IPOS, THE LEVEL OF PRIVATE EQUITY ENGAGEMENT AND STOCK PERFORMANCE MATTERS: EMPIRICAL EVIDENCE FROM GERMANY

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Abstract

Research on IPOs commonly focuses on the relation between firms' pre IPO ownership structure and subsequent stock performance. We extend the literature by additionally focusing on companies' post IPO ownership structure, in particular, private equity capital engagement, to analyse IPOs stock performance matters. For this purpose, we employ a unique dataset on German IPOs from 2004 to 2014 that allows us to identify companies' ownership structures before and after the IPO. We compute stocks' market-adjusted returns and information ratios for the first 200 trading days to answer two research questions. First, do stocks of companies that were (partially) owned by private equity investors prior the IPO show a different performance after the IPO than stocks of companies without prior investments of private equity investors? Second, does the extent of private equity investors' involvement at the IPO (i.e. their pre and post IPO shareholdings) influence the stock performance following the IPO? We do not find evidence that stocks of companies, which had private equity investors as shareholders prior to the IPO, outperform stocks of companies without private equity investors per se. However, for the subsample of companies that had private equity investors as shareholders, we document that the stronger the private equity investors reduce their engagement the stronger is the performance of the issued stock.

Keywords: Initial Public Offering, Private Equity, Performance, Under-pricing, Asymmetric Information

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1. INTRODUCTION

Shareholders of non-listed companies commonly consider an initial public offering (IPO) as the "silver bullet" for raising new capital and changing the ownership structure (e.g. as an exit strategy for previous shareholders like private equity funds). The important role of IPOs for practitioners led to extensive academic research on IPOs. Although IPOs are one of the most studied topics in corporate finance, most researchers commonly focus on the relation between firms' pre IPO ownership structure and subsequent stock performance, however, leaving the relation between firms' post IPO ownership structure and stock performance unconsidered (Michel et al., 2014). While prior studies mainly

examine under- and overpricing phenomena on IPO-markets caused by information asymmetries between existing/senior shareholders and new shareholders (Gomes 1997; Ritter & Welch, 2002; Li et al., 2005; Rhodes, 2011; Müllner, 2012; and Oehler & Schalkowski, 2013; Aggarwal & Klapper, 2016; Chang et al., 2017) and companies' earnings and operating performance (Ibbotson & Jaffe, 1975; Ritter, 1991; Jain & Kini, 1994; Hsu et al., 2010; Aggarwal & Klapper, 2016), we focus on performance matters in dependence of companies' ownership structures both before and after their IPO.

The purpose of this paper is to expand our understanding of the interdependencies between IPOs' stock performance and the engagement of private equity investors as shareholders. We particularly address two research questions. First, do stocks of companies that were (partially) owned by private equity investors prior the IPO show a different performance after the IPO than stocks of companies without prior investments of private equity investors? Second, does the extent of private equity investors' involvement at the IPO (i.e. their pre and post IPO shareholdings) influence the stock performance following the IPO?

In this regard, we analyse the German IPO market because of its relevance in the IPO-market worldwide (PwC 2015) and the comprehensive data situation that allows us to identify companies' ownership structures directly before and after its IPO. Our data set on German IPOs comprises the decade from 2004 to 2014. In this period, two-thirds of the IPOs show private equity investors as prior shareholders. The private equity investors increased their engagement in the manufacturing, trade, and high-tech sectors in Germany and play an important role as issuers in these sectors (Herberger & Oehler, 2011). However, we do not find evidence that stocks of companies that had private equity investors as shareholders prior to the IPO significantly under- or outperform stocks of companies without private equity investors. Therefore, we assume that there is no asymmetric company information dispersion between existing and recent shareholders. For the subsample of stocks with prior private equity shareholders, we find that private equity investors' reduction of shares through the IPO has the strongest predictive power on future stock performance.

The paper is structured as follows: Section 2 gives an overview of the legal framework in Germany, reviews the related IPO literature and develops our hypotheses. Section 3 introduces the data and methodology used in this paper, while Section 4 presents the results and discusses implications for relevant stakeholders. Section 5 concludes.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Within the scope of our paper, we understand private equity engagements as financial and strategic investments and we do not separate between venture capital and private equity investments stringently, because the particular company's stage, i.e. seed, start-up or growth capital, is not the point we focus on. The common denominator is the IPO in principle. The IPO of a company is regarded as the company's first public stock market launch. This includes the transformation of a private company into a public one (Herberger & Oehler, 2011).

An immediate consequence of issuing shares through an IPO is the greater dispersion of shareholdings that means a drift in ownership structures' (Alavi et al., 2008). These drifts have a profound effect on managerial incentive and control considerations (Jensen & Meckling, 1976; Zingales, 1995) and to some extent, have been linked to observed anomalies of IPOs such as underpricing (Booth & Chua, 1996) and underperformance (Jain & Kini, 1994). Ritter and Loughran & Ritter show significant underperformance for IPO stocks generally (Ritter, 1991; Loughran & Ritter, 1995). Jain & Kini (1994), Mikkelson et al. (1997) and Loughran & Ritter (1997) also document a decline in the operating performance of IPO companies (Jain & Kini, 1994; Mikkelson et al., 1997; and Loughran & Ritter, 1997). Similar to these results, Barry et al. (2006) find a strong negative relation between debt financing and initial returns which shows that the ownership (debt or equity financing) has an impact on the performance. They also find that high levels of debt financing are associated with negative stock performance in the five years after the IPO.

