Bubbles and incentives: A post-mortem of the Neuer Markt in Germany

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Abstract:

This paper aims to shed light on some of the major allocative consequences of financial market bubbles. In March 1997, the Neuer Markt in Germany opened. Six years later, in June 2003, it closed forever. In the interim period lay the spectacular rise and fall of the first and most important European market for hi-tech stocks. Given investors' frenzy, the Neuer Markt was a special kind of natural experiment. For some time, financing constraints were virtually non-existent.

Our model of corporate financing shows that bubbles on financial markets will induce entrepreneurs and providers of external finance to enter the "wrong" contract. Incentive compatibility constraints designed to guarantee that corporate decision-makers behave constructively turn out to be invalid, and managers will know this before shareholders do. Thus, faulty valuation by stock markets may directly induce destructive corporate behaviour: slack, empire building, excessive risk-taking, and fraud.

At the time of the IPO, a huge amount of liquidity is injected into the companies, and a dynamic analysis of the balance sheet ratios and income statement items in the following years can teach us the ways in which this liquidity is diffused. We analyse the corresponding dynamics of total assets, tangible assets and equity, as well as the evolution of sales and profits for 204 German non-financial companies out of a total of 326 companies that had their IPO at the Neuer Markt. On the basis of consecutive annual accounts, we retrace the events using a dynamic flow of funds analysis. We assess the explanatory power of our model using non-parametric methods [Median tests, Wilcoxon-Mann-Whitney tests, Kolmogorov-Smirnov tests] and quantile regressions. Our results indicate that valuation has strong and systematic effects on incentives. Experience, as proxied by age at IPO, is shown to have a beneficial effect, whereas support by VC and PE firms does not seem to matter for the success of the enterprises considered.

Keywords: bubbles, corporate governance, quantile regressions, non-parametric statistics

JEL-Classification: G32, D82, D83, D92, C14, C21

Non Technical Summary

This paper aims to shed light on some of the major allocative consequences of financial market bubbles by studying the evolution of economic activity during the build-up and bursting of the hi-tech bubble on the Neuer Markt in Germany – the first and most important European market for hi-tech stocks – at the turn of the century. Given investors' frenzy, the Neuer Markt can be regarded as a special kind of natural experiment, in which standard fincancing constraints were virtually absent. This paper investigates the effect of improper valuation on the economic performance of a company. We present a theoretical model of coporate finance. It is shown that when the extent of overvaluation exceeds some threshold, managers will no longer have the incentive to run the company in a way that maximises its value. Instead, they choose to divert resources to their own benefit. As a result of the distorted incentives, such companies do not perform as well as companies with a market valuation that remains in line with fundamentals.

This mechanism may have been active on the Neuer Markt, contributing to its demise in June 2003. Building on a unique data set of annual accounts, consisting of balance sheets and profit and loss statements, we analyze each firm's time-profile of liquidity use from the respective IPO inflows, given the balance sheet identity and the set-up of the natural experiment. In order to test the predictions of the model we construct two indicators related to incentive problems: one based on the market-to-book values, the other on the share of the original owners after IPO.

Methodologically, we take into account the extremely uncertain environment that surrounded the IPOs of those young, innovative companies, by applying techniques designed to deal with highly dispersed data. We use non-parametric tests and quantile regressions that are robust to extreme observations which do not fulfill standard distributional assumptions.

Empirically, we find evidence for overvaluation and entrepreneurs' share to have a strong effect on subsequent economic performance, thus verifying the main prediction of the model. This result is most pronounced in second and third periods after the IPO. Also, initial valuation is more informative for predicting success stories rather than

abject failures. We also find evidence that experience as measured by companies' age has a positive effect on economic performance. To our surprise, no evidence for the effect of outside support by VC or PE firms can be found.

Nicht technische Zusammenfassung

Diese Arbeit betrachtet die allokative Wirkung von Blasen auf den Finanzmärkten, am Beispiel der Entwicklung der ökonomischen Aktivität während des Aufbaus und nach dem Platzen der Blase am Neuen Markt in Deutschland, dem ersten und wichtigsten Markt für Hochtechnologieaktien in Europa. Vor dem Hintergrund der damaligen Euphorie kann der Neue Markt als eine Art „natürliches Experiment“ betrachtet werden, bei dem die typischen finanziellen Beschränkungen praktisch aufgehoben waren. Wir untersuchen den Einfluss unsachgemäßer Bewertung auf die ökonomische Leistung von Unternehmen. In einem theoretischen Modell zeigen wir, dass die geschäftsführenden Manager nicht länger den Wert des Unternehmens maximieren, wenn die Überbewertung eines Unternehmens einen bestimmten Schwellenwert überschreitet. Die Ressourcen des Unternehmens werden vielmehr zur Erzielung privater Vorteile eingesetzt. Die betroffenen Unternehmen erzielen schlechtere wirtschaftliche Ergebnisse als jene Unternehmen, deren Bewertung fundamental gerechtfertigt ist.

Dieser Mechanismus könnte am Neuen Markt wirksam gewesen sein und zu seinem Untergang im Juni 2003 beigetragen haben. Mit Hilfe eines einzigartigen Datensatzes von Jahresabschlüssen analysieren wir unternehmenspezifische Zeitprofile der Liquiditätsverwendung, die aus den jeweiligen IPOs resultiert. Um die Vorhersagen des Modells zu testen, verwenden wir zwei Indikatoren für Anreizprobleme: einen Überbewertungsindikator, der auf den market-to-book Werten basiert und einen Indikator für besonders geringe Beteiligung der Unternehmensgründer nach dem IPO.

Dem äußert unsicheren Umfeld am Neuen Markt tragen wir durch besondere methodische Sorgfalt Rechnung: wir nutzen Techniken, die für ein hohes Maß an Dispersion in den Daten ausgelegt sind und robust sind gegenüber extremen Beobachtungen, die den gängigen Verteilungsannahmen nicht genügen. Die Hypothesenprüfung erfolgt auf der Basis nicht-parametrischer Tests und Quantilsregressionen.

Unsere Ergebnisse zeigen, dass Überbewertung und der Anteil der Alteigentümer einen großen Einfluss auf die spätere wirtschaftliche Leistung haben. Dieses empirische Resultat bestätigt die zentrale Vorhersage des Modells. Der Effekt ist in der zweiten und dritten Periode nach dem Börsengang am stärksten ausgeprägt. Korrekte Bewertung scheint für die Erklärung von herausragenden Erfolgen noch wichtiger zu sein als für die Vorhersage schlimmer Misserfolge. Weiterhin zeigt sich, dass Erfahrung, gemessen durch das Alter der Unternehmen, die wirtschaftliche Leistung positiv beeinflusst. Andererseits scheint die Unterstützung durch Venture Capital oder Private Equity Unternehmen keinen wesentlichen Einfluss zu haben.

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1 Introduction and overview

The recent implosion on financial markets has revealed the crucial importance of the relationship between valuation, corporate governance and performance. This paper aims to shed light on some of the major allocative consequences of financial market bubbles by studying the evolution of economic activity during the build-up and bursting of the hi-tech bubble at the turn of the century, using a unique company level data set as a basis. In March 1997, the *Neuer Markt* in Germany opened. Six years later, in June 2003, it closed forever. In the interim period lay the spectacular rise and fall of the first and most important European market for hi-tech stocks. Given investors' frenzy, the *Neuer Markt* was a special kind of natural experiment: For a limited time, financing constraints were virtually non-existent. Instead of focusing on possible efficiency losses due to the presence of financing constraints, we can study the harmful consequences of their *absence*.

The *Neuer Markt* was a segment of the Frankfurt stock exchange, with listing requirements designed for the stocks of young hi-tech companies, for which it was intended to perform a function similar to that of *Nasdaq* in New York: "The goal of NASDAQ's listing requirements is to facilitate capital formation for companies worldwide and, at the same time, to protect investors and prospective investors in those companies through the application of quantitative and corporate governance listing requirements, which are enforced through a transparent regulatory process."[1] Before 1997 there was no place in Germany to collect public equity for young and innovative firms and no outlet for venture capital (VC) firms, private

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equity (PE) firms or business angels that had invested in the difficult first stages of company growth. In the new segment, a number of institutional features were introduced to mitigate the typical problems of informational asymmetry for young hi-tech companies and facilitate international investment. Listed firms had to publish annual accounts using international standards (IAS or US GAAP) instead of the German HGB standard, as well as detailed quarterly reports with a flow of funds analysis, rarely encountered in German accounts of the period. Major emphasis was placed on transparency requirements: the share issue prospectus had to be very detailed and, if possible, at least three annual accounts prior to IPO had to be provided at the time of public offering, whereas otherwise in Germany only large companies were obliged to publish their accounts. Important dates had to be pre-announced and major events had to be communicated immediately (*ad hoc* announcements). All relevant information and documentation were to be provided in English.

During the first three years of its existence, the *Neuer Markt* was generally felt to be a huge success. It seemed to be evident that this market segment responded to an urgent need, and the idea was quickly copied in a number of other European countries. Figure 1 (see Appendix D) depicts the evolution of the *Neuer Markt* index, the NEMAX All Share, together with the NASDAQ Composite[2] and DAX 30[3], all of them normalised to 100 on 10 March 1997. Even compared to NASDAQ, the evolution of the *Neuer Markt* looks extreme. On 10 March 2000, the NEMAX All Share reached its ultimate high of 8,583 points, corresponding to an increase of 1,682% since the opening three years earlier. The market capitalisation of the 229 companies listed in the NEMAX All Share index on that date was €243 billion. What then followed was an equally spectacular decline, leading to the closing down of the *Neuer Markt* on 5 June 2003.

As will be shown below in more detail, the evolution of listed firms was far from homogeneous. Some were true success stories, others were abject failures. In order to understand the outcomes, we concentrate on two mechanisms. First, the New Economy bubble may have distorted incentives. We present a model of corporate governance that demonstrates how overvaluation at the time of IPO can trigger destructive behaviour by entrepreneurs, adapting a model by Holmström and Tirole (1998) to a new problem. When entrepreneur-managers

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1 Quote from NASDAQ website, http://www.nasdaq.com/about/FAQsInitial.stm, April 2009.

2 The NASDAQ Composite is a market-value-weighted index of all stocks at NASDAQ, commonly used to track technology stocks.

recognise that the value of the equity stake left for them is small, they may turn to taking legal or illegal private benefits, instead of maximising firm value in the interests of equity holders. On the other hand, given the large number of young and inexperienced companies in the segment, variables related to experience may have been important for the fate of companies.

We build on the database of a commercial provider of financial information and assemble a rich panel of annual accounts, consisting of balance sheets and profit and loss statements. This allows us to trace the evolution of firm activity over time and relate it to measures of experience and incentive problems. The set-up for observing the results of the natural experiment is provided by the balance sheet identity. By definition, the changes in liquidity are equal to the sum of the changes of all other balance sheet positions, as the sum of all assets minus the sum of all liabilities, including equity, is identically zero. This allows us to observe the accretion of liquidity at the time of IPO and its subsequent dissipation, and we can juxtapose it with the dynamics of all other assets and liabilities, to see "where the money has gone". An uninterrupted string of balance sheets then allows a simple flow of funds analysis. This leads to a profile of liquidity use for firms where the standard constraints to outside financing are weakened or absent. We analyse the evolution of equity, tangible assets and total assets, as well as of sales and earnings. Our proxy for relative overvaluation is generated from individual market-to-book ratios. This is backed up by a measure of the post-IPO share of original owners. Furthermore, we use age and support by VC and PE companies as proxies for experience, referring to theories of organisational learning (Nelson and Winter, 1974 and 1982, Silverberg, Dosi and Orsenigo, 1988) and to the contribution of outside information brokers (Franzke, 2005).

In order to perform this type of analysis, we need uninterrupted strings of annual accounts. The data are rather dispersed and, especially at the time around IPO, the company dynamics are rather violent. The traditional way of cleaning data, by eliminating extreme percentiles, would destroy the integrity of our data. With each observation eliminated, an entire company would go. Thus, instead of throwing out "outliers" that may contain the most valuable pieces of information, we use non-parametric methods which focus on order statistics and do not rely on specific distributional assumptions. We also use quantile regressions that are robust to extreme values and permit a separate analysis of the conditional distribution.

[3] The DAX 30 is an index comprising 30 biggest companies in Germany. It is the leading index for the German stock market.

Specifically, the quantile regressions allow us to reconstruct "typical" time paths for different types of companies and compare them with each other.

As a result of our empirical work, we find strong evidence for overvaluation of new equity to bias the incentives of entrepreneurs towards destructive and inefficient behaviour. Growth of total assets and equity is lower for overvalued firms, and the evolution of profits and sales is clearly worse. The quantile regressions show that this effect is concentrated in the second and third periods after IPO, and that the predictive power of indicators for overvaluation and original owners' share is highest at the upper quantiles, i.e. when it comes to explaining success. We find clear evidence for the importance of age at IPO, and no effect at all of outside support by VC or PE firms on the success of the respective firm.

The remainder of this paper is organised as follows. Section 2 summarises the theoretical model, with the details given in Appendix A. Section 3 introduces the way in which our data are organised and describes the dynamics of key outcome variables. Section 4 uses graphs to compare aggregate growth dynamics of various subgroups. Section 5 tests the differences for significance, employing a battery of non-parametric tests. We perform median tests, Wilcoxon-Mann-Whitney tests, and Kolmogorov-Smirnov tests. Section 6 evaluates entire time paths using quantile regressions. Section 7 concludes.

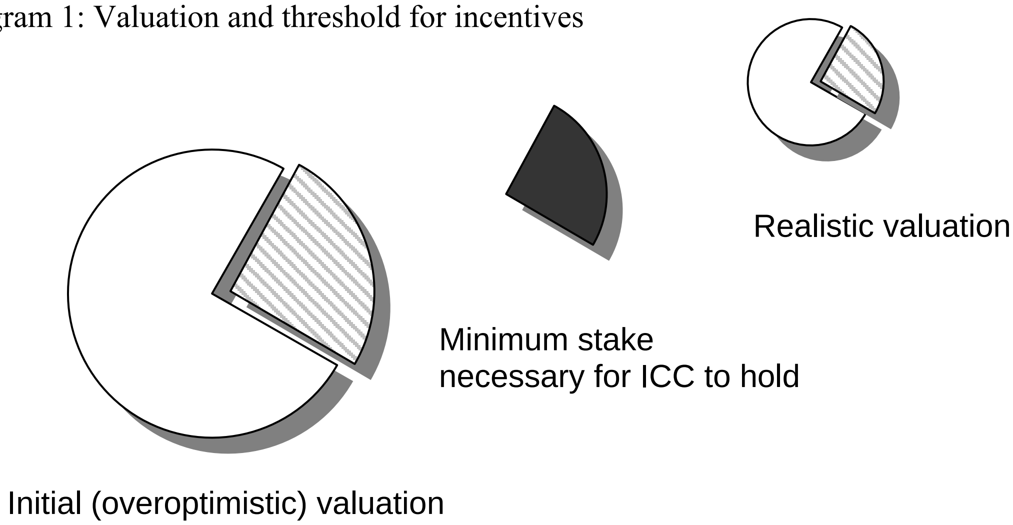
2 Exaggerated returns expectations, and management behaviour

With any sort of outside financing, investors relinquish control over their funds to a large degree to the entrepreneurs. They need to make sure that the entrepreneurs' interest in the success of the project is strong enough to keep them from misusing funds in such a way that it benefits the entrepreneurs, but not the outsiders. This is a classical topic in Corporate Finance, see Jensen and Meckling (1976), Innes (1990) and Sappington (1983). The literature has uncovered a multitude of ways in which decision-makers can use funds for private benefit. Apart from taking perks, managers can transfer funds out of the company using transfer pricing or sweetheart deals. They can embark in overly risky projects or indulge in empire-building, enhancing their social position. They may grant themselves high salaries, bonus payments, and contractual golden handshakes. And, of course, outright theft is possible, as well as enjoying a life of ease.

The stake of entrepreneurs in the project must be large enough, in absolute terms, to keep incentives aligned. A sober valuation of the company is of utmost importance in this respect. If the valuation of the company's earning prospects is overly optimistic, then ex post the entrepreneurs' share may not be worth enough, and decision makers will prefer to take the private benefits instead of maximising firm value. Therefore, an overvalued company may obtain "too much" external financing, in such a way that destructive behaviour is induced.

Diagram 1 below illustrates the basic argument under the assumption that the share of the entrepreneur is contractually fixed as a percentage of total returns, as would be the case with common stock financing, following an IPO. If the firm is overvalued at the time of granting external finance, the share of the entrepreneur may fall below the threshold stake necessary to keep incentives aligned when ultimately the perceived value of the company is corrected.

Diagram 1: Valuation and threshold for incentives



The argument is made formally in Appendix A, providing a moral hazard model for the use of outside financing.

If return expectations are exaggerated, outside investors will be unable to reap a return equal to the market interest rate in expected value. More importantly, if the incentive compatibility constraint (ICC) is violated *ex post*, the entrepreneurs turn destructive when they learn about the truth, as their true stake in the project is so small that it does not merit forgoing the private benefits. An unexpectedly high number of defaults (project failures) will occur, in addition to returns, given success, being low. Dishonest behaviour will increase the aggregate return shortfall. In our eyes, this is perhaps the greatest harm an asset bubble and its subsequent bursting can do. Von Kalckreuth (2005) treats a similar outcome as a consequence of financial distress. Johnson, Boone, Breach and Friedman (2000) have shown that measures of corporate governance, particularly the protection of minority shareholders, can explain the variation in the extent of losses during the Asian crisis.

