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Predictive Ability of Low-Frequency Volatility Measures: Evidence from the Hong Kong Stock Markets

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Highlight

- There is a significant negative relationship between the long-term IVOL as well as the MAX and one-month ahead stock returns in the Hong Kong stock market from 1980 to 2015;
- Both the IVOL and the MAX effect co-exist in the Hong Kong stock markets;
- Our results are robust after controlling for the financial crisis, January effect, and tiny stocks.

Predictive Ability of Low-Frequency Volatility Measures:

Evidence from the Hong Kong Stock Markets

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Abstract

We employ low-frequency data to estimate historical volatility measures for Hong Kong stocks and examine the relationship between these measures and the one-month ahead stock return over thirty-five years. First, we employ a stock's past three-year weekly return to compute idiosyncratic volatility. Second, we use a stock's past three-year maximum weekly return to create a MAX measure. We find that both IVOL and MAX are significant and negatively related to the one-month ahead stock return. Both effects co-exist in the Hong Kong stock markets and are robust after controlling for the financial crisis, January effect, and tiny stocks.

JEL Classification: **G11, G12**

Keywords: total volatility, idiosyncratic volatility, maximum weekly returns, asset pricing, weekly data, Hong Kong stock markets

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1. Introduction

Ang et al. (2006, 2009) present a new anomaly in the U.S. and in 23 other developed stock markets, called the 'idiosyncratic volatility effect' (hereafter *IVOL effect*). They find that expected stock return is negatively related to idiosyncratic risk, measured by idiosyncratic volatility. Similarly, Blitz and van Vliet (2007) find that expected stock return is also negatively related to the firm's total volatility (hereafter TV) in the U.S., European and Japanese stock markets from 1986 to 2006. They call this '*total volatility effect*' (thereafter *TV effect*), where TV is measured by the standard deviation of past three-year weekly returns. However, Ang et al.'s (2006) findings are challenged by Bali and Cakici (2008), who argue that the *IVOL effect* is impacted by the data frequency in estimating IVOL. Khovansky and Zhylyevskyy (2013) find that the sign of the IVOL coefficient for U.S. stocks alters with changes in data frequency in estimating IVOL, such as using daily, monthly, quarterly and annual data for the period 2000 to 2011.

On the other hand, Bali et al. (2011) find a negative relationship between a firm's maximum daily return in the previous month and subsequent monthly return (the MAX effect) in the U.S. stock markets, and suggest that the MAX effect subsumes the IVOL effect found by Ang et al. (2006). However, Nartea et al. (2017) find that the negative MAX and the IVOL effects co-exist in China. Empirical studies indicate that the MAX effect is caused by the preference of retail investors for lottery stocks, such as stocks that have high MAX, high IVOL, low price, and positive skewness (Bali et al., 2001; and Nartea et al., 2017).

Our study attempts to answer two questions: First, is there an *IVOL/TV effect* in the Hong Kong (HK) stock market? Second, do both the IVOL/TV and MAX effects co-exist in the HK stock markets?

The HK stock markets provide a great opportunity to examine the *IVOL/TV effect* as well as the MAX effect because: first, only a list of designated stocks can be sold short in the HK stock markets unlike in the U.S stock markets (Chang et al., 2007).[2] Second, the portfolios of about 2.06 million local retail HK investors are extremely under-diversified (Jones and Lipson, 2005) and these investors are likely to ask for compensation for bearing idiosyncratic risk. Finally, gambling behavior is a well-accepted social behavior in HK (Wong. 2010), therefore HK investors could presumably be risk-seeking investors. This is important as the extant literature suggests that the MAX effect is driven by investors' risk-seeking behavior.

We extend the literature in two ways. First, we find that long-term IVOL is consistently negatively priced in the HK stock markets even after controlling for our control variables,[3] while TV is not. Our results differ from those of Nartea and Wu (2013) who use daily data to estimate both TV and IVOL. Our findings also do not support the findings of Blitz and van Vliet (2007). Thus we suggest that data frequency and estimation horizon used in estimating volatility measures do indeed have an impact on the relationship between volatility

[2] Gu et al. (2016) argue that limits to arbitrage would affect the role of IVOL in pricing stocks.

