Appendix A – Portfolio performance using short interest ratio (SIR)

We use Days to Cover (DTC) as our measure of short interest in the paper. Short Interest Ratio (SIR) is also commonly used to measure short interest. DTC may be a stronger indicator of investor belief (or the value of investor private information) because it is more difficult, or expensive, for short sellers to cover high DTC positions, at least collectively. High SIR positions may be easily covered if a stock has sufficient trading volume. In this appendix, we replicate some key results from the paper using SIR instead of DTC. We continue to find that high volatility stocks with low short interest perform well, but to lesser degree.

Figure A-1 replicates Figure 2 from the paper, but uses SIR instead of DTC to sort on short interest. The figure shows the value of a $1 investment in equally weighted portfolios of low and high volatility stocks with varying level of short interest from July 1991 through December 2012. The low vol/low SI and high vol/low SI portfolios hold the stocks with the lowest 20% of SIR within the respective volatility quintiles. The low vol/high SI and high vol/high SI portfolio holds the stocks with the highest 20% of SIR within the respective volatility quintiles.

As in the paper, the low SI portfolios outperform the high SI portfolios, and the high vol/low SI portfolio outperforms all others. At the end of 2012, the high vol/low SI portfolio is worth $24.25, while the low vol/low SI portfolio is worth $18.06. On the other hand, the high vol/high SI portfolio is worth $0.56, while the low vol/high SI portfolio is worth $8.62. Compared to the portfolios formed using DTC, the portfolios formed using SIR show better performance for the high SI portfolios and worse performance for the low SI portfolios. In particular, the final value of the high vol/low SI portfolio fell by about 36% when using SIR.

Table A-1, Panel A shows annualized performance measures for these portfolios. The high vol/low SI portfolio has an average return of 18.9% per year with a standard deviation of 29.0%, while the low vol/low SI portfolio has an average return of 14.1% with a standard deviation of 11.0%. The returns are larger for the high vol/low SI portfolio, but the Sharpe and Treynor ratios are larger for the low vol/low SI portfolio. Compared to the portfolios formed using DTC in Table 2 in the paper, both low SI portfolios formed using SIR have lower returns and performance ratios. However, using the value weighted portfolios in Panel B, the ratios for the low SI portfolios formed using SIR are greater than those for the same portfolios formed using DTC.

The high vol/high SI portfolio has an average return of 3.7% per year with a standard deviation of 36.4%. The Sharpe and Treynor ratios are about zero. The low vol/high SI portfolio has an average return of 11.1% with a standard deviation of 14.4%. The Sharpe and Treynor ratios of the low vol/high SI portfolio are about equal to those of high vol/low SI portfolio. Compared to the portfolios formed using DTC in Table 2 in the paper, both high SI portfolios formed using SIR have higher returns and ratios. The value weighted portfolios in Panel B show similar results.

We measure the FF-PS five-factor alpha of the high vol/low SI and high vol/high SI portfolios formed using SIR in Table A-2.[1] Looking first at the equally weighted results, the high vol/low SI portfolio has an alpha of 0.69% per month, compared to -0.48% for the high vol/high SI portfolio. This difference of 1.17% per month (14.0% per year) covers nearly the entire 15.2% gap in average annual return between the portfolios found in Table A-1. A similar alpha gap of 0.57% per month (6.8% per year, *p*-value = .229) exists between the value weighted portfolios,

[1] We refer to the Fama-French-Carhart (1993, 1997) four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor as the FF-PS five-factor model.

which covers much of the 8.8% gap in average annual return between those portfolios. Each portfolio formed using SIR has an alpha with a lower absolute value than its matching portfolio formed using DTC from Table 3 in the paper. However, the alphas for the portfolios formed using SIR are still economically large.

Finally, Table A-3 replicates Table 5 from the paper, but replaces DTC with SIR in our panel model. In Column 4 of Table A-3, we test the effects of idiosyncratic volatility and SIR on expected return. We find having an idiosyncratic volatility one standard deviation above the mean in the prior month predicts an expected return 0.24% lower in the next month. We also find having an SIR one standard deviation above the mean in the prior month predicts an expected return 0.19% lower in the next month. In Column 6, we include our interacted dummy variables. We find no significant non-linear effects for short interest or volatility, but in addition to the previously discussed effects of being high volatility and high short interest, there is a -0.37% effect for being both simultaneously. Unlike our results in Table 5, we do not find an additional effect for being both high volatility and low short interest simultaneously when using SIR as our measure of short interest.

Overall, our results using SIR are generally somewhat weaker than those found using DTC. But regardless of our choice of short interest measure, the high vol/low SI portfolio still shows strong performance.

Figure A-1: The return on one dollar invested in low and high volatility stocks with low and high short interest – SIR
This figure shows the value of a $1 investment in equally weighted portfolios of low and high volatility stocks with low and high short interest from July 1991 through December 2012. A stock is considered low (high) volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if short interest ratio (SIR) in month *t* - 1 falls within the lowest (highest) 20% among stocks in the same volatility quintile.

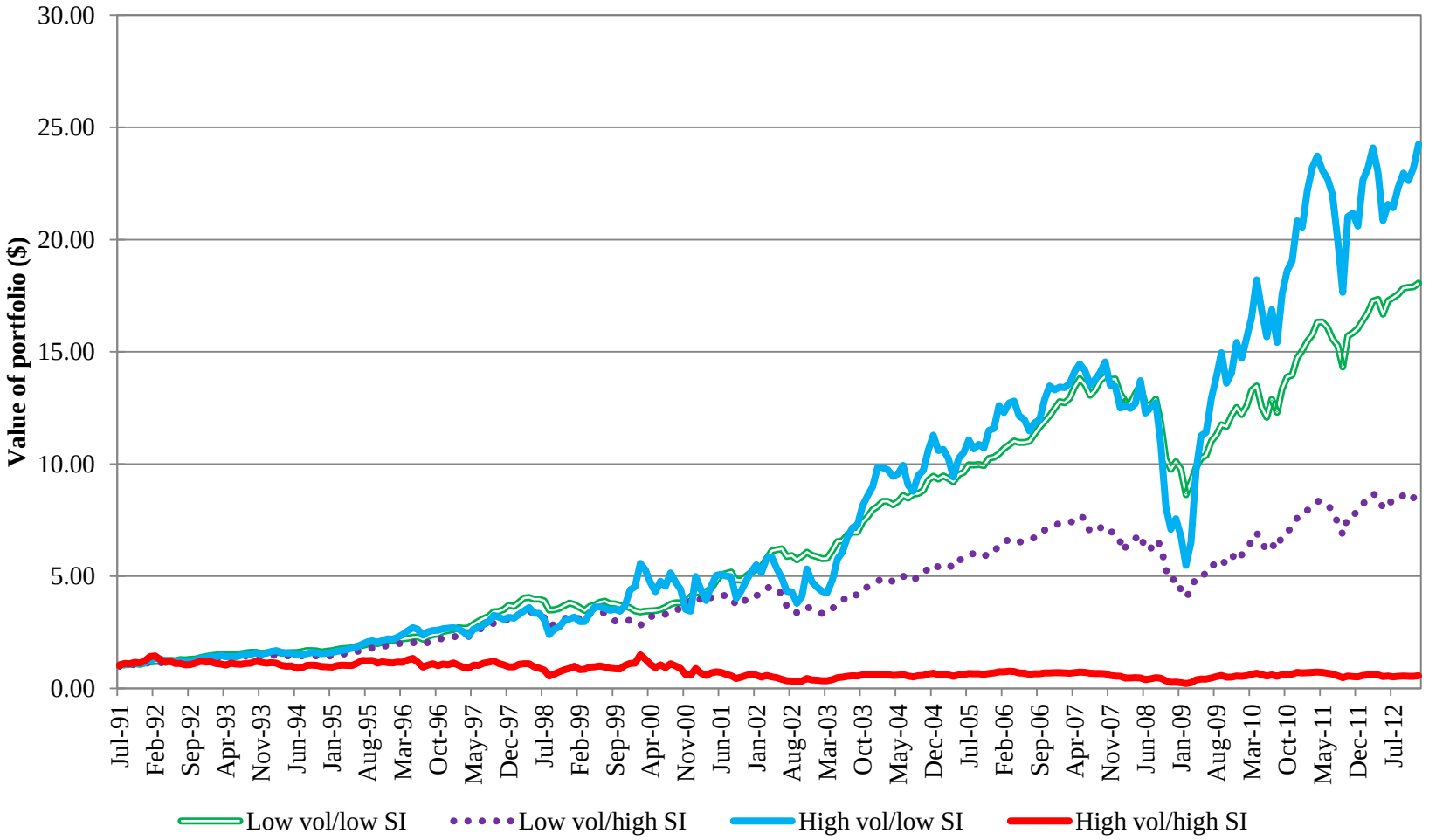

Table A-1: Return on low and high volatility stocks with low and high short interest – SIR
This table shows the return on portfolios of low and high volatility stocks with low and high short interest from July 1991 through December 2012. A stock is considered low (high) volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its short interest ratio (SIR) in month *t* - 1 falls within the lowest (highest) 20% among stocks in the same volatility quintile. We present results for equally weighted portfolios in Panel A and value weighted portfolios in Panel B. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. Average return is the annualized mean monthly return. Geometric return is the annualized monthly compound return. Median return is the annualized median monthly return. Standard deviation is the annualized standard deviation of monthly returns. Sharpe (Treynor) ratio is the annualized average of the monthly returns less the risk-free rate divided by the annualized standard deviation of monthly returns (CAPM beta).

Panel A: Equally weighted portfolios

	Low volatility		High volatility	
	Low SI	High SI	Low SI	High SI
Average return	14.1%	11.1%	18.9%	3.7%
Geometric return	13.5%	10.1%	14.9%	-2.7%
Median return	18.7%	17.8%	20.7%	-1.0%
Standard deviation	11.0%	14.4%	29.0%	36.4%
Sharpe ratio	1.01	0.56	0.55	0.02
Treynor ratio	0.20	0.10	0.11	0.00

Panel B: Value weighted portfolios

	Low volatility		High volatility	
	Low SI	High SI	Low SI	High SI
Average return	11.1%	11.6%	16.4%	7.6%
Geometric return	10.4%	10.5%	13.0%	1.0%
Median return	15.3%	17.8%	24.2%	5.3%
Standard deviation	11.9%	14.7%	26.0%	36.4%
Sharpe ratio	0.68	0.58	0.52	0.12
Treynor ratio	0.14	0.11	0.10	0.02

Table A-2: Do high volatility stocks with low and high short interest have alpha? – SIR
This table shows the results from regressing monthly percentage returns on portfolios of high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its short interest ratio (SIR) in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2012. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

	Equally Weighted			Value Weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
Beta	1.12***	1.35***	-0.23***	1.07***	1.49***	-0.41***
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.002]
SMB	1.19***	1.38***	-0.19**	0.79***	0.98***	-0.19
	[0.000]	[0.000]	[0.014]	[0.000]	[0.000]	[0.170]
HML	0.11	-0.38***	0.49***	-0.00	-0.63***	0.63***
	[0.245]	[0.000]	[0.000]	[0.982]	[0.000]	[0.000]
UMD	-0.51***	-0.67***	0.16***	-0.24***	-0.42***	0.18
	[0.000]	[0.000]	[0.005]	[0.009]	[0.000]	[0.175]
PS Liq	0.00	-0.02	0.02	0.09	-0.15*	0.24**
	[0.934]	[0.762]	[0.725]	[0.218]	[0.070]	[0.047]
Alpha	0.69***	-0.48*	1.17***	0.43	-0.14	0.57
	[0.005]	[0.061]	[0.000]	[0.179]	[0.672]	[0.229]
Observations	258	258	258	258	258	258
r^2	0.86	0.89	0.32	0.71	0.80	0.24

Table A-3: What is the simultaneous effect of high volatility and short interest? – SIR
This table presents results from equation (1) in the paper:

$$\text{Return}_{i,t} = \text{FF Controls}_{i,t-1} + \text{Idio Vars}_{i,t-1} + \text{Short Interest Vars}_{i,t-1} + \text{Time FE} + \varepsilon_{i,t}$$

The dependent variable is the percentage stock return for stock *i* in month *t*. We include four $\text{FF Controls}_{i,t-1}$. Beta, ln(size), and book-to-market are measured following Fama and French (1992). 12-month return is the return for stock *i* from month *t* - 13 to month *t* - 1. We include two $\text{Idio Vars}_{i,t-1}$. Idio vol is the standard deviation of the residuals from regressing month *t* - 1 daily returns for stock *i* against the Fama-French four-factor model. High vol dummy equals one if the idio vol of stock *i* in month *t* - 1 falls within the highest 20% among stocks in the sample, zero otherwise. We include three $\text{Short Interest Vars}_{i,t-1}$. Short interest ratio is the last reported value of short interest for stock *i* in month *t* - 1 divided by total shares outstanding for stock *i* at the end of month *t* - 1. Low (high) SIR dummy is equal to one if the short interest ratio for stock *i* in month *t* - 1 falls within the lowest (highest) 20% among stocks within the month *t* - 1 volatility quintile of stock *i*, zero otherwise. We interact the high vol dummy and the two SIR dummy variables in some models. All right-hand-side variables, except beta and the dummy variables, are *z*-scored (demeaned and divided by standard deviation) within each -month. Before *z*-scoring, we winsorize all variables, except beta and the dummy variables, at 1% and 99%. We include monthly time fixed effects in all models and cluster standard errors on time. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Beta	-0.07	0.13	0.04	0.20	0.21	0.21
	[0.851]	[0.669]	[0.909]	[0.492]	[0.466]	[0.478]
ln(size)	0.02	-0.06	0.00	-0.06	-0.06	-0.05
	[0.835]	[0.455]	[0.995]	[0.414]	[0.470]	[0.493]
Book-to-market	0.19***	0.16**	0.17**	0.14**	0.14**	0.14**
	[0.010]	[0.018]	[0.023]	[0.039]	[0.044]	[0.044]
12-month return	0.13	0.12	0.13	0.12	0.12	0.12
	[0.311]	[0.337]	[0.323]	[0.345]	[0.344]	[0.348]
Idio vol		-0.26***		-0.24**	-0.19**	-0.19**
		[0.010]		[0.018]	[0.044]	[0.044]
Short interest ratio			-0.22***	-0.19***	-0.16***	-0.14***
			[0.000]	[0.000]	[0.000]	[0.003]
High vol dummy					-0.16*	-0.12
					[0.083]	[0.240]
Low SIR dummy					0.14	0.12
					[0.108]	[0.169]
High SIR dummy					-0.04	-0.01
					[0.518]	[0.839]
High Vol * Low SIR						0.13
						[0.364]
High Vol * High SIR						-0.37***
						[0.008]

Appendix B – The performance of the low volatility portfolios

The initial tests in the paper included analyses of both low and high volatility stocks. However, we choose to focus on high volatility stocks for the majority of our discussion. In this appendix, we replicate some key results from the paper with an increased focus on low volatility stocks.

