



ELSEVIER

Journal of Financial Economics 66 (2002) 241–269

JOURNAL OF  
Financial  
ECONOMICS

www.elsevier.com/locate/econbase

# Stocks are special too: an analysis of the equity lending market<sup>☆</sup>

Christopher C. Geczy<sup>a</sup>, David K. Musto<sup>a,\*</sup>, Adam V. Reed<sup>b</sup>

<sup>a</sup>*The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA*

<sup>b</sup>*The Kenan-Flagler Business School, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA*

Received 18 June 2001; accepted 2 January 2002

---

## Abstract

With a year of equity loans by a major lender, we measure the effect of actual short-selling costs and constraints on trading strategies that involve short-selling. We find the loans of initial public offering (IPOs), DotCom, large-cap, growth and low-momentum stocks to be cheap relative to the strategies' documented profits and that investors who can short only stocks that are cheap and easy to borrow can enjoy at least some of the profits of unconstrained investors. Most IPOs are loaned on their first settlement days and throughout their first months, and the underperformance around lockup expiration is significant even for the IPOs that are cheap and easy to borrow. The effect of short-selling frictions appears strongest in merger arbitrage. Acquirers' stock is expensive to borrow, especially when the acquirer is small, though the major influence on trading profits is not through expense but availability.

© 2002 Elsevier Science B.V. All rights reserved.

*JEL classification:* G12; G21; G34

*Keywords:* Short-selling; Security lending; IPO; Merger arbitrage

---

---

<sup>☆</sup>The authors thank Malcolm Baker, Alon Brav, Mark Carhart, Domenico Cuoco, Gary Gorton, Don Keim, Matt Richardson, Jay Ritter, Jason Segal, Shiv Srinivasan, Rob Stambaugh, an anonymous referee and seminar participants at Berkeley, Chicago, Northwestern, NYU, Temple, UNC Chapel Hill, the Q Group Meeting in Scottsdale, AZ, and Goldman Sachs Asset Management for helpful comments and advice, and Sam Byun, Wes Gray, Victoria Von Krause, and Xiaoting Zhu for outstanding research and computing assistance. We are grateful for financial support from the Q Group and the Rodney L. White Center for Financial Research.

\*Corresponding author.

*E-mail address:* musto@wharton.upenn.edu (D.K. Musto).

0304-405X/02/\$ - see front matter © 2002 Elsevier Science B.V. All rights reserved.

PII: S 0 3 0 4 - 4 0 5 X ( 0 2 ) 0 0 2 2 5 - 8

## 1. Introduction

The finance literature identifies a number of situations in which one asset appears overvalued relative to another, in the sense that an investor apparently profits from shorting the first asset and buying the second, if shorting the first asset is feasible and sufficiently cheap. Yet it is well known and acknowledged in the literature that short positions can be expensive or impossible and can be involuntarily terminated. So the feasibility and expense of realizing overvaluations through short-selling is an important open question. We address this question with a unique new database that allows us to track the performance of long/short trading strategies subject to the actual short-selling costs and constraints that applied. By the same token, it shows us the revenue that holders of the short-sold assets could have earned by lending, rather than selling, their shares.

The database is a year of equity loans by one of the world's most active lenders. An investor must generally borrow shares he shorted to give his buyer what she paid for. Thus the cost, availability, and dependability issues related to shorting generally result from the pricing, availability, and termination of these equity loans. Our database contains every U.S. equity loan by our data provider from November 1998 to October 1999, complete with loan size, pricing, and end date. Because the data are daily, they allow us to replicate short-selling strategies subject to actual stock-by-stock short-selling constraints on the correct days. When a strategy calls for shorting a particular stock, we observe directly whether our data provider loaned the stock, and on what terms, so we can judge whether the short-sale was feasible, and if so, at what cost. In particular, we can observe the short exposure available to investors who can borrow the expensive-to-borrow stocks, known as "specials," that our data provider loaned, we observe their borrowing expense, and we can observe the short exposure available to investors who cannot borrow such stocks.

After an overview of relevant regulation and institutional features, we provide summary statistics on our sample loans and then address trading strategies. From the literature, we collect several strategies that involve short-selling. We then replicate each strategy at three levels of access to equity loans: one that represents the poor access of a small retail investor by assuming that specials are unavailable, one that represents the good access of a major institution by assuming that specials are available at wholesale, and one that represents the standard assumptions of the literature by imposing zero costs and constraints. The empirical question is how the returns enjoyed at the first two access levels compare to the returns enjoyed at the third.

Our first strategies come from the factor-pricing literature, which finds high average returns for portfolios short in big stocks and long in small stocks, for portfolios short in growth stocks and long in value stocks, and for portfolios short in low-momentum stocks and long in high-momentum stocks. We replicate these strategies at the three access levels and find that the expected return differences between the constrained and unconstrained strategies are too small to offset the documented profits to the unconstrained strategies. The result is significant at the 10% rejection level for value minus growth at the poor access level; otherwise, it is significant at 5% or better.

The next strategy we consider is short-selling internet-oriented stocks, i.e. DotComs. Our sample period covers a time when DotComs rose substantially and traded at prices much higher than shortly before or after. One potential explanation for the high prices is that DotComs were difficult or expensive to short. We find, however, that short exposure to these stocks was available to investors with either poor or good access to equity loans. We do find that the expensive-to-borrow DotComs were generally more sensitive to the index than other DotComs were, but their wholesale cost was small relative to DotCom fluctuations.

Initial public offerings (IPOs) raise several questions relevant to equity loans. The most basic is the feasibility of shorting them. We find that investors with good access can short most IPOs at first, but investors without access to specials can short none of them. After about a month, at least a quarter of IPOs are available to investors without access to specials. Wholesale borrowing costs for short-selling IPOs, and therefore lending revenue to those holding IPOs, are around 3%/year at issuance and drop in 25 trading days to 1.5%/year, so they do not come close to offsetting the approximately 5%/year underperformance of IPOs studied by Loughran and Ritter (1995). We also address underperformance by constructing an index of the least seasoned stocks that have been public for 6–12 months, IPOs in which Loughran and Ritter (1995) show underperformance. For an investor with access to our data provider's specials, the specialness cost of this index is only 0.44%/year, and we can reject the hypothesis that none of the profits in Loughran and Ritter (1995) are available. This hypothesis is rejected, at a lower significance level, even for investors with no access to specials.

We also address the underperformance, found in several recent papers, around IPO insider-lockup expirations. The pattern is strong and significant in the full sample of IPOs, and also in the subsamples of IPOs that can be borrowed with either good or poor access to equity loans. Borrowing costs for these trades are trivial.

Finally, we investigate the cost and feasibility of capturing the average returns of merger arbitrage. The standard trade is to buy the target and short the acquirer (see, e.g., Baker and Savasoglu, 2002). We find that the incidence of share loans of the acquirer by our data provider is generally low, and that merger arbitrage profits are greatly reduced—though still large—in our sample period when investors can borrow only when our data provider lends. The expense of borrowing an acquirer increases as the market capitalization of the acquirer decreases, but its effect on profitability is small relative to the effect of not being able to borrow expensive-to-borrow stocks.

The rest of the paper is in six sections. Section 2 gives some background and describes our data, Section 3 covers factor portfolios, Section 4 covers DotComs, Section 5 covers IPOs, Section 6 covers merger arbitrage, and Section 7 concludes.

## **2. Background and data description**

### *2.1. Overview of equity loans and the data*

An equity loan is a temporary swap of ownership. The equity lender transfers legal ownership (including voting rights) of a block of shares to the borrower, who

simultaneously transfers collateral. Collateral is almost always cash, and the standard collateral for U.S. equities is 102% of the shares' value. At the loan origination the parties negotiate a *rebate rate*, which is the amount of interest on the collateral that the lender will rebate to the borrower. The equity-borrower therefore is also a *lender* of cash, and the rebate rate is his interest on this loan. Most loans are on a continuing basis, meaning they are subject to renegotiation and to termination by either party every day. Term loans, which are *not* open to renegotiation until a specific future date, are also available.

Under Regulation T, the permitted purposes for equity loans are facilitating short-sales and covering failed deliveries (12 C.F.R. §220.10(a)). U.S. equity transactions settle  $t + 3$ , which means that if an investor short sells equities on trading day  $t$  and does not cover by the close of trading then shares must be delivered to his counterparty on trading day  $t + 3$ . Equity *loans* settle  $t + 0$ , so the standard way to acquire the needed shares is to borrow them on  $t + 3$ . Similarly, if an investor buys on  $t$  but his counterparty is unable or unwilling to deliver shares, he can receive shares anyhow through an equity loan on  $t + 3$ .

Equity loans are intermediated by brokers. If an investor wants to short  $n$  shares of a hard-to-borrow stock, the investor's broker generally must have a *locate* on  $n$  shares. This means that the broker has contacted an equity lender who agrees (though does not commit) to loan  $n$  shares three days later.<sup>1</sup> The set of potential lenders is large and loosely organized, so there can be an opportunity cost, which a broker may not wish to expend on small orders or customers, to locating shares.

Our data provider is a custodian bank, acting as a lending agent for its custodial clients (mutual funds, pension funds, etc.). Its borrowers are generally, if not always, broker/dealers borrowing shares as required by short-sales or delivery problems. Since the broker/dealers are free to charge mark-ups, the prices we observe are best viewed as wholesale, lower-bound prices. By the same token, they are upper bounds for the lending revenue that the custodial clients enjoy, since lending agents make money.

The data are the terms of every equity loan that was outstanding on any day from November 1998 through October 1999 (the "sample period"), a total of 249 trading days in the equity-loan market. For every day of every loan we have the number of shares and the current rebate rate. There are 273,225 separate loans, with a median duration of three trading days, and 7,144 different stocks appear at least once. On an average day, loans of 3,170 stocks are outstanding.

---

<sup>1</sup>During our sample period, NYSE Rule 440C and NYSE Information Memorandum 91-41 (1991) require affirmative determination (a locate) of borrowable or otherwise attainable shares for members who are not market makers, specialists, or odd-lot brokers in fulfilling their market-making responsibilities. NASD Rule 3370 and NASD Rules of Fair Practice, Article III, Section 1, Interpretation 04 Paragraph (b)(2)(a) (See Ketchum, 1995, and SEC Release No. 34-35207 (Securities and Exchange Commission, 1995)), and, for the AMEX, Securities Exchange Act Release No. 27542 require affirmative determination of borrowable shares during the period treated in the paper (SEC Release No. 34-37773 (Securities and Exchange Commission, 1996)).

The database does not distinguish continuing and term loans, but we were advised that very few of the loans are term.<sup>2</sup> Accordingly, we assume that all loans are continuing, which allows us to interpret the rebate of a given loan on a given day as the rebate that would have been negotiated for a loan originated that day, even if the loan was not originated that day.

