

Internet Appendix to “Price Efficiency and Short Selling”

Pedro A. C. Saffi
IESE Business School

Kari Sigurdsson
Blackrock

1 Data Description

In Table 1, we present the summary statistics for the measures of price efficiency, characteristics of the returns distribution and explanatory variables. Panel A shows the results for the main sample of firms, whereas Panel B repeats the calculations using a smaller sample with book-to-market and free float data available. The average correlation between contemporaneous weekly returns and lagged market returns is -0.03%. Stock returns are skewed to the right, with mean skewness equal to -0.12, similar to the values found by [Bris, Goetzmann, and Zhu \(2007\)](#). The percentage of weekly returns two standard deviations below (or above) the previous year’s average is around 7% (or 5%). These figures are larger than the 2.28% expected from a normal distribution and reflect the wider tails found in empirical data. In Panel B, the average free float is 71% with a standard deviation of 23%. This spread highlights the fact that many firms have a majority of shares unavailable to ordinary investors, which could thus affect a stock’s liquidity.

2 Additional Robustness Tests

Our data also allow us to compute another measure of short-sale constraints, loan utilization, calculated by dividing the total amount of shares lent out by the lending supply available. The results are displayed in Table 2.¹ Controlling for lending supply, a high utilization implies that a relatively higher number of shares are being borrowed by investors, which can increase price efficiency or be indicative of short-

¹We only report the estimated coefficients for lending, loan fees and utilization but use the same set of control variables as in the tables in the main text.

Table 1: Characteristics of stock markets around the world

The table shows summary statistics based on the annual values between 2005 and 2008 using Datastream price data. Each firm must have at least 50 weekly return observations, less than 10 zero-return observations and more than 5 lending observations in a given year. Furthermore, each country must have more than 15 firms in a given year. Cross-correlation is the correlation between contemporaneous weekly stock returns and lagged local market returns. D1 and D2 are proxies for price delay proposed by [Hou and Moskowitz \(2005\)](#). The frequency of extreme negative (positive) returns is the fraction of returns two standard deviations below (above) the previous year's average, Down Risk is the variance of weekly below-average returns in a year, and Volatility is the standard deviation of weekly returns. Supply is the average lending supply relative to market capitalization, whereas Fee is the average annual fee computed from available loan transactions. "ADR or GDR" is a dummy variable equal to one if the firm cross-lists in the US or the UK, Market cap measures firm capitalization, Zero-return weeks is the proportion of zero-return weeks in a given year, Turnover is the sum of weekly dollar trading volume scaled by market capitalization, Free Float is the fraction of total shares available to ordinary investors, and Bid-Ask is the weekly closing spread, scaled by the closing price. Panel A displays results for the main sample, whereas Panel B includes firms without B/M, free float and the bid-ask spread as controls.

PANEL A: Main sample

	Obs.	Mean	Median	St.dev.	Min.	Max
Cross-correlation	19,071	-0.03	-0.03	0.16	-0.53	0.66
D1	19,071	0.31	0.24	0.25	-0.02	1.00
D2	19,071	0.52	0.50	0.21	0.03	1.00
Skewness of raw returns	19,071	-0.12	-0.08	1.05	-6.98	7.01
Skewness of abnormal returns	19,071	0.04	0.09	1.07	-6.99	6.86
Kurtosis of raw returns	19,071	2.89	1.53	4.52	-1	50
Kurtosis of abnormal returns	19,071	2.83	1.44	4.44	-1	50
Freq. extreme negative returns	18,699	0.07	0.04	0.07	0.00	0.92
Freq. extreme positive returns	18,699	0.05	0.04	0.05	0.00	1.00
Down Risk (x100)	19,071	4.29	3.49	2.92	0.06	39
Volatility (x100)	19,071	6.85	5.65	4.68	0.09	96.31
Supply(% mc)	19,071	0.08	0.06	0.06	0.00	0.89
Fee (% p.a.)	19,071	0.92	0.22	1.47	-0.11	8.25
ADR or GDR dummy	19,071	0.04	0.00	0.20	0.00	1.00
Market cap (USD billions)	19,071	3.43	0.48	14.47	0.00	465.41
Zero-return Weeks (%)	19,071	0.01	0.00	0.02	0.00	0.17
Turnover (%)	19,071	37.79	24.59	42.60	0.00	325.21
Free Float (%)	10,501	71.43	77.00	22.82	1.00	100.00
Bid-Ask (%)	19,071	0.34	0.12	0.78	0.00	45.23