[3] We conduct a preliminary test to examine the predictive ability of our control variables on the subsequent monthly returns from July 1980 to December 2015 for univariate regressions with the Newey-West (1987) t-statistics. The dependent variable is one-month ahead stock return. We find significantly positive BM, MOM, ROE, and OWNER effects and significant negative coefficients of MABA and MAX^{Long} in the HK stock markets. We do not report these results in detail due to limits of space, but are available upon request.

measures and expected stock returns. Second, we present a new variable, long-term MAX (as MAX^{Long}), and find that it is consistently negatively related to subsequent monthly HK stocks returns.[4] More importantly, we find that both $IVOL^{Long}$ and MAX^{Long} co-exist in the HK stock markets over the sample period, which confirms most findings in emerging stock markets, but differs from the findings of Chan and Chui (2016).[5] Overall, we emphasize the necessity of examining by country verification, anomalies which are originally discovered in the U.S. and other developed stock markets to mitigate the data snooping problem.

2. Data and Methods

Data on both weekly and monthly stock returns on both the main board and Growth Enterprise Market of the HK stock exchange from January 1980 to December 2015, as well as accounting information of stocks are obtained from DataStream. Sample stocks must continuously have weekly return records in the past 156 weeks, otherwise, they are excluded in that particular month.[6] We take several steps to filter our sample to mitigate any potential data problems caused by DataStream by following Ince and Porter (2006).[7]

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[4]This result is supportive of the existence of a negative MAX effect as in other studies (see for example, Bali et al., 2011; Annaert et al., 2013; Walkshäusl, 2014; Chan and Chui, 2016; and Nartea et al., 2017).

[5] Chan and Chui (2016) report that the IVOL effect is a proxy for the MAX effect in the HK stock market when they use daily return data to estimate both IVOL and MAX.

[6] The sample also includes both active and "dead" stocks listed in DataStream to mitigate survival bias. However, the following investment vehicles are excluded from the sample, i.e. investment trusts, closed-end funds, exchange traded funds and preferred shares, because they are either under different trading arrangements or regulated by different accounting standards compared to common shares. Stocks with negative book-to-market (BM) ratios or with missing accounting data in a particular month are also excluded from the sample to reduce the noise in computing volatility measures for stocks.

[7] One problem is dealing with the zero-return for stocks. DataStream computes stock returns as the percentage change in stock return index, and carries forward the return index from the previous

Finally, we winsorized both weekly and monthly returns at the 0.5% and 99.5% level. These procedures help ensure that our empirical results are not unduly influenced by outliers. This results in 37 stocks in January 1980, and increases to 1488 stocks in December 2015.

We use an adapted Fama-French (FF) three-factor model to estimate the IVOL for HK stocks, IVOL is computed at the beginning of each month as the standard deviation of the residuals ($\varepsilon_{i,t}$) from the model using the previous *156* weekly return data.[8] Furthermore, we create a new variable, called MAX^{Long} by following Bali et al.'s (2011) method, which matches the estimation period of our long-term TV and IVOL. The MAX^{Long} is a stock's highest weekly return in the past 156 weeks[9]. We define all control variables in Table 1.

[Insert Table 1 here]

3. Empirical Analysis

3.1 Historical volatility Effects

We investigate the long-term volatility effects by testing the relationships between the TV^{Long} ($IVOL^{Long}$) and expected portfolio returns. Panel A in Table 2 shows that high TV^{Long} portfolios underperform the low TV^{Long} portfolios by 1.24% per month for the equal-weighted (EW) portfolios, but the underperformance is statistically insignificant; or by 2.17%

period to the current period. If a stock has a zero return in the current period, this could either be due to the fact that there is really no change in the return in the current month, or because there is no trading in the stock. We screen the return index to ensure that only traded stocks are included in our sample. Another problem is the missing return observations in DataStream. We used price and dividend information to create price-based returns for stocks with missing return observations if at least the price information is available.