3 Data structure and descriptive analysis

The financial accounts data for our investigation were provided by the commercial business information agency *PPA Gesellschaft für Finanzanalyse und Benchmarks* in Darmstadt, Germany. From the 1990s until 2006, this agency recorded all published annual accounts in Germany in order to create a database for benchmarking. The final data set does not contain information on all of the 326 firms that had their IPO on the *Neuer Markt*. For reasons of comparability, the agency did not collect annual accounts from the financial services industry and countries outside Germany and Austria, and we accept and follow this policy. For a company to enter our data set, we need at least the last annual account before IPO and the first one after. As a rule, the database contains annual account information according to IAS or US GAAP for consolidated accounts (at the group level), whereas the parent companies complied with their legal obligation to submit their accounts according to the German HGB rules. Where possible, we use consolidated IAS or US GAAP accounts. Especially in the years before IPO, the relevant accounting data are quite often missing. In 19 cases, where there are no noteworthy holdings of dependent companies (less than 2% of the sum of assets), we replace the missing IAS or US GAAP group accounts by HGB accounts for the parent company. We interrupt a string of accounts in cases where a company was acquired, or a merger changed the nature of the company or fraudulent, or manipulated accounts were detected later on.[4] All this leaves us with a panel of 204 companies with consecutive strings of observations. The distribution of observations over analytical time is given in Table 1 in Appendix C.

We first sketch the evolution of some key annual accounts items. Descriptive statistics for the positions “total assets”, “liquidity”, “tangible fixed assets”, “equity”, “sales” and “profits” are summarised in Table 2 and Table 3, parts 1-6, in Appendix C. The last account before IPO is denoted as $t=0$, followed by the first account after IPO ($t=1$). Regarding the first five items, we are interested in relative changes of the respective position, and we take log differences. Equity assumes negative values in a few instances, leading to missing values. The last item, profit, is a flow variable that conceptually is a change to equity. Negative values for the

[4] We did not interrupt the string after major acquisitions, as these are regarded as a specific use of investors' funds.

variable are so numerous as to render logs useless. Instead, we report levels and normalise them by equity in *t=1*, i.e. the equity just after IPO. As a rough approximation, when any subsequent secondary emission is ignored, these quantities can be regarded as returns to the investment of new outside equity holders in *t=1*. In addition to the mean, standard deviation, minimum and maximum, we consider three quantiles, the first quartile, the median and the last quartile.

Table 2 in Appendix C gives overall summary statistics for the principal variables of our analysis, encompassing the time between *t=0*, the last annual account before IPO, and *t=4*. The ensuing sequence of tables in Appendix C, 3.1 – 3.6, shows the dynamics in a breakdown according to analytical time. Note that the number of observations for the change in the log of sales as well as profits normalised by equity in *t=1* is smaller than the number of observations for the aggregates from the balance sheets. This is due to the fact that our method of adjusting the time pattern of stock (balance sheet) variables in cases where two consecutive accounts are not exactly one year apart is not applicable to flow data from profit and loss accounts. For details see Appendix B.

Table 3.1 in the Appendix depicts the evolution of total assets, demonstrating the remarkable growth typical of the firms listed on the *Neuer Markt*. In the last year prior to the IPO, the median log difference for total assets was 0.366, which corresponds to a growth rate of 44%. Immediately after the IPO, growth of total assets accelerated even more. The median log difference just before and immediately after the IPO was 1.2570, constituting a growth rate of 251%! In the following year, growth was much flatter, and during the third period the sum of total assets actually shrank.

Table 3.2 documents the development of liquidity, defined as the sum of liquid assets, short term securities and other current assets. Median log difference was 2.3535 in the year of the IPO, corresponding to a factor of 10.5. The level of liquidity is not diffused instantaneously – secondary emissions make for a relatively gradual decline.

When looking at the development of tangible fixed assets, depicted in Table 3.3, it is immediately apparent that its growth was smoother than that of total assets. The median change in the log of tangible fixed assets is 0.6065 in the year of IPO, and 0.3030 in the following year. These much lower growth rates suggest that, in many cases, funds were not primarily used for the financing of tangible fixed assets.

Table 3.4 indicates an alternative use of the liquidity from the IPO. In the median, equity increases by far more than the sum of total assets, i.e. the equity-to-assets ratio rises strongly after the IPO. Not in all cases does this mean that debts were paid back using the funds from the IPO. For the marginal financing of new activities, however, debt was completely replaced by cheap equity. This "improvement" in the debt-equity ratio was so distinct that it could have warned investors. Table 3.5 in Appendix C describes the evolution of sales. Unlike the others, this variable is not part of the balance sheet identity. However, sales growth follows the same general pattern as total assets, with a sharp acceleration in the first few years followed by a decline, and a pronounced variation over firms. Ultimately, Table 3.6 depicts annual profits over time, normalised by equity in $t=1$. Instead of increasing after IPO, profits decrease heavily from the outset. The median firm starts from a profit of around zero and makes increasingly huge losses thereafter, not to become profitable again within the time horizon considered.

Figure 2 in Appendix D shows this in chart form. We plot, period by period, the log changes of total assets, liquidity, tangible assets, equity and sales, as well as the evolution of profits, divided by equity in $t=1$. For each analytical period, we show the first decile, the first quartile, the median, the third quartile, the last decile and the mean. Counting starts with the first annual report after IPO. In those cases where time spans between two annual accounts were not exactly one year, the changes are annualised. For details, see Appendix B.

The tables and graphs readily demonstrate the wide variability of outcomes. Thinking of a "representative" *Neuer Markt* company seems to be inadequate. They also give an impression of the extent of losses. The equity schedule and the schedule for profits both show that only about one-quarter of the companies considered in each period were able to use the money in a profitable way. It is interesting to see that the distribution of normalised profits is heavily skewed: in all periods, means are much lower than medians.

4 Structuring the outcomes

The moral hazard model outlined in Section 2 and elaborated in Appendix A relates the incentives of entrepreneurs and managers to the value of their share in the company at the time of decision making. It predicts that incentives for fraudulent and wasteful behaviour are greater when the firm is overvalued at the time when external finance is provided, and that the chances of economic success are smaller when a certain threshold for overpricing is exceeded.

Another potential explanation for the dismal performance of many *Neuer Markt* companies is given by their relative inexperience, which may have led to fatal strategic mistakes. Obviously, the two explanations are not mutually exclusive.

4.1 Indicators for incentives and experience

In order to test the valuation hypothesis, we want to separate firms into a group of strongly overvalued companies and juxtapose them with companies with a more moderate valuation at the time of IPO. It is difficult to come up with an error-free indicator of overvaluation. Simply using stock market returns following IPO would create an endogeneity problem when we relate our grouping to the evolution of economic performance. In an aggregate sense, however, we can still use hindsight. We know that market expectations were exaggerated, which is something that market participants at the time could not know.[5] Following the distinction made by Baker, Ruback and Wurgler (2007) we use *ex ante* misvaluation indicators, while relying on the evolution of the entire market *ex post* as a rationale for their information content. We construct a group indicator on the basis of a variable that may single out strongly overvalued firms. The market-to-book value divides the market capitalisation of a company by the book equity from the latest balance sheet. Directly after IPO, most companies consist mainly of liquid assets. For these companies, the book value seems to be adequate. If this is also true of debts, then large differences between the market value and book values of equity are driven by investors' return fantasies. In order to eliminate the influence of capital structure, we calculate an adjusted market-to-book value from Datastream MTBV information. Our adjustment relates the market valuation of the *entire* company (debt + equity) to the book value of total assets:

$$MTBV_{adj} = \frac{\text{Liabilities}}{\text{Total assets}} + MTBV \frac{\text{Equity}}{\text{Total assets}}.$$

This quantity is measured at the date where the first annual account after IPO is available, and a dummy is created for firms with $MTBV_{adj}$ larger than the median.

[5] At the time, there was an animated discussion on this issue among central bankers, without a conclusive result. It was possible to make plausible assumptions that would justify the high valuations. There were different and competing interpretations of the world, and only *ex post* did it become clear which one was adequate. Whether or not there was an overvaluation *ex ante*, given investors' knowledge at the time, is a question difficult to answer. See Pastor and Veronesi (2006) for an investigation regarding Nasdaq share prices over the same period. For our analysis, it is sufficient that there was a massive revaluation at a later stage.

It should be pointed out that this indicator is not designed to identify overvalued firms correctly on a case-by-case basis. What is needed for statistical identification is that – to the right of the median of, say, $MTBV_{adj}$ – the number of firms with a large downward revaluation potential is higher than to the left of the median.

A second grouping relevant for our hypothesis does not need any direct measure of relative overvaluation. If, after IPO, the share of original owners in the firm is small, chances are that the incentive compatibility constraint will be violated after a major downward correction of valuation. As original owners were required to keep holding their share for an extended time, we can calculate the share of original owners in the post-IPO company by relating nominal equity at $t=0$ to nominal equity at $t=1$, which is, in essence, the share of dividends that is apportioned to shares issued before IPO. The post-IPO share is a valid indicator of incentive problems if the private benefits managers can draw from misusing the funds of the firm are proportional to total assets. Our share indicator, LO_SHARE assigns a value of one to those firms with a share of original owners below or equal to the median.

In order to separate experienced from inexperienced companies, we first sort companies by age at date of IPO, classifying those with an age exceeding the median as "old". Median age of firms at the time of IPO happens to be ten years. Second, we sort firms according to whether they had external support by a VC or PE company, using data from Franzke (2005). This information is available for a subset of 183 firms in our data set.

To facilitate exposition and comparison, grouping variables are defined in such a way that a value of 1 is expected to be associated with *weaker* economic performance. Thus, the grouping variables are as shown below.

HI_MTBV		an adjusted market to book value above median
LO_SHARE	...are indicators for...	a share of pre-IPO nominal equity in post-IPO nominal equity below median
LO_AGE		an age at IPO younger than median
NO_SUPPORT		no support by either venture capital or private equity firm

Table 4 in Appendix C shows descriptive statistics for the variables on which groupings are based, both unconditionally and conditional on group membership. Among other things, it indicates the respective cutoff-values and the remaining variation within groups.

Table 5 in Appendix C gives the correlation of the groupings. It shows that the incentive-related indicators HI_MTBV and LO_SHARE are weakly positively correlated. The overvaluation indicator and the experience indicator LO_AGE are rather unrelated. Interestingly, LO_SHARE and LO_AGE seem to be somewhat related among each other, with a correlation coefficient of 0.12. NO_SUPPORT is *negatively* correlated with the overvaluation indicator, with a correlation coefficient of -0.12.

We deliberately did not use any information on post-IPO returns for our groupings. However, it is interesting to check whether and, if so, how well the groupings are related to post-IPO performance, especially the two incentive-related indicators. We would expect to see a sizeable negative correlation with post-IPO performance. In Table 6 of Appendix C we display the correlation between the various indicators and average stock market returns between the date of IPO and the closing down of the *Neuer Markt* or the delisting, whichever came first. In this respect, the overvaluation indicator HI_MTBV has solid predictive power, with a correlation coefficients of -0.18. LO_SHARE has a weak negative relationship with later profitability, LO_AGE has no predictive power at all. If there is an effect of age on performance, it has been adequately priced by markets. NO_SUPPORT shows a weak positive correlation with later profitability (with a coefficient of 0.09). The Mann-Whitney-Wilcoxon test, a non-parametric rank sum test on whether two samples have come from the same population, confirms that the return distribution is, in fact, different in the subgroups defined by the overvaluation indicator, whereas the associations with LO_SHARE, LO_AGE and NO_SUPPORT are insignificant.

4.2 Comparing outcomes across groups of firms

Our aim is to compare the economic performance of firms over time, according to various groupings. We look, as in Section 3, at the evolution of total assets, tangible assets and equity, as well as of sales and earnings. Importantly, we take the inflow of liquidity at the time of IPO as given and try to understand the changes induced by this inflow of external equity. Within the chosen framework it is not possible to directly test theories of overinvestment (Jensen and Meckling, 1976, Stein, 1996) or underinvestment (Myers and Majluf, 1984), as here misvaluation would jointly cause the terms and size of the public offering, the investment decision and the efficiency of outcome.[6] However, by looking at profits over time we test a major implication common to the whole group of theories, namely that investment will be inefficient.

Regarding investment spending, our working hypothesis is that an overvalued company faced with a given inflow of new equity would rather shy away from investing in fixed capital, as it is difficult to generate private benefits from funds once they have been vested in capital goods that are recorded in the balance sheets and the flow of funds statements. Regarding all other outcome variables, our working hypothesis is simply that overvalued companies do worse in all respects, i.e. predicted outcomes are lower.

4.3 Two different outcome metrics

We compare the economic activity of firms over time in two different ways. The first is simply to sum up relative changes between $t=1$ and $t=4$ i.e. taking the value of $t=1$, right after IPO, as a given. This is done in order to avoid the enogeneity bias that results from the liquidity effect of overvaluation. Consider the growth of major balance sheet aggregates, such as total assets, liquidity, tangible assets, equity at the time of IPO. Between analytical periods 0 and 1, balance sheet aggregates will jump, as a response to the new funds taken up on the equity market. But when the return potential of a company is overestimated, this company will receive more funds at the IPO, and all aggregates will jump higher, compared to what would have happened under realistic valuation. And indeed, the median IPO proceedings were € 36.5 million for the overvalued group as measured by HI_MTBV, as opposed to the median IPO proceedings of € 30.6 million for the rest. What can meaningfully be compared is the sum of total changes *after* IPO, taking the post-IPO situation as a point of departure.

Our first measure thus sums up log changes in total assets, tangible assets, equity and sales. Regarding profits, which are very often negative, we use the levels and divide them by equity in $t=1$ before summing up. The sum of log changes is equivalent to an overall proportional change, whereas the sum of profits, normalised by equity in $t=1$, is a measure of total returns to capital investment over time (using a zero discount rate). The resulting distribution across firms will, of course, depend on the analytic time period for which the sum is taken.

[6] See Baker, Ruback and Wurgler (2007) for an overview and Chirinko and Schaller (2009) for a recent

Second, we look at the sum of absolute changes over time between *t=0* (just before IPO) and *t=4*, normalised by the size of the initial inflow in *t=1*. This aims at taking into account the influence of the endogeneity of the liquidity inflow by looking at overall changes in aggregates relative to the size of the initial impulse. We define the firm-specific quantity $ipoproc_i$ as the difference between statutory capital immediately after IPO and immediately before,[7] and for any balance sheet aggregate $y_{i,t}$ we consider the quantities $\Delta y_{i,t} / ipoproc_i$, and their respective sums over time. Using this second metric, we keep the information on changes between *t=0* and *t=1* in the dataset. Furthermore, the alternative metric does not lose observations on equity because of a negative sign. For analytical periods 1 to 4, in 28 instances the log difference of equity could not be computed because accounting equity was negative in one or both years.

4.4 Depicting cumulative log changes

Figures 3 and 4 in Appendix D depict the cumulative log changes of our principal variables according to analytical time and groups. We show conditional distributions for total assets, tangible assets, equity, sales and profits. Accumulation of log changes is done with *t=1* as a point of reference. Regarding profits, we sum up levels and divide by equity in *t=1*. The groups we compare are formed by HI_MTBV, LO_SHARE, LO_AGE and NO_SUPPORT. Compare this to Figure 2 depicting *unconditional* distributions of *log differences.*

Figures 3 and 4 are arranged as a matrix. The columns relate to different group indicators, the rows to different variables. In each cell, the distribution conditional on some indicator taking a value of zero (dashed lines) is held against the conditional distribution for the same indicator taking a value of one (bold lines). We show three conditional quantiles: the first quartile, the median and the third quartile.

In Figure 3, the underlying groups are formed by HI_MTBV and LO_SHARE, The upper graph in the first column, for example, differentiates cumulative log changes in total assets according to whether or not companies had a relatively high $MTBV_{adj}$ at the time immediately after IPO. It shows distributions of the relevant sums over one, two, three, and four periods. Down the first column, the distributions of cumulative changes for high

empirical paper that summarises the state of research regarding misvaluation and investment.

[7] In a few cases, when statutory capital was not available in one of the balance sheets around IPO, we had to use the difference of wider equity aggregates instead.

$MTBV_{adj}$ companies are depicted along the distributions for low $MTBV_{adj}$ firms. The second column in the first row gives the distributions for cumulative log changes in total assets, conditional on LO_SHARE.

We see strong differences between the evolution of firms that were overvalued according to HI_MTBV and the rest. For total assets, tangible assets, equity and profits, the differences are quite marked: the outcomes for relative changes are much smaller and more often negative for overvalued firms. The finding concerning tangible assets is interesting, because it is more difficult to squander funds once they are invested in tangible assets, and their valuation cannot be manipulated as easily. The conditional distributions of accumulated profits and equity for overvalued firms are shifting *downwards* over time, showing that what is accumulated is mainly losses! The same is true of total assets and tangible assets. The evolution of sales differs less clearly between the groups, with some distinction emerging only in period 4.

The second column separates those firms with a relatively large share of the original owners after IPO (dashed line) from those where the share was low. The general picture looks similar to what the overvaluation indicator yields. However, for the growth of tangible assets, the distribution of companies with a low share of original owners initially lies *above* the distribution for the other firms, although this picture is later reversed. Perhaps the pattern reflects the attempt to persuade newcomers that their funds will not be misused.

Figure 4 plots conditional distributions according to our two experience related indictors LO_AGE and NO_SUPPORT. The first column of Figure 4 compares older and younger firms. It shows that profits of older firms (dashed line) were higher in much the same way as the profits of companies that were not classified as relatively overvalued according to HI_MTBV (Figure 3). It is easier to value an older company correctly, and therefore it is a straightforward to suspect a partial identity between those two groupings. However, the correlation structure given in Table 5 in Appendix C shows that the measures of age and overvaluation are almost unrelated. The results for other variables are less clear-cut, and the evolution of sales actually was better for younger firms, as many of the very young firms were only building up operations at the time of IPO.