Filatotchev et al. (2007) suggest that institutional factors such as the depth and breadth of the private equity industry and corporate governance-related regulatory initiatives may affect the IPO investment process, the governance roles, and the IPO firm performance. In this sense, Barry & Mihov provide some evidence that firms backed by reputable venture capital firms perform better after their IPO compared to companies without venture capitalists as shareholders. This effect applies especially in the long-run for companies with a high debt level (Barry & Mihov, 2015). Bloom et al. find indications that private equity owned firms are typically well managed. These firms employ significant better management practices than almost all other companies such as family-run, founder owned, or government owned firms (Bloom et. al., 2015a; Bloom et. al., 2015b; Bloom & Van Reenen, 2007). Their results are robust to different industries, firm size, and developing grade of the economy. Li & Masulis show that prior shareholdings of both commercial and investment banks significantly reduce IPO under-pricing (Li & Masulis, 2005). In addition, Carter & Manaster and Carter et al. provide evidence that companies experience less under-pricing and better long-term performance if their IPO is underwritten by a highly ranked investment bank as a financial intermediary (Carter & Manaster, 1990; Carter et al., 1998). Following these results, the certification and participation of top investment banks or venture capital investors can be interpreted as a positive signal for good stock performance in the future as defined by signalling theory (Spence, 1973; Akerlof, 1970). However, Chen & Liang (2016) show that VC backed IPOs with high excess cash underperform non-VC backed IPOs.

Regarding the relation between performance and asymmetric information, Ritter & Welch argue that theories based on asymmetric information are unlikely to explain average first-day returns. Underwriters do not concentrate multiple offerings together which would lower average uncertainty and the need for under-pricing in the context of information models. Thus, the authors assume that future explanations will need to focus on agency conflicts and share allocation issues and behavioural explanations (Ritter & Welch, 2002). Nevertheless, Chang et al. (2017) suggest that agency problems between underwriters and issuers can lead to excessive under-pricing. Li et al. investigate the asymmetric information in the IPO aftermarket. Their results show that the adverse selection costs are significantly smaller in the earlier periods of the IPO aftermarket than those in the later periods. The authors suggest that the lower asymmetric information in the earlier periods is a combination of several factors. The dominant market-making role played by underwriters reduces the adverse selection risk. In addition, the provisions of the SEC and underwriter agreements between underwriters and issuers in the earlier IPO aftermarket restrict informed trading and limit investors´ access to private information (Li et al., 2005). On the basis of supposed relations between performance matters, the impact of asymmetric information and ownership we therefore hypothesize:

Hypothesis 1: Companies that were (partially) owned by private equity investors prior the IPO show better stock performance after the IPO than companies without prior investments of private equity investors.

Zhou identifies the group of stakeholders which gains the most from the under-pricing of Chinese examining opening-price returns, first-day initial returns, and first-month initial returns of 2,225 Chinese IPOs from 1992 to 2011. The results show that more than 95 percent of the first-day initial return is earned by initial subscribers who sell the shares at the market on the first trading day. The results are not consistent with the asymmetric information theory regarding the supply side which would suggest that insiders have better information about IPOs. Instead, the results are consistent with the asymmetric information theory from the demand side: investors, as a group, have more accurate information about the overall market demand for new IPO shares. Further, the opening price reflects all the information in the market and therefore is an efficient indicator of the first and twenty-first trading day closing prices (Zhou, 2014). Agarwal et al. also use Asian data by the Stock Exchange of Hong Kong to examine the investors' relationship in deep. They show a strong relationship between investor demand and the short- and long-run performance of the issued stocks. First, the authors document that the returns on the first trading day indicate that the IPOs with high investor demand are significantly under-priced, while the IPOs with low investor demand are over-priced. Second, they find that the long-run size-adjusted excess returns of IPOs are, in contrast, negatively related to the investors' demands. The results also show that the high-demand IPO portfolio significantly underperforms the market whereas the low-demand IPO portfolio outperforms the market. Overall, the IPOs with high investor demand have large positive initial returns but negative longer-run excess returns, while the IPOs with low investor demand have negative initial returns but positive longer-run excess returns (Agarwal et al., 2008). Bergström et al. (2006) find that institutional investors may avoid selling PE-backed IPOs in the early aftermarket due to their interest in being considered in the allocation process of subsequent PE-backed IPOs. Similar, Bessler et al. (2012) find evidence that VC-backed IPOs generate positive returns for specific time periods subsequent to the IPO. VCs that are already invested in the company prior to the IPO, first profit from high initial or first day returns and second from high positive returns during the first year after going public. The same holds for an investor who got shares allocated at the time of the IPO. Finally, Campbell et al. (2006) investigate the relation between the degree of venture capital involvement and long run stock performance. IPO firms backed by venture capital with greater proportions of monitoring directors perform better, indicating that these directors play a valuable role in reducing agency costs. They also find that companies with high levels of institutional block ownership are associated with better long run performance. The latter finding is supported by Field & Lowry (2009) and Anderson & Huang (2017). These studies furthermore show that the outperformance of newly issued stocks can be explained by stock purchases of institutional investors after the IPO. On the basis of supposed relations between performance matters and involvement of private equity investors we hypothesize:

Hypothesis 2: The higher the involvement of private equity investors at the IPO, the better the companies' stock performance after the IPO.

