

Internet Appendix For Liquidity risk and exchange-traded-fund returns, variances, and tracking errors

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The Internet Appendix (IA) includes additional robust tests that are referenced in the main paper. We perform the main results in Table 5 by using alternative liquidity measures: effective spread(Table IA1), quoted spread(Table IA2), and relative quoted spread(Table IA3). We also perform the main results in Table 5 by dividing our sample period into three regimes: before(2002-2006), during(2007-2008), and after(2009-2012) the financial crisis period(Table IA4). Moreover, we perform the main results in Tables 8-11 by using the equal-weighted methods (Tables IA5-8).

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Table IA1: Effective Spread and tracking errors : Instrumental Variable Approach

This table reports coefficients estimates of daily regressions of ETF tracking errors on ETF illiquidity. The dependent variables are daily tracking errors, calculated by taking the absolute values of daily return differences between ETF and its index (I, IV), between ETF and its NAV (II, V), or between NAV and its index (III, VI). The first three columns are pooled OLS estimation results and the remaining three columns are two-stage regression results by employing an instrumental variable. The instrumental variable is an indicator variable if an ETF receives a threshold flag. The first day of the threshold flag as the indicator value is one if the ETF receives the threshold flag on consecutive days. The main independent variable is the daily effective spread computed from the NYSE TAQ. All other daily variables are defined in Appendix B. All regressions include day fixed effects. T-statistics based on standard errors double clustered at the fund and day level are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

| | Panel Regression | | | Instrumental Variable Regression | | |
|----------------------------|-----------------------|-----------------------|----------------------|----------------------------------|----------------------|----------------------|
| | (I) ETF-IND | (II) ETF-NAV | (III) NAV-IND | (IV) ETF-IND | (V) ETF-NAV | (VI) NAV-IND |
| Effective Spread | 0.011*** (9.08) | 0.012*** (10.19) | 0.001 (1.39) | 0.160** (2.25) | 0.206*** (2.62) | -0.017 (-0.49) |
| Log(AUM) | -0.001*** (-6.75) | -0.001*** (-6.59) | -0.000 (-0.59) | -0.005*** (-2.93) | -0.006*** (-3.12) | 0.000 (0.40) |
| Log(Dollar Trading Volume) | 0.001*** (6.27) | 0.001*** (6.77) | 0.000** (2.32) | 0.001*** (5.47) | 0.001*** (4.78) | 0.000** (2.11) |
| Absolute Order Imbalance | -0.000* (-1.79) | -0.000 (-1.42) | 0.000 (0.45) | -0.000** (-2.41) | -0.000** (-2.56) | 0.000 (0.65) |
| Intraday Volatility | 0.000*** (3.30) | 0.000*** (3.62) | 0.000** (1.96) | -0.003* (-1.76) | -0.004** (-2.05) | 0.001 (0.65) |
| Shares Outstanding Growth | 0.001*** (2.62) | 0.000 (0.01) | 0.001*** (3.47) | 0.001 (1.58) | -0.000 (-0.07) | 0.001*** (3.44) |
| Log(Shares Outstanding) | 0.001*** (4.06) | 0.001*** (4.09) | -0.000 (-1.48) | 0.006** (2.47) | 0.007*** (2.75) | -0.001 (-0.73) |
| Equity-type ETF | -0.000 (-0.62) | -0.001 (-1.10) | -0.000 (-0.57) | 0.001 (0.84) | 0.001 (0.92) | -0.000 (-0.77) |
| Invested in US assets | -0.005*** (-13.44) | -0.003*** (-13.73) | -0.003*** (-7.83) | -0.002 (-0.86) | 0.001 (0.67) | -0.003*** (-3.92) |
| Swap Based | 0.002 (0.91) | -0.001 (-1.00) | 0.004* (1.69) | 0.004* (1.72) | 0.001 (0.52) | 0.004 (1.51) |
| Derivatives Based | -0.001 (-0.49) | -0.002 (-1.61) | 0.000 (0.60) | 0.002 (1.04) | 0.001 (0.73) | 0.000 (0.24) |
| Leveraged Fund | 0.000 (0.07) | 0.001 (1.42) | -0.001 (-0.37) | -0.003 (-0.90) | -0.002 (-0.84) | -0.001 (-0.24) |
| Futures Available | -0.001* (-1.72) | -0.000 (-0.49) | -0.000 (-1.29) | -0.002** (-2.51) | -0.001** (-2.03) | -0.000 (-0.64) |
| Options Available | -0.000* (-1.75) | -0.001*** (-5.72) | 0.001*** (4.04) | 0.001 (1.19) | 0.001 (0.79) | 0.001** (2.04) |
| Inkind | -0.000 (-1.10) | -0.000 (-0.92) | -0.000 (-1.54) | -0.000 (-0.26) | -0.000 (-0.10) | -0.000 (-1.61) |
| Optimized | 0.000 (0.28) | 0.001*** (2.71) | -0.001*** (-4.26) | 0.000 (0.82) | 0.001** (2.28) | -0.001*** (-4.03) |
| Expense Ratio | 0.002*** (2.69) | 0.003*** (5.56) | -0.000 (-0.70) | 0.001 (0.51) | 0.001 (0.61) | -0.000 (-0.41) |
| Day Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1, 113, 226 | 1, 155, 597 | 1, 113, 376 | 1, 113, 226 | 1, 155, 597 | 1, 113, 376 |
| Adjusted R^2 | 0.252 | 0.213 | 0.110 | -0.823 | -1.850 | 0.079 |