## 2.2. *Related literature*

The sections of this paper describe several causes of expensive borrowing in the equity lending market: initial public offerings, merger arbitrage strategies, and fundamental stock characteristics. Each section discusses literature specific to its topic, and this section describes the literature relevant to equity lending in general. Because equity loans and short selling are tightly linked, the short-selling literature is closely related to this work. This paper, however, is fundamentally different. We address the availability and pricing of equity loans, while most of the extant short-selling literature is concerned with their aggregate quantity. The study most similar to ours is that of Krishnamurthy (2001), who replicates the new bond/old bond Treasury-market arbitrage subject to the actual cost of borrowing the new bond.

The literature has identified several explanations for the quantity of short-sales. MacDonald and Baron (1973) show that stocks with more idiosyncratic risk have higher short interest. Brent et al. (1990) find that stocks with traded options, convertible securities, or high betas tend to have high short interest. In addition, as evidence of strategies using short-selling for tax purposes, they find that short interest follows a seasonal pattern. Gintschell (2000) documents an association between short interest on Nasdaq stocks and the stocks' float. Dechow et al. (2001) find that stocks with low ratios of accounting performance measures to market value tend to have higher short interest. Safieddine and Wilhelm (1996) show an increase in short interest around the issuance of seasoned equity offerings. Richardson (2000) finds no increase in the short interest of high accrual firms even though high accruals predict future underperformance.

In contrast to explaining the causes of short selling, a set of papers has examined the consequences of short-selling. The effect of short selling on stock prices has been examined in papers dating back to Seneca (1967), who shows that high aggregate short interest is associated with lower returns for the S&P 500. Similarly, Figlewski (1981) finds that short interest is negatively correlated with future excess returns. Asquith and Meulbroek (1996) find that a portfolio of firms with high short interest underperforms the market over short and long horizons. Senchack and Starks (1993) find that intra-daily decrease in stock prices after the announcement of higher than

---

<sup>2</sup>Lending agents sometimes must retain the option to terminate loans with five day's notice (see D'Avolio, 2001), which prevents them from explicitly guaranteeing longer terms. Yet they can structure the lending fee as a back-end charge, to be paid only if the loan is not prematurely terminated, and keep the loan going, when the original shares are needed back, by borrowing from elsewhere or by simply buying. At least one of the lenders we have contacted structures term loans this way.

expected short interest. Using Nasdaq short interest, Desai et al. (2000) find similar results, and they find an increase in the probability of delisting for firms with high short interest. Introduction of stock options gives investors indirect access to short-sales with lower transactions costs, which Sorescu (2000) and Danielsen and Sorescu (2001) associate with price drops.

Short-sale constraints have also generated a long history of theoretical research. Miller (1977) and Figlewski (1981) both hypothesize that short-sale constraints lead to upward biases in stock prices, as pessimistic investors are restricted from short-selling. Diamond and Verrecchia's (1987) rational expectations model shows that stock prices will not be biased if market participants know that short-selling is restricted, but informational efficiency will be reduced. In a model in which some investors' information is hidden, Hong and Stein (2001) show that large price movements and left-skewness can be a result of short-sale constraints. Two recent papers, D'Avolio (2001) and Duffie et al. (2001), describe the equity lending market theoretically.

Several recent papers use data from the equity-loan market. Reed (2001) measures the impact of costly short-selling on the informational efficiency of stock prices, verifying Diamond and Verrecchia's (1987) hypothesis that short-sale restrictions lead to stock price distributions with higher values and more left-skewness as information is announced. Ofek and Richardson (2001) demonstrate that rebates are generally lower for internet stocks in early 2000, Mitchell et al. (2001) show extremely low rebates for stocks in equity carve-out transactions, and D'Avolio (2001) relates the cross section of end-of-month specialness to a variety of stock-specific characteristics. Jones and Lamont (2001) show that specials had relatively low future returns in the years around the 1929 crash.

### 2.3. Specialness

In the Repo market there is a *General Collateral*, or GC, interest rate that applies when the repurchased bond is not scarce (see Duffie, 1996). When a bond is *on special*, the applicable rate is below the GC rate, and the shortfall is the bond's *specialness*. The same terminology and measurement applies in the equity market, except that the interest rates in Repos correspond to rebate rates in equity loans, so we can identify GC stocks and specials, and calculate specialness, using our rebate data.

To infer *market* specialness from the loans in the database, we must first identify and remove the transaction-specific effect of our data provider's volume discounting. Specifically, our data provider sorts all loans by dollar amount into Large, Medium, and Small,<sup>3</sup> then prices Large loans relative to a Large GC rate, Medium loans relative to a Medium GC rate, and Small loans on a case-by-case basis. To determine a stock's market specialness, we must first determine the Large and Medium GC rates for each day and then compare the rebates for Large and Medium loans to their respective GC rates. Small loans by our data provider are not

---

<sup>3</sup>The dollar-value breakpoints between loan sizes are proprietary.

usable for determining market specialness because there is no benchmark Small GC rate.<sup>4</sup>

Because few stocks are special on a given day, the GC rate for a given loan size and day is easily apparent as the mode for that size and day. For each day, we calculate the mode rebate for Large loans and for Medium loans and count the number of loans at, below, and above their respective modes. The results, in Table 1, show 98% and 76% of Large and Medium loans, respectively, at their modes. We define the Large and Medium GC rebates to be these modes. They are very close to standard overnight market rates; the Large GC rate is 8 bp below the Federal Funds Effective Rate, on average, and the Medium GC rate is 15 bp below.

There are often several loans of a given stock on a given day, and these loans may imply different amounts of specialness. To arrive at a single specialness number, we calculate the specialness of each loan, i.e., the GC rate for the loan's size minus the loan's rebate rate,<sup>5</sup> and take the value-weighted average across the loans. We define a stock to be *on special* on a given day if its specialness on that day is observable and more than 25 bp. Interest rebates, and therefore specialness costs, are calculated on an interest-bearing basis. For example, if an investor borrows \$1MM of stock with a specialness of 250 bp for seven calendar days, the specialness cost (with 102% collateral) is  $(\$1.02\text{MM})(0.025)(7/360) = \$496$ .

#### 2.4. Estimating short-sale constraints from the database

The major empirical question we address with the measurements of market specialness is how they affect the returns to trading strategies that involve short selling. We do this by calculating trading-strategy returns at three levels of access to equity loans, making the usual assumption that all transactions are at the market close. Short selling at the close of day  $t$  necessitates an equity loan on day  $t + 3$ , so an investor needs to borrow on  $t + 3$  to earn  $-1$  times a stock's  $t + 1$  return. This means that the short-selling time series we can create lag our sample period by two trading days, i.e. from the 10/28/98–10/29/98 return through to the 10/26/99–10/27/99 return. The three access levels are *Unconstrained*, which allows shorting of any stock at no cost, *GC Only*, which allows borrowing only of GC stocks, and *GC + Specials*, which allows borrowing of specials as well, for which the specialness cost must be paid.

The *GC Only* access level approximates the situation of a small retail investor by assuming zero access to any stock we do not observe to be GC. A *GC Only* investor

<sup>4</sup>In addition, our data provider imputes transaction-specific considerations, such as the dollar value of other loans to that borrower that day, into the rebate of a Small loan. This makes their rebates less representative of the rebate another borrower would receive.

<sup>5</sup>For some loans the collateral is not cash but other securities. In these cases there is a lending fee, not a rebate. If the lending fee is  $f$  bp, we estimate the specialness to be  $f - 20$  bp. This is because we estimate the market rate for overnight loans to our data provider to be around 10 bp above Fed Funds, which means that the opportunity cost of getting the GC rate on an overnight loan to our data provider is about 20 bp (i.e.  $Fed\ Funds + 10\ bp - [Fed\ Funds - 8\ to\ 15\ bp]$ ), so a lending fee of 20 bp corresponds, in opportunity cost, to a GC cash-collateral loan.

Table 1

## Rebate rates relative to mode

For each trading day from November 1, 1998 through October 31 1999 we calculate the mode rebate rate of Medium-size loans and of Large-size (as categorized by our data provider) domestic equity loans by our data provider. The table shows, for the two size-categories separately and then for the two combined the percentage of loans with rebates below, at, and above their respective size-modes for the day.

Loan size	< Mode (%)	= Mode (%)	> Mode (%)	Total (%)
Medium	21.76	76.10	2.15	29.08
Large	1.05	98.30	0.65	70.92
Medium and large	7.07	91.85	1.09	100.00

can short a stock on  $t$ , and therefore to earn  $-1$  times its  $t + 1$  return, if and only if our data provider had a Medium or Large loan outstanding on  $t + 3$ , and specialness was below 25 bp. Because a *GC Only* investor cannot short specials, his specialness cost is zero.

The next level, representing good access, is *GC + Specials*. Investors at this level can short a stock on  $t$  if it is observed to be either *GC* or *Special* on  $t + 3$ . *Every* stock is either *GC* or *Special*, as the categorization is exhaustive, but we constrain the *GC + Specials* investor to only those stocks whose specialness we observe, because only in that case can we calculate his specialness cost, i.e., the average specialness of the stocks he shorts. Since our rebates are wholesale, the costs we calculate represent a zero mark-up and therefore best represent the costs of the largest, best-situated investors (e.g., large hedge funds). Similarly, the assumption that a *GC + Specials* investor can borrow all our data provider's specials is also appropriate only for major operators. Note, too, that we are not addressing any trading costs other than specialness cost.

Both the *GC Only* and *GC + Specials* access levels are conservative in that they represent access to only one lender. If our data provider does not loan a stock or makes only Small loans, we assume that the stock cannot be borrowed. To gauge the availability of stocks not loaned by our data provider, we can compare the list of its loaned issues as of December 31, 1998 with the list of issues loaned that day by another lender, Dimensional Fund Advisors (DFA), which (thanks to its popular small-stock index funds; see Keim, 1999) is a major source of small-stock loans. On that day, our data provider had loans (of any size) of 3,289 issues, and DFA had loans of 499 issues. Of the 499 DFA issues, 334 were also loaned by our data provider, but 165 were not. These 165 were in the borrowable universe but we do not let *GC Only* and *GC + Specials* investors borrow them that day. We are also conservative with respect to "recall risk," the risk of a short-sale being involuntarily terminated by the lender, by terminating short-sales when our data provider ceases to have a Medium or a Large loan outstanding, because we do not know who terminated the loans in our database and we do not know whether the short could have been extended by a new loan elsewhere.



