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IPO investment strategies and pseudo market timing

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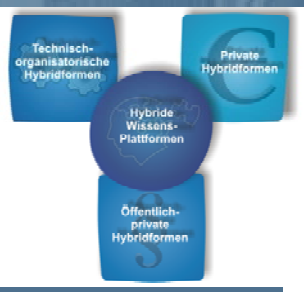

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IPO Investment Strategies and Pseudo Market Timing

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Abstract

We analyse the performance of simple investment strategies in IPOs based on a large sample of IPOs in Germany between 1985 and 2002. In particular, we compare the performance of the following strategies: Invest equally weighted in each IPO, invest market value weighted in each IPO, invest in an equally weighted portfolio of recent IPOs or invest in a value weighted portfolio of recent IPOs. We find that investors pursuing the first two investment strategies would realise significantly negative abnormal returns on average. In contrast, applying a bootstrapping procedure, we find that investing according to the latter two investment strategies does not yield significant underperformance. The difference in performance among investment strategies points to the phenomenon that firms going public in hot IPO markets perform worse than those going public in cold markets. We analyse to what extent this phenomenon can be attributed to pseudo market timing. Based on simulations, our results indicate that pseudo market timing can partly explain the performance of IPO investment strategies between 1996 and 2002.

JEL-classification: G10, G11, G14

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1 Introduction

Initial Public Offerings (IPOs) frequently attract a lot of public attention due to extensive marketing and broad media coverage. In particular, IPOs often serve as a "gateway drug" to the stock market for private investors. For example, large IPOs like those of Deutsche Telekom AG and Deutsche Post AG initiated individual investors' stock investments in Germany in many cases. Consequently, it is worth asking how investments in German IPOs performed on average. Indeed, subsequent to the seminal study by Ritter (1991), numerous studies investigated the long-run performance of IPOs in different countries including Germany. Many of them found significant underperformance of IPOs, an observation that prompted Loughran and Ritter (1995) to claim „Investing in firms issuing stock is hazardous to your wealth". However, most of the literature focuses on the implications of underperformance for market efficiency (e.g., see Fama (1998)). Little research is done explicitly on the performance of different investment strategies in IPOs. In this paper, we discuss the performance of four simple IPO investment strategies. In addition, we analyse to what extent the pseudo market timing theory proposed by Schultz (2003) is able to explain differences in performance among IPO investment strategies.

An obvious way to invest in IPOs is to purchase shares of each firm that goes public and to sell those shares after a certain holding period. The length of the holding period may be chosen arbitrarily subject to the individual perception of when an IPO firm turns to be an established publicly listed company. In this study, we focus on holding periods of three and five years. Depending on the capital invested in each IPO, we can distinguish two sub strategies. On the one hand, an investor might want to invest the same amount of capital in each IPO (strategy 1 hereafter). On the other hand, an investor might want to acquire the same proportion of each IPO's market value (strategy 2 hereafter). Throughout this study, we refer to this family of investment strategies as "each-IPO investment strategies". With an each-IPO investment strategy, the capital invested varies with IPO activity. Thus, these strategies implicitly assume that investors do not face a budget constraint. The uncertainty about the capital needs is amplified in case of strategy 2. Here, capital needs fluctuate not only with IPO activity but also with variance in the market value of firms going public. We analyse the performance of these investment strategies in comparison to simultaneous investments in an equally weighted and a market value weighted broad market portfolio in Germany between 1985 and 2002. In order to realise excess returns, investors would have to sell the benchmark portfolio when investing in an IPO and to repurchase the benchmark portfolio from the proceeds of the IPO sale at the end of the holding period. For simplicity, we assume that investors make their investment decision at the end of each calendar month.

An alternative to investing in each IPO is to invest in a portfolio that comprises firms that went public recently. Again, the definition of recently is arbitrary subject to the individual perception of when an IPO firm turns to be an established publicly listed company. We refer

to the period of time in which newly listed companies are considered in the IPO portfolio as formation period. As with holding periods, we focus on formation periods of three and five years. As with strategies 1 and 2, we can distinguish between two sub strategies with respect to the weighting of each firm in the portfolio. On the one hand, an investor might want to weight each IPO equally (strategy 3). On the other hand, an investor might want to weight each IPO according to its market value (strategy 4). In contrast to strategies 1 and 2, there is no uncertainty about the capital invested as investors decide about the investment amount only once at the beginning of the investment period. Afterwards, purchases of new IPOs and sales of former IPOs are considered by rebalancing the IPO portfolio. In compliance with strategies 1 and 2, we assume that investors revise their IPO portfolio at the end of each calendar month. In case of strategy 3, this implies portfolio rebalancing whenever newly listed firms are included or former IPO firms are excluded. It implies mandatory monthly rebalancing in case of strategy 4.

Frequent portfolio rebalancing is associated with considerable transaction costs in practice. Such transaction costs question the feasibility of investment strategies 3 and 4 for individual investors. However, individual investors could easily implement these investment strategies if there existed investment funds or certificates that emulate such an IPO portfolio. To our knowledge, there are two certificates available to private investors in Germany that resemble an IPO portfolio. The „IPO-Select Basket Zertifikat“ issued by Sal. Oppenheim represents a portfolio of selected European IPOs.[1] An opportunity to invest into a portfolio of firms that went public in Germany within the last ten years is provided by certificates on the German Entrepreneurial Index (GEX®). Again, the GEX® only comprises a selection of German IPOs as there are criteria for incorporation in this index other than an IPO within the last ten years.[2]

We calculate the performance of all investment strategies by the very same monthly returns of the IPOs and the benchmarks, respectively. Thus, any difference in performance among strategies must be due to the different methods of aggregating monthly returns implied by the different investment strategies. We find that investments in IPOs according to strategies 1 and 2 underperform compared to investments in the benchmark portfolios. According to a skewness-adjusted test statistic, this underperformance is highly significant in most cases. Strategies 3 and 4 yield underperformance, too. However, applying a bootstrapping methodology, we do not find significant underperformance. These results imply that firms going public in periods of high IPO activity perform worse than firms going public at other times. A popular explanation for worse IPO performance in “hot” IPO markets is Market Timing. Market Timing states that managers or owners take their firms public if markets

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[1] Vgl. Sal. Oppenheim (2006). IPO firms may be included in the basket within the first year after the going public. No information is given on the time IPO firms may stay in the basket.

[2] Apart from a going public within the last ten years, firms are incorporated in the GEX® only if the owners are active managers of the firm, too. For further information see Achleitner/Kaserer/Moldenhauer (2005).

overvalue IPOs. Underperformance emerges if the markets learn about the firm's true value subsequent to the IPO.

However, Schultz (2003) provides a rational explanation for worse IPO performance in hot markets which he calls Pseudo Market Timing.[1] This explanation is based on the assumption that IPO activity rises with market prices and especially with prices of recent IPOs as managers' or owners' willingness to go public increases with potential IPO proceeds irrespective of their ability to predict future market returns. Consequently, IPO activity will peak at market peaks. As we explain in detail in section 3.1, this results in long-run underperformance on average if returns of recent IPOs are positively correlated in a calendar month. Note that this theory does not require that markets overvalue IPOs at some periods in time. In a second part of our study, we use simulations in order to analyse the power of this theory to explain the significant underperformance of the invest-in-each-IPO-strategies in Germany. Here, we proceed as follows: First, we apply regression analysis to test the relation between IPO activity and price levels in our sample. Second, we construct an ex ante efficient capital market. The expected return of this market and the variance of IPO returns to market returns are estimated by real market and IPO returns in our sample. We simulate the performance of this market in our sample period 50,000 times. For each market simulation, we generate IPO activity according to the regression function estimated in step one. Finally, we calculate the performance of our IPO investments strategies in each market simulation. Averaging over 50,000 simulations yields expected performance of IPO investment strategies. We find that Pseudo Market Timing can explain parts of the performance differences in IPO investment strategies between 1985 and 2002. Its explanatory power is considerably greater for the IPOs between 1996 and 2002 than for those between 1985 and 2002.

This paper adds to the literature on German IPOs in several ways. Firstly, we focus on differences in performance among investment strategies involving IPOs. While investment strategies 1 and 2 resemble the methodology of event studies on the long-run performance of IPOs, strategies 3 and 4 have not been studied systematically on German IPOs yet. Taking budget restrictions of investors into account, strategies 3 and 4 are more feasible. Recent product innovations like Sal. Oppenheim's "IPO-Select Basket Zertifikat" or certificates on the GEX® suggest the relevance of these investment strategies. We study the performance of IPO investment strategies on the basis of a large sample including all German IPOs between 1985 and 2002. To control for institutional changes in Germany's primary capital markets and an evolution of equity culture since the mid-1990, we divide our sample period into sub samples comprising 1985 to 1995 and 1996 to 2002, respectively. Secondly, we discuss Pseudo Market Timing as a rationale explanation of differences in performance among IPO investment strategies in Germany. Thereby, we complement the literature on rationales for

[1] Miller (1977) provides an alternative rational explanation based on heterogeneous expectations. Here, we focus on the pseudo market timing explanation.

long-run underperformance of IPOs in Germany that is dominated by behavioural explanations so far.

The paper is organised as follows. Section 2 describes the data and methodology, briefly reviews the literature on long-run performance of IPOs in Germany and analyses the performance of the IPO investment strategies described above. Section 3 introduces Pseudo Market Timing as a rationale for differences in performance of IPO investment strategies and discusses the explanatory power of Pseudo Market Timing for the performance differences observed among investment strategies in Germany. Section 4 summarises and concludes.

2 Performance of IPO investment strategies in Germany

2.1 Data and Methodology

We study the long-run performance of IPOs in Germany from 1985 to 2002. In addition to the analysis of the entire sample period, we take a separate look on the sub-periods 1985 to 1995 and 1996 to 2002, respectively. The rationales for this division are changes in the institutional environment for IPOs and changes in the German equity culture from the mid-1990s onwards.

The institutional framework for IPOs changed with the shift from fixed-price offerings to book-building in 1996 as well as with the establishment of the "Neuer Markt" in Frankfurt in 1997. In June 1996, Eurobike AG was the first German firm to go public via the book-building procedure. This mechanism allows IPO pricing closer to the market as the offer price set based on market demand. 443 companies went public via bookbuilding following the IPO of Eurobike AG till the end of 2002, compared to only 25 firms using a fixed-price offering in the same time period.[1] The Neuer Markt provided a platform for small and medium size firms with high growth potential willing to enter the stock exchange. It soon attracted the attention of both these firms and the public. 292 companies went public on the Neuer Markt between its establishment and its closure in June 2003. In the same time, only 165 companies went public on other segments of the German stock exchange. The Neuer Markt thus remarkably accelerated the establishment of an equity culture in Germany. Apart from the Neuer Markt, the German equity culture evolved from the IPO of Deutsche Telekom AG in November 1996.[2] With an issue volume of 19.7 billion Deutsche Mark (10.1 billion €), this IPO outnumbered all previous IPOs in Germany by far. Deutsche Telekom shares were marketed intensively in the media and presented to the public as people's shares („Volksaktien"). This caused a strong interest of private investors in this IPO. The finance minister at the time, Theo Waigel, characterised the impact the Deutsche Telekom IPO as follows: „The privatisation of Deutsche Telekom AG is associated with crucial impulses to the stimulation of the financial market and the popularisation of shares […]."[3] The favourable performance of the „T-Aktie" until 2000 nourished a continuing interest of private investors and the media in IPOs.