Panel B: Including B/M & Free Float

	Obs.	Mean	Median	St.dev.	Min.	Max
Cross-correlation	9,959	-0.03	-0.03	0.16	-0.52	0.66
D1	9,959	0.29	0.21	0.24	-0.02	1.00
D2	9,959	0.50	0.47	0.21	0.03	1.00
Skewness of raw returns	9,959	-0.09	-0.07	0.99	-6.88	6.70
Skewness of abnormal returns	9,959	0.06	0.09	1.02	-6.71	6.86
Kurtosis of raw returns	9,959	2.65	1.43	4.18	-1	49
Kurtosis of abnormal returns	9,959	2.63	1.33	4.22	-1	49
Freq. extreme negative returns	9,599	0.07	0.04	0.07	0.00	0.52
Freq. extreme positive returns	9,599	0.05	0.04	0.05	0.00	1.00
Down Risk (x100)	9,959	3.89	3.15	2.61	0.06	38.60
Volatility (x100)	9,959	6.13	5.05	4.02	0.09	72.33
Supply(% mc)	9,959	0.07	0.06	0.06	0.00	0.62
Fee (% p.a.)	9,959	0.76	0.21	1.21	-0.11	8.25
ADR or GDR dummy	9,959	0.05	0.00	0.22	0.00	1.00
Market cap (USD billions)	9,959	3.39	0.65	12.14	0.00	291.16
Zero-return Weeks (%)	9,959	0.01	0.00	0.02	0.00	0.17
Turnover (%)	9,959	35.21	21.49	41.75	0.00	325.21
Free Float (%)	9,959	70.91	76.00	22.82	1.00	100.00
Bid-Ask (%)	9,959	0.31	0.12	0.79	0.00	45.23

sale constraints. This is similar to the econometric problems that arise when short interest, a measure of short-selling demand, is used as a sole proxy for short-sale constraints [Cohen, Diether, and Malloy \(2007\)](#). From Panel A, lending supply is still significant for all price efficiency measures, but the significance of loan fees is now replaced by utilization. Utilization coefficients have the same sign as those of lending supply, indicating that high utilization is not indicative of short-sale constraints. In Panel B, the introduction of utilization does not add much explanatory power to our tests. The lending supply parameters are qualitatively the same, with loan fees being positively related with kurtosis, downside risk and total volatility, and negatively related to the frequency of negative returns. Utilization is negatively related to excess skewness and positively linked to excess kurtosis, downside risk and total volatility.

Another concern is that our standard errors may not be sufficiently conservative. In addition to the double-clustering by firm and year [[Thompson \(2009\)](#)], we also run separate regressions for each of the four years in the sample to rule out the possibility that events in a particular year or country have a disproportionate effect on the regressions. In [Table 3](#) we present the average coefficients, the number of years that they are positive and the number of statistically significant parameters. Lending supply coefficients are negative and significant in most years for all price efficiency measures. In Panel B we also find that similar results of the previous tables in terms of lending supply's association with the characteristics of the distribution of returns. As before, the loan fee results are less robust and although the average coefficients have similar values, they are usually not significant. The only exception is for the total volatility measures, which are positive and significant in all years but 2005. The reduced significance in 2005 is possibly explained by the smaller database coverage observed in that year.

Another source of bias could be the disproportionate impact of the financial crises in 2008, especially for financial firms. In [Table 4](#), we present two sets of estimates. In Panel A, we exclude the financial firms and find similar results, although we no longer find a negative link between lending supply and the frequency of extreme positive returns. In Panel B, we explore whether removing the data for the year 2008 has any effect on the usefulness of our short selling proxies, with results for lending supply remaining unaffected.² The coefficients of loan fees are broadly consistent, but we find

²Excluding both financial firms and 2008 observations yield similar conclusions.