First, we measure the alpha of portfolios of low volatility stocks with low and high short interest. We find the low vol/low SI portfolio outperforms the low vol/high SI portfolio, but underperforms the high vol/low SI portfolio. Second, we compare the performance of the low vol/low SI portfolio to the high vol/low SI portfolio during the "dot-com" bubble and the recent financial crisis. We show that the low vol/low SI portfolio underperforms the high vol/low SI portfolio during those events. And finally, we test whether the vol and SI "stack;" i.e., is the sum of the two anomalies greater than or less than its parts? We find that being low volatility and low short interest simultaneously produces returns smaller than would be expected based on the two anomalies alone.

B.1 The risk-adjusted performance of low volatility stocks with low and high short interest

Table 2 in the paper shows the returns to the low vol/low SI and low vol/high SI portfolios. We measure the alpha and factor exposures of those portfolios using the FF-PS five-factor model in Table B-1.[1] We compare the alpha of low vol/low SI portfolio to the alpha of the low vol/high SI portfolio in Panel A and the high vol/low SI portfolio in Panel B. We present results for both equally and value weighted portfolios.

[1] We refer to the Fama-French-Carhart (1993, 1997) four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor as the FF-PS five-factor model.

Looking at the equally weighted portfolios in Panel A, the low vol/low SI portfolio is low beta with significant small cap and value exposures. The factor loadings for the low vol/low SI portfolio are similar to those of the low vol/high SI portfolio. The low vol/low SI portfolio has an alpha of 0.53% per month compared to -0.09% per month (*p*-value = .441) for the low vol/high SI portfolio. This difference of 0.62% per month (7.4% per year) more than covers the 6.2% gap in average annual return between the portfolios found in Table 2 from the paper. Using value weighting, the low vol/low SI portfolio has little small cap or value exposure and has an alpha of only 0.23% per month (*p*-value = .173).

Compared to the high vol/low SI portfolio in Panel B, the low vol/low SI portfolio underperforms. Alpha for the high vol/low SI portfolio is 0.43% per month greater (*p*-value = .115) than for the low vol/low SI portfolio using the equally weighted portfolios and 0.33% per month greater (*p*-value = .295) using the value weighted portfolios. The two portfolios also differ greatly in factor exposure. The equally weighted portfolios have statistically and economically significant differences across all five FF-PS factors. A long/short position designed to capture the difference in alpha between the two portfolios results in a low beta portfolio with large small cap and growth exposures.

B.2 What happens to the low vol/low SI portfolio during turbulent market?

Figures 3 and 4 in the paper show that the high vol/low SI portfolio performs well compared to the market during the "dot-com" bubble and the recent financial crisis. Here we compare the performance of the high vol/low SI portfolio to the low vol/low SI portfolio during the same market events.

We first study the performance of the portfolios during the "dot-com" bubble in Figure B-1. We show the value of a $1 investment in the equally weighted high vol/low SI and low vol/low SI portfolios from January 1998 through December 2000. For comparison, we show the value of $1 investment in the CRSP value weighted index. The high vol/low SI portfolio peaks in value at the end of February 2000 at $2.55. At that same time, the low vol/low SI portfolio has a value of $0.97. Between that date and end of 2000, the high vol/low SI portfolio loses 41% of its value and drops to $1.51. The low vol/low SI portfolio has a 25% return over that same time, but its final value is only $1.21. So while the high vol/low SI portfolio did have a higher peak and subsequent fall during the "dot-com" bubble, it still ends 2000 worth 24% more than the low vol/low SI portfolio.

We further compare the performance of the portfolios during the "dot-com" bubble in Panel A of Table B-2. Looking first at the equally weighted portfolios, the annualized compound return of the high vol/low SI portfolio was 7.4% per year greater than that of the low vol/low SI portfolio. The high vol/low SI portfolio has an annualized standard deviation of returns of 40.2%, compared to only 11.2% for the low vol/low SI portfolio, but the Sharpe and Treynor ratios are greater for the high vol/low SI portfolio. Looking next at the value weighted portfolios, the difference in performance between the high vol/low SI portfolio and the low vol/low SI portfolio is much greater. The difference in annualized compound return increases to 21.3%, with the low vol/low SI portfolio having an annualized compound return of -2.0%. So while the high vol/low SI portfolio was very volatile during the "dot-com" bubble, it offered a significantly higher return than low vol/low SI portfolio.

We turn our attention to the recent financial crisis in Figure B-2. We show the value of a $1 investment in the equally weighted high vol/low SI and low vol/low SI portfolios from

January 2007 through December 2009. For comparison, we again show the value of a $1 investment in the CRSP value weighted index. The high vol/low SI portfolio underperforms the low vol/low SI portfolio early in this period, but both experience large losses from August 2008 through February 2009. The high vol/low SI portfolio decreases in value from $0.85 to $0.38, while the low vol/low SI portfolio decreases in value from $1.03 to $0.69. However, the primary difference in their performance occurs after that point. The low vol/low SI portfolio has a return of 49% between February 2009 and the end of that year, but the high vol/low SI portfolio has a return of 213% over that same period. The low vol/low SI portfolio barely breaks even with a final value of $1.03, while the high vol/low SI portfolio has a final value of $1.21.

We further compare the performance of the portfolios during this period in Panel B of Table B-2. Looking first at the equally weighted portfolios, the annualized compound return of the high vol/low SI portfolio is 5.4% per year greater than that of the low vol/low SI portfolio. The high vol/low SI portfolio has an annualized standard deviation of returns of 47.4%, compared to 17.5% for the low vol/low SI portfolio, but the high vol/low SI portfolio has significantly greater Sharpe and Treynor ratios. Looking next at the value weighted portfolios, the high vol/low SI portfolio has an annualized compound return 5.3% lower than the low vol/low SI portfolio. Overall, the high vol/low SI portfolio shows no exceptionally poor and much positive performance during the financial crisis compared to the low vol/low SI portfolio.

B.3 Do the vol and SI anomalies "stack"?

The vol anomaly and the SI anomaly predict higher returns for low volatility stocks and low short interest stocks, but it is unclear how the anomalies interact. The low vol/low SI portfolio may generate its returns simply by "stacking" the anomalies together or there may be

an extra effect from the combination. Table 5 in the paper shows that there is an additional benefit to being high volatility and low short interest simultaneously. Table B-3 replicates the panel model used in Table 5 from the paper with a focus on the interaction between low volatility and low short interest.

We include an additional dummy variable in our modified model. Low vol dummy is equal to one if the idiosyncratic volatility of stock *i* in month *t* - 1 falls within the lowest 20% among stocks in the sample, zero otherwise. We interact this variable with the short interest dummy variables in some models. We still include beta, ln(size), book-to-market, or 12-month return in our model, but we suppress the coefficients for brevity. The results for those variables are similar to those presented in Table 5.

Column 1 shows that as idiosyncratic volatility and days to cover increase expected returns decrease. Columns 2 includes the low vol dummy variable in the model. The low vol dummy has a significant effect of -0.28% per month, indicating a non-linear relationship between volatility and return. Specifically, the effect of low volatility anomaly is overestimated when ignoring the non-linearity.

Column 3 interacts the low vol dummy and the short interest dummy variables. We find that stacking the vol and SI anomalies together produces lower returns than would expected based on the individual anomalies. A stock that is both low volatility and low short interest benefits from the previously discussed effects, but the expected return is 0.25% less per month if a stock is both simultaneously. On the other hand, a stock that is both low volatility and high short interest simultaneously has its expected return increase by 0.26% per month. Columns 4 and 5 replicate these results while including the high vol dummy variable and finds similar results. The low vol/low SI portfolio underperforms given the strength of the separate anomalies.

Figure B-1: The return on one dollar invested in low/high volatility stocks with low short interest – The "dot-com" bubble
This figure shows the value of a $1 investment in equally weighted portfolios of low and high volatility stocks with low short interest from January 1998 through December 2000. A stock is considered low (high) volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample. A stock is considered low short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest 20% among stocks in the same volatility quintile. The value of the CRSP value weighted index is presented for comparison.

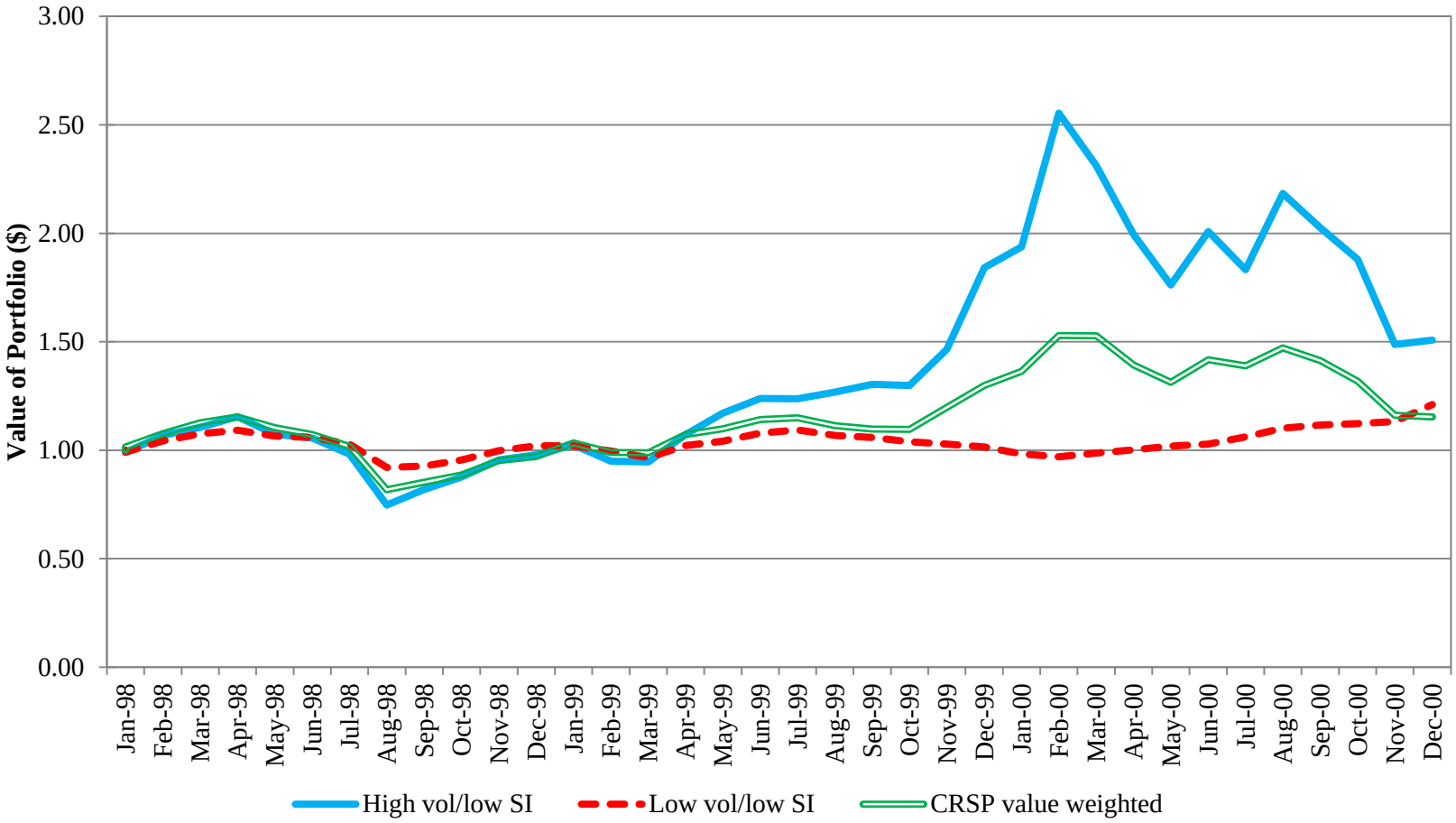

Figure B-2: The return on one dollar invested in low/high volatility stocks with low short interest – The financial crisis
This figure shows the value of a $1 investment in equally weighted portfolios of low and high volatility stocks with low short interest from January 2007 through December 2009. A stock is considered low (high) volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample. A stock is considered low short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest 20% among stocks in the same volatility quintile. The value of the CRSP value weighted index is presented for comparison.