### 3. Factor portfolios

Are the factor portfolios of the performance-evaluation literature feasible? That is, can investors actually realize the returns of these long-short portfolios? D'Avolio (2001) shows that growth and low-momentum stocks are relatively more likely to be on special, raising the possibility that the book-to-market strategy of DeBondt and Thaler (1987) and Fama and French (1993) and the Momentum strategy of Jegadeesh and Titman (1993) involve prohibitive specialness costs. Yet specialness is rare overall, so the incidence of specialness could still be low relative to the documented profits, and the more numerous GC stocks could be sufficient for tracking the strategies closely. We can address this issue by forming the portfolios available at the *Unconstrained* access level, which correspond to the portfolios in the literature, then forming the portfolios available at the *GC + Specials* and *GC Only* levels, and finally comparing. The relevant questions are how much extra the *GC + Specials* investor must pay for the specials, and whether the difference in expected profit between the constrained and unconstrained portfolios could outstrip the unconstrained portfolios' documented expected profit.<sup>6</sup>

We first calculate portfolio assignments for each trading day, without regard to short-selling constraints. Assignments follow the literature's conventions, particularly those in Carhart (1997), and are recalculated each Wednesday (or the first trading day thereafter). All breakpoints are calculated with NYSE stocks only. Stocks in the bottom 30% of capitalizations are assigned to *SMALL*, and stocks in the top 30% to *BIG*. Stocks in the top 30% of book-to-market ratios go to *HIBM*, and stocks in the bottom 30% to *LOBM*. Stocks in the top 30% of returns from 28 to two weeks before are assigned to *WIN*, and stocks in the bottom 30% to *LOSE*. The day  $t$  returns of the long portfolios— $SMALL_t$ ,  $HIBM_t$  and  $WIN_t$ —and of the *Unconstrained* short portfolios— $BIG_{U,t}$ ,  $LOBM_{U,t}$  and  $LOSE_{U,t}$ —are the equal-weighted returns of stocks assigned to them for  $t$ . The day  $t$  returns of the *GC + Specials* and *GC Only* short portfolios  $BIG_{GS,t}$ ,  $LOBM_{GS,t}$ ,  $LOSE_{GS,t}$  and  $BIG_{G,t}$ ,  $LOBM_{G,t}$ ,  $LOSE_{G,t}$ , respectively, are the equal weighted returns of the *GC + Special* and *GC*, respectively, stocks that are assigned to them for  $t$ . The specialness cost of the *GC + Specials* portfolio is calculated separately.<sup>7</sup>

We start with the calculation of the *GC + Specials* portfolios' specialness, and to put these figures in context, we calculate the specialness of all triciles. For each day of each of the size portfolios—*SMALL*, *BIG* and the stocks in between—we calculate the average specialness of stocks with observable specialness, and we also calculate the percentage of all stocks in the portfolio whose specialness is observable. These daily statistics are then averaged across days, and the results are in the first row of

<sup>6</sup>We note that the zero investment portfolios developed by Fama and French (1993) and others need not necessarily be tradeable as part of asset pricing models. However, they may be tradeable and, as Pastor and Stambaugh (2001) find, they may be very valuable to investors. In addition, long-short mutual and hedge funds may offer this type of opportunity.

<sup>7</sup>As is common in the literature on long-short strategies, the interest rebate from the equity loan is assumed to offset interest charged on the purchase price of the long side, so specialness is the *net* interest cost.

Table 2

Specialness and firm characteristics: univariate sorts

Each Wednesday from October 29, 1998 through October 27, 1999 we independently sort all stocks in the CRSP universe into three size portfolios, three book/market portfolios and three momentum portfolios. All breakpoints are calculated with NYSE Stocks only. Stocks in the bottom 30%, top 30%, and middle 40% of capitalizations are assigned to *SIZE-LO*, *SIZE-HI*, and *SIZE-MED*, respectively. Stocks in the bottom 30%, top 30%, and middle 40% of book/market are assigned to *B/M-LO*, *B/M-HI* and *B/M-MED*, respectively. Stocks in the bottom 30%, top 30%, and middle 40% of return from 28 to two weeks previously are assigned to *MOM-LO*, *MOM-HI* and *MOM-MED*, respectively. For each day of each stock we calculate its specialness, defined as the value-weighted average shortfall of the rebate rates of all Medium or Large (as categorized by our data provider) loans of the stock from the Medium or Large mode rebates, respectively, if specialness is not missing. For each portfolio we calculate the average specialness each day and also the percentage of stocks in the portfolio with observable (i.e. non-missing) specialness. The averages of the two statistics for portfolio  $X$ – $Y$  are in the row labeled  $X$  and the column labeled  $Y$ ; average specialness is on top, in basis points per year, and the average percentage with observable specialness is on the bottom.

	LO	MED	HI
<i>SIZE</i>	38 bp 13%	15 bp 56%	4 bp 77%
<i>B/M</i>	21 bp 51%	10 bp 29%	15 bp 19%
<i>MOM</i>	27 bp 28%	12 bp 31%	14 bp 41%

Table 2. Specialness decreases from 38 to 15 to 4 bp/year moving from small to big, suggesting low costs for shorting big stocks, but the specialness number for small stocks represents only 13% of the assigned stocks, so it is unclear what relationship holds in the full sample. Likewise, in the second and third rows, which cover book-to-market and momentum, there is mild variation of specialness from low to high, and the costs of shorting the growth and low-momentum stocks with observable specialness come to only 21 and 27 bp/year, respectively, but these represent only 51% and 28% of the stocks, respectively, of the stocks in the unconstrained portfolios. So the answer to the first question is that the specialness costs of the shorted stocks with *observable* specialness is low, but the growth and low-momentum stocks with observable specialness are only a half and a quarter, respectively, of the unconstrained populations.

To address the second question directly, we test whether the difference in expected returns between the *Unconstrained* portfolios and the other portfolios could be large enough to offset the documented profits to the strategies. Specifically, we accumulate the daily constrained and unconstrained profits into monthly profits, calculate the means and associated standard errors of the monthly profits of the constrained profits minus the unconstrained profits (net of specialness costs for  $GC + Specials$ ), and test ( $t$ -test with 11 df) whether the means are significantly above  $-1$  times the average monthly profitability, shown by Carhart (1997), of the unconstrained

Table 3

## Comparison of factor portfolio returns

For each trading day  $t$  from October 29, 1998 through October 27, 1999 we calculate nine long-short portfolio returns to the close of  $t$  from the close of  $t - 1$ . The specialness of a stock is the value-weighted average shortfall of the rebate rates of all Medium or Large (as categorized by our data provider) loans of the stock from the Medium or Large mode rebates, respectively. A stock is a *special* if its specialness is at least 25 bp, and is *GC* if its specialness is lower. Portfolio assignments for each trading day are calculated first, without regard to short-selling constraints. Assignments are recalculated each Wednesday (or the first trading day thereafter). All breakpoints are calculated with NYSE stocks only. Stocks in the bottom 30% of capitalizations are assigned to *SMALL*, and stocks in the top 30% to *BIG*. Stocks in the top 30% of book-to-market ratios go to *HIBM*, and stocks in the bottom 30% to *LOBM*. Stocks in the top 30% of returns from 28 to two weeks before are assigned to *WIN*, and stocks in the bottom 30% to *LOSE*. The day  $t$  returns of the long portfolios—*SMALL* <sub>$t$</sub> , *HIBM* <sub>$t$</sub> , and *WIN* <sub>$t$</sub> —and of the *Unconstrained* short portfolios—*BIG* <sub>$U,t$</sub> , *LOBM* <sub>$U,t$</sub> , and *LOSE* <sub>$U,t$</sub> —are the equal-weighted returns of stocks assigned to them for  $t$ . The day  $t$  returns of the *GC + Specials* and *GC Only* short portfolios *BIG* <sub>$GS,t$</sub> , *LOBM* <sub>$GS,t$</sub> , *LOSE* <sub>$GS,t$</sub>  and *BIG* <sub>$G,t$</sub> , *LOBM* <sub>$G,t$</sub> , *LOSE* <sub>$G,t$</sub> , respectively, are the equal weighted returns of the *GC + Special* and *GC*, respectively, stocks that are assigned to them for  $t$ . Panel A: The first row summarizes the monthly returns, i.e., the daily returns summed up within months, of  $(SMALL_t - BIG_{G,t}) - (SMALL_t - BIG_{U,t}) = BIG_{U,t} - BIG_{G,t}$ . The second and third rows summarize the analogous time series created from *HIBM - LOBM* and *WIN - LOSE*. The average return difference over the 12 months is *Mean*, and the associated standard error is *std. err.* The  $t$  statistics for the null hypotheses  $BIG_{U,t} - BIG_{G,t} \leq -29$  bp,  $LOBM_{U,t} - LOBM_{G,t} \leq -46$  bp, and  $LOSE_{U,t} - LOSE_{G,t} \leq -82$  bp are  $t(H_0)$ , and the associated  $p$ -value is  $p$ -val. Panel B: the same as Panel A except that in place of *BIG* <sub>$G,t$</sub> , *LOBM* <sub>$G,t$</sub>  and *LOSE* <sub>$G,t$</sub>  we use *BIG* <sub>$GS,t$</sub> , *LOBM* <sub>$GS,t$</sub>  and *LOSE* <sub>$GS,t$</sub> , respectively, and the average monthly specialness cost of *BIG* <sub>$GS,t$</sub>  (and analogously, *LOBM* <sub>$GS,t$</sub>  and *LOSE* <sub>$GS,t$</sub> ) *spec*, is subtracted from *Mean* for the calculation of  $t(H_0)$  (i.e., *Mean* is gross of *spec*, but *Mean - spec* is used for calculating  $t(H_0)$ ).

## Panel A: Constrained is GC only

## Unconstrained - Constrained

return of:	Mean	std. err.	$t(H_0)$	$p$ -val
<i>BIG</i>	-1 bp	9 bp	3.19	0.4%
<i>LOBM</i>	8 bp	36 bp	1.52	7.9%
<i>LOSE</i>	103 bp	60 bp	3.10	0.5%

## Panel B: Constrained is GC+Specials

## Unconstrained - Constrained

return of:	Mean	spec	std. err.	$t(H_0)$	$p$ -val
<i>BIG</i>	-3 bp	0.3 bp	9 bp	2.91	0.7%
<i>LOBM</i>	7 bp	1.8 bp	27 bp	1.91	4.2%
<i>LOSE</i>	108 bp	2.2 bp	56 bp	3.36	0.3%

strategies. From Table 2 of that paper, they are 29 bp/month for *SMALL - BIG*, 46 bp/month for *HIBM - LOBM*, and 82 bp/month for *WIN - LOSE*. Thus the empirical question for *SMALL - BIG*, for example, is whether we reject that the expected monthly return of the constrained *SMALL - BIG* minus the unconstrained *SMALL - BIG*, i.e., the unconstrained *BIG* minus the constrained *BIG*, is -29 bp or below. We run this test first for the *GC Only* portfolios and report the results in Panel A of Table 3. For the *GC + Specials* portfolios, we take the average monthly specialness cost from Table 2 (i.e., the value in the table times 1/12), and subtract it from the mean before the hypothesis test (note that we are being

conservative here by not *adding* the specialness of the long side, which could be earned by lending; this applies to all hypothesis tests in the paper); results are in Panel B of Table 3.