Table IA2: Quoted Spread and tracking errors: Instrumental Variable Approach

This table reports coefficients estimates of daily regressions of ETF tracking errors on ETF illiquidity. The dependent variables are daily tracking errors, calculated by taking the absolute values of daily return differences between ETF and its index (I, IV), between ETF and its NAV (II, V), or between NAV and its index (III, VI). The first three columns are pooled OLS estimation results and the remaining three columns are two-stage regression results by employing an instrumental variable. The instrumental variable is an indicator variable if an ETF receives a threshold flag. The first day of the threshold flag as the indicator value is one if the ETF receives the threshold flag on consecutive days. The main independent variable is the daily quoted half spread computed from the NYSE TAQ. All other daily variables are defined in Appendix B. All regressions include day fixed effects. T-statistics based on standard errors double clustered at the fund and day level are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

| | Panel Regression | | | Instrumental Variable Regression | | |
|----------------------------|-----------------------|-----------------------|----------------------|----------------------------------|---------------------|----------------------|
| | (I) ETF-IND | (II) ETF-NAV | (III) NAV-IND | (IV) ETF-IND | (V) ETF-NAV | (VI) NAV-IND |
| Quoted Spread | 0.006*** (8.03) | 0.007*** (9.77) | 0.000 (0.65) | 0.188 (1.58) | 0.221* (1.84) | -0.020 (-0.48) |
| Log(AUM) | -0.001*** (-6.35) | -0.001*** (-6.09) | -0.000 (-0.49) | -0.006* (-1.92) | -0.007** (-2.12) | 0.000 (0.42) |
| Log(Dollar Trading Volume) | 0.001*** (6.31) | 0.001*** (6.82) | 0.000** (2.31) | 0.001*** (3.35) | 0.001*** (3.20) | 0.000 (1.17) |
| Absolute Order Imbalance | -0.000 (-1.62) | -0.000 (-1.23) | 0.000 (0.48) | -0.000* (-1.67) | -0.000* (-1.82) | 0.000 (0.60) |
| Intraday Volatility | 0.000*** (3.98) | 0.001*** (4.36) | 0.000** (2.11) | -0.003 (-1.29) | -0.004 (-1.50) | 0.001 (0.63) |
| Shares Outstanding Growth | 0.001** (2.52) | -0.000 (-0.14) | 0.001*** (3.46) | -0.000 (-0.28) | -0.001 (-1.17) | 0.001*** (3.05) |
| Log(Shares Outstanding) | 0.001*** (3.46) | 0.001*** (3.33) | -0.000* (-1.65) | 0.008* (1.70) | 0.009* (1.92) | -0.001 (-0.65) |
| Equity-type ETF | -0.000 (-0.61) | -0.001 (-1.09) | -0.000 (-0.58) | 0.002 (1.15) | 0.003 (1.23) | -0.001 (-0.71) |
| Invested in US assets | -0.005*** (-13.70) | -0.003*** (-14.12) | -0.003*** (-7.90) | 0.000 (0.07) | 0.003 (0.83) | -0.004*** (-2.88) |
| Swap Based | 0.002 (0.87) | -0.001 (-1.03) | 0.004* (1.68) | 0.004 (1.42) | 0.001 (0.38) | 0.004 (1.48) |
| Derivatives Based | -0.001 (-0.53) | -0.002 (-1.64) | 0.000 (0.59) | 0.002 (1.00) | 0.002 (0.75) | 0.000 (0.14) |
| Leveraged Fund | 0.000 (0.11) | 0.001 (1.49) | -0.001 (-0.36) | -0.003 (-0.74) | -0.002 (-0.60) | -0.001 (-0.23) |
| Futures Available | -0.001 (-1.64) | -0.000 (-0.41) | -0.000 (-1.28) | -0.002* (-1.87) | -0.002 (-1.56) | -0.000 (-0.50) |
| Options Available | -0.000* (-1.86) | -0.001*** (-5.82) | 0.001*** (4.02) | 0.001 (1.08) | 0.001 (0.89) | 0.001 (1.40) |
| Inkind | -0.000 (-1.10) | -0.000 (-0.91) | -0.000 (-1.54) | 0.000 (0.13) | 0.000 (0.20) | -0.000 (-1.59) |
| Optimized | 0.000 (0.24) | 0.001*** (2.63) | -0.001*** (-4.26) | 0.000 (0.57) | 0.001 (1.31) | -0.001*** (-3.85) |
| Expense Ratio | 0.002*** (2.72) | 0.003*** (5.62) | -0.000 (-0.69) | -0.000 (-0.07) | -0.000 (-0.02) | -0.000 (-0.28) |
| Day Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1, 113, 226 | 1, 155, 597 | 1, 113, 376 | 1, 113, 226 | 1, 155, 597 | 1, 113, 376 |
| Adjusted R^2 | 0.249 | 0.210 | 0.109 | -2.643 | -4.465 | 0.039 |