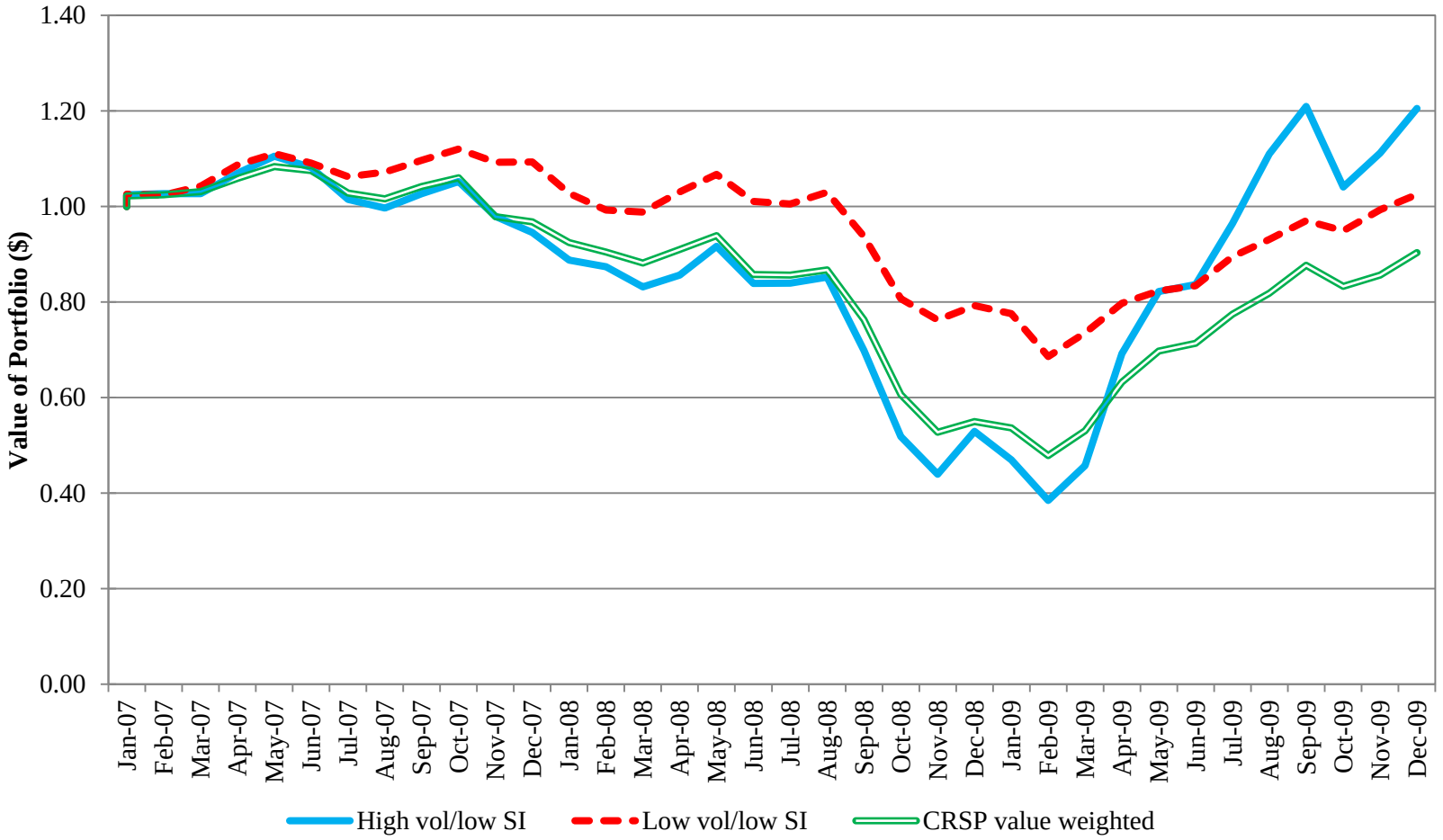

Table B-1: The alpha of low volatility stocks with low and high short interest

This table shows the results from regressing monthly percentage returns on portfolios of low and high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. A stock is considered low (high) volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among stocks in the same volatility quintile. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2012. Panel A presents results for the low volatility portfolios with low and high short interest. Panel B compares the performance of low short interest portfolios with low and high volatility. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

Panel A: Low volatility stocks with high and low short interest

	Equally weighted			Value weighted		
	Low vol Low SI	Low vol High SI	Difference	Low vol Low SI	Low vol High SI	Difference
Beta	0.62***	0.74***	-0.13***	0.76***	0.84***	-0.08
	[0.000]	[0.000]	[0.004]	[0.000]	[0.000]	[0.283]
SMB	0.24***	0.22***	0.02	-0.02	-0.08	0.06
	[0.000]	[0.000]	[0.655]	[0.682]	[0.130]	[0.448]
HML	0.43***	0.58***	-0.16***	0.14	0.44***	-0.30**
	[0.000]	[0.000]	[0.007]	[0.174]	[0.000]	[0.020]
UMD	-0.01	-0.03	0.02	0.01	0.00	0.01
	[0.632]	[0.227]	[0.544]	[0.734]	[0.976]	[0.840]
PS Liq	0.06	0.04	0.01	-0.01	0.03	-0.04
	[0.124]	[0.187]	[0.776]	[0.897]	[0.336]	[0.520]
Alpha	0.53***	-0.09	0.62***	0.23	0.03	0.20
	[0.000]	[0.441]	[0.000]	[0.173]	[0.807]	[0.376]
Observations	258	258	258	258	258	258
r^2	0.79	0.81	0.13	0.61	0.75	0.09

Panel B: Low short interest stocks with high and low volatility

	Equally weighted			Value weighted		
	High vol Low SI	Low vol Low SI	Difference	High vol Low SI	Low vol Low SI	Difference
Beta	1.24***	0.62***	0.62***	1.32***	0.76***	0.56***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
SMB	1.33***	0.24***	1.10***	0.95***	-0.02	0.97***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.682]	[0.000]
HML	-0.08	0.43***	-0.51***	-0.40***	0.14	-0.54***
	[0.377]	[0.000]	[0.000]	[0.001]	[0.174]	[0.000]
UMD	-0.53***	-0.01	-0.52***	-0.34***	0.01	-0.35***
	[0.000]	[0.632]	[0.000]	[0.000]	[0.734]	[0.000]
PS Liq	-0.06	0.06	-0.12*	-0.03	-0.01	-0.02
	[0.287]	[0.124]	[0.090]	[0.656]	[0.897]	[0.763]
Alpha	0.95***	0.53***	0.43	0.56**	0.23	0.33
	[0.000]	[0.000]	[0.115]	[0.038]	[0.173]	[0.295]
Observations	258	258	258	258	258	258
r^2	0.87	0.79	0.76	0.82	0.61	0.62

Table B-2: Low and high volatility stocks with low short interest during turbulent markets
This table shows the return on portfolios of low and high volatility stocks with low short interest. Panel A shows results from January 1998 through December 2000. Panel B shows results from January 2007 through December 2009. A stock is considered low (high) volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among stocks in the same volatility quintile. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. We present the CRSP value weighted index for comparison. Average return is the annualized mean monthly return. Geometric return is the annualized monthly compound return. Median return is the annualized median monthly return. Standard deviation is the annualized standard deviation of monthly returns. Sharpe (Treynor) ratio is the annualized average of the monthly returns less the risk-free rate divided by the annualized standard deviation of monthly returns (CAPM beta).

Panel A: "Dot-com" bubble (1998-2000)

		Equally weighted		Value weighted	
	CRSP value	High vol Low SI	Low vol Low SI	High vol Low SI	Low vol Low SI
Average return	12.2%	21.5%	7.0%	29.1%	0.5%
Geometric return	10.3%	13.8%	6.4%	19.3%	-2.0%
Median return	31.3%	29.6%	10.8%	43.2%	16.7%
Standard deviation	19.1%	40.2%	11.2%	44.5%	21.4%
Sharpe ratio	0.37	0.41	0.18	0.54	-0.21
Treynor ratio	0.07	0.11	0.07	0.14	-0.06

Panel B: Financial crisis (2007-2009)

		Equally weighted		Value weighted	
	CRSP value	High vol Low SI	Low vol Low SI	High vol Low SI	Low vol Low SI
Average return	-2.4%	16.4%	2.4%	0.7%	-0.9%
Geometric return	-4.6%	6.2%	0.8%	-7.5%	-2.2%
Median return	13.3%	10.6%	18.8%	10.0%	12.0%
Standard deviation	21.1%	47.4%	17.5%	40.0%	15.7%
Sharpe ratio	-0.21	0.30	0.01	-0.04	-0.19
Treynor ratio	-0.04	0.07	0.00	-0.01	-0.04

Table B-3: What is the simultaneous effect of volatility and short interest?
This table presents results from equation (1) in the paper:

$$\text{Return}_{i,t} = \text{FF Controls}_{i,t-1} + \text{Idio Vars}_{i,t-1} + \text{Short Interest Vars}_{i,t-1} + \text{Time FE} + \varepsilon_{i,t}$$

The dependent variable is the percentage stock return for stock *i* in month *t*. We include four $\text{FF Controls}_{i,t-1}$. Beta, ln(size), and book-to-market are measured following Fama and French (1992). 12-month return is the return for stock *i* from month *t* - 13 to month *t* - 1. We include three $\text{Idio Vars}_{i,t-1}$. Idio vol is the standard deviation of the residuals from regressing month *t* - 1 daily returns for stock *i* against the Fama-French four-factor model. Low (high) vol dummy equals one if the idio vol of stock *i* in month *t* - 1 falls within the lowest (highest) 20% among stocks in the sample, zero otherwise. We include three $\text{Short Interest Vars}_{i,t-1}$. Days to cover is the last reported value of short interest for stock *i* in month *t* - 1 divided by average daily trading volume for stock *i* in month *t* - 1. Low (high) DTC dummy is equal to one if days to cover for stock *i* in month *t* - 1 falls within the lowest (highest) 20% among stocks within the month *t* - 1 volatility quintile of stock *i*, zero otherwise. We interact the two volatility dummies and the two DTC dummy variables in some models. All right-hand-side variables, except beta and the dummy variables, are *z*-scored (demeaned and divided by standard deviation) within each month. Before *z*-scoring, we winsorize all variables, except beta and the dummy variables, at 1% and 99%. We include monthly time fixed effects in all models and cluster standard errors on time. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels. Beta, ln(Size), and book-to-market, and 12-month return are included in all models, but not presented for brevity.

	(1)	(2)	(3)	(4)	(5)
Idio vol	-0.30***	-0.35***	-0.35***	-0.33***	-0.35***
	[0.003]	[0.001]	[0.001]	[0.000]	[0.000]
Days to cover	-0.26***	-0.15***	-0.15***	-0.15***	-0.16***
	[0.000]	[0.001]	[0.001]	[0.001]	[0.000]
Low vol dummy		-0.28***	-0.28***	-0.27***	-0.27***
		[0.001]	[0.002]	[0.002]	[0.005]
High vol dummy				-0.03	0.07
				[0.738]	[0.555]
Low DTC dummy		0.32***	0.36***	0.32***	0.29***
		[0.000]	[0.000]	[0.000]	[0.002]
High DTC dummy		-0.21***	-0.25***	-0.21**	-0.08
		[0.010]	[0.005]	[0.011]	[0.377]
Low vol * Low DTC			-0.23**		-0.17*
			[0.012]		[0.067]
Low vol * High DTC			0.26**		0.11
			[0.014]		[0.270]
High vol * Low DTC					0.26*
					[0.072]
High vol * High DTC					-0.60***
					[0.000]

Appendix C – Measuring the alpha of the high volatility portfolios

We measure the alpha of the high vol/low SI and high vol/high SI portfolios using the FF-PS five-factor model in the paper. In that model, we included the Fama and French (1993) three-factors, the Carhart (1997) momentum factor, and the Pastor and Stambaugh (2003) liquidity factor. We examine alternative measures of these alphas in this appendix. First, we measure the alpha using the same method as in the paper, but with various permutations of the Fama-French model and the Cremers, Petajisto, and Zitzewitz (2012) four- and seven-factor models (CPZ4 and CPZ7). Then, we measure the alphas on a month-by-month basis using daily returns to control for the time-varying factor loadings of the portfolios. We find that regardless of model or method, the high vol/low SI portfolio outperforms both the market and the high vol/low SI portfolio.

Table C-1 shows monthly percentage alphas on the high vol/low SI and high vol/high SI portfolios. The portfolios and measurement methods are the same as those used in in Table 3 from the paper, but the factor model we use varies. We also reduce our time period to July 1991 through December 2010 because the CPZ factors are not available for 2011 and 2012. We show results for both the equally and value weighted portfolios. For brevity, we do not present the factor loadings.

Looking first at the equally weighted results, the high vol/low SI portfolio has a large, positive alpha regardless of model. The smallest alpha, 0.50% per month, occurs using the Fama-French three-factor model. The high vol/high SI portfolio has a large, negative alpha regardless of model. The largest alpha, -0.25% per month (p-value = 0.407), occurs using the CPZ7 model. The difference in alpha between the portfolios is greater than 1.50% per month in all models. Our results are similar, but weaker, for the value weighted portfolios. The difference in alpha

between the portfolios is greater than 0.70% per month in all models, but individual portfolios both have statistically insignificant alphas in some models.