The results are strong evidence that the factor portfolios, subjected to the shorting frictions, are still at least somewhat profitable. In the hypothesis tests, the null is rejected at the 1% level at both the *GC Only* and *GC + Specials* access levels for both *BIG* and *LOSE*. For *LOBM* the hypothesis is rejected at the 10% level for *GC Only* and at the 5% level for *GC + Specials*.<sup>8</sup> Investors in the constrained versions of *SMALL – BIG*, *HIBM – LOBM* and *WIN – LOSE* therefore enjoy at least some of the documented profitability of the unconstrained versions. For each of the three strategies, the additional effect of access to specials, beyond access to only GC stocks, is small. It is worth noting that we handicap the constrained strategies by always taking the equal-weighted average of the available stocks; in practice, investors can optimize over weights.<sup>9</sup>

The results indicate that although the factor portfolios of the asset-pricing literature are not strictly feasible, they are close to portfolios that *are* feasible, even for investors who cannot short scarce stocks at all. Our data provider's specials cost little and have only a modest impact on tracking. Specials may be over-represented among growth and loser stocks, but they are too scarce to interfere with these strategies.

#### 4. DotComs

Internet-based companies traded at very high valuations from the late 1990s to early 2000, relative to a short time before or after. Why did their markets clear at such high prices? One potential contributing factor, noted by Ofek and Richardson (2001), is that these stocks, also known as “DotComs,” were difficult or prohibitively expensive to sell short.<sup>10</sup> We can address this argument by comparing the returns available to *GC Only* and *GC + Specials* investors to the *Unconstrained* return. The empirical question is not who makes more money—we already know that DotComs went *up* over 200% in our sample period—but instead how closely the constrained returns track the unconstrained version, and how much the *GC + Specials* investor must pay. This tells us whether equity-loan frictions were a significant barrier to short exposure to DotComs in our sample period, when they were on their way up.

<sup>8</sup>The correlations of  $LOSE_U$  to  $LOSE_{GS}$  and  $LOSE_G$  are 94% and 92%, respectively; the analogous figures for *LOBM* are 98% and 97%, and the analogous figures for *BIG* are 99.8% and 99.8%.

<sup>9</sup>Investors during our sample period also could have reduced the transactions cost of putting on SMB by shorting SPY, the S&P Depository receipt tracking the S&P 500, rather than shorting individual large stocks. In our data, SPY is loaned on all but two days, with an average specialness of 3 bp/year. Today's investors can reduce the cost of HML by shorting the Small- and Midcap-Growth ETFs IJT and IJK, which started trading in July 2000.

<sup>10</sup>See also the October 12, 2001 issue of *The Economist*: “Perhaps the rise of Internet shares would have been less exuberant had there been more shorters. Dotcom firms floated only small chunks of their shares, which shot up partly thanks to restricted supply. “It was impossible to borrow the stock to short,” says [Giuseppe Ciardi, a hedge-fund manager],” (p. 71).

To structure our empirical tests we need to define the trading strategy of the *Unconstrained* investor. For simplicity, and also for direct comparison to the existing literature, we define it as the equal-weighted Internet index in Ofek and Richardson (2001). That is, we start with the list of DotCom stocks used by Ofek and Richardson (2001)<sup>11</sup> (see that paper for a description), and we assume that the investor wants to short an equal-weighted portfolio of as many stocks on the list as possible.<sup>12</sup> The return of the *Unconstrained* investor therefore corresponds (negatively) to the “Internet index” in Fig. 1A of Ofek and Richardson (2001). *GC Only* and *GC + Specials* investors short equal-weighted portfolios of all GC and all GC and Special stocks, respectively.

To keep the comparison with Ofek and Richardson (2001) and others simple, we discuss the results in terms of long portfolios, so the *Unconstrained*, *GC Only* and *GC + Specials* portfolios are simply equal-weighted portfolios of all, GC, and *GC + Special* stocks, respectively. The specialness cost of the *GC + Special* portfolios is calculated separately and not added to the return series. In Table 4 we quantify the relations between the time series with simple regressions. In Panel A we regress the *GC + Specials* and *GC Only* returns on the *Unconstrained* returns, finding high  $R^2$ 's (96% and 90%, respectively), insignificant intercepts, and a higher slope for *GC + Specials* than for *GC Only*. Both constrained portfolios track the unconstrained portfolio closely, but the portfolio with specials moves more than 1 for 1 with the unconstrained portfolio, whereas the portfolio with easy-to-borrow stocks varies almost exactly 1 for 1. In Panel B we calculate and compare long-short portfolio returns, long in the DotComs and short in the Nasdaq; results are similar.

The specialness cost of the *GC + Specials* portfolio, summed over the entire year, is 1.15%. We do not know how 1.15% compares to the expected returns of the investors of the time, but it is orders of magnitude smaller than the large positive returns of DotComs in our sample period, and the large negative returns later on.

Our data show that substantial short exposure to DotComs was available even to investors incapable of shorting hard-to-borrow stocks, but they also show that the hard-to-borrow DotComs offered investors relatively more exposure, dollar for dollar, to the equal-weighted index of all DotComs. In addition, we find that wholesale borrowing costs were small relative to the realized returns. This evidence from a year of the DotCom episode indicates that equity-loan shortages were a minor impediment to trading on the belief that DotComs were overvalued.

## 5. Initial public offerings

The shortability questions raised by initial public offerings, IPOs, are similar to those of DotComs. Historically, IPOs have significantly underperformed standard

<sup>11</sup>Thanks to Matt Richardson for providing the list.

<sup>12</sup>Since its March 1999 inception, the ETF QQQ has been widely regarded as a DotCom bet, so investors in the latter part of our sample period may have found shorting QQQ rather than individual DotComs to be more economical. Our data show no loans of QQQ, so we cannot judge the attractiveness of this other source of short exposure to DotComs.

Table 4

## Comparison of DotCom index returns

For each trading day  $t$  from October 29, 1998 through October 27, 1999 we calculate three equal-weighted averages of returns of DotCom stocks (as enumerated by Ofek and Richardson, 2001) to the close of  $t$  from the close of  $t - 1$ . The specialness of a stock is the value-weighted average shortfall of the rebate rates of all Medium or Large (as categorized by our data provider) loans of the stock from the Medium or Large mode rebates, respectively. A stock is *on special* if its specialness is at least 25 bp.  $Unconstrained_t$  is the average across all stocks,  $GC + Special_t$  is the average across all stocks with Medium or Large loans on  $t + 2$ , and  $GC\_Only_t$  is the average across all stocks that have a Medium or Large loan and that are not on special on  $t + 2$ . Regressions of  $GC + Special$  and  $GC\_Only$  on  $Unconstrained$  are in Panel A, and regressions of  $GC + Special - NASD$  and  $GC\_Only - NASD$  on  $Unconstrained - NASD$ , where  $NASD_t$  is the Nasdaq index return on day  $t$ .  $t$ -statistics are below coefficients, in parentheses. Each regression has 251 observations. The residual standard deviation of the dependent variable is below the  $R^2$ , in basis points.

<i>Panel A: Total index returns</i>			
$GC + Special_t$	= -0.0001 (-0.18)	+1.184 $Unconstrained_t + \varepsilon_t$ (81.9)	$R^2 = 96.4\%$ $\sigma_\varepsilon = 70$ bp/day
$GC\_Only_t$	= -0.0007 (-1.05)	+1.020 $Unconstrained_t + \varepsilon_t$ (47.3)	$R^2 = 90.0\%$ $\sigma_\varepsilon = 105$ bp/day
<i>Panel B: Market-excess index returns</i>			
$(GC + Special_t - NASD_t)$	= 0.0002 (0.64)	+1.200 $(Unconstrained_t - NASD_t) + \varepsilon_t$ (49.8)	$R^2 = 90.9\%$ $\sigma_\varepsilon = 80$ bp/day
$(GC\_Only_t - NASD_t)$	= -0.0003 (-0.51)	+0.921 $(Unconstrained_t - NASD_t) + \varepsilon_t$ (29.5)	$R^2 = 77.7\%$ $\sigma_\varepsilon = 104$ bp/day

benchmarks (though not all benchmarks; see Brav et al. (2000) for a discussion) from half a year to five years post-IPO (Loughran and Ritter, 1995), indicating that shorting IPOs and buying the benchmarks over this period may be a profitable trading strategy. Yet because IPOs are generally regarded as hard to short (e.g., D'Avolio, 2001), the feasibility of this strategy is an open question. As with the DotComs, we can gauge the feasibility by comparing IPO indices with the different levels of equity-loan access, measuring the goodness-of-fit and wholesale specialness cost. The wholesale specialness cost is also informative about the lending revenue that a long-term IPO investor could enjoy, offsetting losses to underperformance.

In addition to the long-term trade, the literature also indicates a short-term trade in the days around lockup expirations. Underwriting contracts generally oblige insiders not to sell their shares until a future lockup-expiration date, usually 180 days post-IPO. Several recent studies<sup>13</sup> find a significantly negative market-excess return in the days around lockup expiration, so abstracting from execution quality and shorting constraints, shorting IPOs, and buying the market across lockup expiration has been profitable. Ofek and Richardson (2000) and Field and Hanka (2001) show

<sup>13</sup>See Field and Hanka (2001), Keasler (2001), Ofek and Richardson (2000), Brav and Gompers (2001) and Bradley et al. (2001).

that paying the bid/ask spread eliminates much or all of the profit, so execution quality is crucial. How crucial are the cost and availability of equity loans? We can answer this question by simulating the trade, at closing prices, at our three levels of access.

Before addressing either the long-term or short-term trades we first establish the actual difficulty of shorting IPOs, subject to the usual caveat that we observe the market specialness of only those stocks our data provider loans. Of particular interest is the cross-section of specialness in the first month, which features price support for weaker issues, and tighter lending restrictions for all issues.

For this study we construct a panel of all IPOs from November 1997 through October 1999. Following the standard practice of the IPO literature, we eliminate all non-U.S., unit, and closed-end fund offerings, leaving 853 offerings. For each we have the number of shares offered (including the overallotment, if any), the offering price, and the offering and lockup expiration dates, compiled from Bloomberg, ipo.com, SDC, and the Edgar database of SEC filings.

### 5.1. Borrowing IPOs in the first month

An IPO's first month is qualitatively different, with regard to equity lending, from the months following. Lendable supply is constrained by brokerage rules forbidding purchases on margin in the first 30 days, which mean those brokers cannot lend to customers from other customers' margin accounts. Members of the underwriting syndicate are generally obliged not to lend in the first 30 days (Houge et al., 2001). Shorting demand may also be different, due to price support. Lead underwriters attempt to prop up the prices of weak offerings until about a month post-IPO, then they stop (Ellis et al., 2000; Aggarwal, 2000). Investors may associate this practice with temporarily inflated prices and consequently sell short.