3. DATA & METHODOLOGY

We analyse all 119 IPOs at the German law regulated stock market[5] in the period from 2004 to 2014. For the analysis of the companies' shareholder structure around their IPO, we use data from the Deutsche Boerse Group. Information on the categorization of shareholder types (private equity investor or non-private equity) is hand-collected from the relative companies' website or IPO prospect. The data is provided for two points of time: right before the IPO and at the IPO after all new shareholders received their shares but before shares were traded at the stock exchange. To control our results for a possible industry impact, we assign each IPO to its industrial sector according to MSCI and Standard & Poor's Global Industry Classification Standard (GICS)[6]. For the performance analysis of the shares, we use daily close prices at the XETRA stock exchange of Deutsche Boerse Group. For all IPOs we compute share returns of their first, the first 5 (as proxy for

[5] "Regulierter Markt" (since Nov. 2007); the „Geregelter Markt" and the „Amtlicher Handel" (before Nov. 2007).

[6] The 10 industrial sectors are: Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Financials, Information Technologies, Telecommunication Services, Utilities (*MSCI 2015*).

one trading week), 20 (as proxy for one trading month), 50 (as proxy for one trading quarter), 100 (as proxy for one half year of trading), and 200 trading days (as proxy for one trading year). The share returns are adjusted by the returns of the HDAX and the SDAX. The HDAX represents 80 German companies with the highest market capitalization free float (which are also constituents of the DAX or MDAX) plus 30 high-technology firms (which are also constituents of the TECDAX). The HDAX is used as a benchmark for the development of the German stock market. Since the analysed IPOs tend to have relatively low market capitalisations, we additionally consider the SDAX as a benchmark, because it consists of 50 German companies with relatively low market capitalisation that are not listed in the HDAX.

The market-adjusted return of a stock i (cumulative abnormal return in a period of T days, CAR T) after its IPO is defined as:

$$CAR\ T = \frac{P_{i,T}}{P_{i,0}} - \frac{P_{M,T}}{P_{M,0}} \quad (1)$$

Where: $P_{i,0}$ is the subscription price of the stock i and $P_{M,t}$ is the price of the market index at time t. $P_{M,0}$ is the close price of the market index on the day before the IPO of company i.

Since we compare only two investment-possibilities: (1) investment in a stock at its IPO and (2) investment in a market index; there is no risk-free rate as an investment alternative. Therefore we use the information ratio to estimate whether participating in IPOs is a desirable investment alternative. The excess log-return of a stock i in a period of T days ($LNR_{i,T}$) is defined as:

$$LNR_{i,T} = \sum_{t=0}^{T}\left(\ln\frac{P_{i,t+1}}{P_{i,t}} - \ln\frac{P_{M,t+1}}{P_{M,t}}\right) \quad (2)$$

The information ratio of a stock i in a period of T days after the IPO (*IR T*) is defined as:

$$IR\ T = \frac{LNR_{i,T}}{\sqrt{var\left[\ln\frac{P_{i,t+1}}{P_{i,t}} - \ln\frac{P_{M,t+1}}{P_{M,t}}\right]}} \quad (3)$$

We analyse the influence of a company's shareholder structure before its IPO on the stock performance (measured as market-adjusted return and as information ratio) after the IPO by providing bivariate correlation analyses. In detail, we examine whether stocks that show a higher percentage of private equity investors as shareholders before the IPO, underperform stocks with a lower percentage of private equity investors. In addition, we test the relation between a number of shares that private equity investors sell at the IPO and the future stock performance. Furthermore, we check whether a company's market capitalisation at its IPO influences the future stock performance. We additionally provide multivariate linear regression analyses to quantify the influences of the above-mentioned factors on the stock performance after the IPO.

4. RESULTS AND DISCUSSION

80 of the 119 companies had private equity investors as shareholders before their IPO at the German stock market. This indicates a substantial influence of private equity investors on the German IPO market and supports the empirical results of Herberger & Oehler (2011). Table 1 reports descriptive statistics of companies' market values at the IPO. Market values differ between 24 and 8,591 million EUR. The mean (median) market value of the 119 companies at their IPO is 919 (230) million EUR. With respect to the market values, the two subsamples of companies with and without private equity investors as shareholders before the IPO are not different at statistically significant levels (P-values of t-tests are not reported in the paper.).

Table 1. Descriptive statistics of IPOs at the German stock market from 2004-2014

Panel A: All IPOs at the German stock market from 2004-2014							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
Company's market value at IPO (in MM. EUR)	919	24	100	230	826	8,591	119
Panel B: IPOs with private equity investors (PEI) as shareholders prior the IPO at the German stock market from 2004-2014							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
Company's market value at IPO (in MM. EUR)	812	24	125	239	755	6,508	80
Amount of PEIs' shareholdings before IPO	.64	.03	.32	.70	1	1	80
Amount of PEIs' shareholdings after IPO	.37	0	.17	.36	.54	.97	80
Panel C: IPOs without PEIs as shareholders prior the IPO at the German Stock Market from 2004-2014							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
Company's Market Value at IPO (in MM. EUR)	1,139	24	83	222	945	8,591	39

Note: In each Panel, we report aggregated mean and median values as well as the .25- and .75-quartiles and the minimum and maximum values of the analysed companies' market values in million Euros. N is the number of analysed stocks. Panel A includes all IPOs at the German Stock Market from 2004-2014. In addition to the market values, we report the amounts of PEIs' shareholdings before the IPO. Panel B shows descriptive statistics for IPOs with PEIs as shareholders before the IPO at the German stock market from 2004-2014. In Panel B we report companies' market values and a number of PEIs' shareholdings before and after the IPO. Panel C shows market values of companies that have no PEIs as shareholders before the IPO.