Table IA3: Relative Quoted Spread and tracking errors : Instrumental Variable Approach

This table reports coefficients estimates of daily regressions of ETF tracking errors on ETF illiquidity. The dependent variables are daily tracking errors, calculated by taking the absolute values of daily return differences between ETF and its index (I, IV), between ETF and its NAV (II, V), or between NAV and its index (III, VI). The first three columns are pooled OLS estimation results and the remaining three columns are two-stage regression results by employing an instrumental variable. The instrumental variable is an indicator variable if an ETF receives a threshold flag. The first day of the threshold flag as the indicator value is one if the ETF receives the threshold flag on consecutive days. The main independent variable is the daily relative quoted spread computed from the NYSE TAQ. All other daily variables are defined in Appendix B. All regressions include day fixed effects. T-statistics based on standard errors double clustered at the fund and day level are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

| | Panel Regression | | | Instrumental Variable Regression | | |
|----------------------------|-----------------------|-----------------------|----------------------|----------------------------------|---------------------|----------------------|
| | (I) ETF-IND | (II) ETF-NAV | (III) NAV-IND | (IV) ETF-IND | (V) ETF-NAV | (VI) NAV-IND |
| Relative Quoted Spread | 0.198*** (7.36) | 0.252*** (8.43) | -0.002 (-0.11) | 3.121*** (2.65) | 3.977*** (3.19) | -0.326 (-0.49) |
| Log(AUM) | -0.001*** (-4.88) | -0.001*** (-4.12) | -0.000 (-0.42) | 0.001 (1.35) | 0.002** (2.13) | -0.000 (-0.60) |
| Log(Dollar Trading Volume) | 0.001*** (6.08) | 0.001*** (6.52) | 0.000** (2.31) | 0.001*** (3.93) | 0.000*** (3.36) | 0.000** (2.49) |
| Absolute Order Imbalance | -0.000 (-1.38) | -0.000 (-0.99) | 0.000 (0.51) | -0.000** (-2.16) | -0.000** (-2.03) | 0.000 (0.69) |
| Intraday Volatility | 0.001*** (4.15) | 0.001*** (4.53) | 0.000** (2.07) | -0.000 (-1.17) | -0.001* (-1.67) | 0.000 (1.01) |
| Shares Outstanding Growth | 0.001** (2.52) | -0.000 (-0.15) | 0.001*** (3.47) | 0.000 (0.55) | -0.001 (-1.15) | 0.001*** (3.49) |
| Log(Shares Outstanding) | 0.000** (2.15) | 0.000 (1.52) | -0.000* (-1.75) | -0.001 (-1.20) | -0.001** (-2.05) | -0.000 (-0.53) |
| Equity-type ETF | -0.000 (-0.55) | -0.001 (-0.97) | -0.000 (-0.60) | 0.002 (1.26) | 0.002 (1.45) | -0.000 (-0.76) |
| Invested in US assets | -0.005*** (-13.58) | -0.003*** (-13.83) | -0.003*** (-7.88) | -0.002** (-2.04) | 0.000 (0.19) | -0.003*** (-4.64) |
| Swap Based | 0.002 (0.85) | -0.001 (-1.04) | 0.004* (1.68) | 0.003 (1.08) | -0.001 (-0.39) | 0.004 (1.64) |
| Derivatives Based | -0.001 (-0.51) | -0.002 (-1.61) | 0.000 (0.58) | 0.001 (0.90) | 0.000 (0.39) | 0.000 (0.30) |
| Leveraged Fund | 0.000 (0.15) | 0.001 (1.60) | -0.001 (-0.36) | 0.001 (0.21) | 0.002 (1.24) | -0.001 (-0.37) |
| Futures Available | -0.001* (-1.71) | -0.000 (-0.52) | -0.000 (-1.27) | -0.002*** (-2.73) | -0.001** (-2.35) | -0.000 (-0.62) |
| Options Available | -0.000* (-1.71) | -0.001*** (-5.51) | 0.001*** (4.02) | 0.001* (1.66) | 0.001 (1.32) | 0.001* (1.79) |
| Inkind | -0.000 (-1.15) | -0.000 (-0.98) | -0.000 (-1.55) | -0.000 (-0.76) | -0.000 (-0.59) | -0.000 (-1.48) |
| Optimized | 0.000 (0.42) | 0.001*** (2.85) | -0.001*** (-4.25) | 0.001* (1.82) | 0.002*** (3.17) | -0.001*** (-3.26) |
| Expense Ratio | 0.002*** (2.70) | 0.003*** (5.65) | -0.000 (-0.68) | 0.001 (0.85) | 0.001* (1.77) | -0.000 (-0.47) |
| Day Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1, 113, 226 | 1, 155, 597 | 1, 113, 376 | 1, 113, 226 | 1, 155, 597 | 1, 113, 376 |
| Adjusted R^2 | 0.250 | 0.212 | 0.109 | -0.520 | -1.217 | 0.090 |