One concern with such a long time series is time-varying factor loadings. Figure C-1 shows the HML (value) and UMD (momentum) loadings for the equally weighted high vol/low SI portfolio each year from 1992 through 2012. The loadings are measured using the FF-PS five-factor model and monthly returns. The HML loading for the portfolio is 1.21 in 1999, but -1.64 in 2008. In a similar fashion, the UMD loading for the portfolio is 1.62 in 2005, but -1.71 in 2012. So while Table 3 from the paper shows that on average the high vol/low SI portfolio has a slight, negative HML exposure and large, negative UMD exposure, there is significant variation from year-to-year. We find a similar variation in the factor loadings for the high vol/high SI portfolio.

We control for the time-varying factor loadings by separately measuring the alpha for the portfolios each month using daily returns. We then average the alphas across all months to aggregate portfolio performance. This method allows the factor loadings to change each month to reflect any variation across time. Table C-2 shows the daily percentage alpha for the high vol/low SI and high vol/high SI portfolios measured following this method. We again test both the equally and value weighted portfolios, but the number of factor models we use is reduced because the Pastor and Stambaugh (2003) liquidity factor is not available on a daily basis. For brevity, we do not present the average factor loadings.

Looking first at the equally weighted results, the high vol/low SI portfolio has an alpha of about 0.06% to 0.08% per day regardless of model. The high vol/high SI portfolio has a statistically insignificant alpha in all models. The difference in alpha between portfolios ranges between 0.07% and 0.10% per day. We find similar results using the value weighted portfolios.

The high vol/low SI portfolio has a large, positive alpha regardless of model, and the high vol/high SI portfolio has a statistically insignificant alpha in all models. The difference in alpha between the portfolios ranges between 0.07% and 0.13% per day. Thus, allowing the factor loadings to vary does not change our conclusions about the performance of the high vol/low SI portfolio, but the high vol/high SI portfolio does not perform as poorly in this specification.

Overall, the results in this appendix indicate the performance of the high vol/low SI portfolio is robust to factor model and method of estimation. Regardless of how alpha is calculated, the high vol/low SI portfolio outperforms both the market and the high vol/high SI portfolio. The exact estimate of alpha varies but the conclusion does not.

Figure C-1: How much variation is there in the factor loadings of a portfolio high volatility stocks with low short interest?
This figure shows the HML (value) and UMD (momentum) factor loadings for an equally weighted portfolio of high volatility stocks with low short interest each year from 1992 through 2012. The monthly returns in each year are regressed separately against the FF-PS five-factor model to estimate the factor loadings. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest 20% among high volatility stocks.

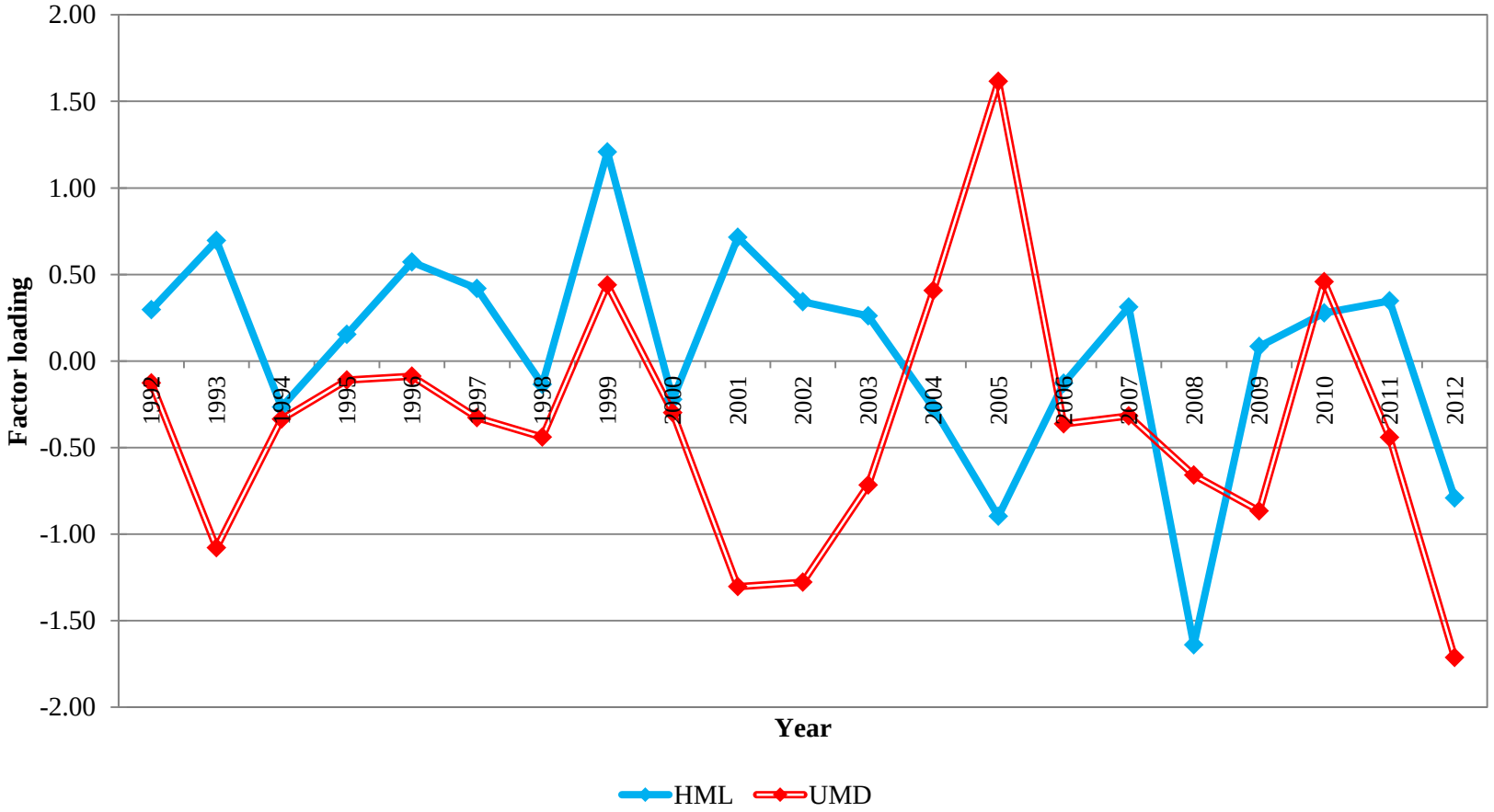

Table C-1: Do high volatility stocks with low and high short interest have alpha?
This table shows the alphas obtained from regressing monthly percentage returns on portfolios of high volatility stocks with low and high short interest against various factor models. We use the following models: Capital Asset Pricing Model (CAPM); Fama-French three-factor (FF3); Fama-French four-factor (FF4); Fama-French four-factor and Pastor and Stambaugh (2003) liquidity factor (FF4 + PS); Fama-French four-factor, Pastor and Stambaugh (2003) liquidity factor, and one month lags of all factors (FF4 + PS w/ lags); Cremers, Petajisto, and Zitzewitz (2012) four-factor (CPZ4); and Cremers, Petajisto, and Zitzewitz (2012) seven-factor (CPZ7). A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2010. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels. For brevity, we do not present the factor loadings.

	Equally weighted			Value weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
CAPM	0.77**	-1.06***	1.83***	0.31	-0.67*	0.98**
	[0.042]	[0.006]	[0.000]	[0.406]	[0.075]	[0.014]
FF3	0.50*	-1.29***	1.78***	0.28	-0.81***	1.09***
	[0.056]	[0.000]	[0.000]	[0.334]	[0.008]	[0.005]
FF4	0.98***	-0.74***	1.72***	0.58**	-0.39	0.97**
	[0.000]	[0.008]	[0.000]	[0.043]	[0.161]	[0.014]
FF4 + PS	1.03***	-0.75***	1.78***	0.59**	-0.37	0.96**
	[0.000]	[0.008]	[0.000]	[0.050]	[0.211]	[0.022]
FF4 + PS w/ Lags	1.04***	-0.85***	1.89***	0.52*	-0.46	0.98**
	[0.000]	[0.003]	[0.000]	[0.097]	[0.149]	[0.026]
CPZ4	1.27***	-0.51*	1.78***	0.75**	-0.21	0.96**
	[0.000]	[0.091]	[0.000]	[0.011]	[0.442]	[0.014]
CPZ7	1.27***	-0.25	1.51***	0.66**	-0.05	0.72*
	[0.000]	[0.407]	[0.000]	[0.025]	[0.854]	[0.085]

Table C-2: Do time-varying factor loadings explain the large alphas?
This table shows the average daily alphas obtained from regressing daily percentage returns on portfolios of high volatility stocks with low and high short interest against various factor models. We estimate the alpha separately in each month and present the average across all months. We use the following models: Capital Asset Pricing Model (CAPM); Fama-French three-factor (FF3); Fama-French four-factor (FF4); Fama-French four-factor and one month lags of all factors (FF4 w/ lags); Cremers, Petajisto, and Zitzewitz (2012) four-factor (CPZ4); and Cremers, Petajisto, and Zitzewitz (2012) seven-factor (CPZ7). A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2010. *p*-values from Newey-West standard errors with six lags are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels. For brevity, we do not present the average factor loadings.

	Equally weighted			Value weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
CAPM	0.08***	-0.02	0.10***	0.06***	-0.01	0.07***
	[0.000]	[0.328]	[0.000]	[0.001]	[0.509]	[0.000]
FF3	0.07***	-0.02	0.09***	0.08***	-0.02	0.10***
	[0.000]	[0.147]	[0.000]	[0.001]	[0.264]	[0.000]
FF4	0.06***	-0.01	0.07***	0.08***	-0.02	0.10***
	[0.000]	[0.258]	[0.000]	[0.000]	[0.152]	[0.000]
FF4 w/ Lags	0.07***	0.00	0.06***	0.10***	-0.03	0.13***
	[0.000]	[0.917]	[0.001]	[0.000]	[0.118]	[0.000]
CPZ4	0.07***	-0.00	0.07***	0.07***	-0.02	0.09***
	[0.000]	[0.778]	[0.000]	[0.000]	[0.255]	[0.000]
CPZ7	0.08***	0.00	0.08***	0.08***	-0.02	0.10***
	[0.000]	[0.679]	[0.000]	[0.000]	[0.180]	[0.000]

Appendix D – The investability of the high volatility portfolios

We found in Table 6 of the paper that high volatility stocks with low short interest perform well regardless of their relative liquidity, share turnover, and/or level of institutional holdings. However, it is possible that factors other than those measures of execution costs could prevent investors from actually realizing the portfolio returns we calculated. In this appendix, we test three other possible barriers to investing.

First, we test if our results our driven by changes in short interest instead of levels. The performance of the high vol/low SI or high vol/high SI portfolio may be caused by a small subsample of firms that have experienced a sudden change in investor beliefs. Second, we measure portfolio performance after forcing a delay in information about short interest. If investors cannot quickly obtain or trade with new information on short interest, they will not be able to hold the portfolios we described in the paper. And finally, we measure portfolio performance assuming investors only update their information on volatility and short interest once per quarter. The trading expenses from updating information and trading every month may offset performance. Details follow, but, in sum, we find that our results are not related to changes in short interest, but information delays and less frequent information updating do meaningfully impact portfolio performance.

D.1 Are our results driven by levels or changes in short interest?

We find that levels of short interest are highly persistent. In Table D-1, we rank all stocks in our sample into deciles each month based on their days to cover (DTC). In Panel A, we show the decile of stocks in month *t* given their decile in month *t* - 1. 59.6% of stocks in the lowest decile in the prior month remain in the lowest decile in the next month. Only 0.1% move to the

highest decile. At the same time, 69.4% of stocks in the highest decile in the prior month remain in the highest decile in the next month. Only 0.1% move to the lowest decile. Across all deciles, the most common ranking for a stock in month *t* is its ranking in month *t* - 1. In Panel B, we show the decile of stocks in month *t* given their decile in month *t* - 6 and find similar results.

While short interest may be persistent, our results could still be driven entirely by stocks that do have large changes in short interest. We test this possibility by dropping all stocks outside the 10th and 90th percentile of change in DTC from month *t* - 2 to *t* - 1 from our high vol/low SI and high vol/high SI portfolios. Figure D-1 shows the value of a $1 investment in these modified equally weighted portfolios from July 1991 through December 2012. We present the CRSP value weighted index for comparison. The high vol/low SI portfolio has a final value of $38.55, and the high vol/high SI portfolio has a final value of $0.35. These results are similar to those for the unmodified portfolios in Figure 2 from the paper. In that figure, the high vol/low SI portfolio had a final value of $37.70, and the high vol/high SI portfolio had a final value of $0.44.

Table D-2 shows the annualized performance measures for the same modified portfolios. The high vol/low SI portfolio has an average return of 22.3% per year with a standard deviation of 33.1%. The Sharpe and Treynor ratios for the high vol/low SI portfolio are greater than those of the CRSP index. The high vol/high SI portfolio has an average return of 1.4% per year with a standard deviation of 35.9%. The Sharpe and Treynor ratios of the high vol/high SI portfolio are both negative. These results are similar to those for the unmodified portfolios in Table 2 from the paper. If we value weight the portfolios, the performance of the modified and unmodified portfolios remains similar.

We measure the alpha for the modified portfolios using the FF-PS five-factor model in Table D-3.[1] The high vol/low SI portfolio has an alpha of 0.95% per month, compared to -0.68% for the high vol/high SI portfolio. The difference in alpha of 1.63% per month between the two modified portfolios is about the same as that of the unmodified portfolios in Table 3 in the paper (1.67% per month). If we value weight the portfolios, the difference in alpha for the modified portfolios decreases to 0.75%, and alpha for the high vol/high SI portfolio is only -0.18% (*p*-value = .280). The unmodified portfolios see a similar, albeit smaller, decrease after switching from equal to value weighting.

