Estimating Beta

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Online Appendix

Section A1 presents the results on the analysis of the information content using monthly return data. Section A2 examines the out-of-sample estimation accuracy employing additional loss functions and Section A3 presents more detailed results on the analyses in Section IV of the main paper. Section A4 provides further results on the information content of estimators that have experienced a simple bias removal and the results on additional attempts to remove the bias in estimates.

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A1 Information Content – Monthly Data

Monthly Estimators   In this section, we repeat the analyses on the information content in the main paper using monthly return data. The results are reported in Table A1. Except for KKS1 and BV, the univariate regressions in Panel A of the Table show all approaches to be biased for all portfolios, having an intercept significantly different from zero, a slope parameter significantly different from one, and consequently a strongly significant F-test. For BV, the F-test yields significant values in only three out of the five cases, while KKS1 is shown to be biased for four of the five portfolios.[1] Throughout all approaches, except KKS1, that does not rely on return data at all, the adjusted R^2 is substantially smaller than that in the regressions using daily estimates, with most values being close to zero. The highest adjusted R^2 is obtained for the BV approach, being the only one, except KKS1, that has substantial explanatory power over all portfolios.

In the encompassing regressions in Panel B of Table A1, the general performance is poor and not much can be stated about methods being informationally more efficient or subsuming one another, except that the BV approach turns out to be informationally more efficient compared to all other approaches. For some portfolios, BV even subsumes all information incorporated in these approaches, while it is also shown to be informationally more efficient than KKS1, which does not rely on return data at all. Again, the adjusted R^2 substantially increases when adding BV as an additional explanatory variable in every case.

Daily versus Monthly Estimators   Table A2 presents the results of directly comparing estimators relying on daily versus monthly data. It can be seen that daily estimators are mostly informationally more efficient than their monthly counterparts for HIST, RW, and BV when evaluating the estimates using realized beta computed from six months of daily returns. Thus, especially when estimating beta for short horizons, relying on daily data is favorable. Naturally, our study design inherently favors estimators based on daily data by evaluating the estimations using realized beta, which is itself based on daily data. Furthermore, the time period, in addition to only the sampling frequency (daily versus monthly), differs between daily and monthly estimates (one year versus five years). Consequently, part

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[1]Note that the overall results change as the stocks are sorted differently using monthly historical beta obtained in the sorting period.

of the difference in informational efficiency could also be induced by that. Thus, caution has to be applied when aiming to generalize these findings.

In summary (including the results of the main paper), estimators using daily instead of monthly return data yield a better performance, and in both cases the Buss and Vilkov (2012) approach is most favorable regarding informational efficiency.

A2   ESTIMATION ACCURACY – ADDITIONAL LOSS FUNCTIONS

We examine three additional loss functions, commonly applied in the literature, namely mean absolute errors (MAE), mean absolute percentage errors (MAPE), and mean squared percentage errors (MSPE) to evaluate the performance of the different beta estimation techniques:

$$\text{MAE} \;=\; \frac{1}{n} \sum_{t=1}^{n} \mid \beta_{t,T}^{R} - \zeta_{t,T} \mid, \tag{A1}$$

$$\text{MAPE} \;=\; \frac{1}{n} \sum_{t=1}^{n} \mid \frac{\beta_{t,T}^{R} - \zeta_{t,T}}{\beta_{t,T}^{R}} \mid, \tag{A2}$$

$$\text{MSPE} \;=\; \frac{1}{n} \sum_{t=1}^{n} \left(\frac{\beta_{t,T}^{R} - \zeta_{t,T}}{\beta_{t,T}^{R}} \right)^{2}. \tag{A3}$$

Here, n is the number of estimation windows, $\beta_{t,T}^{R}$ again denotes the realized beta over a period from t until T, and $\zeta_{t,T}$ is the respective beta estimate.[2] Patton (2011) shows that only MSE, as opposed to the loss functions employed here (MAE, MAPE, and MSPE), is robust to the presence of noise in the evaluation proxy. Thus, further care has to be applied when interpreting the results presented here.

Daily Data   Table A3 summarizes the estimation errors using daily return data in more detail. Starting with MAE in Panel A, we observe that BV yields the smallest estimation error (as indicated by *italic* font) for four and RW yields the smallest estimation error for

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[2]Note that the percentage loss functions exhibit very high values when realized beta gets close to zero which, unlike in many other situations such as volatility estimation, is certainly possible in the case of beta. Thus, MAPE and MSPE must be interpreted with care.

one portfolio(s). On average, BV obtains the lowest error, followed by RW and HIST. Considering RMSE in Panel B, the results are quite similar. Regarding MAPE and MSPE in Panels C and D, the results rather favor RW, but for four and three portfolios BV still yields the smallest MAPE and MSPE, respectively. Performing best in the portfolio with lowest historical betas during the sorting period, RW yields the smallest average MAPE and MSPE. For all loss functions the fully implied CCJV and the GARCH DCC achieve the worst and second-worst performance, respectively.

To further examine the results, we analyze whether the differences we observe in Table A3 are statistically significant. Table A4 presents the mean differences in absolute errors (AE), squared errors (SE), absolute percentage errors (APE), and squared percentage errors (SPE) in the upper triangular matrices and the respective median differences in the lower triangular matrices.

Looking at Panel A in Table A4 we find that BV always obtains lower average mean and median absolute errors than the other methods. These differences are statistically significant for all portfolios compared to DCC, FGK, CCJV, KKS1, and RPadj, whereas when comparing to HIST and RW, the MAE is significantly lower for two and one portfolio(s) and the median AE is significantly lower for four and three portfolios, respectively. HIST and RW outperform all other methods (except KKS1 and BV) for at least four out of the five portfolios. Examining the other loss functions SE, APE, and SPE the picture is quite similar, except that RW obtains the smallest average (mean) errors in both percentage loss functions, but even so the (net) significance is in favor of BV, which also has the smallest average median errors over all loss functions including the percentage loss functions. Nevertheless, the evidence indicates that overall the BV approach obtains the best out-of-sample accuracy, followed by RW and HIST.

Monthly Data Looking at the estimators using monthly return data in Tables A5 and A6, the picture is even clearer. We find that BV, computed with the correlations over the past five years of monthly returns, significantly outperforms all other approaches based

on monthly return data.[3] Moreover, BV based on monthly return data seems not to produce larger outliers compared to the other methods, since the results from mean and median loss functions are quite similar. While the fully implied KKS1, that does not rely on return data at all, is the second-best estimator, the historical estimate (HIST), based on five years of monthly returns, significantly outperforms all other approaches at least partially relying on historical return data, except monthly RW, in at least two of the five portfolios each, while RW is also frequently outperformed for some portfolios.

A3   Detailed Results on Section IV of the Main Paper

In this section, we present the results of Section IV of the main paper, namely longer horizons, further models for implied beta, option liquidity, and further time-series models, in more detail. In Table A7, we report the RMSE of each of the individual portfolios, instead of only the averages. The discussion of the results can be found in the main paper.

A4   Bias Removal

In this section, we provide further insight on the information content of estimators on which we have performed the simple bias removal, scaling the estimates so that the value-weighted cross-sectional average beta of each estimation techniques equals one (Section IV.E of the main paper). We perform univariate and encompassing regressions as in equation (28) in the main paper. The results are presented in Table A8. For HIST and RW the bias (as can be seen in Table 1 of the main paper) is very small and the removal does not change much. Considering the F-test, for only one portfolio the null hypothesis of unbiasedness cannot be rejected for HIST. DCC and CCJV are still biased, but their explanatory power

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[3]Note that the even lower average errors compared to the BV approach using daily return data result from the slightly different sorting approach using five years of monthly returns, yielding substantially less dispersion in the respective beta estimates for the portfolios and thereby reducing the probability of large errors (and even more strongly reducing the probability of high percentage errors, as realized beta only rarely comes close to zero). When sorting the daily estimates in the same way all, loss functions yield lower errors when using daily return data.

increases substantially compared to the non-bias-removed estimates. The biggest impact of the bias removal is obtained on FGK and RPadj, leaving both unbiased for two out of five portfolios after setting their value-weighted cross-sectional average to one. Nevertheless, in encompassing regressions together with BV, BV is still shown to be informationally more efficient.

Table A9 presents the results of further possibilities to try and remove the bias in the estimates. In particular, we perform the regressions as described in Section IV.E of the main paper on the level of individual estimates. This might be more precise than the portfolio approach considered in the main paper. For each firm, we first regress the six-month ex post realized beta on the ex ante estimates obtained by each approach using the estimates and realizations available at time t during the period $t-17$ up to $t-6$ (as realized beta with a six-month window is only available up to $t-6$ at time t), namely 12 monthly observations. After obtaining the regression coefficients $\hat{a}$ and $\hat{b}_\beta$, we manipulate the current estimates using the following equation:

$$\beta_{j,t}^{\mathrm{ADJ}} = \hat{a} + \hat{b}\beta_{j,t}^{\mathrm{UNADJ}}, \tag{A4}$$

where $\beta_{j,t}^{\mathrm{ADJ}}$ and $\beta_{j,t}^{\mathrm{UNADJ}}$ are the adjusted and unadjusted estimates, respectively. In a second approach, analog to the main paper, we combine the estimates with HIST.

