

The results based on RV (realized volatility) should be included, and details about RV should be provided (data source, RV measure construction, etc.).

Response: Thanks for the suggestions.

In this revision, we introduce the RV measure construction and data source in footnote 9 as follows:

⁹ We also use realized volatility calculated as the sum of squared intraday 10-minute logarithmic returns (Andersen and Bollerslev, 1998) as the proxy for actual volatility. The high frequency data are collected from PiTrading and spans from January 3, 2006 to May 15, 2020. The corresponding results can be found in the Appendix, which hardly change the in-sample and out-of-sample conclusions.

¹⁰ The GARCH (1,1) specification is selected according to the AIC and BIC rules.

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Furthermore, we provide the in-sample and out-of-sample results based on RV in the Appendix in this revision as follows:

“Appendix

In this appendix, we provide the in-sample (Table A1) and out-of-sample (Table A2) volatility prediction performance employing realized volatility (RV) as the proxy for actual volatility. Our purchased high-frequency data ends on May 15, 2020. Thus, the last sub-period (H4 sub-period) in Table A2 is from March 4, 2020 to May 15, 2020 instead of from March 4, 2020 to December 30, 2020 as in Table 6.

The results are completely consistent with those employing $h_t = \frac{1}{4 \ln(2)} (R_t^r)^2$ as the proxy (Tables 4 and 6), except during the H4 sub-period, when the PM-H model is superior to the PM-H-MRS model instead. This slight difference is understandable, since the H4 sub-period for Table A2 is much shorter due to data availability constraints.

Table A1. In-sample volatility prediction performance employing RV as the proxy for actual volatility.

	PM	PM-MRS	PM-H	PM-H-MRS	CRM	CRM-MRS	CRM-H	CRM-H-MRS	GARCH	ECARR
MAE	0.6211***	0.5583***††	0.4745***††††	0.4491***††††††††	0.6260**	0.5611***††	0.5079***†††††	0.4676***†††††††	0.8569	0.5542
MSE	3.8894***	3.9087***	2.9392***†††††	2.7847***††††††††	3.9976**	3.9960***†	3.3186***†††††	3.1888***†††††††	4.8845	3.9152
MAE _{in}	0.6403***	0.5485***††	0.4401***†††††	0.4050***††††††††	0.6461***	0.5576***††	0.4694***†††††	0.4275***†††††††	0.8282	0.5386
MSE _{in}	0.6361***	0.4728***††	0.3141***†††††	0.2619***††††††††	0.6474***	0.4857***††	0.3514***†††††	0.2886***†††††††	1.0209	0.4636

Notes: Bolding means that the prediction performance is the best. “***” indicates that the corresponding model significantly outperforms the GARCH model in the DM test at the 1% significance level. “***” indicates that the corresponding model significantly outperforms the ECARR model in the DM test at the 1% significance level. “†††” indicates that the corresponding model significantly outperforms its short memory comparative in the DM test at the 1% significance level. “†††” (“†”) indicates that the corresponding model significantly outperforms its linear comparative in the DM test at the 1% (10%) significance level.

Table A2. Out-of-sample volatility prediction performance employing RV as the proxy for actual volatility.