D.2 How does a delay in information about short interest affect portfolio performance?

We sorted on the short interest value measured in the middle of the prior month in the paper. That value is made publically available before the end of that month. Regardless, investors may experience a delay in receiving new short interest information or in being able to use that information to trade. We test how such a delay affects portfolio performance by modifying our high vol/low SI and high vol/high SI portfolios to sort stocks based on DTC in month t - 2 rather than month t - 1. This creates a gap of about six weeks between short interest measurement and portfolio formation and gap of about one month between public availability and portfolio formation.

Figure D-2 shows the value of a $1 investment in these modified equally weighted portfolios from July 1991 through December 2012. We present the CRSP value weighted index for comparison. The high vol/low SI portfolio has a final value of $16.64, and the high vol/high SI portfolio has a final value of $0.92. These results are meaningfully different from those

[1] We refer to the Fama-French-Carhart (1993, 1997) four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor as the FF-PS five-factor model.

presented in Figure 2 from the paper. In that figure, the high vol/low SI portfolio had a final value of $37.70, and the high vol/high SI portfolio had a final value of $0.44. The delay more than halves the final value of the high vol/low SI portfolio and more than doubles the final value of the high vol/high SI portfolio. However, the high vol/low SI (high vol/high SI) portfolio still significantly outperforms (underperforms) the CRSP index, which had a final value $6.29.

Table D-4 shows the annualized performance measures for these modified portfolios. The high vol/low SI portfolio has an average return of 18.4% per year with a standard deviation of 33.1%. The Sharpe and Treynor ratios for the high vol/low SI portfolio are greater than those of the CRSP index. The high vol/high SI portfolio has an average return of 4.2% per year with a standard deviation of 30.9%. The Sharpe and Treynor ratios of the high vol/high SI portfolio are both near zero. These results are meaningfully different from those presented for the unmodified portfolios in Table 2 from the paper. The annual compound return for the modified high vol/low SI portfolio is 3.9% per year lower. The same return for the modified high vol/high SI portfolio is 3.4% per year higher. Those differences are smaller, but still significant, if the portfolios are value weighted.

We measure the alpha for the modified portfolios using the FF-PS five-factor model in Table D-5. The high vol/low SI portfolio has an alpha of 0.61% per month, compared to -0.42% (*p*-value = .109) for the high vol/high SI portfolio. The difference in alpha of 1.03% per month between the two modified portfolios is smaller than that of the unmodified portfolios in Table 3 from the paper (1.67% per month), but still economically large. If we value weight the portfolios, the difference in alpha for the modified portfolios decreases to 0.69%. Alpha for each individual modified portfolio is still economically large, but statistically insignificant. Switching from equal to value weighting also decreased the alpha of the unmodified portfolios, but to a lesser degree.

D.3 How do the portfolios perform if investors only update their information once per quarter?

We updated our measures of idiosyncratic volatility and short interest every month in the paper. Therefore, an investor would have to trade every month to hold the high vol/low SI or high vol/high SI portfolio. We test how a reduction in information updating affects portfolio performance by only updating our measures of idiosyncratic volatility and short interest once per quarter (at the beginning of January, April, July, and October). A stock that enters either portfolio at the beginning of a quarter remains in the portfolio until the end of the quarter. The equally weighted portfolios still rebalance at the beginning of each month, but the value weighted portfolios trade only at the beginning of each quarter.

Figure D-3 shows the value of a $1 investment in these modified equally weighted portfolios from July 1991 through December 2012. We present the CRSP value weighted index for comparison. The high vol/low SI portfolio has a final value of $18.29, and the high vol/high SI portfolio has a final value of $0.79. These results are meaningfully different from those in Figure 2 from the paper. In that figure, the high vol/low SI portfolio had a final value of $37.70, and the high vol/high SI portfolio had a final value of $0.44. Less frequent information updating about halves the final value for the high vol/low SI portfolio. However, the modified high vol/low SI portfolio still significantly outperforms the CRSP index, which had a final value $6.29.

Table D-6 shows the annualized performance measures for the same modified portfolios. The high vol/low SI portfolio has an average return of 18.4% per year with a standard deviation of 32.0%. The Sharpe and Treynor ratios for the high vol/low SI portfolio are greater than those of the CRSP index. The high vol/high SI portfolio has an average return of 3.6% per year with a standard deviation of 31.2%. The Sharpe and Treynor ratios of the high vol/high SI portfolio are

both about zero. These results are meaningfully different from those presented for the unmodified portfolios in Table 2 from the paper. The annual compound return for the modified high vol/low SI portfolio is 3.4% per year lower. The same return for the modified high vol/high SI portfolio is 2.7% per year higher. Those differences are similar if the portfolios are value weighted.

We measure the alpha for the modified portfolios using the FF-PS five-factor model in Table D-7. The high vol/low SI portfolio has an alpha of 0.61% per month, compared to -0.51% for the high vol/high SI portfolio. The difference in alpha of 1.12% per month between the two modified portfolios is smaller than that of the unmodified portfolios in Table 3 from the paper (1.67% per month), but still economically large. If we value weight the portfolios, the difference in alpha for the modified portfolios decreases to 0.49% (*p*-value = .205). Alpha for each individual modified portfolio is still economically large, but statistically insignificant. Switching from equal to value weighting decreased the alpha of the unmodified portfolios as well, but to a lesser degree.

In conclusion, we find that our results are driven by levels of short interest, not changes. Dropping the stocks with the largest month to month changes in short interest from our portfolios does not meaningful impact performance. On the other hand, information delays and less frequent information updating do have a significant effect on performance. The high vol/low SI portfolio with either constraint imposed has lower returns than the high vol/low SI portfolio used in the paper; however, despite the performance decrease, the modified high vol/low SI portfolios still outperform the overall market.

Figure D-1: The return on one dollar invested in high volatility stocks with low and high short interest – Change in short interest

This figure shows the value of a $1 investment in equally weighted portfolios of high volatility stocks with low and high short interest from August 1991 through December 2012. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered high volatility and low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We drop all stocks above the 90th percentile and below the 10th percentile of change in DTC from month *t* - 2 to *t* - 1 from the portfolios. The value of the CRSP value weighted index is presented for comparison.

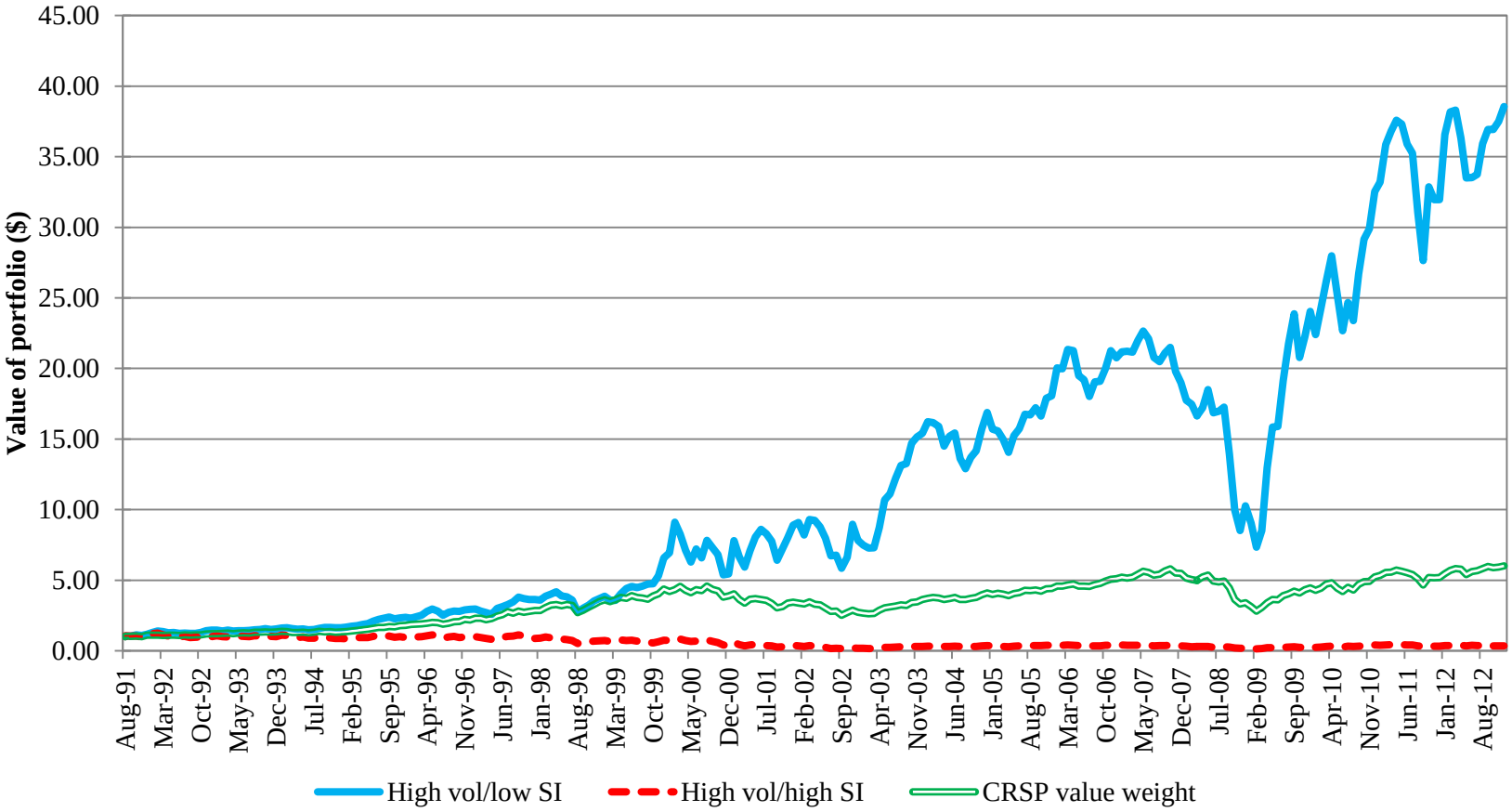

Figure D-2: The return on one dollar invested in high volatility stocks with low and high short interest – Delay in using short interest

This figure shows the value of a $1 investment in equally weighted portfolios of high volatility stocks with low and high short interest from July 1991 through December 2012. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered high volatility and low (high) short interest in month *t* if its days to cover in month *t* - 2 falls within the lowest (highest) 20% among high volatility stocks. The value of the CRSP value weighted index is presented for comparison.

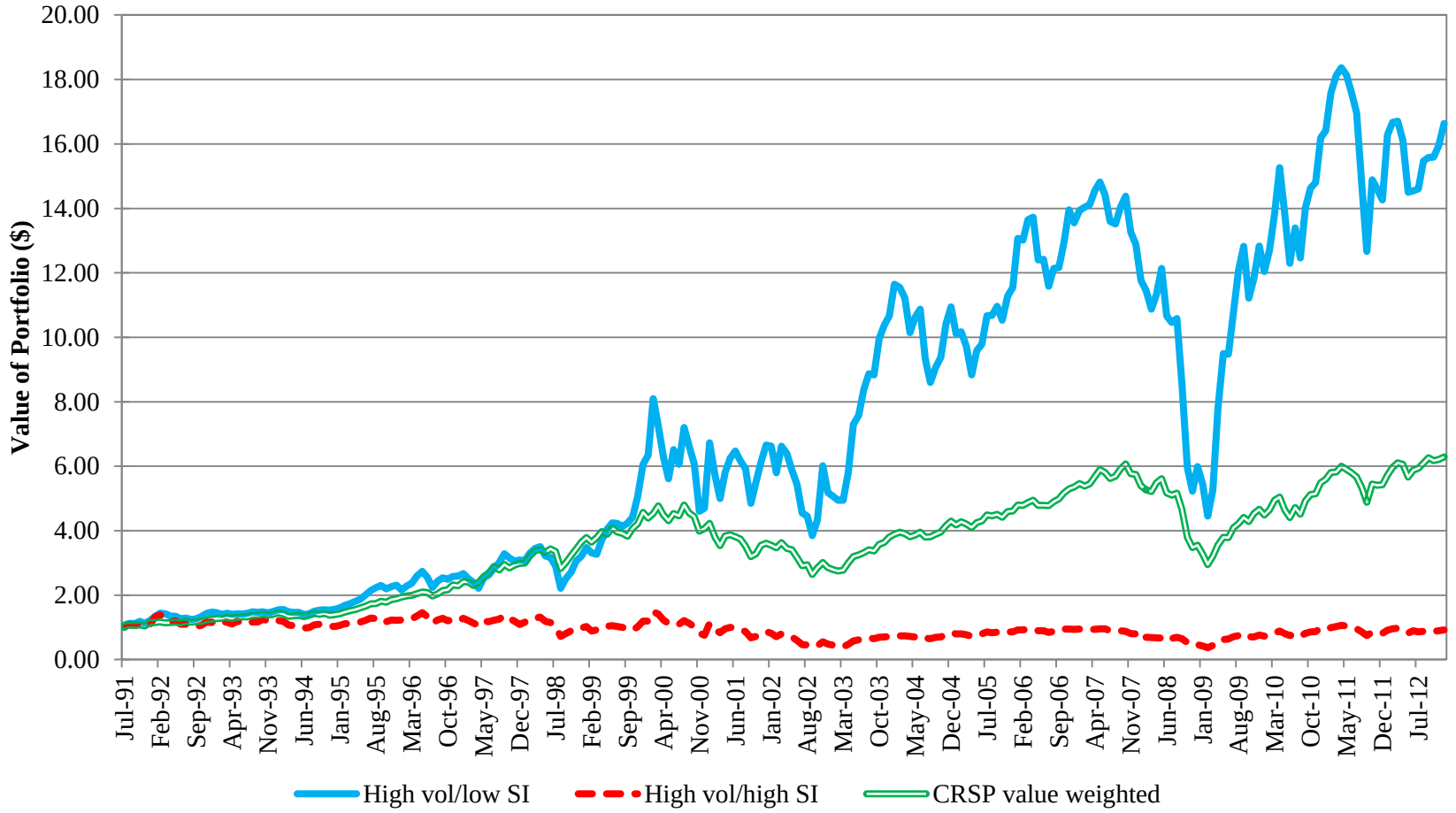

Figure D-3: The return on one dollar invested in high volatility stocks with low and high short interest – Quarterly updating portfolios

This figure shows the value of a $1 investment in equally weighted portfolios of high volatility stocks with low and high short interest from July 1991 through December 2012. Days to cover (DTC) and idiosyncratic volatility are only updated once per quarter (at the beginning of January, April, July, and October). A stock is considered high volatility in a quarter if its idiosyncratic volatility in the month immediately preceding the start of the quarter falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in a quarter if its DTC in the month immediately preceding the start of the quarter falls within the lowest (highest) 20% among high volatility stocks. The value of the CRSP value weighted index is presented for comparison.