[8] The total volatility of a stock is computed as the standard deviation ($\sigma_{i,t}$) of the past weekly returns.

[9] We also use a one-year rolling window to estimate both the IVOL and the MAX for the sample stocks. We find that the results are qualitatively similar to those reported in Table 2, 3 and 4. These results are available upon request. We thank an anonymous reviewer for suggesting this test.

per month for the value-weighted (VW) portfolios significant at 1% level. More importantly, the alphas in panel A in Table 2 show that a statistically significant difference between high- and low-TV^{Long} portfolios is an annualized -5.76% for EW portfolio or -16.44% for VW portfolios.

Panel B in Table 2 shows a negative relationship between high- and low $IVOL^{Long}$ portfolio, at -1.19% (-2.52%) per month for equal- (value-) weighted portfolios, but it is only significant for value-weighted portfolios. The alpha spreads between the high- and low $IVOL^{Long}$ portfolio are annualized at -5.28% (-18.72%) for the EW (VW) portfolio, both are statistically significant.

[Insert Table 2 here]

Table 3 reports the time-series averages of the slope coefficients of each variable over 294 months from July 1980 to December 2015, with the *Newey-West* (1987) *t*-statistics reported in parentheses by using the univariate, bivariate, and multivariate regressions. In general, results in both Panel A and Panel B in Table 3 are consistent with corresponding results reported in Table 2, with both TV^{Long} and $IVOL^{Long}$ showing significant negative relation with expected stock returns.

[Insert Table 3 here]

3.2 Can MAX Drive Out the Volatility Effect?

We examine the robustness of our results by controlling for MAX^{Long} in this section in response to Bali et al.'s (2011) argument.[10] Table 4 shows that the significant negative relationship between our volatility measures survives after controlling for MAX^{Long}; MAX^{Long} is also significant and negatively related to the subsequent stock returns in Lines (1) and (2). The multi-variate regression results in Lines (3) and (4) show that both the $IVOL^{Long}$ and MAX^{Long} are significantly negative, but the coefficient of TV^{Long} becomes insignificant.

[Insert Table 4 here]

3.3 Three Robustness Tests

We perform three robustness tests in this section. First, we examine if the *IVOL/TV effects* in the HK stock markets are caused by the effect of financial crises in response to Ang et al. (2006) and Bekaert et al.'s (2012) arguments. We exclude two periods from our study sample to re-examine the *IVOL/TV effects*: July 1997 to June 1998 (Asian financial crisis) and September 2008 to April 2009 (2008 global financial crisis).[11] Second, Doran et al. (2012) report that the significant negative IVOL effect is present only in non-January months in the U.S. stock markets because there are more loser stocks in the high IVOL portfolio in

[10] As indicated in the literature, MAX and IVOL are highly correlated. Thus, we examine the correlation coefficients between our MAX^{Long} and *historical volatility* measures before we conduct any further analysis. The result shows that the correlation coefficients between our MAX^{Long} and *historical volatility* measures are all higher than 0.80, which could potentially create a multicollinearity problem in the Fama-MacBeth regression analysis. Therefore, we orthogonalise these variables before conducting the bivariate and multivariate regressions by regressing MAX^{Long} on each of our *historical volatility* measures and use residuals as a proxy for MAX^{Long}.

[11] We also perform the tests that include the financial crisis periods, July 1997 to June 1998 (Asian financial crisis) and September 2008 to April 2009 (2008 global financial crisis). The results show that only $IVOL^{Long}$ is significantly negative, but none of the MAX variables are statistically significant at any levels. We do not report these results in detail due to space limitations but they are available upon request.

December, which result in a stronger reversal effect in January (Huang et al., 2011). Lastly, Angelidis and Tessaromatis (2008) assert that the volatility effect in stock markets might be caused by stocks with the smallest prices, such that IVOL is a proxy for non-traded risk. We test their argument by removing stocks priced under HK$1.

