson and Weiss (1991), Bruton, Chahine and Filatotchev (2009) and Mogilevsky and Murgulov (2012). Therefore, *H1* was observed.

With regard to the control variables, the significantly positive relationships between volume of IPO shares and IPO lead co-ordinator are contrary to those expected by the theories of market timing and signalling, respectively. These same results were also reported by Sonoda (2008) and Altynnikova and Sarampasina (2017). The other control variables had not statistical significance. In addition to the regression model test, a non-parametric mean difference test using independent samples was performed, indicating robustness. As a result, one can observe that the underpricing of companies without prior

Variable	Observations	Mean	SD	Minimum	Maximum
UND	89	0.023033	0.109351	-0.37	0.43
PFUN	89	0.071906	0.156612	0	0.94
VOL	89	18.35292	1.141	14.09	21.08
MKC	89	0.182022	0.099660	0.02	0.32
IDA	89	2.98191	1.138152	0	4.72
RM	89	-0.000003	0.013934	-0.047481	0.031618
ME	89	0.222134	0.203148	-0.031	0.78

Table V.
Descriptive statistics

	UND	PFUN	VOL	MKC	IDA	RM	ME	DNM
UND	1							
PFUN	-0.2309 [0.0295]	1						
VOL	0.2724 [0.0098]	-0.1311 [0.2206]	1					
MKC	0.1142 [0.2864]	-0.1937 [0.0690]	-0.0070 [0.9482]	1				
IDA	0.0541 [0.6144]	-0.1576 [0.1403]	0.0437 [0.6842]	0.0995 [0.3535]	1			
RM	0.0653 [0.5432]	-0.0819 [0.4454]	0.0004 [0.9970]	-0.0032 [0.9762]	0.0038 [0.9721]	1		
ME	0.1238 [0.2479]	-0.0958 [0.3720]	-0.0079 [0.9412]	-0.0859 [0.4234]	-0.2271 [0.0323]	0.0306 [0.7757]	1	
DNM	0.0346 [0.7473]	-0.0258 [0.8107]	0.1505 [0.1593]	-0.0462 [0.6674]	-0.0604 [0.5736]	-0.2194 [0.0389]	-0.0348 [0.7459]	1

Notes: Upper values represent the level of correlation, whereas lower values in square brackets represent the significance level of the correlation. At last, the values in italic are statistically significant at the levels of 1 and 5 per cent

Table VII.
Cross-sectional
regression analysis

Variables	Coefficient	Robust SE	<i>t</i> -statistics	<i>p</i> -value	95% confidence interval	
PFUN	-0.1097558	0.049038	-2.24	<i>0.028</i>	-0.2073261	-0.0121855
VOL	0.0239245	0.011303	2.12	<i>0.037</i>	0.001435	0.046414
MKC	0.1088828	0.0488404	-2.23	<i>0.029</i>	-0.2060598	-0.0117058
IDA	0.0037503	0.0087164	0.43	0.668	-0.0135925	0.0210932
RM	0.4087845	0.8126132	0.50	0.616	-1.208061	2.02563
ME	0.0682422	0.066457	1.03	0.308	-0.0639865	0.2004708
DNM	0.0041684	0.0276983	0.15	0.881	-0.0509425	0.0592794
Const	-0.4565914	0.23257	-1.96	0.053	-0.9193327	0.0061499
Obs				89		
R^2				0.1366		
F(7, 81)				2.50		
Prob > <i>F</i>				0.0226		

Note: Values in italic are statistically significant at 5 per cent of level

participation of VC/PE funds was statistically higher ($p = 0.2823$) than that of invested companies before IPO, thus confirming *H1*.

Finally, Table VIII shows analysis of *H2*, which was performed by using the Wilcoxon's sign test. Of the 58 companies having participation of VC/PE funds in their capital structure, 32 have negative or zero underpricing and 26 have positive underpricing prior IPO participation. These 26 companies with positive underpricing were classified into four quartiles (Q), in which Q1 contained companies with less participation of funds and Q2 contained those with greater participation. It was expected that the difference between Q4 and Q1 resulted in a statistically negative value different from zero. Companies in Q4 had less underpricing compared to those in Q1. However, the null hypothesis was accepted as the mean values were statistically equal, meaning that *H2* could not be confirmed.