In Panel A of Table A9, we present the results for the individual regression approach. It can be seen that all approaches produce a larger average RMSE compared to the uncorrected BV$^{\mathrm{UC}}$. Combining the estimates with HIST, shown in Panel B, also does not yield an improvement.

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References

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Table A1: Univariate and Encompassing Estimates for Realized Beta – Monthly Data

This table presents the results from regressions of ex post realized beta over the horizon of six months on competing monthly ex ante estimates for each of the five portfolios, respectively. Each row corresponds to one regression. Each month, we sort our estimates in an ascending order according to the historical (equation (9)) beta obtained in a sorting period strictly before the estimation period of the historical beta. The sorting and estimation periods are without overlap and have equal length. The stocks are then allocated to quintile portfolios. Portfolio betas and returns are value-weighted. a denotes the regression intercept, b_{HIST}, b_{RW}, b_{DCC}, b_{CCJV}, b_{KKS1}, b_{BV}, and b_{RPadj} refer to the slope coefficients for the historical, random walk, DCC, FGK, CCJV, KKS1, BV, and risk premium adjusted estimate for beta, respectively. For each regression coefficient we report Newey and West (1987) t-statistics ($t(.)$) using 6 lags, where we test both a against zero and b against one in the univariate regressions (Panel A), while we test both a against zero and b against one in the univariate regressions (Panel B). R^2_{adj} denotes the adjusted R^2 of the regressions. The columns F_1 and F_2 refer to the F-test statistic and p gives the corresponding p-values. In the univariate regressions in Panel A, for the F-test (reported in F_1) we test the joint hypothesis of the intercept being equal to zero and the slope coefficient being equal to one. In multivariate regressions in Panel B, the joint underlying hypothesis is that the first slope coefficient is equal to zero and the second slope coefficient is equal to zero and vice versa for F_1 and F_2, respectively. t-statistics and p-values in **bold** font indicate significance at the 5 % level. The sample period is January 1996 until December 2012 with 198 (188 when RPadj is included) monthly observations.

Panel A. Univariate Regressions

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p
HIST	1	0.96	**(7.15)**	-0.24	**(-6.59)**															0.03	166.45	**(0.00)**
	2	0.70	**(13.19)**	0.28	**(-11.46)**															0.29	360.43	**(0.00)**
	3	0.69	**(6.80)**	0.32	**(-6.69)**															0.17	94.84	**(0.00)**
	4	0.71	**(16.71)**	0.33	**(-15.23)**															0.32	197.35	**(0.00)**
	5	1.06	**(9.26)**	0.10	**(-10.05)**															0.00	111.86	**(0.00)**
RW	1	0.85	**(5.78)**			-0.08	**(-5.66)**													0.00	66.45	**(0.00)**
	2	0.69	**(12.83)**			0.27	**(-11.83)**													0.29	332.39	**(0.00)**
	3	0.85	**(10.03)**			0.16	**(-10.25)**													0.04	128.90	**(0.00)**
	4	0.89	**(13.56)**			0.16	**(-13.71)**													0.13	434.42	**(0.00)**
	5	0.90	**(8.13)**			0.23	**(-7.93)**													0.04	75.82	**(0.00)**
DCC	1	0.69	**(11.48)**					0.16	**(-11.22)**											0.04	234.97	**(0.00)**
	2	0.82	**(17.21)**					0.14	**(-16.23)**											0.11	599.91	**(0.00)**
	3	0.90	**(19.36)**					0.12	**(-17.39)**											0.07	482.00	**(0.00)**
	4	1.01	**(12.57)**					0.05	**(-13.18)**											0.01	565.31	**(0.00)**
	5	1.28	**(11.09)**					-0.08	**(-12.96)**											0.01	250.60	**(0.00)**

Table A1: Univariate and Encompassing Estimates for Realized Beta – Monthly Data (continued)

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p
FGK	1	0.92	**(6.51)**							-0.23	**(-4.60)**									0.02	478.03	**(0.00)**
	2	0.77	**(13.16)**							0.26	**(-7.99)**									0.14	1274.35	**(0.00)**
	3	0.86	**(7.81)**							0.21	**(-4.96)**									0.07	915.11	**(0.00)**
	4	0.86	**(9.42)**							0.26	**(-5.96)**									0.14	1252.45	**(0.00)**
	5	0.86	**(3.63)**							0.37	**(-2.24)**									0.09	400.07	**(0.00)**
CCJV	1	0.50	**(6.30)**									0.29	**(-9.49)**							0.20	489.70	**(0.00)**
	2	0.93	**(12.03)**									0.00	**(-14.73)**							-0.01	762.84	**(0.00)**
	3	0.83	**(13.43)**									0.16	**(-14.91)**							0.13	647.51	**(0.00)**
	4	0.93	**(13.67)**									0.12	**(-13.66)**							0.06	517.53	**(0.00)**
	5	1.09	**(6.43)**									0.08	**(-6.29)**							0.01	172.05	**(0.00)**
KKS1	1	-0.14	(-0.46)											1.07	(0.21)					0.18	43.42	**(0.00)**
	2	-0.06	(-0.37)											1.03	(0.19)					0.36	16.29	**(0.00)**
	3	0.07	(0.32)											0.94	(-0.28)					0.26	1.07	(0.34)
	4	0.07	(1.06)											0.98	(-0.26)					0.65	108.81	**(0.00)**
	5	0.32	(0.84)											0.78	(-0.62)					0.09	25.82	**(0.00)**
BV	1	-0.13	(-0.51)													1.12	(0.41)			0.27	5.13	**(0.01)**
	2	0.03	(0.38)													0.96	(-0.46)			0.50	1.41	(0.25)
	3	-0.04	(-0.19)													1.04	(0.22)			0.34	0.92	(0.40)
	4	0.01	(0.15)													1.01	(0.16)			0.65	14.32	**(0.00)**
	5	-0.58	(-0.80)													1.53	(0.83)			0.29	10.05	**(0.00)**
RPadj	1	0.95	**(9.63)**															-0.25	**(-7.93)**	0.08	347.48	**(0.00)**
	2	0.84	**(19.14)**															0.11	**(-15.70)**	0.09	876.96	**(0.00)**
	3	0.94	**(10.14)**															0.08	**(-7.97)**	0.02	525.27	**(0.00)**
	4	1.01	**(12.91)**															0.07	**(-11.12)**	0.02	583.86	**(0.00)**
	5	0.72	**(4.21)**															0.42	**(-3.46)**	0.34	131.35	**(0.00)**

Panel B. Multivariate Regressions

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p	F_2	p
HIST + RW	1	0.93	**(5.31)**	-0.26	(-1.36)	0.06	(0.30)													0.03	106.21	**(0.00)**	57.50	**(0.00)**
	2	0.68	**(12.23)**	0.14	(1.20)	0.15	(1.34)													0.30	287.83	**(0.00)**	308.31	**(0.00)**
	3	0.73	**(7.78)**	0.47	**(3.75)**	-0.19	(-1.73)													0.20	101.20	**(0.00)**	172.57	**(0.00)**
	4	0.70	**(16.81)**	0.44	**(8.54)**	-0.10	(-1.55)													0.34	200.15	**(0.00)**	581.89	**(0.00)**
	5	0.98	**(8.90)**	-0.20	(-1.21)	0.38	**(2.16)**													0.05	67.32	**(0.00)**	52.07	**(0.00)**
HIST + DCC	1	0.88	**(6.76)**	-0.34	(-1.75)			0.23	**(2.69)**											0.11	124.33	**(0.00)**	139.59	**(0.00)**
	2	0.69	**(12.80)**	0.26	**(3.76)**			0.02	(0.38)											0.29	277.63	**(0.00)**	586.20	**(0.00)**
	3	0.68	**(6.86)**	0.33	**(3.08)**			0.00	(-0.10)											0.17	94.36	**(0.00)**	481.68	**(0.00)**
	4	0.73	**(17.28)**	0.40	**(5.52)**			-0.09	(-1.40)											0.36	209.05	**(0.00)**	874.35	**(0.00)**
	5	1.09	**(9.78)**	0.19	(1.71)			-0.13	(-1.22)											0.03	63.93	**(0.00)**	249.66	**(0.00)**
HIST + FGK	1	0.98	**(6.70)**	-0.21	(-0.74)					-0.07	(-0.19)									0.03	106.29	**(0.00)**	66.46	**(0.00)**
	2	0.71	**(11.72)**	0.32	**(5.26)**					-0.08	(-0.75)									0.29	279.90	**(0.00)**	184.41	**(0.00)**
	3	0.69	**(6.32)**	0.34	**(3.34)**					-0.03	(-0.17)									0.17	94.53	**(0.00)**	129.74	**(0.00)**
	4	0.71	**(11.28)**	0.32	**(5.98)**					0.01	(0.10)									0.32	191.77	**(0.00)**	185.97	**(0.00)**
	5	0.91	**(4.58)**	-0.05	(-0.32)					0.39	(1.22)									0.08	74.17	**(0.00)**	28.60	**(0.00)**
HIST + CCJV	1	0.51	**(3.53)**	0.00	(-0.02)							0.29	**(4.60)**							0.20	148.58	**(0.00)**	153.31	**(0.00)**
	2	0.60	**(8.01)**	0.29	**(4.30)**							0.07	(1.84)							0.30	287.30	**(0.00)**	613.00	**(0.00)**
	3	0.46	**(4.99)**	0.34	**(4.68)**							0.17	**(4.77)**							0.33	139.76	**(0.00)**	569.66	**(0.00)**
	4	0.49	**(5.28)**	0.36	**(8.12)**							0.16	**(2.73)**							0.44	255.28	**(0.00)**	731.89	**(0.00)**
	5	0.95	**(4.42)**	0.10	(1.14)							0.08	(0.58)							0.01	61.56	**(0.00)**	154.70	**(0.00)**