In the subsample of companies that were partially owned by private equity investors before their IPO, the mean (median) amount of private equity investors' shareholding is 64 (70) percent. At the IPO, private equity investors reduce their shareholdings to a mean (median) value of 37 (36) percent. With relation to our first hypothesis, we analyse the cumulative abnormal returns and information ratios of all 119 stocks in a period of 200 trading days after their IPO. Two benchmarks are used for the market adjustments, the SDAX and the HDAX. The respective results are presented in Table 2.

Table 2. Cumulative abnormal stock returns (CAR) and information ratios (IR), adjusted by SDAX and HDAX, of all stocks in the 200 trading days after their IPO in the period from 2004-2014

Panel A: Stock Performance adjusted by SDAX							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
CAR 1	.03	-.22	-.04	0	.05	1.74	119
CAR 5	.04	-.37	-.05	0	.07	1.88	119
CAR 20	.01	-.51	-.10	-.03	.07	2.03	119
CAR 50	-.02	-.52	-.17	-.03	.06	2.41	119
CAR 100	-.06	-.87	-.22	-.05	.05	2.27	115
CAR 200	-.02	-1.00	-.35	-.05	.12	3.89	109
IR 5	.05	-10.32	-1.98	-.09	2.04	7,75	119
IR 20	-.94	-13.50	-3.95	-1.45	2.61	10.42	119
IR 50	-1.52	-20.39	-6.46	-2.05	3.43	15.16	119
IR 100	-3.07	-31.71	-9.05	-2.56	1.80	24.85	115
IR 200	-3.54	-42.41	-13.21	-2.09	5.19	43.08	109
Panel B: Stock Performance adjusted by HDAX							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
CAR 1	.03	-.22	-.04	0	.05	1.74	119
CAR 5	.04	-.37	-.06	0	.07	1.88	119
CAR 20	0	-.57	-.12	-.02	.06	2.04	119
CAR 50	-.03	-.59	-.17	-.04	.08	2.43	119
CAR 100	-.07	-.93	-.23	-.08	.08	2.32	115
CAR 200	-.04	-1.00	-.39	-.13	.14	3.94	109
IR 5	-.07	-11.52	-2.00	.11	1.61	8.11	119
IR 20	-.86	-11.58	-3.93	-.98	2.14	12.26	119
IR 50	-1.75	-17.71	-6.97	-2.43	4.39	12.96	119
IR 100	-3.51	-30.11	-8.86	-3.48	2.45	22.22	115
IR 200	-4.63	-42.75	-14.58	-6.28	4.58	43.83	109

Note: In each Panel, we report aggregated mean and median values as well as the .25- and .75-quartiles and the minimum and maximum values of the cumulative abnormal stock returns (CAR) and the information ratios (IR) in a period of T trading days. N is the number of analysed stocks. Panel A includes CARs and IRs, adjusted by the SDAX, of all IPOs at the German Stock Market from 2004-2014. In Panel B we report CARs and IRs, adjusted by the HDAX, of all IPOs at the German Stock Market from 2004-2014. Adjusted by the SDAX, for example, the median information ratio of the first 20 trading days of all IPOs is -1.45, meaning that more than half of the stocks show an underperformance with respect to the SDAX after the first 20 trading days.

With respect to both indices the SDAX and the HDAX, the mean CARs of the issued stocks are positive for the first 20 trading days. Nevertheless, median returns are roughly zero, indicating that the outperformance in the first trading days is driven by a handful of stocks with an extreme outperformance of up to 200 percent in the first 20 trading days. However, the outperformance of the newly issued stocks seems to turn into an underperformance around the fifth trading day since the CARs reach a peak and the IRs, which use risk adjusted log returns instead of relative returns, are nearly zero after 5 trading days. The tendency of declining outperformance or rather growing underperformance continues for the rest of the observed period until the 200th trading day, supporting the findings of Shachmurove (2004) who finds that it is false to assume that investors demand very high annualized and cumulative return rates as compensation for the risks they take by financing ventures. Instead, the mean return rates are found to be very moderate and often negative.

In addition, some stocks are not even traded 200 days due to acquisition or insolvency and the following delisting again. These results confirm the findings of Fama & French who detect a dramatic decline in the survival rates of new listed firms over the past several decades (Fama & French, 2004; Demers & Joos, 2007). The demonstrated short-run performance and earlier positive stock development in our dataset may be explained by small adverse selection costs and lower asymmetric information in the earlier periods of the IPO aftermarket (Li et al., 2005).

The results for the subsamples of companies with private equity investors as former shareholders are shown in Table 3.

Following our first hypothesis, the performance of companies that were partially owned by private equity investors prior the IPO should be better than the above described overall performance. With respect to the results in Table 3, we can hardly find indications to support this hypothesis: the performances for the different observed periods of time are nearly equal to the above described overall results. Nevertheless, results for the maximal CARs and IRs indicate that the best-performing stocks have private equity investors as prior shareholders. However, t-tests between the two samples' performance do not confirm differences at statistically significant levels. Regarding our first hypothesis, we, therefore, state that stocks with a private equity investor do not outperform stocks without prior private equity investors.

