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Institutional investors and firm performance: Evidence from IPOs☆

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ABSTRACT

We investigate the post-IPO evolution of institutional investor holdings and the manner in which operating performance is related to these holdings. During the first year after the IPO, average institutional holdings increase from 24% to 36% of shares outstanding and stabilize at about 42% by the end of the second year. We document that post-IPO operating performance is positively related to institutional holdings, but this relation subsides in the third year after the IPO. Overall, our findings indicate that institutional ownership is a valid indicator of the firm's operating performance in its initial years as a public company.

1. Introduction

The IPO is a defining event in a firm's life. It provides successful young firms with funds to grow further and leverages the scale of operations. IPOs enable the public to share in the firm's success while letting entrepreneurs alleviate risks. They are generally associated with a substantial change in the firm's ownership structure, giving voting power to new investors. There is also great variability in the post-IPO operating performance of IPO firms. Some perform spectacularly well after the IPO (Microsoft, Apple, Google). Others perform very poorly and even go bankrupt and disappear within a short period of time after the IPO (Webvan, TheGlobe.com, Pets.com). IPOs have demonstrated strongly increasing economic significance. Companies globally raised $222 billion in 2018, up from $1.3 billion in 1980.[1] It is therefore not surprising that IPOs have been of great interest to researchers of corporate finance. Indeed, various aspects of IPOs, including short-term and long-term price and operating performance, have been investigated extensively.

One important investor group that intensively engages in IPOs, and has also grown dramatically over recent decades, consists of institutional investors (pension and mutual funds, insurance companies, etc.).[2] Institutional investors are deeply involved in the

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[1] See, for example, PWC Global IPO Watch Q4 2018 report.

[2] Institutional investor ownership grew from 8% in 1950 to 67% in 2010 (Blume & Keim, 2012).

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book-building process, they are given priority in allocations, and their allocations have been shown to be related to first-day returns (Ritter & Welch, 2002; Aggarwal, Prabhala, & Puri, 2002; Jenkinson & Jones, 2004; Brown & Kovbasyuk, 2017, and Eom, 2017). They also trade aggressively in the stock immediately after the IPO (Aggarwal, 2003; Boehmer, Boehmer, & Fishe, 2006; Hanley & Wilhelm, 1995; Krigman, Shaw, & Womack, 1999). Moreover, they have been shown to affect numerous corporate policies such as compensation (Hamdani & Yaffe, 2013; Hartzell & Starks, 2003), payout policy (Grinstein & Michaely, 2005; Gaspar, Massa, Matos, Patgiri, & Rehman, 2013; Crane, Michenaud, & Weston, 2016), and R&D investment (Bushee, 1998). It is also generally the investor group that takes the lead in shareholder activism and monitoring of the firm (Smith, 1996; Stoughton & Zechner, 1998; Gillan & Starks, 2000; Cornett, Marcus, Saunders, & Tehranian, 2007; Aggarwal, Saffi, & Sturgess, 2015).

Given the documented power and governance skills of institutional investors, one important question is how the operating performance of these IPO firms is related to the institutional investors' involvement. The main purpose of this study is to answer this question. Earlier studies on institutional investors and IPOs consider the manner in which institutional investors exploit private information through their IPO allocations, their trades in the financial markets right after the IPO, and their gains based on stock price performance. However, to our knowledge, there has not been an earlier systematic inquiry into the relation between institutional ownership and IPO firm operating performance. Given the economic significance of these investors, we believe it is important to study the nature of their holdings in newly public firms, the characteristics of the IPO firms in which they tend to invest for the long run, and whether the great variability documented in an IPO firm's post-IPO operating performance can be related to institutional investors' presence.

The relation between institutional holdings and operating performance may be different and more interesting for IPO firms as compared to the general population. First, IPO firms' earnings tend to be negative, but unlike non-IPO public firms, negative earnings for IPO firms are not a sign of bad performance. This is, in turn, because they tend to be young firms that simply did not have enough time to turn earnings positive. Second, there is more uncertainty about IPO firms because these firms are young and unstable. This uncertainty is exacerbated by the fact that there is a very short history describing their operating performance. The higher uncertainty about their future leaves more room for institutional investors to impact the resolution of this uncertainty than for established stable firms. Third, IPOs are associated with a substantial ownership change that gives institutions the opportunity to change their ownership substantially, and hence, provide a natural laboratory for studying the impact of change in institutional holdings on performance. Institutions can change their ownership in all firms, but this change is structured and significant in IPOs. Even seasoned equity offerings do not involve a substantial change in ownership as IPOs do. Lastly, IPOs are associated with a substantial change in regulation and information disclosure requirements with respect to their operating performance. These changes are unique to IPO firms, and are likely to be of special interest to institutional investors as they are a highly regulated investor group.

In this study, we investigate how post-IPO institutional investors' holdings (henceforth "II holdings" or "institutional holdings") are related to post-IPO firm operating performance. Accordingly, our investigation of institutional holdings starts right after the IPO; in particular, we focus on II holdings after most flipping ends.[3] Thus, in this study we are not interested in the dynamics of II holdings before and around the IPO. We first track the evolution of institutional ownership following the IPO. Our variable of interest is institutions as a shareholder group regardless of when they acquired their shares. Here we document that institutional holdings increase dramatically in the first few years of the newly public firm. The average holdings of institutional investors immediately following the IPO is 24%, but by the end of the first year it reaches 36%. It then stabilizes at 42% by the end of the second year, and remains at the same level onwards. This result complements findings of earlier studies that focus on the holdings of institutional investors prior to an IPO and studies describing how these original investors alter (sell) their holdings after the IPO. Chemmanur, Hu, and Huang (2010), for example, consider the evolution of original institutional investors' holdings and find that they sell 70% of their holdings within the first year after the IPO. Our findings suggest that original institutional investors are actually replaced by new institutional investors. As we show, the dramatic increase in total institutional holdings after the IPO that we find here cannot be attributed merely to the general growth in institutional holdings over time documented in the literature (e.g. Gaspar, Massa, & Matos, 2005).

Next, we use regression analysis to investigate how operating performance is related to institutional holdings in the first three years following the IPO. In this analysis, we first measure operating performance according to standard measures. However, we also measure abnormal operating performance relative to industry average and median (see Section 3 on the measurement of standard and abnormal operating performance). While it is not unusual in the literature to adjust operating performance and other variables for some expected value (e.g. Jain & Kini, 1994 adjust operating performance for a matched sample), the measures we use are to our knowledge novel.

We control for firm size and leverage in the year prior to the IPO as they have been shown to be related to performance. Following Megginson and Weiss (1991) and Field and Lowry (2009) we also control for firm age at the time of the IPO and for VC backing as these variables have been documented to affect institutional holdings of IPO firm shares. Last, we repeat the above analysis for the relation between the change in operating performance and the change in institutional holdings.

We find that regardless of the way we measure operating performance and whether we look at levels or changes, operating performance is positively related to institutional holdings and to lagged institutional holdings. This relation is strong in the first and second year following the IPO. However, it is less significant in the third year after the IPO. Our interpretation of these findings is that higher institutional holdings improve operating performance of newly issued companies. These findings further imply that

[3] Most flipping (the practice of buying shares at the IPO and selling them in the market right afterwards) happens within the first few days after the IPO; see, for example, Aggarwal (2003), and Cheng et al. (2010).

institutional investors' involvement in IPOs is not only information-advantage driven, as suggested in earlier studies on IPOs and II holdings. Rather, institutional investors' investment in IPO firms may also be related to their ability to affect IPO firms' future operating performance.

Furthermore, the analysis of abnormal performance rather than naïve performance at times provides more significant findings. This paper's contribution is thus also in suggesting that the use of abnormal operating performance, in addition to naïve operating performance, can enrich robustness in operating performance investigations.

Changes in ownership may take time to affect performance. Hence, we have also verified that our findings are robust for the relation between operating performance and lagged holdings (rather than contemporaneous holdings). To alleviate the concern of endogeneity we utilize a regression discontinuity design (RDD) and provide supporting evidence that operating performance is positively related to institutional holding. Lastly, earlier studies document that institutional investors have an information advantage in the IPO that they exploit in the IPO process (see literature review section). We therefore also consider the relation between institutional holdings and post-issue stock return in the years following the IPO. We do not find that institutions have the ability to time the market after the firm becomes public. These findings are consistent with recent evidence that institutional investors are not good stock pickers (see, for example, Lowellen, 2011, and Edelen, Ince, & Kadlec, 2016).

The rest of this paper is organized as follows. Section 2 reviews the literature. Section 3 describes data summary statistics and methodology. Section 4 reports results on the long run relation between levels of institutional holdings and operating performance, and Section 5 reports our findings on the relation between changes in institutional holdings and operating performance. Section 6 considers extensions and robustness tests. Section 7 concludes.

2. Related literature

2.1. Institutional ownership and performance in general

There is a vast body of literature on the relation between institutional investors' holdings and operating performance in general (unrelated to IPOs). The focus of this literature is on monitoring and governance. The reasoning behind the hypothesis that institutional investment will be associated with better performance is that the holdings of institutional investors tend to be large, and hence they have the voting power to influence decisions, while at the same time they have enough shares to benefit from their (costly) monitoring and governance activity (Jensen & Meckling, 1976; Jensen, 1986). Indeed, the size of institutional investors' holdings is important. Shleifer and Vishny (1986) show that the willingness of shareholders to intervene in corporate affairs increases with the size of their stake and the value creation stemming from such intervention.

As mentioned earlier, institutional investors are generally the investor group that takes the lead in shareholder activism and monitoring of the firm (Cornett et al., 2007; Gillan & Starks, 2000; Smith, 1996). More recently, Aggarwal et al. (2015) find that institutional investors value the right to vote and use the proxy process as an important channel for affecting corporate governance (see also McCahery, Sautner, & Starks, 2016). Other studies show that institutional holdings also enhance performance in mutual funds (e.g. Pan, Wang, & Zykaj, 2015).

Gompers and Metricks (2001) show that institutional investors prefer large, liquid, and high book-to-market stocks and that their preferences affect stock returns. Gaspar et al. (2005) suggest that it is the investment horizon of institutional investors that is positively related to the firm's stock price performance. Smith (1996), however, does not find an impact of institutional shareholders' activism on operating performance, but Cornett et al. (2007) find that Tobin's Q is positively related to institutional holdings. Their interpretation of this finding is that institutional investors improve operating performance. Harford, Kecskes, and Mansi (2015) find that firms with more long-term institutional investors tend to have more shareholder-friendly corporate governance. Cheng, Hong, and Scheinkman (2015) find that the presence of institutional investors reduces managers' risk taking.

2.2. Institutional investors and IPOs

Earlier literature mostly considers the manner in which institutional investors exploit private information to benefit from their holdings in the IPO. Aggarwal et al. (2002) investigate allocations to institutional investors in IPOs and find they are positively correlated with first-day returns, and that institutional allocation in underpriced issues is in excess of that explained by book-building theories alone. Jenkinson and Jones (2004) find that this ability to receive superior allocations in good IPOs is the result of institutional investors' good relations with the investment banks. Aggarwal (2003) documents the involvement of institutional investors in flipping activity immediately after the IPO. Fernando, Krishnamurthy, and Spindt (2004) find that higher priced IPOs show a higher fraction of institutional investment. Boehmer et al. (2006) further show that institutions are able to get better allocations of IPOs with superior long-run stock market performance. Kale, Kini, and Payne (2012) find that the smaller the IPO firm's level of institutional ownership, the greater is the probability that the firm will initiate dividends.