Table A1: Univariate and Encompassing Estimates for Realized Beta − Monthly Data (continued 2)

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p	F_2	p
HIST + KKS1	1	-0.01	(-0.04)	-0.11	(-0.75)									1.01	(3.22)					0.18	144.71	(0.00)	1.05	(0.15)
	2	0.11	(0.60)	0.12	(1.46)									0.75	(3.36)					0.38	333.46	(0.00)	4.07	(0.00)
	3	-0.02	(-0.11)	0.24	(3.05)									0.79	(4.12)					0.35	147.03	(0.00)	14.01	(0.00)
	4	0.09	(1.12)	0.07	(1.66)									0.89	(9.26)					0.66	476.49	(0.00)	2.59	(0.02)
	5	0.00	(-0.01)	0.18	(2.26)									0.86	(2.55)					0.11	78.51	(0.00)	3.36	(0.01)
HIST + BV	1	0.04	(0.19)	-0.26	(-1.80)											1.14	(4.11)			0.31	189.65	(0.00)	6.97	(0.00)
	2	-0.01	(-0.07)	-0.04	(-0.39)											1.04	(4.34)			0.50	436.33	(0.00)	0.63	(0.26)
	3	0.00	(-0.02)	0.10	(1.07)											0.91	(4.14)			0.35	145.73	(0.00)	2.00	(0.05)
	4	-0.02	(-0.30)	-0.05	(-0.76)											1.10	(8.65)			0.65	470.53	(0.00)	1.02	(0.15)
	5	-0.54	(-0.78)	-0.11	(-0.82)											1.62	(2.37)			0.29	125.20	(0.00)	6.05	(0.00)
HIST + Rpadj	1	1.03	(6.96)	-0.15	(-0.63)													-0.21	(-1.07)	0.09	116.88	(0.00)	222.80	(0.00)
	2	0.71	(14.65)	0.34	(4.61)													-0.08	(-1.19)	0.25	299.41	(0.00)	762.55	(0.00)
	3	0.65	(6.59)	0.45	(4.08)													-0.10	(-0.88)	0.21	101.69	(0.00)	479.41	(0.00)
	4	0.73	(14.95)	0.41	(7.05)													-0.11	(-1.58)	0.38	219.57	(0.00)	732.49	(0.00)
	5	0.80	(4.48)	-0.07	(-0.44)													0.44	(2.45)	0.34	138.86	(0.00)	90.22	(0.00)
RW + BV	1	-0.02	(-0.07)			-0.19	(-1.10)									1.16	(3.90)			0.28	111.93	(0.00)	2.64	(0.02)
	2	-0.09	(-0.51)			-0.10	(-0.91)									1.18	(4.22)			0.51	475.01	(0.00)	2.43	(0.03)
	3	-0.04	(-0.21)			-0.05	(-0.70)									1.10	(5.36)			0.34	228.79	(0.00)	0.71	(0.24)
	4	-0.05	(-0.81)			-0.09	(-2.37)									1.16	(13.74)			0.68	1285.41	(0.00)	7.59	(0.00)
	5	-0.58	(-0.81)			0.00	(-0.04)									1.53	(2.28)			0.28	102.16	(0.00)	4.80	(0.00)
DCC + BV	1	-0.23	(-0.95)					0.16	(2.52)							1.12	(3.80)			0.31	208.44	(0.00)	6.65	(0.00)
	2	0.04	(0.47)					0.02	(0.56)							0.93	(8.42)			0.50	875.86	(0.00)	0.68	(0.25)
	3	-0.07	(-0.33)					-0.02	(-0.61)							1.09	(5.29)			0.34	624.76	(0.00)	0.38	(0.39)
	4	0.02	(0.24)					-0.02	(-0.81)							1.02	(17.42)			0.65	1692.89	(0.00)	0.46	(0.34)
	5	-0.53	(-0.81)					-0.14	(-1.52)							1.63	(2.58)			0.33	405.54	(0.00)	11.27	(0.00)
FGK + BV	1	-0.15	(-0.64)							0.03	(0.20)					1.14	(3.95)			0.27	119.18	(0.00)	0.49	(0.33)
	2	0.04	(0.46)							0.03	(0.36)					0.92	(7.23)			0.50	301.03	(0.00)	0.58	(0.28)
	3	-0.04	(-0.19)							0.00	(0.02)					1.04	(4.87)			0.33	184.81	(0.00)	0.09	(0.67)
	4	-0.02	(-0.30)							-0.11	(-1.27)					1.12	(9.38)			0.67	478.53	(0.00)	4.46	(0.00)
	5	-0.61	(-0.85)							0.20	(0.91)					1.40	(2.61)			0.31	70.06	(0.00)	8.56	(0.00)
FGK + RPadj	1	0.84	(6.34)							0.47	(0.98)							-0.47	(-1.59)	0.10	78.69	(0.00)	227.91	(0.00)
	2	0.78	(15.25)							0.26	(1.24)							-0.02	(-0.15)	0.10	153.20	(0.00)	625.12	(0.00)
	3	0.78	(8.12)							0.66	(2.80)							-0.28	(-1.56)	0.12	113.82	(0.00)	420.96	(0.00)
	4	0.79	(10.33)							0.83	(4.47)							-0.40	(-2.87)	0.31	182.36	(0.00)	648.99	(0.00)
	5	0.95	(6.83)							-0.59	(-2.33)							0.70	(2.97)	0.40	95.44	(0.00)	109.56	(0.00)
CCJV + BV	1	-0.25	(-0.85)									0.24	(2.73)			0.98	(2.96)			0.40	238.48	(0.00)	22.43	(0.00)
	2	-0.13	(-1.07)									0.10	(2.35)			1.02	(9.91)			0.53	957.44	(0.00)	7.53	(0.00)
	3	0.00	(0.01)									0.05	(1.27)			0.94	(4.96)			0.35	585.67	(0.00)	1.89	(0.05)
	4	-0.02	(-0.29)									0.05	(1.47)			0.98	(15.43)			0.66	1267.05	(0.00)	3.17	(0.01)
	5	-0.62	(-0.81)									0.05	(0.45)			1.51	(2.48)			0.29	253.35	(0.00)	5.38	(0.00)
KKS1 + BV	1	-0.27	(-0.89)											0.36	(0.84)	0.92	(2.09)			0.28	13.82	(0.00)	2.04	(0.04)
	2	0.17	(1.00)											-0.45	(-1.06)	1.28	(4.18)			0.51	30.80	(0.00)	2.58	(0.02)
	3	-0.05	(-0.24)											0.10	(0.38)	0.96	(4.07)			0.33	11.42	(0.00)	0.21	(0.52)
	4	-0.01	(-0.11)											0.51	(2.41)	0.54	(2.79)			0.68	9.60	(0.00)	9.03	(0.00)
	5	-0.50	(-0.78)											-0.32	(-0.58)	1.77	(1.85)			0.29	30.09	(0.00)	6.03	(0.00)
BV + Rpadj	1	-0.06	(-0.22)													1.09	(3.62)	-0.06	(-0.62)	0.29	4.78	(0.00)	310.14	(0.00)
	2	0.04	(0.35)													0.96	(6.56)	-0.02	(-0.36)	0.44	3.88	(0.01)	1051.38	(0.00)
	3	-0.08	(-0.38)													1.09	(5.42)	-0.01	(-0.07)	0.35	5.00	(0.00)	609.45	(0.00)
	4	0.00	(0.07)													1.08	(13.20)	-0.07	(-1.63)	0.69	17.40	(0.00)	1582.54	(0.00)
	5	-0.30	(-0.51)													1.00	(2.07)	0.30	(2.08)	0.43	31.07	(0.00)	117.38	(0.00)

Table A2: Encompassing Estimates for Realized Beta – Daily and Monthly Data

This table presents the results from regressions of ex post realized beta over the horizon of six months on competing ex ante estimates for each of the five portfolios, respectively. Each month, we sort our estimates in an ascending order according to the historical (equation (9)) beta obtained in a sorting period strictly before the estimation period of the historical beta. The sorting and estimation periods are without overlap and have equal length. The stocks are then allocated to quintile portfolios. Portfolio betas and returns are value-weighted. a denotes the regression intercept, b_{HIST}, b_{RW}, b_{DCC}, b_{FGK}, b_{CCJV}, b_{BV} and b_{RPadj} refer to the slope coefficients for the historical, random walk, DCC, FGK, CCJV, BV and risk premium adjusted estimate for beta, respectively. For each regression coefficient we report Newey and West (1987) t-statistics ($t(.)$) using 6 lags, where we test a and b against zero in multivariate regressions. R^2_{adj} denotes the adjusted R^2 of the regressions. The columns F_1 and F_2 refer to the F-test statistic and p gives the corresponding p-values. In multivariate regressions, the joint underlying hypothesis is that the first slope coefficient is equal to one and the second slope coefficient is equal to zero and vice versa for F_1 and F_2, respectively. t-statistics and p-values in **bold** font indicate significance at the 5 % level. The sample period is January 1996 until December 2012 with 198 monthly observations.

