

ONLINE APPENDIX TO
“ARBITRAGE INVOLVEMENT AND SECURITY PRICES”

This Draft: January 2017

Appendix B.1
Number of Addition Events by Year

This table reports the number of addition events by calendar year. An addition event is specified as one in which an individual stock is added to the Hong Kong short-sale list and, therefore, can be sold short from the effective date. Our sample period runs from January 2001 through August 2012.

Year	Number of Addition Events
2001	10
2002	21
2003	33
2004	35
2005	45
2006	71
2007	135
2008	34
2009	92
2010	128
2011	100
2012	3

Appendix B.2
Number of Addition Events by Industry

This table reports the number of addition events by four-digit-GICS industry. An addition event is specified as one in which an individual stock is added to the Hong Kong short-sale list and, therefore, can be sold short from the effective date.

GICS Industry Code	GICS Industry Name	Number of Addition Events
1010	Energy	27
1510	Materials	77
2010	Capital Goods	92
2020	Commercial & Professional Services	10
2030	Transportation	24
2510	Automobiles and Components	13
2520	Consumer Durables and Apparel	88
2530	Consumer Services	54
2540	Media	43
2550	Retailing	46
3010	Food & Staples Retailing	9
3020	Food, Beverage & Tobacco	25
3030	Household & Personal Products	11
3510	Health Care Equipment & Services	9
3520	Pharmaceuticals, Biotechnology & Life Sciences	28
4020	Diversified Financials	5
4040	Real Estate	13
4510	Software & Services	28
4520	Technology Hardware & Equipment	61
4530	Semiconductors & Semiconductor Equipment	11
5010	Telecommunication Services	10
5510	Utilities	23

Appendix B.3

Cumulative Abnormal Returns and Changes in Hedge Fund Holdings around Additions to the Hong Kong Short-Sale List:
Alternative Measures of “Difficulty to Hedge Industry Risk prior to Addition”

This table mirrors Table 3, but considers alternative measures of “Difficulty to Hedge Industry Risk prior to Addition. For reference, in Table 3, we compute, for every year and each four-digit-GICS industry, the fraction of firms with nonzero short-selling volume. An observation is categorized as coming from a more-difficult-to-short industry if it resides in an industry that is in the bottom decile based on its fraction of firms shorted in the year prior to the addition event, and as coming from a less-difficult-short industry otherwise. In Panels A and B, an observation is now categorized as coming from a more-difficult-to-short industry if it resides in an industry that is in the bottom decile based on its *number* of firms shorted in the year prior to the addition event, and as coming from a less-difficult-to-short industry otherwise. In Panels C through F, we try to re-construct the historical lists of securities that can be shorted (as detailed in Section 4.1.1). We then estimate the fraction and number of stocks that *could be shorted* in the industry and year of the addition event (as opposed to the fraction and number of stocks that were actually shorted in the industry and year prior to the addition event). *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Cumulative Abnormal Returns [%]		Hedge Fund Holdings (HFH) and Long-Only Investor Holdings (LIH) in Seemingly Underpriced Stocks [%]				
	Hedge Stock	Seemingly Underpriced Stocks	HFH Before Addition	HFH After Addition	Δ HFH	Δ LIH	ΔΔ
<i>Panel A: Industry Less-Difficult-to-Short Prior to Addition Based on the Number of Shorted Stocks (→ Less Hedging Demand)</i>							
[-5,-1]	-1.13*** (-2.74)	0.03 (0.45)	1.71				
[0,+5]	-0.24 (-0.56)	0.59*** (3.80)		2.02	0.31*** (15.67)	0.15 (1.48)	0.16*** (9.86)
<i>Panel B: Industry More-Difficult-to-Short Prior to Addition Based on the Number of Shorted Stocks (→ More Hedging Demand)</i>							
[-5,-1]	-0.83*** (-2.75)	0.12 (0.11)	1.73				
[0,+5]	0.53 (0.50)	1.56** (2.10)		2.35	0.62*** (3.24)	0.18 (1.15)	0.43** (1.98)

Appendix B.3. Continued.