Table IA4: ETF illiquidity and tracking errors with Different time period : Instrumental Variable Approach

This table reports coefficients estimates of daily regressions of ETF tracking errors on ETF illiquidity. The dependent variables are daily tracking errors, calculated by taking the absolute values of daily return differences between ETF and its index (I, IV, VII), between ETF and its NAV (II, V, VII), or between NAV and its index (III, VI, IX). We divide our sample period into three regimes: before(2002-2006), during(2007-2008), and after(2009-2012) the financial crisis period. All regressions are two-stage regression results by employing an instrumental variable. The instrumental variable is an indicator variable if an ETF receives a threshold flag. The first day of the threshold flag as the indicator value is one if the ETF receives the threshold flag on consecutive days. The main independent variable is the daily relative effective spread (ETF illiquidity) computed from the NYSE TAQ. All other daily variables are defined in Appendix B. All regressions include day fixed effects. T-statistics based on standard errors double clustered at the fund and day level are provided in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

| | Year < 2007 | | | Year = 2007 or 2008 | | | Year > 2008 | | |
|----------------------------|----------------------|----------------------|---------------------|---------------------|--------------------|--------------------|----------------------|----------------------|--------------------|
| | (I) ETF-IND | (II) ETF-NAV | (III) NAV-IND | (IV) ETF-IND | (V) ETF-NAV | (VI) NAV-IND | (VII) ETF-IND | (VIII) ETF-NAV | (IX) NAV-IND |
| ETF Illiquidity | 1.027 (0.62) | 3.960** (2.33) | -0.922 (-0.65) | 1.929 (0.44) | -10.295 (-0.54) | 5.172 (0.75) | 3.466*** (3.65) | 3.470*** (4.27) | 5.172 (0.75) |
| Log(AUM) | -0.000 (-0.11) | 0.002 (1.57) | -0.001 (-0.74) | -0.000 (-0.08) | -0.009 (-0.66) | 0.004 (0.82) | 0.001 (1.23) | 0.001* (1.81) | 0.004 (0.82) |
| Log(Dollar Trading Volume) | 0.000** (2.40) | 0.000*** (2.69) | 0.000 (0.10) | 0.001*** (3.67) | 0.001 (1.57) | 0.000 (0.98) | 0.000** (2.18) | 0.000** (2.38) | 0.000 (0.98) |
| Absolute Order Imbalance | -0.000* (-1.74) | -0.000 (-1.26) | 0.000 (0.57) | -0.000 (-0.92) | 0.000 (0.41) | -0.000 (-0.75) | -0.000* (-1.79) | -0.000* (-1.70) | -0.000 (-0.75) |
| Intraday Volatility | -0.000 (-0.05) | -0.012* (-1.66) | 0.004 (0.78) | -0.000 (-0.12) | 0.005 (0.61) | -0.002 (-0.66) | -0.001 (-1.58) | -0.001* (-1.77) | -0.002 (-0.66) |
| Shares Outstanding Growth | -0.000 (-0.73) | -0.000 (-0.61) | 0.000 (0.43) | -0.000 (-0.29) | 0.002 (0.51) | -0.001 (-0.59) | 0.002*** (3.16) | 0.001 (1.54) | -0.001 (-0.59) |
| Log(Shares Outstanding) | 0.000 (0.22) | -0.001 (-1.42) | 0.000 (0.52) | 0.000 (0.12) | 0.005 (0.65) | -0.003 (-1.06) | -0.000 (-0.02) | -0.000 (-0.80) | -0.003 (-1.06) |
| Derivatives Based | 0.000 (0.23) | -0.001 (-0.88) | 0.002*** (3.16) | 0.000 (0.05) | -0.010 (-0.64) | 0.005 (0.81) | 0.000 (0.20) | -0.001 (-0.71) | 0.005 (0.81) |
| Swap Based | 0.000 (0.27) | 0.000 (0.52) | -0.001** (-2.28) | 0.002 (0.32) | -0.021 (-0.68) | 0.011 (0.97) | 0.002 (1.18) | -0.000 (-0.44) | 0.011 (0.97) |
| Equity-type ETF | -0.001 (-1.05) | -0.001 (-0.59) | -0.001 (-1.27) | 0.002* (1.68) | -0.002 (-0.33) | 0.001 (0.94) | 0.000 (0.28) | 0.000 (0.08) | 0.001 (0.94) |
| Invested in US assets | -0.002** (-2.42) | -0.001 (-1.09) | -0.001 (-1.50) | -0.005 (-1.20) | -0.015 (-0.83) | 0.001 (0.22) | -0.003*** (-3.37) | -0.001 (-1.16) | 0.001 (0.22) |
| Futures Available | -0.000 (-0.46) | -0.001 (-1.64) | 0.000 (0.23) | -0.001 (-1.13) | 0.001 (0.58) | -0.002* (-1.83) | -0.002*** (-2.86) | -0.001*** (-2.61) | -0.002* (-1.83) |
| Options Available | -0.001*** (-3.57) | -0.001*** (-3.85) | 0.000* (1.73) | -0.000 (-0.18) | -0.004 (-0.79) | 0.002 (1.05) | 0.001** (2.07) | 0.001 (1.42) | 0.002 (1.05) |
| Leveraged Fund | -0.003** (-2.18) | -0.001 (-1.24) | -0.001 (-0.94) | -0.002 (-0.23) | 0.026 (0.69) | -0.013 (-0.93) | 0.002 (0.72) | 0.002** (2.06) | -0.013 (-0.93) |
| Expense Ratio | 0.002** (2.49) | 0.001 (0.79) | 0.000 (0.08) | 0.003** (2.36) | 0.004 (1.20) | 0.001 (0.48) | 0.001 (1.29) | 0.002*** (3.45) | 0.001 (0.48) |
| Inkind | -0.001* (-1.91) | -0.001 (-1.42) | -0.000 (-0.73) | -0.001* (-1.74) | -0.003 (-0.99) | -0.000 (-0.11) | -0.000 (-0.04) | 0.000 (0.14) | -0.000 (-0.11) |
| Optimized | -0.000 (-0.08) | -0.001 (-1.43) | 0.000 (1.06) | 0.001 (0.80) | -0.001 (-0.25) | -0.000 (-0.14) | 0.001** (2.11) | 0.001*** (3.81) | -0.000 (-0.14) |
| Day Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 162,136 | 172,988 | 162,158 | 209,492 | 226,313 | 209,542 | 741,598 | 756,296 | 209,542 |
| Adjusted R ² | 0.300 | -0.080 | -0.028 | 0.183 | -4.155 | -1.721 | -0.160 | -0.311 | -1.721 |