		a	$t(a)$	b_{HIST_d}	$t(b)$	b_{HIST_m}	$t(b)$	b_{RW_d}	$t(b)$	b_{RW_m}	$t(b)$	b_{BV_d}	$t(b)$	b_{BV_m}	$t(b)$	R^2_{adj}	F_1	p	F_2	p
HIST$_d$ + HIST$_m$	1	0.24	(1.59)	0.73	**(3.16)**	-0.10	(-0.96)									0.34	11.27	**(0.00)**	167.03	**(0.00)**
	2	0.20	(1.57)	0.87	**(5.29)**	-0.08	(-0.81)									0.60	6.37	**(0.00)**	246.71	**(0.00)**
	3	0.13	(1.00)	0.89	**(4.33)**	-0.03	(-0.27)									0.63	3.95	**(0.01)**	154.66	**(0.00)**
	4	-0.05	(-0.53)	0.83	**(5.47)**	0.19	(1.49)									0.76	4.86	**(0.00)**	87.40	**(0.00)**
	5	0.67	**(3.30)**	0.45	**(2.85)**	0.05	(0.40)									0.21	33.92	**(0.00)**	151.58	**(0.00)**
RW$_d$ + RW$_m$	1	0.20	(1.88)					0.82	**(5.13)**	-0.12	(-0.96)					0.45	11.36	**(0.00)**	147.55	**(0.00)**
	2	0.19	**(2.21)**					0.85	**(6.61)**	-0.06	(-0.78)					0.65	11.27	**(0.00)**	213.45	**(0.00)**
	3	0.18	(1.64)					0.79	**(5.10)**	0.01	(0.12)					0.64	10.88	**(0.00)**	189.17	**(0.00)**
	4	0.19	**(2.15)**					0.81	**(9.78)**	0.01	(0.10)					0.71	11.91	**(0.00)**	236.56	**(0.00)**
	5	0.55	**(3.78)**					0.60	**(5.61)**	-0.01	(-0.08)					0.37	28.22	**(0.00)**	228.85	**(0.00)**
BV$_d$ + BV$_m$	1	-0.28	(-1.55)									0.72	**(2.09)**	0.56	(1.55)	0.53	5.90	**(0.00)**	14.45	**(0.00)**
	2	-0.38	**(-2.91)**									1.25	**(4.04)**	0.16	(0.43)	0.75	21.18	**(0.00)**	81.94	**(0.00)**
	3	-0.29	**(-2.75)**									1.26	**(5.34)**	0.02	(0.10)	0.83	22.99	**(0.00)**	88.69	**(0.00)**
	4	-0.37	**(-3.46)**									1.24	**(3.31)**	0.13	(0.30)	0.83	31.14	**(0.00)**	63.57	**(0.00)**
	5	-0.09	(-0.49)									0.82	**(2.45)**	0.31	(0.94)	0.44	2.27	**(0.03)**	14.89	**(0.00)**

Table A3: Estimation Errors: Six-Month Horizon – Daily Data

This table reports the out-of-sample estimation errors of competing estimators, using daily return data, for realized beta over the horizon of six months for each portfolio. We build five quintile portfolios into which the stocks are allocated in an ascending order according to their historical beta in the sorting period (taking place directly before the estimation period for historical beta without overlap and with equal length). We determine portfolio betas and returns as value-weighted averages. Panels A and B report the mean absolute errors (MAE) and the root mean squared errors (RMSE) of the estimation models for each portfolio, respectively. Panel C reports the mean absolute percentage errors (MAPE) and panel D reports the mean squared percentage errors (MSPE). avg. denotes the respective errors averaged over all five portfolios. For each portfolio and the average, the lowest errors among all approaches are indicated by *italic* font.

Panel A. Mean Absolute Errors (MAE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1114	*0.1024*	0.1732	0.1592	0.2952	0.1762	0.1104	0.1408
2	0.0873	0.0794	0.1687	0.1771	0.2289	0.1028	*0.0693*	0.1229
3	0.0679	0.0699	0.1792	0.1636	0.2040	0.0720	*0.0512*	0.1134
4	0.0621	0.0667	0.1752	0.1757	0.1781	0.0790	*0.0549*	0.1033
5	0.1780	0.1632	0.2684	0.2599	0.2167	0.1743	*0.1407*	0.1536
avg.	0.1013	0.0963	0.1929	0.1871	0.2246	0.1209	*0.0853*	0.1268

Panel B. Root Mean Squared Errors (RMSE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1517	*0.1375*	0.2283	0.2006	0.3498	0.2252	0.1423	0.1883
2	0.1177	0.1110	0.2293	0.2019	0.2929	0.1592	*0.0933*	0.1696
3	0.0971	0.0984	0.2511	0.1879	0.2609	0.1141	*0.0724*	0.1580
4	0.0788	0.0864	0.2636	0.2019	0.2188	0.0999	*0.0735*	0.1475
5	0.2452	0.2174	0.3656	0.3091	0.2693	0.2537	0.2003	*0.1953*
avg.	0.1381	0.1301	0.2676	0.2203	0.2783	0.1704	*0.1164*	0.1718

Table A3: Estimation Errors: Six-Month Horizon – Daily Data (continued)

Panel C. Mean Average Percentage Errors (MAPE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	1.0532	*0.6647*	1.1013	1.0683	2.5807	1.8380	0.9794	1.5415
2	0.1275	0.1171	0.2281	0.2281	0.3479	0.1839	*0.1102*	0.1925
3	0.0892	0.0886	0.2084	0.1850	0.2547	0.1020	*0.0666*	0.1478
4	0.0598	0.0640	0.1680	0.1632	0.1694	0.0715	*0.0507*	0.1006
5	0.1231	0.1141	0.1862	0.1801	0.1589	0.1118	*0.0917*	0.1104
avg.	0.2905	*0.2097*	0.3784	0.3649	0.7023	0.4614	0.2597	0.4186

Panel D: Mean Squared Percentage Errors (MSPE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	63.482	*16.589*	49.609	60.094	391.58	187.67	45.473	140.73
2	0.0537	*0.0473*	0.1181	0.0812	0.3632	0.1838	0.0509	0.1549
3	0.0278	0.0239	0.0919	0.0492	0.1556	0.0489	*0.0153*	0.0754
4	0.0066	0.0078	0.0685	0.0357	0.0456	0.0084	*0.0051*	0.0250
5	0.0276	0.0221	0.0614	0.0433	0.0405	0.0212	*0.0140*	0.0200
avg.	12.719	*3.3379*	9.9898	12.061	78.436	37.587	9.1116	28.202

Table A4: Differences of Estimation Errors: Six-Month Horizon − Daily Data

This table reports the differences in the out-of-sample estimation errors of competing estimators, using daily return data, for realized beta over the horizon of six months. In panel A–C, the upper triangular matrix reports the mean difference of absolute (AE), as well as differences in mean absolute percentage (APE), and squared percentage (SPE) estimation errors, respectively, averaged over the five portfolios. Similarly, the lower triangular matrices report the average median difference of estimation errors. We compute the difference between the errors of the model *[name in row]* and those of the model *[name in column]*. The absolute numbers in parentheses indicate the percentage of portfolios for which the difference is significant (e.g., 0.4 indicates that the differences for two out of five portfolios are statistically significant). If the differences are significant for all five portfolios, the figure is printed in **bold** font. Significance is tested by the modified Diebold–Mariano and the Wilcoxon signed rank tests for the upper and lower triangular matrices, respectively. The sign indicates the direction of the significant differences.