5. Conclusion

In Brazil, the participation of VC/PE funds is increasingly more relevant as an option of financing for companies, mainly in view of the current economic recession scenario. IPO is among the most common ways of VC/PE fund investments. In this process, one can sometimes observe the occurrence of underpricing, that is, an under-evaluation of the prices of shares in relation to their real market price. Nevertheless, the presence of VC/PE funds invested in companies contributes to reducing the information asymmetry in the market by fund managers.

Therefore, the present study is aimed at assessing whether the presence of VC/PE funds in invested companies contributes to reducing the underpricing their shares in the

Table VIII.
Mean difference test

Q4	Observations	Rank sum	Expected
0	7	57.5	52.5
1	7	47.5	52.5
Combined	14	105	105
Unadjusted variance	61.25		
Adjustment for ties	-0.27		
Adjusted variance			60.98
H_0			$\text{und}(q4 = 0) = \text{und}(q4 = 1)$
<i>z</i>			0.640
Prob > <i>z</i>			0.5220

IPO period. The resulting hypotheses were the following: *H1* – companies with prior participation of VC/PE funds have less underpricing of IPO shares compared to those without such participation, and *H2* – the greater the prior participation of VC/PE funds in these companies' capital, the less the underpricing of IPO shares. In order to examine its pertinence to the Brazilian market, a final sample of 89 companies making IPO in B3 between 2007 and 2017 was considered. The tests applied were the mean difference test between companies with prior participation of VC/PE funds and those without such participation, descriptive statistics, correlation analysis and cross-sectional regression with validation of hypotheses.

As a result, *H1* was confirmed. The statistically significant negative relationship of prior participation of VC/PE funds in the companies indicates to the market that these funds have an effective involvement with the corporate management. This fact can mitigate agency-related problems, thus reducing information asymmetry and consequently the under-evaluation of the company based on a value lower than the potential one in the IPO period. This result is supported by Megginson and Weiss (1991), Bruton et al. (2009) and Mogilevsky and Murgulov (2012), being characterised as an evolution in relation to the Brazilian studies conducted by Fernandes (2007) and Sonoda (2008).

With regard to *H2*, it was observed that it was not confirmed. Nevertheless, it should be highlighted that among the companies with participation of VC/PE fund, only 26 (45 per cent) had positive underpricing, which limits the sample size and may have influenced our results. In this way, this is the first original contribution of the present study showing that either a high or a low level of property has different impacts on the underpricing of these companies.

With regard to theoretical aspects, the present study contributes to the empirical analysis of the participation of VC/PE funds in the companies' capital structure before the IPO period, thus being an instrument to mitigate the information asymmetry between managers and shareholders as well as to indicate the quality of these companies and re-affirm the reputation of these funds. As for the economic and commercial impacts, one can observe that this mitigating effect allows to better price the shares, which reduces costs and makes volume captions viable for investments, in addition to giving credibility to the market information effectiveness.

However, the present study has a limitation in that a small amount of IPOs was used during the sampling period because of national and international economic crises. In addition, one can highlight the difficulties in obtaining information on the participation of VC/PE funds in the companies' capital structure, among other reasons, due to business combinations. At last, it is suggested that the relationship with other characteristics of VC/PE funds affecting the underpricing of the companies should be analysed, such as date of establishment, nationality and number of invested companies before IPO.

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(The Appendix follows overleaf.)