Results reported in Panel a.,[12] Panel b.,[13] and Panel c. in Table 5 are qualitatively similar to the results in Table 4, in which both the $IVOL^{Long}$ and MAX^{Long} are significantly negatively related to the expected stock returns when all of the variables are simultaneously controlled under different scenarios.

[Insert Table 5 Here]

Our findings have two important implications. First, the negative $IVOL^{Long}$ effect is consistently significant and robust, but the TV^{Long} effect is not. Our findings support Ang et al.'s (2006) results, but do not support the findings of Blitz and van Vliet (2007), as well as Nartea and Wu's (2013) findings in the HK stock markets who employ data frequency and estimation horizons different to ours. Our results indicate that the negative volatility effect for HK stocks is related to data frequency and the estimation horizon for the volatility measures, providing empirical support to the arguments of Bali and Cakici (2008) and Khovansky and Zhylyevskyy (2013). Second, we find that both $IVOL^{Long}$ and MAX^{Long} co-exist in the HK stock markets over the study period. This is contrary to previous findings in the

[12] We perform the same tests for the full sample and a sub-sample from 1993 to 2011. The results are similar to those reported in this section, and are available upon request.

[13] We also perform multi-variate regression results for a sample that contains only January data. We do not observe any significant positive relationship between our *historical volatility* measures and subsequent stock returns. These results are available upon request.

developed stock markets (Bali et al., 2011), but supportive of other findings in emerging stock markets (Nartea et al., 2017). The significant negative IVOL and MAX effects in the HK stock market indicate that HK investors prefer lottery-type stocks, which suggest risk-seeking behaviour.

4. Conclusion

This is the first study to use low-frequency data and long horizon estimation period to estimate historical volatility measures for HK stocks by using past 156-week weekly data. We create a new variable, called MAX^{Long}, which is the maximum weekly stock return in the past 156 weeks. We test the predictive ability of our *historical volatility* measures on the expected stock returns in the following month over a 35-year period.

Our results show that both coefficients of $IVOL^{Long}$ and MAX^{Long} are consistently significant and negatively related to expected stock returns over the study period. The results are robust even when we control for eight variables. Second, we find that both $IVOL^{Long}$ and MAX^{Long} effects co-exist in the HK stock markets. Our findings support the suggestion of Bali and Cakici (2008) and Khovansky and Zhylyevskyy (2013) that the volatility effect is sensitive to data frequency in estimating volatility measures. For example, our findings are different to previous results reported by Nartea and Wu (2013) and Chan and Chui (2016) who used daily stock returns in estimating both IVOL and MAX for HK stocks.

Our results underscore the importance of examining in other markets, anomalies that are originally discovered in the U.S. stock markets. Our results imply that HK investors prefer to pay a premium for lottery stocks, and thus their preference results in a low return for these

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stocks in the following month. Consequently, we suggest that investors should carefully choose their measures of volatilities when they adopt a volatility trading strategy in the HK stock markets.

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Table 1. Definition of Variables

Variable	Symbol	Definition
Realised Return	R_t	Realised stock return in month *t*
Firm Size	SIZE	Log of the firm's market capitalisation at the end of month *t*
Book-to-market Ratio	BM	The firm's book-to-market ratio with six months lagged period, i.e. the BTM in month *t-6*;
Momentum	MOM	The stock's 11-month past return lagged one month, i.e. return from month *t-12* to month *t-2*
Short-term Reversal	REV	The return of a stock in month *t-1*
Return on Equity	ROE	Returns on equity
Institutional Ownership	Owner	The total percentage of shares that a firm has been controlled by institutional investors, i.e. both central and local government, investment companies, mutual funds, insurance companies, and pension funds;
Growth Options	MABA	The market-to-book ratio of assets (Total assets – Total common equity + Market capitalisation)/Total Assets
The Maximum Returns	MAX^{Long}	the highest maximum weekly returns in the previous 156 weeks

Table 2. Risk-return Relationship of Portfolios Sorted by Long-term Volatility Measures

The table reports results for stocks sorted into portfolios by their long-term total (idiosyncratic) volatility at the beginning of every month during the period Jul. 1980 to Dec. 2015. We compute long-term total volatility as the standard deviation (σi,t) of the stock's weekly return in the past 156-week, whereas the long-term idiosyncratic volatility is the standard deviation of the residuals of the FF3-factor model. The table reports both equal- and value-weighted portfolios' raw returns for the current month, whereas the estimated equal- and value-weighted portfolios' alphas (α coefficient) from the FF3-factor model are also reported. T-statistics are reported in brackets. The last row of each panel presents the difference between high and low long-term volatility portfolios, including raw return, alpha, Size, and BM. [a] Market capitalisation in million HK$.