Panel A. Absolute Errors (AE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		0.0050	-0.0916	-0.0858	-0.1232	-0.0195	0.0161	-0.0255
		(0.0)	**(-1.0)**	**(-1.0)**	(-0.8)	(-0.2)	(0.4)	(-0.8)
RW	0.0002		-0.0966	-0.0908	-0.1283	-0.0246	0.0110	-0.0305
	(-0.4)		**(-1.0)**	**(-1.0)**	**(-1.0)**	(-0.2)	(0.2)	(-0.8)
DCC	0.0639	0.0637		0.0058	-0.0316	0.0721	0.1076	0.0661
	(1.0)	**(1.0)**		(0.0)	(-0.4)	(0.8)	**(1.0)**	**(1.0)**
FGK	0.1001	0.0999	0.0362		-0.0374	0.0662	0.1018	0.0603
	(1.0)	**(1.0)**	(0.2)		(-0.2)	(0.8)	**(1.0)**	(0.8)
CCJV	0.1143	0.1141	0.0504	0.0142		0.1037	0.1393	0.0978
	(1.0)	**(1.0)**	(0.6)	(0.4)		(0.8)	**(1.0)**	**(1.0)**
KKS1	0.0113	0.0110	-0.0526	-0.0888	-0.1031		0.0356	-0.0059
	(0.4)	(0.6)	(-0.8)	(-0.8)	**(-1.0)**		**(1.0)**	(-0.2)
BV	-0.0111	-0.0113	-0.0750	-0.1112	-0.1254	-0.0224		-0.0415
	(-0.8)	(-0.6)	**(-1.0)**	**(-1.0)**	**(-1.0)**	**(-1.0)**		(-0.6)
RPadj	0.0256	0.0254	-0.0383	-0.0745	-0.0888	0.0143	0.0367	
	(0.8)	(0.8)	**(-1.0)**	**(-1.0)**	**(-1.0)**	(0.2)	**(1.0)**	

Table A4: Differences of Estimation Errors: Six-Month Horizon – Daily Data (continued)

Panel B. Absolute Percentage Errors (APE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		0.0808 (0.0)	-0.0879 (-0.8)	-0.0744 (-0.8)	-0.4118 (-0.6)	-0.1709 (0.0)	0.0308 (0.4)	-0.1280 (-0.6)
RW	-0.0015 (-0.4)		-0.1687 (-0.8)	-0.1552 (-0.8)	-0.4926 (-0.8)	-0.2517 (0.0)	-0.0500 (0.6)	-0.2089 (-0.6)
DCC	0.0643 **(1.0)**	0.0658 **(1.0)**		0.0135 (0.0)	-0.3239 (-0.2)	-0.0830 (0.6)	0.1187 **(1.0)**	-0.0402 (0.4)
FGK	0.1016 **(1.0)**	0.1032 **(1.0)**	0.0373 (0.2)		-0.3374 (0.0)	-0.0965 (0.6)	0.1052 (0.8)	-0.0536 (0.4)
CCJV	0.1278 **(1.0)**	0.1294 **(1.0)**	0.0635 (0.8)	0.0262 (0.0)		0.2409 (0.8)	0.4426 (0.8)	0.2837 (0.8)
KKS1	0.0187 (0.4)	0.0202 (0.6)	-0.0456 (-0.8)	-0.0830 (-0.6)	-0.1092 **(-1.0)**		0.2017 (0.8)	0.0429 (-0.2)
BV	-0.0083 (-0.8)	-0.0068 (-0.6)	-0.0726 **(-1.0)**	-0.1099 **(-1.0)**	-0.1361 **(-1.0)**	-0.0270 **(-1.0)**		-0.1588 (-0.6)
RPadj	0.0308 (0.8)	0.0323 (0.8)	-0.0336 **(-1.0)**	-0.0709 (-0.8)	-0.0971 **(-1.0)**	0.0121 (0.2)	0.0390 **(1.0)**	

Panel C. Squared Percentage Errors (SPE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		9.3816 (0.0)	2.7297 (-0.8)	0.6589 (-0.6)	-65.7168 (-0.6)	-24.8677 (0.0)	3.6079 (0.0)	-15.4823 (0.0)
RW	-0.0003 (-0.4)		-6.6519 (-0.8)	-8.7227 (-0.8)	-75.0984 (-0.6)	-34.2492 (0.0)	-5.7737 (0.2)	-24.8639 (0.0)
DCC	0.0142 **(1.0)**	0.0145 **(1.0)**		-2.0708 (0.2)	-68.4465 (0.0)	-27.5973 (0.4)	0.8782 (0.8)	-18.2120 (0.4)
FGK	0.0255 **(1.0)**	0.0258 **(1.0)**	0.0113 (0.4)		-66.3757 (0.0)	-25.5265 (0.4)	2.9490 (0.6)	-16.1412 (0.2)
CCJV	0.0435 **(1.0)**	0.0438 **(1.0)**	0.0293 (0.6)	0.0180 (0.0)		40.8492 (0.8)	69.3247 (0.8)	50.2345 (0.6)
KKS1	0.0064 (0.4)	0.0067 (0.4)	-0.0079 (-0.8)	-0.0192 (-0.6)	-0.0371 **(-1.0)**		28.4755 (0.4)	9.3853 (0.0)
BV	-0.0008 (-0.8)	-0.0005 (-0.6)	-0.0150 **(-1.0)**	-0.0263 **(-1.0)**	-0.0442 **(-1.0)**	-0.0071 **(-1.0)**		-19.0902 (0.0)
RPadj	0.0062 (0.8)	0.0065 (0.8)	-0.0081 **(-1.0)**	-0.0194 **(-1.0)**	-0.0373 **(-1.0)**	-0.0002 (0.2)	0.0069 **(1.0)**	

Table A5: Estimation Errors: Six-Month Horizon – Monthly Data

This table reports the out-of-sample estimation errors of competing estimators, using monthly return data, for realized beta over the horizon of six months for each portfolio. We build five quintile portfolios into which the stocks are allocated in an ascending order according to their historical beta in the sorting period (taking place directly before the estimation period for historical beta without overlap and with equal length). We determine portfolio betas and returns as value-weighted averages. Panels A and B report the mean absolute errors (MAE) and the root mean squared errors (RMSE) of the estimation models for each portfolio, respectively. Panel C reports the mean absolute percentage errors (MAPE) and panel D reports the mean squared percentage errors (MSPE). avg. denotes the respective errors averaged over all five portfolios. For each portfolio and the average, the lowest errors among all approaches are indicated by *italic* font.

Panel A. Mean Absolute Errors (MAE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1504	0.1209	0.1818	0.2784	0.2308	0.1104	*0.0911*	0.2296
2	0.1324	0.1287	0.1799	0.2976	0.2280	0.0593	*0.0478*	0.2213
3	0.1052	0.1229	0.1762	0.2899	0.2176	0.0608	*0.0571*	0.2094
4	0.1005	0.1449	0.1850	0.2852	0.1726	0.0619	*0.0437*	0.1982
5	0.1812	0.1701	0.2156	0.2982	0.2087	0.1036	*0.0822*	0.1772
avg.	0.1339	0.1375	0.1877	0.2899	0.2115	0.0792	*0.0644*	0.2071

Panel B. Root Mean Squared Errors (RMSE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.2067	0.1661	0.2311	0.3078	0.2802	0.1392	*0.1122*	0.2717
2	0.1650	0.1593	0.2279	0.3139	0.2686	0.0784	*0.0645*	0.2652
3	0.1285	0.1504	0.2366	0.3134	0.2596	0.0872	*0.0826*	0.2618
4	0.1256	0.1911	0.2275	0.3034	0.2135	0.0756	*0.0556*	0.2367
5	0.2330	0.2083	0.2997	0.3436	0.2637	0.1713	*0.1412*	0.2041
avg.	0.1718	0.1751	0.2446	0.3164	0.2571	0.1103	*0.0912*	0.2479

Table A5: Estimation Errors: Six-Month Horizon – Monthly Data (continued)

Panel C. Mean Average Percentage Errors (MAPE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1867	0.1568	0.2283	0.3413	0.3085	0.1617	*0.1261*	0.3009
2	0.1465	0.1401	0.1941	0.3194	0.2527	0.0668	*0.0527*	0.2441
3	0.1053	0.1217	0.1739	0.2847	0.2180	0.0592	*0.0554*	0.2116
4	0.0950	0.1377	0.1707	0.2666	0.1660	0.0569	*0.0410*	0.1881
5	0.1518	0.1423	0.1743	0.2418	0.1755	0.0780	*0.0629*	0.1489
avg.	0.1371	0.1397	0.1883	0.2908	0.2241	0.0845	*0.0676*	0.2187

Panel D. Mean Squared Percentage Errors (MSPE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.0625	0.0504	0.0822	0.1346	0.1610	0.0575	*0.0301*	0.1529
2	0.0350	0.0316	0.0593	0.1127	0.0929	0.0089	*0.0056*	0.0897
3	0.0166	0.0220	0.0538	0.0927	0.0683	0.0066	*0.0057*	0.0730
4	0.0147	0.0340	0.0419	0.0801	0.0436	0.0047	*0.0028*	0.0526
5	0.0375	0.0291	0.0540	0.0723	0.0496	0.0120	*0.0085*	0.0289
avg.	0.0333	0.0334	0.0582	0.0985	0.0831	0.0179	*0.0105*	0.0794

Table A6: Differences of Estimation Errors: Six-Month Horizon – Monthly Data

This table reports the differences in the out-of-sample estimation errors of competing estimators, using monthly return data, for realized beta over the horizon of six months. In panel A–D, the upper triangular matrix reports the mean difference of absolute (AE), root mean squared (SE), as well as differences in mean absolute percentage (APE), and squared percentage (SPE) estimation errors, respectively, averaged over the five portfolios. Similarly, the lower triangular matrices report the average median difference of estimation errors. We compute the difference between the errors of the model *[name in row]* and those of the model *[name in column]*. The absolute numbers in parentheses indicate the percentage of portfolios for which the difference is significant (e.g., 0.4 indicates that the differences for two out of five portfolios are statistically significant). If the differences are significant for all five portfolios, the figure is printed in **bold** font. Significance is tested by the modified Diebold–Mariano and the Wilcoxon signed rank tests for the upper and lower triangular matrices, respectively. The sign indicates the direction of the significant differences.