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1 „Trius AG" went public via a uniform price auction on May 9, 2000.

2 Anecdotal evidence for the evolution of equity culture is provided by the IPO's media coverage, e.g.: Borggreve (1995), Borggreve/Dobrikat (1995) or Kutzer (1997). For a detailed illustration of the Deutsche Telekom IPO see Reuschenbach (2000).

3 This quote was taken from Kutzer (1995). The original quote was in German: "Die Privatisierung der Deutschen Telekom AG ist mit entscheidenden Impulsen für die Belebung des Finanzmarkts und die Popularisierung der Aktie verbunden […]."

From the new issue database of Deutsches Aktieninstitut e. V. and the website of Deutsche Börse AG we identified 667 IPOs in Germany between 1985 and 2002. Closing prices and market values on the last trading days of the 61 months following each IPO, the benchmark performance in the respective months as well information on dividends and other payments are provided by Thomson Financial Datastream and the financial database Karlsruher Kapitalmarktdatenbank. Information not provided by these databases is collected from the financial sections of the daily newspapers Frankfurter Allgemeine Zeitung and Handelsblatt. As we ceased collecting market prices in August 2005, we do not have 61 months time series for each IPO in the sample. Based on the monthly data, we calculate the total return per calendar month for each firm assuming that dividend payments and other cash distributions are reinvested in the firm's shares. Due to the calculation of returns based on end of calendar month prices, the first monthly total return is available for the month following the IPO month. This procedure implies that investors take their investment decisions at the end of each month in case of strategies 1 and 2. Accordingly, investors rebalance their IPO portfolios at the end of each month in case of strategies 3 and in case of 4 if necessary. Summarising, at the end of each month investors put money in those companies which went public in this very month.[1]

Table 1 presents some descriptive statistics on the IPOs in our sample and in the sub samples. Between 1985 and 2002, an average of 3.09 companies went public per month. Comparing the first and the second sub-period reveals that the average issuance activity has tripled since 1996. The mean market capitalisation of firms going public in the second sub period was more than twice as high as in the first sub period. In all sample periods, market capitalisation considerably varies among IPOs and the median size is about a quarter of mean size. The latter observation indicates that mean IPO size is driven by few very large issues. The largest IPO in the sample is that of T-Online AG in April 2000. After five years, quotes of 38 new issues had been ceased, out of which 16 had filed for bankruptcy, 19 had been acquired and 3 had been merged with other companies. Insolvencies as well as mergers and acquisitions are predominantly a phenomenon of the IPOs between 1996 and 2002. In fact, 30 of the 38 firms subject to insolvency, mergers or acquisitions went public in 1999 or 2000. The subsequent downturn of stock prices prompted these firms to engage in takeover activities which is reflected by a mean time between the IPO and such activities of slightly above three years. The fact that the time between IPO and insolvency is about three and a half years indicates that firms that did not engage in takeover activities successfully failed subsequently.

The firms which had filed for bankruptcy remain in the sample for five years to avoid distortions owing to survivorship bias (e.g., see Brown, Goetzmann, Ibbotson and Ross (1992)). In case of mergers and acquisitions, we assume investors behave as follows: Mergers

[1] Alternatively, if investors would receive allocations in each IPO, the success of the investment strategies could be analysed on the basis of issue prices, thereby including underpricing. However, as investors may not receive an allocation in case of oversubscription, such an investment strategy would involve allocation risk.

have to be approved by investors in the shareholders' meeting. Thus, if an IPO firm merges with a second firm to a new entity, we assume that investors convert their shares into those of the new entity. The IPO firm's time series of returns is therefore complemented by the returns of the new entity subsequent to the merger. In the case of acquisitions, however, investors' behaviour is less obvious. If the IPO firm is acquired by purchasing its shares in the market, investors selling shares receive cash payments. If the acquiring company suggests an exchange of shares, the IPO firm's investors can either agree or obtain an cash compensation at the time of the delisting. For reasons of simplicity, we assume that investors prefer cash compensations in any case. This cash compensation or the cash payment in return for selling shares is invested in the benchmark portfolio. Thus, the relative abnormal performance at the time of the acquisition is preserved in the time series.

Table 1: Descriptive statistics on the IPO sample

Market capitalisation is calculated on the basis of the closing price of the last trading day of the IPO month. The number of mergers, acquisitions and insolvencies within 60 months after the IPO and the mean number of months after IPOs are calculated on the basis of the delisting dates.

	85-02	**85-95**	**96-02**
Total number of IPOs	667	196	471
Number of IPOs per month			
Mean	3.09	1.48	5.61
Median	1.00	1.00	2.50
Market capitalisation [€ million]			
Mean	538.86	245.75	660.84
Median	136.21	76.49	162.66
Min	1.96	2.70	1.96
Max	45429.96	8037.50	45429.96
Mergers (up to 60 months after IPO)			
Number	3	0	3
Mean number of months after IPO	39	N/A	39
Acquisitions (up to 60 months after IPO)			
Number	19	2	17
Mean number of months after IPO	38.2	38.4	37
Insolvencies (up to 60 months after IPO)			
Number	16	2	14
Mean number of months after IPO	43.2	50.5	42.3

Choosing an appropriate benchmark portfolio is a delicate task as it may significantly alter results. Generally, the benchmark portfolio's risk profile should correspond to the risk profile of the IPO sample. A broad market index seems to be a self-evident benchmark portfolio to a large sample of IPOs. However, IPO firms may systematically differ from the market in terms of risk characteristics as IPO firms tend to be young growth firms with low market values.

Ignoring this difference may yield incorrect estimates for the abnormal performance of IPOs.[1] Thus, Brav and Gompers (1997), Ritter and Welch (2002) and others point out that IPOs should be compared to benchmark portfolios of firms with similar market values and similar market-to-book ratios.[2] Loughran and Ritter (1999) mention benchmark contamination as another obstacle when choosing a benchmark portfolio: If IPO firms are constituents of the benchmark portfolio, too, the estimate for abnormal performance will be biased downwards. Comparing IPO firms to benchmark portfolios adjusted for size and market-to-book ratios and avoiding benchmark contamination at the same time causes practical problems for the German market and adds subjectivity to the analysis. A broad market index, however, should be least affected by benchmark contamination.

We test the long-run performance of new issues in comparison to the value weighted Composite DAX® (CDAX hereafter) and the equally weighted version of the "Deutscher Aktien-Forschungsindex" (DAFOX). The CDAX is a broad market index that contains all firms listed on the market segments "Amtlicher Handel" or "Geregelter Markt". The equally weighted DAFOX (ewDAFOX) comprises all stocks listed on the Amtlicher Handel (see Göppl and Schütz (1995) for details). As the focus of our analysis is on differences in performance among IPO strategies rather than on the absolute level of abnormal performance, a potential loss of accuracy due to the choice of broad market benchmark portfolios does not affect our main results. Further, comparing the equal weighting strategies 1 and 3 to the ewDAFOX and the value weighting strategies to the CDAX allows controlling for potential size effects in parts.

2.2 Empirical results of previous studies

Table 2 presents results of selected studies concerning the long-run performance of IPOs in Germany.[3] In all studies, abnormal returns are calculated in event time methodology which implies that each IPO is weighted equally. This resembles the each-IPO investment strategy 1 proposed in this study. Regarding methodology, a majority of studies applies the Buy-and-

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[1] It is not entirely certain if small firms are systematically over- or undervalued. The „size-effect" found by Banz (1981) and Reinganum (1981) for the first time states that low market value firms generate significant excess returns on a risk adjusted basis. Stehle (1997) proved the existence of a „size-effect" on the German capital market. In the years following its discovery, however, the size-effect seemingly has disappeared (Schwert (2003)). Brav/Gompers (1997) as well as Brav/Geczy/Gompers (2000), however, observe the relatively poor long-term development of small new issues compared to the total market. They find no significant abnormal performance when comparing these IPOs with firms similar in size and market-to-book ratio.

[2] For instance, Ritter/Welch (2002) provide evidence for negative excess of US IPOs between 1980 and 2001 amounting to -23.4% compared to a market index but only to -5.1% compared to a portfolio of matching firms with similar market values and similar market-to-book ratios.

[3] For more detailed literature overviews see e.g. Stehle/Ehrhardt (1999), p. 1412 as well as Stehle/Ehrhardt/ Przyborowsky (2000).

Hold Abnormal Return (BHAR) method to measure long-run abnormal performance. We discuss the calculation methods in the following sections. The results of the literature are mixed. Until the early 1990s, the majority of studies does not provide evidence for significant positive or negative abnormal returns of German IPOs after holding periods of three years. Studies by Ehrhardt (1997), Stehle and Ehrhardt (1999) and Stehle/Ehrhardt/Przyborowsky (2000) compare returns of IPOs with those of equally weighted and market value weighted portfolios of shares with similar market capitalisation. The latter find significant abnormal returns neither in comparison to equally weighted and market value-weighted market portfolios nor in comparison to benchmark firms with marginally higher or lower market capitalisation.

Table 2: Studies on the long-run performance of IPOs in Germany

*/**/***: statistically significant on a 10%-/5%-/1%-level; AH: Amtlicher Handel; NM: Neuer Markt; ew: equally weighted; mvw: market value weighted; [a)] Benchmark firm's market value slightly above IPO firm's market value; [b)] Benchmark firm's market value slightly below IPO firm's market value; BHAR: Buy-and-Hold Abnormal Return; WR: Wealth Relative; CAR: Cumulative Abnormal Return.