Panel A. Returns of Portfolios Sorted by Long-term Total Volatility

	Raw Return		Size[a]	B/M	Alpha	
	Mean	Std. Dev			Mean	Std. Error
Panel A: Equal-weighted						
High TV^{Long}	-0.0019 (-0.3043)	0.0062	989.97 (30.8448)	0.8732 (33.2651)	-0.0024 (-1.1338)	0.0021
Medium TV^{Long}	0.0058 (1.1498)	0.0051	3298.19 (34.1554)	1.2278 (38.5863)	0.0003 (0.2190)	0.0016
Low TV^{Long}	0.0105 (2.9724)	0.0035	17211.29 (36.6420)	1.1482 (41.5510)	0.0024 (2.1054)	0.0011
High- Low	-0.0124 (-1.7328)	0.0072	-16222.33 (-34.4564)	-0.2749 (-7.2136)	-0.0048 (-1.9955)	0.0024
Panel B: Value-weighted						
High TV^{Long}	-.0.0115 (-1.7454)	0.0066	989.97 (30.8448)	0.8732 (33.2651)	-0.0128 (-4.0256)	0.0032
Medium TV^{Long}	0.0054 (1.0059)	0.0053	3298.19 (34.1554)	1.2278 (38.5863)	-0.0025 (-1.3553)	0.0018
Low TV^{Long}	0.0102 (2.5919)	0.0039	17211.29 (36.6420)	1.1482 (41.5510)	0.0009 (1.3840)	0.0007
High- Low	-0.0217 (-2.8249)	0.0077	-16222.33 (-34.4564)	-0.2749 (-7.2136)	-0.0137 (-4.2220)	0.0032

Panel B. Returns of Portfolios Sorted by Long-term Idiosyncratic Volatility

	Raw Return		Size[a]	B/M	Alpha	
	Mean	Std. Dev			Mean	Std. Error
Panel A: Equal-weighted						
High IV^{Long}	-0.0020 (-0.3348)	0.0061	791.57 (29.9624)	0.8627 (35.0871)	-0.0031 (-1.5620)	0.0020
Medium IV^{Long}	0.0049 (0.9816)	0.0050	2139.83 (27.3643)	1.1651 (33.3492)	0.0002 (0.1585)	0.0016
Low IV^{Long}	0.0098 (2.5238)	0.0039	18709.25 (39.6504)	1.2410 (46.4469)	0.0014 (1.1415)	0.0012
High- Low	-0.0119	0.0072	-17917.68	-0.3783	-0.0044	0.0023

	(-1.6424)		(-37.9135)	(-10.4171)	(-1.9274)	
Panel B: Value-weighted						
High IV^{Long}	-0.0152	0.0065	791.57	0.8627	-0.0146	0.0033
	(-2.3324)		(29.9624)	(35.0871)	(-4.4051)	
Medium IV^{Long}	0.0027	0.0051	2139.83	1.1651	-0.0031	0.0019
	(0.5387)		(27.3643)	(33.3492)	(-1.6651)	
Low IV^{Long}	0.0101	0.0041	18709.25	1.2410	0.0010	0.0005
	(2.4525)		(39.6504)	(46.4469)	(1.7829)	
High- Low	-0.0252	0.0077	-17917.68	-0.3783	-0.0156	0.0034
	(-3.2813)		(-37.9135)	(-10.4171)	(-4.6355)	

Table 3. Univariate, Bivariate and Multivariate Fama-MacBeth Regression Results for Long-term Volatilities

We perform a firm-level Fama-MacBeth regression of the expected individual stock returns with monthly control variables over the full sample period, from 1980:07 to 2015:12. The time-series averages of the slope coefficients and their associated Newey-West t-statistics are reported on each row. TV^{Long} is the realized long-term total volatility computed as the standard deviation of the weekly stock return in the last 156-week, whereas the IV^{Long} is the realised long-term idiosyncratic volatility computed by as the standard deviation of the residuals of the FF3-factor model. Other control variables are defined in Table 1, including SIZE, BM, MOM, REV, ROE, OWNER, and MABA.