Table 2: Robustness Test: Lending Supply & Utilization

The table displays how lending supply, loan fees, and loan utilization are related to price efficiency measures and the characteristics of stock return distribution between 2005 and 2008. Each firm-year needs at least 50 weekly return observations and less than 10 weeks with zero-returns. A country must have more than 15 companies to be included in the sample. All variables are normalized to have zero mean and unit standard deviation in a given country-year. In Panel A, we have price efficiency measures: ρ^{Cross} is the cross-correlation between firm returns and lagged local index returns, $|VR|$ is the variance ratio, defined as the absolute value of the variance of monthly returns divided by 4 times the variance of weekly returns, less one; and D1 and D2 are proxies of price delay proposed by [Hou and Moskowitz \(2005\)](#). In Panel B, we have characteristics of the distribution of stock return: Skewness and Kurtosis of weekly stock returns, Exc(Skew) and Exc(Kurt) are based on the residuals of a local market-model regression, Extreme Down (Extreme Up) is the fraction of returns two standard deviations below (above) the previous year's average, Down Risk is the variance of negative weekly returns in a year, and Vol is the standard deviation of weekly returns. Supply is lending supply relative to market cap, Fee is the annualized loan fee, and Utilization is the number of shares on loan divided by lending supply. Unreported controls also included are as follows: ADR/GDR is a dummy for whether the firm cross-lists in the US or the UK, Market Cap is market capitalization, B/M is the book-to-market ratio, Zero-return weeks, Turnover is total turnover, Free Float is the fraction of shares available to ordinary investors, and Bid-Ask is the closing spread scaled by price. Regressions include country and year dummies. Standard errors are double clustered at the firm and year levels as in [Thompson \(2009\)](#). Standard deviations are reported in brackets, and the significance levels are as follows: **=significant at the 10% percent level; *=significant at the 5% percent level; += 1% level.

4

	Panel A: Price Efficiency				Panel B: Return Distribution Characteristics							
	ρ^{Cross}	$ VR $	D1	D2	Skew	Exc(Skew)	Kurt	Exc(Kurt)	Down	Up	Down Risk	Vol
Supply	-0.107 [0.046]*	-0.058 [0.019] ⁺	-0.103 [0.015] ⁺	-0.083 [0.025] ⁺	-0.062 [0.023] ⁺	-0.103 [0.013] ⁺	-0.069 [0.021] ⁺	-0.027 [0.014]**	-0.006 [0.017]	-0.050 [0.008] ⁺	-0.005 [0.010]	-0.026 [0.012]*
Fee	0.034 [0.027]	0.004 [0.002]**	0.014 [0.011]	-0.007 [0.019]	0.016 [0.015]	0.020 [0.012]	0.020 [0.009]*	0.020 [0.010]**	-0.042 [0.013] ⁺	-0.009 [0.007]	0.063 [0.021] ⁺	0.100 [0.029] ⁺
Utilization	-0.061 [0.024]*	0.003 [0.018]	-0.046 [0.012] ⁺	-0.043 [0.026]**	-0.005 [0.033]	-0.029 [0.016]**	-0.007 [0.018]	0.009 [0.005]*	-0.005 [0.004]	0.008 [0.017]	0.117 [0.011] ⁺	0.137 [0.009] ⁺
Obs.	18,560	18,560	18,560	18,560	18,560	18,560	18,560	18,560	18,189	18,189	18,560	18,560
Firms	8,226	8,226	8,226	8,226	8,226	8,226	8,226	8,226	8,226	8,226	8,226	8,226
R^2	0.08	0.01	0.26	0.07	0.07	0.01	0.01	0.04	0.02	0.01	0.01	0.21

Table 3: Robustness Test: Annual Regressions

The table displays the results of the estimation of annual regressions of measures of price efficiency and characteristics of the return distribution from 2005 to 2008 in terms of the firm's characteristics. For each explanatory variable, we display the average value of estimated parameters, the number of years that the values are positive, and the number that are significant at the 5% level in brackets. In Panel A, we have price efficiency measures: ρ^{Cross} is the cross-correlation between firm returns and lagged local index returns, $|VR|$ is the variance ratio, defined as the absolute value of the variance of monthly returns divided by 4 times the variance of weekly returns, less one; D1 and D2 are proxies of price delay proposed by [Hou and Moskowitz \(2005\)](#). In Panel B, we have characteristics of the distribution of stock return: Skewness and Kurtosis of weekly stock returns, Exc(Skew) and Exc(Kurt) are based on the residuals of a local market-model regression, Down (Up) is the fraction of returns two standard deviations below (above) the previous year's average, Down Risk is the variance of weekly below-average returns in a year, and Vol is the standard deviation of weekly returns. The explanatory variables are: Supply is lending supply relative to market cap, Fee is the annualized loan fee, Mkt. Cap is market capitalization, B/M is the book-to-market ratio, Zero-return weeks, Turnover is total turnover, and Bid-Ask is the closing bid-ask spread scaled by price. All regressions include country dummies.