Author(s) (year)	Sample period	Number of IPOs	Benchmark	Holding period (months)	Excess return (%)	Calculation method
Ehrhardt (1997)	1960-1990	159	Size-portfolio (ew)	36	-0.6	BHAR
		159	Size-portfolio (mvw.)	36	-3.8	BHAR
Ljungqvist (1997)	1970-1990	189	mvwDAFOX	36	-12.1 *	WR
Stehle/Ehrhardt (1999)	1960-1992	187	Size-portfolio (ew)	36	-5.0	BHAR
			Size-portfolio (mvw)	36	1.5	BHAR
Sapusek (2000)	1983-1993	142	Benchmark firms (by size)	60	-34.7	CAR
			DAX	60	1.8	CAR
Stehle/Ehrhardt/	1960-1992	187	Market portfolio (ew)	36	-5.0	BHAR
Przyborowsky (2000)			Market portfolio (mvw)	36	1.54	BHAR
			Benchmark firms [a)]	36	-11.6	BHAR
			Benchmark firms [b)]	36	-3.4	BHAR
Gerke/Fleischer (2001)	1997-2000	263 (NM)	Nemax All-Share	12	96.6 ***	BHAR
Rehkugler/Schenek (2001)	1983-1996	450	CDAX	36	-8.5	CAR
Mager (2001)	1987-1997	152	ewDAFOX	36	-13.5	CAR
				60	-41.3 **	CAR
Neuhaus/Schremper	1995-2000	27 (AH)	CDAX	36	-31.8 **	BHAR
(2003)		25 (NM)	CDAX	36	-72.9 ***	BHAR
Rath/Tebroke/Tietze (2004)	1997-2001	301 (NM)	CDAX	36	-87.8 ***	BHAR
Lubig (2004)	1997-2002	326 (NM)	Nemax All-Share	24	5.0	BHAR

Ljungqvist (1997), however, detects long-run underperformance of IPOs to the broad market index DAFOX which is significant on a 10%-level.[1] Sapusek's (2000) analysis of the performance of IPOs after up to five years shows significant negative abnormal returns in

[1] Stehle/Ehrhardt (1999) partly attribute the negative abnormal returns in comparison to the DAFOX found by Ljungqvist (1997) to the chosen methodology. See Stehle/Ehrhardt (1999), p. 1408 for details.

comparison to benchmark firms as well as to the equally-weighted DAFOX. Rehkugler and Schenek (2001) as well as Mager (2001) examine the performance of German IPOs in the 1980s and 1990s. While Rehkugler and Schenek find negative, but non-significant abnormal returns, Mager (2001) observes significant negative abnormal returns in comparison to the ewDAFOX after five years, but not after three years.

Some more recent studies analyse the long-run performance of IPOs on the Neuer Markt in Frankfurt. Gerke and Fleischer (2001) find significant positive abnormal returns for holding periods of one year. Lubig (2004) does not find evidence for significant abnormal returns of Neuer Markt-IPOs if each IPO is held for two years. In these studies the Nemax All-Share index is chosen as benchmark portfolio. As the Nemax All-Share comprised all firms listed at the Neuer Markt, the results mentioned above suffer from benchmark contamination. In effect, these studies test the performance of later IPOs to early IPOs on the Neuer Markt. Neuhaus and Schremper (2003) and Rath, Tebroke and Tietze (2004) compare returns of IPOs at Neuer Markt to the CDAX. They detect significant negative abnormal returns three years after the IPOs. Studies of IPOs on the Neuer Markt point at the influence of the length of the holding period on long-run performance. In particular, the longer the holding period, the worse the performance compared to the respective benchmarks. In general, the empirical results of previous studies underline the sensitivity of IPO abnormal performance to variations in the sample period, the choice of the benchmark portfolio and the length of the holding period. As regards the sample periods, significant underperformance is predominantly found for IPOs in the 1990s and for IPOs on Neuer Markt in particular. Regarding the holding period, underperformance rises with an increasing holding period.

There are few studies resembling IPO investment strategies 2 in Germany. For instance, Kiss and Stehle (2002) study the performance of Neuer Markt IPOs in case of equally and value weighting each IPO. They find that strategy 2 performs similar to strategy 1 if each IPO is held for one year. To our knowledge, strategies 3 and 4 have not been analysed in Germany yet. However, there is some international evidence on strategies 2 and 3. Brav and Gompers (1997) find long-run underperformance on average in the USA if each IPO is value weighted. Gompers/Lerner (2003) and Schultz (2003) find no underperformance of US IPOs if each calendar month is weighted equally. In contrast, Loughran and Ritter (1995) detect long-run negative returns in calendar time for US IPOs.

2.3 Each-IPO investment strategies

We study the performance of an investment in each IPO by comparing the buy-and-hold return of each IPO to the buy-and-hold benchmark return irrespective of the IPO point in calendar time. As we ignore calendar time, this analysis resembles an event study methodology. Several different approaches to measuring long-term performance of stocks in event time are discussed in the literature. Among the most established methodologies are the Buy-and-Hold Abnormal Return approach (BHAR) firstly mentioned by Cusatis, Miles and

Woolridge (1993), the Cumulative Abnormal Return approach (CARs) by Fama et al. (1969) and the Wealth Relative method by Ritter (1991).

The BHAR-method calculates the equally or value weighted mean of differences between the buy-and-hold return of an IPO and the buy-and-hold benchmark return. The $BHAR_{H,i}$ of firm i exhibiting a total return $R_{i,t}$ in calendar month t following the IPO versus the total return of a benchmark portfolio $R_{B,i,t}$ for firm i in calendar month t for a maximum holding period H is calculated as

$$BHAR_{H,i} = \left(\prod_{h=1}^{H}\left(R_{i,t}+1\right)\right) - \left(\prod_{h=1}^{H}\left(R_{B,i,t}+1\right)\right) \quad . \qquad (1)$$

The mean of the buy-and-hold abnormal returns $BHAR_{H,i}$ of $i = 1 \ldots N$ IPOs in the sample is calculated in case of investment strategies S={1,2} as

$$\overline{BHAR}_H^S = \sum_{i=1}^{N} w_i \left[\left(\prod_{h=1}^{H}\left(R_{i,t}+1\right)\right) - \left(\prod_{h=1}^{H}\left(R_{B,i,t}+1\right)\right)\right] \qquad (2)$$

where

w_i = 1/N in case of investment strategy 1 and

w_i = market value of firm i at the end of the IPO month / sum of market values of all firms at the end of the respective IPO months in case of investment strategy 2.

In order to draw statistical inference on abnormal performance of IPOs in investment strategies 1 and 2, we test the null hypothesis $H_0 : \overline{BHAR}_H^S = 0$ to the alternative hypothesis $H_A : \overline{BHAR}_H^S \neq 0$. As monthly IPO and benchmark returns are combined multiplicatively, the distributions of buy-and-hold returns of the IPOs and of the benchmarks are right-skewed. We obtain a right-skewed distribution of the buy-and-hold abnormal returns $BHAR_{H,i}$, too. As a consequence, standard t-statistics for hypotheses tests are inefficient. We apply a transformed t-statistic proposed by Hall (1992). This statistic allows efficient hypotheses tests even in case of severely skewed distributions.[1]

According to the CAR-method monthly returns of the IPOs and the benchmark portfolio are not combined multiplicatively but additively. Due to the additive cumulation the distribution of CARs is expected to be less skewed than the distribution of BHARs. To measure the result of investment strategies 1 and 2 this methodology is less suitable since the additive

[1] Lyon/Barber/Tsai (1999) suggest a bootstrapped version of Johnson's (1978) transformed t-statistic. However, Hall (1992) applies simulations to demonstrate that his transformed t-statistic is more efficient than the one suggested by Johnson (1978) as the latter does not fully adjust for skewness.

combination of returns implies an equal weighting of monthly returns. This, in turn, requires monthly rebalancing of each IPO which is not intended for investment strategies 1 and 2.[1]

Stehle and Ehrhardt (1999) as well as Jakobsen and Sørensen (2001) argue that the "Wealth Relative"-method (WR) is appropriate for measuring the long-term performance of IPOs. Here, the monthly returns of the IPOs and the benchmark portfolios are combined multiplicatively like in formula (1) to determine buy-and-hold returns of the IPOs and the benchmarks. However, the abnormal performance is measured by the ratio of IPO buy-and-hold-returns to benchmark buy-and-hold returns. Thus, the WRs express the relative performance of IPOs to their benchmark portfolios. Based on a sample of Danish IPOs, Jakobsen and Sørensen (2001) show that WRs are log-normal distributed. The log-WRs are hence an appropriate basis for significance tests. For two reasons we prefer the BHAR-method to the WR-method. First, we deal with skewed distributions by testing significance on the basis of a skewness-adjusted test statistic. Second, the success of the investment strategies cannot easily be interpreted economically if measured by WRs. Though the WR-method answers the question of the mean relative performance of IPOs to their benchmarks and thereby indicates out- or underperformance, by its nature the method does not allow drawing conclusions on average monetary wealth gains. In contrast, mean BHARs can easily be interpreted as mean wealth gains or losses in percentage points of the capital invested.

Table 3 exhibits the $\overline{BHAR}_H^S$ of investment strategies 1 and 2 for holding periods of three and five years compared to the CDAX and the ewDAFOX in the sample and sub sample periods. At the end of the sample periods, all IPO investments are liquidated irrespective of the time elapsed since the going public.[2] We observe non-significant outperformance in case of an equally weighted investment in IPO firms between 1985 and 1995 with holding periods of 36 months. All other variations of investment strategies 1 and 2 underperform the benchmark. The magnitude of the underperformance varies between and within the two strategies depending on the sample period, the holding period and the benchmark portfolio. Firstly, we take a closer look at the performance of the equally weighted strategy 1. It is remarkable that strategy 1 performs considerably worse with 60 months holding periods than with 36 months holding periods irrespective of the sample period and the benchmark. According to the p-values of the skewness adjusted t-statistic, the underperformance for three year holding

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1 The appropriateness of these and other performance measures for analyzing the long-run performance of IPOs in general is discussed in detail in Stehle/Ehrhardt (1999).

2 Consequently, the average holding period of IPOs in the sample periods is lower than 36 months and 60 months, respectively. In case of the entire sample period, the average holding period amount to 33.7 and to 45.6 months, respectively. The average holding periods in the sub sample period 1985 to 1995 amount to 30.9 and 48.0 months, respectively, while in the sub sample period 1996 to 2002 they amount to 32.8 and 39.7 months, respectively. In an analysis not presented in this paper, we analyse the performance of strategies 1 and 2 if the IPO investments may be held up to December 2004. This raises the averages holding period close to 36 and 60 months. In this analysis we observe even worse underperformance in any case. However, the significance levels as well as the patterns of abnormal returns with respect to the benchmark, the holding period and the sample period do not differ from the results reported here.

periods is not significant, whereas the underperformance for five year holding periods is highly significant except for the first sub sample period in comparison to the CDAX. The separation of the sample period into the sub samples 1985 to 1995 and 1996 to 2002 reveals that investment strategy 1 performs substantially worse in the second sub sample. In the first sub sample, statistically significant underperformance can only be found compared to the ewDAFOX with a holding period of 60 months.[1] Irrespective of holding period and sample period, mean BHARs are lower compared to the value weighted CDAX than compared to the equally weighted ewDAFOX. This points to a relative out-performance of the ewDAFOX compared to the CDAX in the average calendar time holding period. In turn, this implies that firms predominantly went public prior to periods in which small firms outperformed large firms.

Table 3: Strategy 1 and 2 mean BHARs for holding periods of 36 and 60 months

Holding periods of 36 and 60 months indicate maximum holding periods as each IPO investment is liquidated at the end of the sample periods (1995 and 2002, respectively). BHAR is calculated according to expression (2). Italic figures below BHARs are p-values of skewness-adjusted t-statistics according to Hall (1992). P-values of strategy 2 BHARs are calculated by duplicating BHARs based on the market value at the end of the IPO month. The number of duplications is determined by the number of 10 million € pieces of market value exceeding a market value of 10 million €.