Field and Lowry (2009) consider the evolution of the stock price after the IPO in relation to initial institutional investor holdings. They show that institutions are able to get higher returns on their investment in IPOs. They find that this is mainly due to institutions being able to avoid the worst performers. Field and Lowry relate this qualification to the institutions' access to private information through their involvement in the book-building process. They also document the evolution of aggregate institutional holdings after the IPO and show it increases over time. Chemmanur, Hu et al. (2010) investigate the trade after the IPO of original institutional investors (i.e. institutional shareholders who own shares before the IPO). By tracking long-run returns after their trade, they show that these original institutional investors utilize private information to benefit from their holdings (selling shares) when they sell.

Both Field and Lowry (2009) and Chemmanur, Hu et al. (2010), Chemmanur, He and Nandy (2010) study the manner in which institutional investors take advantage of private information to benefit from IPOs, and therefore investigate the period around or shortly after the IPO. We are interested in the relation between institutional holdings and operating performance and thus follow the evolution of the relation between their holdings and performance long *after* the IPO. Furthermore, as they are focused on gains from information, these papers use stock returns. In particular, Field and Lowry (2009) consider stock returns on initial holdings while Chemmanur, Hu et al. (2010), Chemmanur, He et al. (2010) consider trading gains from selling the stock. We, instead, are interested in the relation between holdings and firm value and hence consider operating performance. In short, our analysis complements that of Field and Lowry (2009) and Chemmanur, Hu et al. (2010), Chemmanur, He et al. (2010) by exploring the relation of institutional holdings to operating performance instead of how they fare from the information they have in making investment in the stock and trading in it.

2.3. Post-IPO operating performance

There are also studies that look at post-IPO operating performance in general (unrelated to institutional investors' holdings). The general findings here are deterioration in operating performance. Indeed, a decline in firms' profitability is documented in Degeorge and Zeckhauser (1993), Jain and Kini (1994), Mikkelson, Parch, and Shah (1997), Teoh, Welch, and Wong (1998), Pagano, Panetta, and Zingales (1998), Pastor, Taylor, and Veronesi (2009), and Chemmanur, He et al. (2010). Krishnan, Ivanov, Masulis, and Singh (2011), however, find that this performance depends on venture capitalists' reputations. Brau, Couch, and Sutton (2012) find that post-IPO performance is negatively related to the tendency of the IPO firm to engage in acquisition activity. Michel, Oded and Shaked (2014) find a U shape relation between the public float (PF) and long-run abnormal returns. Specifically, for low levels of PF, higher PF is associated with lower long-run returns, while for high levels of public float, higher PF is associated with greater long-run returns. They offer an agency costs explanation: at low levels of public float increasing the public float exacerbates agency problems because it reduces their motivation due to lower ownership more than it enhances disciplining insiders, while at high levels of public float, the ability of outsiders (new public investors) to govern and monitor increases with increasing public float.

3. Data and methodology

Our initial firm-level data comes from the merger of four databases. The IPO sample was obtained from the SDC database for the period January 1, 1996 through December 31, 2008. Price data is taken from CRSP, and operating performance data is taken from Compustat. Institutional investor holdings data is obtained from 13F filings to the SEC, obtained from Thompson Reuters. CRSP, Compustat, and Thompson Reuters data is obtained through the WRDS platform.

We start in 1996 because before then data availability for this study is limited. 2008 was used as the final year of the sample because in the years immediately following 2008 there were very few IPOs and also because we required three years of data following the IPOs to measure long-run performance. We did not go beyond 2008 also because our ability to process the raw data was limited. This is because, as will be explained below, we had to manually fix both the SDC IPO data and the Thompson Reuters institutional holdings data.

From the initial sample of all IPOs in the SDC for the period of study we removed all utility and financial firms (see, for example, Field & Karpoff, 2002), resulting in a sample size of 2119 firms. Of this sample, 52 firms were missing price data on CRSP and 39 firms were missing Compustat data. Following earlier studies (e.g. Loughran & Ritter, 1995, Eckbo, Masulis, & Norly, 2007), 74 ADRs were also dropped, resulting in 1954 firms. Due to missing and erroneous institutional investor data, 47 additional firms were dropped, resulting in the final sample of 1907 firms.[4] Panel A of Table 1 reports summary statistics of the IPO sample by year and for the complete sample (bottom row). Column (1) reports the number of IPOs per year over the sample period 1996–2008, and Column (2) reports these as a fraction of the total sample.

3.1. Measuring institutional investor holdings

The main institutional investor holdings variable we are interested in is the fraction of shares held by institutional investors immediately following the IPO, and the evolution of this variable after the IPO over time.[5] Following Grinstein and Michaely (2005) and Cornett et al. (2007), we obtain institutional holdings data for all the IPOs in our sample using 13F forms from Thompson Reuters (available through the WRDS platform) for the period 1996–2011. This is the IPO sample period 1996–2008 plus 12 quarters (three years) after the IPO. Institutions that file 13Fs are mutual funds, pension funds, bank trusts, insurance companies, large brokerage firms, and endowments. The 13F forms are filed on a quarterly basis.[6] It is the institutions (managers) that file, and Thompson

[4] The analysis around the IPO date is based on this sample of 1907 firms. Due to missing data the sample ranges between 1,907 and 1,073 firms depending on the horizon of the analysis.

[5] We focus on total institutional ownership. Excluding institutions that are not likely to respond to performance (e.g. short term institutional investors) is only likely to strengthen our findings. Focusing on total ownership will be appropriate for the endogeneity tests performed in Section 6 (as in Bird & Karolyi, 2016, and Crane et al., 2016).

[6] Only institutions with holdings of $100 million or more have to file the 13F form. They are required to report holdings in all U.S. firms, for all holdings that are more than $200,000 or 10,000 shares.

Table 1
Summary statistics.

Panel A: Summary statistics of IPO sample

	(1)	(2)
Year	Number of IPOs	Percentage (of Total)
1996	404	21%
1997	295	15%
1998	111	6%
1999	277	15%
2000	181	9%
2001	39	2%
2002	49	3%
2003	48	3%
2004	133	7%
2005	115	6%
2006	115	6%
2007	124	7%
2008	16	1%
TOTAL	1907	100%

Panel B: Summary statistics of II holding, operating performance variables and variables used to construct them, and control variables

		Average	Med	Stdev	N			Average	Med	Stdev	N
II holdings	Q1	24.27%	20.50%	18.85%	1907	*ROA*	Y0	−0.1239	0.0925	0.5804	1387
	Y1	34.91%	30.13%	24.30%	1876		Y1	−0.0336	0.0756	0.3246	1580
	Y2	39.85%	34.01%	28.71%	1727		Y2	−0.0869	0.0587	0.4187	1480
	Y3	41.36%	37.34%	30.61%	1510		Y3	−0.0693	0.0659	0.3814	1289
OIBD	Y0	28.514	3.124	106.27	1401	*RO_ALC*	Y0	−0.6124	0.1012	1.9694	1387
	Y1	32.779	5.982	122.97	1581		Y1	−0.5461	0.0983	2.1130	1580
	Y2	35.448	5.6895	122.38	1480		Y2	−0.6593	0.0771	2.5074	1480
	Y3	47.897	7.418	153.53	1292		Y3	−0.5358	0.0801	2.1659	1289
ATQ	Y0	239.67	35.672	786.31	1860	*ROS*	Y0	−2.4300	0.0711	11.374	1339
	Y1	361.39	105.74	947.12	1861		Y1	−2.8735	0.0806	18.568	1536
	Y2	441.13	125.17	1137.4	1689		Y2	−2.6255	0.0612	17.047	1453
	Y3	546.48	137.08	1489.9	1461		Y3	−1.8002	0.0639	10.646	1265
CHEQ	Y0	19.442	5.291	53.361	1858	*MtoB*	Q1	6.5691	3.9799	10.670	1804
	Y1	60.391	28.947	113.29	1859		Y1	4.6035	3.0799	5.7057	1815
	Y2	64.721	25.074	133.84	1688		Y2	3.8326	2.2983	5.7678	1621
	Y3	72.844	24.538	181.36	1461		Y3	3.7435	2.0134	5.8761	1383

(*continued on next page*)

Table 1 (*continued*)

Panel B: Summary statistics of II holding, operating performance variables and variables used to construct them, and control variables

		Average	Med	Stdev	N			Average	Med	Stdev	N
REV	Y0	248.47	39.794	852.56	1809	*LnMV*	Q1	5.5779	5.5343	1.2117	1854
	Y1	306.96	68.464	933.09	1838		Y1	5.3954	5.4500	1.3908	1847
	Y2	368.69	92.946	1050.4	1671		Y2	5.1060	5.1601	1.6745	1681
	Y3	471.04	110.20	1401.0	1443		Y3	5.0231	5.0958	1.8199	1454
MV	Q1	579.65	253.22	1159.1	1854	*LEVER*	Y0	0.2472	0.0954	0.3363	1849
	Y1	600.97	232.76	1437.8	1847		Y1	0.1253	0.0126	0.2004	1842
	Y2	626.03	174.18	1804.2	1681		Y2	0.1514	0.0211	0.2277	1674
	Y3	724.55	163.33	2228.0	1454		Y3	0.1612	0.0248	0.2468	1449
Firm Age		15.97	8	22.11	1907						

This table describes summary statistics. Panel A reports summary statistics for the IPO sample by year and for the complete sample (bottom row). Column (1) reports the number of IPOs per year over the sample period 1996–2008 and Column (2) reports this number as a fraction of the total sample. Panel B reports summary statistics of institutional holdings (top of left side of panel); performance variables components in millions of dollars (rest of left side of panel); and performance and control variables (right side of panel) over time. For institutional holdings, the statistics are reported for *Q1* after the IPO, which is the first quarter they are available, and also for the end of *Y1*, *Y2*, and *Y3* after the IPO. For the performance variables and their components and for control variables the statistics are reported for *Y0, Y1*, *Y2*, and *Y3* after the IPO, except for market value (*MV*) and variables that depend on it that are reported for *Q1* instead of *Y0*. In the left column, *OIBD* is operating income before depreciation calculated by aggregating Compustat quarterly data items *OIBDPQ* over four fiscal quarters. *ATQ* is the Compustat quarterly total asset variable from the last quarter of the relevant year relative to the IPO. *CHEQ* is cash at the end of the relevant quarter. *REV* is revenue calculated by aggregating Compustat quarterly data items *REVQ* over four fiscal quarters. *MV* is market value of equity calculated as number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). For book value of equity we use Compustat data item *SEQQ*. *Age* is the age of the IPO firm in years at the time of the IPO. On the right side of the panel, *ROA* is operating return on assets calculated as operating income before depreciation divided by end-of-year total assets (*OIBD* divided by *ATQ*). *RO_ALC* is operating return on assets-less-cash, calculated as *OIBDPQ* divided by *ATQ*-less-*CHEQ*; *ROS* is operating performance to revenue ratio, calculated as *OIDB* divided by *ATQ*. *MtoB* is market-to-book, calculated as the ratio of market value (*MV*) to book value of the firm's equity. For book value of equity we use Compustat data item *SEQQ*. *lnMV* is firm size, calculated as the natural log of the firm's market value of equity (*MV*). *LEVER* is leverage calculated as the ratio of long term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) in the last quarter of the relevant year. All regressions include year fixed effects and year relative to IPO fixed effects.

