Online Appendix
for
"Evaporating Liquidity"

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This Online Appendix reports additional robustness checks.

Predictive regression bias. Given that VIX is quite persistent, one might worry that the predictive regressions with VIX as predictor could suffer from predictive regression bias. However, the bias-adjustment proposed by Stambaugh (1999) is virtually zero in this case here. The reason is that the time-t innovation in the predictor variable (VIX) has virtually zero correlation with the innovation in time-t reversal strategy returns. As a result, the bias-adjustment is also extremely close to zero. This is very different from the situation in typical stock market return prediction regressions with scaled price ratios as predictors, where the correlation of these innovations is far from zero. Thus, there is little reason to believe that the predictive regressions in the paper suffer from predictive regression bias.

Return horizon in construction of reversal strategy portfolio weights. The reversal strategies in the main analysis are constructed as an overlay of sub-strategies with portfolio weights conditioned on day $t-1$, $t-2$, ..., $t-5$ returns. Table OA.1 shows that focusing on the reversal strategy with portfolio weights conditioned on day $t-1$ returns only delivers a similar relationship between reversal strategy returns and the VIX as in the analysis in Table 2 of the main article. Only for industry portfolios, the relationship with VIX becomes weak. For portfolios like the industry portfolios in this analysis, non-synchronous trading or lead-lag relationships between firms within an industry is a potential explanation for small short-run

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continuations in industry portfolio returns. Overlaying sub-strategies with portfolio weights conditioned on day $t-1$, $t-2$, ..., $t-5$ returns as in the main analysis helps to reduce the influence of these short-run continuations.

Alternative scaling of reversal strategy portfolio weights. The portfolio weights of the reversal strategies in the main analysis are scaled to sum up to \$1 long and \$1 short. Table OA.2 repeats the regressions from Table 2 in the main article for a reversal strategy that is constructed with alternative portfolio weights $w_{it} = -\left(\sum_{i=1}^{N}\left(R_{it-1}-R_{mt-1}\right)^2\right)^{-1}\left(R_{it-1}-R_{mt-1}\right)$. In this case, the reversal strategy profit is the negative of the slope coefficient in a cross-sectional regression of market-adjusted returns on their own lag, and hence, effectively, the negative of a cross-sectional estimate of the autocorrelation. Table OA.2 shows that VIX is a strong predictor of the profits from this alternative specification of reversal strategies. Table OA.3 shows results for a reversal strategy with weights $w_{it} = -\left(1/N\right)\left(R_{it-1}-R_{mt-1}\right)$, which yields, effectively, the negative of a cross-sectional estimate of the autocovariance of market-adjusted returns. VIX is again a strong predictor of reversal strategy profits for this alternative formulation.

Heterogeneity in scale. In the model, all stocks are of the same size. In reality, there are large differences in scale between stocks. A unit of unexpected order flow has less price impact for a large stock than for a small stock. Market maker inventory, and hence market maker's portfolios and profits are likely to be heavily dominated by large stocks. For this reason, Table OA.4 explores value-weighted reversal strategies where the weights $w_{it} = -\left(\frac{1}{2}\sum_{i=1}^{N}\left|\left(R_{it-1}-R_{mt-1}\right)M_{it-1}\right|\right)^{-1}\left(R_{it-1}-R_{mt-1}\right)M_{it-1}$ have been multiplied with M_{it-1}, stock i's lagged market capitalization. The results are similar to those of Table 2 in the main article. VIX is still strongly related to reversal strategy profits. This demonstrates that the results in the main paper are not driven just by small stocks. One notable difference, though, is that the reversal strategy profits in terms of transaction-price returns and quote-midpoint returns are now almost identical. This reflects the fact that large stocks have tiny bid-ask spreads, and hence there is hardly any difference between quote-midpoints and transaction

prices.

Long and short components of reversal strategy. Table OA.5 splits the reversal strategy (9) in the main article into long and short positions to check whether there is any asymmetry in the returns from liquidity provision between the long and short side. The reversal strategy portfolio is split into two components: stocks with positive portfolio weight (long) and stocks negative portfolio weights (short). The equal-weighted market return is subtracted from the long component and added to the short component, so that both components represent \$1 long/\$1short strategies. As Table OA.5 shows, there is little difference in the results for the long and short components. Only for the industry reversal strategy, there is some evidence for a higher sensitivity to VIX on the long side which indicates that the industry reversals arise mostly from price impact of sell orders.