		Strategy 1				**Strategy 2**			
Benchmark portfolio		**CDAX**		**ewDAFOX**		**CDAX**		**ewDAFOX**	
Holding period		**36**	**60**	**36**	**60**	**36**	**60**	**36**	**60**
85-02	**BHAR**	-4.87%	-30.29%	-15.59%	-44.05%	-6.07%	-29.98%	-18.98%	-48.74%
N = 667	***p-value***	*0.8798*	*0.0000*	*0.5384*	*0.0004*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
85-95	**BHAR**	2.80%	-6.91%	-5.93%	-14.79%	-13.28%	-20.74%	-17.33%	-24.68%
N = 196	***p-value***	*0.5144*	*0.2094*	*0.1973*	*0.0068*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
96-02	**BHAR**	-3.51%	-28.86%	-18.61%	-53.63%	-3.89%	-26.11%	-3.95%	-26.19%
N = 471	***p-value***	*0.9895*	*0.0000*	*0.5992*	*0.0000*	*0.0012*	*0.0000*	*0.0005*	*0.0000*

Investment strategy 2 results in similar underperformance when investing over the whole sample period. Again, holding each IPO for 60 months considerably increases underperformance. In contrast to strategy 1, however, IPOs significantly underperform the benchmark for the 36-months holding period, too. A comparison of the first and the second sample period reveals investing equally weighted in IPOs was preferable to investing value weighted between 1985 and 1995, while value weighted IPO investments performed better than equally weighted investments between 1996 und 2002. This allows further insights into

[1] A critical reader might be surprised by the fact that mean BHARs to the CDAX in the entire sample period are higher than the sum of mean BHARs in the sub samples even though the whole sample period consists of both sub samples. The rationale is that in the first sub period, the return series of IPOs are cut after December 1995. In the entire sample period the return series of firms that went public till December 1995 are considered completely.

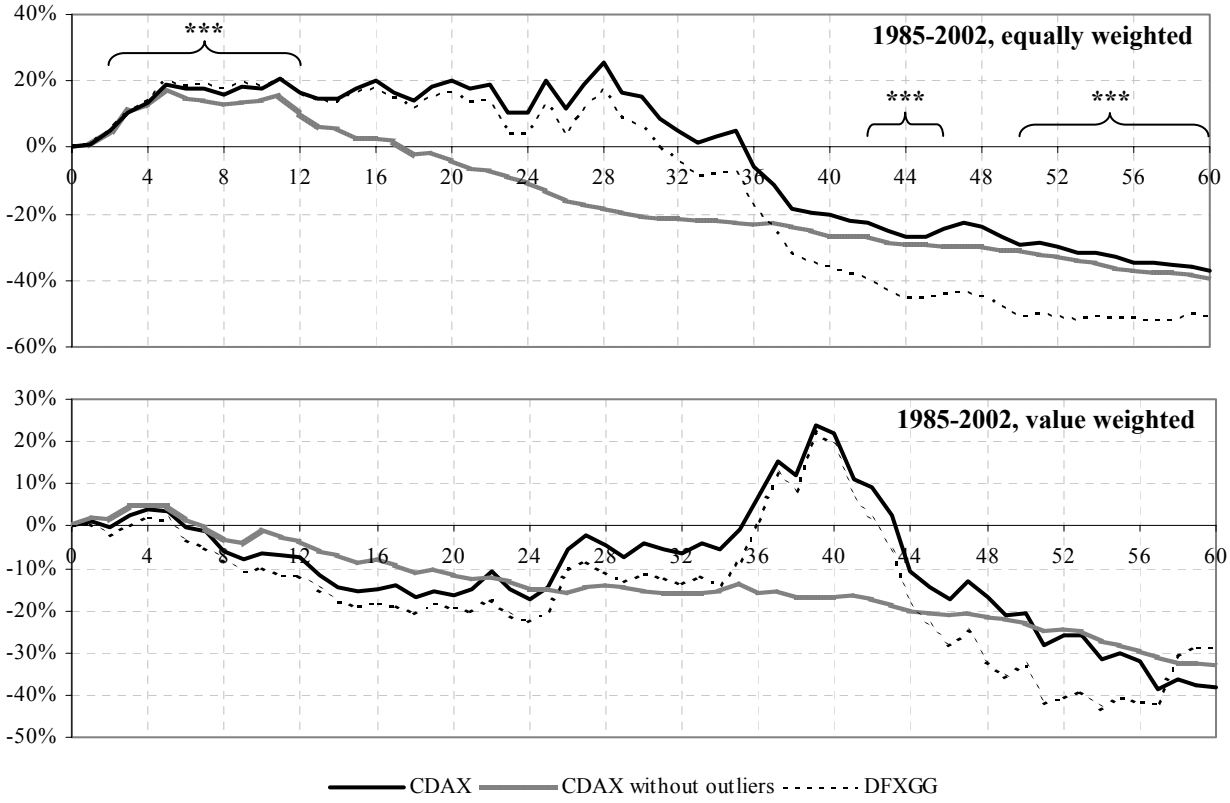
the relation between size and long-run performance. Consistent with Stehle (1997) who provides evidence for a size-effect in Germany, weighting each IPO equally results in lower underperformance in the first sub-period. In turn, this implies that the average underperformance of investment strategy 1 is mainly caused by large IPOs. In the second sub period, however, small IPOs are the main drivers of the average underperformance as strategy 1 performs worse than strategy 2.

Further, we analyse the relation between $\overline{BHAR}_H^S$ and the length of the holding period. Figure 1 shows the long-run performance of all IPOs compared to the CDAX and the ewDAFOX for holding periods between 1 and 60 months. The upper graph plots the long-run abnormal performance of equally weighted IPOs, while the lower graph plots the long-run abnormal performance if IPOs are weighted according to their market value at the end of the IPO month. Bold black lines illustrate the IPO performance compared to the CDAX, dashed black lines the performance compared to the ewDAFOX and hatched grey lines the performance to the CDAX if outliers are excluded. Note that these graphs resemble, but do not exactly mirror investment strategies 1 and 2. Here, a data point for a certain holding period H only comprises IPOs whose return series is long enough to compute a $BHAR_{H,i}$. For example, the $\overline{BHAR}_{60}^S$ comprises 601 IPOs.

The upper graph reveals that IPOs outperform their benchmarks by roughly 20% for short holding periods. The outperformance to the CDAX illustrated by the bold black line is highly significant for holding periods between 2 and 12 months. Only after three years IPOs perform worse than the CDAX. We observe highly significant underperformance to the CDAX for holding periods between 42 and 46 months as well as for holding periods greater than 50 months. The IPO performance to the ewDAFOX is similar for holding periods up to 20 months. Thereafter, the IPOs perform worse on average than compared to the CDAX. The hatched grey line provides further insights into the drivers of the IPO performance as it represents the IPO performance to the CDAX if three extreme outliers are excluded. These outliers are Ballmaier & Schulz Wertpapier AG (B&S), a securities broker, Mobilcom AG, a mobile telecommunication provider and EM.TV & Merchandising AG, a multimedia firm. B&S went public in July 1994 and experienced an extreme stock price jump in spring 1998 resulting in a *BHAR* of 3,746% after 47 months. The lack of significance of the underperformance between 45 and 47 months reflects the B&S stock price jump. Mobilcom went public in March 1997 and experienced a very favourable stock price performance culminating in a BHAR of 2,474% after 22 months. The EM.TV stocks that were taken public in October 1997 reached the highest relative price levels in the IPO sample culminating in a BHAR of 27,820% after 28 months. The deviation of the hatched grey line from the bold black line between 10 and 44 months reflects the extreme performance of Mobilcom and EM.TV. Without these two outliers, IPOs would have performed worse than the CDAX after a holding period of 18 months yet. Excluding all outliers, the IPO underperformance almost monotonically increases in the holding period.

Figure 1: Average BHAR in relation to the holding period

The upper graph plots $\overline{BHAR}_T^1$ if IPOs are weighted equally. The lower graph plots $\overline{BHAR}_T^2$ if IPOs are weighted according to their market value at the end of the IPO month. Bold black lines illustrate the performance of IPOs compared to the CDAX. Dashed black lines illustrate the performance of IPOs to the ewDAFOX. Hatched grey lines illustrate the performance of IPOs compared to the CDAX if the following three outliers are excluded: Ballmaier & Schultz Wertpapier AG, Frankfurt, Mobilcom AG, Büdelsdorf and EM.TV & Merchandising AG, Unterföhring. Curly braces indicate holding periods associated with a significant out- or underperformance compared to the CDAX on a 1% significance level.



As the lower graph shows, weighting each IPO according to its market value generates a very different picture. Here, IPOs only slightly outperform the CDAX or the ewDAFOX for holding periods up to six month. Holding each IPO longer than six month yields a worse average performance than investing in the benchmarks except for holding periods between 35 and 43 months in case of the CDAX and between 36 and 42 month in case of the ewDAFOX, respectively. Again, results are driven by an extreme outlier, which is Deutsche Telekom AG in this case. Although Deutsche Telekom was only the third largest IPO by market value in Germany, it reached the highest overall market value in our sample by far. Deutsche Telekom's value culminated in 186.2 billion € 39 months after the IPO in February 2000 which is consistent with the peak of the IPO performance relative to the CDAX after 39 months. Excluding this outlier, the value weighted performance of IPOs is similar to the equally weighted performance in the sense that the value weighted performance increases in

the holding period, too. The level of underperformance is higher in case of equally weighted IPOs for holding periods greater than 27 months.

2.4 IPO-portfolio investment strategies

Investors pursuing IPO investment strategies 3 and 4 do not invest in each IPO, but in a portfolio that comprises firms that went public recently. The IPO portfolio may either be equally weighted (strategy 3) or value weighted (strategy 4). The meaning of "recently" may be arbitrarily concretised by choosing a certain formation period. We concentrate on formation periods of 36 and 60 months which is in line with the holding periods in strategies 1 and 2. With strategies 3 and 4, investors put money into the IPO portfolio only once at the beginning of the investment period. At the end of each month the investors rebalance the IPO portfolio by including firms that went public this month and by taking out firms for which the time since IPO exceeds the formation period. In addition, strategy 3 requires monthly rebalancing in order to keep the portfolio equally weighted. Transaction costs associated with portfolio rebalancing are not incorporated in our analysis. As discussed in the introduction, we assume individual investors implement investment strategies 3 and 4 if they can purchase investment funds or certificates that duplicate the IPO portfolio at low transaction costs.