Original Order	File Date	Manager Name	Manager Number	Type Code	Report Date	Prior Report Date	Cusip	Shares Held at End of Qtr	Net Change In Shares Since Prior Report	Stock Name	Ticker Symbol	Stock Class Description	Share Price, as of FDATE	Shares Outstanding In Millions, as of FDATE	Shares Outstanding In 1000s, as of FDATE
545735	31MAR2002	AIM MANAGEMENT GROUP,INC.	140	5	31MAR2002	31DEC2001	83616710	117700	46500	SOURCECORP	SRCP	COM	29.49	17	17377
545736	31MAR2002	AELTUS INVESTMENT MGMT, INC.	500	5	31MAR2002	31DEC2001	83616710	3200	1300	SOURCECORP	SRCP	COM	29.49	17	17377
545737	31MAR2002	AID ASSOCIATION FOR LUTHERANS	650	5	31MAR2002	31DEC2001	83616710	14900	14900	SOURCECORP	SRCP	COM	29.49	17	17377
545738	31MAR2002	AMALGAMATED BANK OF NEW YORK	1380	1	31MAR2002	31DEC2001	83616710	13919	519	SOURCECORP	SRCP	COM	29.49	17	17377
545739	31MAR2002	AMERICAN INTL GROUP INC	2470	2	31MAR2002	31DEC2001	83616710	4409	-3726	SOURCECORP	SRCP	COM	29.49	17	17377
545740	31MAR2002	APEX CAPITAL, LLC	4422	5	31MAR2002	31DEC2001	83616710	35500	35500	SOURCECORP	SRCP	COM	29.49	17	17377
545741	31MAR2002	AWAD ASSET MANAGEMENT, INC.	5350	5	31MAR2002	31DEC2001	83616710	694035	531550	SOURCECORP	SRCP	COM	29.49	17	17377
545742	31MAR2002	BNP PARIBAS ARBITRAGE SNC	5810	4	31MAR2002	30SEP2001	83616710	11480	11480	SOURCECORP	SRCP	COM	29.49	17	17377
545743	31MAR2002	BANK ONE CORPORATION	5955	1	31MAR2002	31DEC2001	83616710	4939	1260	SOURCECORP	SRCP	COM	29.49	17	17377
545744	31MAR2002	FORT POINT CAP MGMT, L.L.C.	6161	5	31MAR2002	31DEC2001	83616710	134400	134400	SOURCECORP	SRCP	COM	29.49	17	17377
545745	31MAR2002	BNY ASSET MANAGEMENT	6890	1	31MAR2002	31DEC2001	83616710	12300	500	SOURCECORP	SRCP	COM	29.49	17	17377
545746	31MAR2002	PROFUND ADVR LLC	7633	5	31MAR2002		83616710	12411		SOURCECORP	SRCP	COM	29.49	17	17377
545747	31MAR2002	DEUTSCHE BK AKTIENGESELLSCHAFT	7800	1	31MAR2002	31DEC2001	83616710	63253	9397	SOURCECORP	SRCP	COM	29.49	17	17377
545748	31MAR2002	BARCLAYS BANK PLC	7900	4	31MAR2002	31DEC2001	83616710	503094	80206	SOURCECORP	SRCP	COM	29.49	17	17377
545749	31MAR2002	BEAR, STEARNS & CO. INC.	8238	5	31MAR2002	31DEC2001	83616710	63	-1937	SOURCECORP	SRCP	COM	29.49	17	17377
545750	31MAR2002	CIBC WORLD MARKETS CORP.	11190	5	31MAR2002	31DEC2001	83616710	46653	1630	SOURCECORP	SRCP	COM	29.49	17	17377
545751	31MAR2002	CREDIT SUISSE FIRST BOSTON COR	11800	5	31MAR2002	31DEC2001	83616710	21344	-4465	SOURCECORP	SRCP	COM	29.49	17	17377
545752	31MAR2002	CALIFORNIA STATE TEACH RETIRE	12120	5	31MAR2002	31DEC2001	83616710	20900	-15693	SOURCECORP	SRCP	COM	29.49	17	17377
545753	31MAR2002	CCM PTNR	12970	5	31MAR2002	31DEC2001	83616710	570		SOURCECORP	SRCP	COM	29.49	17	17377
545754	31MAR2002	CENTURY CAPITAL MGMT, INC.	15090	5	31MAR2002	31DEC2001	83616710	12000	6000	SOURCECORP	SRCP	COM	29.49	17	17377
545755	31MAR2002	TIMESSQUARE CAPITAL MGMT, INC	16180	5	31MAR2002	31DEC2001	83616710	348100	25600	SOURCECORP	SRCP	COM	29.49	17	17377
545756	31MAR2002	COLLEGE RETIRE EQUITIES	18265	3	31MAR2002	31DEC2001	83616710	93416	1300	SOURCECORP	SRCP	COM	29.49	17	17377
545757	31MAR2002	PUBLIC EMP' RETIREMENT ASSN CO	18740	5	31MAR2002	31DEC2001	83616710	47700	-14900	SOURCECORP	SRCP	COM	29.49	17	17377
545829	30JUN2002	PUBLIC EMP' RETIREMENT ASSN CO	18740	5	31MAR2002	31DEC2001	83616710	47700	-14900	SOURCECORP	SRCP	COM	26.5	17	17424
545758	31MAR2002	COOKE & BIELER, INC.	21350	5	31MAR2002	31DEC2001	83616710	247800	247800	SOURCECORP	SRCP	COM	29.49	17	17377
545759	31MAR2002	SG COWEN SECURITIES CORP	21560	5	31MAR2002	31DEC2001	83616710	11975	500	SOURCECORP	SRCP	COM	29.49	17	17377
545760	31MAR2002	DEERE & COMPANY	22300	5	31MAR2002	31DEC2001	83616710	24600	6900	SOURCECORP	SRCP	COM	29.49	17	17377
545761	31MAR2002	DENVER INVESTMENT ADVR LLC	22860	5	31MAR2002	31DEC2001	83616710	145700	145700	SOURCECORP	SRCP	COM	29.49	17	17377
545762	31MAR2002	ARTEMIS INVESTMENT MGMT, LLC	22940	5	31MAR2002	31DEC2001	83616710	175750	40800	SOURCECORP	SRCP	COM	29.49	17	17377
545763	31MAR2002	DIMENSIONAL FD ADVISORS, INC.	23000	5	31MAR2002	31DEC2001	83616710	236000	106300	SOURCECORP	SRCP	COM	29.49	17	17377
545764	31MAR2002	AXA FINANCIAL, INC.	25610	2	31MAR2002	31DEC2001	83616710	81795	59095	SOURCECORP	SRCP	COM	29.49	17	17377

Fig. 1. Example of raw institutional holding data – Source Data Corporation Q1 2002. Source: F13 filings to the SEC, obtained from Thompson Reuters through WRDS.

Reuters aggregates the filings by the firm in which the investment is reported and the quarter of reporting. The institutional holdings' data retrieved for the IPO sample consists of about 1.5 million rows, each row reporting end-of-quarter holdings in a firm by a manager (institutional investor). Fig. 1 shows an example of the raw data from Thompson Reuters Services for Source Data Services Corporation (Ticker: SRSV), which went public on July 30, 1996. The reporting is for the quarter that ended March 31, 2002. For every firm-quarter, we then aggregate the number of shares held reported by the institutions (managers) to get the aggregate number of shares held by institutions per firm.

We obtain total shares outstanding data per firm by end of quarter from Compustat.[7] Then, for every firm-quarter, we divide the aggregate number of shares held by institutions (which is calculated based on the 13F forms data) by the number of outstanding shares from Compustat, to obtain the fraction of shares held by institutional investors per firm-quarter. In calculating the fraction of II ownership of outstanding shares, we ensure that II holdings and shares outstanding are adjusted for stock splits.

Institutional investors are required to report on a quarterly basis: a) the number of shares they hold, and b) the change in holdings during the quarter. However, the data retrieved from Thompson Reuters is often missing and inconsistent. Although institutions are required to report holdings continuously, some institutions report their holdings in a firm only when their holdings in that firm change. Also, reported shares held and changes in holdings are often inconsistent. Generally, whenever we had inconsistencies in the data, first, we gave priority to later data. Second, we gave priority to the shares held report over the net change report since we noticed that firms are more accurate and cautious about reporting the former. The detailed construction process of the II holdings variable from the raw reported data is available from the authors upon request.

Fig. 2 illustrates the evolution of average institutional investor holdings relative to the IPO date over time. In the top chart (Fig. 2A), the solid line plots the average institutional holdings of the complete sample of 1907 firms. It can be observed that in the first quarter following the IPO, average institutional holdings are at approximately 24%. The average holdings increase gradually but consistently over the first few quarters after the IPO and reach about 36% by the end of the first year (Q4). By the end of the second year following the IPO (Q8), they reach about 41%, remaining stable afterwards, and reaching about 42% by the end of Q12 after the IPO.[8] This result provides an interesting complement to the findings in Chemmanur, Hu et al. (2010) on the holdings of original institutional investors who own shares at the time of the IPO. They show that these original institutions sell about 70% of their shares within one year after the IPO. The findings here suggest that total institutional holdings (original and new) do not fall after the IPO as a result of original institutions selling their shares. Instead, they suggest that the original institutions are replaced by new institutional investors, and overall institutional holdings actually increase over time. Original institutional investors are clearly still among those measured in the first year of the study. While they may be equally good monitors as new investors, some of them are likely selling to explore private information (that new institutional investors do not have), as suggested by Chemmanur, Hu et al. (2010), Chemmanur, He et al. (2010).

We note, however, that three years after the IPO, the average holdings of institutional investors in IPO firms is low relative to the

[7] The Thompson Reuters Institutional Investor data set also includes shares outstanding, but for the period prior to 2001, the data is inaccurate and often missing, and hence was not used for this study.

[8] Field and Lowry document average institutional holdings increasing from 11% at the IPO increasing to 23% of outstanding shares three years after the IPO on a sample of IPOs from the earlier years 1980–2000. The higher average holdings we find for the years 1996–2008 are consistent with the overall growth in institutional holdings over time.