The second column of Figure 4 compares companies with external support by VC or PE firms with those that had no such support. We are unable to discern qualitative differences between the two groups for any of the considered quantities. This is somewhat surprising given that most of the firms are rather young, and external expertise could – or should – have had a big effect.

4.5 Depicting cumulative normalised level changes

Figures 5 and 6 repeat the analysis on the basis of absolute cumulative changes, normalised by the initial inflow of liquidity during IPO. It can be seen that the differences in period 1 (as measured by the first available balance sheet after IPO) are not very informative. This is to be expected if the first balance sheet mainly shows the inflow of liquidity, and not too many uses of funds have occurred as yet. Later periods show a tendency for between-group differences to be especially marked at the highest (75%) quantile, particularly for total assets, tangible assets and sales. This feature is not shared by the comparison of accumulated log-differences in Figures 3 and 4, and it may well be an artefact of our measurement. Given that the funds raised at IPO are a large part of total assets at period 1, our second measure is similar to a growth rate, which is bounded by -1 for negative values, but unbounded for positive numbers. Uniform shifts in the distribution of log differences could thus translate into asymmetric shifts in the distribution of normalised changes.

Apart from these two differences, the general picture resembles the one we obtained from Figures 3 and 4: The development of total assets, tangible assets, equity, sales and profits seems to be negatively related to our overvaluation indicator. The share indicator is informative as well, as is the age indicator. No meaningful differences can be found between companies with and without support from VC or PE firms.

5 Non-parametric tests

Building on the analysis in Section 4 above, we formally test whether the differences recorded graphically are significant. We carry out three different non-parametric tests:[8]

[8] See any textbook on non-parametric statistics, such as Büning and Trenkler (1994). For the test statistics to be valid, the sub-samples need to be independently drawn. In our application, sub-samples were defined by the position of company outcomes with respect to the median of some variable in the entire sample. As this median may be considered a random variable itself, the independence assumption may not be fulfilled. We therefore repeated our tests eliminating the central 20% of observations. The results did not differ substantially.

1. The **median test** is based on a count of outcomes from sample 1 larger than the median of the combined sample. Under the null of equal distributions in the two samples, this statistic follows a hypergeometric distribution;

2. The **Mann-Whitney-Wilcoxon test** combines and sorts the outcomes of the two samples and counts the sum of ranks for outcomes of sample 1. If the distribution for sample 1 is situated to the left of the distribution for sample 2, this statistic will be low. The distribution under the null is calculated using a recursion formula;

3. The **Kolmogorov-Smirnov test** computes the maximum distance between the empirical distribution functions of two samples. Again, the null distribution of this statistic is calculated under the hypothesis that the samples are drawn from the same distribution.

For our tests, we use the two alternative measurements for our activity variables: cumulative log differences and cumulative normalised changes (see Section 4). Table 7 in Appendix C summarises the results of these tests for cumulative log differences. Table 8 does the same with respect to the cumulative normalised changes.

In Table 7, owing to the endogeneity problem with the size of the IPO, the evaluation of cumulative log differences starts only with the first balance sheet after IPO. The sums are evaluated after analytical periods 2, 3 and 4. In Table 8 the test results start with *t=1* and *t=0* as the reference period. The tested outcomes correspond fully to what is shown in Figures 3 to 6 on cumulative log differences and normalised changes.

The tables list the test results using a conventional ”star” notation: One star means a level of significance at the 10% level, two stars means 5% and three stars means one per cent. All grouping indicators g_k have been defined such that distributions conditional on $g_k = 1$ are expected to be situated to the left of distribution conditional on $g_k = 0$. Symbols x, xx, and xxx indicate significant results that “point to the wrong direction”, i.e. which are not in line with our priors. These test results, taken for themselves, would be consistent with the conditional distribution for $g_k = 1$ being situated to the right of the conditional distribution for

$g_k = 0$, such as overvalued firms growing faster, accumulating more equity and tangible assets or having higher earnings per unit of new equity.[9]

The tests corroborate the results of the visual inspection in Figures 3 to 6. The first balance sheet after IPO usually dates from only a few weeks or months after the event. Therefore, the tests for *t=1* in Table 8 are not very informative. On the other hand, Table 1 shows that the number of observations levels off somewhat in period 4 and after, possibly introducing a survivor bias. We should therefore expect to see the clearest results in periods 2 and 3.

Differences between groups are especially marked for the distinction according to $MTBV_{adj}$. With the exception of sales, almost every single test is significant at the 1% level, with the detected differences pointing in a direction consistent with our expectations. Concerning sales, this is true only of the normalised cumulative differences in Table 8, not for the log differences in Table 7. Regarding the share indicator, the effects of relatively small post-IPO share of original owners (LO_SHARE = 1) are less clear-cut. In the earlier years (*t=2* and *t=3*), they seem to affect profits and changes in equity in a pronounced way whereas later on (*t=4*) the difference in total assets become strongly significant. The tests based on the second metric (cumulative normalised changes) show marked differences in the evolution of sales at every time horizon after *t=2*, which is not the case with the first metric based on log differences. Age seems to be rather important for the evolution of profits in Table 7 and for total assets and profits in Table 8, which is seen most clearly in periods 2 and 3. Again, the sign of the difference is consistent with our expectations, i.e. the evolution of total assets, equity, profits and turnover is more favourable for experienced firms. Ultimately, the grouping by external support does not lead to a meaningful result. In the first period, the tests report a number of differences, but many of them have an unexpected sign. The differences in period 2 and after are insignificant. This lack of distinction is consistent with the results obtained by Franzke (2005), who used the same grouping regarding external support on a different problem, namely the probability of insolvency.

[9] The information on direction was collected using the one-sided version of the respective test.

6 Comparing time paths using quantile regressions

In the previous section, we aggregated over time in order to calculate test statistics embracing the entire process, and we have shown that the distributions conditional on several grouping indicators differ. In this section, we will take a closer look at three aspects. First, we quantify the differences between groups. Second, it is worthwhile and interesting to study the time profile of the effect. Both for incentive-based indicators and for age, we would expect to see the largest differences relatively soon after IPO, as malevolent managers have to act quickly, and the possible advantage granted by experience will evaporate over time. Third, the effect of distorted incentives or experience does not need to be the same over the entire distribution of outcomes: Figures 3 – 6 convey the impression that overvaluation leads to a drastic reduction in the number of highly successful outcomes, rather than to a sharp increase in the number of abject failures. Given the large variability of our data, we need a method that is robust to outliers and does not need specific distributional assumptions.

While standard regressions estimate conditional expectations of the LHS variable, quantile regressions (QR) focus on *conditional quantiles*. Consider the conditional distribution $F\left(y|\mathbf{x}\right)$ of a variable *y*, given a vector of variables **x.** A median regression, for example, will quantify how the median of the conditional distribution of **y** is related to the conditioning variables **x**,

$$Q_{0.5}\left(y|\mathbf{x}\right)=\mathbf{x'}\beta_{0.5}.$$

Koenker and Bassett (1978) have shown that consistent estimators can be obtained by minimising the sum of absolute deviations. Thus, the median estimator is much more robust to outliers than are standard regressions, which focus on conditional means and minimising squared deviations. In a similar way, conditional quantile functions for the τ th quantile are defined as

$$Q_{\tau}\left(y|\mathbf{x}\right)=\mathbf{x'}\beta_{\tau},$$

and β_τ will be estimated by minimising an appropriately weighted sum of absolute deviations:[10]

$$\hat{\beta}_\tau = \arg\min_{\hat{\beta}_\tau} \sum_{i:y_i<\mathbf{x}_i'\beta_\tau}^{n} (1-\tau)(y_i - \mathbf{x}_i'\beta_\tau) + \sum_{i:y_i\geq\mathbf{x}_i'\beta_\tau}^{n} \tau(y_i - \mathbf{x}_i'\beta_\tau).$$

The equations we want to estimate are particularly simple, as the set of regressors define mutually exclusive cells:

$$z_{i,t} = \boldsymbol{\alpha}_\tau'\mathbf{d}_t + \boldsymbol{\beta}_\tau'(\mathbf{d}_t \cdot g_i) + u_{\tau i} \qquad (1)$$

for $\tau \in \{0.1, 0.25, 0.5, 0.75, 0.9\}$. Here, $z_{i,t}$ is a normalised accounting item of firm *i* in period *t*. The regressor $\mathbf{d}_t$ denotes a vector of synthetic time dummies, and g_i indicates the group. There is no requirement as to the distribution of the error term $u_{\tau i}$ apart from the quantile restriction $Q_\tau(u_{\tau i} | \mathbf{d}_t, g_i) = 0$. The vector $\boldsymbol{\alpha}_\tau$ yields a set of baseline time coefficients for the group defined by $g_i = 0$. The $\boldsymbol{\beta}_\tau$-coefficients belong to interaction terms $\mathbf{d}_t \cdot g_i$ and quantify how much the time coefficients for the group defined by $g_i = 1$ differ from the baseline time coefficients collected in $\boldsymbol{\alpha}_\tau$. These coefficients are what we are interested in. In effect, they tell us what consequence group membership had for the respective outcome in year 2, year 3 and year 4, and they do so for five different quantiles.

Tables 9 – 11 show the results for year-on-year changes in log total assets, log tangible assets, log equity and log sales, as well as normalised earnings. We group companies using partitions by HI_MTBV (Table 9), LO_SHARE (Table 10) and LO_AGE (Table 11). We will not consider external support here, because the non-parametric tests reported in the preceding section have not shown any meaningful differences along this dimension. The test statistics are calculated on the basis of block-bootstrapped standard deviations, with a block encompassing all observations from one company and a number of 100 draws (paired bootstraps).[11] The bootstrap is necessary because of heteroscedasticity and the fact that outcomes in various years are correlated for a given firm and, hence, the classic independence

[10] See Koenker (2005) for a thorough treatment, and Koenker and Hallock (2001) or Cameron and Trivedi (2005), Sect. 4.6 for introductions.

[11] See Cameron and Trivedi (2005), Sect. 11.

assumption cannot be made. Owing to the large number of regressions, the α-coefficients for the baseline group are not reported. For the first quartile, the median and the third quartile, their values are implicit in Figures 3 and 4.

We start with the results for the grouping along HI_MTBV (Table 9). With respect to growth of total assets, the shortfall of the relatively overvalued firms was most marked at the 0.9 quantile. As we use year-on-year changes in our quantile regressions, we can investigate the distribution of the overall shortfall over time. The bulk of the difference between groups is generated in the second period after IPO (around 45%), followed by the third period (around 33%). At other quantiles, the shortfall is smaller, but – except for the third quartile – also concentrated in the second period. The second analytical period is the time between the first balance sheet after IPO and the second balance sheet, i.e. it usually starts shortly after IPO. For sales, there are exceptionally strong differences at the higher quantiles, which are more evenly distributed over time, and the changes in tangible assets show a similar structure over time and quantiles. The picture is less clear for profits and the changes in equity: The differences between conditional distributions seem to be concentrated somewhat at the lower and central quantiles.

Comparing more generally the quantile regressions for total assets and the other activity variables for the groupings related to valuation and original owners' share, one may observe both *falling* profiles – i.e. with the interaction coefficients increasing in numerical size according to quantile – and *inverted U shapes*, where differences seem to be especially pronounced at the extremer quantiles. The change of total assets according to HI_MTBV is an example of the first pattern, the change of the same variable according to LO_SHARE in Table 10 follows the second pattern. Quite typically, the negative coefficients with the largest (absolute) size are situated at the highest quantile. This means that compatible incentives of entrepreneurs and outside investors are something like a necessary condition for an IPO to be a *true success.* In many cases, the profile shows a second spike at the 0.1 quantile. In these cases, the indicators are also informative on the probability of the IPO being an *abject failure.*

Quantitatively, the largest differences according to the valuation indicator are visible in analytical periods 2 and 3. After four years, the effects of valuation at IPO seem to taper off. This may either be due to the decreasing importance of initial conditions characteristic of any stable dynamic system, or else the outcome of selectivity: whatever company can still be observed after four years is already among the less ill-fated. The effect of a low share of original owners seems to be more persistent: it is still clearly visible at period 4 along a number of dimensions. This has been commented upon in the preceding section.

Age at IPO (Table 11) seems to have had a beneficial effect mainly for the higher quantiles, the sole exception being normalised profits. Organisational experience seems to be a precondition for a good idea to be turned into a success, but does not seem to make too much of a difference when it comes to abject failures.

We have found effects of distorted incentives (overvaluation and low share of original shareholders) as well as of experience. In order to make sure that these are two distinct effects, we run a set of quantile regressions where time dummies are interacted both with the $MTBV_{adj}$ indicator and the age grouping:

$$z_{i,t} = \boldsymbol{\alpha}_\tau'\mathbf{d}_t + \boldsymbol{\beta}_\tau'\left(\mathbf{d}_t \cdot g_i^{MTBV}\right) + \boldsymbol{\gamma}_\tau'\left(\mathbf{d}_t \cdot g_i^{age}\right) + u_{\tau i}, \qquad (2)$$

with g_i^{MTBV} and g_i^{age} representing indicators for a high $MTBV_{adj}$ and a low age at IPO. The results are shown in Table 12. Qualitatively, they are very similar to adding up the results from Tables 9 and 11. Regarding the changes in stock variables (total assets and tangible assets) and sales, the effects of both initial valuation and age are especially strong at the highest quantiles. As far as equity is concerned, a significantly negative effect of overvaluation can be found in *t=2* at the lower quantiles. The lack of statistically significant effects at other quantiles and in other periods may be due to the fact that in 28 cases the difference of *log* equity could not be computed because equity was negative in one or both years. Concerning profits, no clear picture emerges (e.g. the largest statistical difference between more and less overvalued firms can be found at the median), which may be a result of the different metric. For age, significantly negative effects of inexperience are present at higher quantiles in *t=2* and *t=3*.

Our measure of time in the graphs and tests is synthetic, as it relates to time since IPO. The blowing up and bursting of the bubble, however, was a process unfolding in calendar time. If the grouping indicators pick up a temporal pattern, it is conceivable that our results might be driven by a calendar component reflecting macroeconomic effects. Table 13 displays the median IPO date across grouping indicator variables for each respective indicator value. The most straightforward way of accounting for the calendar time would be to include calendar time dummies in (1) and (2) and re-estimate the equations. Unfortunately, the bootstrap procedure fails to converge for the most quantiles when using so many regressors. Hence, we use a two step procedure, first regressing each normalised accounting item $z_{i,t}$ on calendar time dummies, in order to extract the calendar component from our dependent variables. This is done by OLS. The residuals $z_{i,t}^{res}$ are accounting items with the average time component removed. We then re-estimate our quantile regressions using $z_{i,t}^{res}$ as LHS variables. The estimates allow us to check whether the group differences are driven by the business cycle.[12] The results for HI_MTBV, LO_SHARE and LO_AGE are obtained from estimating

$$z_{i,t}^{res} = \boldsymbol{\alpha}_{\tau}'\mathbf{d}_t + \boldsymbol{\beta}_{\tau}'\left(\mathbf{d}_t \cdot g_i\right) + u_{\tau i} \tag{3}$$

and can be found in tables 14, 15 and 16, respectively.

The equation

$$z_{i,t}^{res} = \boldsymbol{\alpha}_{\tau}'\mathbf{d}_t + \boldsymbol{\beta}_{\tau}'\left(\mathbf{d}_t \cdot g_i^{MTBV}\right) + \boldsymbol{\gamma}_{\tau}'\left(\mathbf{d}_t \cdot g_i^{age}\right) + u_{\tau i}, \tag{4}$$

which controls for overvaluation and age, is also re-estimated using calendar time-adjusted LHS-variables. Table 17 displays the results for (4).

All in all, the results of these estimates corroborate our previous findings. Despite the changes in the magnitude for some estimated coefficients, the overall picture remains unchanged: distorted incentives and inexperience are associated with worse economic outcomes. Again, the statistically significant effects are most pronounced at the higher quantiles.

7 Conclusions

The effects of valuation on incentives are key for understanding the economic consequences of bursting bubbles or sudden revaluations of asset prices in general. In this paper, we look at the evolution of companies after IPO in something that strongly resembles a controlled experiment: The companies are similar in terms of sector, country of origin and regulatory framework, and the time horizon is relatively short. These firms are all exposed to a liquidity shock – a positive liquidity shock, where money is very cheap for some limited time. Our

[12] Time effects might differ across quantiles. In estimation, we are unable to make this distinction.

model of corporate governance under overvaluation arrives at the prediction that the probability of success will be low when the firm is strongly overvalued, with entrepreneur-managers indulging in private benefits instead of working efficiently. We also investigate the role of experience, either of the company itself or as the effect of external support.

Analytically, we compare entire time paths in three stages: first, descriptively and visually, then using non-parametric tests to compare overall outcomes, and, ultimately, by quantile regressions to look at the effects at different quantiles and in different periods.

We find strong evidence for a systematic effect of overvaluation on the success of IPOs. The effect seems to be strongest at the high quantiles, i.e. when it comes to predicting successful outcomes. After a bubble has burst, the remaining incentives for manager-entrepreneurs are insufficient for making them fully exhaust the economic potential. The effect will not necessarily turn an outright failure into something even worse. We also find evidence for learning theories. Experience, as measured by age at IPO, also seems to be important at higher quantiles, i.e. it helps to turn good ideas into a success. Support by venture capital and private equity firms seems to be immaterial. This is perhaps due to the fact that their activity was primarily directed towards maximising the IPO proceedings and not so much to the performance of the company in the time that followed.[13]

[13] In this context, the positive correlation between the NO_SUPPORT indicator and ex-post performance of shares as shown in Table 6 may be indicative.

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Appendix A: Overvaluation, outside finance and inside managers' incentives

We start from a standard moral hazard model for the provision of outside finance; see Tirole (2006 Chapters 3-5), Holmström and Tirole (1998) or Aghion, Fally and Scarpetta (2007).