	Panel A: Price Efficiency				Panel B: Characteristics of the Return Distribution							
	ρ^{Cross}	$ VR $	D1	D2	Skew	Exc(Skew)	Kurt	Exc(Kurt)	Down	Up	Down Risk	Vol
Supply	-0.087	-0.054	-0.089	-0.073	-0.063	-0.095	-0.056	-0.025	-0.014	-0.053	-0.033	-0.062
Years Positive	1	0	0	0	0	0	0	0	2	0	0	0
# Sig. @ 95%	[3]	[2]	[4]	[2]	[3]	[4]	[3]	[2]	[2]	[3]	[1]	[3]
Fee	0.008	0.006	-0.001	-0.029	0.014	0.020	0.007	0.011	-0.046	-0.020	0.089	0.124
Years Positive	2	3	1	0	4	4	3	3	0	1	3	3
# Sig. @ 95%	[1]	[0]	[1]	[1]	[0]	[0]	[0]	[0]	[2]	[0]	[3]	[3]
ADR or GDR	-0.007	0.190	0.051	-0.035	0.099	0.079	0.042	0.040	0.008	0.133	0.135	0.188
Years Positive	2	3	3	2	4	3	3	2	3	3	4	4
# Sig. @ 95%	[2]	[0]	[1]	[0]	[1]	[1]	[0]	[0]	[1]	[1]	[1]	[3]
Market Cap.	-0.171	0.015	-0.311	-0.192	-0.014	0.031	-0.102	-0.098	0.033	-0.023	-0.249	-0.263
Years Positive	0	3	0	0	2	4	1	0	3	1	0	0
# Sig. @ 95%	[3]	[2]	[4]	[4]	[1]	[1]	[3]	[3]	[1]	[3]	[4]	[4]
Zero-return weeks	0.030	0.023	0.059	0.027	0.031	0.032	0.078	0.062	-0.038	0.023	-0.033	-0.033
Years Positive	3	3	3	4	3	3	3	3	0	1	1	1
# Sig. @ 95%	[2]	[2]	[3]	[2]	[1]	[1]	[4]	[4]	[2]	[2]	[2]	[2]
Turnover	0.024	0.009	-0.004	0.024	-0.015	-0.015	0.075	0.096	0.089	0.057	0.315	0.364
Years Positive	2	3	2	3	4	4	4	4	4	4	0	0
# Sig. @ 95%	[3]	[2]	[1]	[2]	[2]	[0]	[3]	[3]	[2]	[3]	[4]	[4]
Bid-Ask	0.016	0.075	0.176	0.083	-0.016	-0.032	0.036	0.027	0.114	0.064	0.185	0.225
Years Positive	2	4	4	4	2	1	2	2	4	4	4	4
# Sig. @ 95%	[2]	[2]	[3]	[2]	[1]	[1]	[4]	[4]	[2]	[2]	[2]	[2]
Number of Years	4	4	4	4	4	4	4	4	4	4	4	4
Average Obs.	4,768	4,768	4,768	4,768	4,768	4,768	4,768	4,768	4,675	4,675	4,768	4,768
Average R^2	0.08	0.02	0.26	0.09	0.01	0.02	0.05	0.03	0.03	0.03	0.22	0.31

negative, albeit small, coefficients for D1 and D2.