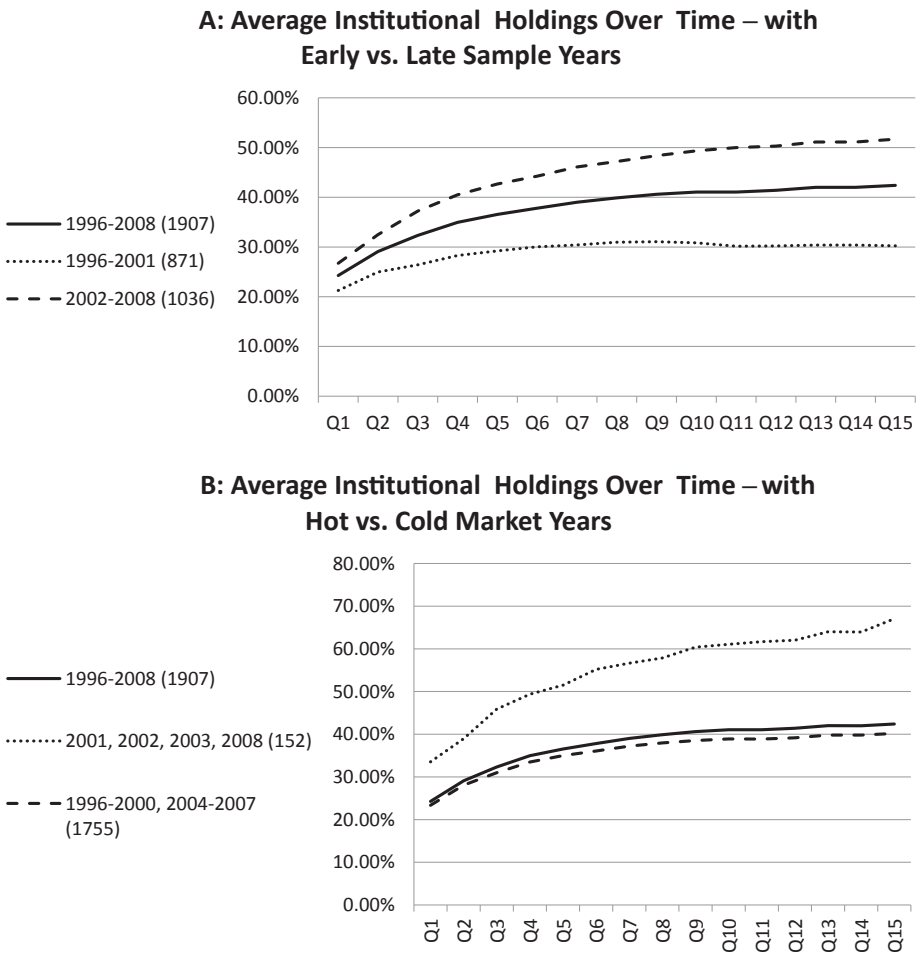

Fig. 2. Institutional investor holdings over time. This figure describes the evolution of institutional shareholders' holdings as a fraction of shares outstanding over the first 15 quarters after the initial public offering for our IPO sample. Fig. 2A plots the average holdings for the complete sample of 1907 IPOs (solid line) and for two sub-samples: the early years (1996–2001, dotted line, 871 IPOs) and the late years (2002–2008, dashed line, 1036 IPOs). The graphs plot 15 quarters after the IPO, the solid line is constructed using institutional holdings over the years 1996–2012, the dotted line is constructed using institutional holdings over the years 1996–2005, and the dashed line is constructed using institutional holdings over the years 2002–2012. Fig. 2B plots the average holdings for the complete sample (solid line) and for two sub-samples: cold market years (2001–2003, 2008, dotted line, 152 IPOs) and hot market years (1996–2000, 2004–2007, dashed line, 1755 IPOs).

average holdings suggested in footnote 2 in the introduction (67% in 2010). This is consistent with the findings in Boehmer et al. (2006) that institutions have preferences for size, liquidity, and book-to-market. This is, in turn, because IPO firms tend to be small and are growth-oriented firms. We argue, however, that given the tendency of institutional investors to invest in large firms, and in particular in firms that are included in indices, the initial investment (24%) and the rapid growth to 42% within three years should not be regarded as low.

The literature documents a continuous increase in institutional holdings in the stock market over the last decades (e.g. Gaspar et al., 2005). It is thus important to verify that the increase in institutional holdings in the first three years after the IPO reflected in Fig. 1 is not a simple artifact of this trend. Therefore, we split the IPO sample into two sub-periods: 1996–2001 and 2002–2008, and plot the average institutional holdings for each of these sub-samples. The dotted line in the chart plots the average institutional holdings over the early years of the sample (1996–2001) and indicates that they increase over the first two years following the IPO from 21% to 30%. The dashed line plots the average institutional holdings over the later years of the sample (2002–2008) and indicates that the average holdings increase over the first two years after the IPO from 27% to about 50%. Thus, the dashed line starts and ends above the dotted line, consistent with the overall increase in institutional holdings over time, documented in the literature. The dramatic increase in holdings within the first two years, in each of the two sub-samples (about 9% and 23%, respectively), and the flattening afterwards cannot be explained by the general increase in II holdings over time. However, the higher starting and ending points for the earlier period relative to the later period is consistent with this trend.

The bottom chart in the figure (Fig. 2B) includes the split of institutional holdings over cold and hot market years where 2001–2003 and 2008 are the cold market years in our sample and the rest are hot market years. Here, too, the solid line plots the

average institutional holdings over time relative to the IPO for the complete sample as in Fig. 1A. The dotted line plots the average of the cold years in the sample, while the dashed line plots average institutional holdings over the hot years of the sample. As can be observed from the figure, the dotted line starts and ends substantially higher than the dashed line, indicating that institutions tend to hold a larger fraction of IPO firm shares in the years following the IPO in cold market years relative to hot market years. This gap is consistent with the findings of Chemmanur, Hu et al. (2010) that in cold market years original institutional investors are slower to sell their shares.

In Panel B of Table 1 (top of left column) summary statistics of institutional holdings are reported for the end of the first quarter and the end of the first three years following the IPO.

3.2. Measuring operating performance

We measure operating performance using four different common measures.[9] The first three are operating income based measures: operating return on assets, *ROA*, measured as operating income before depreciation divided by end-of-year total assets, calculated using Compustat data items *OIBDPQ* and *ATQ*; operating return on assets-less-cash, *RO_ALC*, calculated using Compustat data items *OIBDPQ*, *ATQ*, and *CHEQ*; and the ratio of operating performance to revenue, *ROS*, calculated using Compustat data items *OIBDPQ* and *REVQ*. Here we use quarterly Compustat data for the construction of these variables for better resolution relative to the IPO date (see also Lie, 2005). That is, Compustat quarterly variables *OIBDPQ* and *REVQ* are aggregated yearly relative to the quarter of the IPO.

In addition, for each of the above variables we calculate abnormal values as follows. We first calculate industry benchmarks for each of the three performance variables based on value-weighted average, and industry median.[10] Then, for each firm we calculate abnormal performance relative to the two benchmarks. Level of abnormal performance is calculated for years 0, 1, 2, 3 relative to the IPO, and changes in operating performance are calculated between pairs of subsequent years. Year 0 (*Y0*) is the year ending in the last fiscal quarter immediately preceding the IPO, year 1 (*Y1*) is the year ending in the fourth quarter after the IPO, and so on.

Barber and Lyon (1996) recommend using changes instead of levels to examine unexpected or abnormal performance because the test statistics based on changes are more powerful than those based on levels. Accordingly, for each of the above variables we use both levels and changes from year to year.

The fourth operating performance measure is market-to-book (*MtoB*), which is the ratio of the market value of the firm's equity to the book value of the firm's equity. Here, market value is calculated as number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*), and for book value we use Compustat data item *SEQQ*.[11],[12]

We include four control variables in the analysis, size, leverage, firm age, and VC backing, as follows: For size we use *lnMV*, the natural log of the firm's equity calculated as number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). Leverage (*LEVER*) is calculated as the ratio of long-term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) at the last quarter of the relevant year.[13] *Firm Age* is the age of the firm at the time of the IPO and *VC* is a dummy variable that accepts the value of 1 if the IPO is backed by venture capitalists. All variables are winsorized at 0.5% (on each side, high and low values).

In the literature, *MtoB* is often used as a control variable. Accordingly, we also ran all the regressions that have the other three performance variables as explanatory variables, including *MtoB* as a control variable. All results are qualitatively the same when *MtoB* was included as a control variable. For compactness we do not include this analysis in the paper.

Table 1 Panel B, reports summary statistics of performance and control variables (left columns) and of the components used to construct them (right columns). The statistics are reported for the end of the last year before the IPO (*Y0*), except for market value and variables that are constructed using market value, for which the statistics are reported at the end of the first quarter after the IPO (*Q1*). For all variables the statistics are also reported for the end of each of the first three years after the IPO. As described in the table, the average performance is negative (though the median is positive). This is consistent with earlier findings that IPO firms underperform after the IPO, as discussed above in related literature.

The detailed construction process from Compustat data of operating performance variables, abnormal operating performance and the benchmarks used to calculate this abnormal performance, as well as the construction process of the control variables size and leverage and the benchmarks used for calculating abnormal performance for the variables *ROA* (return on assets), *RO_ALC* (return on assets-less-cash), and *ROS* (return on sales) are available from the authors upon request.

[9] The literature commonly uses these measures or similar variations. See, for example, Jain and Kini (1994), Mikkelson et al. (1997), Grullon and Michaely (2004), Cornett et al. (2007), and Gu and Hackbarth (2013).

[10] We also calculated abnormal operating performance relative to equally weighted averages. The results here were weaker than the results under value-weighted average and median, suggesting that the findings are stronger for the larger firms. The results were, however, generally significant also under the equally weighted average benchmark.

[11] Our definition of *MtoB* follows that used in Jain and Kini (1994). Other studies calculate *MtoB* as market value of equity plus book value of debt divided by book assets (e.g. Lie, 2005).

[12] For more on our four measures and their applicability see, for example, Barber and Lyon (1996), Jain and Kini (1994), Grullon and Michaely (2004), and Lie (2001, 2005).

[13] Some studies include the current portion of long-term debt when calculating leverage. This variable is similar to the one we use because it tends to be small relative to long-term debt.

Table 2
Operating performance as a function of institutional holdings.

Panel A: Operating performance as a function of contemporaneous institutional holdings over time

	$t = 1$				$t = 2$				$t = 3$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ROA_t	RO_ALC_t	ROS_t	$MtoB_t$	ROA_t	RO_ALC_t	ROS_t	$MtoB_t$	ROA_t	RO_ALC_t	ROS_t	$MtoB_t$
Intercept	−0.3335***	−1.4671***	−5.5594***	−3.7576***	−0.4579***	−1.8857***	−4.9124***	−2.7298***	−0.3562***	−1.1095***	−2.8866**	−2.0523***
	(−10.503)	(−6.240)	(−2.520)	(−6.590)	(−12.303)	(−7.303)	(−2.621)	(−4.960)	(−9.796)	(−4.758)	(−2.408)	(−3.382)
II_t	0.1892***	0.9787***	6.6501***	−2.1994***	0.2393***	0.9063***	5.7653***	−2.4139***	0.2393***	0.7568***	2.1015	−3.3646***
	(5.463)	(3.817)	(2.777)	(−3.450)	(5.493)	(2.999)	(2.625)	(−3.662)	(5.577)	(2.750)	(1.488)	(−4.701)
$lnMV_t$	0.0704***	0.2121***	0.6722	1.7209***	0.0866***	0.3036***	0.2514	1.4430***	0.0602***	0.1567***	0.3641	1.4292***
	(11.690)	(4.754)	(1.613)	(15.866)	(12.190)	(6.160)	(0.702)	(13.694)	(8.693)	(3.527)	(1.598)	(12.596)
$LEVER_t$	−0.0154	0.3673	0.5145	2.4897***	−0.0756*	0.1112	−0.4289	1.8017**	0.0055	0.4418*	0.8282	0.5050
	(−0.426)	(1.373)	(0.207)	(3.423)	(−1.817)	(0.385)	(−0.205)	(2.466)	(0.137)	(1.720)	(0.627)	(0.612)
Firm Age	0.0013***	0.0054**	0.0266	−0.0212***	0.0014***	0.0055*	0.0260	−0.0162**	0.0013***	0.0046*	0.0126	−0.0091
	(3.823)	(2.156)	(1.143)	(−3.313)	(3.275)	(1.821)	(1.186)	(−2.404)	(3.030)	(1.696)	(0.905)	(−1.245)
VC	−0.1639***	−0.7858***	−3.6538***	0.5550**	−0.1821***	−0.8177***	−1.5821	1.2843***	−0.1749***	−0.7807***	−2.2300***	1.3326***
	(−10.744)	(−6.955)	(−3.451)	(2.016)	(−9.201)	(−5.955)	(−1.586)	(4.297)	(−8.752)	(−6.093)	(−3.377)	(3.926)
Adj R^2	0.2993	0.1143	0.0280	0.1572	0.3147	0.1184	0.0114	0.1427	0.2745	0.0974	0.0253	0.1285
N	1549	1549	1503	1787	1449	1449	1422	1593	1252	1252	1227	1347