The size of the project is I, and the entrepreneur owns assets A, with $I - A \geq 0$, such that outside finance is needed. The probability p of success is p_H if the entrepreneurs put effort into the project (behave honestly) and $p_L < p_H$ if they behave dishonestly, in which case they are able to appropriate a private benefit of value B. If successful, the return is commonly believed to be R. In the event of failure, return will be zero, with no scrap value left. The time line of events is as follows:

Diagram 2: Time line

We assume that the project has a positive net expected value $pR - I$ only if the incentive scheme induces the entrepreneur to behave honestly, that is if p assumes a value of p_H and not of p_L. The entrepreneur and all other market participants are risk-neutral and the market rate of interest is normalised to zero.[14] All market participants, including the entrepreneur, are protected by limited liability: payout in the case of failure cannot take negative values.

Market participants compete for offering the financing contract to the entrepreneur, as in a competitive banking sector, an IPO or a bond market. The financing contract fixes

- the amount of outside finance, F_I, this also implies the decision on whether or not the project is financed;
- a sharing rule, or equivalently, a reward for the entrepreneur for each outcome.

[14] These assumptions are immaterial. See von Kalckreuth (2005) for a slightly more complex model where valuation is based on a stochastic discount factor.

Limited liability of the investor implies that the reward in the case of failure is zero, as the project has no residual value in the case of failure. The financing contract will thus maximise the objective function of the entrepreneur, subject to the constraint that the investors earn at least the (zero) market interest rates:

$$pR_I \geq I - A. \tag{A1}$$

This is the *participation constraint* of the outside investor. The optimal contract will fulfil this condition as equality. Thus, the project must have a positive net expected value. Any optimal contract must induce honest behaviour. With R_E being the entrepreneurs' remuneration in the case of success, their expected utility is

$$U_E = \begin{cases} p_H R_E & \text{if honest} \\ p_L R_E + B & \text{if dishonest.} \end{cases}$$

The incentive compatibility constraint is

$$p_H R_E \geq p_L R_E + B \text{ , or}$$

$$R_E \geq \frac{B}{\Delta p}\text{, with } \Delta p = p_H - p_L \text{ .} \tag{A2}$$

The stake of the entrepreneurs, i.e. their return in the case of success, must be large enough to overcome the temptation of taking the private benefit. This minimum return will be high if private benefits are elevated or if they are easy to take, i.e. if the difference Δp is small.

With (A1) holding as equality, we obtain, as a condition for the project to obtain outside financing:

$$p_H \left(R - \frac{B}{\Delta p} \right) \geq I - A \text{ .} \tag{A3}$$

The left-hand side of this expression is the maximum expected return that can be promised to outside investors without violating either of conditions (A1) or (A2). If condition (A3) is fulfilled, an amount $F_I \geq I - A$ is provided, and the return R_I is fixed in such a way that condition (A1) is fulfilled with equality.

Now assume that outside investors expect a return R that is higher than the true return, R^*, or a probability of success that is higher than warranted by the true probability p_H^*. They may then be willing to finance projects that could not have been financed if the true parameters had been known. The condition for this to be the case is simply

$$p_H\left(R-\frac{B}{\Delta p}\right)\geq I-A>p_H^*\left(R^*-\frac{B}{\Delta p^*}\right), \tag{A4}$$

with "true" values denoted by a star. One or both of the contracting parties will lose money in expectations. Possibly, projects will be financed that have a negative NPV even if managers behave honestly. However, the return shortfall also has an impact on incentives that may amplify the damage severely. Provided that managers know the true return structure or learn about it before they choose the level of effort, the incentive compatibility constraint will not be fulfilled if the entrepreneurs' stake in the firm is not large enough to warrant the effort. In this case, the financing contract triggers destructive behaviour.

Up to this point, the analysis is entirely general and encompasses any sort of external finance. Details depend on how the return shortfall is distributed among the contracting partners, i.e. on the sharing agreement. In the case of pure credit financing, a fixed payment R_I is contracted. Thus $R_E^*=R^*-R_I$, and (A4) is enough to ensure that

a) the project is financed, and

b) managers behave dishonestly when they learn about the true earning prospects.

An unexpectedly high number of defaults (project failures) will occur, in addition to returns R^* given success being low. Dishonest behaviour will increase the aggregate return shortfall, and the high rate of default will result in a substandard return for outside investors, too. Destructive behaviour can be triggered even in the opposite extreme, however, when the contract specifies a fixed payout R_E to the entrepreneur in the case of success. Owing to limited liability, the investor cannot be forced to make additional payments, and if

$$R^* < \frac{B}{\Delta p^*},$$

the return is not sufficient to keep the entrepreneur from behaving dishonestly.

In the intermediate case of standard equity finance, the returns shortfall is shared proportionately between outside investors and inside owners. With *e* denoting the share of entrepreneurs in the returns, destructive behaviour is triggered when

$$eR^* \leq \frac{B}{\Delta p^*}.$$

IPO financing can be directly mapped into our simple financing model, as we now proceed to show. Formally, IPO is a two-step procedure where, first, the number of offered shares is fixed. Then, book building finds the price of these stocks. Shorting, Greenshoe options and follow-up offerings blur the sequentiality so much that modelling the fixing of sharing rules and the size of outside financing as simultaneous is adequate.

In an IPO, inside owners sell a number of new stock S_I to investors for a price of P. They retain a number of stocks S_E. Thus, the amount of outside financing the company obtains is

$$F_I = P \cdot S_I.$$

The sharing rule for profits is

$$R_I = \frac{S_I}{S_I + S_E} R \text{ and } R_E = R - R_I = \frac{S_E}{S_I + S_E} R = eR.$$

We assume that S_E is given, as is the value of initial assets A (cash) in the company. The magnitudes P and S_I thus induce the amount of outside financing and the sharing rules. In terms of the magnitudes of the basic model, we have

$$S_I = \frac{R_I}{R - R_I} \cdot S_E, \text{ and } \qquad P = \frac{F_I}{S_I} = \frac{F_I}{S_E} \frac{R - R_I}{R_I},$$

with R the value of the return taken for granted ex ante. Thus, we can model an IPO using the notion of outside investors competing to give inside owners the optimal contract in terms of returns shares R_E and outside financing volume F_I. Marginal shareholders will need some coordination device to make sure that the incentive compatibility constraint holds, such as a leading investor or a book-building procedure.

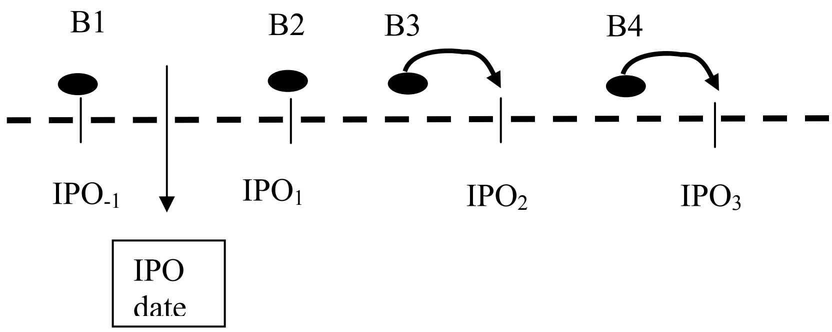
Appendix B: Dealing with time spans between annual accounts that are less than a year

For ten firms in our sample, there are accounting periods of less than a year at least once. Typically, this happens in order to switch from an accounting year that finishes in, say, March 31 to December 31. In this year, an annual account in March 31 is followed by an annual account in December 31 of the same year. Furthermore, in some cases there is an "extra" balance sheet in the months before the IPO that is followed by a return to the usual regular time pattern.

Our study wants to follow the effect of liquidity increases due to IPO over time. Therefore, the changes that occur between the publication dates of annual accounts need to be made comparable. Ideally, this comparability relates both to *changes* and to *levels*.

Our *reference point* in time is the date of the last annual account before the IPO. Our *reference period* is one year. In case of a shorter annual account, we therefore impute the *level* of the principal aggregates and the sum of assets one year ahead from the last regular account. We take a time-weighted average between the next balance sheet (that covers a period of less than one year) and the following one (that will be following more than one year after the last "regular" account). If the firm switches over to a new time pattern, this procedure needs to be repeated for each consecutive period. It also needs to be done retroactively, to make the periods *before* the IPO comparable.

Diagram 3: Making different time spans between annual accounts comparable



In the example shown in the chart, the third annual account, B3, covers a period of time which is less than one calendar year. This is taken into account by imputing the levels one year from B2 by averaging B3 and B4.[15]

At the end of a contiguous string of annual accounts, the full calendar year cannot be imputed using time averages. We omit these observations instead of imputing the missing values by extrapolation. Flow variables from profit and loss statements can not be imputed either. These variables are set to missings after a switch in the account frequency occurs. This is the case for 21 observations coming from 10 different firms.

15 In principle, this procedure could lead to errors regarding the level of IPO proceedings, a variable that is used for normalisation purposes, and the LO_SHARE, if either of the two balance sheets involved (the last before IPO and the first after IPO) is subject to imputations. This occurs in only one case, and here the difference between the imputed value and the actual value is almost nil.

Appendix C: Tables

Table 1 Neuer Markt annual accounts in the final data set by analytical time

Analytical time period	-1	0	1	2	3	4	5
Number of firms	133	204	204	191	161	136	125

Note: Analytical time is number of annual accounts since IPO.

Table 2 Descriptive statistics for the key accounting variables
Data for 204 firms listed on the *Neuer Markt*, from analytical periods *t=0* to *t=4*.

Item	Freq.	Mean	Median	Std. Dev.	Min.	Max.
Δ*log*Total Assets	692	0.3828	0.0865	0.8858	-2.1872	5.9893
Δ*log*Liquidity	691	0.4780	-0.0423	1.8259	-4.8552	10.3122
Δ*log*Tangible Assets	691	0.2865	0.1652	0.7945	-4.8536	6.7802
Δ*log*Equity	664	0.5253	0.0327	1.3506	-2.9235	7.1263
Δ*log*Sales	683	0.2925	0.2289	0.5579	-2.2998	4.5468
Profits / $Equity_1$	683	-0.1764	-0.0564	0.6254	-9.6889	2.4576

Note: The number of observations is not homogeneous for two reasons. First of all, there are missings in the pre-IPO data or negative values (for negative equity, *log* equity is undefined). Second, our method of adjusting the time pattern of stock (balance sheet) variables in cases where two consecutive accounts are not exactly one year apart is not applicable for flow data (sales and profits). For details see Appendix B.

Table 3 Key accounting items
Reference year: Year prior to the IPO, *t=0*

Table 3.1 Annual change in the log of the total assets								
t	**Freq.**	**Mean**	**Std. Dev.**	**0.25-Quantile**	**Median**	**0.75-Quantile**	**Min.**	**Max.**
0	133	0.5461	0.6709	0.1458	0.3660	0.6384	-0.3567	4.1457
1	204	1.4044	0.8259	0.8573	1.2570	1.7809	-0.0522	5.9893
2	191	0.1090	0.4550	-0.1172	0.0634	0.2525	-1.1682	2.1386
3	161	-0.1515	0.4999	-0.3810	-0.1058	0.0657	-2.1872	2.1070
4	136	-0.1326	0.3344	-0.2580	-0.1000	0.0033	-1.0611	2.1703

Table 3.2 Annual change in the log of the liquidity								
t	**Freq.**	**Mean**	**Std. Dev.**	**0.25-Quantile**	**Median**	**0.75-Quantile**	**Min.**	**Max.**
0	132	0.9200	1.5926	0.0227	0.6951	1.5317	-4.8521	6.2765
1	203	2.6396	1.6739	1.4869	2.3535	3.3127	-0.5264	10.3122
2	191	-0.5582	0.8673	-0.9900	-0.4646	-0.0799	-3.5570	2.5053
3	161	-0.5121	1.0437	-0.8222	-0.4028	-0.0062	-4.8552	2.7683
4	136	-0.1210	0.6488	-0.4776	-0.0489	0.2248	-2.0370	1.6967

Table 3.3 Annual change in the log of the tangible fixed assets								
t	**Freq.**	**Mean**	**Std. Dev.**	**0.25-Quantile**	**Median**	**0.75-Quantile**	**Min.**	**Max.**
0	133	0.4843	0.6483	0.0828	0.3410	0.7460	-0.9449	4.4321
1	203	0.7990	0.8530	0.3275	0.6065	1.0524	-0.4999	6.7802
2	191	0.3958	0.6562	0.0590	0.3030	0.6587	-3.5559	4.2845
3	161	-0.0645	0.6595	-0.2339	-0.0736	0.1665	-4.8536	2.8869
4	136	-0.2164	0.4498	-0.4005	-0.1688	-0.0184	-2.2168	1.8332

Table 3.4 Annual change in the log of equity								
t	**Freq.**	**Mean**	**Std. Dev.**	**0.25-Quantile**	**Median**	**0.75-Quantile**	**Min.**	**Max.**
0	111	0.8450	1.0097	0.1187	0.5140	1.2979	-0.4526	4.3918
1	186	2.3267	1.0613	1.5978	2.1477	2.7435	0.3125	7.1263
2	191	-0.0594	0.5810	-0.2186	-0.0300	0.1145	-2.3703	2.2969
3	157	-0.2701	0.6382	-0.5020	-0.1646	0.0183	-2.9235	2.3234
4	130	-0.2325	0.4860	-0.3558	-0.0693	0.0410	-2.0855	0.6334

Table 3.5 Annual change in the log of sales								
t	**Freq.**	**Mean**	**Std. Dev.**	**0.25-Quantile**	**Median**	**0.75-Quantile**	**Min.**	**Max.**
0	128	0.3989	0.5252	0.1423	0.3270	0.5496	-1.9819	3.0992
1	203	0.6242	0.6027	0.2289	0.4605	0.8215	-0.2661	4.5468
2	188	0.3797	0.4229	0.1220	0.3346	0.5450	-0.6214	2.1667
3	159	0.0584	0.5224	-0.1443	0.0823	0.3159	-2.2998	2.5690
4	133	-0.0575	0.3204	-0.2098	0.0039	0.1147	-1.3986	0.8983

Table 3.6 Annual profits normalised by equity in *t=1*								
t	**Freq.**	**Mean**	**Std. Dev.**	**0.25-Quantile**	**Median**	**0.75-Quantile**	**Min.**	**Max.**
0	204	0.0023	0.0636	-0.0228	0.0115	0.0339	-0.3091	0.2026
1	203	-0.0486	0.2060	-0.0900	0.0035	0.0531	-1.3552	0.5175
2	188	-0.2054	0.6405	-0.2943	-0.0837	0.0462	-7.6941	0.5688
3	159	-0.3070	0.8873	-0.3511	-0.1768	0.0014	-9.6889	1.2009
4	133	-0.1741	0.6208	-0.2380	-0.0485	0.0356	-4.4676	2.4576

Table 4 Descriptive statistics for variables underlying group membership

Variable		Freq.	Mean	Median	Std Dev.	Min.	Max.
Adjusted market to book value at IPO	HI_MTBV = 0	101	2.60	2.85	0.91	0.34	4.00
	HI_MTBV = 1	100	10.01	6.06	16.99	4.07	157.48
	Both groups	201	6.26	3.92	12.51	0.34	157.48
Share in issued capital	LO_SHARE = 0	102	0.54	0.61	0.23	0.16	0.87
	LO_SHARE = 1	102	0.05	0.04	0.04	0	0.16
	Both groups	204	0.30	0.16	0.30	0	0.87
Age at IPO	LO_AGE = 0	115	19.14	17	10.43	11	91
	LO_AGE = 1	89	5.78	6	2.83	1	10
	Both groups	204	11.75	10	9.85	1	91
External support	NO_SUPPORT = 0	82	The information on VC or PE support is taken from Franzke (2005). A number of 82 companies had external support, the remaining 101 did not.				
	NO_SUPPORT = 1	101					
	Both groups	183					

Notes: The market-to-book value is missing for three companies.

Table 5 Correlation across grouping indicator variables

Data for 201 firms listed on the Neuer Markt

	HI_MTBV	LO_SHARE	LO_AGE	NO_SUPPORT
HI_MTBV	1.0000			
LO_SHARE	0.0647	1.0000		
LO_AGE	0.0157	0.1159	1.0000	
NO_SUPPORT	-0.1169	-0.0135	-0.0383	1.0000

Table 6 Grouping indicator variables and ex post returns

	Correlation coefficients	Mann-Whitney-Wilcoxon test (p-values)	Observations
HI_MTBV	-0.1834	0.0028	198
LO_SHARE	-0.0800	0.5078	199
LO_AGE	0.0011	0.3258	199
NO_SUPPORT	0.0896	0.3188	181

Note: The Mann-Whitney-Wilcoxon test is a non-parametric test on whether two independent drawings are taken from the same distribution. The table gives the p-values for the two-sided version of the test. See Section 5 for more details on the test.