We calculate the excess return $BHAR^{S}_{F,\mathrm{T}}$ of investment strategies S={3,4} for a formation period of F months and a sample period of τ = T calendar months as

$$BHAR^{S}_{F,\mathrm{T}} = \prod_{\tau=1}^{\mathrm{T}}\left[\left(\sum_{i_\tau=1}^{N_{F,\tau}} w_{i,\tau}\cdot R_{i,\tau}\right)+1\right] - \prod_{\tau=1}^{\mathrm{T}}\left[\left(\sum_{i_\tau=1}^{N_{F,\tau}} w_{i,\tau}\cdot R_{b,i,\tau}\right)+1\right] \qquad (3)$$

where

$R_{i,\tau}$ = return of firm i in calendar month τ,

$R_{b,t,\tau}$ = return of the benchmark portfolio b for firm i in calendar month τ,

$N_{F,\tau}$ = number of firms that went public in the F months prior to calendar month τ,

$w_{i,\tau}$ = 1 in case of each IPO is weighted equally (strategy 3) and

$w_{i,\tau}$ = market value of firm i in calendar month τ divided by the sum of the market values of all firms $N_{F,\tau}$ in calendar month τ (strategy 4).

As with strategies 1 and 2, we test the null hypothesis $BHAR^{S}_{F,\mathrm{T}} = 0$ against the alternative hypothesis $BHAR^{S}_{F,\mathrm{T}} \neq 0$. In contrast to strategies 1 and 2, we do not have a distribution of abnormal returns that could serve as a basis for statistical tests. When calculating strategy 3's and 4's performance according to expression (3), we obtain a single data point instead. We apply a bootstrapping procedure in order to generate an empirical distribution of $BHAR^{S}_{F,\mathrm{T}}$ that may serve as a basis for statistical inference. We proceed as follows: From our entire

sample period of 215 calendar months we randomly draw a new sample of 215 months. We calculate the $BHAR_{F,\mathrm{T}}^{S^*}$ of the newly generated sample period from the empirical IPO portfolio and benchmark returns associated with the calendar months in the randomly drawn sample. This procedure is repeated 10,000 times. We can now use the empirical distribution of X = 10,000 $BHAR_{F,\mathrm{T}}^{S^*}$ to test the null hypothesis. In order to determine the critical values of the empirical distribution, we sort the $BHAR_{F,\mathrm{T}}^{S^*}$ in ascending order where $BHAR_{F,\mathrm{T}}^{S^*1} \leq \ldots \leq BHAR_{F,\mathrm{T}}^{S^*X}$. For a significance level α the critical values are equal to $BHAR_{F,\mathrm{T}}^{S^*}(1-\alpha/2)X$ and $BHAR_{F,\mathrm{T}}^{S^*}(\alpha X/2)$, respectively. As the empirical distribution of $BHAR_{F,\mathrm{T}}^{S^*}$ is asymmetric due to the multiplicative combination of monthly returns, we mirror the critical values on the mean of the distribution of $BHAR_{F,\mathrm{T}}^{S^*}$ according to the percentile bootstrapping method (e.g., see Trede (2002)). Therefore, we obtain $c_{low} = 2\overline{BHAR}_{F,\mathrm{T}}^{S^*} - BHAR_{F,\mathrm{T}}^{S^*}(1-\alpha/2)X$ and $c_{high} = 2\overline{BHAR}_{F,\mathrm{T}}^{S^*} - BHAR_{F,\mathrm{T}}^{S^*}(\alpha X/2)$. The null hypothesis is rejected if all $BHAR_{F,\mathrm{T}}^{S^*}$ within the range c_{low} and c_{high} are greater than zero or smaller than zero, respectively. P-values indicate the smallest α and hence widest range $[c_{low}, c_{high}]$ for which the null hypothesis is rejected. We proceed in the same way in case of the sub sample periods.

Table 4: Strategy 3 and 4 BHARs for holding periods of 36 and 60 months

BHARs are calculated according to expression (3). P-values are based on empirical distributions of BHARs generated by 10,000 bootstrapped resamples of the original sample of calendar months. P-values indicate the smallest significance level α and hence widest range $[c_{low}, c_{high}]$ for which the null hypothesis is rejected. T indicates the number of calendar months in the (sub) sample.

		Strategy 3		**Strategy 4**	
Benchmark		**ewDAFOX**		**CDAX**	
Formation period		**36**	**60**	**36**	**60**
85-02	BHAR	-251.23%	-265.73%	-179.33%	-194.60%
T = 215	*p-value*	*0.2362*	*0.1794*	*0.3164*	*0.2648*
85-95	BHAR	-67.56%	-79.88%	-109.39%	-105.37%
T = 131	*p-value*	*0.2508*	*0.1984*	*0.2486*	*0.2524*
96-02	BHAR	-71.76%	-68.16%	-42.28%	-45.38%
T = 78	*p-value*	*0.3218*	*0.3558*	*0.8304*	*0.4886*

Table 4 shows buy-and-hold abnormal returns of investment strategies 3 and 4 for formation periods of 36 and 60 months. We analyse the performance of the equal weighting strategy 3 in comparison to the equally weighted ewDAFOX and the performance of the value weighting strategy 4 to the value weighted CDAX. Note that the number of calendar months T does not equal the number of years in the sample period times twelve as we observe the first calendar month IPO return in February 1985. In the sub sample 1996-2002 we observe the first calendar month IPO return in July 1996. In case of the entire sample period, the buy-and-hold return of the IPO portfolio is considerably lower than the buy-and-hold return of the benchmark portfolio. For example, pursuing strategy 3 yields a difference of IPO return and benchmark return of more than -265% for 60 months holding periods.

Consistent with our findings for strategies 1 and 2, the equally weighted IPO investment strategy performs worse than the value weighted strategy. The underperformance of the 60 months formation period differs only slightly from the 36 months formation period. This contrasts to the impact of holding periods on the performance of strategies 1 and 2. In spite of the large underperformance, the p-values obtained by bootstrapping indicate no statistical significance. The BHARs for the sub sample periods are negative, too, even though the absolute level of underperformance is substantially lower. In the first sub period strategy 4 performs worse than strategy 3, while in the second sub period strategy 4 outperforms. This indicates that small IPOs perform disproportionately well in the first sub period and disproportionately poorly in the second sub period which is consistent with our findings for strategies 1 and 2. Again, the sub sample BHARs are not statistically significant.

It appears that strategies 3 and 4 are very unattractive to investors as regards the large underperformance observed in our sample periods. However, we can infer from the non-significant p-values that strategies 3 and 4 are not unattractive in general. In addition, we can conclude that strategies 3 and 4 are more attractive than strategies 1 and 2 as the latter strategies performed significantly worse than their benchmark in many cases. This somewhat curious result is confirmed in Table 5. Here, we compare the monthly mean abnormal performance of the equal weighting strategies 1 and 3. We obtain monthly means for strategy 1 as follows: For each IPO we calculate the monthly mean abnormal return by subtracting the monthly geometric mean of IPO returns from the monthly geometric mean return of the benchmark portfolio. The monthly mean abnormal returns are the arithmetic averages of the IPO mean abnormal returns in the different settings. For strategy 3, we calculate monthly mean abnormal returns as geometric averages of the monthly abnormal returns in the sample periods. We find negative monthly mean abnormal returns with strategy 1 as well as with strategy 3. Yet, the magnitude of monthly underperformance with strategy 1 is a multiple of the strategy 3 underperformance for the entire sample period and the later sub sample period. In sub period 1985 to 1995 strategy 1 monthly underperformance is still greater than that of strategy 3. Strategy 1 monthly mean abnormal returns are highly significant in any case, while strategy 3 monthly mean abnormal returns are significant in no case. These results strongly support our findings for the performance of investment strategies.

Recall that the performance of all investment strategies is calculated by the very same monthly returns of the IPOs and the benchmarks, respectively. Thus, any difference in performance among strategies must be due to the different methods of aggregating monthly returns defined by expressions (2) and (3). Strategies 1 and 2 imply an equal (respectively market value) weighting of each IPO irrespective of calendar months, while strategies 3 and 4 imply an equal weighting of calendar month irrespective of the number of IPOs in a calendar month. In the latter strategies, each IPO's weight in a calendar month return depends on the number of IPOs in the formation period of that calendar month. It follows that the more firms go public within a certain formation period, the less weight is attributed to each IPO.

Table 5: Monthly mean abnormal returns of strategies 1 and 3

Months specifies the length of the holding period in case of strategy 1 and the length of the formation period in case of strategy 3. In case of strategy 1, mean refers to the arithmetic mean of the monthly mean abnormal returns of the IPOs in the sample where the monthly mean abnormal return of each IPO is calculated by subtracting the monthly geometric mean of IPO returns from the monthly geometric mean return of the benchmark portfolio. In case of strategy 3, mean refers to the geometric mean of the monthly abnormal returns in each sample period. P-values are based on t-statistics in case of strategy 1. P-values are based on t-statistics of the log-transformed distribution of the monthly returns in case of strategy 3. N specifies the number of IPOs in the sample period of strategy 1. T specifies the number of calendar months in the sample period of strategy 3.

		Strategy 1				**Strategy 3**			
Benchmark		**CDAX**		**ewDAFOX**		**CDAX**		**ewDAFOX**	
Months		**36**	**60**	**36**	**60**	**36**	**60**	**36**	**60**
85-02	**Mean**	-3.43%	-3.60%	-4.08%	-4.40%	-0.57%	-0.65%	-0.57%	-0.64%
	p-value	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.1506*	*0.0704*	*0.1247*	*0.0541*
	N / T	*667*	*667*	*667*	*667*	*215*	*215*	*215*	*215*
85-95	**Mean**	-0.38%	-0.58%	-0.26%	-0.42%	-0.25%	-0.29%	-0.22%	-0.27%
	p-value	*0.0035*	*0.0000*	*0.0492*	*0.0023*	*0.5984*	*0.4817*	*0.1924*	*0.1037*
	N / T	*196*	*196*	*196*	*196*	*131*	*131*	*131*	*131*
96-02	**Mean**	-4.62%	-4.75%	-5.52%	-5.90%	-0.99%	-0.91%	-1.09%	-1.00%
	p-value	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.2536*	*0.2756*	*0.2670*	*0.2830*
	N / T	*471*	*471*	*471*	*471*	*78*	*78*	*78*	*78*

As we observe significant underperformance with strategies 1 and 2 but not with strategies 3 and 4, we can infer that IPOs performed disproportionately poorly in periods of high issuance activity. This pattern is consistent with international evidence that IPOs in hot markets perform worse than IPOs in cold markets (e.g., see Helwege and Liang 2004). This leads over to section III which discusses Pseudo Market Timing as an explanation for the differences in underperformance among investment strategies.

3 Pseudo Market Timing in Germany

3.1 Market Timing vs. Pseudo Market Timing

Market timing describes a manager's ability to explicitly time a going public into a period of irrational overvaluation of his firm, the firm's industry or the entire stock market. As a matter of fact, two out of three CFOs responding to a survey by Graham and Harvey (2001) confirm the considerable influence of over- or undervaluation on the decision to go public.