Panel B: Operating performance as a function of lagged institutional holdings over time

	$t=1$				$t=2$				$t=3$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ROA_t	RO_ALC_t	ROS_t	$MtoB_t$	ROA_t	RO_ALC_t	ROS_t	$MtoB_t$	ROA_t	RO_ALC_t	ROS_t	$MtoB_t$
Intercept	−0.3011***	−1.7665***	−8.7705***	−1.0209	−0.4062***	−1.9148***	−5.3744***	−0.5183	−0.3613***	−1.3107***	−3.7447***	−0.0565
	(−7.985)	(−6.621)	(−3.426)	(−1.485)	(−9.325)	(−6.626)	(−2.573)	(−0.795)	(−9.054)	(−5.299)	(−2.966)	(−0.086)
II_{t-1}	0.0954**	0.2814	4.5421*	−2.7206***	0.2475***	0.9950***	5.5250**	−2.7186***	0.2405***	0.6666**	1.7772	−3.1879***
	(2.365)	(0.985)	(1.668)	(−3.549)	(5.235)	(3.172)	(2.433)	(−3.770)	(5.349)	(2.392)	(1.250)	(−4.274)
$lnMV_{t-1}$	0.0701***	0.3237***	1.4654***	1.1400***	0.0698***	0.2881***	0.4019	0.9939***	0.0577***	0.2013***	0.5555**	0.9567***
	(10.262)	(6.693)	(3.168)	(9.166)	(8.463)	(5.266)	(1.017)	(7.996)	(7.591)	(4.272)	(2.310)	(7.692)
$LEVER_{t-1}$	0.0223	0.2676*	0.9924	1.1575***	0.0748	0.6488*	−0.8189	1.1900	0.0158	0.3314	0.5066	0.8187
	(0.999)	(1.693)	(0.655)	(2.719)	(1.468)	(1.918)	(−0.336)	(1.425)	(0.359)	(1.217)	(0.366)	(0.993)
Firm Age	0.0015***	0.0059**	0.0239	−0.0116*	0.0017***	0.0058*	0.0289	−0.0069	0.0014***	0.0050*	0.0133	−0.0042
	(4.062)	(2.342)	(1.000)	(−1.697)	(3.603)	(1.877)	(1.307)	(−0.974)	(3.172)	(1.792)	(0.948)	(−0.553)
VC	−0.1662***	−0.8257***	−3.5427***	0.3553	−0.1666***	−0.7478***	−1.5479	1.1795***	−0.1695***	−0.7685***	−2.1441***	1.3906***
	(−10.470)	(−7.351)	(−3.297)	(1.233)	(−7.982)	(−5.402)	(−1.544)	(3.749)	(−8.208)	(−6.006)	(−3.278)	(4.013)
Adj R^2	0.2403	0.1093	0.0264	0.0718	0.2346	0.1028	0.0095	0.0619	0.2367	0.0983	0.0274	0.0609
N	1520	1520	1475	1744	1450	1450	1423	1589	1258	1258	1235	1353

This table reports regression results on operating performance as a function of institutional holdings in year t (Yt) after the IPO, t = 1, 2, 3. In Panel A the independent variable is contemporaneous institutional holdings, and in Panel B the independent variable is 1-year lag of institutional holdings. *Y1* is the end of the fourth quarter following the IPO, and so on. *ROA* is operating return on assets calculated as operating income before depreciation divided by end-of-year total assets (where *OIBD* is calculated by aggregating Compustat quarterly data items *OIDPQ* over four fiscal quarters, and *ATQ* is the Compustat quarterly total asset variable from the last quarter of the relevant year relative to the IPO). *RO_ALC* is operating return on assets-less-cash calculated using Compustat data items *OIDPQ*, *ATQ* and *CHEQ*; *ROS* is the operating performance to revenue ratio, calculated using Compustat data items *OIDPQ* and *REVQ*. *MtoB* is market-to-book, calculated as the ratio of market value to book value of the firm's equity. Market value of the firm's equity is calculated as the number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). For book value of equity we use Compustat data item *SEQQ*. *II* is the fraction of institutional holdings at the end of the relevant year. Firm size, *lnMV* is calculated as the natural log of the firm's market value of equity. *LEVER* is leverage calculated as the ratio of long-term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) in the last quarter of the relevant year. All regressions include year fixed effects. *t*-statistics are reported in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

4. The long-run relation between institutional investor holdings and operating performance

In this section we use regression analysis to investigate the manner in which operating performance is related to institutional investor holdings (II holdings) in the first three years following the IPO. For operating performance we consider both naïve performance (Section 4.1) and abnormal performance relative to industry averages and medians (Section 4.2). Our findings here generally show a positive and significant relation between institutional holdings and operating performance.

4.1. Institutional investor holdings and operating performance over time

We first consider the operating performance and institutional holdings over time. Table 2 reports regression results on the contemporaneous relation between operating performance and institutional holdings in the first three years after the IPO. Panel A reports our findings using contemporaneous II holdings. Columns (1)–(3) report regression results for the first year following the IPO, where the explanatory variable is II holdings and the dependent variables are the performance variables *ROA*, *RO*_ALC, and *ROS*, respectively, controlling for size, leverage, firm age, and VC backing. As shown in the table, institutional holdings are statistically significant at the 1% level for all operating variables. In Regression 4, the dependent variable is *MtoB*. This regression indicates a negative correlation between II holdings and *MtoB*, suggesting institutions prefer value firms vs. growth firms.[14]

Columns (5)–(8), and (9)–(12) report regression results on the relation of operating performance and *MtoB* with II holdings at the end of the second and third year following the IPO, respectively. These regressions report similar results as in *Y1*. The coefficient of II holdings is positive and generally significant in explaining the three operating variables performance also in *Y2* a nd *Y3*, but the level of significance fades over time. In *Y3*, only the coefficients for *ROA* and *RO_ALC* are significant, but not for *ROS*. The relation between II holdings and *MtoB* remains negative and significant in *Y2* and *Y3*. Overall, the findings in Columns (5)–(8) and (9)–(12) of Table 2 suggest that while the relation between operating performance and II holdings may fade over time a little, institutions' preference for value firms over growth firms is persistent over time. The findings for *ROA* and *RO_ALC* are also economically significant. For example, a 1% increase in *ROA* is associated with a 5.6% increase in II holdings.[15]

If institutional investors have the skills and power to affect operating performance, it will take time for operating performance to respond to the level of institutional holdings. Accordingly, for robustness, in Panel B of Table 2 we have performed the analysis done in Panel A on the relation between operating performance and 1-year *lags* of II holdings. That is, we regress operating performance in *Yt* on II holdings in *Yt-1* for $t = 1, 2, 3$, where *Y0* is the year that ends in the last reported quarter prior to the IPO, *Y1* is the year ending in the fourth quarter following the IPO, and so on.[16] As Panel B shows, the results of this analysis were qualitatively similar, except in the first year after the IPO where *RO_ALC* is insignificant and *ROS* is only weakly significant. Overall, based on the findings in Table 2, we argue that there exists a positive and significant relation between operating performance and II holdings.

In both Panels of Table 2 the relationship between VC-backing and IPO operating performance is negative. The explanation we suggest for this negative relation is the following. VC funds generally have a period of illiquidity of a minimum of 10 years (Mulcahy, 2014). This term makes sense as it often takes years for investments in new ventures to pay off. Moreover, limited partners generally pay a 2% annual fee to the VCs on their committed capital. As a result, VC fund managers earn significant returns for themselves just waiting to see how their investments in IPOs fare. Consequently, their incentive to deliver is less and they may be less selective in constructing their portfolios. Furthermore, VC fund managers generally collect 20% of the profit from their investments, but do not participate in losses. This motivates them to invest in risky ventures and select IPO firms which are by nature risky, even if the expected return is negative. This is because they benefit from the upside of the risk, but do not suffer from its downside.

Our findings about the negative relation between VC backing and operating performance has strong support in recent industry reports using recent data (see, for example, Cambridge Associates Venture Capital Report, March 31, 2019, and HBR article "Venture capitalists get paid well to lose money," August 5, 2014). Existing academic studies use earlier data and provide partial support for our findings. Field and Lowry (2009) find lower buy-and-hold abnormal returns in the first 6 quarters (year and a half) after the IPO for VC-backed IPOs, but not afterwards. Owen and Suchard (2013) and Wang, Wang and Lu (2013) find a negative relation between VC-backing and post-IPO performance, but Nahata (2008) and Levis (2011) find this relation is positive.

4.2. Institutional holdings and abnormal operating performance over time

We next repeat the analysis in Section 4.1, replacing the three operating performance measures *ROA*, *RO_ALC*, and *ROS* with their

[14] Some earlier investigations in the literature utilize the market-to-book ratio as a measure for operating performance (e.g. Krishnan et al., 2011). Under this interpretation of *MtoB* our findings here suggest that institutions prefer poorly performing firms because the correlation between *MtoB* and II holdings is negative, in contrast to our results with the three natural operating performance measures (*ROA*, *RO_ALC*, and *ROS*). However, other studies use *MtoB* as a measure of growth opportunity (e.g. Jain & Kini, 1994. Given our findings about the natural operating performance variables, our interpretation is that II prefer value over growth.

[15] Regression (1) of Table 2 indicates that a 1% increase in II holdings results in a 0.1892% increase in *ROA*. In addition, the summary statistics (Table 1, Panel B) indicate that the average *ROA* in year 1 (*Y1*) is −3.36%. Thus, a 1% increase in II holdings is associated with an increase in *ROA* from −3.36% to −3.36% + 0.1892% = −3.17% which is a 5.6% (=0.1892%/-3.36%) increase in *ROA*.

[16] Institutional investors are not required to report their holdings before the firm becomes public. Thus, in the lagged regressions, for II holdings in *Y0*, we use the first reported II holdings, that is, the holdings in the first quarter following the IPO. This quarter is included in the operating performance of *Y1*. The overlap exists only in lagged regressions for *Y1*, and is only over one quarter.

Table 3
Abnormal operating performance as a function of lagged institutional holdings over time.

