

Evaporating Liquidity - Replication Report

Ruilong Guo, Sifei Zhao, Zhiyuan Liu, Junhan Fu

March 10, 2024

1 Introduction

This project replicates Table 1 and 2 in Evaporating Liquidity[Nagel(2012)]. The author shows that the returns of short-term reversal strategies are generated by liquidity provision, and therefore are highly predictable by the VIX index. The author also found that reversal strategies on not only individual stocks but also industry portfolios produce high returns, especially during periods of high VIX.

The author constructs the reversal strategy by averaging the returns of five substrategies that weight stocks (or industries) proportional to the negative of market-adjusted returns on days $t - 1$ to $t - 5$.

$$w_{it}^R = - \left(\frac{1}{2} \sum_{i=1}^N |R_{it-1} - R_{mt-1}| \right)^{-1} (R_{it-1} - R_{mt-1}), \quad (1)$$

where $R_{mt-1} = \frac{1}{N} \sum_{i=1}^N R_{it-1}$ is the equal-weighted market return. Table 1 reports the summary statistics of the reversal strategies on individual stocks and industry portfolios. For individual stocks, the returns are calculated based on end-of-day transaction prices and quote midpoints.

Table 2 reports the results of the following predictive regression

$$L_t^R = a + bVIX_{t-5} + c'g_{t-5} + e_t, \quad (2)$$

where L_t^R is the return of the reversal strategy. VIX_{t-5} is the VIX index lagged by 5 days, divided by $\sqrt{250}$. g_{t-5} is a vector of control variables, including pre-decimalization dummy (takes a value of one prior to April 9, 2001 and a value of zero thereafter) and market return.

This project replicates these two tables using the same sample range as the original paper (from January 1998 to December 2010). We also provide the updated tables using data from January 1998 to December 2023.

2 Data Description

Table: Additional Summary Statistics of Reversal Strategy Returns

Apart from the original statistical analysis of reversal strategy provided by the paper, we create a new version of performance matrix which includes VaR(0.05), CVaR(0.05), max drawdown, and other drawdown-based strategy performance, and we also add CRSP value weighted index as the benchmark to evaluate the performance of reversal strategies.

Compared to the CRSP value weighted index, the reversal strategy based on individual stocks tends to have much higher annualized mean return and lower annualized volatility, which cause a way higher annualized sharpe ratio. The mean return of industry reversal strategy is a little bit lower than the banchmark, but it has lower volatility with higher sharpe ratio.

With regard to max drawdown, the transact price based individual reversal strategy is the best(-4.38%) among all the reversal strategies(quote-midpoints: -7.70%, industry: -13.90%) and the CRSP index(-57.18%). That strategy dropped form the peak on 2009-10-22 after the period of financial crisis. And it only used 7 days to recover the lose since the peak, while the industry reversal strategy took 433 days to recover and CRSP value weighted index didn't recover to the peak.

	Transact. prices	Quote-midpoints	Industry portfolio	CRSP Value Weighted Index
Annualized Mean Return(%)	76.97	48.23	4.02	7.86
Annualized Volatility(%)	8.94	10.60	8.85	19.65
Annualized Sharpe Ratio	8.61	4.55	0.45	0.40
Skewness	3.01	3.55	0.77	-0.27
Kurtosis	38.46	49.69	14.60	12.01
VaR (0.05)(%)	-0.33	-0.61	-0.74	-1.92
CVaR (0.05)(%)	-0.67	-1.02	-1.22	-2.96
Max Drawdown(%)	-4.38	-7.70	-13.90	-57.18
Peak	2000-04-11	2001-07-13	1998-04-09	2007-10-09
Bottom	2000-04-14	2001-09-21	1998-10-08	2009-03-09
Recovery Date	2000-04-18	2001-10-24	1999-06-16	2013-03-08
Duration (days)	7	103	433	1977