	Cumulative Abnormal Returns [%]		Hedge Fund Holdings (HFH) and Long-Only Investor Holdings (LIH) in Seemingly Underpriced Stocks [%]				
	Hedge Stock	Seemingly Underpriced Stocks	HFH Before Addition	HFH After Addition	Δ HFH	Δ LIH	ΔΔ
<i>Panel C: Industry Less-Difficult-to-Short Prior to Addition Based on the Number of Shortable Stocks (→ Less Hedging Demand)</i>							
[-5,-1]	-1.26*** (-2.83)	0.01 (0.33)	1.71				
[0,+5]	-0.16 (-0.61)	0.59*** (3.75)		2.12	0.41*** (14.25)	0.18 (1.57)	0.23*** (8.82)
<i>Panel D: Industry More-Difficult-to-Short Prior to Addition Based on the Number of Shortable Stocks (→ More Hedging Demand)</i>							
[-5,-1]	-0.90* (-1.70)	0.04 (0.41)	1.69				
[0,+5]	0.27 (0.30)	1.09* (1.84)		2.31	0.62*** (5.50)	0.17 (1.56)	0.45*** (2.51)
<i>Panel E: Industry Less-Difficult-to-Short Prior to Addition Based on the Fraction of Shortable Stocks (→ Less Hedging Demand)</i>							
[-5,-1]	-1.12*** (-2.79)	0.04 (0.90)	1.78				
[0,+5]	-0.12 (-0.30)	0.56*** (3.60)		2.29	0.41*** (14.12)	0.19 (1.52)	0.23*** (6.35)
<i>Panel F: Industry More-Difficult-to-Short Prior to Addition Based on the Fraction of Shortable Stocks (→ More Hedging Demand)</i>							
[-5,-1]	-0.92*** (-2.68)	-0.53 (-1.05)	0.99				
[0,+5]	-0.22 (-1.36)	1.36** (2.23)		1.63	0.64*** (6.85)	0.10 (0.76)	0.54*** (4.79)

Appendix B.4
 Cumulative Abnormal Returns and Changes in Hedge Fund Holdings around Additions to the Hong Kong Short-Sale List:
 Subsample Analysis of “Difficulty to Hedge Industry Risk prior to Addition”

This table mirrors Table 3, but reports results separately for 2001 through 2006 and 2007 through 2012.

	Cumulative Abnormal Returns [%]		Hedge Fund Holdings (HFH) and Long-Only Investor Holdings (LIH) in Seemingly Underpriced Stocks [%]				
	Hedge Stock	Seemingly Underpriced Stocks	HFH	HFH	Δ HFH	Δ LIH	$\Delta\Delta$
			Before Addition	After Addition			
<i>Panel A: 2001 – 2006: Industry Less-Difficult-to-Short Prior to Addition (→ Less Hedging Demand)</i>							
[-5,-1]	-1.35*** (2.72)	0.16 (0.17)	1.51				
[0,+5]	0.01 (0.02)	1.21** (2.00)		2.11	0.60*** (3.86)	0.18 (1.36)	0.42*** (2.76)
<i>Panel B: 2007 – 2012: Industry Less-Difficult-to-Short Prior to Addition (→ Less Hedging Demand)</i>							
[-5,-1]	-0.95 (-1.21)	-0.02 (-0.12)	2.00				
[0,+5]	-0.21 (-0.43)	0.46*** (3.63)		2.26	0.26* (1.67)	0.15 (1.43)	0.11 (1.26)

Appendix B.4. Continued.

	Cumulative Abnormal Returns [%]		Hedge Fund Holdings (HFH) and Long-Only Investor Holdings (LIH) in Seemingly Underpriced Stocks [%]				
	Hedge Stock	Seemingly Underpriced Stocks	HFH Before Addition	HFH After Addition	Δ HFH	Δ LIH	$\Delta\Delta$
<i>Panel C: 2001 – 2006: Industry More-Difficult-to-Short Prior to Addition (→ More Hedging Demand)</i>							
[-5,-1]	-1.16*** (-2.17)	0.39 (0.93)	1.08				
[0,+5]	0.01 (0.09)	2.07*** (2.99)		1.91	0.83*** (6.65)	0.03 (0.81)	0.80*** (3.44)
<i>Panel D: 2007 – 2012: Industry More-Difficult-to-Short Prior to Addition (→ More Hedging Demand)</i>							
[-5,-1]	-1.35*** (-2.72)	0.41 (0.90)	1.45				
[0,+5]	0.02 (0.19)	1.09*** (2.46)		1.92	0.47*** (11.70)	0.01 (1.28)	0.46*** (8.87)