Year	Company	Listing segment	Volume R\$	Date of IPO	Operating segment	Lead co-ordinator
2007	Rodobens	NM	91,935,670	31 January 2007	Building construction	JP Morgan
	Camargo Corrêa	NM	116,011,470	31 January 2007	Building construction	Credit Suisse
	GVT	NM	359,916,150	16 February 2007	Fixed telephony	Credit Suisse
	Anhanguera	N2	187,898,540	12 March 2007	Educational services	Credit Suisse
	Heringer	NM	59,911,110	12 April 2007	Fertilisers and pesticides	UBS Pactual
	JHSF	NM	43,512,160	12 April 2007	Building construction	Credit Suisse
	Metalfrio	NM	60,138,700	13 April 2007	Electrical equipment	UBS Pactual
	Bematech	NM	151,073,110	19 April 2007	Computers and equipment	Itaú BBA
	AGRA	NM	131,162,080	26 April 2007	Building construction	Credit Suisse
	Cremer	NM	143,800,150	30 April 2007	Medications and other products	Merrill Lynch
	Sofisa	N1	84,027,910	2 May 2007	Banks	UBS Pactual
	Paraná	N1	1,313,360	14 June 2007	Banks	UBS Pactual
	Cruzeiro do Sul	N1	97,059,840	26 June 2007	Banks	UBS Pactual
	Daycoval	N1	173,614,250	29 June 2007	Banks	UBS Pactual
	Indusval	N2	39,084,130	12 July 2007	Banks	Credit Suisse
	Redecard	NM	670,726,050	13 July 2007	Diverse financial services	Unibanco
	ABC Springs	N2	91,562,500	25 July 2007	Banks	UBS Pactual
	Providência	NM	47,767,640	27 July 2007	Threads & fabrics	Credit Suisse
	General Shopping	NM	48,725,640	27 July 2007	Diverse materials	UBS Pactual
	Sul América	NM	45,306,270	30 July 2007	Real estate business	JP Morgan
Subtotal			53,450,330	5 October 2007	Insurance services	Unibanco
2009	Sul América	N2	2,697,997,060	21		
	Cetip	NM	932,766,250	7 October 2009	Banks	Santander
			261,788,030	28 October 2009	Diverse financial services	Itaú BBA
	Subtotal		1,194,554,280	2		
2010	EcoRodovias	NM	78,087,380	1 April 2010	Toll road services	Itaú BBA
	Julio Simões	NM	25,610,200	22 April 2010	Road transport	Bradesco BBI
	Renova	N2	5,357,880	13 July 2010	Electrical energy	Santander
	Subtotal		109,055,460	3		
2011	Sonae	NM	66,473,440	3 February 2011	Real estate business	Credit Suisse
	Autometal	NM	51,233,060	7 February 2011	Road materials	Santander
	Subtotal		117,706,500	2		
2012	Unicasa	NM	35,366,070	25 April 2012	Real estate business	BTG Pactual
	Subtotal		35,366,070	1		
2013	Biosev	NM	14,865,490	15 April 2013	Sugar and alcohol	BTG Pactual
	Subtotal		14,865,490	1		
2017	Petrobrás	NM	766,169,446	15 December 2017	Oil exploration, refinement and distribution	Citibank
	Subtotal		766,169,446	1		
	Total		4,935,714,306	31		

Table AI.
Main characteristics of IPOs of companies without prior VC/PE fund investments

Year	Company	Listing segment	Volume R\$	Date of IPO	Operating segment	Lead co-ordinator
2007	PDG	NM	107,740,910	26 January 2007	Building construction	UBS Pactual
	Tecnisa	NM	189,215,700	1 February 2007	Building construction	Credit Suisse
	Iguatemi	NM	250,514,760	7 February 2007	Real estate business	UBS Pactual
	São Martinho	NM	163,826,230	12 February 2007	Diverse foods	UBS Pactual
	JBS	NM	244,733,260	29 March 2007	Meat and derivatives	JP Morgan
	Even	N1	45,270,100	2 April 2007	Building construction	Itaú BBBA
	Pine	N1	96,212,800	2 April 2007	Banks	Credit Suisse
	BR Malls	NM	136,210,410	5 April 2007	Real estate business	UBS Pactual
	SLC	NM	72,237,400	15 June 2007	Diverse foods	Credit Suisse
	Log-In	NM	238,891,170	21 June 2007	Waterway transport	UBS Pactual
	EZTEC	NM	120,477,790	22 June 2007	Building construction	UBS Pactual
	Marfrig	N1	77,383,410	29 June 2007	Meat and derivatives	Merrill Lynch
	Tegma	NM	67,776,300	3 July 2007	Road transport	JP Morgan
	Minerva	NM	149,000,600	20 July 2007	Meat and derivatives	Credit Suisse
	TPI	NM	157,819,930	23 July 2007	Toll road services	Credit Suisse
	MRV	NM	360,083,930	23 July 2007	Building construction	UBS Pactual
	Multiplan	NM	97,159,890	27 July 2007	Real estate business	UBS Pactual
	Estácio	NM	56,751,600	30 July 2007	Educational services	UBS Pactual
	Tenda	N1	124,169,070	15 October 2007	Building construction	Itaú BBBA
	Trisul	N1	49,015,550	15 October 2007	Building construction	Morgan Stanley
	Helbor	NM	17,408,860	29 October 2007	Building construction	Bradesco BBI
	Subtotal		2,821,899,670	21		
2008	Hypermarcas	NM	81,819,300	18 April 2008	Diverse products	Citibank
	Le Lis Blanc	NM	17,993,250	29 April 2008	Fabrics, clothing and footwear	Merrill Lynch
	Subtotal		99,812,550	2		
2009	Visanet	NM	670,726,050	29 June 2009	Diverse financial services	Unibanco
	Direcional	NM	29,792,720	19 September 2009	Building construction	Santander
	Fleury	NM	163,257,660	17 December 2009	Medical and diagnostic services	Bradesco BBI
	Subtotal		863,776,430	3		
2010	Aliansce	NM	25,689,720	29 January 2010	Real estate business	BTG Pactual
	BR Properties	NM	45,561,050	8 March 2010	Real estate business	Itaú BBA
	Mills	NM	52,496,220	16 April 2010	Serviços diversos	Itaú BBA
	Raia	NM	301,211,320	20 December 2010	Medications	Itaú BBA
	Subtotal		424,958,310	4		
2011	Arezzo	NM	309,359,700	2 February 2011	Fabrics, clothing and footwear	Itaú BBA
	QGEP	NM	146,964,850	9 February 2011	Oil exploration/refinement	Itaú BBA
	International Meal	NM	15,631,400	9 March 2011	Restaurant and similar services	BTG Pactual
	Time For Fun	NM	62,814,860	13 April 2011	Events and show production	Credit Suisse
	Magazine Luiza	NM	143,468,800	2 May 2011	Household appliances	Itaú BBA
	Brazil Pharma	NM	72,685,700	27 June 2011	Medications	BTG Pactual