Panel A: The benchmark for operating performance is the industry value-weighted average (VW)

	t = 1			*t = 2*			*t = 3*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	AbnROA $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$	*AbnROA* $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$	*AbnROA* $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$
Intercept	−0.4441***	−1.9454***	−8.8820***	−0.5507***	−2.0892***	−5.4967***	−0.5111***	−1.4929***	−3.8738***
	(−11.859)	(−7.284)	(−3.470)	(−12.640)	(−7.233)	(−2.632)	(−12.595)	(−6.023)	(−3.067)
II $_{t-1}$	0.1036***	0.3065	4.5661*	0.2500***	1.0006***	5.5560**	0.2318***	0.6561**	1.7960
	(2.585)	(1.072)	(1.677)	(5.287)	(3.192)	(2.447)	(5.070)	(2.349)	(1.263)
lnMV $_{t-1}$	0.0681***	0.3207***	1.4556***	0.0683***	0.2847***	0.3937	0.0597***	0.2030***	0.5495**
	(10.032)	(6.625)	(3.148)	(8.284)	(5.207)	(0.997)	(7.723)	(4.299)	(2.285)
LEVER $_{t-1}$	0.0264	0.2868*	0.9604	0.0846*	0.6936**	−0.9223	0.0216	0.3709	0.4346
	(1.190)	(1.813)	(0.634)	(1.660)	(2.052)	(−0.378)	(0.483)	(1.360)	(0.314)
Firm Age	0.0015***	0.0061**	0.0244	0.0017***	0.0059*	0.0295	0.0015***	0.0052*	0.0139
	(4.243)	(2.414)	(1.021)	(3.681)	(1.929)	(1.336)	(3.357)	(1.866)	(0.997)
VC	−0.1623***	−0.8302***	−3.5618***	−0.1653***	−0.7528***	−1.5748	−0.1681***	−0.7751***	−2.1694***
	(−10.293)	(−7.383)	(−3.316)	(−7.922)	(−5.440)	(−1.570)	(−8.008)	(−6.044)	(−3.315)
Adj R^2	0.2248	0.1103	0.0266	0.2212	0.1033	0.0097	0.2278	0.1004	0.0279
N	1520	1520	1475	1450	1450	1423	1258	1258	1235

Panel B: The benchmark for operating performance is the industry median (Med)

	t = 1			*t = 2*			*t = 3*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	AbnROA $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$	*AbnROA* $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$	*AbnROA* $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$
Intercept	−0.3227***	−1.6997***	−8.6851***	−0.4617***	−1.9538***	−5.3922***	−0.4034***	−1.3464***	−3.7585***
	(−9.006)	(−6.637)	(−3.397)	(−11.128)	(−6.906)	(−2.584)	(−10.966)	(−5.607)	(−3.035)
II $_{t-1}$	0.0644*	0.2136	4.4853*	0.1921***	0.8530***	5.4043**	0.1741***	0.5040*	1.6257
	(1.678)	(0.779)	(1.649)	(4.265)	(2.778)	(2.382)	(4.203)	(1.864)	(1.166)
lnMV $_{t-1}$	0.0600***	0.2970***	1.4321***	0.0705***	0.2892***	0.3965	0.0620***	0.2103***	0.5585**
	(9.235)	(6.397)	(3.100)	(8.977)	(5.400)	(1.005)	(8.842)	(4.594)	(2.365)
LEVER $_{t-1}$	0.0033	0.2469	0.9368	0.0121	0.5754*	−0.9987	−0.0485	0.2392	0.3044
	(0.154)	(1.627)	(0.619)	(0.249)	(1.738)	(−0.410)	(−1.199)	(0.906)	(0.225)
Firm Age	0.0009***	0.0051**	0.0235	0.0011**	0.0047	0.0285	0.0009**	0.0040	0.0130
	(2.766)	(2.084)	(0.985)	(2.561)	(1.581)	(1.289)	(2.070)	(1.476)	(0.947)
VC	−0.0987***	−0.6752***	−3.3768***	−0.1035***	−0.5998***	−1.3946	−0.1079***	−0.6233***	−1.9500***
	(−6.544)	(−6.262)	(−3.147)	(−5.209)	(−4.426)	(−1.392)	(−5.675)	(−5.024)	(−3.042)
Adj R^2	0.1491	0.0878	0.0247	0.1761	0.0848	0.0082	0.1973	0.0817	0.0246
N	1520	1520	1475	1450	1450	1423	1258	1258	1235

This table reports regression results on the level of abnormal operating variables as a function of previous year institutional holdings in year *t* (*Yt*), *t* = 1, 2, 3, i.e. in the first, second and third years after the IPO. Abnormal operating performance is measured relative to two different benchmarks. In Panel A, the benchmark is the value-weighted industry average (VW) and in Panel B the benchmark is the median in the industry (Med). For industry formation, see Section III.C. The prefix *Abn* for the variable names indicates abnormal values. *ROA* is operating return on assets, calculated as operating income before depreciation divided by end-of-year total assets (where *OIBD* is calculated by aggregating Compustat quarterly data items *OIDPQ* over four fiscal quarters, and *ATQ* is the Compustat quarterly total asset variable from the last quarter of the relevant year relative to the IPO). *RO_ALC* is operating return to assets-less-cash, calculated using Compustat data items *OIDPQ*, *ATQ* and *CHEQ*); *ROS* is the operating performance to revenue ratio, calculated using Compustat data items *OIDPQ* and *REVQ*. *II* is the fraction of institutional holdings at the end of the relevant year. Firm size, *lnMV*, is the natural log of the firm's equity, where the firm's equity is calculated as the number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). *LEVER* is leverage, calculated as the ratio of long-term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) in the last quarter of the relevant year. All regressions include year fixed effects. *t*-statistics are reported in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

abnormal levels. Unlike in Section 4.1, we do not consider abnormal *MtoB*. This is because the negative correlation found between *MtoB* and II holdings suggests an interpretation of value vs. growth for this variable in our analysis. We report only the results using 1-year lagged II holdings. The results using contemporaneous II holdings are qualitatively stronger.

Table 3 reports regression results for *abnormal* operating performance as a function of lagged II holdings in the first, second, and third years following the IPO. The abnormal levels are calculated as described in Section 3.3, relative to the industry value-weighted average and the industry median.[17] In Panel A, abnormal operating performance variables *AbnROA*, *AbnRO_ALC*, and *AbnROS* are measured relative to the industry value-weighted average. Regressions (1)–(3) report the findings in *Y1* for these variables,

[17] As stated in Section 3.3, we also calculated abnormal operating performance relative to equally weighted averages. The results under equally weighted averages were weaker than the results under value-weighted average and median, but were generally significant.

respectively, controlling for size, leverage, firm age and VC backing. As can be observed, II holdings are positive and significant at the 1% level for *abnROA* and at the 10% level for *abnROS*. They are, however, insignificant for *abnRO_ALC*. Regressions 4–6 and 7–9 repeat the analysis in Regressions (1)–(3) for *Y2* and *Y3*, respectively. Here the results are stronger and are statistically significant at the 1% level, except for *AbnROS* in *Y3*. Panel B of Table 3 reports regression results on the relation between abnormal operating performance and II holdings at the end of *Y1*, *Y2* and *Y3*, respectively, where the benchmark is now the industry median (Med). The findings are similar to those reported in Panel A (the value-weighted benchmark). I.e., the coefficients of II holdings is positive and significant at the 1% level except for *AbnROS* in *Y3*. Overall, the findings in Table 3 suggest that the relation between abnormal operating performance and II holdings is positive and significant.[18]

5. The long-run relation between *changes* in institutional holdings and operating performance

In this section we repeat the analysis in Section 4, but consider changes rather than levels. Specifically, we report regression results where the dependent variable is yearly *change* in operating performance and the independent variable is yearly *change* in II holdings. We have performed the analysis for both lagged change in II holdings and contemporaneous change in II holdings but for compactness show only the findings for lagged change (The results are similar). We perform the analysis for both naïve operating performance and abnormal operating performance. However, while for naïve performance (Table 4, Panel A) we investigate the relation between change in II holdings and *change* in performance, for abnormal performance (Table 4, Panel B) we consider the relation between change in II holdings and the *level* of abnormal operating performance (rather than changes in *abnormal* operating performance). The reasoning is that abnormal performance is already a relative measure. Hence, economically, if institutional holdings affect relative performance, *abnormal* performance should capture this positive effect and there is no need to go to a second order of relativity. Similarly, in this section, we exclude *MtoB*, because as shown earlier, its interpretation as a value vs. growth proxy is well understood, whereas the change of this variable is less informative.

Panel A of Table 4 reports the findings of the relation between *change* in operating performance and *lagged change* in II holdings for year t where $t = 2, 3$. Regressions (1)–(3) of Panel A report results of regressions in which the dependent variables are *change* in measures of operating performance in *Y2* and the independent variable is *change* in II holdings over *Y1*, controlling for size, leverage, firm age and VC backing.[19] As can be observed, only a change in *RO_ALC* is positively and significantly related II holdings. Regressions (4)–(6) report similar findings on the relation of *change* in operating performance variables in *Y3* and lagged *change* with II holdings in *Y2*. Thus, the results in Panel A of Table 4 do not show a significant relation between *change* in operating performance and previous-year change in II holdings.

Next, we consider the relation between *abnormal* operating performance and change in II holdings. As in Section 4.2, we measure abnormal performance relative to both industry value-weighted average and industry median. When the benchmark is the industry median, the qualitative results are identical (same level of significance 1%, 5%, and 10%) for all performance variables. Hence, for brevity we report here the results only for value-weighted average.[20]

Panel B of Table 4 reports results of regressions in which the dependent variable is *abnormal level* of operating performance and the independent variable is the 1-year *lagged change* in II holdings and controlling for size, leverage, firm age, and VC backing. Abnormal performance is measured relative to the industry value-weighted average. Regressions (1)–(3) report the findings in *Y2*. As can be observed, unlike in Panel A, II holdings are significant at the 1% level for *AbnROA*, *AbnRO_ALC*, and at the 5% level for *AbnROS*. Regressions 4–6 report similar, but somewhat weaker findings for Y3. II holdings are significant at the 1% and 5% levels for *AbnROA*, and *AbnRO_ALC*, respectively, but are unsignificant in explaining *AbnROS*.

Thus, the analysis in Panel B of Table 4 using abnormal operating performance suggests that abnormal operating performance is positively related to lagged change in II holdings. These findings are consistent with institutional investors' presence enhancing operating performance. Furthermore, recall that in Panel A of Table 4, where changes were measured using naïve performance rather than abnormal performance, no relation was found between II holdings and operating performance. Our findings thus suggest that measuring abnormal operating performance rather than naïve operating performance provides new insights not available in naïve performance. As in measuring stock returns, abnormal performance relative to the market/industry is probably more important to investors than naïve performance.

We add one concluding note about our performance measures *ROA*, *RO_ALC* and *ROS*. Our findings in the regression analysis generally give weaker results for the last measure, *ROS*, if a relation to II holdings is found at all, both for naïve performance and abnormal performance. This is consistent with the great variability of this variable documented in Table 1 (summary statistics). We

[18] In an untabulated analysis we have also investigated whether the relation between operating performance and II holdings is industry dependent using the 10 Fama-French industries. The relation was generally similar across industries.

[19] We are abusing notation here as the first year change in II holdings is actually nine months from the first report till the fourth report. This is because we have II holdings data only from the first report since II do not have to report earlier. Still, for continuity of the operating performance measure relative to the pre-IPO period, in the first year, when measuring change in performance, we also include the quarter of the IPO, while change in II holdings is calculated only over the last three quarters of the year.Moreover, here we calculate leverage from the end of the first quarter after the IPO. For size we take the log of the market value of equity at the end of the first quarter after the IPO because market value is not available for the period prior to the IPO. Controlling for size and leverage using book values at the end of the last quarter before the IPO, instead, yields the same qualitative results.