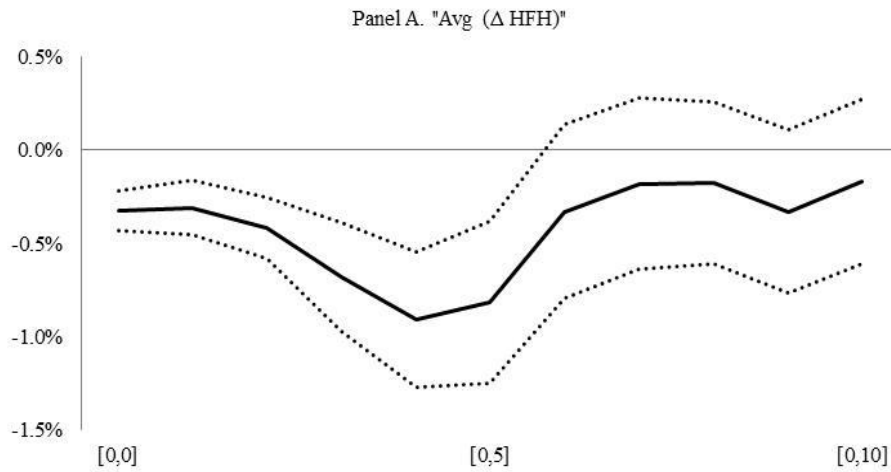
Appendix B.5
Trading around Additions to the Hong Kong Short-Sale List

This tables contrasts performance statistics of various simple calendar-time trading strategy. The “*Hang Seng Strategy*” simply invests in the Hang Seng Index. The “*Long Strategy*” is as follows: If, on trading day t , there is an addition event, we purchase shares of each *Industry Peer* that is in the bottom industry market-to-book-ratio quintile. We close out positions after five trading days. If, on a given trading day, there is no addition event, we invest in the risk-free asset. The “*Long-Short Strategy*” is as follows: If, on trading day t , there is an addition event, we purchase shares of each *Industry Peer* that is in the bottom industry market-to-book-ratio quintile and we short its shortable substitute securities that are on the short-sale list. We close out positions after five trading days. If on a given trading day, there is no addition event, we invest in the risk-free asset. In Panel A, Column (1), we combine the *Hang Seng Strategy* with the risk-free asset such that the combined portfolio has a monthly standard deviation of 2%. We do the equivalent for Panels B–E and Columns (2)–(3). *Average Monthly Return* is the average monthly return of the combined portfolio. *Holding Period Return* (MM\$) shows how much \$1 million invested in the combined portfolio in 2001 (the beginning of our sample period) would have grown to by August 2012 (the end of our sample period).

	Combined Portfolio Based on Risk-free Asset and ...			(3) – (2)
	Hang Seng Strategy (1)	Long Strategy (2)	Long–Short Strategy (3)	
<i>Panel A: Target Standard Deviation = 2%</i>				
Standard Deviation	2.00%	2.00%	2.00%	
Average Monthly Return	0.23%	0.35%	0.48%	
Holding Period Return (MM\$)	\$1.39MM	\$1.65MM	\$1.98MM	\$0.33MM
<i>Panel B: Target Standard Deviation = 4%</i>				
Standard Deviation	4.00%	4.00%	4.00%	
Average Monthly Return	0.35%	0.59%	0.85%	
Holding Period Return (MM\$)	\$1.65MM	\$2.35MM	\$3.37MM	\$1.02MM
<i>Panel C: Target Standard Deviation = 6.46% (= Standard Deviation of the Hang Seng Index)</i>				
Standard Deviation	6.46%	6.46%	6.46%	
Average Monthly Return	0.50%	0.89%	1.30%	
Holding Period Return (MM\$)	\$2.05MM	\$3.60MM	\$6.45MM	\$2.85MM
<i>Panel D: Target Standard Deviation = 8%</i>				
Standard Deviation	8.00%	8.00%	8.00%	
Average Monthly Return	0.59%	1.08%	1.59%	
Holding Period Return (MM\$)	\$2.35MM	\$4.71MM	\$9.68MM	\$4.97MM
<i>Panel E: Target Standard Deviation = 10%</i>				
Standard Deviation	10.00%	10.00%	10.00%	
Average Monthly Return	0.72%	1.33%	1.96%	
Holding Period Return (MM\$)	\$2.79MM	\$6.67MM	\$16.35MM	\$9.68MM