Table 7 Non-parametric tests (cumulative log differences)

			Indicators			
			HI_ MTBV	LO_SHARE	LO_AGE	NO_SUPPORT
t=2	Median test	Cum. change in logs of total assets	***			
		Cum. change in logs of tangible assets		x		
		Cum. change in logs of equity	***	*		
		Cum. change in logs of sales				
		Cum. profits normalised by equity in *t=1*	***	*	**	
	Wilcoxon-Mann-Whitney-Test	Cum. change in logs of total assets	***			
		Cum. change in logs of tangible assets		xx		
		Cum. change in logs of equity	***	**		
		Cum. change in logs of sales				
		Cum. profits normalised by equity in *t=1*	***	**	***	
	Kolmogorov-Smirnov test	Cum. change in logs of total assets	***			
		Cum. change in logs of tangible assets		xx		
		Cum. change in logs of equity	***	*	*	
		Cum. change in logs of sales				
		Cum. profits normalised by equity in *t=1*	***	**	***	
t=3	Median test	Cum. change in logs of total assets	***	*		
		Cum. change in logs of tangible assets	**			
		Cum. change in logs of equity	***			
		Cum. change in logs of sales				
		Cum. profits normalised by equity in *t=1*	***	*	***	
	Wilcoxon-Mann-Whitney test	Cum. change in logs of total assets	***	**		
		Cum. change in logs of tangible assets	**			
		Cum. change in logs of equity	***	**		
		Cum. change in logs of sales				
		Cum. profits normalised by equity in *t=1*	***	*	***	
	Kolmogorov-Smirnov test	Cum. change in logs of total assets	***			
		Cum. change in logs of tangible assets	**			
		Cum. change in logs of equity	***			
		Cum. change in logs of sales		*		
		Cum. profits normalised by equity in *t=1*	**		***	

Symbols *,**,*** denote significant results at the 10%, 5%, 1% level consistent with the working hypotheses. Grouping indicators g have been defined such that distributions conditional on $g = 1$ are expected to be situated to the left of distributions conditional on $g = 0$. Symbols x, xx, xxx indicate significant results that "point to the wrong direction". In these cases, test results are consistent with the conditional distribution for $g = 1$ being to the *right* of the conditional distribution for $g = 0$.

Table 7 (cont'd) Non-parametric tests (cumulative log differences)

			Indicators			
			HI_ MTBV	LO_SHARE	LO_AGE	NO_SUPPORT
t=4	Median test	Cum. change in logs of total assets	***	***		
		Cum. change in logs of tangible assets	***			
		Cum. change in logs of equity	**			
		Cum. change in logs of sales			xx	
		Cum. profits normalised by equity in *t=1*	**		**	
	Wilcoxon-Mann-Whitney test	Cum. change in logs of total assets	***	***		
		Cum. change in logs of tangible assets	***			
		Cum. change in logs of equity	***			
		Cum. change in logs of sales		*	xx	
		Cum. profits normalised by equity in *t=1*	***		***	
	Kolmogorov-Smirnov test	Cum. change in logs of total assets	***	**		
		Cum. change in logs of tangible assets	***			
		Cum. change in logs of equity	***			
		Cum. change in logs of sales			xx	
		Cum. profits normalised by equity in *t=1*	**		**	

Symbols *,**,*** denote significant results at the 10%, 5%, 1% level consistent with the working hypotheses. Grouping indicators g have been defined such that distributions conditional on g = 1 are expected to be situated to the left of distributions conditional on g = 0. Symbols x, xx, xxx indicate significant results that "point to the wrong direction". In these cases, test results are consistent with the conditional distribution for g = 1 being situated to the right of the conditional distribution for g = 0.

Table 8 Non-parametric tests (cumulative normalised variables)

			Indicators			
			HI_ MTBV	**LO_SHARE**	**LO_AGE**	**NO_SUPPORT**
t=1	**Median test**	Cum. normalised change in total assets				xxx
		Cum. normalised change in tangible assets				
		Cum. normalised change in equity			*	x
		Cum. normalised change in sales				
		Cum. normalised profits		*	*	
	Wilcoxon-Mann-Whitney test	Cum. normalised change in total assets	*			xxx
		Cum. normalised change in tangible assets				
		Cum. normalised change in equity	**	*	***	xxx
		Cum. normalised change in sales	***	*		
		Cum. normalised profits	***		***	xx
	Kolmogorov-Smirnov test	Cum. normalised change in total assets				xxx
		Cum. normalised change in tangible assets				
		Cum. normalised change in equity			***	xx
		Cum. normalised change in sales	**			
		Cum. normalised profits	**		***	x
t=2	**Median test**	Cum. normalised change in total assets	***			
		Cum. normalised change in tangible assets	**			
		Cum. normalised change in equity	***	*		
		Cum. normalised change in sales	***	**	**	
		Cum. normalised profits	***		*	
	Wilcoxon-Mann-Whitney test	Cum. normalised change in total assets	***	*		
		Cum. normalised change in tangible assets	**			
		Cum. normalised change in equity	***	*		
		Cum. normalised change in sales	***	**	*	
		Cum. normalised profits	***	**	***	
	Kolmogorov-Smirnov test	Cum. normalised change in total assets	***	*		
		Cum. normalised change in tangible assets	**			
		Cum. normalised change in equity	***	*		
		Cum. normalised change in sales	***	***		
		Cum. normalised profits	***	**	***	

Symbols *,**,*** denote significant results at the 10%, 5%, 1% level consistent with the working hypotheses. Grouping indicators g have been defined such that distributions conditional on $g = 1$ are expected to be situated to the left of distributions conditional on $g = 0$. Symbols x, xx, xxx indicate significant results that "point to the wrong direction". In these cases, test results are consistent with the conditional distribution for $g = 1$ being situated to the *right* of the conditional distribution for $g = 0$.

Table 8 (cont'd) Non-parametric tests (cumulative normalised variables)

			Indicators			
			HI_ MTBV	LO_SHARE	LO_AGE	NO_SUPPORT
t=3	**Median test**	Cum. normalised change in total assets	***	*		
		Cum. normalised change in tangible assets	**			
		Cum. normalised change in equity	***			
		Cum. normalised change in sales	***	***		
		Cum. normalised profits	**		***	
	Wilcoxon-Mann-Whitney test	Cum. normalised change in total assets	***	*	**	
		Cum. normalised change in tangible assets	***		**	
		Cum. normalised change in equity	***	*	*	
		Cum. normalised change in sales	***	***	*	
		Cum. normalised profits	***		***	
	Kolmogorov-Smirnov test	Cum. normalised change in total assets	***	*	*	
		Cum. normalised change in tangible assets	***			
		Cum. normalised change in equity	***			
		Cum. normalised change in sales	**	**		
		Cum. normalised profits	***		***	
t=4	**Median test**	Cum. normalised change in total assets	***	*		
		Cum. normalised change in tangible assets	**			
		Cum. normalised change in equity	***			
		Cum. normalised change in sales	**			
		Cum. normalised profits	*			
	Wilcoxon-Mann-Whitney test	Cum. normalised change in total assets	***	*		
		Cum. normalised change in tangible assets	***			
		Cum. normalised change in equity	***			
		Cum. normalised change in sales	***	***		
		Cum. normalised profits	**		***	
	Kolmogorov-Smirnov test	Cum. normalised change in total assets	***	*		
		Cum. normalised change in tangible assets	***			
		Cum. normalised change in equity	***			
		Cum. normalised change in sales	***	**		
		Cum. normalised profits	**		**	

Symbols *,**,*** denote significant results at the 10%, 5%, 1% level consistent with the working hypotheses. Grouping indicators g have been defined such that distributions conditional on g = 1 are expected to be situated to the left of distributions conditional on g = 0. Symbols x, xx, xxx indicate significant results that "point to the wrong direction". In these cases, test results are consistent with the conditional distribution for g = 1 being situated to the right of the conditional distribution for g = 0.

Table 9 Quantile regressions - HI_MTBV

β_τ-coefficient of the **HI_MTBV-indicator** estimated at the τ-th quantile for periods *t=2*, *t=3*, and *t=4*, see eq. (1). Baseline coefficients are not reported.

		ΔlogTotal Assets$_t$	ΔlogTangible Assets$_t$	ΔlogEquity$_t$	Profits$_t$ / Equity$_1$	ΔlogSales$_t$
t=2	$\beta_{0.1}$	-0.2733*** (0.0847)	-0.2239* (0.1246)	-0.5108*** (0.1925)	-0.2424 (0.1616)	-0.0489 (0.1374)
	$\beta_{0.25}$	-0.2554*** (0.0848)	-0.1596* (0.0942)	-0.2821** (0.1435)	-0.2262** (0.0968)	-0.1281 (0.0827)
	$\beta_{0.5}$	-0.3235*** (0.0858)	-0.2459* (0.1483)	-0.4028* (0.2113)	-0.1315*** (0.0437)	-0.1380 (0.0930)
	$\beta_{0.75}$	-0.4305** (0.1868)	-0.3787* (0.2260)	-0.0432 (0.4276)	-0.0864*** (0.0335)	-0.2915** (0.1204)
	$\beta_{0.9}$	-1.0265*** (0.3977)	-0.6902** (0.3164)	-1.8069 (0.6789)	-0.0323 (0.0392)	-0.5360 (0.3630)
t=3	$\beta_{0.1}$	-0.2302 (0.2160)	-0.4500*** (0.1583)	-0.2181 (0.3784)	0.0636 (0.2344)	-0.1953 (0.2465)
	$\beta_{0.25}$	-0.1803* (0.1004)	-0.2721** (0.1068)	-0.1708 (0.1492)	0.0354 (0.0935)	-0.2380** (0.0935)
	$\beta_{0.5}$	-0.2954*** (0.1076)	-0.3555*** (0.1332)	-0.3475 (0.2328)	-0.0744 (0.0523)	-0.1394 (0.0957)
	$\beta_{0.75}$	-0.5039*** (0.1592)	-0.6742*** (0.2058)	0.0080 (0.4133)	-0.0871** (0.0381)	-0.1797 (0.1180)
	$\beta_{0.9}$	-0.7313* (0.3938)	-0.7001** (0.3257)	-0.0317 (0.6550)	-0.0883** (0.0431)	-0.4984 (0.3324)
t=4	$\beta_{0.1}$	-0.1765 (0.1377)	-0.2283 (0.1909)	-0.1634 (0.4470)	0.2279 (0.1624)	-0.2706 (0.1838)
	$\beta_{0.25}$	-0.0466 (0.1004)	-0.2623** (0.1187)	-0.0534 (0.1780)	0.0467 (0.1109)	-0.2799*** (0.0872)
	$\beta_{0.5}$	-0.1668* (0.0861)	-0.4147*** (0.1456)	-0.1700 (0.2164)	0.0192 (0.0406)	-0.1401 (0.0869)
	$\beta_{0.75}$	-0.2825* (0.1620)	-0.5841*** (0.1784)	0.0753 (0.4139)	-0.0233 (0.0277)	-0.2177* (0.1122)
	$\beta_{0.9}$	-0.4733 (0.3807)	-0.7202** (0.3213)	0.0445 (0.6447)	0.0015 (0.0451)	-0.3904 (0.2989)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 10 Quantile regressions - LO_SHARE

β_τ-Coefficient of the **LO_SHARE-indicator** estimated at the τ-th quantile for periods *t=2*, *t=3*, and *t=4*, see eq. (1). Baseline coefficients are not reported.

		ΔlogTotal $Assets_t$	ΔlogTangible $Assets_t$	$\Delta log Equity_t$	$Profits_t$ / $Equity_1$	$\Delta log Sales_t$
t=2	**$\beta_{0.1}$**	-0.1429 (0.1236)	0.0790 (0.1581)	-0.4916* (0.2968)	-0.2080 (0.1377)	-0.1901 (0.1961)
	$\beta_{0.25}$	-0.3194*** (0.0830)	0.1319 (0.1037)	-0.3413** (0.1534)	-0.1211 (0.1055)	-0.1468* (0.0869)
	$\beta_{0.5}$	-0.2178*** (0.0751)	0.2118 (0.1321)	-0.5213*** (0.1947)	-0.1198*** (0.0342)	-0.0550 (0.1000)
	$\beta_{0.75}$	-0.2510 (0.1683)	-0.0643 (0.2418)	-0.5278 (0.4115)	-0.0075 (0.0395)	-0.0324 (0.1234)
	$\beta_{0.9}$	-0.5291 (0.4957)	-0.1658 (0.2886)	-0.3964 (0.6948)	-0.0373 (0.0272)	-0.3727 (0.3278)
t=3	**$\beta_{0.1}$**	-0.2598 (0.2427)	-0.2987 (0.2610)	-0.7887** (0.3258)	-0.0840 (0.1857)	-0.4990** (0.2435)
	$\beta_{0.25}$	-0.2396** (0.1104)	-0.0725 (0.1179)	-0.3988** (0.1994)	-0.1183 (0.0784)	-0.3218*** (0.1016)
	$\beta_{0.5}$	-0.2040** (0.0857)	-0.0230 (0.1109)	-0.4786** (0.2027)	-0.0572 (0.0525)	-0.2050** (0.1025)
	$\beta_{0.75}$	-0.3418* (0.1839)	-0.5113** (0.2294)	-0.5313 (0.4148)	-0.0059 (0.0537)	-0.1513 (0.1056)
	$\beta_{0.9}$	-0.8838* (0.4779)	-0.5615** (0.2377)	-0.5052 (0.6477)	-0.0731 (0.0468)	-0.5928* (0.3478)
t=4	**$\beta_{0.1}$**	0.0440 (0.1707)	-0.0051 (0.2319)	0.2029 (0.5353)	0.1729 (0.1943)	-0.2706 (0.2417)
	$\beta_{0.25}$	-0.2815*** (0.0963)	-0.0796 (0.1246)	-0.2123 (0.1796)	-0.0267 (0.0942)	-0.2498** (0.1016)
	$\beta_{0.5}$	-0.2129*** (0.0748)	-0.0693 (0.1239)	-0.5439*** (0.1978)	-0.0632* (0.0375)	-0.1332 (0.0846)
	$\beta_{0.75}$	-0.2851* (0.1680)	-0.4865** (0.2141)	-0.6056 (0.4071)	-0.0377 (0.0374)	-0.1151 (0.0996)
	$\beta_{0.9}$	-0.8033* (0.4351)	-0.6837*** (0.2364)	-0.5426 (0.6086)	-0.0756* (0.0450)	-0.5788* (0.3224)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 11 Quantile regressions - LO_AGE

β_τ-Coefficient of the **LO_AGE-indicator** estimated at the τ-th quantile for periods *t=2*, *t=3*, and *t=4*, see eq. (1). Baseline coefficients are not reported.

		ΔlogTotal Assets$_t$	ΔlogTangible Assets$_t$	ΔlogEquity$_t$	Profits$_t$ / Equity$_1$	ΔlogSales$_t$
t=2	$\beta_{0.1}$	-0.1963* (0.1054)	-0.1865 (0.1174)	-0.0517 (0.2873)	-0.2459 (0.1589)	-0.0973 (0.1675)
	$\beta_{0.25}$	-0.1567* (0.0858)	-0.2068** (0.0901)	-0.1010 (0.1163)	-0.2121*** (0.0805)	-0.1146 (0.1006)
	$\beta_{0.5}$	-0.0944 (0.0948)	-0.1244 (0.1359)	-0.0987 (0.2232)	-0.0749 (0.0517)	-0.1431* (0.0870)
	$\beta_{0.75}$	-0.4004** (0.1879)	-0.5232** (0.2243)	-0.1812 (0.3275)	-0.0277 (0.0287)	-0.2463** (0.1244)
	$\beta_{0.9}$	-0.9925** (0.4812)	-0.4048 (0.2822)	-0.7714 (0.6656)	-0.0165 (0.0259)	-0.4693 (0.2935)
t=3	$\beta_{0.1}$	-0.3653 (0.2343)	-0.4473* (0.2318)	-0.4572 (0.4200)	-0.4859* (0.2569)	-0.3925* (0.2256)
	$\beta_{0.25}$	-0.3032*** (0.0913)	-0.2287** (0.1123)	-0.1939 (0.1373)	-0.1828** (0.0758)	-0.2040* (0.1057)
	$\beta_{0.5}$	-0.2559** (0.1066)	-0.3355** (0.1384)	-0.2565 (0.2279)	-0.1112** (0.0432)	-0.1584* (0.0831)
	$\beta_{0.75}$	-0.5252*** (0.1902)	-0.7991*** (0.1983)	-0.1685 (0.3309)	-0.0749 (0.0515)	-0.2030** (0.0946)
	$\beta_{0.9}$	-1.1379** (0.4791)	-0.6425*** (0.2481)	-0.7744 (0.6203)	-0.0072 (0.0518)	-0.4792* (0.2782)
t=4	$\beta_{0.1}$	-0.1544 (0.1363)	-0.1575 (0.2160)	-0.5493 (0.3542)	-0.1257 (0.2060)	-0.0130 (0.1876)
	$\beta_{0.25}$	-0.2022** (0.0989)	-0.2306** (0.1028)	-0.0999 (0.1618)	-0.0537 (0.0851)	-0.0354 (0.1027)
	$\beta_{0.5}$	-0.1276 (0.0993)	-0.3668*** (0.1207)	-0.0137 (0.2178)	0.0188 (0.0479)	-0.1899** (0.0805)
	$\beta_{0.75}$	-0.4004** (0.1854)	-0.6997*** (0.1937)	-0.2039 (0.3283)	-0.0164 (0.0270)	-0.3140*** (0.0943)
	$\beta_{0.9}$	-1.1328** (0.4729)	-0.5992*** (0.2152)	-0.8340 (0.5985)	0.0103 (0.0601)	-0.5887* (0.3059)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 12 Quantile regressions - HI_MTBV and LO_AGE

β_τ-Coefficient of the **HI_MTBV-dummy** measuring relative overvaluation estimated at the τ-th quantile; **γ_τ**- Coefficient of the **LO_AGE-dummy** estimated at the τ-th quantile, see eq. (2). Baseline coefficients are not reported.