Panel A. Absolute Errors (AE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		-0.0036	-0.0537	-0.1559	-0.0776	0.0547	0.0696	-0.0732
		(0.0)	(-0.6)	**(-1.0)**	(-0.8)	(0.8)	**(1.0)**	(-0.8)
RW	0.0074		-0.0502	-0.1524	-0.0740	0.0583	0.0731	-0.0696
	(0.2)		(-0.6)	**(-1.0)**	(-0.6)	(0.8)	(0.8)	(-0.8)
DCC	0.0373	0.0300		-0.1022	-0.0238	0.1085	0.1233	-0.0195
	(1.0)	(0.6)		**(-1.0)**	(0.0)	**(1.0)**	**(1.0)**	(-0.4)
FGK	0.1695	0.1621	0.1321		0.0783	0.2107	0.2255	0.0827
	(1.0)	**(1.0)**	**(1.0)**		(0.8)	**(1.0)**	**(1.0)**	**(1.0)**
CCJV	0.0801	0.0727	0.0427	-0.0894		0.1323	0.1472	0.0044
	(0.8)	(0.8)	(0.6)	**(-1.0)**		**(1.0)**	**(1.0)**	(0.0)
KKS1	-0.0497	-0.0571	-0.0870	-0.2192	-0.1298		0.0148	-0.1279
	(-0.8)	(-0.8)	**(-1.0)**	**(-1.0)**	**(-1.0)**		(0.8)	**(-1.0)**
BV	-0.0590	-0.0664	-0.0963	-0.2285	-0.1391	-0.0093		-0.1428
	(-1.0)	**(-1.0)**	**(-1.0)**	**(-1.0)**	**(-1.0)**	(-0.8)		**(-1.0)**
RPadj	0.0871	0.0797	0.0498	-0.0823	0.0071	0.1368	0.1461	
	(0.8)	(0.8)	(0.6)	**(-1.0)**	(0.0)	**(1.0)**	**(1.0)**	

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Panel B. Squared Errors (SE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		-0.0033	-0.0728	-0.1446	-0.0853	0.0614	0.0806	-0.0761
		(-0.4)	(-0.6)	**(-1.0)**	(-0.6)	(0.8)	**(1.0)**	(-0.8)
RW	0.0074		-0.0695	-0.1414	-0.0821	0.0647	0.0838	-0.0728
	(0.4)		(-0.8)	**(-1.0)**	(-0.6)	(0.6)	**(1.0)**	(-0.6)
DCC	0.0373	0.0299		-0.0719	-0.0125	0.1342	0.1534	-0.0033
	(1.0)	(0.6)		(-0.8)	(0.0)	**(1.0)**	**(1.0)**	(0.0)
FGK	0.1695	0.1621	0.1321		0.0593	0.2061	0.2252	0.0685
	(1.0)	**(1.0)**	**(1.0)**		(0.4)	**(1.0)**	**(1.0)**	(0.6)
CCJV	0.0801	0.0727	0.0427	-0.0894		0.1468	0.1659	0.0092
	(0.8)	**(1.0)**	(0.6)	**(-1.0)**		**(1.0)**	**(1.0)**	(0.2)
KKS1	-0.0497	-0.0571	-0.0870	-0.2192	-0.1298		0.0191	-0.1376
	(-0.8)	(-0.8)	**(-1.0)**	**(-1.0)**	**(-1.0)**		(0.6)	(-0.8)
BV	-0.0590	-0.0664	-0.0963	-0.2285	-0.1391	-0.0093		-0.1567
	(-1.0)	**(-1.0)**	**(-1.0)**	**(-1.0)**	**(-1.0)**	(-0.8)		(-0.8)
RPadj	0.0871	0.0797	0.0498	-0.0823	0.0071	0.1368	0.1461	
	(0.8)	(0.8)	(0.4)	**(-1.0)**	(-0.2)	**(1.0)**	**(1.0)**	

Panel C. Absolute Percentage Errors (APE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		-0.0026	-0.0512	-0.1537	-0.0871	0.0526	0.0694	-0.0817
		(-0.2)	(-0.6)	**(-1.0)**	(-0.8)	(0.8)	**(1.0)**	(-0.8)
RW	0.0019		-0.0486	-0.1511	-0.0844	0.0552	0.0721	-0.0790
	(0.2)		(-0.6)	**(-1.0)**	(-0.6)	(0.8)	(0.8)	(-0.8)
DCC	0.0368	0.0349		-0.1025	-0.0359	0.1038	0.1206	-0.0305
	(0.8)	(0.6)		**(-1.0)**	(0.0)	(0.8)	**(1.0)**	(-0.2)
FGK	0.1697	0.1678	0.1329		0.0666	0.2063	0.2231	0.0720
	(1.0)	**(1.0)**	**(1.0)**		(0.8)	**(1.0)**	**(1.0)**	(0.8)
CCJV	0.0776	0.0757	0.0408	-0.0921		0.1396	0.1565	0.0054
	(0.8)	(0.8)	(0.6)	**(-1.0)**		**(1.0)**	**(1.0)**	(0.0)
KKS1	-0.0530	-0.0549	-0.0898	-0.2227	-0.1306		0.0169	-0.1342
	(-0.8)	(-0.8)	**(-1.0)**	**(-1.0)**	**(-1.0)**		(0.8)	**(-1.0)**
BV	-0.0616	-0.0635	-0.0984	-0.2312	-0.1392	-0.0086		-0.1511
	(-1.0)	**(-1.0)**	**(-1.0)**	**(-1.0)**	**(-1.0)**	(-0.4)		**(-1.0)**
RPadj	0.0877	0.0858	0.0509	-0.0820	0.0101	0.1407	0.1493	
	(0.8)	(0.8)	(0.6)	**(-1.0)**	(0.0)	**(1.0)**	**(1.0)**	

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Table A6: Differences of Estimation Errors: Six-Month Horizon – Monthly Data
(continued 2)

Panel D. Squared Percentage Errors (SPE)

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
HIST		-0.0002	-0.0250	-0.0652	-0.0498	0.0153	0.0227	-0.0461
		(-0.2)	(-0.4)	**(-1.0)**	(-0.8)	(0.8)	**(1.0)**	(-0.6)
RW	0.0000		-0.0248	-0.0650	-0.0497	0.0155	0.0229	-0.0460
	(0.4)		(-0.6)	**(-1.0)**	(-0.8)	(0.8)	(0.8)	(-0.8)
DCC	0.0097	0.0097		-0.0402	-0.0248	0.0403	0.0477	-0.0212
	(0.8)	(0.6)		(-0.8)	(0.0)	(0.8)	**(1.0)**	(0.2)
FGK	0.0682	0.0682	0.0585		0.0154	0.0805	0.0879	0.0191
	(1.0)	**(1.0)**	**(1.0)**		(0.2)	**(1.0)**	**(1.0)**	(0.4)
CCJV	0.0243	0.0243	0.0146	-0.0439		0.0651	0.0725	0.0037
	(0.8)	**(1.0)**	(0.6)	**(-1.0)**		**(1.0)**	**(1.0)**	(0.2)
KKS1	-0.0093	-0.0094	-0.0190	-0.0776	-0.0336		0.0074	-0.0615
	(-0.8)	(-0.8)	**(-1.0)**	**(-1.0)**	**(-1.0)**		(0.6)	**(-1.0)**
BV	-0.0100	-0.0101	-0.0197	-0.0783	-0.0343	-0.0007		-0.0689
	(-1.0)	(-0.8)	**(-1.0)**	**(-1.0)**	**(-1.0)**	(-0.4)		**(-1.0)**
RPadj	0.0296	0.0296	0.0199	-0.0386	0.0053	0.0389	0.0396	
	(0.8)	(0.8)	(0.4)	**(-1.0)**	(-0.2)	**(1.0)**	**(1.0)**	

Table A7: Portfolio Root Mean Squared Errors (Section 4 of the Main Paper)

This table reports the out-of-sample estimation errors of competing estimators, using daily return data, for realized beta over the horizon of six months for each portfolio in Panels D to F and over the horizon indicated in the panel headlines for Panels A to C. We build five quintile portfolios into which the stocks are allocated in an ascending order according to their historical beta in the sorting period (taking place directly before the estimation period for historical beta without overlap and with equal length). We determine portfolio betas and returns as value-weighted averages. We report the root mean squared errors (RMSE) of the estimation models for each portfolio. avg. denotes the errors averaged over all five portfolios. For each portfolio and the average, the lowest errors among all approaches are indicated by *italic* font.