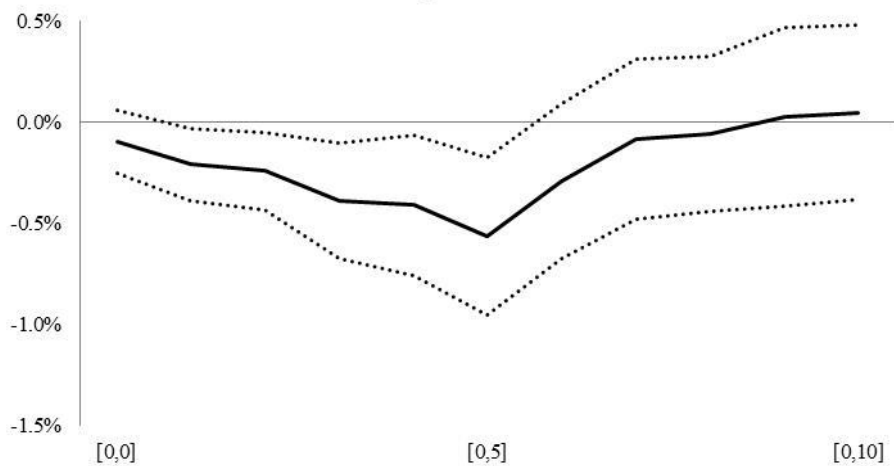
Appendix B.6
Prices of Hedge Stocks around Addition Events

We plot the coefficient estimates for $Avg(\Delta HFH)$, $Avg(Cum.Abn.Ret.)$, and $First\ Time\ Addition$, along with the corresponding 95% corresponding confidence intervals across eleven regression equations. The dependent variable in the first regression is the return of the hedge stock on the day of the addition event, $t=0$; the dependent variable in the second regression is the cumulative return of the hedge stock from the day of the addition event, $t=0$, through the next trading day, $t=+1$; the dependent variable in the third regression is the cumulative return of the hedge stock from $t=0$ through $t=+2$; etc. The independent variables include year and industry fixed effects along with controls for the hedge stocks' market capitalization, price level and trading volume. In Panels A and B, we include $Avg(\Delta HFH)$ and $Avg(Cum.Abn.Ret.)$, respectively. $Avg(\Delta HFH)$ is the value-weighted average change in hedge fund holdings in the seemingly underpriced stocks and $Avg(Cum.Abn.Ret.)$ is the value-weighted average cumulative abnormal returns of the seemingly underpriced stocks over $[0, 5]$. These two variables are meant to capture how aggressively hedge funds pursue the seemingly underpriced stocks: The more hedge funds increase their holdings in seemingly underpriced stocks and, perhaps as a result, the more positive these stocks' returns, the more aggressive we deem hedge funds' involvement to be. In Panel C, the independent variables also include $First\ Time\ Addition$. For every year and each four-digit-GICS industry, we compute the fraction of firms with nonzero short-selling volume. An observation is categorized as a " $First\ Time\ Addition$ " if it resides in an industry that is in the bottom decile based on the industry's fraction of shorted firms in the year prior to the addition event. To facilitate interpretation of the economic magnitude, we multiply the coefficient estimates by the standard deviation of the corresponding independent variables.