Table IA5: Properties of equal-weighted portfolios

This table presents the characteristics of 10 equal-weighted liquidity and tracking error portfolio. The 10 liquidity portfolios are constructed for each month m by ranking all ETFs with their liquidity measures at the end of month $m - 1$. The liquidity (c) for each month is the average of the daily relative effective half-spread of each ETF with at least 15 observations in each month. The 10 tracking error portfolios are formed for each month m by sorting the ETFs with at least 15 observations in the previous year with tracking error. The tracking error ($|1 - \theta|$) is defined as the absolute difference between one and the estimated coefficient (θ) from the regression of the ETF return on the underlying index return. $Prem$ is the ETF premium or discount, defined as the difference between the ETF price and the NAV divided by the NAV. trn denotes the daily ETF turnover defined as the trading volume divided by the ETF shares outstanding. $\sigma(r^P)$ is the standard deviation of the daily portfolio return. $\sigma(r^{e:P})$ is the standard deviation of the daily portfolio excess return on the underlying index return. Numbers in parentheses are t-statistics.

| | β^{1p} (.10) | β^{2p} (.10) | β^{3p} (.10) | β^{4p} (.10) | $E(c^P)$ (%) | $ 1 - \theta $ (%) | $Prem$ (%) | trn (%) | $\sigma(r^P)$ (%) | $\sigma(r^{e:P})$ (%) |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------|-----------------------|---------------|--------------|----------------------|--------------------------|
| <i>Panel A. Illiquidity portfolios</i> | | | | | | | | | | |
| 1 | 11.039 (188.22) | 0.002 (55.84) | -0.050 (-7.22) | -0.010 (-5.62) | 0.031 | 8.209 | 0.033 | 7.823 | 1.179 | 0.203 |
| 2 | 11.272 (186.82) | 0.005 (50.51) | -0.053 (-7.50) | -0.018 (-4.25) | 0.052 | 9.317 | 0.047 | 6.392 | 1.204 | 0.180 |
| 3 | 9.941 (173.37) | 0.005 (77.47) | -0.047 (-7.33) | -0.027 (-7.45) | 0.065 | 9.832 | 0.043 | 6.434 | 1.068 | 0.174 |
| 4 | 10.014 (185.29) | 0.007 (67.05) | -0.048 (-7.53) | -0.023 (-4.31) | 0.080 | 10.066 | 0.039 | 6.771 | 1.070 | 0.168 |
| 5 | 10.025 (167.23) | 0.008 (79.16) | -0.052 (-8.14) | -0.033 (-5.65) | 0.096 | 11.652 | 0.034 | 4.735 | 1.080 | 0.212 |
| 6 | 10.467 (174.66) | 0.009 (77.28) | -0.053 (-7.94) | -0.052 (-8.32) | 0.115 | 14.943 | 0.028 | 3.726 | 1.124 | 0.220 |
| 7 | 11.114 (178.16) | 0.010 (71.41) | -0.054 (-7.62) | -0.064 (-8.67) | 0.141 | 15.946 | 0.030 | 3.074 | 1.192 | 0.255 |
| 8 | 11.609 (190.15) | 0.014 (77.62) | -0.063 (-8.57) | -0.074 (-7.51) | 0.180 | 19.654 | 0.030 | 2.495 | 1.238 | 0.339 |
| 9 | 11.023 (149.02) | 0.015 (63.15) | -0.069 (-9.62) | -0.095 (-8.32) | 0.250 | 21.440 | 0.046 | 2.106 | 1.201 | 0.481 |
| 10 | 11.399 (130.09) | 0.026 (59.77) | -0.080 (-10.76) | -0.144 (-7.15) | 0.438 | 25.232 | 0.046 | 1.942 | 1.263 | 0.479 |
| <i>Panel B. Tracking Error Portfolios (Regression)</i> | | | | | | | | | | |
| 1 | 10.921 (143.56) | 0.007 (48.59) | -0.050 (-7.06) | -0.051 (-9.02) | 0.097 | 6.191 | 0.043 | 6.107 | 1.198 | 0.168 |
| 2 | 11.217 (173.93) | 0.009 (57.07) | -0.057 (-7.94) | -0.034 (-4.85) | 0.101 | 6.486 | 0.045 | 6.219 | 1.208 | 0.176 |
| 3 | 10.821 (185.72) | 0.008 (62.08) | -0.049 (-7.17) | -0.054 (-8.41) | 0.104 | 6.851 | 0.045 | 6.377 | 1.160 | 0.163 |
| 4 | 11.085 (173.04) | 0.010 (63.03) | -0.057 (-8.15) | -0.042 (-5.35) | 0.113 | 7.732 | 0.046 | 5.776 | 1.195 | 0.180 |
| 5 | 10.363 (167.70) | 0.009 (62.22) | -0.054 (-8.21) | -0.059 (-8.44) | 0.122 | 8.785 | 0.049 | 5.502 | 1.119 | 0.186 |
| 6 | 10.649 (182.90) | 0.012 (66.02) | -0.056 (-8.33) | -0.053 (-6.03) | 0.136 | 10.706 | 0.056 | 4.649 | 1.142 | 0.192 |
| 7 | 11.023 | 0.010 | -0.057 | -0.060 | 0.156 | 13.236 | 0.083 | 3.883 | 1.177 | 0.259 |

Table IA5: Properties of equal-weighted portfolios - Continued

| | β^{1p} | β^{2p} | β^{3p} | β^{4p} | $E(c^p)$ | $ 1 - \theta $ | $Prem$ | trn | $\sigma(r^p)$ | $\sigma(r^{e.p})$ |
|----|--------------------|------------------|-------------------|-------------------|----------|----------------|--------|-------|---------------|-------------------|
| | (.10) | (.10) | (.10) | (.10) | (%) | (%) | (%) | (%) | (%) | (%) |
| 8 | (192.60) 11.357 | (57.97) 0.010 | (-8.26) -0.059 | (-7.40) -0.054 | 0.177 | 16.808 | 0.099 | 3.527 | 1.214 | 0.342 |
| 9 | (191.05) 10.648 | (49.13) 0.014 | (-8.22) -0.067 | (-6.27) -0.064 | 0.195 | 22.734 | 0.154 | 2.765 | 1.158 | 0.464 |
| 10 | (154.81) 8.893 | (54.61) 0.011 | (-9.94) -0.055 | (-5.43) -0.062 | 0.217 | 42.705 | 0.139 | 2.443 | 0.996 | 0.598 |
| | (122.59) | (34.06) | (-9.45) | (-5.29) | | | | | | |

Panel C. Tracking Error Portfolios (Excess Return Volatility)