(continued)

Table AII.
Main characteristics of
IPOs of companies
with prior VC/PE fund
investments

Year	Company	Listing segment	Volume R\$	Date of IPO	Operating segment	Lead co-ordinator
	Qualicorp	NM	141,035,710	29 June 2011	Medical and diagnostic services	Merrill Lynch
	Technos	NM	47,172,780	1 July 2011	Accessories	Itaú BBA
	Abril	N2	34,496,800	26 July 2011	Journals, books and magazines	Credit Suisse
	Subtotal		973,630,600	9		
2012	Companhia Locação	NM	9,029,300	23 April 2012	Automobile renting	Itaú BBA
	Subtotal		9,029,300	1		
2013	Linx	NM	251,882,210	6 February 2013	Software and services	Credit Suisse
	Alupar	N2	97,371,030	24 April 2013	Electric energy	Itaú BBA
	Smiles	NM	332,832,240	29 April 2013	Loyalty programmes	Credit Suisse
	BB	NM	1,430,522,490	29 April 2013	Insurance services	BB
	Seguridade					Investments
	CPFL	NM	10,776,440	19 July 2013	Electric energy	Merrill Lynch
	Anima	NM	81,554,280	28 October 2013	Educational services	Itaú BBA
	SER	NM	73,033,520	29 October 2013	Educational services	BTG Pactual
	CVC	NM	55,323,170	9 December 2013	Travels and Tourism	Itaú BBA
	Subtotal		2,333,295,380	8		
2014	Ouro Fino	NM	52,291,129	21 October 2014	Medications and products	JP Morgan
	Subtotal		52,291,129	1		
2016	Imagem Diagnósticos	NM	122,334,647	28 October 2016	Medical and diagnostic services	Itaú BBA
	Subtotal		122,334,647	1		
2017	Movida	NM	68,711,487	8 February 2017	Automobile renting	Bradesco BBI
	Hermes Pardini	NM	213,521,317	14 February 2017	Medical and diagnostic services	Itaú BBA
	Azul	N2	292,446,466	11 April 2017	Air transport	Itaú BBA
	Carrefour	NM	509,619,074	20 July 2017	Foods	Itaú BBA
	Omega	NM	93,796,916	31 July 2017	Electric energy	BTG Pactual
	IRB	NM	318,090,881	31 July 2017	Insurance services	Bradesco BBI
	Camil	NM	179,141,094	28 September 2017	Diverse foods	Merrill Lynch
	BK	NM	369,823,387	18 December 2017	Restaurant and similar services	Itaú BBA
	Subtotal		2,045,150,622	8		
	Total		7,701,028,016	58		

Table AII.

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