To examine the market for IPO shares in the first month, we assemble the 311 IPOs that are covered by our sample period for their first 25 trading days, a few trading days more than one month (as above, specialness for day  $t$  is observed on  $t + 3$ ). For an overview, Fig. 1 shows the breakdown each day into the four major categories: Not Loaned, Small Only, On Special, and GC. The IPOs available to a *GC Only* investor grow steadily from none to a quarter of the sample, while the fraction of IPOs loaned by our data provider starts at three quarters and shrinks somewhat in the last week. Thus investors with access to specials can short most IPOs as soon as the first day, but investors without that access are initially incapable of shorting *any* IPOs, and they only gradually gain access to a few. The growth of "Not Loaned" near the end is consistent with the diminished role of custodians such as our data provider after 30 calendar days, when loans from margin accounts and syndicate members become available.

Fig. 1 shows cross sectional variation in the expense of borrowing IPOs. We address this variation with a cross sectional regression of specialness on some intuitive factors. First, however, we address the potential for selection bias in the observable sample. An IPO is selected for the observable sample by a Medium or Large loan, an event that is presumably more likely for larger offerings, which are

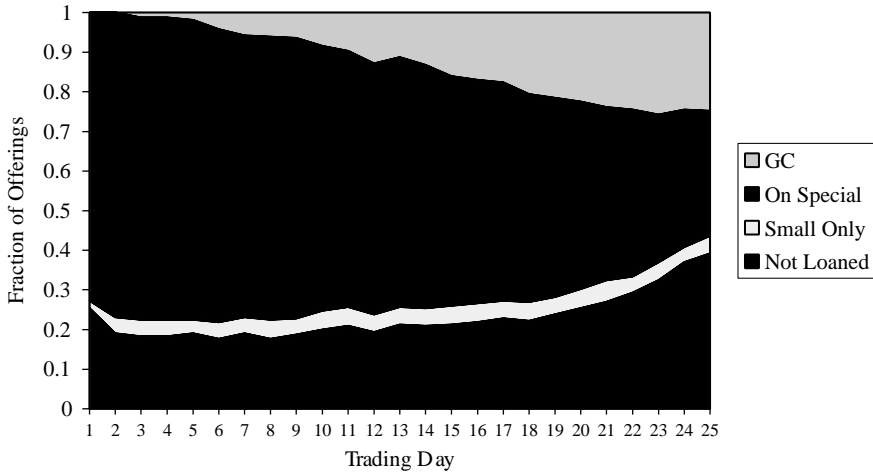


Fig. 1. Loan Activity and Status of IPOs in their first 25 trading days. IPOs with specialness below 25 bp are represented by “GC,” IPOs with higher specialness are “On Special,” IPOs loaned in Small size only (for which specialness is unobservable) are “Small Only,” and IPOs not loaned by our data provider are “Small Only.”

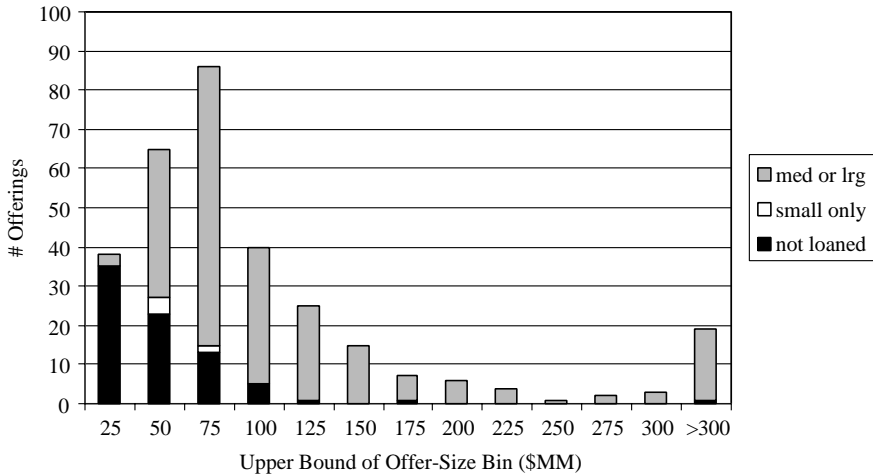


Fig. 2. Lending of IPOs on the first settlement day, sorted by IPO offer size. IPOs loaned in Medium or Large size (as defined by our data provider) are represented by “med or lrg,” IPOs loaned in Small size only are represented by “small only,” and IPOs not loaned at all by our data provider are represented by “not loaned.”

presumably less scarce. An interaction between selection and scarcity could produce a specification error of the sort addressed by Heckman (1976, 1979). Fig. 2, which shows lending activity for day 1 (i.e., loans by our data provider on day 4) sorted by offer size, locates the unobservable offerings in the smallest size bins. Selection clearly interacts with issue size, which promotes the two-stage “Heckit” selection-



correction model. The first stage is a probit model explaining selection with issue size, and the second stage is OLS combining the explanatory variables with the Inverse Mills Ratio (commonly denoted  $\lambda$ ) from the probit.

The dependent variable is the specialness of IPO  $i$  for shorting on day  $t$  (i.e., the specialness of loans on day  $t + 3$ ). The explanatory variables are six intuitive measures of supply and shorting demand. We have the log of the initial supply of IPO  $i$ ,  $LSIZE_i$ , and the log-relative return from the offering price to trading day  $t$ ,  $LRET_{i,t}$ .  $LSIZE_i$  is also the explanatory variable in the first-stage probit. To flag DotComs, we include  $DOT_i$ , which is 1 for IPOs on the Ofek and Richardson (2001) list of DotComs, and 0 otherwise, and to represent the benchmark index return we include  $LINDX_{i,t}$ , which is the log-relative return from the close before the first day of trading to the close of  $t$  of the appropriate index: the DotCom index of Ofek and Richardson (2001) for DotComs, and the CRSP value-weighted index for the others. The log of day- $t$  share turnover, share volume (plus one) divided by IPO shares, is  $LTURN_{i,t}$ . Finally, to indicate price support situations, we include  $DOG_{i,t}$ , which is 1 if the closing price on day  $t$  is at or below the offering price, and 0 otherwise. Second-stage results for several event days are in Panel A of Table 5.<sup>14</sup>

All regressors except the benchmark index enter significantly on at least three of the six days. Smaller issues are more expensive, as are DotComs. Performance enters nonmonotonically; specialness generally increases with performance, but conditional on that, price-support issues are more expensive. Specialness also increases with turnover.

The issue-size result is intuitive and justifies the Heckit approach. The premium for DotComs shows that the observation in Ofek and Richardson (2001) that DotComs have lower rebates than the general population is robust to all the controls in our regression. Turnover may pick up a positive relation between demand for transactions in general and for short-selling in particular, or it may instead identify stocks that are harder to borrow because their ownership keeps changing. The extra cost of borrowing the weakest offerings supports the view that price support encourages shorting.

The positive relation between specialness and underpricing supports the heterogenous-beliefs analysis of Miller (1977). He associates underpricing with the distribution of investors' valuations; the offering price is the mean valuation, and the initial market price is such that the demand of investors with that valuation or above just equals the offered supply. Thus, controlling for offered supply, more underpricing implies a wider distribution of valuations, which in turn implies a higher incidence of investors with sharply lower valuations and therefore strong desires to short at current prices.

Panel B uses the same data to gauge the revenue from specialness that an IPO investor earns by loaning his shares in the first month. The first row contains the average specialness of the available observations on that trading day. For example, the average specialness across the 226 specialness observations on day 1 is 295 bp.

<sup>14</sup>We also fit Probit models with the other independent variables from the second stage as additional explanatory variables, but these regressors did not enter.

Table 5

Cost of borrowing IPOs: cross section and time series

We construct a panel of 311 IPOs whose first 25 trading days occurred between October 28, 1998 through October 26, 1999. If our data provider made a Medium or Large (as categorized by our data provider) loan of IPOs on its  $t + 3$ rd trading day then its specialness cost for shorting on day  $t$  is the value-weighted average shortfall of the rebate rates of all Medium or Large loans of the stock from the Medium or Large mode rebates, respectively, on  $t + 3$ . If there were no such loans, then specialness is missing. Panel A reports cross sectional regressions where the dependent variable is the cost (in percent) of shorting IPOs on its indicated trading day  $t$ , *DOT* is 1 if IPOs is on the DotCom list of Ofek and Richardson (2001), *LRET* is the log-relative return of the IPO from its offering price to the close of  $t$ , *LINDX* is the contemporaneous log-relative market return (the Internet Index from Ofek and Richardson, 2001, for DotComs, and the value-weighted CRSP index for others), *DOG* is 1 if the IPO closed at or below its offering price on  $t$ , *LSIZE* is the log of the offering price of the IPO times the number of shares offered, and *LVOL* is the log of one plus the number of shares of the IPO traded on  $t$ , divided by the number of shares sold in the IPO. The Inverse Mills Ratio from running a Probit model for selection to the sample (i.e. whether or not the stock was loaned on  $t$ ; the explanatory variable is *LSIZE*) is denoted by  $\lambda$  (i.e., the Heckman (1979) 2-stage procedure). The model is estimated for six values of  $t$ .  $t$ -statistics are below, in italics. At the bottom of each column is the  $R^2$  and the number of observations. Panel B contains average specialness costs for the same days. The first row is the average across the IPOs with non-missing specialness. The second row is across all 311 IPOs, where missing specialness is replaced by estimated specialness using the model of Panel A.