Table 3. Cumulative abnormal stock returns (CAR) and information ratios (IR) of the first 200 trading days, adjusted by SDAX and HDAX, of companies with PEIs as shareholders before their IPO in the period from 2004-2014

Panel A: Stock Performance adjusted by SDAX							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
CAR 1	.03	-.22	-.04	.00	.05	1.74	80
CAR 5	.05	-.37	-.05	.00	.07	1.88	80
CAR 20	.01	-.51	-.10	-.03	.05	2.03	80
CAR 50	-.02	-.52	-.18	-.03	.05	2.41	80
CAR 100	-.05	-.76	-.23	-.07	.04	2.27	77
CAR 200	-.01	-1.00	-.37	-.09	.09	3.89	72
IR 5	-.09	-10.32	-2.36	-.29	2.14	7.75	80
IR 20	-1.35	-13.50	-4.62	-1.87	2.42	10.10	80
IR 50	-1.49	-20.39	-6.21	-1.78	2.71	14.48	80
IR 100	-3.17	-21.12	-9.28	-2.92	1.46	24.85	77
IR 200	-4.09	-42.41	-13.42	-4.96	3.63	43.08	72
Panel B: Stock Performance adjusted by HDAX							
			Quartiles				
	Mean	***Min***	***.25***	***Median***	***.75***	***Max***	***N***
CAR 1	.03	-.22	-.04	.00	.05	1.74	80
CAR 5	.05	-.37	-.06	.00	.06	1.88	80
CAR 20	.01	-.57	-.12	-.02	.06	2.04	80
CAR 50	-.03	-.59	-.15	-.03	.09	2.43	80
CAR 100	-.07	-.93	-.24	-.08	.05	2.32	77
CAR 200	-.06	-1.00	-.39	-.18	.13	3.94	72
IR 5	-.15	-11.52	-2.31	.00	1.66	8.11	80
IR 20	-1.01	-11.58	-3.94	-1.04	2.55	12.26	80
IR 50	-1.49	-17.71	-6.97	-2.06	4.73	12.52	80
IR 100	-3.52	-21.53	-8.95	-3.51	1.87	22.22	77
IR 200	-5.12	-42.75	-14.58	-7.36	4.08	43.83	72

Note: In each Panel, we report aggregated mean and median values as well as the .25- and .75--percentiles and the minimum and maximum values of the cumulative abnormal stock returns (CAR) and the information ratios (IR) in a period of T trading days. N is the number of analysed stocks. Panel A includes CARs and IRs, adjusted by the SDAX, of all IPOs at the German stock market from 2004-2014. In Panel B we report CARs and IRs, adjusted by the HDAX, of all IPOs at the German stock market from 2004-2014. Adjusted by the SDAX, for example, the median information ratio of the first 20 trading days of all IPOs is -1.87, meaning that more than half of the stocks show an underperformance with respect to the SDAX after the first 20 trading days.

Regarding our second hypothesis, we examine whether a number of stocks held by private equity investors before the IPO has some influence on the stock performance after the IPO. We expect that stocks of companies with a high amount of private equity investors outperform stocks with a low amount of private equity investors. We control for this using a bivariate correlation analysis. The respective results are presented in Table 4. The correlation coefficients between the amounts of private equity investors' shareholdings before the IPO have some negative influence on the stock performance of the first 5 days after issuing. However, this correlation is not significant at a statistical level. With respect to both benchmark indices - the SDAX and the HDAX - results for CARs and IRs of the first 50, 100 and 200 trading days show a positive correlation between the amount of private equity investors' shareholding and the respective stock performance. Correlation coefficients are most significant (at the ten and five percent level) for the 200 days period and range between .207 and .266. In the context of the IRs, the positive correlation is already significant for the first 50 trading days. These findings, therefore, support our second hypothesis that a higher involvement of private equity investors leads to a higher stock performance, at least in the longer run.

We check the robustness of these results by analysing the correlation between the stock performance and a number of private equity investors' shareholdings after the IPO and by controlling for the reduction of private equity investors' shareholdings. Results are presented in Table 4. Since no significant correlations can be observed regarding the shareholdings after the IPO, results for the shareholdings prior the IPO seem to be robust at a first glance. We, however, also analyse the correlation between the number of shares sold by private equity investors and the long-term stock performance. We measure the number of sales in two ways: as an absolute reduction of the shares and as relative reduction with respect to the initial amount of shares held by the private equity investors. Again, we provide bivariate correlation analysis. For both measures, we observe significant results. The absolute reduction of private equity investors' shareholdings correlates positively with all long-term stock performance measures. With respect to both benchmark indices, the correlation is significant at the five percent level for performance measures which cover at least the first 50 trading days. The correlation is even more significant for longer time periods. For the performance measures which cover the first 200 trading days, the statistical significance reaches the one percent level with correlation coefficients between .331 and .407. Similar results can be observed for the second measure, the relative reduction of private equity investors' shareholdings. Results are significant for performance measures of the first 50 trading days and longer time periods with a statistical significance at the one percent level. The correlation coefficients are all positive, reaching a maximum of .385.