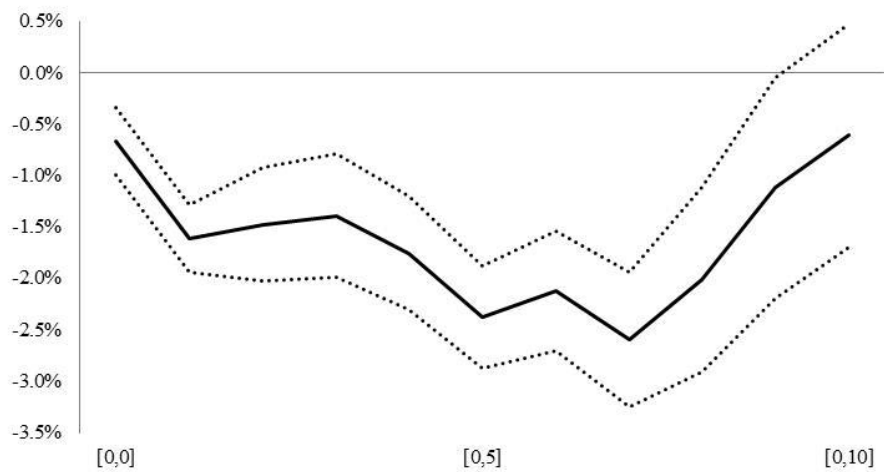


Appendix B.6. Continued.

Panel B. "Avg (Cum. Abn. Ret.)"



Panel C. "First Time Addition"



Appendix C.1
The US Equity Market

The evidence from the Hong Kong stock market presented in the paper suggests that shorting activity need not affect only the stocks being shorted. Here, we examine whether this finding carries over to the US equity market. The US equity market lacks a clear analogue of the institutional feature of the Hong Kong market that we exploit in the main paper. Consequently, the results presented in the online appendix are more suggestive by nature. Nevertheless, we highlight several novel features of the data, which, to us, appear interesting and somewhat surprising.¹

Our US sample consists of NYSE, AMEX, and NASDAQ ordinary shares with monthly short interest data over the 1988 through 2012 period. The data sources are standard. To assess the relevance of hedging considerations in the US, we consider shorting activity in industry peers of earnings-announcing firms. Consider an earnings-announcing company i residing in industry x . On the one hand, a high level of short interest among company i 's industry peers may reflect a bearish view of the overall industry. If so, high levels of short interest among its peers should predict negative outcomes for the earnings-announcing firm. Alternatively, a high level of short interest among its peers may imply that company i is about to announce a positive earnings surprise, informed long-short investors are purchasing shares of company i and they are hedging their long positions by shorting its peers. If so, high levels of short interest among its peers should predict positive outcomes for firm i .

We test these opposing predictions with the following regression specification:

$$E_{i,t} = \alpha + \beta \text{ShortInterest}(\text{LikelyHedge Stocks})_{i,t-1} + X\gamma + \varepsilon_{i,t}, \quad (1)$$

where i indexes firms and t denotes the quarterly earnings announcement. We consider two dependent variables: (1) *Earnings Surprise*, which is the price-scaled difference between the reported quarterly EPS and the consensus EPS forecast across analysts, and (2) *Earnings Announcement Day Returns*, which is the cumulative abnormal return over $[-1,+1]$, where day $t=0$ is the quarterly earnings announcement day or the ensuing trading day if earnings are announced on a non-trading day. Abnormal returns is the difference between raw returns and value-weighted returns of a portfolio with similar size/MB /past returns (Daniel, Grinblatt, Titman, and Wermers 1997).

¹ The temporary US short-sale ban of financial securities from September 18, 2008 to October 8, 2008 does not represent a clear analogue. Investors shorting financial securities in order to hedge industry risk did not have to close out their short positions after the temporary ban became effective. As a result, the lift of the ban on October 8 and the renewed ability to enter short positions in financial securities cannot be thought of as a clean positive shock to the ability to hedge industry risk via short-selling. Also, the US short-sale ban represents only a one-time event affecting one industry only.

Short Interest (Likely Hedge Stocks) is the average most recent short interest across stocks that are in the same four-digit-GICS industry as firm i and that are themselves not announcing earnings in the month surrounding day $t=0$. Other independent variables (X) include: *Short Interest (Ea Announcing Firm)*, which is the earnings-announcing firm i 's most recent level of short interest; *Lagged(DependentVariable)*, which is the dependent variable from the previous earnings announcement; *ForecastDispersion*, which is the price-scaled standard deviation of analysts' EPS forecasts; $\ln(\text{MarketCap})$, which is the natural logarithm of the market capitalization as of the most recent fiscal year end; $\ln(\text{Market/Book})$, which is the natural logarithm of the MB as of the most recent fiscal year end; and *PastReturn*, which is the cumulative stock return over thirty calendar days prior to the earnings announcement. We include year-month fixed effects and we cluster standard errors by year-month. All coefficient estimates are multiplied by 100.