		Δ*log*Total Assets$_t$	**Δ*log*Tangible Assets$_t$**	**Δ*log*Equity$_t$**	**Profits$_t$ /Equity$_1$**	**Δ*log*Sales**
t=2	**$\beta_{0.1}$**	-0.1948** (0.0885)	-0.2438* (0.1284)	-0.4622** (0.1946)	-0.2768* (0.1541)	-0.0974 (0.1723)
	$\beta_{0.25}$	-0.2612*** (0.0920)	-0.1462 (0.0907)	-0.2821* (0.1509)	-0.1568 (0.1063)	-0.1106 (0.0984)
	$\beta_{0.5}$	-0.3214*** (0.0947)	-0.2069 (0.1341)	-0.4141* (0.2449)	-0.1362*** (0.0396)	-0.1706** (0.0848)
	$\beta_{0.75}$	-0.4119*** (0.1495)	-0.3793* (0.2084)	-0.0402 (0.4445)	-0.0957*** (0.0336)	-0.2787** (0.1178)
	$\beta_{0.9}$	-1.1788*** (0.3753)	-0.7483** (0.3583)	-0.8032 (0.6531)	-0.0231 (0.0406)	-0.3319 (0.3208)
	$\gamma_{0.1}$	-0.1436 (0.1126)	-0.1661 (0.1208)	-0.0968 (0.1677)	-0.2099 (0.1572)	-0.1235 (0.1239)
	$\gamma_{0.25}$	-0.0561 (0.1020)	-0.2290** (0.1000)	-0.0247 (0.1341)	-0.1582* (0.0910)	-0.0954 (0.0962)
	$\gamma_{0.5}$	-0.0919 (0.0930)	-0.2198* (0.1288)	-0.0133 (0.2411)	-0.0836* (0.0454)	-0.1634* (0.0969)
	$\gamma_{0.75}$	-0.3340 (0.2096)	-0.2740 (0.1892)	-0.0168 (0.4319)	-0.0617** (0.0284)	-0.1685 (0.1061)
	$\gamma_{0.9}$	-0.6968* (0.3965)	-0.6678*** (0.2547)	-0.3636 (0.7363)	-0.0043 (0.0362)	-0.1448 (0.3208)
t=3	**$\beta_{0.1}$**	-0.1837 (0.1960)	-0.3747*** (0.1301)	-0.0773 (0.3862)	0.0460 (0.2172)	-0.3391 (0.2212)
	$\beta_{0.25}$	-0.1388 (0.1084)	-0.2801*** (0.1028)	-0.1946 (0.1528)	0.0422 (0.0802)	-0.2051* (0.1197)
	$\beta_{0.5}$	-0.3081*** (0.1101)	-0.3311*** (0.1263)	-0.2879 (0.2742)	0.0075 (0.0627)	-0.1440* (0.0747)
	$\beta_{0.75}$	-0.4552*** (0.1335)	-0.6240*** (0.1856)	-0.0017 (0.4331)	-0.0989** (0.0415)	-0.1429 (0.1109)
	$\beta_{0.9}$	-0.8623** (0.3493)	-0.7196*** (0.2583)	-0.0787 (0.6562)	-0.0869* (0.0510)	-0.1863 (0.3359)
	$\gamma_{0.1}$	-0.4312** (0.1996)	-0.2814 (0.3577)	-0.4602 (0.3907)	-0.4640** (0.1962)	-0.3666 (0.2361)
	$\gamma_{0.25}$	-0.2708*** (0.1032)	-0.2371** (0.0946)	-0.2171 (0.1591)	-0.2028** (0.0839)	-0.0656 (0.1099)
	$\gamma_{0.5}$	-0.2813** (0.1243)	-0.3846*** (0.1104)	-0.1516 (0.2648)	-0.1207** (0.0513)	-0.2050** (0.0929)
	$\gamma_{0.75}$	-0.4126** (0.1933)	-0.5379*** (0.1712)	-0.0350 (0.4441)	-0.0618 (0.0402)	-0.1213 (0.0985)
	$\gamma_{0.9}$	-0.8268** (0.3926)	-0.8230*** (0.2521)	-0.3673 (0.7672)	-0.0142 (0.0441)	-0.1771 (0.3717)
t=4	**$\beta_{0.1}$**	-0.1724 (0.1305)	-0.1809 (0.2048)	0.0020 (0.3947)	0.2999 (0.2170)	-0.3129 (0.2252)
	$\beta_{0.25}$	-0.0732 (0.1056)	-0.3306*** (0.1031)	-0.1054 (0.1903)	0.0839 (0.1070)	-0.2672** (0.1040)
	$\beta_{0.5}$	-0.1692* (0.0975)	-0.3532*** (0.1355)	-0.1958 (0.2464)	0.0154 (0.0396)	-0.1881** (0.0766)
	$\beta_{0.75}$	-0.2660** (0.1301)	-0.5259*** (0.1556)	0.1026 (0.4288)	-0.0189 (0.0415)	-0.1326 (0.1006)
	$\beta_{0.9}$	-0.6120* (0.3439)	-0.7440*** (0.2506)	0.0231 (0.6606)	-0.0093 (0.0635)	-0.1950 (0.2976)
	$\gamma_{0.1}$	-0.2302* (0.1228)	-0.1240 (0.2670)	-0.6446* (0.3600)	0.1299 (0.1903)	-0.1445 (0.1462)
	$\gamma_{0.25}$	-0.1813** (0.0922)	-0.2918*** (0.1033)	-0.1047 (0.1840)	-0.0930 (0.0727)	-0.0460 (0.1075)
	$\gamma_{0.5}$	-0.0838 (0.0905)	-0.3904*** (0.1100)	0.0626 (0.2434)	0.0186 (0.0458)	-0.2386*** (0.0781)
	$\gamma_{0.75}$	-0.3006* (0.1815)	-0.4868*** (0.1482)	-0.0318 (0.4414)	-0.0029 (0.0311)	-0.2641*** (0.0918)
	$\gamma_{0.9}$	-0.7506** (0.3497)	-0.7632*** (0.2020)	-0.4857 (0.7546)	0.0130 (0.0681)	-0.2885 (0.3534)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 13 Median IPO date across grouping indicator variables

	Indicator value = 0	Indicator value = 1	Observations
HI_MTBV	14,500* (13.09.1999)	14,656* (16.02.2000)	201
LO_SHARE	14,656* (16.02.2000)	14,541* (24.10.1999)	204
LO_AGE	14,578* (30.11.1999)	14,571* (23.11.1999)	204
NO_SUPPORT	14,642* (02.02.2000)	14,528* (11.10.1999)	183

Notes: * Number of days since 01.01.1960. Corresponding calendar dates are given in parentheses.

Table 14 Quantile regressions - HI_MTBV (time effects extracted)

β_τ-coefficient of the **HI_MTBV-indicator** estimated at the τ-th quantile for periods *t=2*, *t=3*, and *t=4*, see eq. (3). Baseline coefficients are not reported.

		ΔlogTotal Assets$_t$	ΔlogTangible Assets$_t$	ΔlogEquity$_t$	Profits$_t$ / Equity$_1$	ΔlogSales$_t$
t=2	$\beta_{0.1}$	-0.1361 (0.1208)	-0.1250 (0.1076)	-0.2055 (0.1414)	-0.2546 (0.1831)	0.0215 (0.1600)
	$\beta_{0.25}$	0.1020 (0.0996)	-0.0481 (0.1083)	-0.1026 (0.1721)	-0.2288*** (0.0760)	-0.0854 (0.0676)
	$\beta_{0.5}$	-0.4201** (0.1690)	-0.1865 (0.1398)	-0.6722* (0.3587)	-0.0663 (0.0515)	-0.1594 (0.1022)
	$\beta_{0.75}$	-0.5077*** (0.1849)	-0.3517 (0.2345)	-0.2448 (0.4587)	-0.0808*** (0.0308)	-0.1854 (0.1443)
	$\beta_{0.9}$	-0.7367* (0.3947)	-0.5823** (0.2856)	-0.2604 (0.5522)	-0.0659 (0.0443)	-0.5721* (0.3252)
t=3	$\beta_{0.1}$	-0.1954 (0.1738)	-0.2847 (0.2086)	-0.0944 (0.2006)	0.0115 (0.2418)	-0.0296 (0.1530)
	$\beta_{0.25}$	-0.1631 (0.1576)	-0.2531** (0.0990)	-0.1192 (0.3506)	-0.0460 (0.0716)	-0.1462 (0.0934)
	$\beta_{0.5}$	-0.3050** (0.1311)	-0.1972 (0.1653)	-0.1830 (0.2472)	-0.0755 (0.0540)	-0.1673 (0.1191)
	$\beta_{0.75}$	-0.4202** (0.1807)	-0.5641*** (0.2066)	-0.1040 (0.4699)	-0.1062* (0.0583)	-0.2261* (0.1268)
	$\beta_{0.9}$	-0.5857 (0.3982)	-0.6801** (0.3255)	-0.0744 (0.5508)	-0.0606 (0.0564)	-0.4781 (0.3195)
t=4	$\beta_{0.1}$	-0.2645 (0.2164)	-0.4623*** (0.1711)	-0.0070 (0.5019)	0.1570 (0.1238)	-0.1757 (0.1932)
	$\beta_{0.25}$	0.0016 (0.0939)	-0.2239* (0.1239)	-0.0422 (0.1967)	0.0559 (0.1059)	-0.3004*** (0.1137)
	$\beta_{0.5}$	-0.1912* (0.1035)	-0.3115** (0.1252)	-0.1553 (0.2284)	0.0033 (0.0377)	-0.1391 (0.0910)
	$\beta_{0.75}$	-0.3008* (0.1699)	-0.5563*** (0.2053)	-0.1132 (0.4588)	-0.0756 (0.0572)	-0.1643 (0.1052)
	$\beta_{0.9}$	-0.3915 (0.3935)	-0.5718* (0.2929)	0.0251 (0.5482)	-0.0341 (0.0591)	-0.2742 (0.2970)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 15 Quantile regressions - LO_SHARE (time effects extracted)

β_τ-Coefficient of the **LO_SHARE-indicator** estimated at the τ-th quantile for periods *t=2*, *t=3*, and *t=4*, see eq. (3). Baseline coefficients are not reported.

		ΔlogTotal Assets$_t$	ΔlogTangible Assets$_t$	ΔlogEquity$_t$	Profits$_t$ / Equity$_1$	ΔlogSales$_t$
t=2	**$\beta_{0.1}$**	-0.3281*** (0.1078)	-0.0526 (0.1321)	-0.3263 (0.2293)	-0.2297* (0.1365)	-0.2507 (0.1959)
	$\beta_{0.25}$	-0.3376*** (0.1303)	0.0153 (0.1161)	-0.5071*** (0.1815)	-0.1379 (0.0989)	-0.1290 (0.0793)
	$\beta_{0.5}$	-0.5158*** (0.1448)	0.0977 (0.1522)	-1.0571*** (0.3562)	-0.0705** (0.0301)	-0.0986 (0.0961)
	$\beta_{0.75}$	-0.4126** (0.1748)	-0.2138 (0.2054)	-0.8291** (0.3766)	-0.0458 (0.0310)	-0.0909 (0.1263)
	$\beta_{0.9}$	-0.5349 (0.4553)	-0.3812 (0.3176)	-0.3680 (0.5636)	-0.0535 (0.0549)	-0.3603 (0.3602)
t=3	**$\beta_{0.1}$**	-0.3083 (0.2182)	-0.3271 (0.2653)	-0.2331 (0.2389)	-0.0738 (0.1852)	-0.2794 (0.1962)
	$\beta_{0.25}$	-0.4052** (0.1808)	-0.2035* (0.1098)	-0.7975*** (0.3026)	-0.1094 (0.0715)	-0.3486*** (0.1059)
	$\beta_{0.5}$	-0.3199*** (0.1059)	-0.1365 (0.1443)	-0.5473*** (0.1999)	-0.0287 (0.0545)	-0.2896** (0.1179)
	$\beta_{0.75}$	-0.4261** (0.1804)	-0.4789** (0.2018)	-0.8132** (0.3685)	-0.0097 (0.0536)	-0.3058*** (0.1134)
	$\beta_{0.9}$	-0.7650* (0.4572)	-0.7650** (0.3075)	-0.3019 (0.5600)	-0.0360 (0.0616)	-0.4933 (0.3155)
t=4	**$\beta_{0.1}$**	-0.0164 (0.2007)	-0.2123 (0.2194)	0.4456 (0.5352)	0.1129 (0.1463)	-0.1459 (0.2314)
	$\beta_{0.25}$	-0.1676* (0.0932)	-0.1170 (0.1251)	-0.2550 (0.2098)	0.0089 (0.1010)	-0.2248** (0.1026)
	$\beta_{0.5}$	-0.2921*** (0.0757)	-0.1502 (0.1291)	-0.5353*** (0.1832)	-0.0403 (0.0311)	-0.1713** (0.0866)
	$\beta_{0.75}$	-0.4037** (0.1709)	-0.5153** (0.2051)	-0.8128** (0.3799)	-0.0504 (0.0523)	-0.1720** (0.0777)
	$\beta_{0.9}$	-0.6412 (0.4276)	-0.7985*** (0.2391)	-0.2621 (0.5665)	-0.0081 ()	-0.4988 (0.3117)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 16 Quantile regressions - LO_AGE (time effects extracted)

β_τ-Coefficient of the **LO_AGE-indicator** estimated at the τ-th quantile for periods *t=2*, *t=3*, and *t=4*, see eq. (3). Baseline coefficients are not reported.

		ΔlogTotal Assets$_t$	ΔlogTangible Assets$_t$	ΔlogEquity$_t$	Profits$_t$ / Equity$_1$	ΔlogSales$_t$
t=2	$\beta_{0.1}$	-0.0116 (0.1411)	-0.2283* (0.1298)	-0.1102 (0.1544)	-0.2743** (0.1178)	-0.2359 (0.1439)
	$\beta_{0.25}$	0.0270 (0.0969)	-0.0443 (0.1353)	0.0578 (0.1383)	-0.2174** (0.1102)	-0.1220 (0.0869)
	$\beta_{0.5}$	-0.3886** (0.1542)	-0.1995 (0.1625)	-0.3616 (0.3700)	-0.0496 (0.0476)	-0.2257** (0.0948)
	$\beta_{0.75}$	-0.6157*** (0.1894)	-0.5500** (0.2266)	-0.2993 (0.3449)	-0.0398 (0.0335)	-0.0873 (0.1041)
	$\beta_{0.9}$	-0.9500** (0.4412)	-0.7552*** (0.2766)	-0.7235 (0.5235)	0.0038 (0.0533)	-0.6231* (0.3251)
t=3	$\beta_{0.1}$	-0.0737 (0.2119)	-0.4136* (0.2428)	0.2113 (0.2278)	-0.5088* (0.2640)	-0.2401 (0.1511)
	$\beta_{0.25}$	0.0141 (0.1737)	-0.2241* (0.1317)	0.5000 (0.4006)	-0.1908*** (0.0661)	-0.0747 (0.1068)
	$\beta_{0.5}$	-0.3086*** (0.1175)	-0.3170** (0.1576)	-0.0848 (0.2346)	-0.1033** (0.0516)	-0.1877* (0.1049)
	$\beta_{0.75}$	-0.6079*** (0.1776)	-0.6607*** (0.1787)	-0.2499 (0.3639)	-0.0663 (0.0566)	-0.2081* (0.1153)
	$\beta_{0.9}$	-0.9861** (0.4446)	-0.4904* (0.2603)	-0.6322 (0.5360)	-0.0205 (0.0683)	-0.4194 (0.3048)
t=4	$\beta_{0.1}$	-0.1253 (0.2029)	-0.2411 (0.2502)	-0.5961 (0.4635)	-0.0669 (0.1620)	-0.0023 (0.1771)
	$\beta_{0.25}$	-0.0129 (0.0886)	-0.1364 (0.1292)	-0.0207 (0.1933)	-0.0387 (0.0990)	-0.0446 (0.1345)
	$\beta_{0.5}$	-0.2039* (0.1109)	-0.2232* (0.1357)	0.0696 (0.2305)	0.0153 (0.0285)	-0.1849** (0.0923)
	$\beta_{0.75}$	-0.4809*** (0.1591)	-0.6719*** (0.1854)	-0.2477 (0.3732)	0.0212 (0.0620)	-0.2217*** (0.0851)
	$\beta_{0.9}$	-0.9947** (0.4563)	-0.5358** (0.2175)	-0.7175 (0.5219)	-0.0012 (0.0654)	-0.5069* (0.3000)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Table 17 Quantile regressions - HI_MTBV and LO_AGE (time effects extracted)
β_τ-Coefficient of the **HI_MTBV-dummy** measuring relative overvaluation estimated at the τ-th quantile; **γ_τ**- Coefficient of the **LO_AGE-dummy** estimated at the τ-th quantile, see eq. (4). Baseline coefficients are not reported.