Panel A. Total volatility estimated by weekly data from the past 156 weeks

Intercept	TV^{Long}	SIZE	BM	MOM	REV	ROE	OWNER	MABA
0.0196	-0.1647							
(4.8278)	(-2.3266)							
0.0398	-0.2004	-0.0025						
(5.2823)	(-3.0068)	(-2.9441)						
0.0161	-0.2020		0.0035					
(3.8622)	(-2.6556)		(3.7588)					
0.0161	-0.1348			0.0045				
(4.2833)	(-2.0222)			(1.5903)				
0.0188	-0.1881				-0.0150			
(4.6293)	(-2.5443)				(-1.7119)			
0.0149	-0.1219					0.0002		
(3.4163)	(-2.5392)					(4.2612)		
0.0150	-0.1475						0.0001	
(2.8697)	(-2.0264)						(3.2120)	
0.0243	-0.1774							-0.0081
(5.6557)	(-2.4047)							(-3.3133)
0.0467	-0.2075	-0.0046	0.0024	0.0684	-0.0280	0.0000	0.0001	0.0024
(3.9262)	(-3.2382)	(-3.9923)	(3.2747)	(2.3829)	(-3.3928)	(4.3277)	(5.0397)	(0.7532)

Table 3 (continued) Panel B. Idiosyncratic volatility estimated by weekly data from the past 156 weeks

Intercept	IV^{Long}	SIZE	BM	MOM	REV	ROE	OWNER	MABA
0.0172	-0.1820							
(4.1899)	(-2.5882)							
0.0457	-0.2550	-0.0033						
(5.1933)	(-3.4850)	(-3.5390)						
0.0147	-0.2234		0.0033					
(3.4540)	(-2.8957)		(3.3825)					
0.0152	-0.1556			0.0431				
(3.7689)	(-2.3019)			(1.4654)				
0.0163	-0.1935				-0.0108			
(3.8472)	(-2.7025)				(-1.3023)			
0.0153	-0.1746					0.0002		
(3.4561)	(-2.2747)					(4.2663)		
0.0136	-0.1482						0.0001	
(2.4124)	(-2.0628)						(3.3121)	
0.0222	-0.1857							-0.0091
(4.7822)	(-2.4557)							(-3.2746)
0.0486	-0.2190	-0.0050	0.0023	0.0695	-0.0276	0.0000	0.0001	0.0022
(3.9725)	(-3.5391)	(-4.3164)	(3.1657)	(2.3314)	(-3.3613)	(4.2214)	(5.1494)	(0.7055)

Table 4 Multivariate Fama-MacBeth Regression Results with MAX^{LONG}

We perform a firm-level Fama-MacBeth regression of the expected individual stock returns with monthly control variables over the full sample period, from 1980:07 to 2015:12. The average of the time-series slope coefficients and their associated Newey-West t-statistics are reported in each row. TV^{Long} is the realized long-term total volatility computed as the standard deviation of the weekly stock return in the last 156 weeks, whereas the IV^{Long} is the realised long-term idiosyncratic volatility computed by as the standard deviation of the residuals of the FF3-factor model. Other control variables are defined in Table 1, including MAX, SIZE, BM, MOM, REV, ROE, OWNER, and MABA.