| | | | | | | | | | | |
|----|--------------------|------------------|--------------------|--------------------|-------|--------|-------|-------|-------|-------|
| 1 | 10.719 (175.48) | 0.005 (58.75) | -0.048 (-7.07) | -0.023 (-5.66) | 0.055 | 4.357 | 0.029 | 3.888 | 1.153 | 0.083 |
| 2 | 10.836 (177.78) | 0.006 (76.01) | -0.050 (-7.32) | -0.027 (-6.03) | 0.066 | 5.615 | 0.031 | 4.823 | 1.165 | 0.096 |
| 3 | 10.161 (159.35) | 0.007 (74.13) | -0.047 (-7.20) | -0.030 (-5.96) | 0.081 | 8.273 | 0.039 | 5.652 | 1.102 | 0.154 |
| 4 | 9.632 (155.24) | 0.008 (88.66) | -0.042 (-6.72) | -0.041 (-7.11) | 0.095 | 9.852 | 0.044 | 6.098 | 1.047 | 0.158 |
| 5 | 10.071 (179.90) | 0.010 (79.71) | -0.050 (-7.83) | -0.050 (-7.04) | 0.114 | 11.004 | 0.044 | 6.626 | 1.081 | 0.161 |
| 6 | 10.653 (177.55) | 0.015 (58.69) | -0.057 (-8.44) | -0.050 (-4.20) | 0.144 | 13.468 | 0.059 | 5.615 | 1.146 | 0.196 |
| 7 | 11.021 (158.90) | 0.014 (72.23) | -0.057 (-8.18) | -0.077 (-7.48) | 0.184 | 15.871 | 0.085 | 4.322 | 1.196 | 0.298 |
| 8 | 11.958 (162.04) | 0.011 (45.27) | -0.081 (-10.84) | -0.058 (-5.88) | 0.206 | 19.124 | 0.138 | 3.018 | 1.295 | 0.489 |
| 9 | 12.190 (148.19) | 0.011 (46.40) | -0.077 (-9.83) | -0.110 (-10.96) | 0.225 | 23.797 | 0.136 | 2.667 | 1.332 | 0.705 |
| 10 | 9.816 (87.75) | 0.012 (32.59) | -0.051 (-7.37) | -0.083 (-6.20) | 0.254 | 30.697 | 0.154 | 4.650 | 1.178 | 0.699 |

Table IA6: Properties of equal-weighted averages of individual ETFs

This table presents the characteristics of 10 equal-weighted liquidity and tracking error portfolios based on individual betas of ETFs. The method for constructing portfolios and variable definitions are the same as in Table ???. When estimating individual betas, we use the equal-weighted market returns and illiquidity. After estimating yearly betas for each ETF, equal-weighted averages within portfolios are reported. Numbers in parentheses are t-statistics.

| | β^{1p} (.10) | β^{2p} (.10) | β^{3p} (.10) | β^{4p} (.10) | $E(c^p)$ (%) | $ 1 - \theta $ (%) | $Prem$ (%) | trn (%) | $\sigma(r^p)$ (%) | $\sigma(r^{e,p})$ (%) |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------|-----------------------|---------------|--------------|----------------------|--------------------------|
| <i>Panel A. Illiquidity portfolios</i> | | | | | | | | | | |
| 1 | 9.369 (154.53) | 0.001 (1.94) | -0.031 (-4.66) | -0.008 (-3.93) | 0.029 | 5.946 | 0.023 | 7.847 | 1.277 | 0.364 |