Table 4. Correlation between amount of PEIs' shareholdings before and after the IPO, PEIs' reduction of shareholdings, and the stock performance of stocks with PEIs as shareholders before the IPO

Panel A: Stock Performance adjusted by SDAX											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
PEIs' shareholdings before IPO	-.068	-.108	-.001	.140	.181	.245**	-.051	.008	.222*	.199*	.266**
PEIs' shareholdings after IPO	-.098	-.126	-.067	.004	.060	.040	-.085	-.008	.068	.058	.069
Absolute reduction of PEIs' shareholdings	.018	.014	.133	.283**	.288**	.407***	.009	.050	.282**	.284**	.389***
Relative reduction of PEIs' shareholdings	.133	.168	.164	.267**	.255**	.385***	.072	.047	.210*	.239**	.324***
Panel B: Stock Performance adjusted by HDAX											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
PEIs' shareholdings before IPO	-.045	-.087	.017	.160	.145	.207*	.021	.063	.222**	.158	.239**
PEIs' shareholdings after IPO	-.087	-.100	-.061	.010	.037	.052	-.037	.014	.084	.050	.076
Absolute reduction of PEIs' shareholdings	.042	.040	.161	.319***	.248**	.366***	.109	.128	.270**	.224*	.331***
Relative reduction of PEIs' shareholdings	.153	.179	.192	.309***	.239**	.340***	.166	.111	.183	.197*	.275**

*Note: In each Panel, we report correlation coefficients of the cumulative abnormal stock returns (CAR) and the information ratios (IR) in a period of T trading days on the one side and a number of PEIs' shareholdings before and after the IPO and PEIs' reduction of shareholdings on the other side. The symbols *, ** and *** denote statistical significance at the ten, five and one percent level, respectively. Panel A includes the correlation coefficients between the CARs and IRs, adjusted by the SDAX, of German IPOs from 2004-2014 and a number of PEIs' shareholdings before and after the IPO as well as PEIs' absolute and relative reduction of shareholdings. In Panel B we report the correlation coefficients between the CARs and IRs, adjusted by the HDAX, of German IPOs from 2004-2014 and a number of PEIs' shareholdings before and after the IPO as well as PEIs' absolute and relative reduction of shareholdings. Adjusted by the SDAX, for example, the correlation coefficient between the cumulative abnormal stock returns of the first 50 trading days of the IPOs with PEIs as former shareholders and the absolute reduction of PEIs' shareholdings is .283 with a statistical significance at the five percent level; meaning that the more the PEIs reduced their amount of shares at the IPOs the higher are the cumulative abnormal stock returns of the first 50 trading days.*

In a nutshell, the results regarding our second hypothesis are not clear cut. Private Equity investors' shareholdings prior the IPO are positively correlated with long-term stock performance and therefore support our hypothesis. However, also the number of shares sold by private equity investors at the IPO is positively correlated with the following long-term stock performance requiring a multivariate analysis to control for interdependencies.

We moreover analyse whether sector specific effects may influence our findings. Therefore, we assign the IPOs to the industrial sectors according to the Global Industry Classification Standard (GICS). We merge some industrial sectors due to the small number of observed IPOs in these sectors to enhance the explanatory power of our results: *Energy* and *Materials* are merged to *Energy/Materials*; *Consumer Discretionary* and *Consumer Staples* are merged to *Consumer Goods*, and *IT* and *Telecom* are merged to *IT/Telecom*. The respective numbers of IPOs per sector are presented in Table 5 and range between 7 (Health Care) and 28 (Consumer Goods).

Table 5. Number of IPOs per industrial sector

Sector	***Number of IPOs***
Energy/Materials	11
Industrials	27
Consumer Goods	28
Health Care	7
Financials	25
IT/Telecom	21
Sum	119

We provide one-way ANOVAs to analyse whether the cumulative abnormal returns or the information ratios are dependent on the IPOs' industrial sector. The respective results are presented in Table 6. All in all, the ANOVAs do not attest differences between the industrial sectors at statistically significant levels. The only exceptions are the CARs and IRs of the first 20 trading days. However, the observed differences are caused by the smallest subsample *Health Care* which, consequently, shows the highest vulnerability to random outliers. In addition, the respective statistical significance is weak and never exceeds the five percent level. Therefore, and since neither shorter nor longer time horizons show statistically significant differences between the sectors, we state that the findings in the context of our former analyses are no subject to sector specific effects.

Table 6. Results of one-way ANOVA regarding IPOs in different industrial sectors

Panel A: Stock Performance adjusted by SDAX	
	p-values
CAR 1	0.665
CAR 5	0.594
CAR 20	0.090
CAR 50	0.224
CAR 100	0.250
CAR 200	0.157
IR 5	0.233
IR 20	0.052
IR 50	0.400
IR 100	0.097
IR 200	0.370
Panel B: Stock Performance adjusted by HDAX	
	p-values
CAR 1	0.628
CAR 5	0.523
CAR 20	0.077
CAR 50	0.303
CAR 100	0.590
CAR 200	0.248
IR 5	0.031
IR 20	0.044
IR 50	0.734
IR 100	0.466
IR 200	0.324

Note: In each Panel, we report p-values of the one-way ANOVA regarding the cumulative abnormal stock returns (CAR) and the information ratios (IR) in a period of T trading days of IPOs in different sectors. The p-values denote the statistical significance of the differences regarding the CARs and IRs of the IPOs in the different sectors. Panel A includes results regarding the CARs and IRs, adjusted by the SDAX, of German IPOs from 2004-2014. Panel B includes results regarding the CARs and IRs, adjusted by the HDAX, of German IPOs from 2004-2014. Adjusted by the SDAX, for example, the information ratios of the first 50 trading days of all IPOs is not different between the different sectors since the p-value does not undercut a p-value of 0.1.