Model	Intercept	IV^{Long}	TV^{Long}	MAX^{LONG}	SIZE	BM	MOM	REV	ROE	OWNER	MABA
1	0.0493 (4.1336)	-0.2707 (-3.6895)		-0.0050 (-4.3992)	-0.0023 (-3.1611)	0.0646 (2.1032)	0.0275 (3.3312)	-0.0000 (-4.1099)	0.0001 (5.0793)	0.0020 (0.6332)	0.0083 (1.6813)
2	0.0470 (4.1027)		-0.2437 (-2.9994)	-0.0045 (-3.9611)	-0.0024 (-3.2391)	0.0630 (2.1847)	0.0282 (3.4124)	-0.0000 (-4.2043)	0.0001 (4.9993)	0.0020 (0.6571)	0.0056 (1.0543)
3	0.0509 (3.4367)	-0.1824 (-4.3573)	0.4129 (1.2392)		-0.0052 (-3.9322)	0.0023 (3.1960)	0.0762 (3.0392)	-0.0291 (-3.3931)	0.0000 (4.2922)	0.0001 (5.1780)	0.0020 (0.6378)
4	0.0512 (3.5656)	-0.2292 (-4.3560)	0.4019 (1.2212)	-0.0052 (-3.9816)	-0.0023 (-3.1354)	0.0706 (2.7868)	0.0288 (3.3495)	-0.0000 (-4.1686)	0.0001 (5.1609)	0.0018 (0.5765)	0.0072 (1.5307)

Table 5. Multivariate Fama-MacBeth Regression Results for Robustness Tests

Panel a. Multivariate Fama-MacBeth Regression Results Hedged by the Effects of Financial Crises

We perform a firm-level Fama-MacBeth regression of the expected individual stock returns with monthly control variables over the selected sample periods for controlling the effect of financial crisis. The sample period excludes the periods from 1997.07 to 1998.06 (Asian financial crisis) and from 2008.09 and 2009.04 (2008 financial crisis). The average of the time-series slope coefficients and their associated Newey-West t-statistics are reported in each row. TVLong is the realized long-term total volatility computed as the standard deviation of the weekly stock return in the last 156 weeks, whereas the IVLong is the realised long-term idiosyncratic volatility computed by as the standard deviation of the residuals of the FF3-factor model. Other control variables are defined in Table 1, including MAX, SIZE, BM, MOM, REV, ROE, OWNER, AGE and MABA.

Model	Intercept	IV^{Long}	TV^{Long}	MAX^{Long}	SIZE	BM	MOM	REV	ROE	OWNER	MABA
1	0.0532 (4.3144)	-0.2488 (-3.5533)		-0.0051 (-4.3570)	-0.0025 (-3.4319)	0.0804 (4.0467)	0.0240 (2.9264)	-0.0000 (-4.0462)	0.0001 (4.9134)	0.0019 (0.5844)	0.0063 (1.2276)
2	0.0515 (4.4248)		-0.2287 (-3.0056)	-0.0047 (-3.9320)	-0.0026 (-3.4702)	0.0789 (4.3455)	0.0246 (2.9942)	-0.0000 (-4.2188)	0.0001 (4.8169)	0.0020 (0.6074)	0.0042 (0.7723)
3	0.0546 (3.5883)	-0.1794 (-4.4973)	0.3669 (1.1079)		-0.0053 (-3.7181)	0.0025 (3.4428)	0.0884 (4.8149)	-0.0250 (-2.9587)	0.0000 (4.3233)	0.0001 (4.9479)	0.0020 (0.6007)
4	0.0546 (3.7092)	-0.2116 (-4.0687)	0.3527 (1.0834)	-0.0052 (-3.7528)	-0.0025 (-3.4084)	0.0832 (4.7862)	0.0246 (2.9147)	-0.0000 (-4.1977)	0.0001 (4.9557)	0.0018 (0.5342)	0.0054 (1.1295)

Panel b. Multivariate Fama-MacBeth Regression Results Hedged for the January Effect

We perform a firm-level Fama-MacBeth regression of the expected individual stock returns with monthly control variables over the full sample period, from 1980:07 to 2015:12. The sample excludes all January returns. The average of the time-series slope coefficients and their associated Newey-West t-statistics are reported on each row. TV^{Long} is the realized long-term total volatility computed as the standard deviation of the weekly stock return in the last 156 weeks, whereas the IV^{Long} is the realised long-term idiosyncratic volatility computed by as the standard deviation of the residuals of the FF3-factor model. Other control variables are defined in Table 1, including MAX, SIZE, BM, MOM, REV, ROE, OWNER, and MABA.