Panel A: One-Month Horizon

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1659	*0.1520*	0.2047	0.2088	0.4956	0.2540	0.1613	0.1883
2	0.1352	0.1293	0.1869	0.1892	0.4499	0.1810	*0.1231*	0.1634
3	0.1202	0.1112	0.1998	0.1907	0.4135	0.1437	*0.1036*	0.1815
4	0.1180	0.1098	0.1971	0.1932	0.3700	0.1381	*0.1086*	0.1826
5	0.2793	0.2550	0.3272	0.3145	0.4134	0.3085	*0.2452*	0.2726
avg.	0.1637	0.1515	0.2231	0.2193	0.4285	0.2051	*0.1483*	0.1977

Panel B: Three-Month Horizon

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1417	*0.1254*	0.1979	0.1885	0.4076	0.2300	0.1344	0.1651
2	0.1176	0.1073	0.1937	0.1867	0.3563	0.1709	*0.1026*	0.1581
3	0.0978	0.0953	0.2057	0.1766	0.3313	0.1241	*0.0800*	0.1676
4	0.0909	0.0916	0.2060	0.1872	0.2787	0.1060	*0.0813*	0.1753
5	0.2421	0.2207	0.3265	0.2894	0.2935	0.2545	*0.1973*	0.2296
avg.	0.1380	0.1281	0.2259	0.2057	0.3335	0.1771	*0.1191*	0.1791

Panel C: Twelve-Month Horizon

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj
1	0.1638	0.1532	0.2761	0.2111	0.3387	0.2190	*0.1492*	0.2038
2	0.1318	0.1269	0.2954	0.2159	0.2643	0.1519	*0.0995*	0.1842
3	0.1102	0.1068	0.3394	0.1995	0.2325	0.1117	*0.0804*	0.1623
4	0.0835	0.0920	0.3559	0.2078	0.2073	0.1045	*0.0807*	0.1505
5	0.2545	0.2327	0.4202	0.3194	0.2942	0.2516	*0.2038*	0.2465
avg.	0.1488	0.1423	0.3374	0.2307	0.2674	0.1677	*0.1227*	0.1895

Panel D. Further Implied

	HIST	RW	CCJV	SR	KKS1	KKS2	FGK	RPadj	BV
1	0.1517	*0.1375*	0.3498	0.2383	0.2252	0.2279	0.2006	0.1883	0.1423
2	0.1177	0.1110	0.2929	0.1660	0.1592	0.1598	0.2019	0.1696	*0.0933*
3	0.0971	0.0984	0.2609	0.1234	0.1141	0.1142	0.1879	0.1580	*0.0724*
4	0.0788	0.0864	0.2188	0.0900	0.0999	0.1007	0.2019	0.1475	*0.0735*
5	0.2452	0.2174	0.2693	0.2193	0.2537	0.2575	0.3091	*0.1953*	0.2003
avg.	0.1381	0.1301	0.2783	0.1674	0.1704	0.1720	0.2203	0.1718	*0.1164*

Panel E. DJIA

	HIST	RW	DCC	CCJV	SR	KKS1	KKS2	FGK	RPadj	BV
1	0.1375	*0.1274*	0.2003	0.3062	0.2985	0.1889	0.1829	0.1771	0.1829	0.1517
2	0.1763	0.1842	0.2710	0.2192	0.1884	0.1708	0.1632	0.2363	0.2102	*0.1604*
avg.	0.1569	*0.1558*	0.2356	0.2627	0.2434	0.1798	0.1730	0.2067	0.1965	0.1560

Panel F. Further Time-Series Models

	HIST	HIST$_6$	RW	RW$_D$	AR	ARMA	DCC	CCC	BV
1	0.1499	*0.1347*	0.1359	0.1642	0.1879	0.1702	0.2275	0.2047	0.1441
2	0.1144	0.1080	0.1061	0.1593	0.1699	0.1440	0.2266	0.2067	*0.0953*
3	0.0921	0.0963	0.0950	0.1515	0.1468	0.1237	0.2448	0.2247	*0.0699*
4	0.0782	0.0800	0.0844	0.1455	0.1400	0.1610	0.2633	0.2549	*0.0722*
5	0.2430	0.2225	0.2130	0.3144	0.2878	0.3502	0.3570	0.3949	*0.1947*
avg.	0.1355	0.1283	0.1269	0.1870	0.1865	0.1899	0.2638	0.2572	*0.1152*

Table A8: Univariate and Encompassing Estimates for Realized Beta – Bias Removal

This table presents the results from regressions of ex post realized beta on competing ex ante estimates for each of the five portfolios, respectively. Each row corresponds to one regression. Each month, we sort our estimates in an ascending order according to the historical (equation (9)) beta obtained in a sorting period strictly before the estimation period of the historical beta. The sorting and estimation periods are without overlap and have equal length. The stocks are then allocated to quintile portfolios. Portfolio betas and returns are value-weighted. a denotes the regression intercept, b_{HIST}, b_{RW}, b_{DCC}, b_{FGK}, b_{CCJV}, b_{KKS1}, b_{BV}, and b_{RPadj} refer to the slope coefficients for the historical, random walk, DCC, FGK, CCJV, KKS1, BV, and risk premium adjusted estimate for beta, respectively. For each regression coefficient we report Newey and West (1987) t-statistics ($t(.)$) using 6 lags, where we test a against zero and b against zero and one in the univariate regressions (Panel A), while we test both against zero in the multivariate regressions (Panel B). R^2_{adj} denotes the adjusted R^2 of the regressions. The columns F_1 and F_2 refer to the F-test statistic and p gives the corresponding p-values. In the univariate regressions in Panel A, for the F-test (reported in F_1) we test the joint hypothesis of the intercept being equal to zero and the slope coefficient being equal to one. In the multivariate regressions in Panel B, the joint underlying hypothesis is that the first slope coefficient is equal to zero and the second slope coefficient is equal to one and vice versa for F_1 and F_2, respectively. t-statistics and p-values in **bold** font indicate significance at the 5 % level. The sample period is January 1996 until December 2012 with 198 (188 when RPadj is included) monthly observations.

Panel A. Univariate Regressions

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p
HIST	1	0.20	(1.30)	0.72	(-1.22)															0.35	13.44	**(0.00)**
	2	0.16	(1.31)	0.86	(-1.05)															0.63	21.67	**(0.00)**
	3	0.04	(0.28)	0.96	(-0.24)															0.66	1.62	(0.20)
	4	-0.03	(-0.40)	1.02	(0.25)															0.80	3.43	**(0.03)**
	5	0.71	**(5.23)**	0.49	**(-5.66)**															0.24	39.38	**(0.00)**
RW	1	0.17	(1.51)			0.76	(-1.42)													0.45	12.12	**(0.00)**
	2	0.20	**(2.27)**			0.79	**(-2.12)**													0.65	22.75	**(0.00)**
	3	0.17	(1.53)			0.83	(-1.56)													0.64	8.35	**(0.00)**
	4	0.20	**(2.96)**			0.82	**(-3.03)**													0.71	12.72	**(0.00)**
	5	0.57	**(5.13)**			0.58	**(-5.36)**													0.37	33.34	**(0.00)**

Table A8: Univariate and Encompassing Estimates for Realized Beta – Bias Removal (continued)

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p
DCC	1	0.39	**(4.01)**					0.42	**(-4.05)**											0.23	67.85	**(0.00)**
	2	0.40	**(4.19)**					0.56	**(-4.10)**											0.53	87.22	**(0.00)**
	3	0.37	**(2.69)**					0.61	**(-2.83)**											0.45	35.89	**(0.00)**
	4	0.53	**(3.54)**					0.50	**(-3.89)**											0.39	63.78	**(0.00)**
	5	0.80	**(9.54)**					0.41	**(-11.99)**											0.36	135.22	**(0.00)**
FGK	1	0.19	(1.19)							0.70	(-1.31)									0.35	9.67	**(0.00)**
	2	0.13	(1.14)							0.86	(-1.10)									0.65	7.55	**(0.00)**
	3	0.04	(0.28)							0.95	(-0.32)									0.73	0.73	(0.48)
	4	-0.11	(-1.22)							1.10	(1.25)									0.76	2.90	(0.06)
	5	0.49	**(3.44)**							0.67	**(-3.12)**									0.31	13.76	**(0.00)**
CCJV	1	-0.89	**(-3.16)**									1.90	**(2.67)**							0.45	189.18	**(0.00)**
	2	-1.05	**(-4.72)**									2.08	**(4.63)**							0.65	93.58	**(0.00)**
	3	-0.85	**(-3.16)**									1.86	**(3.15)**							0.66	51.58	**(0.00)**
	4	-0.56	**(-4.98)**									1.59	**(5.55)**							0.73	81.18	**(0.00)**
	5	-0.32	(-1.31)									1.39	**(2.07)**							0.34	82.04	**(0.00)**
KKS1	1	-0.61	(-1.64)											1.56	(1.23)					0.25	128.08	**(0.00)**
	2	-1.22	**(-3.86)**											2.27	**(3.65)**					0.37	44.23	**(0.00)**
	3	-0.77	**(-1.99)**											1.78	**(1.99)**					0.49	25.23	**(0.00)**
	4	-0.34	**(-2.64)**											1.38	**(3.21)**					0.70	65.79	**(0.00)**
	5	0.19	(0.61)											0.97	(-0.14)					0.23	46.67	**(0.00)**
BV	1	-0.16	(-0.84)													1.13	(0.49)			0.50	37.11	**(0.00)**
	2	-0.32	**(-2.50)**													1.34	**(2.42)**			0.75	26.82	**(0.00)**
	3	-0.30	**(-2.63)**													1.30	**(2.57)**			0.80	27.26	**(0.00)**
	4	-0.33	**(-3.58)**													1.33	**(3.90)**			0.80	36.75	**(0.00)**
	5	-0.05	(-0.19)													1.10	(0.49)			0.42	21.69	**(0.00)**
RPadj	1	0.21	(1.35)															0.71	(-1.28)	0.35	13.61	**(0.00)**
	2	0.18	(1.50)															0.82	(-1.40)	0.62	14.97	**(0.00)**
	3	0.09	(0.67)															0.90	(-0.69)	0.68	2.65	(0.07)
	4	-0.03	(-0.40)															1.02	(0.32)	0.79	1.43	(0.24)
	5	0.61	**(4.46)**															0.56	**(-4.75)**	0.34	31.93	**(0.00)**