	Day 1	Day 5	Day 10	Day 15	Day 20	Day 25
<i>Panel A: Cross-sectional regressions</i>						
Intercept	4.568 <i>3.42</i>	13.401 <i>9.65</i>	15.463 <i>6.74</i>	12.106 <i>3.86</i>	8.869 <i>2.37</i>	6.92 <i>0.74</i>
<i>DOT</i>	0.122 <i>1.58</i>	0.207 <i>2.24</i>	0.410 <i>2.55</i>	0.461 <i>2.23</i>	0.423 <i>1.74</i>	0.312 <i>1.10</i>
<i>LRET</i>	0.562 <i>5.50</i>	0.467 <i>3.59</i>	0.492 <i>2.41</i>	0.686 <i>2.60</i>	0.217 <i>0.74</i>	0.197 <i>0.62</i>
<i>LINDX</i>	0.188 <i>0.13</i>	-0.293 <i>-0.58</i>	-0.542 <i>-0.98</i>	-0.612 <i>-0.96</i>	-0.077 <i>-0.12</i>	0.702 <i>1.02</i>
<i>DOG</i>	0.332 <i>3.10</i>	0.288 <i>2.38</i>	0.465 <i>2.23</i>	0.436 <i>1.66</i>	0.185 <i>0.57</i>	0.656 <i>1.64</i>
<i>LSIZE</i>	-0.107 <i>-1.54</i>	-0.575 <i>-7.85</i>	-0.707 <i>-5.87</i>	-0.539 <i>-3.32</i>	-0.370 <i>-1.91</i>	-0.250 <i>-0.55</i>
<i>LVOL</i>	0.127 <i>2.06</i>	0.074 <i>1.39</i>	0.111 <i>1.47</i>	0.197 <i>2.20</i>	0.222 <i>2.19</i>	0.395 <i>3.18</i>
$\lambda$	-0.036 <i>-0.17</i>	-1.122 <i>-4.44</i>	-1.068 <i>-2.89</i>	-0.718 <i>-1.36</i>	-0.073 <i>-0.13</i>	-0.007 <i>-0.00</i>
$R^2$	30.4%	39.6%	30.5%	26.0%	15.6%	17.8%
$N(obs)$	226	241	234	230	217	175
<i>Panel B: Average specialness (in percent)</i>						
Observable	2.95	2.77	2.41	2.04	1.75	1.47
All 311 (est)	2.96	3.17	2.85	2.36	1.84	1.46

The second row includes the estimated specialness of the unobserved IPOs, where the estimator is the regression model above. We include the second number to address the selection bias noted above. On day 1, the average across the 226 observations and the 85 estimates is 296 bp, almost the same, though on later days the disparity is wider. By either measure, specialness in the early days is falling and always below the > 500 bp/year IPO underperformance calculated by Loughran and Ritter (1995) for more seasoned IPOs, which is one indication that lending income does not offset underperformance.

### 5.2. Realizing IPO underperformance

We get a more direct indication by repeating the methodology of the DotCom section on an IPO index. That is, we calculate the return on an IPO index at the three access levels, and measure tracking error and shorting cost. We use an equal-weighted index of IPOs that are 6–12 months old, because the frictions associated with borrowing IPOs should be more apparent in earlier days, and 6–12 months is the earliest period in which Loughran and Ritter (1995) find underperformance.

First, we calculate the specialness cost for the *GC + Specials* investor, which comes to 44 bp/year, far from the 450 bp profit indicated for *half* a year<sup>15</sup> in Loughran and Ritter (1995). Next, we regress the *GC Only* and *GC + Specials* index returns on the *Unconstrained* return. Results, in Panel A of Table 6, show  $R^2$ 's around 80% for both regressions, similar slopes and insignificant intercepts.

The Loughran and Ritter (1995) portfolio is short in IPOs and long in matched non-IPOs. We approximate this construction with long-short portfolios that are short in the portfolios of Table 6, Panel A, and long in matched indices (which include IPOs). If the short side has  $n$  DotCom IPOs and  $m$  other IPOs, then the long side is  $n$  times the DotCom index of Ofek and Richardson (2001) plus  $m$  times the value-weighted CRSP index, divided by  $(n + m)$ . To see how well the constrained long-short portfolios track the unconstrained portfolio, we run the regressions of Table 6, Panel A. The results, Panel B of Table 6 (where we have added the prefix *Im* to the variables to indicate the *Index matching*) show lower  $R^2$ 's, in the neighborhood of 45%. So the available stocks do not track seasoned IPOs as well as they track DotComs.

Finally, to gauge the expected-return difference between the *GC Only* and *Unconstrained* long-short portfolios, we run the test of Table 3 on the mean of the monthly *GC Only* long-short profits minus the monthly *Unconstrained* long-short profits. The sample mean is –44 bp, and its standard error is 18 bp, so the  $t$ -statistic for the null hypothesis that the true mean is below –75 bp is  $(-44 - (-75))/18 = 1.72$ , which has a  $p$ -value ( $t$ -statistic with 11 degrees of freedom) of 5.65%. With this marginal significance, we reject the hypothesis that investors cannot get some of the Loughran and Ritter (1995) underperformance profits using only GC stocks.

<sup>15</sup>In Loughran and Ritter (1995), Table 3, Panel A, row 2 minus row 1 of the “Second 6 Months” column.

Table 6

## Comparison of IPO index returns

For each trading day  $t$  from October 29, 1998 through October 27, 1999 we calculate three equal-weighted averages of returns of IPOs that are six to 12 months post-IPO as of  $t$  to the close of  $t$  from the close of  $t - 1$ . The specialness of a stock is the value-weighted average shortfall of the rebate rates of all Medium or Large (as categorized by our data provider) loans of the stock from the Medium or Large mode rebates, respectively. A stock is *on special* if its specialness is at least 25 bp.  $Unconstrained_t$  is the average across all stocks,  $GC + Special_t$  is the average across all stocks with Medium or Large loans on  $t + 2$ , and  $GC\_Only_t$  is the average across all stocks that have a Medium or Large loan and that are not on special on  $t + 2$ . Regressions of  $GC + Special$  and  $GC\_Only$  on  $Unconstrained$  are in the Panel A, and regressions of  $ImGC + Special$  and  $ImGC\_Only$  on  $ImUnconstrained$ , where  $Im$  indicates that each IPO return is subtracted from the return of the appropriate market index: the Internet Index of Ofek and Richardson (2001) for stocks on the list of DotComs in that paper, and the value-weighted CRSP index for all other stocks.  $t$ -statistics are below coefficients, in parentheses. Each regression has 251 observations. The residual standard deviation of the dependent variable is below the  $R^2$ , in basis points.

*Panel A: Total index returns*

$GC + Special_t$	= -0.0002 (-0.41)	+1.403 $Unconstrained_t + \varepsilon_t$ (33.5)	$R^2 = 81.8\%$ $\sigma_\varepsilon = 82$ bp/day
$GC\_Only_t$	= -0.0003 (-0.55)	+1.357 $Unconstrained_t + \varepsilon_t$ (29.4)	$R^2 = 77.6\%$ $\sigma_\varepsilon = 91$ bp/day

*Panel B: Market-excess index returns*

$ImGC + Special_t$	= -0.0001 (-0.23)	+0.793 $ImUnconstrained_t + \varepsilon_t$ (15.2)	$R^2 = 48.2\%$ $\sigma_\varepsilon = 75$ bp/day
$ImGC\_Only_t$	= -0.0004 (-0.64)	+0.774 $ImUnconstrained_t + \varepsilon_t$ (12.9)	$R^2 = 40.0\%$ $\sigma_\varepsilon = 86$ bp/day

If instead we compare the  $GC + Specials$  long-short portfolio to the  $Unconstrained$  portfolio, we get a mean and standard error of 4 and 17 bp. Subtracting the 44 bp/year specialness from the 4 bp/month mean, we get a mean of 0 bp and a standard error of 17 bp, which imply a  $p$ -value for the null hypothesis of a mean below -75 bp of 0.06%. Thus from our year of data it appears likely that investors, especially investors with good access to equity loans, can realize at least some of the profits documented in IPO returns.

## 5.3. Lockup expiration

It is implausible that specialness costs could offset a meaningful portion of the extensively documented lockup-expiration return. The specialness that offsets a 1% profit earned over a week is over 50%. Specialness of that magnitude is extremely rare (see D'Avolio (2001) and Mitchell et al. (2001) for some outlier borrowing costs), and the lockup-expiration trades appear to earn more than 1% (gross of transactions costs) in less than a week. The interesting empirical question therefore is not whether costs overwhelm the profits, but rather whether the abnormal returns are still significant in the subset of stocks that we observe to be  $GC$ , or  $GC + Special$ .

Table 7

## Lockup-expiration trades

Day 0 is the trading day when an IPOs insider lockup expires. For each day in a window around day 0, an investor shorts the IPO and buys the appropriate index (the Internet index of Ofek and Richardson, 2001, for IPOs on the DotCom list in that paper, and the value-weighted CRSP index for all other stocks) to the close of the next day if shorting the IPO is possible. The specialness of a stock is the value-weighted average shortfall of the rebate rates of all Medium or Large (as categorized by our data provider) loans of the stock from the Medium or Large mode rebates, respectively. A stock is *on special* if its specialness is at least 25 bp. The *Unconstrained* investor can short all stocks, the *GC + Specials* investor can short stocks with at least one Medium or Large loan three days later, and the *GC Only* investor can short stocks with Medium or Large loans that are not on special. *Mean* and *t-stat* are the investor's average return, and the associated *t*-statistic, across all the IPOs he can short at least one day, *N(obs)* is the number of IPOs he shorts, and *spec* is the average specialness cost (specialness times the number of days over 360) for *GC + Specials*. Results for a five-day window around day 0 (hold from -3 to 2, if possible) are on the left side, and results for a three-day window (hold from -2 to 1, if possible) are on the right.

	Day -3 to Day 2				Day -2 to Day 1			
	Mean (%)	t-stat	N(obs)	spec (%)	Mean (%)	t-stat	N(obs)	spec (%)
<i>Unconstrained</i>	3.09	3.75	226		2.13	3.04	229	
<i>GC + Specials</i>	4.76	4.22	109	0.02	4.52	5.04	106	0.01
<i>GC Only</i>	3.20	2.88	81		3.63	4.10	74	

We refer to the lockup-expiration day, the first day when insiders can sell their shares, as day 0. The literature finds abnormal returns in different holding periods around the expiration date. We use two: a three-day window from the close of day -2 to the close of day 1, for which we have 229 IPOs, and a five-day window from the close of day -3 to the close of day 2, for which we have 226 IPOs. For each IPO, the trade is to short the IPO and buy the appropriate index. As above, the appropriate index is the Ofek and Richardson (2001) DotCom index for DotComs, and the value-weighted CRSP index for all other stocks. Also as above, availability is determined day-to-day, so an investor closes out both sides of her trade whenever she cannot borrow three days later. Results are in Table 7.

With *Unconstrained* access, the return is significant in either holding period, and in the neighborhood of previous studies' results. The second row repeats the test for *GC + Specials* access and again finds significance either way. Specialness cost is trivial. Even with *GC Only* access (the third row) the trade is significantly profitable either way. We therefore conclude that shorting frictions do not explain the expiration return.

## 6. Merger arbitrage

Merger arbitrage strategies can generate large profits. In these strategies, shares of acquiring firms are sold short in the expectation that the share prices of acquiring and target firms will converge by the time the merger is effective. Merger arbitrage can lock in the implied profits by short-selling shares of the acquiring firm and

covering the short loan with shares of the target firm on the date of the merger. Results presented here indicate that even though the cross section of borrowing costs is heavily influenced by the specifics of merger arbitrage deals, the increased borrowing costs do not wipe out merger arbitrage profits.

Arbitrage strategies take advantage of the likely convergence of the merger acquirer's and target's stock prices, but uncertainty about deal terms makes these strategies risky. As discussed in Jindra and Walkling (2001), there is always a substantial risk that a merger will not go through. Furthermore, the terms of the exchange are subject to change before the merger takes place. In particular, the ratio at which equities are exchanged is the key to determining the profitability of an arbitrage opportunity, and the ratio can change or be announced for the first time between the merger announcement date and the effective date.