In a further robustness check we analyse the correlations of companies' market values at their IPO with their respective stock performance in three samples: all 119 stocks with an IPO between 2004 and 2014, those stocks with private equity investors as shareholders before the IPO, and stocks without private equity investors as shareholders before the IPO. Results are presented in Table 7.

Table 7. Correlation of companies' market values at their IPO and their adjusted stock performance after the IPO

Panel A: All stocks											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
SDAX	.106	.185**	.187**	.328***	.165*	.140	.192**	.163*	.286***	.111	.123
HDAX	.093	.198**	.218**	.317***	.187**	.136	.208**	.214**	.271***	.129	.132
Panel B: Stocks with PEIs as shareholders before IPO											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
SDAX	.154	.226**	.253**	.409***	.288**	.332***	.200*	.229**	.354***	.227**	.252**
HDAX	.163	.245**	.291***	.388***	.294***	.215*	.258**	.314***	.312***	.226**	.238**
Panel C: Stocks without PEIs as shareholders before IPO											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
SDAX	.003	.128	.046	.139	-.029	-.100	.187	.061	.132	-.048	-.040
HDAX	-.014	.110	.082	.144	.008	.064	.134	.043	.160	-.004	.013

*Note: In each Panel, we report correlation coefficients of the cumulative abnormal stock returns (CAR) and the information ratios (IR), both adjusted by the SDAX and the HDAX, in a period of T trading days on the one side and the market values at the IPO of the respective companies on the other side. The symbols *, ** and *** denote statistical significance at the ten, five and one percent level, respectively. Panel A includes the correlation coefficients between the CARs and IRs of all German IPOs from 2004-2014 and the market values at the IPO of the respective companies. In Panel B we report the correlation coefficients between the CARs and IRs of German IPOs from 2004-2014 with PEIs as shareholders before IPO and the market values at the IPO of the respective companies. In Panel C we provide results for German IPOs from 2004-2014 without PEIs as shareholders before IPO. Adjusted by the SDAX, for example, the correlation coefficient between the cumulative abnormal stock returns of the first 50 trading days of the IPOs with PEIs as former shareholders and market values of the respective companies at the IPO is .409 with a statistical significance at the one percent level, meaning that the higher the companies' market values at the IPOs the higher are the cumulative abnormal stock returns of the first 50 trading days.*

The stock performance measures within the first sample consistently show a positive correlation with the market values. Correlations are statistically significant for an array of performance measures beginning with the performance of the first five trading days and ending with the performance of the first 100 trading days. The most significant correlations can be observed for the measures of the first 50 trading days. In the light of the second and third sample's results, the mentioned positive correlation seems to have its origin in the second sample, which is the sample of stocks with private equity investors as shareholders before the IPO. Results for the third sample are not significant at all. In contrast, the positive correlation in the second sample is even stronger for all performance measures than in the first sample. Furthermore, the correlation is significant for all measures but the abnormal returns of the first trading day. Correlation coefficients are again most significant (at the one percent level) for the performance of the first 50 trading days and reach their maximum value with .409.

On the other side, it remains unclear, which one (or which combination) of the three analysed factors (private equity investors' shareholdings before the IPO, reduction of private equity investors' shareholdings through the IPO, company's market value at the IPO), influences the future stock performance of IPOs most and, therefore, might help to forecast future stock returns. According to a correlation analysis of the three factors, they all correlate positively with each other with a statistical significance at the five percent level, at least. The complete results are presented in Table 8.

Table 8. Correlation of amount of PEIs' shareholdings before and after the IPO, PEIs' reduction of shareholdings, and companies' market values at their IPO of stocks with FIs as shareholders before the IPO

	PEIs' shareholdings after IPO	***Absolute reduction of PEIs' shareholdings***	***Relative reduction of PEIs' shareholdings***	***Company's market value at IPO***
PEIs' shareholdings before IPO	.790***	.728***	.255**	.354***
PEIs' shareholdings after IPO		.256**	-.277**	.205
Absolute reduction of PEIs' shareholdings			.794***	.407***
Relative reduction of PEIs' shareholdings				.308***

*Note: For all German IPOs from 2004-2014 with FIs as shareholders before the IPO, we report correlation coefficients of a number of PEIs' shareholdings before and after the IPO, PEIs' absolute and relative reduction of shareholdings and the market values at the IPO of the respective companies. The symbols *, ** and *** denote statistical significance at the ten, five and one percent level, respectively. The correlation coefficient between the amount of PEIs' shareholding before the IPO and market values of the respective companies at the IPO is, for example, .354 with a statistical significance at the one percent level, meaning that the higher the amounts of PEIs' shareholding before the IPO the higher are the companies' market values at the IPOs.*

We provide linear regression analysis to identify the factor(s) with the highest predictive power on future stock performance. The regression models consist of the respective performance measure as dependent variable on the one side and private equity investors' shareholdings before the IPO, relative reduction of private equity investors' shareholdings through the IPO, company's market value at the IPO (in million EUR), and an absolute term as independent variables on the other side. The results of the regression analysis are presented in Table 9.