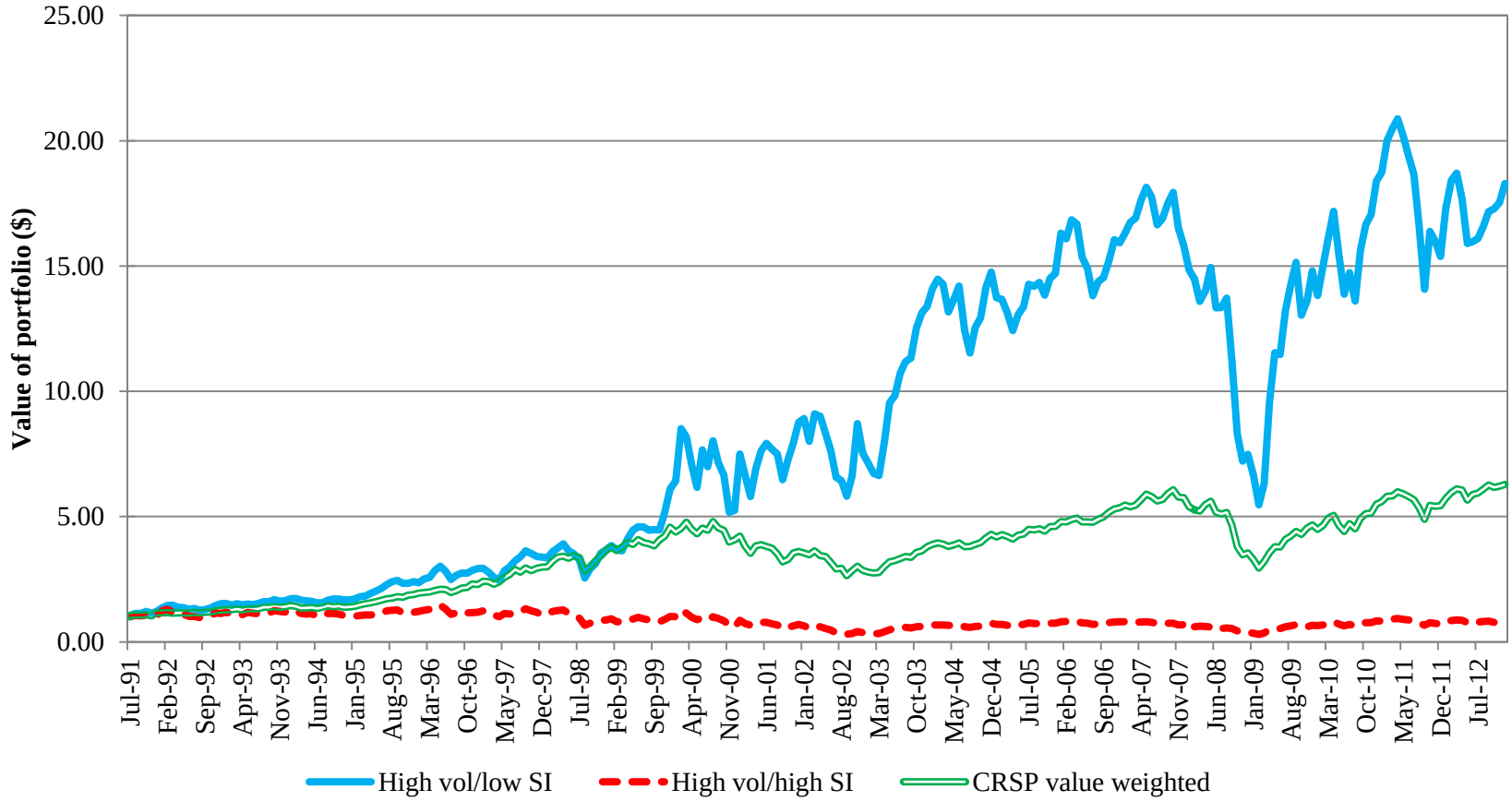

Table D-1: How much does short interest change over time?

This table shows the change in the short interest level of stocks from month to month. We rank all stocks in the sample from July 1991 through December 2012 into deciles each month based on their days to cover (DTC). Panel A shows the percentage of stocks in each month *t* DTC decile given their month *t* - 1 DTC decile. Panel B shows the percentage of stocks in each month *t* DTC decile given their month *t* - 6 DTC decile. We bold the diagonal of each panel to ease finding matching deciles.

Panel A: Month *t* DTC decile given month *t* - 1 decile

Decile month *t* - 1	Decile month *t*									
	1	2	3	4	5	6	7	8	9	10
1	**59.6%**	23.6%	8.7%	3.7%	2.0%	1.1%	0.6%	0.4%	0.3%	0.1%
2	23.4%	**35.7%**	22.1%	10.0%	4.7%	2.2%	1.1%	0.6%	0.2%	0.1%
3	8.5%	22.1%	**28.2%**	20.7%	11.1%	5.4%	2.5%	1.0%	0.4%	0.1%
4	3.7%	9.9%	20.3%	**25.2%**	20.0%	11.6%	5.9%	2.3%	0.9%	0.2%
5	1.9%	4.5%	10.8%	19.4%	**23.6%**	19.9%	11.9%	5.7%	1.8%	0.3%
6	1.1%	2.2%	5.4%	11.3%	19.2%	**23.9%**	20.1%	11.8%	4.3%	0.7%
7	0.7%	1.1%	2.5%	5.5%	11.4%	19.4%	**25.5%**	21.4%	10.7%	1.8%
8	0.4%	0.6%	1.2%	2.6%	5.3%	11.2%	20.6%	**29.2%**	23.2%	5.6%
9	0.3%	0.3%	0.6%	1.1%	2.1%	4.5%	9.7%	21.7%	**38.2%**	21.7%
10	0.1%	0.1%	0.2%	0.3%	0.6%	1.1%	2.2%	5.9%	20.1%	**69.4%**

Panel B: Month *t* DTC decile given month *t* - 6 decile

Decile month *t* - 6	Decile month *t*									
	1	2	3	4	5	6	7	8	9	10
1	**42.7%**	23.1%	12.9%	7.2%	4.8%	3.2%	2.3%	1.7%	1.2%	0.8%
2	22.8%	**25.1%**	18.4%	11.8%	8.0%	5.3%	3.7%	2.5%	1.7%	0.8%
3	12.5%	18.6%	**19.6%**	15.9%	11.7%	8.6%	5.7%	3.9%	2.5%	1.0%
4	7.3%	12.0%	16.1%	**17.5%**	15.2%	12.0%	8.7%	6.1%	3.6%	1.5%
5	4.6%	7.9%	11.9%	15.2%	**16.5%**	15.0%	12.3%	9.2%	5.4%	2.0%
6	3.0%	5.2%	8.4%	12.3%	15.3%	**16.4%**	15.5%	12.4%	8.2%	3.3%
7	2.1%	3.5%	5.7%	8.8%	12.2%	15.6%	**17.5%**	16.6%	12.5%	5.4%
8	1.5%	2.3%	3.8%	6.1%	8.8%	12.7%	16.8%	**19.5%**	18.7%	9.8%
9	1.1%	1.5%	2.3%	3.5%	5.3%	8.0%	12.4%	18.8%	**25.8%**	21.4%
10	0.6%	0.9%	1.1%	1.6%	2.1%	3.4%	5.6%	9.7%	20.5%	**54.4%**

Table D-2: The return on high volatility stocks with low and high short interest – Change in short interest

This table shows the return on portfolios of high volatility stocks with low and high short interest from August 1991 through December 2012. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We drop all stocks above the 90th percentile and below the 10th percentile of change in DTC from month *t* - 2 to *t* - 1 from the portfolios. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. We present the CRSP value weighted index for comparison. Average return is the annualized mean monthly return. Geometric return is the annualized monthly compound return. Median return is the annualized median monthly return. Standard deviation is the annualized standard deviation of monthly returns. Sharpe (Treynor) ratio is the annualized average of the monthly returns less the risk-free rate divided by the annualized standard deviation of monthly returns (CAPM beta).

	Equally weighted		Value Weighted		
	Low SI	High SI	Low SI	High SI	CRSP value
Average Return	22.3%	1.4%	16.3%	3.5%	9.6%
Geometric Return	17.2%	-4.9%	11.5%	2.0%	8.4%
Median Return	20.9%	-2.2%	22.0%	4.5%	16.0%
Standard Deviation	33.1%	35.9%	30.7%	17.2%	15.5%
Sharpe Ratio	0.58	-0.05	0.43	0.03	0.43
Treynor Ratio	0.12	-0.01	0.08	0.01	0.07

Table D-3: Do high volatility stocks with low and high short interest have alpha? – Change in short interest

This table shows the results from regressing monthly percentage returns on portfolios of high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We drop all stocks above the 90th percentile and below the 10th percentile of change in days to cover from month *t* - 2 to *t* - 1 from the portfolios. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is August 1991 through December 2012. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

	Equally weighted			Value weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
Beta	1.27***	1.30***	-0.04	1.26***	0.64***	0.62***
	[0.000]	[0.000]	[0.718]	[0.000]	[0.000]	[0.000]
SMB	1.35***	1.21***	0.13	0.88***	0.46***	0.42***
	[0.000]	[0.000]	[0.317]	[0.000]	[0.000]	[0.004]
HML	-0.04	-0.22	0.17	-0.44***	-0.27***	-0.17
	[0.629]	[0.112]	[0.202]	[0.000]	[0.001]	[0.187]
UMD	-0.55***	-0.71***	0.16	-0.34***	-0.23***	-0.11
	[0.000]	[0.000]	[0.167]	[0.000]	[0.000]	[0.117]
PS Liq	-0.04	0.04	-0.08	-0.03	-0.03	-0.00
	[0.533]	[0.636]	[0.391]	[0.628]	[0.477]	[0.968]
Alpha	0.95***	-0.68*	1.63***	0.57**	-0.18	0.75**
	[0.000]	[0.056]	[0.000]	[0.033]	[0.280]	[0.016]
Observations	257	257	257	257	257	257
r^2	0.87	0.81	0.04	0.81	0.73	0.41

Table D-4: The return on high volatility stocks with low and high short interest – Delay in using short interest

This table shows the return on portfolios of high volatility stocks with low and high short interest from July 1991 through December 2012. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 2 falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. We present the CRSP value weighted index for comparison. Average return is the annualized mean monthly return. Geometric return is the annualized monthly compound return. Median return is the annualized median monthly return. Standard deviation is the annualized standard deviation of monthly returns. Sharpe (Treynor) ratio is the annualized average of the monthly returns less the risk-free rate divided by the annualized standard deviation of monthly returns (CAPM beta).

	Equally Weighted		Value Weighted		
	Low SI	High SI	Low SI	High SI	CRSP value
Average Return	18.4%	4.2%	15.8%	6.4%	9.8%
Geometric Return	13.1%	-0.4%	10.2%	2.4%	8.6%
Median Return	17.7%	1.0%	22.5%	7.7%	16.1%
Standard Deviation	33.1%	30.9%	33.4%	28.2%	15.4%
Sharpe Ratio	0.46	0.04	0.38	0.12	0.44
Treynor Ratio	0.09	0.01	0.07	0.02	0.07

Table D-5: Do high volatility stocks with low and high short interest have alpha? – Delay in using short interest

This table shows the results from regressing monthly percentage returns on portfolios of high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in month *t* if its days to cover in month *t* - 2 falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2012. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

	Equally weighted			Value weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
Beta	1.31***	1.12***	0.19**	1.41***	1.17***	0.24*
	[0.000]	[0.000]	[0.013]	[0.000]	[0.000]	[0.054]
SMB	1.29***	1.22***	0.07	0.90***	0.90***	-0.01
	[0.000]	[0.000]	[0.555]	[0.000]	[0.000]	[0.965]
HML	-0.11	-0.09	-0.01	-0.44***	-0.19**	-0.25
	[0.232]	[0.378]	[0.892]	[0.000]	[0.037]	[0.112]
UMD	-0.52***	-0.60***	0.08	-0.33***	-0.41***	0.08
	[0.000]	[0.000]	[0.415]	[0.000]	[0.000]	[0.407]
PS Liq	-0.02	-0.01	-0.01	-0.06	-0.05	-0.01
	[0.751]	[0.864]	[0.901]	[0.405]	[0.380]	[0.938]
Alpha	0.61**	-0.42	1.03***	0.44	-0.25	0.69*
	[0.019]	[0.109]	[0.001]	[0.157]	[0.274]	[0.082]
Observations	258	258	258	258	258	258
r^2	0.87	0.86	0.05	0.78	0.83	0.07

Table D-6: The return on high volatility stocks with low and high short interest – Quarterly updating portfolios

This table shows the return on portfolios of high volatility stocks with low and high short interest from July 1991 through December 2012. Days to cover (DTC) and idiosyncratic volatility are only updated once per quarter (at the beginning of January, April, July, and October). A stock is considered high volatility in a quarter if its idiosyncratic volatility in the month immediately preceding the start of the quarter falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in a quarter if its DTC in the month immediately preceding the start of the quarter falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. We present the CRSP value weighted index for comparison. Average return is the annualized mean monthly return. Geometric return is the annualized monthly compound return. Median return is the annualized median monthly return. Standard deviation is the annualized standard deviation of monthly returns. Sharpe (Treynor) ratio is the annualized average of the monthly returns less the risk-free rate divided by the annualized standard deviation of monthly returns (CAPM beta).