Furthermore, practical obstacles can reduce merger arbitrage profits. The profitability of a merger arbitrage strategy depends on the ability of the arbitrageur to short-sell and therefore to borrow acquiring firms' stock. As in the case of relative valuation discrepancies (see, e.g., Lamont and Thaler, 2001), merger acquirers' stock can be difficult to borrow. Since specialness often increases substantially when a stock is a merger acquirer, merger arbitrage profits from raw returns can be substantially more than the profits available in practice.<sup>16</sup> It is also important to point out that some stocks may not be available for borrowing at all; the inability to borrow shares can reduce the profitability of merger strategies and increase the risk of an arbitrage portfolio.

### 6.1. The effect of merger arbitrage on specialness

To relate specialness to the potential profits from merger arbitrage, we construct a sample of stock-swap mergers with announcement dates between October 28, 1998 and September 28, 1999 using data from Securities Data Corporation (SDC). This date range allows us to measure specialness from three to 23 days after the announcement of a merger for all of the mergers in the sample, and it allows us to keep our sample size relatively stable for 20 days after the announcement. After matching with CRSP data, we end up with a sample of 226 mergers over this period. We design an experiment to minimize any forward-looking bias by using only information available on day  $t$  to predict day  $t + 3$  specialness. In particular, we include the 27 ex post unsuccessful mergers in the sample, and we do not include any measure of arbitrage profits that would rely on the rate at which equities are eventually exchanged.

Table 8 presents results from the following regression:

$$Special_{t+3}^A = a + b \ln(MKtcap^A) + c \ln(Mktcap)^T + \varepsilon_t. \quad (1)$$

<sup>16</sup> As an example, consider Mellon Global Securities Lending Market Update Report March 1–12, 1999: "Adelphia Communication's intention to purchase Century Communications caused Adelphia to trade at a margin of 775 basis [sic] as traders locked in spreads for this cash, stock and debt deal."

Table 8

The specialness of merger acquirers

This table presents results from a regression of the specialness of merger acquirers on several explanatory variables:

$$Special_{t+3}^A = a + b \ln(MKtcap^A) + c \ln(Mktcap^T) + \varepsilon_t.$$

$Special_{t+3}^A$  is the difference between the rebate on loans of the acquirer on day  $t + 3$  and the typical rebate on day  $t + 3$ .  $\ln(Mkcap)^A$  is the natural log the market capitalization of the acquirer at the end of the month before the month in which day  $t$  falls.  $\ln(Mkcap)^T$  is the same measure for merger targets. We use mergers announced between October 28, 1998 and September 28, 1999.  $P$ -values and parameter estimates are based on the censored regression model.

Explanatory variable	Trading days since merger announcement				
	0	5	10	15	20
<i>Intercept</i>	5.64 0.003	6.15 0.009	4.65 0.046	3.80 0.185	3.31 0.225
$\ln(Mkcap^A)$	-0.64 0.001	-0.69 0.000	-0.66 0.001	-0.47 0.132	-0.39 0.219
$\ln(Mkcap^T)$	0.27 0.117	0.28 0.104	0.33 0.150	0.19 0.472	0.13 0.613
Observations					
<i>Uncensored</i>	62	50	53	44	45
<i>(Specials)</i>					
<i>Total</i>	226	225	224	224	223

Because the dependent variable is no less than zero, we employ a left-censored regression technique as described in Greene (1993). As above, we use  $t + 3$  to estimate the specialness a short-seller would actually face if he were to short sell the acquirer's stock on day  $t$ . As merger arbitrage strategies involve trading in both the target and the acquirer, the maximum size of a strategy could be limited by either the long position or the short position.<sup>17</sup> As evidence that arbitrage strategies involving small target firms generate less demand for the acquirer's stock, the target firm's market capitalization,  $\ln(Mkcap^T)$ , is positively related to specialness with coefficient of 0.27. Yet, the relationship between specialness and the target's market capitalization is not as significant as the relationship between specialness and the acquirer's market capitalization; the  $p$ -value is 11.67% for the coefficient on  $\ln(Mkcap^T)$ . As expected, the acquirer's capitalization is significantly and negatively related to specialness.

The regression results discussed above are from a cross-sectional regression on the day of the merger announcement. We also run the cross-sectional regression 5, 10,

<sup>17</sup> According to a representative of Mellon's Global Securities Lending Group, when Chase Manhattan Corp. entered into an agreement to acquire J.P. Morgan via a stock swap, the supply of Chase shares was large enough to satisfy borrowing demand without trading at a premium.

15, and 20 days after the announcement. More acquiring firms are on special three days after the day of the announcement than later days; 62 firms are on special three days after the announcement, while 44–53 firms are on special 8, 13, 18, and 23 days after the announcement. Furthermore, the intercept and the coefficient on  $\ln(\text{Mktcap}^A)$  both shrink in magnitude and significance after five days. Jensen and Ruback (1983) summarize evidence indicating that merger announcement days are the most profitable days for merger arbitrage strategies, and our evidence supports the hypothesis that demand for borrowing stock is highest on these profitable days.

## 6.2. Merger arbitrage portfolios

As in the previous sections, the other important question is whether merger profits exist after taking equity-loan frictions into account. We form daily long-short portfolio returns, analogously to above, based on announced stock-swap mergers from the SDC database. Daily portfolio returns are equally weighted averages of individual merger arbitrage positions. The *Unconstrained* investor simply shorts all acquirers and buys all targets in mergers that were announced at least two days before and have not ended, putting the same dollar amount on the target and the acquirer. The two-day gap avoids announcement effects and ensures feasibility. The *GC + Specials* investor needs a Medium or Large loan of the acquirer three days later, and the *GC Only* investor needs the acquirer to be *GC* three days later.

We do not follow Baker and Savasoglu's (2002) method of using the exchange ratios of the stock-swap mergers for two reasons. First, the exchange ratios reported in SDC may not be available to arbitrageurs on the announcement date, and if the ratio changes or is announced after the merger announcement but before the merger is completed or withdrawn, an arbitrage portfolio using the reported exchange ratio would not be feasible. Second, as a practical matter, very few exchange ratios are reported in SDC; using SDC exchange ratios would substantially reduce the sample size. Cumulative profits for an investor who starts with a dollar long and a dollar short on October 28, 1998 are summarized in Table 9.

The results show that cumulative arbitrage portfolio returns are 64% without accounting for short-selling issues. When we use only those merger positions for which the acquirer's stock shows up in the loan database, *GC + Specials*, portfolio returns are reduced to 45%. The additional cost from borrowing special acquirer stocks is small; profits are reduced by only 0.26% when the additional cost of specialness is included in the calculation. Furthermore, if we assume that specials cannot be borrowed, the *GC Only* portfolio profits fall to 31%. The 33% reduction in cumulative returns is both economically and statistically significant.

The *GC Only* portfolio is conservative in the sense that it accounts for short-selling availability and excludes announcement-day returns. Nevertheless, 4-factor alphas indicate significant profitability. The intercept in the *GC Only* regression is equivalent to a 30.97% annual return, and it is statistically significant. The *Unconstrained* regression's alpha is substantially higher at 64%. As with the average returns, the difference between the portfolios is large and statistically significant, indicating that the lack of availability leads to an important reduction in arbitrage



Table 9

The profitability of merger arbitrage when short-selling is costly

We compute returns for a portfolio comprising a long position in the target firm and a short position in the acquiring firm. For the *Unconstrained* portfolio, day  $t$  returns for merger position  $i$  are  $r_{j,t} = r_{T,t} - r_{A,t}$  where  $r_{A,t}$  and  $r_{T,t}$  are day- $t$  returns on the acquiring and target firms' stocks, respectively. For the *GC + Specials* portfolio, a merger pair is only included in the feasible portfolio if our database indicates the existence of a medium or large loan in the acquirer's stock on day  $t + 3$ . *GC Only* requires the existence of a medium or large loan in the acquirer's stock on day  $t + 3$  with specialness of 0.25% or less. *Unconstrained-GC* is the portfolio formed by taking the difference between the *Unconstrained* and the *GC Only* portfolios. The daily returns of the *Unconstrained-GC* portfolios are significantly different from zero. The difference is statistically significant for *All Mergers* and *Successes* with  $p$ -values of 1.36% and 0.15%, respectively. Portfolio returns do not include returns until two trading days after the announcement. When portfolios have no active deals, the portfolio return is the federal funds rate. We compute the cumulative return over the 251 trading days between October 28, 1998 and October 26, 1999 period by compounding in the usual way. The reported results for *Unconstrained-GC* are cumulative daily differences; they are not equal to the difference between cumulative returns of the *Unconstrained* and *GC Only* portfolios. 4-factor alphas are computed as the intercepts from the daily regression:  $R_i = a_i + b_i RMRF + h_i HML + s_i SMB + m_i MOM + \varepsilon_i$  over the sample period and then annualized for each merger portfolio  $i$  (factor construction is described in the fundamentals section of the text).

Portfolio	Return 10/28/98–10/26/99 (%)	4-Factor alpha (annualized) (%)	$P$ -value (for alpha) (%)
<i>All Mergers</i>			
<i>Unconstrained</i>	64.29	64.66	<0.01
<i>GC + Specials</i>	44.57	42.58	0.34
<i>GC Only</i>	31.13	30.97	0.89
<i>Unconstrained – GC</i>	24.86	25.75	2.18
<i>Failures</i>			
<i>Unconstrained</i>	–34.76	–12.98	81.28
<i>GC + Specials</i>	–46.42	–43.55	13.99
<i>GC Only</i>	–35.59	–32.40	30.25
<i>Unconstrained – GC</i>	–4.71	28.68	66.67
<i>Successes</i>			
<i>Unconstrained</i>	82.50	79.23	<0.01
<i>GC + Specials</i>	56.99	53.61	0.08
<i>GC Only</i>	38.86	36.62	0.48
<i>Unconstrained – GC</i>	31.04	31.24	0.37

profits. The risks involved in merger-arbitrage strategies are highlighted by the fact that ex post unsuccessful merger strategies perform significantly worse than strategies that used only ex post successful mergers. The cumulative return of the portfolio of successful mergers is 83% while the portfolio of failed mergers has a –35% cumulative return.

Following the methodology of the IPO and DotCom sections, we can ask how closely the constrained portfolios track the unconstrained portfolio. To answer the question we regress the *GC Only* portfolio's daily time series on the *Unconstrained* portfolio's time series. The statistically significant coefficient on the unconstrained portfolio is 0.71, and the  $R^2$  is 41%; the analogous figures for *GC Only* are smaller.

Even though the constrained portfolios still earn a large, significant profit, the correlation between constrained and unconstrained merger arbitrage portfolios is relatively low.