Table 9. Linear regression analysis of companies' market values at their IPO, PEIs' shareholdings before the IPO, PEIs' reduction of shareholdings and the performance of stocks with FIs as shareholders before the IPO

Panel A: Stock Performance adjusted by SDAX											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
Company's Market Value at IPO (MM. EUR)	.000	.000	.000	.000	.000	.000	.000	.001*	.001	.001	.000
PEIs' shareholdings before IPO	-.119	-.190*	-.172	-.081	-.030	.018	-.725	-.352	2.334	3.663	8.417
Relative reduction of PEIs' shareholdings	.035	-.023	.127	.310*	.409**	.891**	.494	1.096	4.907	8.335*	20.742**
Absolute term	.080	.161**	.044	-.121	-.219*	-.395*	-.150	-2.181	-5.538**	-9.442***	-17.736***
R^2	.034	.052	.046	.067	.068	.095	.032	.044	.090	.095	.139
Panel B: Stock Performance adjusted by HDAX											
	CAR 1	***CAR 5***	***CAR 20***	***CAR 50***	***CAR 100***	***CAR 200***	***IR 5***	***IR 20***	***IR 50***	***IR 100***	***IR 200***
Company's Market Value at IPO (MM. EUR)	.000	.000	.000	.000	.000	.000	.000*	.001**	.001	.001	.000
PEIs' shareholdings before IPO	-.119	-.179*	.174	-.057	-.032	.143	-.100*	-.012	3.079	3.187	8.708
Relative reduction of PEIs' shareholdings	.035	-.024	.134	.034**	.433**	.586*	1.419	1.807	4.205	7.820*	18.195**
Absolute term	.079	.153*	.038	-.158	-.250**	-.390*	-1.008	-2.371*	-5.777**	-9.406***	-18.362**
R^2	.034	.047	.049	.076	.070	.053	.052	.061	.085	.081	.115

*Note: In each Panel, we report regression coefficients of the cumulative abnormal stock returns (CAR) and the information ratios (IR) in a period of T trading days on the one side and the company's market value at the IPO (in MM. EUR), amount of PEIs' shareholdings before the IPO, and PEIs' relative reduction of shareholdings on the other side. Additionally, we report regression coefficients for the absolute term and the R^2 of the regression analysis. The symbols *, ** and *** denote statistical significance at the ten, five and one percent level, respectively. Panel A includes the regression coefficients for CARs and IRs, adjusted by the SDAX, of German IPOs from 2004-2014 as dependent variables. In Panel B we report the regression coefficients for CARs and IRs, adjusted by the HDAX, of German IPOs from 2004-2014 as dependent variables. For a regression analysis with cumulative abnormal stock returns, adjusted by the SDAX, of the first 50 trading days as dependent variable, for example, the regression coefficients for company's market value at the IPO (in MM. EUR), amount of PEIs' shareholdings before the IPO, and PEIs' relative reduction of shareholdings are .000; -.081; and .310, respectively.*

Surprisingly, it is neither the number of private equity investors' shareholdings prior the IPO nor the market value at the IPO, but the relative reduction of private equity investors' shareholdings through the IPO which helps best to explain the stock performance after the IPO. The R^2 of the models is between 5.3 percent and 13.9 percent for an array of performance measures beginning with the performance of the first 50 trading days and ending with the performance of the first 200 trading days. Especially, in the long run, meaning 50 and more trading days, the relative reduction of private equity investors' shareholdings has predictive power with respect to the cumulative abnormal returns at the ten percent level, at least.

5. CONCLUSION

In this paper, we analysed whether a company's ownership structure and the involvement of private equity investors prior and at its IPO help to predict the future stock performance. We expressed two questions in our analysis. First, do stocks of companies that were (partially) owned by private equity investors prior the IPO show a different performance after the IPO than stocks of companies without prior investments of private equity investors? Second, does the extent of private equity investors' involvement at the IPO (i.e. their pre and post IPO shareholdings) influence the stock performance following the IPO?

The stock performance of companies that have private equity investors as shareholders prior to their IPO does not differ from the stock performance of companies that have no private equity investors as prior shareholders at statistically significant levels. Based on our findings we assume that there is no asymmetric information dispersion between different groups of prior, actual and future shareholders on principle. However, for the subsample of companies that had private equity investors as former shareholders, we find evidence that private equity investors' reduction of shares has the strongest influence on future stock performance.

Our findings have implications for applicants of IPO stocks. From the investors' perspective, it seems promising when (1) private equity investors own a high amount of the company's shares prior the IPO and when (2) private equity investors issue their shares in a substantial volume.

The limitations of our study should not stay unmentioned. Compared to the US-market our data set covers a rather small number of IPOs. Nevertheless, the German IPO market is one of the largest IPO markets in terms of IPO volume. Moreover, our performance measures do not employ the often used factor models. The reason is that some of the analysed stocks have low trading volumes. Since liquidity can be a relevant pricing factor (see Amihud et al. 2006 for an overview) and skew the results of the three-, four-, and five-factor models, we chose not to rely on the factor models. Furthermore, our results may be impacted by country effects. Therefore, further research is required. First, it would be helpful to verify our results in other markets (e.g., the US-market) on an equivalent database related to shareholder structures before and after IPOs. This would also allow a more detailed performance analysis. Second, it would be interesting to analyse the role of further financial intermediaries, in particular, IPO-underwriters and IPO-consultants, on companies' post-IPO stock performance and their role in post-IPO M&A activity (see e.g. Anderson & Huang, 2017).

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