Two phenomena are frequently considered to be empirical indicators for IPO market timing in the literature. First, IPOs cluster at market peaks or in times of high market-to-book ratios of comparable firms. Second, firms going public at market peaks or in times of high IPO activity perform considerably worse than firms going public at other times.[1] Our comparison of each-IPO investment strategies to IPO-portfolio investment strategies suggests the same phenomena for German IPOs. Regarding these phenomena, Ritter (1991) was the first to suppose that managers identify periods of overvaluation of IPOs („windows of opportunity") and choose such periods to go public. However, neither a concentration of IPOs at market peaks nor long-term negative abnormal returns of IPOs around market peaks necessitate that the managers have indeed identified a peak and knowingly time the market.[2] If managers were able to identify overvaluations, IPO activity could predict future returns. Loughran, Ritter and Rydqvist (1994) find little evidence for an ability of IPO activity to forecast future returns in different countries. Baker and Wurgler (2000) provide evidence that the proportion of equity issuance in total securities issuance predicts future equity returns in the US. Apart from using IPO clustering and performance as an indicator for market timing, market timing could be tested based on a measure of investor sentiment that indicates market overvaluations.[3] Lee, Shleifer and Thaler (1991) use the closed-end fund discount as an indicator of investor sentiment where low discounts point to overvaluations. Indeed, they find that more firms go public at times of a low closed-end fund discount. Their result is confirmed by Lowry (2003).

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1 Loughran/Ritter (1995, 2000), Webb (1999) and Helwege/Liang (2004) find evidence for the US market, Keloharju (1993) for the Finnish market and Page/Reyneke (1997) for the South-African capital market. Lerner (1994) shows that venture capitalists predominantly take their firms public at market peaks.

2 Löffler (2000) notes that managers decide to go public approximately six month prior to the actual IPO date. Hence, market timing implies that managers predict overvaluations half a year in advance which is an even more difficult task.

3 An overvaluation of IPOs on the secondary market could be the consequence of an irrational investors' behaviour on the primary market. In a survey by Shiller (1990), only 43% of US investors stated to subscribe for IPOs on the basis of fundamentals. 57% subscribe because of attractive products or promising strategic concepts of the firms. Loughran and Ritter (2003) suppose that investors were subject to herding behavior during the internet bubble. An IPO oversubscription due to irrational investors on the primary market could signal an inflated firm value to the secondary market.

Rajan and Servaes (1997) find that IPO activity is positively correlated with analysts' optimism about the growth prospects of recent IPOs.

In contrast to the findings described above, other studies find phenomena and behaviour patterns on US capital markets that contradict the market timing hypothesis. For instance, on the basis of data about insider-trading, Lee (1997) shows that managers buy shares prior to price declines. This is contradictory if managers have market timing abilities. Spiess and Affleck-Graves (1999) find stock underperformance following to debt issuance. According to market timing, firms issue equity in times of overvaluation and debt in times of undervaluation. Thus, market timing implies outperformance after debt issues.

There is little evidence for market timing in Germany. For instance, Rehkugler and Schenek (2001) have to reject the market timing hypothesis as they find larger underperformance for firms that went public in periods of low IPO activity. Similarly at odds with market timing, Loughran, Ritter and Rydqvist (1994) detect a positive correlation between the number of IPOs and future returns. Rath, Tebroke and Tietze (2004) analyse the correlation between market sentiment at the date of the IPOs on Neuer Markt and their long-run performance. Amongst others, they apply business climate indices as indicators for market sentiment. Consistent with market timing, they find worse performance for firms that went public in times of a positive market sentiment.

Schultz (2003) shows that a concentration of IPOs around market peaks and long-run negative abnormal returns of IPOs are not necessarily a consequence of managers timing the market und hence, a consequence of market inefficiencies. Instead, in efficient capital markets negative abnormal returns of IPOs can be observed if the following conditions hold: The probability of a going public increases with the price level of the market and of recent IPOs in particular. Further, excess returns of recent IPOs in a calendar month need to be positively correlated. In this case, IPO clustering at market peaks might be misleadingly perceived as market timing. Schultz (2003) finds that this pseudo market timing can explain the level of long-run underperformance observed in the US in event time. Butler, Grullon and Weston (2005) attribute the predictive power of the proportion of equity issuance found by Baker and Wurgler (2000) to pseudo market timing.

The first condition states that managers or owners take the price level of a benchmark portfolio into account when deciding about an IPO. The entire stock market, a benchmark firm or a portfolio of recent IPOs could serve as appropriate benchmark portfolios. The assumption that managers consider absolute price levels instead of relative performance prior to an IPO can be rationalised as follows:[1] An increasing market price level or increasing price levels of particular industries imply new investment opportunities. These investments have to be funded at least partly by equity. Thus, IPO activity should be positively correlated with

[1] Pastor/Veronesi (2005) provide evidence for a positive correlation between IPO activity and the market returns rather than market price levels.

price levels. Regardless of the underlying investment opportunities, an IPO's attractiveness rises with increasing expected proceeds. Loughran, Ritter and Rydqvist (1994) provide empirical evidence for a positive correlation between IPO activity and stock market price levels in several countries. Pagano, Panetta and Zingales (1998) detect a positive correlation between the probability of Italian firms to go public and the market value of firms in the same industry. Pastor and Veronesi (2005) find a positive correlation between the valuation of IPOs relative to the entire market valuation and IPO activity. Secondly, pseudo market timing requires a positive correlation among the abnormal returns of recent IPOs in a calendar month in order to observe fluctuations of the aggregate price level of IPOs in excess of fluctuations of market price levels. As IPOs of firms within a certain industry cluster in certain time periods, a positive correlation of abnormal returns is plausible.

If managers behave as described above, IPOs concentrate in bullish markets even if managers do not possess timing abilities. In other words: Even though managers are ex ante not able to predict a market peak and hence a trend reversal in share prices, ex post it seems as if managers time the market as IPOs cluster around market peaks. However, this clustering does not reflect any superior abilities of managers, owners or investment bankers to identify periods of overvaluations. Market timing is simply a statistical illusion. Hence, Schultz calls this phenomenon pseudo market timing. If managers behave as predicted by pseudo market timing, and the second condition concerning the correlation of IPO returns holds, negative long-run performance of IPOs will be observed when averaging over all IPOs irrespective of the market's efficiency. Thus, pseudo market timing predicts that investment strategies 1 and 2 underperform in the long-run which is in line with our empirical findings. If each calendar month is weighted equally, however, IPOs do not underperform their benchmarks in efficient capital markets as a clustering of IPOs is irrelevant in an analysis based on calendar time. Thus, pseudo market timing predicts that strategies 3 and 4 do not underperform their benchmarks. Indeed, we observe underperformance of strategies 3 and 4, but not on a statistically significant level.

In the following we illustrate the basic intuition of pseudo market timing on the basis of a simple model consisting of three periods. In this model, the IPO activity in one period is positively correlated to the price level of IPOs which took place in the previous period. In particular, we assume the following relation: If the prices of the previous period's IPOs are below 60, no IPOs will take place. If the previous period's IPOs quote at least at 60 [80, 100, 120, 140], 1 [2, 4, 8, 12] firms will go public. The arrangement of categories and the number of IPOs in each category is arbitrary and irrelevant for the verification of pseudo market timing as long as the number of IPOs rises in higher categories. Following the example in Schultz (2003), we further assume an expected market return of 0%. In each period, IPOs either earn an excess return (ER) of +20% or -20%, each with a probability of 50% which implies that IPO returns are perfectly positively correlated. As the expected abnormal return of IPOs equals 0%, the market is efficient ex ante. In t=0, we assume that the previous period's IPOs quote at 100. The resulting $2^3 = 8$ potential IPO price paths in the following three periods are illustrated in Table 6.

Table 6: A simple example for pseudo market timing

The expected market return amounts to 0%. In the period following the IPO, the IPOs earn an abnormal return of +20% or -20%, each with a probability of 50%. The IPO activity depends on the price level of the previous period's IPOs as follows: If the previous period's IPOs quote below 60, there are no IPOs. If the price of the previous period's IPOs exceeds 60 [80, 100, 120, 140], 1 [2, 4, 8, 12] firms will go public. $\overline{BHAR}_1^1$ indicates Buy-and-Hold Abnormal Return for single holding periods if each IPO is weighted equally (strategy 1). $BHAR_{1,3}^3$ indicates Buy-and-Hold Abnormal Returns for a single formation period over three sample periods if each time period is weighted equally (strategy 3).

	t_0		t_1			t_2			t_3			
path	**IPO price**	**# IPOs**	**ER t_0 - t_1**	**IPO-price**	**# IPOs**	**ER t_1 - t_2**	**IPO-price**	**# IPOs**	**ER t_2 - t_3**	**IPO-price**	$\overline{BHAR}_1^1$	$BHAR_{1,3}^3$
1	100	5	20%	120	8	20%	144	12	20%	172.8	20%	72.8%
2	100	5	20%	120	8	20%	144	12	-20%	115.2	1%	15.2%
3	100	5	20%	120	8	-20%	96	2	20%	115.2	-1%	15.2%
4	100	5	20%	120	8	-20%	96	2	-20%	76.8	-7%	-23.2%
5	100	5	-20%	80	2	20%	96	2	20%	115.2	-2%	15.2%
6	100	5	-20%	80	2	20%	96	2	-20%	76.8	-11%	-23.2%
7	100	5	-20%	80	2	-20%	64	1	20%	76.8	-15%	-23.2%
8	100	5	-20%	80	2	-20%	64	1	-20%	51.2	-20%	-48.8%
										Mean	**-4.4%**	**0%**
										Probability of negative abnormal returns	**75.0%**	**50.0%**

For reasons of simplicity we assume each IPO is held for a single period and the IPO portfolio is formed by the IPOs of a single period, respectively. The long-run performance of an IPO is thus given by the buy-and-hold abnormal return of the first period of its quotation. The $\overline{BHAR}_1^1$ of an each-IPO investment strategy is given by the mean abnormal return of the IPOs on a price path. The $BHAR_{1,3}^3$ of an IPO-portfolio investment strategy is given by the mean abnormal return of a price path in the three periods. As an example, consider price path 3: It is assumed that in t_0 the prices of the previous IPOs are 100, thus five firms will go public. In the first period (t_0-t_1) these firms' prices increase by 20% to 120. Thereon, eight firms will go public in t_1. In the second period these IPOs' prices decrease by 20% to 96. It follows that only two firms will go public in t_2. Their positive performance motivates five firms to go public in t_3. In price path 3 six IPOs outperform the market by 20% each, while eight IPOs underperform the market by 20%. Hence, the average abnormal return amounts to -1% in case of investment strategy 1. In case of investment strategy 3, the average abnormal return amounts to +7% as we observe abnormal returns of +20% in two periods and an abnormal return of -20% in one period. Summing over all price paths yields negative mean abnormal returns in case of strategy 1 and no abnormal performance in case of strategy 3.