## 7. Summary and conclusion

Short-sales generally require equity loans, and the availability and costs of these loans vary across stocks and days. The feasibility and profitability of strategies that involve short-selling are therefore important questions that a cross-section and time series of equity-loan prices and quantities can answer. With a year of equity-loan data from one of the world's most active lenders, we replicate several strategies that involve short-selling at three levels of access to loans: access to any stock for free, access to any stock loaned in size by our data provider at the terms we observe, and access only to non-scarce stocks. We briefly summarize the major findings and consider some implications.

### 7.1. *Zero investment/factor portfolios*

There may be an expected-return difference between the unconstrained factor portfolios of the finance literature and the portfolios that investors can actually hold, but this difference is significantly smaller (at the 10% level in one case, and at 5% or better in the other five) than the unconstrained factors' documented profitability. This supports the interpretation, common in the performance-evaluation literature, that the returns of factor portfolios are available to unskilled managers. If short-selling problems explain this availability, they are problems of another variety, such as short-selling prohibitions (as in Hong and Stein, 2001) or liquidity constraints (as in Shelifer and Vishny, 1997).

### 7.2. *DotComs*

Our results provide little support for the view that short-selling frictions made it hard to bet that DotComs would go back down. Short exposure to DotComs was not costly or difficult; a portfolio constructed from only easy-to-borrow stocks tracks an Internet Index closely over our sample period, and the wholesale specialness cost of a portfolio with harder- to-borrow stocks, which tracks even more closely, is only 1.15% for the year. We do find the harder-to-borrow DotComs to have greater loadings on the Internet Index, suggesting that investors with good access to equity loans could get more short exposure per dollar short than other investors could.

### 7.3. *Initial public offerings*

Short exposure to IPOs is generally feasible for those with good access to equity loans, even in the first days of trading. The popular press reports allegations that

underwriters boosted first-day returns with prearranged trades at high prices; our evidence that well-placed investors can generally short all but the smallest offerings on their first days suggests that this would be difficult. Investors with good access to equity loans could have shorted if they thought prices were artificially high. Across IPOs we find an extra cost to shorting hotter offerings, which supports the Miller (1977) heterogeneous-investors view. We also find, however, that the struggling offerings subject to the price support shown by Aggarwal (2000) and Ellis et al. (2000) are also more expensive, which represents indirect evidence that investors do in fact short offerings they believe to be artificially high. At least some of the underperformance found by Loughran and Ritter (1995) is available to investors who can short specials and pay the specialness cost, and the same is true for investors with no access to specials. The trade indicated by the lockup-expiration literature is also significantly profitable with only readily available shares. In general, the documented underperformance by IPOs cannot be attributed to equity-loan frictions alone.

#### 7.4. *Merger arbitrage*

The area where we find the greatest reduction in opportunity caused by short-selling costs and constraints is in merger arbitrage. Profits drop substantially when we constrain arbitrageurs to short only those acquirers that our data provider loaned, and they drop substantially again when we constrain to only those acquirers that were easy to borrow.

The lesson from our results, combined with those of Lamont and Thaler (2001), D'Avolio (2001), Mitchell et al. (2001) and Reed (2001), is that specialness is a stock-specific, rather than categorical, consideration. Similar to the bond-market results in Krishnamurthy (2001), the equity-market results demonstrate that well-known stock-specific trades, rather than categorical portfolios, may be severely compromised by borrowing problems. As Lamont and Thaler (2001) note, there are other opportunities for short exposure to acquirers, in particular synthetic shorts from the options market. The simultaneous clearing of the option and equity-loan markets for these stocks is a promising topic for future research.

## References

- Aggarwal, R., 2000. Stabilization activities by underwriters after initial public offering. *Journal of Finance* 55, 1075–1103.
- Asquith, P., Meulbroek, L., 1996. An empirical investigation of short interest. Unpublished working paper, Harvard Business School.
- Baker, M., Savasoglu, S., 2002. Limited arbitrage in mergers and acquisitions. *Journal of Financial Economics*, forthcoming.
- Bradley, D., Jordan, B., Roten, I., Yi, H.-C., 2001. Venture capital and IPO lockup expiration: an empirical analysis. *Journal of Financial Research* 24, 465–492.
- Brav, A., Gompers, P.A., 2001. The role of lockups in initial public offerings. Unpublished working paper, Duke and Harvard Universities.

- Brav, A., Geczy, C., Gompers, P.A., 2000. Is the abnormal return following equity issuances anomalous? *Journal of Financial Economics* 56, 209–249.
- Brent, A., Morse, D., Stice, E., 1990. Short interest: explanations and tests. *Journal of Financial and Quantitative Analysis* 25, 273–289.
- Carhart, M., 1997. On persistence in mutual fund performance. *Journal of Finance* 52 (1), 57–82.
- D'Avolio, G., 2001. The market for borrowing stock. Unpublished working paper, Harvard University.
- Danielsen, B.R., Sorescu, S.M., 2001. Why do option introductions depress stock prices? A study of diminishing short-sale constraints. *Journal of Financial and Quantitative Analysis* 36, 451–484.
- DeBondt, W.F.M., Thaler, R.H., 1987. Further evidence on investor overreaction and stock market seasonality. *Journal of Finance* 42, 557–581.
- Dechow, P.M., Hutton, A.P., Meulbroek, L., Sloan, R.G., 2001. Short-sellers, fundamental analysis and stock returns. *Journal of Financial Economics* 61, 77–106.
- Desai, H., Thiagarajan, S.R., Ramesh, K., Balachandran, 2000. An investigation of the informational role of short interest in the Nasdaq market. Unpublished working paper, Southern Methodist University.
- Diamond, D.W., Verrecchia, R.E., 1987. Constraints on short-selling and asset price adjustment to private information. *Journal of Financial Economics* 18, 277–311.
- Duffie, D., 1996. Special repo rates. *Journal of Finance* 51, 493–526.
- Duffie, D., Garleanu, N., Pedersen, L.H., 2001. Securities lending, shorting and pricing. Unpublished working paper, Stanford University.
- Ellis, K., Michaely, R., O'Hara, M., 2000. When the underwriter is the market maker: an examination of trading in the IPO aftermarket. *Journal of Finance* 55, 1039–1074.
- Fama, E., French, K., 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33, 3–56.
- Field, L.C., Hanka, G., 2001. The Expiration of IPO Share Lockups. *Journal of Finance* 56 (2), 471–500.
- Figlewski, S., 1981. The informational effects of restrictions on short sales: some empirical evidence. *Journal of Financial and Quantitative Analysis* 4, 463–476.
- Gintschell, A., 2000. Short interest on NASDAQ. Unpublished working paper, University of Rochester.
- Greene, W.H., 1993. *Econometric Analysis*, 2nd Edition. Macmillian, New York.
- Heckman, J., 1976. The common structure of statistical models of truncation, sample selection, and limited dependent variables and a simple estimator for such models. *Annals of Economic and Social Measurement* 5, 475–492.
- Heckman, J., 1979. Sample selection as a specification error. *Econometrica* 47, 153–161.
- Hong, H., Stein, J., 2001. Differences of opinion, rational arbitrage and market crashes. Unpublished working paper, Stanford and Harvard Universities.
- Houge, T., Loughran, T., Suchanek, G., Yan, X., 2001. Divergence of opinion, uncertainty and the quality of initial public offerings. *Financial Management* 30, 5–23.
- Jegadeesh, N., Titman, S., 1993. Returns to buying winners and selling losers: implications for stock-market efficiency. *Journal of Finance* 48, 93–130.
- Jensen, M.C., Ruback, R.S., 1983. The market for corporate control. *Journal of Financial Economics* 11, 5–50.
- Jindra, J., Walkling, R.A., 2001. Speculation spreads and the market pricing of proposed acquisitions. Unpublished working paper, Ohio State University.
- Jones, C.M., Lamont, O.A., 2001. Short sale constraints and stock returns. *Journal of Financial Economics*, forthcoming.
- Keasler, T.R., 2001. Underwriter lock-up releases, initial public offerings and after-market performance. *Financial Review* 37, 1–20.
- Keim, D.B., 1999. An analysis of mutual fund design: the case of investing in small-cap stocks. *Journal of Financial Economics* 51, 173–194.
- Ketchum, R.G., 1995. Official Correspondence from CEO and EVP, NASD to Richard Lewandowski, Director. The Options Exchange, July 26, 1995.
- Krishnamurthy, A., 2001. The bond/old-bond spread. Unpublished working paper, Northwestern University.

- Lamont, O.A., Thaler, R.H., 2001. Can the market add and subtract? Mispricing in tech stock carve-outs. Unpublished working paper, The University of Chicago.
- Loughran, T., Ritter, J.R., 1995. The new issues puzzle. *Journal of Finance* 50, 23–51.
- MacDonald, J.G., Baron, D.C., 1973. Risk and return on short position in common stocks. *Journal of Finance* 28, 97–107.
- Miller, E.M., 1977. Risk, uncertainty and divergence of opinion. *Journal of Finance* 32, 1151–1168.
- Mitchell, M., Pulvino, T., Stafford, E., 2001. Limited arbitrage in equity markets. Unpublished working paper, Harvard Business School.
- New York Stock Exchange Information Memo Number 91-41, 1991. Rule 440c deliveries against short sales, New York, NY.
- Ofek, E., Richardson, M., 2000. The IPO lock-up period: implications for market efficiency and downward sloping demand curves. Unpublished working paper, New York University.
- Ofek, E., Richardson, M., 2001. DotCom mania: a survey of market efficiency in the Internet sector. Unpublished working paper, New York University.
- Pastor, L., Stambaugh, R., 2001. Investing in equity mutual funds. *Journal of Financial Economics* 63, 315–349.
- Reed, A.V., 2001. Costly short-selling and stock price reactions to earnings announcements. Unpublished working paper, University of Pennsylvania.
- Richardson, S., 2000. Accruals and short selling: an opportunity foregone? Unpublished working paper, University of Michigan.
- Safieddine, A., Wilhelm, W.J., 1996. An empirical investigation of short selling activity prior to seasoned equity offerings. *Journal of Finance* 51, 729–749.
- Securities and Exchange Commission, 1995. Release no. 34-35207; file no. sr-nasd-95-01. Federal Register, Vol. 60, No. 10, Washington, DC.
- Securities and Exchange Commission, 1996. Release no. 34-37773; file no. sr-amex-96-05. Federal Register, Vol. 61, No. 197, Washington, DC.
- Senchack, A.J., Starks, L.T., 1993. Short-sale restrictions and market reaction to short-interest announcements. *Journal of Financial and Quantitative Analysis* 28, 177–194.
- Seneca, J.J., 1967. Short interest: bearish or bullish? *Journal of Finance* 22, 67–70.
- Shelifer, A., Vishny, R.W., 1997. The limits of arbitrage. *Journal of Finance* 52, 35–55.
- Sorescu, S.M., 2000. The effect of options on stock prices. *Journal of Finance* 55, 487–514.