	Equally weighted		Value weighted		
	Low SI	High SI	Low SI	High SI	CRSP value
Average Return	18.4%	3.6%	13.8%	6.9%	9.8%
Geometric Return	13.6%	-1.1%	9.1%	2.2%	8.6%
Median Return	20.5%	4.6%	14.6%	12.4%	16.1%
Standard Deviation	32.0%	31.2%	30.3%	30.9%	15.4%
Sharpe Ratio	0.48	0.02	0.35	0.13	0.44
Treynor Ratio	0.10	0.00	0.07	0.02	0.07

Table D-7: Do high volatility stocks with low and high short interest have alpha? – Quarterly updating portfolios

This table shows the results from regressing monthly percentage returns on portfolios of high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. Days to cover (DTC) and idiosyncratic volatility are only updated once per quarter (at the beginning of January, April, July, and October). A stock is considered high volatility in a quarter if its idiosyncratic volatility in the month immediately preceding the start of the quarter falls within the highest 20% among stocks in the sample. A stock is considered low (high) short interest in a quarter if its DTC in the month immediately preceding the start of the quarter falls within the lowest (highest) 20% among high volatility stocks. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2012. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

	Equally weighted			Value weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
Beta	1.24***	1.15***	0.09	1.34***	1.24***	0.10
	[0.000]	[0.000]	[0.195]	[0.000]	[0.000]	[0.434]
SMB	1.30***	1.28***	0.02	0.78***	1.10***	-0.32**
	[0.000]	[0.000]	[0.850]	[0.000]	[0.000]	[0.019]
HML	-0.07	-0.11	0.04	-0.21	-0.23***	0.02
	[0.449]	[0.256]	[0.678]	[0.112]	[0.005]	[0.921]
UMD	-0.47***	-0.58***	0.11	-0.31***	-0.45***	0.14
	[0.000]	[0.000]	[0.294]	[0.000]	[0.000]	[0.157]
PS Liq	-0.03	0.00	-0.03	-0.02	-0.04	0.02
	[0.677]	[0.938]	[0.654]	[0.815]	[0.517]	[0.832]
Alpha	0.61**	-0.51**	1.12***	0.23	-0.26	0.49
	[0.023]	[0.032]	[0.000]	[0.420]	[0.270]	[0.205]
Observations	258	258	258	258	258	258
r^2	0.86	0.88	0.02	0.78	0.85	0.05

Appendix E – Alternative explanations

We show in the paper that the high vol/low SI portfolio consistently outperforms the market and the high vol/high SI portfolio on a raw or risk-adjusted basis. In this appendix, we test if that performance is robust to some additional, alternative explanations. First, we explore whether industry clustering can explain the performance of the portfolios. Next, we test whether the performance is related to two recently discovered stock anomalies, operating profit and investment. Details follow, but, in sum, we find no evidence that these possibilities explain the performance of the high vol/low SI or the high vol/high SI portfolio.

E.1 Does industry clustering within the portfolios explain the performance?

The high vol/low SI and high vol/high SI portfolios skew towards the same industries, but significant differences exist. Table E-1 shows the percentage of stock-month observations that fall into each of the Fama and French (1997) 49 industries for the both portfolios. Panel A shows the industries where the high vol/low SI portfolio has a higher industry concentration than the high vol/high SI portfolio. The three industries where the high vol/low SI portfolio industry concentration most exceeds that of the high vol/high SI portfolio are electronic equipment, computer software, and petroleum and natural gas. Panel B shows the industries where the high vol/high SI portfolio has a higher industry concentration than the high vol/low SI portfolio. The three industries where the high vol/high SI portfolio industry concentration most exceeds that of the high vol/low SI portfolio are pharmaceutical products, business services, and banking.

We first test whether differences in industry clustering explain out results by dropping the six industries listed above from the both portfolios. Figure E-1 shows the value of a $1 investment in each modified equally weighted portfolio from July 1991 through December 2012.

We present the CRSP value weighted index for comparison. The high vol/low SI portfolio has a final value of $37.75, and the high vol/high SI portfolio has a final value of $0.51. These results are similar to those for the unmodified portfolios in Figure 2 from the paper. In that figure, the high vol/low SI portfolio had a final value of $37.70, and the high vol/high SI portfolio had a final value of $0.44.

Table E-2 shows the annualized performance measures for the same modified portfolios. The high vol/low SI portfolio has an average return of 21.9% per year with a standard deviation of 32.3%. The Sharpe and Treynor ratios for the high vol/low SI portfolio are greater than those of the CRSP index. The high vol/high SI portfolio has an average return of 1.9% per year with a standard deviation of 32.3%. The Sharpe and Treynor ratios of the high vol/high SI portfolio are both negative. These results are similar to those for the unmodified portfolios in Table 2 from the paper. If we value weight the portfolios, the performance of the modified and unmodified portfolios remains similar.

We measure the alpha for the modified portfolios using the FF-PS five-factor model in Table E-3.[1] The high vol/low SI portfolio has an alpha of 0.89% per month, compared to -0.71% for the high vol/high SI portfolio. The difference in alpha of 1.60% per month between the two modified portfolios is about the same as that of the unmodified portfolios in Table 3 from the paper (1.67% per month). If we value weight the portfolios, the difference in alpha for the modified portfolios decreases to 0.73%. The unmodified portfolios see a similar, albeit smaller, decrease after switching from equal to value weighting.

We further test the effect of industry clustering by adjusting our panel model used in Table 5 from the paper. In Panel A of Table E-4, we replicate Table 5, but drop from the sample

[1] We refer to the Fama-French-Carhart (1993, 1997) four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor as the FF-PS five-factor model.

the same six industries discussed previously. The only difference in the results after this change is the high volatility dummy variable gains a large, negative effect. In Panel B of Table E-4, we again replicate the model used in Table 5, but include Fama-French 49 industry fixed effects. There are no meaningful differences in the results after this change.[2]

E.2 Do the operating profit and investment anomalies explain the performance?

Fama and French (2013) show that the operating profit and investment anomalies are as important to explaining returns as size and book-to-market. More profitable firms and firms making smaller investments tend to have higher returns. We find that stocks in the high vol/low SI portfolio have higher average operating profit and lower average investment than stocks in the high vol/high SI portfolio. The high vol/low SI portfolio may outperform the high vol/high SI portfolio because of those differences alone. As in Tables 6 and 7 from the paper, we test the effects of operating profit and investment by dividing the stocks in both portfolios into terciles based on those measures.

There is significant variation in operating profit and investment within both portfolios. For example, within the high vol/low SI portfolio, the highest tercile of operating profit has an average operating profit of 48.1%. The lowest tercile has an average operating profit of -6.28%. Within the high vol/high SI portfolio, the highest tercile of operating profit has an average operating profit of 48.2%, compared to -28.2% for the lowest tercile. The highest (lowest) tercile of each portfolio has an average operating profit higher (lower) than the full sample average of 26.2%. Both portfolios have a significant number of "profitable" and "unprofitable" firms.

In Table E-5, we present the FF-PS five-factor alphas for equally weighted portfolios of high vol/low SI and high vol/high SI stocks sorted on operating profit and investment. Looking

[2] If we use two-digit SIC code fixed effects instead, the results are similar.

first at the operating profit results in Panel A, we find the high vol/low SI portfolio has a large, positive alpha regardless of operating profit. Counter to expectations, the high vol/low SI stocks in the lowest operating profit tercile have an alpha 0.67% per month greater (*p*-value = 0.151) than the high vol/low SI stocks in the highest operating profit tercile. The high vol/high SI portfolio has a large, negative alpha regardless of operating profit. As expected, the high vol/high SI stocks in the highest operating profit tercile have an alpha 1.07% per month greater than the high vol/high SI stocks in the lowest operating profit tercile. But again counter to expectations, the difference in alpha between the high vol/low SI and high vol/high SI portfolios is 1.74% per month greater in the lowest operating profit tercile compared to the highest operating profit tercile.

In Panel B, we perform the same test using investment. We again find a large, positive alpha for each high vol/low SI portfolio. The high vol/low SI stocks in the lowest investment tercile outperform those in highest tercile by 0.82% per month. Within the high vol/high SI portfolio, only the lowest and highest terciles of investment have large, negative alphas. The high vol/high SI stocks in the lowest investment tercile outperform those in highest tercile by 0.43% (*p*-value = 0.240) per month. The difference in alpha between the high vol/low SI and high vol/high SI stocks is an economically large 0.39% per month (*p*-value = 0.455) greater in the lowest investments tercile compared to the highest investment tercile, but the difference is large and positive regardless of investment.

Figure E-1: The return on one dollar invested in high volatility stocks with low and high short interest – Industry clustering
This figure shows the value of a $1 investment in equally weighted portfolios of high volatility stocks with low and high short interest from July 1991 through December 2012. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is considered high volatility and low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We drop the following Fama-French industries from each resulting portfolio: electronic equipment, computer software, petroleum and natural gas, pharmaceutical products, business services, and banking. The value of the CRSP value weighted index is presented for comparison.

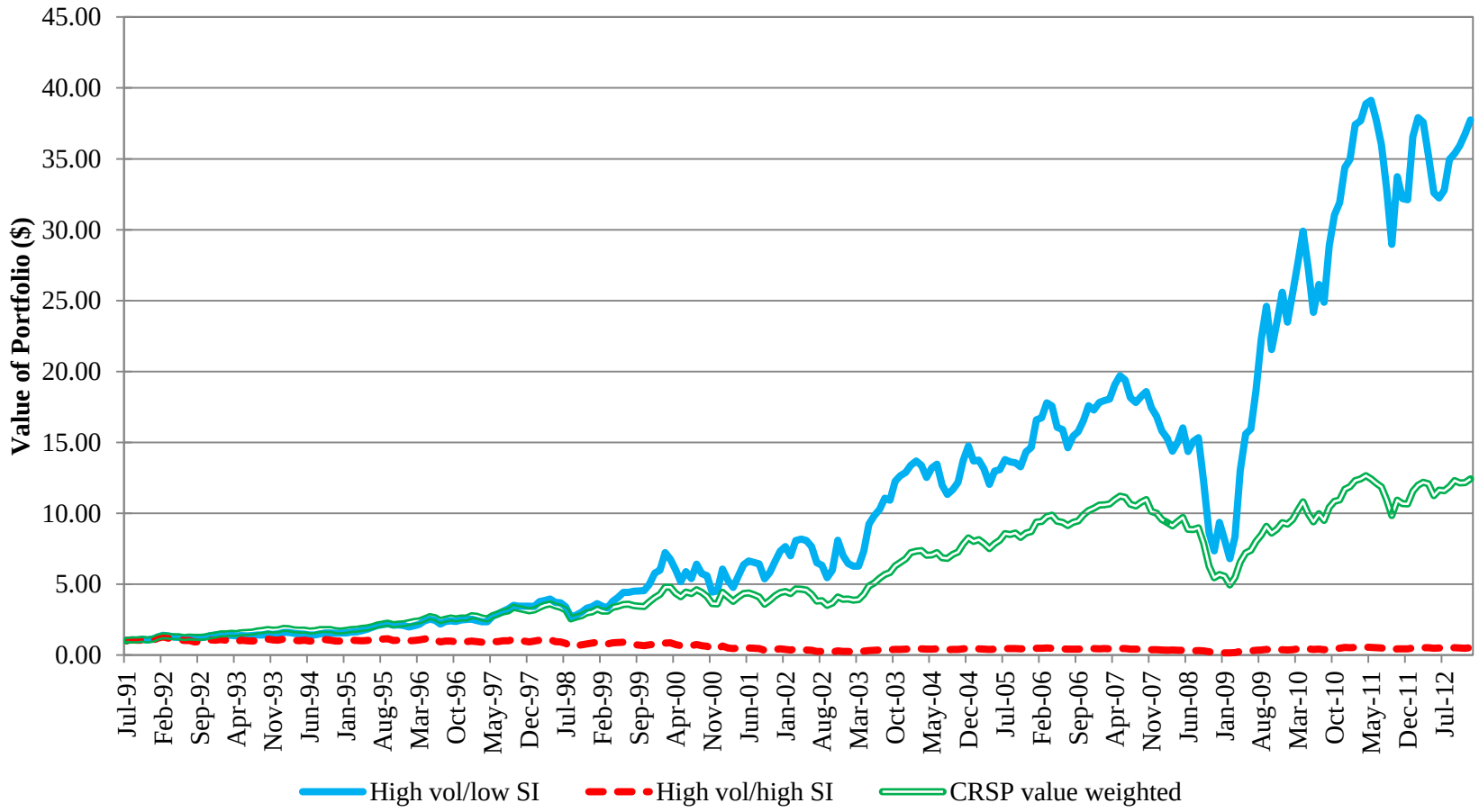

Table E-1: The concentration of industries within the high volatility portfolios

This table shows the percentage of stocks in the high volatility portfolios with low and high short interest that fall into each Fama and French (1997) industry. A stock is considered high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. A stock is low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. The portfolios are formed from July 1991 through December 2012. Panel A shows the industries where the low short interest portfolio has a higher concentration than the high short interest portfolio. Panel B shows the industries where the high short interest portfolio has a higher concentration than the low short interest portfolio.