In addition, Table 6 presents the probability of negative abnormal returns in case of strategies 1 and 3. As abnormal returns of six out of eight possible price paths are negative in case of strategy 1, the probability to observe negative abnormal returns is 75% although the ex ante expected abnormal return for each IPO equals 0%. The negative abnormal returns observed ex

post are caused by pseudo market timing. Note that this result only holds if the IPOs are held for a single period. For holding periods exceeding one time period, the probability to observe negative abnormal returns exceeds 50% regardless of pseudo market timing if IPO returns are more volatile than benchmark returns. This follows from the multiplicative combination of returns. In case of strategy 3, abnormal returns are negative in four out of eight price paths. In general, however, the probability to observe negative abnormal returns also increases above 50% for sample periods greater than one time period. Nevertheless, for strategy 1 holding period lengths equal to strategy 3 sample period lengths, the probability to observe negative abnormal returns is even greater in case of strategy 1 if managers behave as presumed by pseudo market timing.

The extent of negative abnormal returns in the each-IPO investment strategies depends on the variance of IPO returns to market returns. For instance, if abnormal returns amount to +50% or -50% with a probability of 50% each, $\overline{BHAR}_1^1$ drops to -20,5%. The probability to observe negative abnormal returns is not influenced by the variance of IPO returns, but depends on the IPO activity's sensitivity to the price level. Note that hot IPO markets, e.g. t_1 in price paths 3 and 4 and t_2 in price path 2, are followed by negative abnormal returns. This follows as hot IPO markets are defined ex post, after negative abnormal returns decreased the number of IPOs and thereby created a peak in IPO activity. By definition, IPO markets are hot if and only if they are followed by negative abnormal returns that decrease price levels and thereby IPO activity. This constitutes the long-run underperformance of strategy 1.

3.2 Price levels and IPO activity

In order to analyse the ability of pseudo market timing to explain the performance difference of IPO investment strategies in Germany, we first estimate the extent to which managers or owners take price levels into account when deciding to go public. We use a multivariate regression model where the number of IPOs (*NoIPOs*) per month is the dependent variable. This requires a definition of the price level that influences a company's decision to go public. We assume that managers or owners of companies consider the price level of the stock market in general. The higher the price level, the more optimistically investors assess investment opportunities of companies raising their willingness to provide funds. We apply the CDAX as a proxy for the price level of the German stock market. The CDAX is set to 100 in January 1985. Furthermore, we assume that managers or owners will consider the performance of recent IPOs which indicates whether investors are willing to provide funds for companies going public. We presume that managers or owners consider the performance of IPOs dating back a maximum of three years. Starting with a level equal to 100 in January 1985, we compute a monthly equally weighted performance index consisting of companies whose IPOs date back a maximum of three years. A potential bias due to non-stationarity of the CDAX and the IPO index is mitigated by a time variable in the regression model. The time variable starts with one in the first calendar month and increases by one each following month.

The multivariate regression model I can be described as follows:

$$NoIPOs_t^I = \alpha_0 + \alpha_1 \cdot Time + \alpha_2 \cdot IPOx_t + \alpha_3 \cdot CDAX_t + \varepsilon \quad . \tag{4}$$

Since it takes several months to prepare a going public, it can be assumed that managers actually decide to go public up to six months before the first trading day. To capture this time lag, we model the number of IPOs depending on lagged price levels, too, by including the levels of the CDAX and the IPO index three and six months prior to calendar month t.

The multivariate regression model II can be stated as follows:

$$\begin{aligned} NoIPOs_t^{II} = {} & \alpha_0 + \alpha_1 \cdot Time + \alpha_2 \cdot IPOx_t + \alpha_3 \cdot IPOx_{t-3} + \alpha_4 \cdot IPOx_{t-6} \\ & + \alpha_5 \cdot CDAX_t + \alpha_6 \cdot CDAX_{t-3} + \alpha_7 \cdot CDAX_{t-6} + \varepsilon \quad . \end{aligned} \tag{5}$$

We separately estimate the regression models I and II for the time period 1985 to 2002 as well as for the two sub periods 1985 to 1995 and 1996 to 2002. Table 7 shows the results of an Ordinary Least-Squares (OLS) regression estimation of models I and II.

Looking at the results for the entire period 1985 to 2002, the coefficients for the IPO index and the CDAX are significantly positive in case of regression model I. This is consistent with the assumption of pseudo market timing: the higher the price level, the more firms go public. In regression model II the actual and lagged coefficients of the IPO index are significant, while those of the CDAX are not. This implies that managers rather look at price levels of recent IPOs than of the overall stock market when deciding to go public. The negative coefficients for the time variable in both regressions indicate that IPO activity would have decreased with constant IPO and CDAX levels. All in all, the explanatory power of regression model II is higher than that of regression model I which supports our view that the actual decision to go public is taken months before the first listing.

The separate analysis of the two sub periods reveals that the factors influencing the decision to go public has changed since 1995. In the first sub period, the coefficients for both the IPO index and the CDAX in regression model I are positive, but only the CDAX coefficient is weakly significant. This can imply that the decision to go public between 1985 and 1995 was more correlated with the price level of the entire stock market than with recent IPOs. This conclusion is supported by the low IPO volume in this period. Regression model II reveals that actual CDAX levels and lagged IPO levels better explain the number of IPOs. The negative coefficients of IPO_t, IPO_{t-6} and $CDAX_{t-3}$ show that the relation between IPO activity and price levels is very sensitive to the time lags. In the second sub period, the IPO index coefficient is positive and statistically significant while the CDAX coefficient is negative and non-significant. With the increasing IPO activity since 1996 concentrating on a few industries like telecommunication and media only, managers put more weight on the performance of recent IPOs than on the entire stock market. The coefficient for the time variable is negative in the first period 1985 to 1995 and positive in the second sub period. With constant IPO

index and CDAX levels IPO activity would have decreased between 1985 and 1995 and increased thereafter. This might indicate a change in the German stock market culture and in the attitude of managers to issuing equity. The adjusted R^2 of regression model II is significantly higher for the second period (52.0%) than for the first one (11.6%). Among other factors, this is a result of the low IPO activity between 1985 and 1995. While approximately 5.6 companies went public per month between 1996 and 2002, there were only 1.5 IPOs per month in the first sub period.

Table 7: OLS regression of IPO activity on an IPO index and the CDAX

Ordinary Least-Squares regression of models I and II. The dependent variable in all regressions is the number of IPOs. Independent variables are a time variable, an equally weighted performance index of firms going public up to 36 months prior to t and the CDAX. Regression model II includes three months and six months lags for the IPO index and the CDAX to capture the time to prepare a going public.

	Intercept	Time	IPO_t	IPO_{t-3}	IPO_{t-6}	$CDAX_t$	$CDAX_{t-3}$	$CDAX_{t-6}$	N	R^2	adj. R^2
1985-2002											
$NoIPOs_t^I$	-2.560	-0.018	0.021			0.008			210	0.547	0.540
p-value	*0.000*	*0.032*	*0.000*			*0.070*					
$NoIPOs_t^{II}$	-2.379	-0.021	0.016	0.020	-0.020	0.000	0.009	0.004	210	0.605	0.592
p-value	*0.000*	*0.012*	*0.003*	*0.003*	*0.000*	*0.963*	*0.373*	*0.637*			
1985-1995											
$NoIPOs_t^I$	-1.616	-0.026	0.011			0.015			126	0.127	0.106
p-value	*0.086*	*0.000*	*0.110*			*0.077*					
$NoIPOs_t^{II}$	-1.562	-0.025	-0.013	0.058	-0.035	0.031	-0.039	0.024	126	0.166	0.116
p-value	*0.146*	*0.001*	*0.488*	*0.029*	*0.058*	*0.060*	*0.088*	*0.137*			
1996-2002											
$NoIPOs_t^I$	2.333	0.001	0.065			-0.042			84	0.493	0.471
p-value	*0.549*	*0.981*	*0.000*			*0.255*					
$NoIPOs_t^{II}$	3.481	0.036	0.043	0.044	-0.020	-0.034	0.021	-0.046	84	0.567	0.520
p-value	*0.455*	*0.481*	*0.018*	*0.045*	*0.285*	*0.417*	*0.655*	*0.345*			

In addition, we estimate the relation between the number of IPOs and the price levels using the ewDAFOX as a measure of stock market levels. Using an equally weighted market index implies that managers weight each listed firm equally when evaluating the market price level. Table 8 summarises the estimations for the regression models I and II using the ewDAFOX (DFX in the table). For the entire sample period, the values and significance levels of coefficients differ only slightly from those in estimations using the CDAX as a measure of stock market levels. In contrast to the estimations in Table 7, the stock market proxy DFX_t is not significant in model I and Time is not significant in both models. For the sub sample period 1985 to 1995, Table 8 shows that the coefficients of all explanatory variables are non-significant which yields a low explanatory power of 8.3% in case of model I. The estimations for the sub period 1996 to 2002 using the ewDAFOX are similar to those using the CDAX.

Table 8: OLS regression of IPO activity on an IPO index and the ewDAFOX

Ordinary Least-Squares regression of models I and II. The dependent variable in all regressions is the number of IPOs. Independent variables are a time variable, an equally weighted performance index of firms going public up to 36 months prior to t and the ewDAFOX (DFX). Regression model II includes three months and six months lags for the IPO index and the ewDAFOX to capture the time to prepare a going public.

	Intercept	Time	IPO_t	IPO_{t-3}	IPO_{t-6}	DFX_t	DFX_{t-3}	DFX_{t-6}	N	R^2	adj. R^2
1985-2002											
$NoIPOs_t^I$	-2.877	-0.009	0.025			0.003			210	0.540	0.533
p-value	*0.001*	*0.455*	*0.000*			*0.737*					
$NoIPOs_t^{II}$	-3.191	-0.014	0.018	0.022	-0.017	-0.007	0.013	0.001	210	0.592	0.578
p-value	*0.000*	*0.324*	*0.000*	*0.000*	*0.000*	*0.558*	*0.391*	*0.905*			
1985-1995											
$NoIPOs_t^I$	-0.674	-0.020	0.019			0.001			126	0.105	0.083
p-value	*0.397*	*0.082*	*0.318*			*0.974*					
$NoIPOs_t^{II}$	-0.287	-0.022	0.023	0.029	-0.042	-0.007	-0.012	0.027	126	0.133	0.082
p-value	*0.735*	*0.128*	*0.438*	*0.431*	*0.141*	*0.787*	*0.729*	*0.318*			
1996-2002											
$NoIPOs_t^I$	1.646	-0.008	0.052			-0.029			84	0.485	0.463
p-value	*0.797*	*0.811*	*0.000*			*0.604*					
$NoIPOs_t^{II}$	1.006	0.000	0.037	0.044	-0.033	-0.058	0.066	-0.029	84	0.561	0.514
p-value	*0.896*	*1.000*	*0.007*	*0.022*	*0.019*	*0.407*	*0.439*	*0.699*			

3.3 Simulating the IPO activity

We simulate the long-run performance of German IPOs using the historical relation between the number of IPOs and the price level of both the recent IPOs and the stock market. To account for the changes in this relation since 1996, we simulate the long-run performance based on the relation in the entire sample as well as on the relation in both sub samples. We run separate simulations using the CDAX and the ewDAFOX as a proxy for the stock market. The simulations are based on the regression model having the highest explanatory power in the OLS estimation for a certain setting. This is regression model II apart from sub sample 1985 to 1995 using the ewDAFOX. Since the principal methodology of simulating IPO activity is the same for all settings, we describe the simulation based on the historical data for the total sample of 18 years (1985 to 2002) using the CDAX as a proxy for the stock market in the following.