Table OA.1: Predicting Reversal Strategy Returns with VIX: Reversal Strategies Formed Based on Day $t-1$ returns

	Individual stocks Transaction-price returns				Individual stocks Quote-midpoint returns				Industry portfolios			
	Daily			Monthly	Daily			Monthly	Daily			Monthly
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	-0.13	-0.21	-0.12	-0.06	-0.41	-0.38	-0.22	-0.13	-0.06	-0.06	-0.10	-0.08
	(0.13)	(0.10)	(0.09)	(0.08)	(0.11)	(0.11)	(0.10)	(0.12)	(0.06)	(0.06)	(0.06)	(0.05)
VIX	0.77	0.71	0.65	0.61	0.51	0.53	0.43	0.34	0.01	0.00	0.03	0.02
	(0.10)	(0.08)	(0.08)	(0.06)	(0.09)	(0.09)	(0.08)	(0.10)	(0.05)	(0.05)	(0.05)	(0.05)
Pre-decim.		0.70	0.72	0.70		-0.27	-0.25	-0.23		0.03	0.03	0.03
		(0.08)	(0.08)	(0.12)		(0.09)	(0.08)	(0.12)		(0.04)	(0.04)	(0.05)
R_M			-1.52	-1.30			-2.70	-1.59			0.62	-0.12
			(0.58)	(0.68)			(0.88)	(0.89)			(0.42)	(0.43)
Adj. R^2	0.14	0.21	0.21	0.63	0.05	0.05	0.06	0.18	-0.00	-0.00	0.00	-0.01

This table repeats the regressions from Table **??**, but with reversal strategies with portfolio weights formed based on day $t-1$ returns instead of the overlay of sub-strategies formed based on day $t-1$ to $t-5$ returns that is used in the main text. Predictor variables are measured on day $t-1$.

Table OA.2: Predicting Reversal Strategy Returns with VIX: Reversal Strategies Scaled to Estimate Autocorrelation

	Individual stocks Transaction-price returns				Individual stocks Quote-midpoint returns				Industry portfolios			
	Daily			Monthly	Daily			Monthly	Daily			Monthly
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	1.38	1.19	1.72	2.06	0.09	0.07	0.61	0.97	-3.43	-3.51	-2.60	-2.25
	(0.31)	(0.26)	(0.27)	(0.29)	(0.32)	(0.31)	(0.30)	(0.29)	(1.29)	(1.30)	(1.37)	(1.07)
VIX	1.88	1.73	1.38	1.08	1.50	1.48	1.13	0.78	2.66	2.60	2.00	1.64
	(0.22)	(0.20)	(0.20)	(0.18)	(0.24)	(0.25)	(0.23)	(0.20)	(0.86)	(0.87)	(0.88)	(0.62)
Pre-decim.		1.63	1.70	1.80		0.15	0.23	0.41		0.63	0.76	1.02
		(0.30)	(0.28)	(0.38)		(0.30)	(0.28)	(0.35)		(1.06)	(1.05)	(1.24)
R_M			-9.01	-2.28			-9.11	-5.30			-15.40	0.47
			(2.06)	(2.36)			(2.40)	(2.64)			(9.13)	(7.97)
Adj. R^2	0.03	0.05	0.05	0.36	0.02	0.02	0.02	0.14	0.00	0.00	0.00	0.01

This table repeats the regressions from Table **??**, but with reversal strategies with portfolio weights $w_{it} = -\left(\sum_{i=1}^{N}\left(R_{it-1}-R_{mt-1}\right)^2\right)^{-1}\left(R_{it-1}-R_{mt-1}\right)$. The reversal strategy profits in this case correspond to the negative of a cross-sectional autocorrelation estimate.