Table 4: Robustness Tests: Non-Financial Firms Only & Ex-2008 Data

The table displays how lending supply and loan fees relate to price efficiency measures and characteristics of stock return distribution between 2005 and 2008. In Panel A we exclude non-financial firms based on Worldscope's WS06010 variable. In Panel B we retain financial firms but exclude the observations in 2008. The dependent variables are: ρ^{Cross} is the cross-correlation between firm returns and lagged local index returns, $|VR|$ is the variance ratio, defined as the absolute value of the variance of monthly returns divided by 4 times the variance of weekly returns, less one; and D1 and D2 are proxies of price delay proposed by Hou and Moskowitz (2005). Skewness and Kurtosis of weekly stock returns, Exc(Skew) and Exc(Kurt) are based on the residuals of a local market-model regression, Down (Up) is the fraction of returns two standard deviations below (above) the previous year's average, Down Risk is the variance of negative weekly returns in a year, and Vol is the standard deviation of weekly returns. The explanatory variables are: Supply is lending supply relative to market cap, Fee is the annualized loan fee, Mkt. Cap is market capitalization, Zero-return weeks, Turnover is total turnover, and Bid-Ask is the closing spread scaled by price. Regressions also include country dummies, but only the Supply and Fee coefficients are reported. Standard deviations are reported in brackets, and the significance levels are as follows: **=significant at the 10% percent level; *=significant at the 5% percent level; += 1% level.

Panel A: Excludes Financial Firms

	ρ^{Cross}	$ VR $	D1	D2	Skew	Exc(Skew)	Kurt	Exc(Kurt)	Down	Up	Down Risk	Vol
Supply	-0.118 [0.065]**	-0.040 [0.018]*	-0.097 [0.019] ⁺	-0.078 [0.028] ⁺	-0.067 [0.021] ⁺	-0.103 [0.006] ⁺	-0.061 [0.014] ⁺	-0.022 [0.012]**	0.030 [0.019]	-0.022 [0.024]	-0.062 [0.010] ⁺	-0.096 [0.023] ⁺
Fee	0.014 [0.018]	0.034 [0.005] ⁺	0.003 [0.013]	-0.020 [0.003] ⁺	0.028 [0.010] ⁺	0.025 [0.005] ⁺	0.012 [0.010]	0.009 [0.009]	-0.039 [0.008] ⁺	0.003 [0.001]*	0.088 [0.014] ⁺	0.131 [0.023] ⁺
Obs.	15,098	15,098	15,098	15,098	15,098	15,098	15,098	15,098	14,793	14,793	15,098	15,098
Firms	6,127	6,127	6,127	6,127	6,127	6,127	6,127	6,127	6,127	6,127	6,127	6,127
R^2	0.09	0.02	0.25	0.06	0.06	0.01	0.01	0.03	0.02	0.02	0.01	0.22

Panel B: Excludes 2008 Data

	ρ^{Cross}	$ VR $	D1	D2	Skew	Exc(Skew)	Kurt	Exc(Kurt)	Down	Up	Down Risk	Vol
Supply	-0.145 [0.011] ⁺	-0.046 [0.019]*	-0.110 [0.006] ⁺	-0.064 [0.028]*	-0.080 [0.002] ⁺	-0.085 [0.007] ⁺	-0.049 [0.013] ⁺	-0.022 [0.016]	0.011 [0.011]	-0.054 [0.005] ⁺	-0.016 [0.013]	-0.053 [0.017] ⁺
Fee	0.018 [0.029]	0.011 [0.006]**	-0.008 [0.003]*	-0.019 [0.009]*	0.014 [0.010]	0.017 [0.006] ⁺	0.016 [0.011]	0.015 [0.010]	-0.030 [0.002] ⁺	-0.003 [0.004]	0.125 [0.018] ⁺	0.170 [0.026] ⁺
Obs.	13,744	13,744	13,744	13,744	13,744	13,744	13,744	13,744	13,738	13,738	13,744	13,744
Firms	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320	7,320
R^2	0.08	0.01	0.24	0.06	0.06	0.01	0.01	0.04	0.03	0.01	0.01	0.22

References

- Bris, Arturo, William N. Goetzmann, and Ning Zhu, 2007, Efficiency and the Bear: Short Sales and Markets Around the World, *Journal of Finance* 62, 1029–1079.
- Cohen, Lauren, Karl B. Diether, and Christopher J. Malloy, 2007, Supply and Demand Shifts in the Shorting Market, *Journal of Finance* 62, 2061–2096.
- Hou, Kewei, and Tobias J. Moskowitz, 2005, Market Frictions, Price Delay, and the Cross-Section of Expected Returns, *Review of Financial Studies* 18, 981–1020.
- Thompson, Samuel B., 2009, Simple Formulas for Standard Errors that Cluster by Both Firm and Time, *Working Paper*.