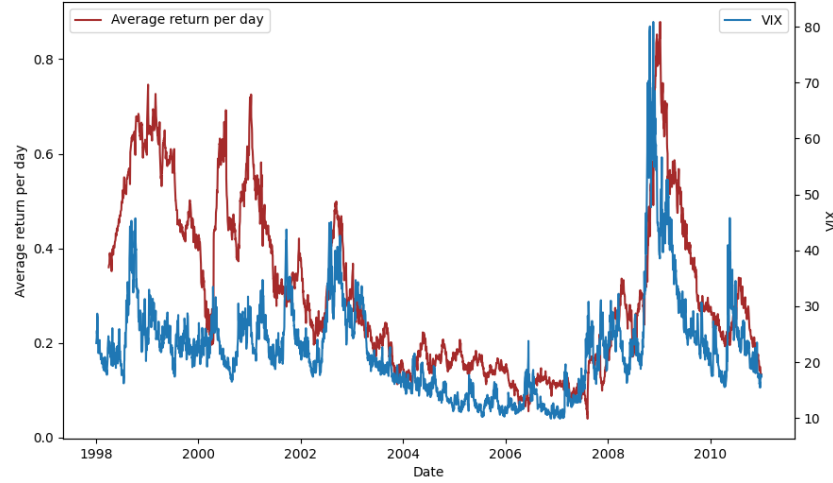


Figure 1: Reversal Strategy and VIX

This figure shows the three-month moving average return of the reversal strategy and VIX index across 1998 to 2010. The blue curve(VIX index) has a pre-trend of the red curve(3-month MA return of reversal strategy), which presents a key finding of the paper that the VIX index has a power to predict the reversal strategy return. During the LTCM crisis in 1998 and Nasdaq decline in 2000, the reversal strategy return increased with VIX increasing. From then until 2007, returns declined steadily to less than 0.2% per day, but during the financial crisis, they surged, surpassing levels seen during the LTCM crisis. The figure illustrates a strong correlation between the time variation in the reversal strategy's return and the VIX index. Since the financial crisis began in 2007, the returns of the reversal strategy and the VIX have closely tracked each other.

Table 1: Summary Statistics of Reversal Strategy Returns

	Indiv. stock reversal Transact. prices	Indiv. stock reversal Quote-midpoints	Industry Portfolio reversal
Panel A: Raw Returns			
Mean return(% per day)	0.30	0.18	0.02
Std.dev.(% per day)	0.56	0.61	0.52
Skewness	3.02	2.74	1.06
Kurtosis	38.21	40.50	17.93
Worst day return(%)	-3.88	-4.76	-3.93
Worst 3-month return(%)	2.56	-2.13	-9.28
Beta	0.11	0.11	0.09
Annualized Sharpe Ratio	8.44	4.50	0.56
Panel B: Returns hedged for conditional market factor exposure			
Mean return(% per day)	0.29	0.17	0.01
Std.dev.(% per day)	0.48	0.54	0.47
Skewness	2.45	2.26	0.88
Kurtosis	31.26	34.51	15.97
Worst day return(%)	-2.26	-3.92	-3.12
Worst 3-month return(%)	2.27	-1.28	-7.97
Beta	0.00	0.00	0.00
Annualized Sharpe Ratio	9.58	4.91	0.44

Table 1: Summary Statistics of Reversal Strategy Returns (Replicated)

	Indiv. stock reversal Transact. prices	Indiv. stock reversal Quote-midpoints	Industry Portfolio reversal
Panel A: Raw Returns			
Mean return(% per day)	0.31	0.19	0.02
Std.dev.(% per day)	0.56	0.67	0.56
Skewness	3.01	3.58	0.77
Kurtosis	38.46	50.26	14.60
Worst day return(%)	-3.84	-4.54	-3.70
Worst 3-month return(%)	2.51	-2.72	-12.17
Beta	0.11	0.09	0.10
Annualized Sharpe Ratio	8.61	4.54	0.45
Panel B: Returns hedged for conditional market factor exposure			
Mean return(% per day)	0.30	0.19	0.01
Std.dev.(% per day)	0.54	0.65	0.54
Skewness	3.02	3.84	0.65
Kurtosis	39.00	55.98	12.20
Worst day return(%)	-3.05	-3.96	-3.31
Worst 3-month return(%)	2.07	-2.02	-9.18
Beta	0.00	0.00	0.00
Annualized Sharpe Ratio	8.87	4.58	0.38

Table 1: Summary Statistics of Reversal Strategy Returns (Updated)

	Indiv. stock reversal Transact. prices	Indiv. stock reversal Quote-midpoints	Industry Portfolio reversal
Panel A: Raw Returns			
Mean return(% per day)	0.23	0.16	0.01
Std.dev.(% per day)	0.67	0.77	0.52
Skewness	-0.51	4.97	0.70
Kurtosis	48.95	136.49	14.54
Worst day return(%)	-12.44	-7.50	-3.70
Worst 3-month return(%)	-7.53	-9.62	-12.17
Beta	0.12	0.10	0.09
Annualized Sharpe Ratio	5.39	3.29	0.32
Panel B: Returns hedged for conditional market factor exposure			
Mean return(% per day)	0.22	0.16	0.01
Std.dev.(% per day)	0.65	0.76	0.50
Skewness	-0.72	5.39	0.64
Kurtosis	52.57	151.89	12.62
Worst day return(%)	-12.47	-7.49	-3.30
Worst 3-month return(%)	-5.39	-9.79	-10.05
Beta	-0.00	-0.00	-0.00
Annualized Sharpe Ratio	5.44	3.27	0.22

Table 2: Predicting Reversal Strategy Returns with VIX

Original Table 2 from the paper.