| 2 | 9.330 (95.94) | 0.002 (1.87) | -0.029 (-4.00) | -0.010 (-2.58) | 0.049 | 6.891 | 0.052 | 8.128 | 1.438 | 0.421 |
| 3 | 9.307 (123.88) | 0.017 (1.12) | -0.050 (-2.23) | -0.013 (-5.22) | 0.063 | 7.232 | 0.041 | 7.105 | 1.533 | 0.470 |
| 4 | 9.352 (71.05) | 0.003 (2.44) | -0.026 (-3.54) | -0.018 (-4.08) | 0.075 | 6.622 | 0.016 | 5.521 | 1.588 | 0.493 |
| 5 | 9.268 (68.80) | 0.004 (2.03) | -0.031 (-3.96) | -0.022 (-3.54) | 0.089 | 7.763 | 0.031 | 4.563 | 1.599 | 0.557 |
| 6 | 9.148 (91.04) | 0.004 (1.70) | -0.029 (-3.64) | -0.027 (-2.65) | 0.108 | 8.818 | 0.016 | 3.225 | 1.595 | 0.586 |
| 7 | 9.062 (99.67) | 0.006 (2.58) | -0.040 (-2.51) | -0.032 (-3.54) | 0.131 | 11.820 | 0.075 | 3.166 | 1.610 | 0.698 |
| 8 | 8.897 (76.06) | 0.012 (1.92) | -0.046 (-2.95) | -0.052 (-3.58) | 0.170 | 13.956 | 0.077 | 2.365 | 1.749 | 0.883 |
| 9 | 8.653 (77.68) | 0.010 (2.25) | -0.063 (-2.67) | -0.061 (-4.59) | 0.210 | 15.518 | 0.139 | 2.284 | 1.774 | 0.987 |
| 10 | 8.765 (54.05) | 0.016 (2.66) | -0.045 (-3.61) | -0.150 (-5.47) | 0.360 | 14.895 | 0.104 | 1.861 | 1.764 | 1.147 |
| <i>Panel B. Tracking Error Portfolios (Regression)</i> | | | | | | | | | | |
| 1 | 9.764 (199.63) | 0.004 (1.64) | -0.036 (-2.70) | -0.019 (-2.23) | 0.082 | 3.175 | 0.019 | 5.432 | 1.621 | 0.358 |
| 2 | 9.724 (198.24) | 0.003 (1.76) | -0.027 (-3.78) | -0.020 (-2.78) | 0.085 | 3.031 | 0.050 | 7.885 | 1.575 | 0.364 |
| 3 | 9.667 (166.62) | 0.003 (1.87) | -0.028 (-3.95) | -0.024 (-3.26) | 0.092 | 3.765 | 0.065 | 4.796 | 1.556 | 0.368 |
| 4 | 9.606 (110.57) | 0.002 (2.32) | -0.025 (-4.53) | -0.024 (-5.12) | 0.090 | 4.690 | 0.031 | 6.262 | 1.608 | 0.405 |
| 5 | 9.490 (137.16) | 0.005 (2.76) | -0.028 (-3.83) | -0.034 (-3.40) | 0.120 | 5.562 | 0.060 | 6.441 | 1.692 | 0.552 |
| 6 | 9.483 (124.50) | 0.003 (1.90) | -0.029 (-3.37) | -0.039 (-6.61) | 0.122 | 6.731 | 0.053 | 5.739 | 1.650 | 0.617 |
| 7 | 9.313 (87.72) | 0.010 (2.15) | -0.044 (-4.39) | -0.040 (-3.06) | 0.160 | 8.647 | 0.070 | 3.402 | 1.589 | 0.746 |
| 8 | 9.008 (58.33) | 0.006 (2.77) | -0.034 (-3.70) | -0.053 (-5.24) | 0.155 | 12.420 | 0.090 | 1.889 | 1.506 | 0.834 |
| 9 | 8.298 (77.86) | 0.012 (2.65) | -0.043 (-2.90) | -0.078 (-4.80) | 0.187 | 17.624 | 0.090 | 1.844 | 1.542 | 1.021 |
| 10 | 6.746 | 0.029 | -0.097 | -0.066 | 0.187 | 34.334 | 0.059 | 2.562 | 1.594 | 1.333 |