[20] As stated in Section 3.3, we also calculated abnormal operating performance relative to equally weighted averages. The results under equally weighted averages were weaker than the results under value-weighted average and median, but generally significant.

Table 4
Operating performance and lagged *change* in institutional holdings over time.

Panel A: Change in operating performance as a function of lagged change in institutional holdings over time

	$t = 2$			$t = 3$		
	(1)	(2)	(3)	(4)	(5)	(6)
	ROA Change$_t$	*RO_ALC Change*$_t$	*ROS Change*$_t$	*ROA Change*$_t$	*RO_ALC Change*$_t$	*ROS Change*$_t$
Intercept	−0.0992**	−0.3145	3.2828**	0.0762**	0.4430**	1.0253
	(−2.423)	(−1.434)	(2.404)	(2.033)	(2.355)	(0.605)
II Change$_{t-1}$	0.0360	−0.0586	−1.7061	−0.0435	0.1326	−0.0881
	(0.799)	(−0.209)	(−1.145)	(−0.840)	(0.510)	(−0.038)
lnMV$_{t-1}$	0.0099	0.0457	−0.5537**	−0.0231***	−0.0860***	−0.0437
	(1.325)	(1.178)	(−2.240)	(−3.625)	(−2.685)	(−0.151)
LEVER$_{t-1}$	0.0022	0.1128	−1.6833**	0.0696*	−0.0006	1.6476
	(0.092)	(0.900)	(−2.126)	(1.664)	(−0.003)	(0.874)
Firm Age	0.0006*	0.0005	−0.0047	−0.0001	−0.0006	−0.0161
	(1.682)	(0.245)	(−0.382)	(−0.289)	(−0.303)	(−0.969)
VC	−0.0076	0.0418	1.6308***	0.0051	0.0897	0.7511
	(−0.448)	(0.465)	(2.874)	(0.291)	(1.020)	(0.945)
Adj R^2	0.0221	0.0028	0.0220	0.0257	0.0103	−0.0041
N	1306	1156	1261	1185	1185	1158

Panel B: *Abnormal* operating performance as a function of lagged change in institutional holdings over time

	t = 2			*t = 3*		
	(1)	(2)	(3)	(4)	(5)	(6)
	AbnROA $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$	*AbnROA* $_t$	*AbnRO_ALC* $_t$	*AbnROS* $_t$
Intercept	−0.4813***	−2.2233***	−4.2822*	−0.4728***	−1.5310***	−4.8542***
	(−9.282)	(−6.578)	(−1.767)	(−10.181)	(−5.490)	(−3.584)
II Change $_{t-1}$	0.3089***	1.3672***	5.4408**	0.2890***	0.7750**	0.6957
	(5.364)	(3.642)	(2.019)	(4.456)	(1.990)	(0.370)
lnMV$_{t-1}$	0.0632***	0.3327***	0.5370	0.0587***	0.2399***	0.8175***
	(6.735)	(5.442)	(1.224)	(7.357)	(5.005)	(3.507)
LEVER$_{t-1}$	0.0499	0.5422***	−1.7192	0.1639***	0.5746*	1.0427
	(1.638)	(2.732)	(−1.196)	(3.133)	(1.830)	(0.688)
Firm Age	0.0022***	0.0074**	0.0372*	0.0018***	0.0059**	0.0146
	(4.558)	(2.361)	(1.663)	(3.794)	(2.088)	(1.083)
VC	−0.1833***	−0.8129***	−2.0643**	−0.1545***	−0.7527***	−1.8899***
	(−8.439)	(−5.744)	(−2.027)	(−7.100)	(−5.760)	(−2.974)
Adj R^2	0.1819	0.0969	0.0081	0.1776	0.0882	0.0241
N	1418	1418	1391	1244	1244	1222

This table reports regression results on the operating performance variables as a function of the change in institutional holdings in year t (*Yt*) for $t = 1, 2, 3$. In Panel A the dependent variable is change in operating performance and in Panel B the dependent variable is abnormal operating performance. Columns (1)–(4), (5)–(8), (9)–(12) report the findings for $t = 1$, $t = 2$, and $t = 3$, respectively. *ROA* is operating return on assets, calculated as operating income before depreciation divided by end-of-year total assets (where OIBD is calculated by aggregating Compustat quarterly data items *OIDPQ* over four fiscal quarters, and ATQ is the Compustat quarterly total asset variable from the last quarter of the relevant year relative to the IPO). *RO_ALC* is operating return on assets-less-cash, calculated using Compustat data items *OIDPQ*, *ATQ* and *CHEQ*. *ROS* is the operating performance to revenue ratio, calculated using Compustat data items *OIDPQ* and *REVQ*. *MtoB* is market-to-book, calculated as the ratio of market value to book value of the firm's equity. Market value of the firm's equity is calculated as the number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). For book value of equity we use Compustat data item *SEQQ*. *II* is the fraction of institutional holdings at the end of the relevant year. Firm size, *lnMV* is the natural log of the firm's equity, where the firm's equity is calculated as the number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). *LEVER* is leverage calculated as the ratio of long-term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) in the last quarter of the relevant year. All regressions include year fixed effects. *t*-statistics are reported in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

believe that this reflects that while *ROS* could be a good performance measure for mature firms as has been shown in earlier studies (e.g. Grullon & Michaely, 2004), it is not a good measure for IPO firms, as there is great variability in their revenue and earnings since they are typically young and growth-oriented firms.

6. Extensions and robustness tests

6.1. Institutional holdings and abnormal stock return

If institutional holdings are positively related to operating performance, they should also be positively related to stock returns, as

stock prices respond to changes in operating performance. Furthermore, stock returns may reflect not only operating performance but also expectations for change in performance. In this section we consider the relation between institutional holdings and stock returns. While we find that the contemporaneous relation between institutional holdings and stock return is positive (like the relation to operating performance), the relation in lags is asymmetric: institutional holdings are positively related to lagged returns, but stock returns are unrelated or negatively related to lagged institutional holdings.

We first calculate buy-and-hold abnormal stock returns for all IPOs in the sample for 1-year, 2-years, and 3-years from the IPO, as well as 1-year abnormal returns for each of the three years after the IPO, based on CRSP data. Then we investigate the relation between these buy-and-hold returns and institutional holdings.

Table 5 reports our findings. Panel A considers the contemporaneous relation. In Columns (1)–(3) of the panel, the dependent variables are the 1-year, 2-year, and 3-year buy-and-hold abnormal stock return following the IPO, respectively. The independent variable in all three regressions is initial institutional holdings, that is, institutional holdings at the end of the first quarter after the IPO. In all regressions we control for firm size, leverage, firm age, and VC backing. As can be seen, the buy-and-hold returns are unrelated to the initial institutional holdings right after the IPO. In particular, the results in Regression (1) for stock returns are consistent with our findings in Table 2 that the first-year operating performance is unrelated to institutional holdings immediately following the IPO.

In Columns (4)–(6), the year-*t* buy-and-hold abnormal returns are regressed over end of year-*t* institutional holdings for years $t = 1$, 2, and 3 after the IPO, respectively. As can be seen, in each of the three years considered, institutional holdings are positive and significant in explaining buy-and-hold abnormal returns. In Regressions 7–9 we repeat the analysis performed in Regressions 4–6 replacing II holdings at the end of year *t* with *change* in institutional holdings over year *t*. The findings here suggest that buy-and-hold abnormal returns are also related to change in institutional holdings in each of the first three years after the IPO.

In Panel B of Table 5 we repeat the analysis in Regressions 4–9 of Panel A using lagged regressions. In Columns (1)–(2) of the panel the dependent variable is buy-and-hold abnormal stock returns over years 1 (*Y1*) and 2 (*Y2*), respectively, and the independent variables are the 1-year lagged institutional holdings. Regression (1) suggests that year 2 buy-and-hold abnormal returns are unrelated to year 1 institutional holdings, while Regression (2) suggests that year 3 abnormal returns are even negatively related to year 2 institutional holdings. In Regressions 3–4 of Panel B we swap the variables and the dependent variable is now institutional holdings in years 2 and 3, respectively, whereas the independent variable is the 1-year lagged buy-and-hold abnormal return. Both regressions suggest that the relation between institutional holdings and lagged abnormal return is positive.

In Columns (5)–(8) of Panel B we repeat the analysis performed in Columns (1)-(4) with institutional holdings growth (change) replacing institutional holdings. The results here are similar: while abnormal returns are unrelated or negatively related to lagged change in institutional holdings, institutional holdings change is positively related to lagged abnormal stock return.

The results in Panel B provide interesting insights. Earlier studies clearly document that institutional investors have an information advantage in the IPO that they exploit in the IPO process (see literature review section). Our findings here suggest that once the firm is public, they no longer have an information advantage. This is because they are not able to buy before the price increases. In fact, they tend to buy after good stock market performance, not before. So while our analysis suggests that after the IPO, institutional investors' holdings are related to operating performance, we do not find that institutions have the ability to time the market after the firm becomes public. These findings are consistent with evidence that institutional investors are not good stock pickers; see, for example, Lowellen (2011) and Edelen et al. (2016).

6.2. Identification

To alleviate the concern of endogeneity we utilize a regression discontinuity design (RDD). The rationale behind RDD is that it can exploit exogenous characteristics of the intervention to elicit causal effects by considering subjects around some exogenous cut-off. Variation around the cut-off is less likely to stem from endogeneity. We follow the literature and look for shocks to institutional ownership associated with Russell index reconstitutions which are presumably exogenous. Specifically, because the reconstitutions are generally hard to predict, this shock in holdings is likely exogenous (see, for example, Chang, Hong, & Liskovich, 2015; Bird & Karolyi, 2016, and Kahn, Srinivasan, & Tan, 2017). If a shock to institutional holdings that is caused by the index reconstitution is associated with a change in operating performance, then endogeneity is less likely.

The Russell 1000 index includes the largest 1000 public firms, while the next largest 2000 firms are in the Russell 2000 index. Together, they are the Russell 3000 index. The literature generally uses the 2000/1000 threshold to test for the shock for II holdings. This is because when a firm moves from the Russell 1000 down to the Russell 2000 around the 1000/2000 threshold, it moves from having a small weight in the Russell 1000 to a large weight in the Russell 2000 index. As a result, institutions that invest in indices will increase their holdings following the shock.

Because our sample consists of IPO firms, many of our firms are too small to be included in the Russell 3000 at all. Hence, most of them are too small to reach the 2000/1000 threshold. To adapt the RDD design to our sample, we thus consider all inclusions in the Russell 2000 index following the index reconstitutions; inclusions from below and from above. That is, we consider firms that move into and out of the Russell 3000, and firms that move into the Russell 2000 from the Russell 1000. The rationale is that both are associated with an increase in II holdings. Specifically, moving from Russell 1000 to Russell 2000 results in an increase in institutional holdings because the increase in the firms' weight in the index as explained above, while moving into the 2000 from below, is also associated with an increase in institutional holdings because the Russell indices are mimicked by many institutional investors (Kahn et al. (2017)) and, therefore, the annual reconstitution leads to changes in institutional holdings that are plausibly exogenous to the firm, not just when a firm moves around the 2000/1000 threshold, but also when it moves into the Russell 2000 from below

Table 5
Abnormal long-run stock returns and institutional holdings.