Panel B. Multivariate Regressions

		a	$t(a)$	b_{HIST}	$t(b)$	b_{RW}	$t(b)$	b_{DCC}	$t(b)$	b_{FGK}	$t(b)$	b_{CCJV}	$t(b)$	b_{KKS1}	$t(b)$	b_{BV}	$t(b)$	b_{RPadj}	$t(b)$	R^2_{adj}	F_1	p	F_2	p
FGK + BV	1	-0.16	(-0.78)							0.01	(0.03)					1.12	**(2.62)**			0.50	42.00	**(0.00)**	1.24	(0.12)
	2	-0.34	(-1.96)							-0.07	(-0.34)					1.44	**(3.77)**			0.75	45.89	**(0.00)**	19.38	**(0.00)**
	3	-0.32	(-1.90)							-0.05	(-0.17)					1.36	**(3.18)**			0.80	34.58	**(0.00)**	21.14	**(0.00)**
	4	-0.30	**(-3.18)**							0.22	(0.93)					1.08	**(3.84)**			0.80	23.36	**(0.00)**	25.91	**(0.00)**
	5	-0.14	(-0.48)							-0.26	(-0.86)					1.44	**(2.95)**			0.42	31.95	**(0.00)**	1.83	(0.06)
BV + RPadj	1	-0.15	(-0.67)													1.08	**(2.22)**	0.03	(0.11)	0.49	3.55	**(0.01)**	35.82	**(0.00)**
	2	-0.37	**(-2.27)**													1.52	**(4.33)**	-0.13	(-0.66)	0.76	24.97	**(0.00)**	64.97	**(0.00)**
	3	-0.36	**(-2.61)**													1.54	**(4.83)**	-0.18	(-0.95)	0.80	24.32	**(0.00)**	60.85	**(0.00)**
	4	-0.28	**(-2.65)**													0.95	**(3.80)**	0.32	(1.64)	0.81	30.87	**(0.00)**	9.21	**(0.00)**
	5	-0.16	(-0.35)													1.33	(1.80)	-0.13	(-0.34)	0.41	2.37	**(0.03)**	46.17	**(0.00)**

Table A9: Bias Removal – Further Possibilities

This table reports the out-of-sample estimation errors of competing bias-removed estimators, using daily return data, for realized beta over the horizon of six months for each portfolio. We build five quintile portfolios into which the stocks are allocated in an ascending order according to their historical beta in the sorting period (taking place directly before the estimation period for historical beta without overlap and with equal length). We determine portfolio betas and returns as value-weighted averages. Panel A presents the results on a simple bias removal, while Panels B and C present the results on bias removals using a regression technique. In each panel, the first row reports the average root mean squared errors (RMSE) of the estimation models over the five portfolios. The lowest errors among all approaches are indicated by *italic* font. The remainder of the tables report the difference in estimation errors. The upper triangular matrix reports the differences in root mean squared estimation errors, averaged over the five portfolios. Similarly, the lower triangular matrix reports the average median difference of estimation errors. We compute the difference between the errors of the model *[name in row]* and those of the model *[name in column]*. The absolute numbers in parentheses indicate the percentage of portfolios for which the difference is significant (e.g., 0.4 indicates that the differences for two out of five portfolios are statistically significant). If the differences are significant for all five portfolios, the figure is printed in **bold** font. Significance is tested by the modified Diebold–Mariano and the Wilcoxon signed rank tests for the upper and lower triangular matrices, respectively. The sign indicates the direction of the significant differences. BV^{UC} refers to the non-corrected BV estimates.

Table A9: Bias Removal – Further Possibilities (continued)

Panel A. Regression Technique – Individual

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj	BV^{UC}
avg.	0.2034	0.2066	0.1715	0.1791	0.1570	0.1609	0.1699	0.1754	*0.1216*
HIST		-0.0033	0.0318	0.0243	0.0464	0.0425	0.0335	0.0280	0.0818
		(0.0)	(0.2)	(0.0)	(0.4)	(0.6)	(0.2)	(0.2)	(0.8)
RW	0.0039		0.0351	0.0276	0.0497	0.0458	0.0367	0.0312	0.0851
	(0.0)		(0.2)	(0.0)	(0.4)	(0.6)	(0.2)	(0.2)	(0.6)
DCC	-0.0118	-0.0157		-0.0075	0.0146	0.0106	0.0016	-0.0039	0.0499
	(-0.6)	(-0.8)		(0.0)	(0.2)	(0.0)	(0.0)	(0.0)	(0.6)
FGK	-0.0063	-0.0101	0.0055		0.0221	0.0182	0.0092	0.0037	0.0575
	(-0.6)	(0.0)	(0.0)		(0.2)	(0.0)	(0.0)	(0.0)	(0.8)
CCJV	-0.0127	-0.0166	-0.0009	-0.0064		-0.0039	-0.0129	-0.0184	0.0354
	(-0.6)	(-0.8)	(-0.2)	(-0.4)		(0.0)	(0.0)	(-0.2)	(0.4)
KKS1	-0.0083	-0.0122	0.0035	-0.0021	0.0043		-0.0090	-0.0145	0.0393
	(-0.4)	(-0.8)	(-0.2)	(-0.4)	(0.0)		(0.0)	(0.0)	(0.6)
BV	-0.0046	-0.0085	0.0072	0.0017	0.0081	0.0038		-0.0055	0.0483
	(-0.6)	(-0.4)	(0.2)	(-0.2)	(0.4)	(0.0)		(0.0)	(0.6)
RPadj	-0.0049	-0.0088	0.0069	0.0013	0.0077	0.0034	-0.0004		0.0538
	(-0.6)	(-0.4)	(0.2)	(0.0)	(0.4)	(0.4)	(0.2)		(0.6)
BV^{UC}	-0.0360	-0.0399	-0.0242	-0.0298	-0.0234	-0.0277	-0.0315	-0.0311	
	(-0.8)	(-0.8)	(-0.8)	(-0.8)	(-0.6)	(-0.8)	(-0.8)	(-0.8)	

Panel B. Regression Technique Combining with HIST – Individual

	HIST	RW	DCC	FGK	CCJV	KKS1	BV	RPadj	BV^{UC}
avg.	0.2034	0.2225	0.2045	0.1950	0.1935	0.1926	0.1808	0.1942	*0.1216*
HIST		-0.0191	-0.0011	0.0083	0.0098	0.0108	0.0225	0.0091	0.0818
		(-0.2)	(0.0)	(0.2)	(0.0)	(0.0)	(0.2)	(0.0)	(0.8)
RW	0.0063		0.0179	0.0274	0.0289	0.0299	0.0416	0.0282	0.1009
	(0.4)		(0.2)	(0.2)	(0.4)	(0.6)	(0.4)	(0.2)	(0.6)
DCC	-0.0025	-0.0088		0.0095	0.0110	0.0119	0.0237	0.0103	0.0829
	(0.0)	(-0.4)		(0.2)	(0.0)	(0.0)	(0.2)	(0.0)	(0.8)
FGK	0.0047	-0.0016	0.0072		0.0015	0.0025	0.0142	0.0008	0.0735
	(0.2)	(-0.2)	(-0.4)		(0.0)	(-0.2)	(0.0)	(0.0)	(0.8)
CCJV	-0.0029	-0.0092	-0.0005	-0.0076		0.0009	0.0127	-0.0007	0.0719
	(-0.4)	(-0.8)	(0.2)	(-0.4)		(0.0)	(0.0)	(0.0)	(0.6)
KKS1	-0.0021	-0.0084	0.0004	-0.0068	0.0008		0.0117	-0.0016	0.0710
	(-0.2)	(-0.2)	(-0.2)	(-0.4)	(0.0)		(0.0)	(0.2)	(0.8)
BV	0.0009	-0.0054	0.0034	-0.0038	0.0039	0.0030		-0.0134	0.0593
	(0.0)	(-0.4)	(-0.2)	(-0.4)	(0.2)	(-0.2)		(0.0)	(0.8)
RPadj	0.0032	-0.0031	0.0057	-0.0015	0.0061	0.0053	0.0023		0.0726
	(0.2)	(-0.4)	(0.0)	(0.0)	(0.2)	(0.0)	(0.2)		(0.8)
BV^{UC}	-0.0360	-0.0423	-0.0336	-0.0407	-0.0331	-0.0339	-0.0370	-0.0392	
	(-0.8)	(-0.8)	(-0.6)	(-0.8)	(-0.8)	(-0.8)	(-0.8)	(-0.6)	