Appendix C2 reveals that short interest among industry peers *positively* predicts subsequent earnings surprises and earnings-announcement-day returns for firm i . The estimate of *Short Interest (Likely Hedge Stocks)* is 0.52 (t -statistic = 2.00) for the earnings surprise regression and 6.19 (t -statistic = 2.99) for the earnings-announcement-day-return regression. The latter estimates suggest a one-standard-deviation increase in *Short Interest (Likely Hedge Stocks)* translates to a 0.01% more positive earnings surprise and 0.12% more positive earnings-announcement-day returns. To put the earnings surprise result in perspective, an increase of 0.01% would promote the median firm (in terms of earnings surprise) to the 55th percentile.

While not as direct a test as the one we applied to the Hong Kong market, the US evidence that positive outcomes for a stock can be predicted via the level of short interest among likely hedge stocks is at least consistent with the notion that hedging considerations also play an important role in US equity markets.

Appendix C.2

US Evidence: Short Interest and Earnings Surprises/Earnings-Announcement-Day Returns

We estimate regression equations of price-scaled earnings surprise/earnings announcement day returns on measures of short interest. The sample period is 1988–2012. *Earnings Surprise*, the dependent variable in Columns (1) and (2), is the price-scaled difference between reported quarterly EPS and the consensus EPS forecast across analysts. *Earnings Announcement Day Returns*, the dependent variable in Columns (3) and (4), is the cumulative abnormal return over [-1,+1], whereby day $t=0$ is the quarterly earnings announcement day or the ensuing trading day if earnings are announced on a non-trading day. Abnormal returns is the difference between raw returns and value-weighted returns of a portfolio with similar size/book-to-market/past returns (Daniel et al. 1997). *Short Interest (Likely Hedge Stocks)* is the most recent average level of short interest across the earnings-announcing firm’s industry peers that are themselves not announcing earnings. *Short Interest (Ea. Announcing Firm)* is the earnings-announcing firm’s most recent level of short interest. *Lagged(Dependent Variable)* is the dependent variable from the previous earnings announcement. *Forecast Dispersion* is the price-scaled standard deviation of analysts’ EPS forecasts. $\ln(\text{Market Cap})$ is the natural logarithm of the market capitalization as of the most recent fiscal year’s end. $\ln(\text{Market/Book})$ is the natural logarithm of the book-to-market ratio as of the most recent fiscal year’s end. *Past Return* is the cumulative stock return over thirty calendar days prior to the earnings announcement. Coefficient estimates are multiplied by 100. We include year-month fixed effects. We do not report the intercept. *T*-statistics are reported in parentheses and are based on standard errors clustered by year-month. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Earnings Surprise		Earnings Announcement Day Return	
	(1)	(2)	(3)	(4)
<i>Short Interest (Likely Hedge Stocks)</i>	0.418 (1.59)	0.523** (2.00)	4.874** (2.36)	6.191*** (2.99)
<i>Short Interest (Ea. Announcing Firm)</i>		-0.229** (-2.55)		-2.856*** (-4.92)
<i>Lagged(Dependent Variable)</i>	12.425*** (16.64)	12.417*** (16.66)	0.079 (0.23)	0.048 (0.14)
<i>Forecast Dispersion</i>	-19.408*** (-2.82)	-19.239*** (-2.78)	-18.206*** (-3.31)	-16.102*** (-2.98)
$\ln(\text{Market Cap})$	0.022*** (9.86)	0.022*** (9.82)	-0.008 (-0.61)	-0.010 (-0.82)
$\ln(\text{Market/Book})$	0.016*** (2.76)	0.018*** (2.95)	0.126*** (3.58)	0.102*** (2.89)
<i>Past Return</i>	0.791*** (18.26)	0.791*** (18.28)	3.048*** (9.85)	3.046*** (9.87)
# Obs.	193,683	193,683	193,683	193,683
Adj. R^2	0.05	0.05	0.01	0.01