Panel A: Greater low short interest portfolio industry concentration

Industry	Low SI	High SI	Low - High
Electronic Equipment	10.56%	5.08%	5.48%
Computer Software	10.70%	7.55%	3.15%
Petroleum and Natural Gas	5.01%	3.29%	1.72%
Insurance	2.70%	1.37%	1.33%
Steel Works Etc	2.02%	0.74%	1.28%
Trading	3.60%	2.53%	1.07%
Machinery	3.19%	2.12%	1.07%
Computers	4.48%	3.54%	0.94%
Transportation	2.21%	1.33%	0.88%
Coal	0.77%	0.13%	0.64%
Electrical Equipment	3.58%	2.96%	0.62%
Precious Metals	0.87%	0.37%	0.50%
Rubber and Plastic Products	0.73%	0.31%	0.42%
Measuring and Control Equipment	2.34%	1.97%	0.37%
Chemicals	1.61%	1.28%	0.33%
Fabricated Products	0.34%	0.08%	0.26%
Shipbuilding, Railroad Equipment	0.23%	0.08%	0.15%
Almost Nothing	0.56%	0.45%	0.11%
Aircraft	0.18%	0.09%	0.09%
Industrial Mining	0.47%	0.39%	0.08%
Textiles	0.55%	0.48%	0.07%
Shipping Containers	0.19%	0.12%	0.07%
Candy & Soda	0.14%	0.08%	0.06%
Construction Materials	1.17%	1.14%	0.03%

Panel B: Greater high short interest portfolio industry concentration

Industry	Low SI	High SI	Low - High
Pharmaceutical Products	6.45%	12.38%	-5.93%
Business Services	5.69%	7.80%	-2.11%
Banking	2.81%	4.82%	-2.01%
Healthcare	1.92%	3.37%	-1.45%
Medical Equipment	2.81%	4.12%	-1.31%
Communication	2.88%	4.02%	-1.14%
Printing and Publishing	0.27%	1.31%	-1.04%
Personal Services	0.72%	1.55%	-0.83%
Retail	4.94%	5.68%	-0.74%
Entertainment	1.04%	1.74%	-0.70%
Restaurants, Hotels, Motels	1.31%	1.81%	-0.50%
Recreation	0.45%	0.95%	-0.50%
Wholesale	3.71%	4.19%	-0.48%
Food Products	1.00%	1.34%	-0.34%
Automobiles and Trucks	1.15%	1.43%	-0.28%
Tobacco Products	0.06%	0.25%	-0.19%
Utilities	0.49%	0.67%	-0.18%
Beer & Liquor	0.06%	0.23%	-0.17%
Real Estate	0.26%	0.43%	-0.17%
Consumer Goods	0.94%	1.09%	-0.15%
Construction	1.17%	1.30%	-0.13%
Apparel	0.78%	0.91%	-0.13%
Agriculture	0.17%	0.28%	-0.11%
Business Supplies	0.47%	0.53%	-0.06%
Defense	0.27%	0.29%	-0.02%

Table E-2: The return on high volatility stocks with low and high short interest – Industry clustering

This table shows the return on portfolios of high volatility stocks with low and high short interest from July 1991 through December 2012. We consider a stock high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. We consider a stock low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We drop the following Fama-French industries from each resulting portfolio: electronic equipment, computer software, petroleum and natural gas, pharmaceutical products, business services, and banking. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. We present the CRSP value weighted index for comparison. Average return is the annualized mean monthly return. Geometric return is the annualized monthly compound return. Median return is the annualized median monthly return. Standard deviation is the annualized standard deviation of monthly returns. Sharpe (Treynor) ratio is the annualized average of the monthly returns less the risk-free rate divided by the annualized standard deviation of monthly returns (CAPM beta).

	Equally weighted		Value weighted		
	Low SI	High SI	Low SI	High SI	CRSP value
Average Return	21.9%	1.9%	15.1%	6.3%	9.8%
Geometric Return	17.0%	-3.1%	9.7%	1.2%	8.6%
Median Return	21.1%	-3.6%	13.2%	12.6%	16.1%
Standard Deviation	32.3%	32.3%	32.3%	31.9%	15.4%
Sharpe Ratio	0.59	-0.03	0.37	0.10	0.44
Treynor Ratio	0.12	-0.01	0.07	0.02	0.07

Table E-3: Do high volatility stocks with low and high short interest have alpha? – Industry clustering

This table shows the results from regressing monthly percentage returns on portfolios of high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. We consider a stock high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. We consider a stock low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. We drop the following Fama-French industries from each resulting portfolio: electronic equipment, computer software, petroleum and natural gas, pharmaceutical products, business services, and banking. We present results for the portfolios using both equal and value weighting. The value weighted portfolios weight stocks by their market capitalization at the end of month *t* - 1. The time period used is July 1991 through December 2012. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

	Equally weighted			Value weighted		
	Low SI	High SI	Low - High	Low SI	High SI	Low - High
Beta	1.27***	1.23***	0.05	1.37***	1.31***	0.06
	[0.000]	[0.000]	[0.591]	[0.000]	[0.000]	[0.632]
SMB	1.25***	1.13***	0.12	0.75***	0.89***	-0.14
	[0.000]	[0.000]	[0.325]	[0.000]	[0.000]	[0.273]
HML	0.13	0.01	0.12	-0.30**	-0.16	-0.14
	[0.107]	[0.918]	[0.280]	[0.028]	[0.130]	[0.364]
UMD	-0.57***	-0.67***	0.10	-0.43***	-0.52***	0.08
	[0.000]	[0.000]	[0.411]	[0.000]	[0.000]	[0.387]
PS Liq	-0.04	0.11*	-0.14*	0.04	0.03	0.01
	[0.514]	[0.098]	[0.086]	[0.652]	[0.674]	[0.961]
Alpha	0.89***	-0.71**	1.60***	0.39	-0.34	0.73*
	[0.001]	[0.014]	[0.000]	[0.217]	[0.240]	[0.081]
Observations	258	258	258	258	258	258
r^2	0.85	0.84	0.03	0.77	0.79	0.02

Table E-4: What is the simultaneous effect of high volatility and short interest? – Industry clustering

This table presents results from equation (1) in the paper:

$$\text{Return}_{i,t} = \text{FF Controls}_{i,t-1} + \text{Idio Vars}_{i,t-1} + \text{Short Interest Vars}_{i,t-1} + \text{Time FE} + \varepsilon_{i,t}$$

The dependent variable is the percentage stock return for stock *i* in month *t*. We include four $\text{FF Controls}_{i,t-1}$. Beta, ln(size), and book-to-market are measured following Fama and French (1992). 12-month return is the return for stock *i* from month *t* - 13 to month *t* - 1. We include two $\text{Idio Vars}_{i,t-1}$. Idio vol is the standard deviation of the residuals from regressing month *t* - 1 daily returns for stock *i* against the Fama-French four-factor model. High vol dummy equals one if the Idio vol of stock *i* in month *t* - 1 falls within the highest 20% among stocks in the sample, zero otherwise. We include three $\text{Short Interest Vars}_{i,t-1}$. Days to cover is the last reported value of short interest for stock *i* in month *t* - 1 divided by average daily trading volume for stock *i* in month *t* - 1. Low (high) DTC dummy is equal to one if Days to Cover for stock *i* in month *t* - 1 falls within the lowest (highest) 20% among stocks within the month *t* - 1 volatility quintile of stock *i*, zero otherwise. We interact the high vol dummy and the two DTC dummy variables in some models. All right-hand-side variables, except beta and the dummy variables, are *z*-scored (demeaned and divided by standard deviation) within each month. Before *z*-scoring, we winsorize all variables, except beta and the dummy variables, at 1% and 99%. We include monthly time fixed effects in all models and cluster standard errors on time. Panel A shows results after dropping the following Fama-French industries: electronic equipment, computer software, petroleum and natural gas, pharmaceutical products, business services, and banking. Panel B shows results after including Fama-French 49 industry fixed effects. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

Panel A: Dropping select industries

	(1)	(2)	(3)	(4)	(5)	(6)
Beta	0.03	0.18	0.00	0.18	0.19	0.19
	[0.940]	[0.535]	[0.989]	[0.531]	[0.524]	[0.513]
ln(size)	0.03	-0.04	-0.00	-0.08	-0.07	-0.08
	[0.679]	[0.628]	[0.989]	[0.282]	[0.334]	[0.311]
Book-to-market	0.17***	0.15**	0.16**	0.13**	0.13**	0.13**
	[0.008]	[0.014]	[0.014]	[0.028]	[0.034]	[0.038]
12-month return	0.11	0.10	0.08	0.07	0.07	0.07
	[0.390]	[0.417]	[0.493]	[0.545]	[0.551]	[0.585]
Idio vol		-0.23**		-0.26***	-0.17	-0.18*
		[0.021]		[0.008]	[0.104]	[0.081]
Days to cover			-0.21***	-0.24***	-0.15***	-0.16***
			[0.000]	[0.000]	[0.001]	[0.000]
High vol dummy					-0.28**	-0.23**
					[0.012]	[0.045]
Low DTC dummy					0.28***	0.21**
					[0.001]	[0.014]
High DTC dummy					-0.16*	-0.04
					[0.072]	[0.612]
High vol * Low DTC						0.35**
						[0.031]
High vol * High DTC						-0.53***
						[0.003]

Panel B: Industry fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)
Beta	-0.14	0.02	-0.14	0.04	0.05	0.06
	[0.619]	[0.923]	[0.606]	[0.873]	[0.836]	[0.817]
ln(size)	0.01	-0.07	-0.02	-0.12	-0.11	-0.12
	[0.884]	[0.357]	[0.747]	[0.120]	[0.139]	[0.131]
Book-to-market	0.20***	0.19***	0.19***	0.16***	0.16***	0.16***
	[0.001]	[0.001]	[0.002]	[0.004]	[0.006]	[0.007]
12-month return	0.12	0.11	0.10	0.09	0.09	0.08
	[0.340]	[0.376]	[0.427]	[0.491]	[0.498]	[0.533]
Idio vol		-0.29***		-0.32***	-0.28***	-0.30***
		[0.002]		[0.001]	[0.002]	[0.001]
Days to cover			-0.22***	-0.25***	-0.14***	-0.16***
			[0.000]	[0.000]	[0.001]	[0.000]
High vol dummy					-0.12	-0.03
					[0.188]	[0.761]
Low DTC dummy					0.32***	0.25***
					[0.000]	[0.003]
High DTC dummy					-0.20**	-0.04
					[0.014]	[0.572]
High vol * Low DTC						0.30**
						[0.036]
High vol * High DTC						-0.62***
						[0.000]

Table E-5: Are the high volatility portfolio returns driven by profit and investment?
This table shows the alpha from regressing monthly percentage returns on varying portfolios of high volatility stocks with low and high short interest against the Fama-French four-factor model augmented with the Pastor and Stambaugh (2003) liquidity factor. We consider a stock high volatility in month *t* if its idiosyncratic volatility in month *t* - 1 falls within the highest 20% among stocks in the sample. We consider a stock low (high) short interest in month *t* if its days to cover in month *t* - 1 falls within the lowest (highest) 20% among high volatility stocks. After those sorts are complete, we sort stocks within those groups into terciles each month based on one of two different variables available as of *t* - 1: operating profit and investment. Both variables are measured following Fama and French (2013). We drop the all stocks outside 1st and 99th percentile of our sort variable. We use the stocks within each tercile to form equally weighted portfolios. Panel A presents monthly alphas for the portfolios after sorting on operating profit. Panel B presents monthly alphas for the portfolios after sorting on investment. The All row shows the performance of all low SI and high SI stocks remaining in the sample after dropping any stocks missing the new sort variable. The time period used is July 1991 through December 2012. *p*-values from robust standard errors are reported below the coefficients in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels.

Panel A: Operating Profit

	Low SI	High SI	Low - High
All	1.07***	-0.76***	1.83***
	[0.000]	[0.007]	[0.000]
High operating profit	0.86***	-0.27	1.14**
	[0.010]	[0.489]	[0.021]
Mid operating profit	0.82***	-0.65*	1.47***
	[0.002]	[0.078]	[0.001]
Low operating profit	1.53***	-1.34***	2.87***
	[0.000]	[0.000]	[0.000]
High - Low	-0.67	1.07**	-1.74**
	[0.151]	[0.019]	[0.011]

Panel B: Investment

	Low SI	High SI	Low - High
All	0.95***	-0.56**	1.51***
	[0.000]	[0.025]	[0.000]
High investment	0.56*	-1.13***	1.70***
	[0.062]	[0.001]	[0.000]
Mid investment	0.88***	0.14	0.75*
	[0.004]	[0.652]	[0.077]
Low investment	1.39***	-0.70**	2.09***
	[0.000]	[0.036]	[0.000]
High - Low	-0.82**	-0.43	-0.39
	[0.025]	[0.240]	[0.455]