Table OA.3: Predicting Reversal Strategy Returns with VIX: Reversal Strategies Scaled to Estimate Autocovariance

	Individual stocks Transaction-price returns				Individual stocks Quote-midpoint returns				Industry portfolios			
	Daily			Monthly	Daily			Monthly	Daily			Monthly
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	-0.66	-0.76	-0.59	-0.39	-0.62	-0.66	-0.50	-0.33	-0.14	-0.14	-0.11	-0.08
	(0.15)	(0.16)	(0.14)	(0.11)	(0.17)	(0.17)	(0.15)	(0.12)	(0.04)	(0.04)	(0.03)	(0.02)
VIX	1.05	0.98	0.87	0.72	0.79	0.76	0.65	0.53	0.11	0.11	0.09	0.07
	(0.12)	(0.13)	(0.12)	(0.09)	(0.14)	(0.15)	(0.13)	(0.11)	(0.03)	(0.03)	(0.03)	(0.02)
Pre-decim.		0.83	0.85	0.87		0.34	0.36	0.39		-0.00	0.00	0.01
		(0.12)	(0.12)	(0.15)		(0.14)	(0.14)	(0.15)		(0.03)	(0.03)	(0.03)
R_M			-2.85	-0.45			-2.72	-0.40			-0.54	-0.01
			(0.87)	(1.32)			(0.96)	(1.39)			(0.23)	(0.22)
Adj. R^2	0.10	0.13	0.14	0.53	0.04	0.05	0.05	0.27	0.01	0.01	0.01	0.13

This table repeats the regressions from Table **??**, but with reversal strategies with portfolio weights $w_{it} = -(1/N)(R_{it-1} - R_{mt-1}) \times 100$. The reversal strategy profits in this case correspond to the negative of a cross-sectional autocovariance estimate of percentage market-adjusted returns.

Table OA.4: Predicting Reversal Strategy Returns with VIX: Value-weighted Reversal Strategies

	Individual stocks Transaction-price returns				Individual stocks Quote-midpoint returns				Industry portfolios			
	Daily			Monthly	Daily			Monthly	Daily			Monthly
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	-0.14	-0.15	-0.09	-0.05	-0.16	-0.18	-0.11	-0.06	-0.06	-0.06	-0.02	-0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.03)
VIX	0.20	0.20	0.15	0.13	0.25	0.24	0.19	0.15	0.06	0.07	0.04	0.03
	(0.03)	(0.04)	(0.03)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Pre-decim.		0.07	0.08	0.09		0.13	0.14	0.16		-0.02	-0.01	-0.01
		(0.04)	(0.04)	(0.04)		(0.06)	(0.06)	(0.06)		(0.04)	(0.03)	(0.03)
R_M			-1.14	-0.57			-1.18	-1.10			-0.62	-0.34
			(0.28)	(0.41)			(0.35)	(0.58)			(0.34)	(0.29)
Adj. R^2	0.03	0.03	0.03	0.27	0.02	0.02	0.02	0.25	0.00	0.00	0.00	0.03

This table repeats the regressions from Table **??**, but with value-weighted reversal strategies with portfolio weights $w_{it} = -\left(\frac{1}{2}\sum_{i=1}^{N}|(R_{it-1}-R_{mt-1})M_{it-1}|\right)^{-1}(R_{it-1}-R_{mt-1})\,M_{it-1}$, where M_{it-1} is stock i's lagged market capitalization.

Table OA.5: Long and Short Components of Reversal Strategy

	Individual stocks Transaction-price returns				Individual stocks Quote-midpoint returns				Industry portfolios			
	Daily		Monthly		Daily		Monthly		Daily		Monthly	
	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	-0.04	-0.02	0.01	0.01	-0.05	-0.03	-0.02	-0.00	-0.05	-0.03	-0.05	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
VIX	0.11	0.09	0.08	0.07	0.07	0.09	0.05	0.07	0.04	0.02	0.04	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.00)
Pre-decim.	0.12	0.09	0.13	0.10	0.04	0.03	0.04	0.03	-0.02	0.02	-0.02	0.02
	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)	(0.03)	(0.05)	(0.01)	(0.01)	(0.01)	(0.01)
Adj. R^2	(0.05)	(0.04)	(0.46)	(0.27)	(0.01)	(0.01)	(0.06)	(0.06)	(0.01)	(0.00)	(0.10)	(0.01)

This table repeats the regressions from Table **??**, but with reversal strategy portfolios split into those with positive portfolio weight (long) and negative portfolio weights (short). The equal-weighted market return is subtracted from the long component and added to the short component. The returns used in the regressions are hedged against conditional market factor exposure as in Table **??**.

References

Stambaugh, R. F. 1999. Predictive Regressions. *Journal of Financial Economics* 54:375–421.