		Δ*log*Total Assets$_t$	**Δ*log*Tangible Assets$_t$**	**Δ*log*Equity$_t$**	**Profits$_t$ /Equity$_1$**	**Δ*log*Sales**
t=2	**$\beta_{0.1}$**	-0.1001 (0.1203)	-0.0137 (0.1456)	-0.1706 (0.1645)	-0.0989 (0.1224)	0.0268 (0.1765)
	$\beta_{0.25}$	0.1092 (0.1216)	-0.0863 (0.1183)	-0.1273 (0.1698)	-0.2286** (0.1023)	-0.0544 (0.0941)
	$\beta_{0.5}$	-0.3844** (0.1788)	-0.1618 (0.1420)	-0.6711 (0.4106)	-0.1004*** (0.0346)	-0.1907** (0.0768)
	$\beta_{0.75}$	-0.4920*** (0.1665)	-0.3332* (0.1863)	-0.3016 (0.4690)	-0.0561 (0.0383)	-0.2159* (0.1270)
	$\beta_{0.9}$	-0.7431* (0.4003)	-0.6090** (0.2535)	-0.2303 (0.6262)	-0.0550 (0.0442)	-0.3629 (0.3451)
	$\gamma_{0.1}$	0.0150 (0.1202)	-0.1508 (0.1456)	-0.0994 (0.1796)	-0.2347* (0.1356)	-0.2367* (0.1435)
	$\gamma_{0.25}$	-0.0364 (0.1280)	-0.0615 (0.1527)	0.0033 (0.1702)	-0.0945 (0.1069)	-0.0994 (0.0865)
	$\gamma_{0.5}$	-0.2030 (0.1537)	-0.2222 (0.1394)	0.0003 (0.3796)	-0.0864** (0.0389)	-0.2483*** (0.0893)
	$\gamma_{0.75}$	-0.4820*** (0.1791)	-0.3682** (0.1800)	-0.1057 (0.4248)	0.0031 (0.0394)	-0.0748 (0.1227)
	$\gamma_{0.9}$	-0.7083** (0.3251)	-0.7538*** (0.2615)	-0.2718 (0.6163)	0.0039 (0.0456)	-0.3785 (0.3619)
t=3	**$\beta_{0.1}$**	-0.0900 (0.2018)	-0.3160 (0.2128)	-0.1068 (0.2516)	0.0250 (0.1642)	0.0039 (0.1798)
	$\beta_{0.25}$	-0.1753 (0.1598)	-0.2622** (0.1158)	-0.1313 (0.3084)	0.0098 (0.0654)	-0.1124 (0.1178)
	$\beta_{0.5}$	-0.2446* (0.1284)	-0.2447 (0.1559)	-0.1676 (0.2624)	-0.0577 (0.0541)	-0.2221** (0.0942)
	$\beta_{0.75}$	-0.3855** (0.1670)	-0.5510*** (0.1541)	-0.1719 (0.4624)	-0.1063* (0.0546)	-0.2261* (0.1274)
	$\beta_{0.9}$	-0.6244* (0.3756)	-0.7402*** (0.2312)	-0.0816 (0.5952)	-0.0548 (0.0640)	-0.2280 (0.3218)
	$\gamma_{0.1}$	-0.0788 (0.2088)	-0.3837* (0.2099)	0.2028 (0.2666)	-0.4976** (0.1998)	-0.2401* (0.1369)
	$\gamma_{0.25}$	0.0292 (0.1699)	-0.2477* (0.1276)	0.3687 (0.3654)	-0.2011*** (0.0763)	-0.0908 (0.0980)
	$\gamma_{0.5}$	-0.2122* (0.1096)	-0.3872*** (0.1396)	-0.0449 (0.2462)	-0.0962 (0.0623)	-0.1791* (0.0955)
	$\gamma_{0.75}$	-0.4390** (0.1925)	-0.4326*** (0.1389)	-0.0710 (0.4578)	-0.0326 (0.0537)	-0.1032 (0.1457)
	$\gamma_{0.9}$	-0.7598** (0.3158)	-0.6353*** (0.2033)	-0.2923 (0.6292)	0.0059 (0.0585)	-0.1361 (0.3252)
t=4	**$\beta_{0.1}$**	-0.1641 (0.2262)	-0.4023** (0.1855)	-0.4096 (0.4445)	0.1978 (0.1572)	-0.2121 (0.2415)
	$\beta_{0.25}$	-0.0567 (0.0913)	-0.2235* (0.1332)	-0.0985 (0.1904)	0.0639 (0.1075)	-0.2706** (0.1208)
	$\beta_{0.5}$	-0.1983** (0.0990)	-0.3235** (0.1315)	-0.1406 (0.2311)	-0.0030 (0.0433)	-0.1575** (0.0780)
	$\beta_{0.75}$	-0.2840* (0.1576)	-0.5441*** (0.1542)	-0.1787 (0.4597)	-0.0661 (0.0527)	-0.1856** (0.0944)
	$\beta_{0.9}$	-0.4758 (0.3618)	-0.6428*** (0.1883)	0.0623 (0.5853)	-0.0157 (0.0527)	-0.1147 (0.3167)
	$\gamma_{0.1}$	-0.0711 (0.1847)	-0.1244 (0.2535)	-0.5223 (0.4605)	0.0108 (0.1481)	-0.0093 (0.1642)
	$\gamma_{0.25}$	-0.0796 (0.0836)	-0.1309 (0.1191)	0.0013 (0.2028)	-0.0378 (0.0897)	0.0199 (0.1240)
	$\gamma_{0.5}$	-0.1171 (0.0996)	-0.2719** (0.1153)	0.1165 (0.2503)	0.0201 (0.0411)	-0.1962** (0.0763)
	$\gamma_{0.75}$	-0.3740** (0.1658)	-0.4758*** (0.1344)	-0.0290 (0.4599)	-0.0047 (0.0575)	-0.1885** (0.0956)
	$\gamma_{0.9}$	-0.6918** (0.3150)	-0.6826*** (0.2008)	-0.2529 (0.6190)	0.0067 (0.0642)	-0.2867 (0.3289)

Symbols *(**,***) denote significance at the 10% (5%, 1%) level. Bootstrapped standard errors are in parentheses

Appendix D: Figures

Figure 1 Evolution of NEMAX All Share, NASDAQ Composite and DAX 30 since 10.03.1997