	PM	PM-MRS	PM-H	PM-H-MRS	CRM	CRM-MRS	CRM-H	CRM-H-MRS	GARCH	ECARR
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Panel A: Full out-of-sample period.										
MAE	0.4542***	0.4376**	0.3896*****	0.3248*****	0.4417***	0.4477***	0.3571*****	0.3530*****	0.7133	0.4460
MSE	1.7055***	1.6530**	1.2876***	1.0727*****	1.5703***	1.7130***	1.1830*****	1.2146*****	2.8588	1.8554
MAE _{ln}	0.6585***	0.6346**	0.5597*****	0.4616*****	0.6405***	0.6420***	0.4871*****	0.4890*****	0.9227	0.6293
MSE _{ln}	0.6853***	0.6216***	0.4978*****	0.3478*****	0.6311***	0.6313***	0.3769*****	0.3791*****	1.2302	0.6367
Panel B: H1 sub-period.										
MAE	0.7786***	0.7590***	0.6996*****	0.5651*****	0.7836***	0.7905***	0.6289*****	0.6245*****	1.1403	0.7541
MSE	2.5712***	2.0273***	2.2062***	1.6450*****	2.2663***	2.1755***	2.0413*****	1.9673*****	3.9679	2.8114
MAE _{ln}	0.6379***	0.6478***	0.5474*****	0.4431*****	0.6697***	0.6660***	0.4665*****	0.4818*****	0.8224	0.5871
MSE _{ln}	0.6451***	0.6507***	0.4707*****	0.3209*****	0.6891***	0.6803***	0.3548*****	0.3728*****	0.9849	0.5625
Panel C: H2 sub-period.										
MAE	0.6115***	0.5819***	0.5177*****	0.4441*****	0.5906***	0.6043***	0.5101*****	0.4967*****	0.7883	0.6205
MSE	3.8096***	3.6856***	3.4946*****	2.8792*****	3.7112***	3.8202***	3.3038*****	3.2124*****	4.2233	4.0737
MAE _{ln}	0.6513***	0.5911***	0.5104*****	0.4302*****	0.6175***	0.6257***	0.4896*****	0.4866*****	0.8146	0.6487
MSE _{ln}	0.7200***	0.6157***	0.4682*****	0.3139*****	0.6375***	0.6572***	0.3968*****	0.3855*****	1.0545	0.7268
Panel D: H3 sub-period.										
MAE	0.3628***	0.3208***	0.3258*****	0.2473*****	0.3201***	0.3221***	0.2835*****	0.2622*****	0.6202	0.3840
MSE	0.5984***	0.4115***	0.4276*****	0.2487*****	0.3931***	0.4281***	0.3266*****	0.2998*****	1.0264	0.6111
MAE _{ln}	0.6338***	0.5850***	0.5703*****	0.4516*****	0.5820***	0.5832***	0.4775*****	0.4603*****	0.9377	0.6462
MSE _{ln}	0.6512***	0.5536***	0.5056*****	0.3147*****	0.5326***	0.5435***	0.3404*****	0.3243*****	1.2209	0.6635
Panel E: H4 sub-period.										
MAE	2.8665***	3.0472***	2.2756*****	2.1442*****	2.7236***	3.1251***	2.2565*****	2.3663*****	6.2977	2.9261
MSE	29.971***	35.8310***	16.6850*****	17.501*****	29.659***	36.921***	16.6360*****	19.654*****	73.0520	34.2900
MAE _{ln}	0.6997***	0.7011***	0.5186*****	0.5208*****	0.6105***	0.6894***	0.4952*****	0.5285*****	1.1024	0.5779
MSE _{ln}	0.7348***	0.7926***	0.3789*****	0.4322*****	0.5964***	0.7287***	0.4076*****	0.4376*****	1.5677	0.5988
Panel F: L sub-period.										
MAE	0.2600***	0.2481***	0.2148*****	0.1825*****	0.2571***	0.2490***	0.1942*****	0.1932*****	0.3877	0.2429
MSE	0.4178	0.3854	0.3330*****	0.2591*****	0.3640***	0.3801**	0.2611*****	0.2648*****	0.3847	0.4158
MAE _{ln}	0.6733***	0.6509***	0.5703*****	0.4745*****	0.6540***	0.6536***	0.4966*****	0.4997*****	0.9648	0.6370
MSE _{ln}	0.7026***	0.6282***	0.5139*****	0.3706*****	0.6426***	0.6345***	0.3919*****	0.3958*****	1.3365	0.6399

Notes: Panel A displays the results of the full out-of-sample period. Panel B displays the results of the first high volatility regime (H1 sub-period) from January 4, 2010 to November 30, 2011. Panel C displays the results of the second high volatility regime (H2 sub-period) from August 21, 2015 to July 28, 2016. Panel D displays the results of the third high volatility regime (H3 sub-period) from February 5, 2018 to November 8, 2019. Panel E displays the results of the fourth high volatility regime (H4 sub-period) from March 4, 2020 to May 15, 2020. Panel F displays the results of the three low volatility regimes (L sub-periods) from December 1, 2011 to August 20, 2015, from July 29, 2016 to February 2, 2018 and from November 11, 2019 to March 3, 2020. Bolding means that the prediction performance is the best. “***” (**) indicates that the corresponding model significantly outperforms the GARCH model in the DM test at the 1% (5%) significance level. “***” (“**”/“*”) indicates that the corresponding model significantly outperforms the ECARR model in the DM test at the 1% (5%/10%) significance level. “+++” (“++”/“+”) indicates that the corresponding model significantly outperforms its short memory comparative in the DM test at the 1% (5%/10%) significance level. “+++” (“+”/“”) indicates that the corresponding model significantly outperforms its linear comparative in the DM test at the 1% (5%/10%) significance level.”