	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	-0.03 (0.03)	-0.05 (0.02)	-0.02 (0.02)	0.02 (0.02)	-0.06 (0.03)	-0.07 (0.03)	-0.04 (0.03)	-0.01 (0.02)	-0.08 (0.02)	-0.09 (0.02)	-0.06 (0.02)	-0.05 (0.01)
VIX	0.22 (0.02)	0.20 (0.02)	0.18 (0.02)	0.15 (0.01)	0.16 (0.02)	0.16 (0.02)	0.13 (0.02)	0.10 (0.02)	0.07 (0.02)	0.07 (0.02)	0.05 (0.02)	0.04 (0.01)
Pre-decim.		0.22 (0.03)	0.22 (0.03)	0.23 (0.03)		0.08 (0.03)	0.09 (0.03)	0.09 (0.03)		0.00 (0.02)	0.01 (0.02)	0.01 (0.02)
R_M			-0.60 (0.19)	-0.03 (0.26)			-0.59 (0.21)	-0.16 (0.28)			-0.42 (0.17)	-0.05 (0.16)
Adj. R^2	0.07	0.11	0.11	0.56	0.03	0.03	0.04	0.25	0.01	0.01	0.01	0.07

Table 2: Predicting Reversal Strategy Returns with VIX (Replicated)

Replicated Table 2, which uses the same sample range as the original (from January 1998 to December 2010). It has been verified that coefficients of predictor variables in the replicated result have the same sign with the original result. The coefficients of replicated result are within the 99.7% confidence interval of the original result.

	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	-0.06 (0.03)	-0.09 (0.02)	-0.06 (0.03)	-0.01 (0.02)	-0.06 (0.03)	-0.07 (0.03)	-0.03 (0.04)	0.00 (0.03)	-0.10 (0.03)	-0.10 (0.03)	-0.07 (0.03)	-0.04 (0.02)
VIX	0.25 (0.02)	0.23 (0.02)	0.21 (0.02)	0.18 (0.01)	0.18 (0.03)	0.17 (0.03)	0.14 (0.03)	0.11 (0.02)	0.08 (0.02)	0.08 (0.02)	0.06 (0.02)	0.04 (0.01)
Pre-decim.		0.23 (0.03)	0.24 (0.03)	0.25 (0.03)		0.11 (0.03)	0.11 (0.03)	0.12 (0.03)		0.01 (0.02)	0.01 (0.02)	0.02 (0.02)
R_M			-0.45 (0.19)	0.10 (0.23)			-0.78 (0.23)	-0.28 (0.26)			-0.57 (0.21)	-0.21 (0.16)
Adj. R^2	0.07	0.10	0.10	0.65	0.02	0.03	0.03	0.27	0.01	0.01	0.01	0.07

Table 2: Predicting Reversal Strategy Returns with VIX (Updated)

Updated Table 2, using data from January 1998 to December 2023. The results are consistent.

	Individual stocks				Individual stocks				Industry			
	Transaction-price returns				Quote-midpoint returns				portfolios			
	Daily		Monthly		Daily		Monthly		Daily		Monthly	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	-0.08	-0.08	-0.05	-0.01	-0.09	-0.09	-0.06	-0.02	-0.09	-0.09	-0.07	-0.06
	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
VIX	0.24	0.21	0.19	0.15	0.19	0.18	0.17	0.12	0.08	0.08	0.07	0.05
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)
Pre-decim.		0.26	0.27	0.28		0.09	0.10	0.12		0.00	0.00	0.01
		(0.03)	(0.03)	(0.03)		(0.03)	(0.03)	(0.03)		(0.02)	(0.02)	(0.02)
R_M			-0.39	0.03			-0.47	-0.04			-0.24	-0.03
			(0.17)	(0.18)			(0.23)	(0.26)			(0.16)	(0.13)
Adj. R^2	0.04	0.05	0.05	0.53	0.02	0.02	0.02	0.19	0.01	0.01	0.01	0.08

References

[Nagel(2012)] Nagel, Stefan. 2012. “Evaporating Liquidity.” *The Review of Financial Studies* 25 (7):2005–2039. URL <https://doi.org/10.1093/rfs/hhs066>.