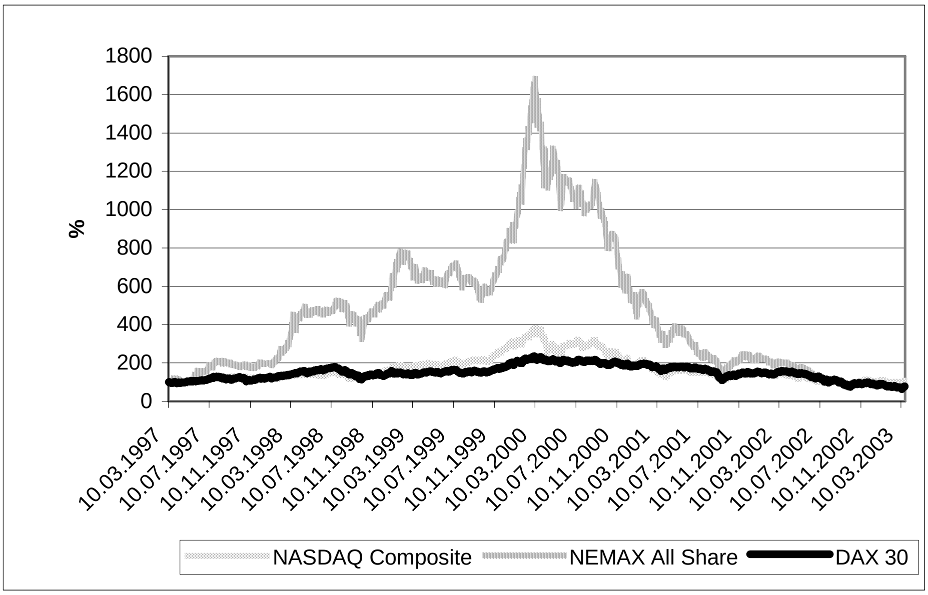


Figure 2.1 Mean and percentiles of annual changes in logs of total assets

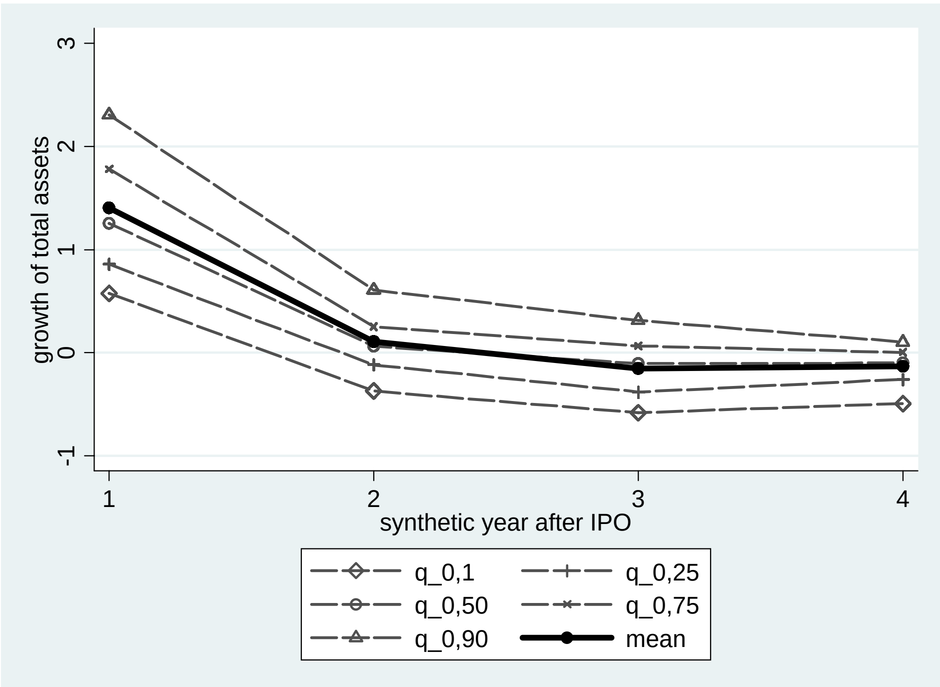


Figure 2.2 Mean and percentiles of annual changes in logs of liquidity

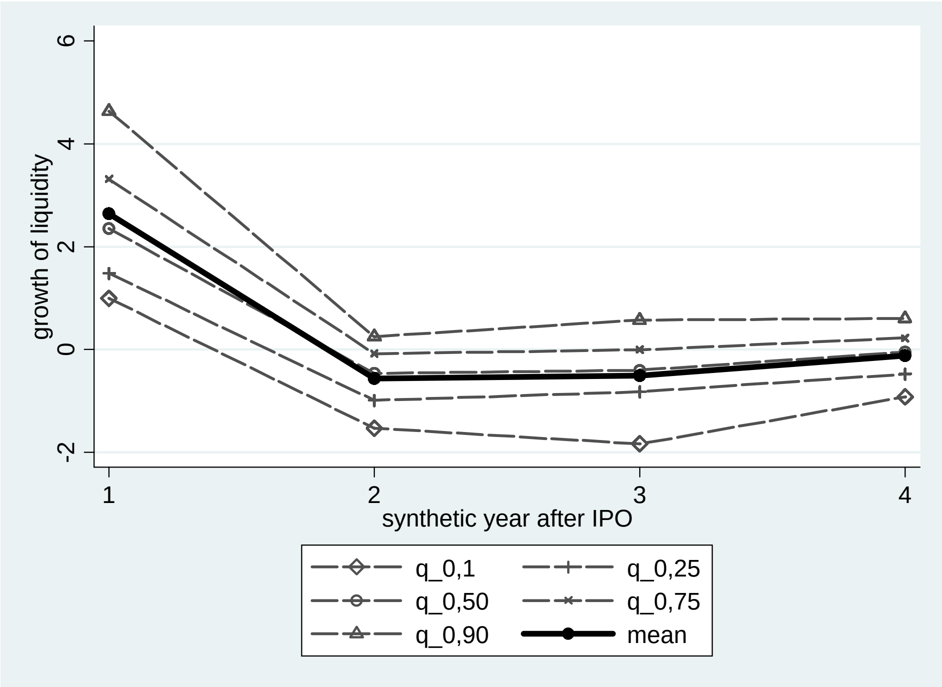


Figure 2.3 Mean and percentiles of annual changes in logs of tangible assets

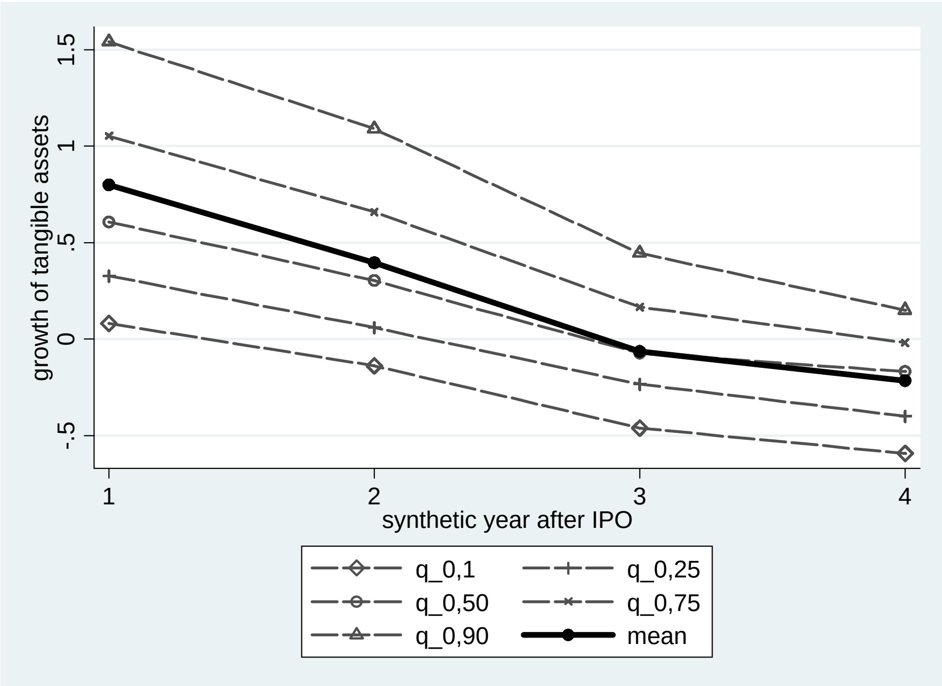


Figure 2.4 Mean and percentiles of annual changes in logs of equity

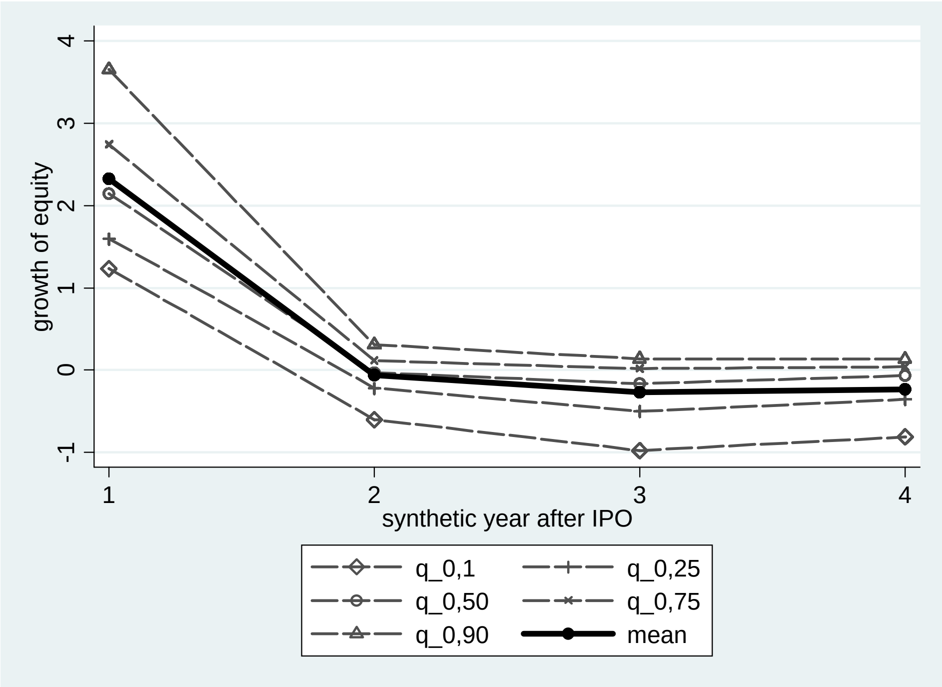


Figure 2.5 Mean and percentiles of annual changes in logs of sales

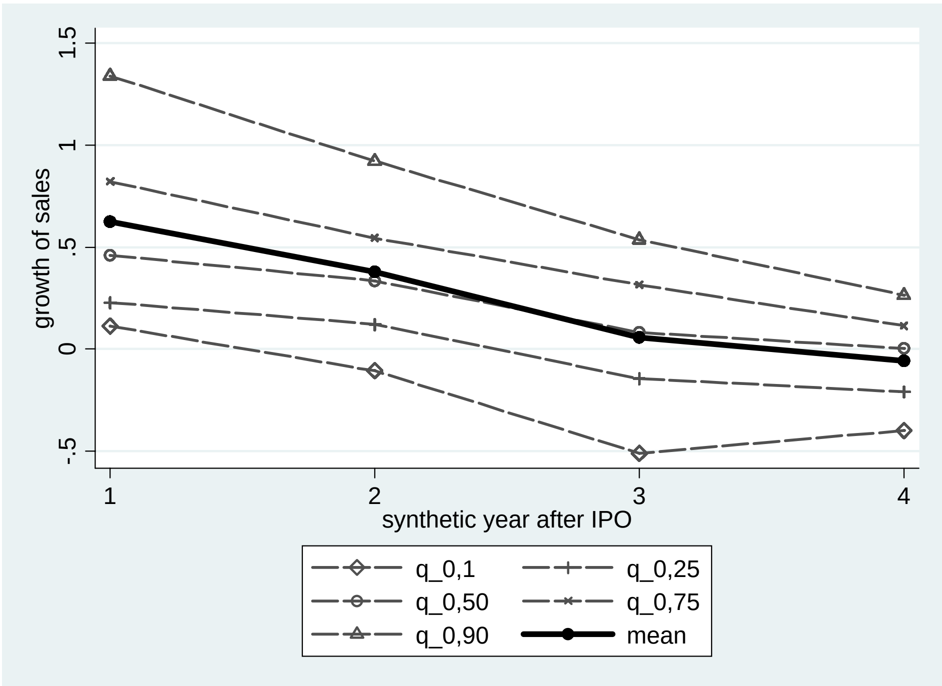


Figure 2.6 Mean and percentiles of annual profits, normalised by equity in *t=1*

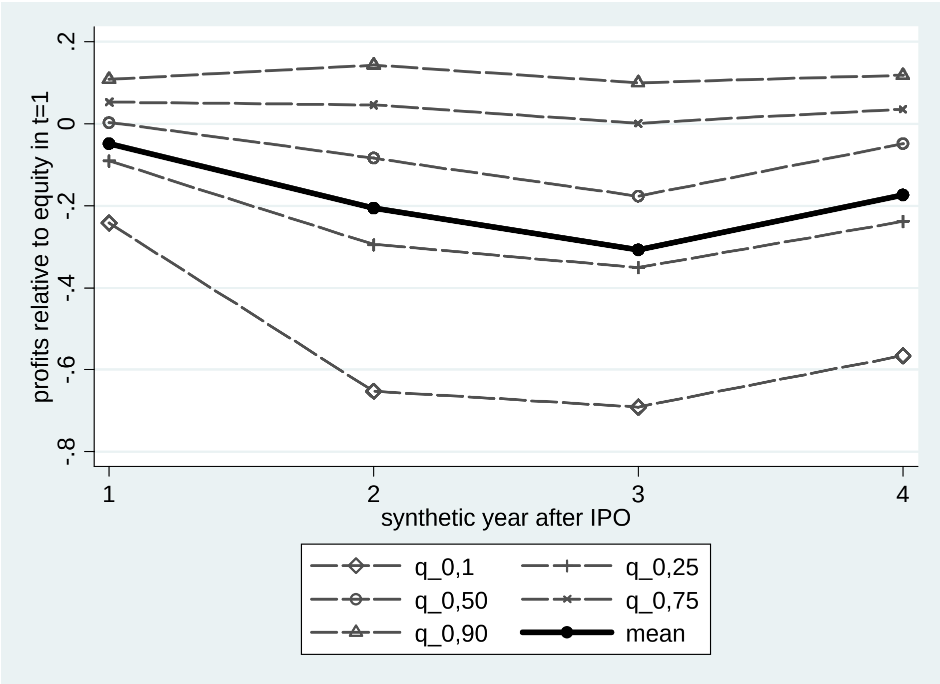
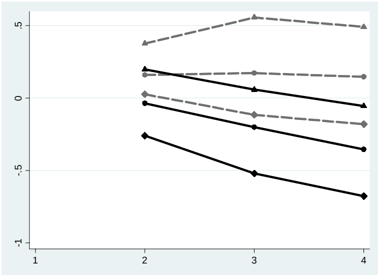
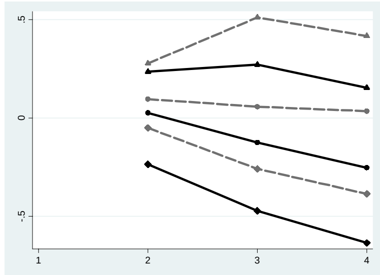
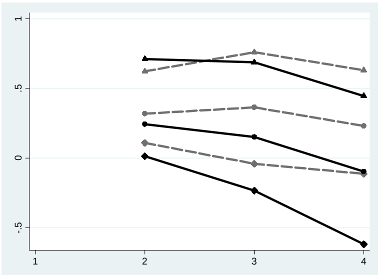
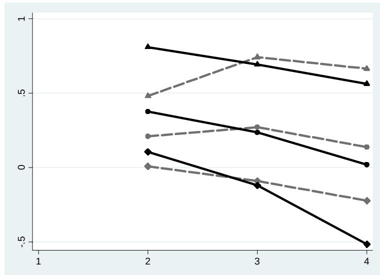
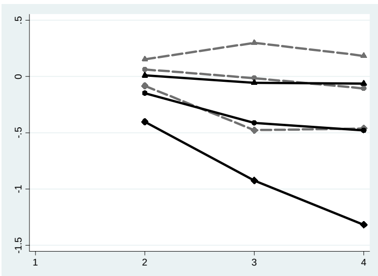
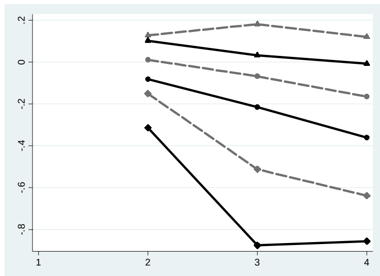
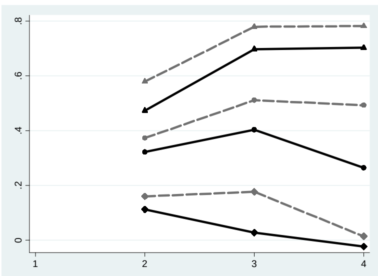
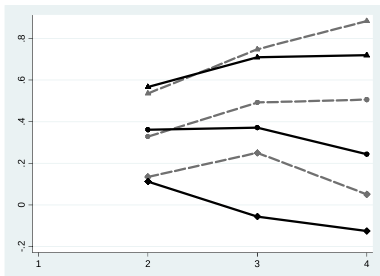
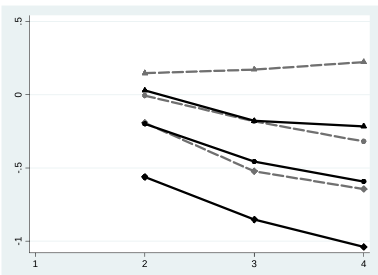
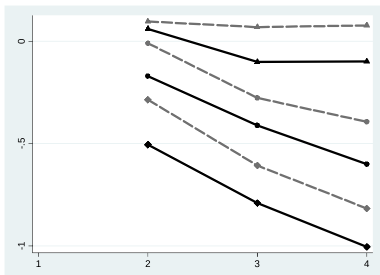
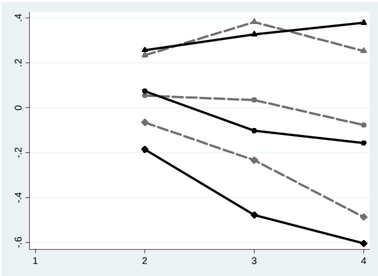
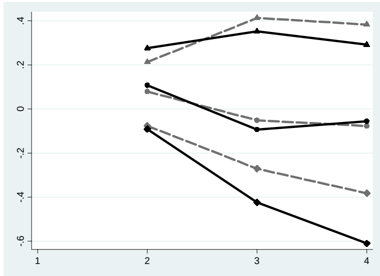
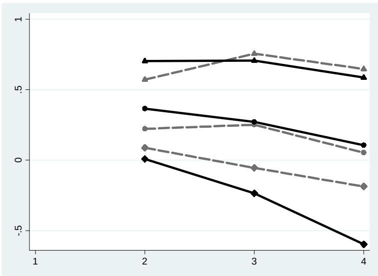
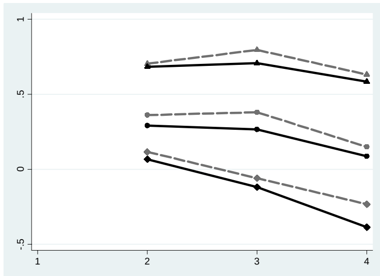
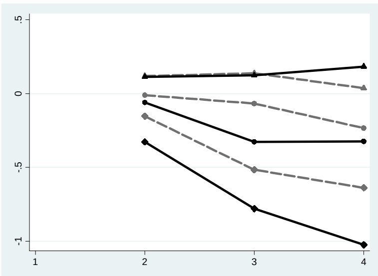
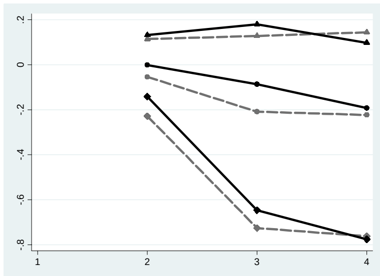
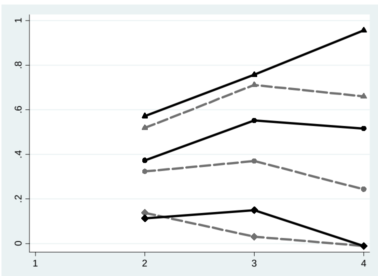
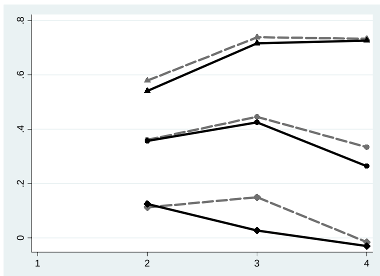
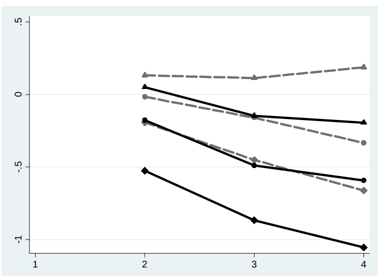
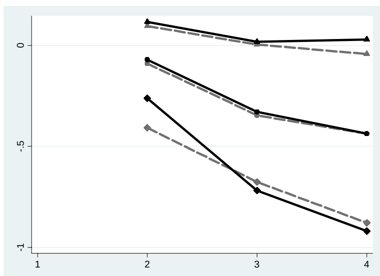


Figure 3 Quantiles for cumulative log changes, by HI_MTBV, LO_SHARE

	HI_MTBV	LO_SHARE
Cum. changes in logs of total assets		
Cum. changes in logs of tangible assets		
Cum. changes in logs of equity		
Cum. changes in logs of sales		
Cum. profits normalised by equity in *t=1*		

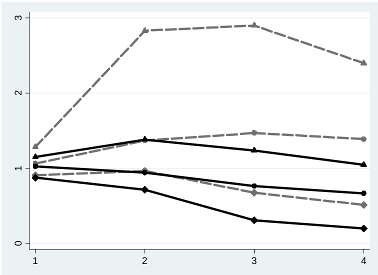
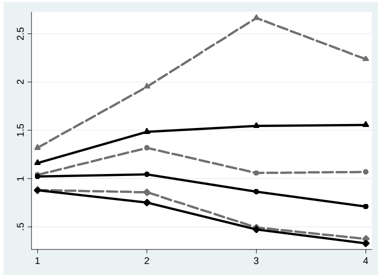
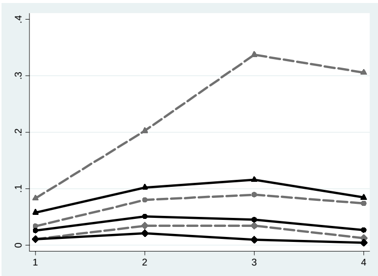
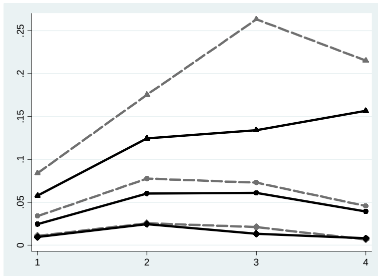
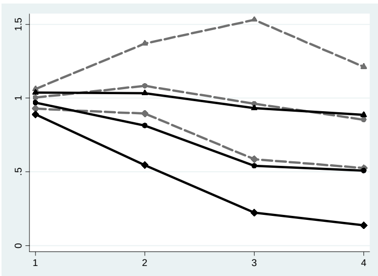
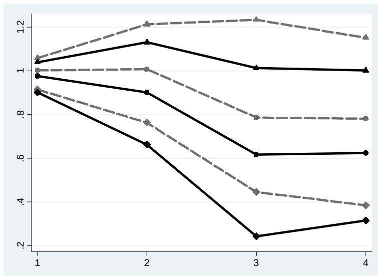
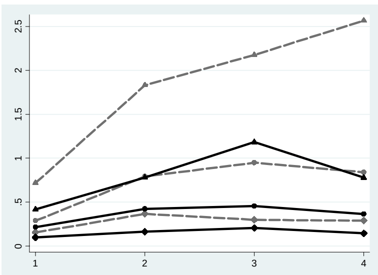
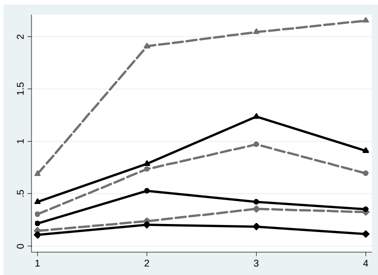
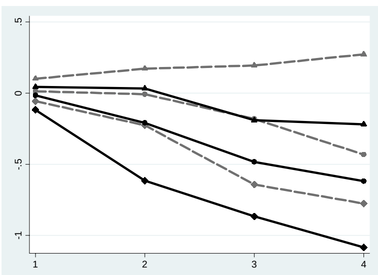
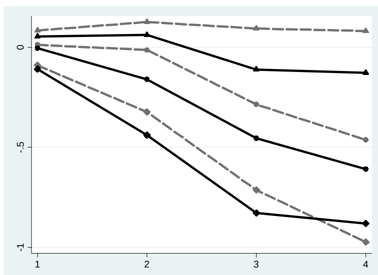
Note: Dashed lines (solid lines) denote group expected to be associated with high (low) values of the respective accounting item. In order to deal with negative values, profits are in levels, normalised by equity in *t=1*.

Figure 4 Quantiles for cumulative log changes, by LO_AGE, NO_SUPPORT

	LO_AGE	NO_SUPPORT
Cum. changes in logs of total assets		
Cum. changes in logs of tangible assets		
Cum. changes in logs of equity		
Cum. changes in logs of sales		
Cum. profits normalised by equity in *t=1*		

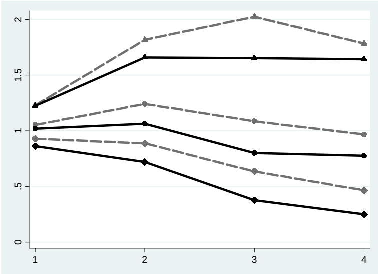
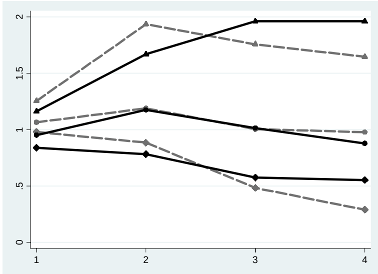
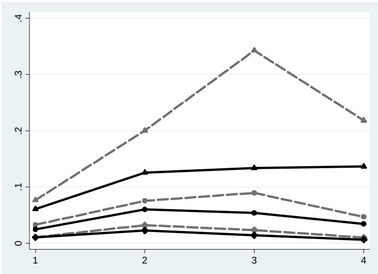
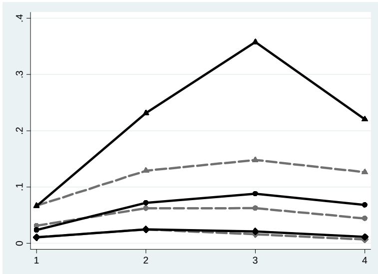
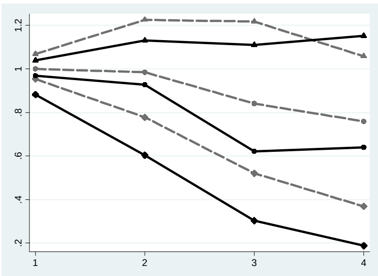
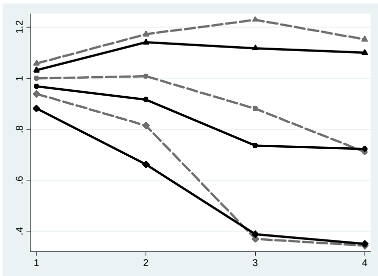
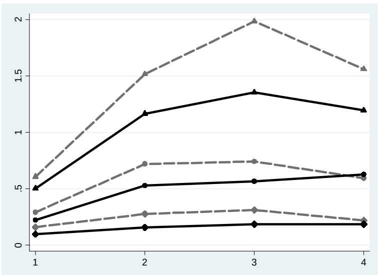
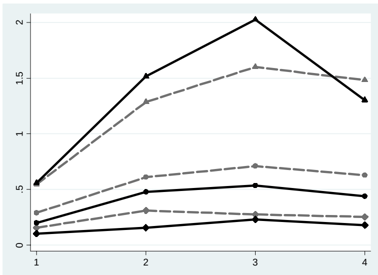
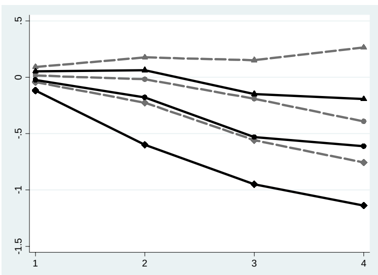
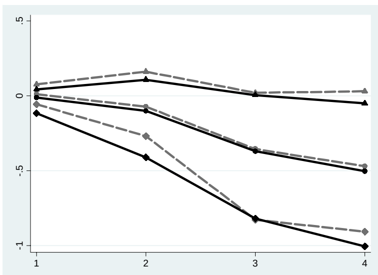
Note: Dashed lines (solid lines) denote group expected to be associated with high (low) values of the respective accounting item. In order to deal with negative values, profits are in levels, normalised by equity in *t=1*.

Figure 5 Quantiles for cumulative normalised level changes, by HI_MTBV, LO_SHARE

	HI_MTBV	LO_SHARE
Cum. normalised changes in total assets		
Cum. normalised changes in tangible assets		
Cum. normalised changes in equity		
Cum. normalised changes in sales		
Cum. normalised profits		

Note: Dashed lines (solid lines) denote group expected to be associated with high (low) values of the respective accounting item. Level changes are normalised by equity inflow at IPO. Regarding profits, we report cumulative normalised levels, as annual profits is a flow variable.

Figure 6 Quantiles for cumulative normalised level changes, by LO_AGE, NO_SUPPORT

	LO_AGE	NO_SUPPORT
Cum. normalised changes in total assets		
Cum. normalised changes in tangible assets		
Cum. normalised changes in equity		
Cum. normalised changes in sales		
Cum. normalised profits		

Note: Dashed lines (solid lines) denote group expected to be associated with high (low) values of the respective accounting item. Level changes are normalised by equity inflow at IPO. Level changes are normalised by equity inflow at IPO. Regarding profits, we report cumulative normalised levels, as annual profits is a flow variable.