Panel A: *Abnormal* long-run stock returns and contemporaneous institutional holdings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	B&H 1-year	*B&H 2-year*	*B&H 3-year*	*B&H t = 1*	*B&H t = 2*	*B&H t = 3*	*B&H t = 1*	*B&H t = 2*	*B&H t = 3*
Intercept	−0.1080	−0.2233	−0.2347	−0.0325	0.1092	0.5633	0.0548	0.0920	0.5359***
	(−1.138)	(−1.486)	(−1.177)	(−0.351)	(1.084)	(4.621)	(0.600)	(0.938)	(4.679)
II $_{Q1}$	−0.1652	−0.1161	−0.2389						
	(−1.575)	(−0.699)	(−1.084)						
II $_{t}$				0.7449***	0.7269***	0.6261***			
				(8.674)	(7.170)	(4.657)			
II Change $_{t}$							1.2777	1.5392	2.0472
							(12.467)	(11.440)	(10.892)
lnMV $_{t-1}$	0.0506***	0.0700***	0.0984***	−0.0083	−0.0580***	−0.1133***	−0.0066	−0.0188	−0.0668***
	(2.949)	(2.575)	(2.727)	(−0.479)	(−2.963)	(−4.868)	(−0.396)	(−1.100)	(−3.586)
LEVER $_{t-1}$	−0.1049*	−0.0923	−0.1169	−0.1392**	−0.0570	−0.1369	−0.0920*	−0.0157	−0.0063
	(−1.843)	(−1.025)	(−0.977)	(−2.528)	(−0.476)	(−1.000)	(−1.708)	(−0.134)	(−0.048)
Firm Age	0.0010	0.0021	0.0023	−0.0003	0.0004	−0.0006	0.0006	0.0010	−0.0001
	(1.0297)	(1.4641)	(1.1922)	(−0.3399)	(0.3844)	(−0.4542)	(0.7383)	(0.9668)	(−0.0486)
VC	−0.0733*	0.0551	0.0802	−0.0870**	0.0897*	0.0397	−0.1106***	0.0719	0.0395
	(−1.8364)	(0.8720)	(0.9562)	(−2.2467)	(1.8468)	(0.6171)	(−2.9110)	(1.5101)	(0.6467)
Adj R2	0.0739	0.0737	0.0367	0.1094	0.0797	0.0506	0.1465	0.1211	0.1077
N	1813	1813	1813	1787	1682	1468	1787	1678	1466

Panel B: *Abnormal* long-run stock returns and institutional holdings in lags

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	B&H t = 2	*B&H t = 3*	*II t = 2*	*II t = 3*	*B&H t = 2*	*B&H t = 3*	*II Growth t = 2*	*II Growth t = 3*
Intercept	−0.0328	0.2748**	−0.0816***	−0.1615***	−0.0592	0.3316***	−0.0147	−0.0188
	(−0.293)	(2.339)	(−2.831)	(−5.909)	(−0.527)	(2.824)	(−0.707)	(−1.065)
II t-1	−0.0883	−0.3597						
	(−0.854)	(−3.043)						
B&H t-1			0.0906***	0.0728***			0.0346***	0.0361***
			(12.406)	(11.134)			(6.626)	(8.579)
II Change t-1					−0.2961**	0.0119		
					(−2.351)	(0.074)		
LnMV t-1	0.0177	0.0018	0.0718***	0.0882***	0.0229	−0.0309	0.0075**	0.0003
	(0.844)	(0.080)	(13.885)	(18.767)	(1.124)	(−1.511)	(2.009)	(0.093)
LEVERQ t-1	0.0490	−0.0482	0.0485***	0.0161	0.0408	−0.0727	0.0086	−0.0467**
	(0.739)	(−0.345)	(2.823)	(0.504)	(0.616)	(−0.519)	(0.698)	(−2.275)
Firm Age	0.0012	0.0001	0.0015***	0.0014***	0.0011	−0.0003	0.0002	0.0001
	(1.1202)	(0.1053)	(5.5471)	(4.7314)	(1.0362)	(−0.2297)	(0.9328)	(0.4415)
VC	0.1190**	0.0727	0.0398***	0.0360***	0.1252***	0.0584	0.0297***	0.0036
	(2.5507)	(1.2826)	(3.2782)	(2.7438)	(2.6817)	(1.0243)	(3.4199)	(0.4248)
Adj R2	0.0474	0.0342	0.3944	0.4523	0.0500	0.0287	0.1042	0.0716
N	1787	1682	1640	1468	1787	1678	1638	1466

This table reports regression results on the relation between abnormal stock return and institutional holdings. In Panel A the dependent variable in all regressions is buy-and-hold abnormal stock return for different time periods. Abnormal returns are measured using a model that is based on the three Fama-French factors and the Carhart (1997) momentum factor (4-factor alpha). In Columns (1)–(3) the independent variable is II holdings at the end-of *Q1* after the IPO while the dependent variable is buy-and-hold abnormal return over 1, 2, and 3 years after the IPO, respectively. In Columns (4)–(6) the year-*t* buy-and-hold abnormal return is regressed over end-of-year-*t* II holdings for years *t* = 1, 2, and 3 after the IPO, respectively. In Regressions 7–9 we repeat the analysis performed in Regressions 4–6, replacing II holdings at the end of year *t* with *change* in II holdings over year *t*. In Panel B we consider the relation in lags. In Regressions (1)–(2) of the panel the dependent variable is buy-and-hold abnormal stock return over years 1 and 2, respectively, and the independent variables are the 1-year lagged institutional holdings. In Regressions 3–4 of Panel B the dependent variable is institutional holdings in years 2 and 3, respectively, and the dependent variable is the 1-year lagged buy-and-hold abnormal return. In Columns (5)–(8) of Panel B we repeat the analysis performed in Columns (1)–(4) of this panel, with institutional holdings growth replacing institutional holdings. In both Panels A and B, in all regressions, we control for firm size and leverage as follows: Firm size, *lnMV*, is the natural log of the firm's equity, where the firm's equity is calculated as number of shares outstanding (Compustat data item *CSHOQ*) times share price (Compustat data item *PRCCQ*). *LEVER* is leverage, calculated as the ratio of long-term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) in the last quarter of the relevant year. All regressions include year fixed effects. *t*-statistics are reported in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 6
. Identification.

	(1)	(2)	(3)	(4)
	II	*ROA*	*RO_ALC*	*ROS*
Intercept	−0.05202***	−0.4833***	−1.9433***	−5.8377***
	(−5.19967)	(−24.094)	(−14.660)	(−5.941)
Est_II	–	0.5439***	2.0810***	7.5014***
		7.647	4.427	2.149
D	0.1753***	–	–	–
	27.000			
LnMV	0.0653***	0.0545***	0.1548***	0.2801
	34.820	8.196	3.521	0.862
LEVER	0.0454***	0.0680***	0.7579***	1.7851
	4.307	2.981	5.028	1.605
Adj R^2	0.2974	0.2272	0.0787	0.0126
N	6687	4296	4296	4195

This table reports the results of regression discontinuity design (RDD) analysis. Column (1) reports the results of the first step of the analysis. The dependent variable is II holdings. *D* is a dummy variable that takes on the value of 1 when the firm is in the Russell 2000 and the value of 0 otherwise. *lnMV* is firm size, calculated as the natural log of the firm's market value of equity. *LEVER* is leverage, calculated as the ratio of long-term debt (Compustat data item *DLTTQ*) to total assets (Compustat data item *ATQ*) in the last quarter of the relevant year. Columns (2)–(4) report the results of the second stage of the RDD analysis. Here, *Est_II* is the estimate of II holdings using the first stage of the analysis (from Column (1)). *ROA* is operating return on assets, calculated as operating income before depreciation divided by end-of-year total assets (where OIBD is calculated by aggregating Compustat quarterly data items *OIDPQ* over four fiscal quarters, and *ATQ* is the Compustat quarterly total asset variable from the last quarter of the relevant year relative to the IPO). *RO_ALC* is operating return on assets-less-cash, calculated using Compustat data items *OIDPQ*, *ATQ* and *CHEQ*. *ROS* is the operating performance to revenue ratio, calculated using Compustat data items *OIDPQ* and *REVQ*. All regressions include year fixed effects. *t*-statistics are reported in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

(i.e. into the Russell 3000 index), as many institutions limit their investment to index-included firms.[21] The key to the RDD identification strategy is to show that a discontinuous jump in institutional ownership at the threshold is followed by a similar discontinuous jump in operating performance at the threshold.

We adapt the RDD in Bird and Karolyi (2016) to our IPO sample. That is, we use a two stage model. In the first step (Eq. (1)) we estimate II holdings

$$II_{i,t} = \alpha + \tau D_{i,t} + \pi X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where *IIi,t* is institutional holdings in firm *i* and year *t*. *Di,t* is an indicator variable that equals one if firm *i* is assigned to the Russell 2000 Index in year *t* and zero otherwise. X*i,t* represents controls, where controls are size (*lnMV*) and leverage (*LEVER*). Observations from all three years after the IPO are included in this regression, resulting in 6687 observations. The regression includes year fixed effects, and year relative to IPO fixed effects.

In the second step (Eq. (2)), we use the estimate from the first stage, *Est_II*, to estimate *OP*, the three operating performance measures (*ROA*, *RO_ALC*, and *ROS*).

$$OPi,\ t = \beta_0 + \beta_1 Est\_IIi,\ t + \beta_2 Xi,\ t + \ \varepsilon i,\ t \quad (2)$$

Here, too, observations from all three years are included in the regression. Our results are reported in Table 6. Column (1) reports the results of the first-stage regression. It shows that τ, the coefficient of *Di,t*, is indeed positive and significant. That is, firms in the Russell 2000 tend to have higher institutional ownership relative to firms outside the Russell 2000 (i.e. firms in the Russell 1000, and firms outside the Russell 3000). Columns (2)–(4) of Table 6 report the results of the second-stage regressions for *ROA*, *RO_ALC* and *ROS*, respectively. As can be seen, the coefficient of *Est_IIi,t* is positive and significant for all three operating performance variables. While not tabulated, results using abnormal operating performance are qualitatively similar. The findings in Table 6 thus support institutional ownership affecting operating performance.

7. Conclusion

We investigate the post-issue relation between institutional holdings and operating performance in IPO firms. During the first year after the IPO, average institutional holdings increase from 24% to 36% of shares outstanding and stabilize at about 42% by the end of the second year. We also find that post-IPO operating performance is positively related to institutional holdings. This relation is robust. It holds also when we consider abnormal operating performance, and when we consider changes rather than levels of institutional holdings and operating performance. The relation however subsides towards the third year after the IPO. Overall, our findings indicate that institutional ownership is a valid indicator of the firm's operating performance in its initial years as a public

[21] The 2000/1000 threshold provides a leaner test than entering the Russell 2000 from below because entering the Russell 2000 from below is associated with larger firm size, which is not the case for the 2000/1000. Because we control for firm size we do not view this as a major flaw in the research design.

company. The analysis of abnormal performance in addition to naïve performance at times identifies relations that are not detected by naïve performance alone. Although other adjustments have been used in the literature (e.g. matched sample), these findings, suggest that the use of abnormal operating performance in addition to naïve operating performance can enrich robustness in operating performance investigations. Furthermore, while earlier studies find that institutions are able to benefit from their investments in IPOs, we here find that after the firm becomes public, institutions do not have the ability to time the market in IPO stocks.

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