Model	Intercept	IV^{Long}	TV^{Long}	MAX^{Long}	SIZE	BM	MOM	REV	ROE	OWNER	MABA
1	0.0481	-0.2472		-0.0049	-0.0022	0.0729	0.0245	-0.0000	0.0001	0.0019	0.0056
	(3.9379)	(-3.0103)		(-4.2049)	(-2.7628)	(2.4018)	(2.6472)	(-3.2578)	(4.5382)	(0.6090)	(0.9451)
2	0.0462		-0.2259	-0.0045	-0.0022	0.0704	0.0252	-0.0000	0.0001	0.0020	0.0036
	(3.8297)		(-2.4991)	(-3.8251)	(-2.7504)	(2.4841)	(2.7132)	(-3.3274)	(4.4561)	(0.6422)	(0.5628)
3	0.0494	-0.1772	0.3543		-0.0051	0.0022	0.0838	-0.0269	0.0000	0.0001	0.0022
	(3.2332)	(-3.8328)	(0.9732)		(-3.7441)	(2.7621)	(3.3594)	(-2.7809)	(3.4446)	(4.8864)	(0.7188)
4	0.0494	-0.2140	0.3464	-0.0050	-0.0022	0.0781	0.0264	-0.0000	0.0001	0.0019	0.0056
	(3.3420)	(-3.5524)	(0.9639)	(-3.7626)	(-2.6951)	(3.0710)	(2.7394)	(-3.3533)	(4.6131)	(0.6228)	(0.9823)

Panel c. Multivariate Fama-MacBeth Regression Results Hedged for the Tiny Stocks

We perform a firm-level Fama-MacBeth regression of the expected individual stock returns with monthly control variables over the full sample period, from 1980:07 to 2011:12. The sample excludes share with price under HKD$1. The average of the time-series slope coefficients and their associated Newey-West t-statistics are reported on each row. TV^{Long} is the realized long-term total volatility computed as the standard deviation of the weekly stock return in the last 156 weeks, whereas the IV^{Long} is the realised long-term idiosyncratic volatility computed by as the standard deviation of the residuals of the FF3-factor model. Other control variables are defined in Table 1, including MAX, SIZE, BM, MOM, REV, ROE, OWNER, and MABA.

Model	Intercept	IV^{Long}	TV^{Long}	MAX^{Long}	SIZE	BM	MOM	REV	ROE	OWNER	MABA
1	0.0293 (3.1190)	-0.3792 (-4.5019)		-0.0021 (-2.3949)	-0.0016 (-1.7449)	0.1297 (3.2842)	0.0082 (0.8529)	-0.0001 (-1.9135)	0.0001 (2.8683)	0.0047 (1.3270)	0.0044 (0.5409)
2	0.0252 (2.6832)		-0.3224 (-3.4441)	-0.0015 (-1.6486)	-0.0018 (-1.8909)	0.1318 (3.4956)	0.0102 (1.0411)	-0.0001 (-1.8954)	0.0001 (2.7794)	0.0048 (1.3584)	-0.0023 (-0.2683)
3	0.0494 (3.2332)	-0.1772 (-3.8328)	0.3543 (0.9732)		-0.0051 (-3.7441)	0.0022 (2.7621)	0.0838 (3.3594)	-0.0269 (-2.7809)	0.0000 (3.4446)	0.0001 (4.8864)	0.0022 (0.7188)
4	0.0327 (2.8918)	-0.2647 (-3.8303)	0.3709 (0.9685)	-0.0026 (-2.5965)	-0.0016 (-1.6952)	0.1500 (4.0242)	0.0084 (0.7836)	-0.0001 (-2.4005)	0.0001 (3.1538)	0.0046 (1.2944)	-0.0009 (-0.1229)