First, we generate a market index for a sample path of 216 months. The monthly returns of this market index are drawn from a normal distribution with mean and standard deviation equivalent to the historical parameters of the CDAX. The monthly mean return on the CDAX equals 0.69%, the standard deviation 6.15% in the entire sample period. The market index

starts with 100 in each sample path. In order to construct an IPO index, we first estimate the relation between monthly returns of the actual strategy 3 IPO portfolio and monthly CDAX returns using an OLS regression model. This yields a slope coefficient of 0.90 and a standard error of 5.35%. The unadjusted return of the IPO index is generated by multiplying the simulated market return with the slope coefficient and adding an error term that is drawn from a normal distribution with zero mean and a standard deviation of 5.35%. As the slope coefficient is below one, the IPO portfolio yields systematically lower returns than the market. In order to analyse the sole effect of pseudo market timing on the performance of IPO investment strategies in Germany, we adjust each IPO index return so that the expected return of the IPO portfolio equals the expected return of the market, which is 0.69% in the setting described here. The unadjusted expected IPO returns equals 0.69%*0.90=0.62%. Thus, we add 0.07% to the IPO return in each month. In general, the adjustment term is derived by subtracting the product of the slope coefficient and the expected market return from the expected market return. The IPO index starts with 100 in each sample path.

Finally, the number of IPOs per month in a simulated market is estimated by the regression models I and II, respectively. We simulate the IPO activity in 50,000 capital markets in each setting. Table 9 summarises the parameters for the simulation of the market index and the IPO index in all settings.

Table 9: Parameters for simulating IPO activity

Slope coefficient and standard deviation of residuals are derived from an OLS regression with the monthly return of the historical strategy 3 IPO portfolio as the dependent variable and market return as the independent variable. Mean return and standard deviation of the monthly market returns are calculated from the historical data. The adjustment term is derived by subtracting the slope coefficient times the expected market return from the expected market return.

Benchmark	Slope coefficient	*P-value of slope coefficient*	Standard deviation of residuals	Mean monthly return of index	Standard deviation of index return	Adjustment term
CDAX						
1985 - 2002	0.90	*0.000*	5.35%	0.69%	6.15%	0.07%
1985 - 1995	0.70	*0.000*	2.66%	0.86%	5.65%	0.26%
1996 - 2002	1.14	*0.000*	8.47%	0.31%	7.09%	-0.04%
ewDAFOX						
1985 - 2002	1.23	*0.000*	5.80%	0.66%	4.09%	-0.15%
1985 - 1995	0.72	*0.000*	1.65%	0.86%	4.34%	0.24%
1996 - 2002	1.85	*0.000*	9.50%	0.28%	3.77%	-0.24%

3.4 Investment strategy performance in simulated markets

3.4.1 Each-IPO investment strategies

Knowing the number of IPOs in each month of a simulated sample period we calculate the buy-and-hold abnormal return of each IPO in the simulated market according to expression (1). We assume that all IPOs realise the same return in each calendar months, which is the return of the IPO portfolio. This implies a perfectly positive correlation among IPO returns in each calendar month. Based on the individual IPO's buy-and-hold abnormal performance, we compute the mean buy-and-hold abnormal return of IPOs according to expression (2). As our simulations yield the number of IPOs per month but not the market value of each IPO, we assume equal market values of all IPOs. Incorporating market values in the simulations properly requires an analysis as to whether the market values of IPOs are endogeneous to price levels, IPO activity or other variables. These questions are left to future research.

Note that by construction, the expected value of the IPO index equals the expected value of the market index irrespective of the length of the sample period. Thus, any abnormal performance of investment strategy 1 cannot be traced back to a misspecification of the benchmark portfolio, but to pseudo market timing. Table 10 presents mean BHARs of IPOs in the 50000 simulated capital markets compared to the CDAX and the ewDAFOX, respectively.

Table 10: Average performance of strategy 1 in simulated capital markets

Mean is calculated as the average of the mean BHARs of the 50,000 simulated capital markets where the mean BHAR in each simulation is calculated as the average of the BHARs of the IPOs in this simulated market according to expression (2). Std. deviation denotes the standard deviation of BHARs. P-values are based on skewness adjusted t-statistics.

Benchmark		**CDAX**		**ewDAFOX**	
Holding period		**36**	**60**	**36**	**60**
1985-2002	**Mean**	-3.68%	-6.00%	-8.37%	-13.60%
	Std. deviation	14.57%	23.76%	15.78%	25.74%
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001
1985-1995	**Mean**	2.00%	3.16%	0.38%	0.61%
	Std. deviation	11.00%	18.16%	7.31%	12.59%
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001
1996-2002	**Mean**	-8.54%	-10.71%	-10.64%	-13.15%
	Std. deviation	30.51%	43.97%	32.18%	46.05%
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001

In simulations based on the sample period 1985 to 2002, IPOs significantly underperform the respective market index for holding periods of 36 and 60 months. This partly resembles the

empirical findings for strategy 1 in the entire sample period. Consistent with the empirical findings, IPOs perform worse in case of 60 months holding periods. However, the simulations understate the absolute level of underperformance observed empirically by more than 25 percentage points. In case of 36 months holding periods, the simulations overstate the absolute level of underperformance slightly. In contrast to the empirical findings, the simulations show highly significant underperformance after 36 months. The simulations based on the sub sample period 1985 to 1995 yield highly significant positive mean BHARs compared to the respective market index, although most of the IPO index and market index coefficients are positive in the OLS regressions. This remarkable finding can be attributed to the slope coefficients of IPO returns to the respective market returns being well below one. Such slope coefficients imply that if the market decreases, IPOs tend to decrease to a lesser extent. This yields positive abnormal returns in bearish markets. Generally, the performance of investment strategy 1 in simulated markets is at odds with the empirical findings which can also be attributed to the low explanatory of the regression models. The performance of investment strategy 1 in the simulations based on the second sub sample period are similar to those of the entire sample period. Simulations yield highly significant underperformance in case of both holding periods. Again, IPOs perform worse if held for up to 60 months. These results are generally in line with the empirical findings, even though underperformance after 36 months is overstated while underperformance after 60 months is understated. Regardless of the simulated sample period, investment strategy 1 performs worse in comparison to the ewDAFOX than to the CDAX. This is consistent with our empirical findings.

The simulations show that pseudo market timing can explain part of the long-run underperformance of IPOs observed in Germany between 1985 and 2002. Depending on the benchmark portfolio and the holding period, between 16% and 75% of the underperformance of investment strategy 1 can be attributed to pseudo market timing. Dividing the entire sample period into sub sample periods reveals that pseudo market timing was predominantly a phenomenon of firms going public between 1996 and 2002 in Germany. We find little evidence that managers acted according to pseudo market timing between 1985 and 1995. This is a consequence of the weak relation between IPO activity and price levels in this period.

3.4.2 IPO-portfolio investment strategies

For each simulated capital market, we calculate the performance of an IPO-portfolio investment strategy according to expression (3). Again, we solely analyse the performance of strategy 3 in the simulated capital markets as we do not have information on IPO market values. From the assumption that each IPO earns the return of the simulated IPO index in a particular calendar month it follows that the length of the formation period does not affect results. Since the formation period only alters the number of IPOs considered in the portfolio in a calendar month, it is irrelevant in an analysis of portfolio performance if each IPO earns exactly the same return per calendar month. Thus, Table 11 presents the mean BHARs of

investment strategy 3 in the 50000 simulated capital markets irrespective of the formation period.

Table 11: Average performance of strategy 3 in simulated capital markets

Mean is calculated as the average BHAR of IPO-portfolio investment strategy 3 in each simulated capital market. The BHAR in each simulated market is calculated according to expression (3). Standard deviation denotes the standard deviation of the 50,000 BHARs. Std. deviation denotes the standard deviation of BHARs. P-values are based on skewness-adjusted t-statistics.

Benchmark		**CDAX**	**ewDAFOX**
1985-2002	**Mean**	-3.56%	-1.94%
	Std. deviation	526.94%	548.52%
	p-value	0.1358	0.4369
1985-1995	**Mean**	-0.22%	-0.22%
	Std. deviation	129.05%	80.07%
	p-value	0.7071	0.5370
1996-2002	**Mean**	-0.72%	-1.03%
	Std. deviation	136.47%	153.97%
	p-value	0.2407	0.1433

By construction, the mean BHAR of investment strategy 3 should equal zero. Indeed, we find non-significant average BHARs close to zero in each sample period. The slight deviations from zero are caused by chance as the multiplicative combination of the return series causes very high standard deviations. Extreme outliers are not even fully averaged out after 50,000 simulations. Overall, the performance of IPO investment strategies in simulated markets is in line with the performance observed empirically except for the sub period 1985 to 1995.

4 Conclusion

Based on a large sample of IPOs in Germany between 1985 and 2002, we analyse the performance of simple investment strategies in IPOs. In particular, we compare the performance of each-IPO investment strategies and IPO-portfolio investment strategies. Weighting each IPO equally in an each-IPO investment strategy yields non-significant underperformance if each IPO is held for three years. However, for a holding period of 5 years this strategy highly significantly underperforms the CDAX and the equally weighted DAFOX. Weighting each IPO according to its market value yields highly significant underperformance even if each IPO is held for three years. In general, IPO underperformance increases with the length of the holding period. In order to control for institutional changes in the German primary markets and the evolution of a German equity culture since the mid-1990 that might affect the long-run performance of IPOs, we separately analyse the sub sample periods 1985 to 1995 and 1996 to 2002. Investing in each IPO equally yields considerably worse performance in the second sub sample than in the first. However, this result changes in case of value weighted investments. This allows interesting insights into the cross-section of IPO performance. Between 1985 and 1995 small IPOs performed disproportionately well, while those IPOs performed disproportionately poorly between 1996 and 2002. IPO-portfolio investment strategies underperform their benchmarks, too. However, based on a bootstrapping methodology we do not find significant underperformance.

The finding that each-IPO investment strategies significantly underperform benchmark investments while IPO-portfolio investment strategies do not points to the pseudo market timing phenomenon. Managers pseudo time the market if their willingness to go public increases with price levels. This behaviour causes long-run abnormal returns if monthly IPO returns are positively correlated. Simulations of IPO activity based on the historical relation between IPO activity and price levels show that pseudo market timing explains a small part of the underperformance of each-IPO investment strategies in the entire sample period. A separate analysis of the sub sample periods reveals that pseudo market timing has little explanatory power with respect to the performance of IPO investment strategies between 1985 and 1995. However, pseudo market timing partly explains the IPO investment strategy performance between 1996 and 2002. Our results indicate considerable changes in the behaviour of managers thinking about taking their firms public since the mid-1990s.

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