Table IA6: Properties of equal-weighted averages of individual ETFs

| | β^{1p} | β^{2p} | β^{3p} | β^{4p} | $E(c^p)$ | $ 1 - \theta $ | $Prem$ | trn | $\sigma(r^p)$ | $\sigma(r^{e.p})$ |
|--|-------------------|-----------------|-------------------|-------------------|----------|----------------|--------|-------|---------------|-------------------|
| | (.10) | (.10) | (.10) | (.10) | (%) | (%) | (%) | (%) | (%) | (%) |
| | (33.55) | (1.77) | (-3.48) | (-3.09) | | | | | | |
| <i>Panel C. Tracking Error Portfolios (Excess Return Volatility)</i> | | | | | | | | | | |
| 1 | 9.713 (218.43) | 0.003 (1.67) | -0.028 (-5.03) | -0.012 (-2.50) | 0.045 | 2.421 | 0.017 | 3.968 | 1.217 | 0.174 |
| 2 | 9.621 (181.19) | 0.004 (2.22) | -0.039 (-3.57) | -0.018 (-2.70) | 0.056 | 3.404 | 0.027 | 4.644 | 1.292 | 0.227 |
| 3 | 9.571 (115.66) | 0.032 (1.93) | -0.058 (-2.69) | -0.021 (-2.50) | 0.074 | 5.730 | 0.015 | 5.818 | 1.416 | 0.297 |
| 4 | 9.466 (99.27) | 0.012 (2.12) | -0.037 (-4.20) | -0.027 (-2.36) | 0.087 | 5.848 | 0.058 | 5.184 | 1.460 | 0.372 |
| 5 | 9.475 (106.53) | 0.000 (0.00) | -0.044 (-3.19) | -0.031 (-4.53) | 0.103 | 6.307 | 0.018 | 5.360 | 1.579 | 0.439 |
| 6 | 9.424 (92.94) | 0.005 (1.98) | -0.034 (-3.55) | -0.042 (-3.30) | 0.138 | 8.414 | 0.054 | 7.284 | 1.647 | 0.595 |
| 7 | 9.155 (68.54) | 0.006 (2.31) | -0.039 (-2.95) | -0.049 (-2.82) | 0.166 | 10.635 | 0.052 | 4.414 | 1.728 | 0.749 |
| 8 | 8.929 (53.39) | 0.005 (2.46) | -0.050 (-2.70) | -0.064 (-6.87) | 0.180 | 12.905 | 0.141 | 2.915 | 1.661 | 0.954 |
| 9 | 8.136 (70.70) | 0.005 (2.56) | -0.036 (-3.84) | -0.054 (-4.09) | 0.201 | 19.470 | 0.153 | 2.678 | 1.741 | 1.177 |
| 10 | 7.633 (36.35) | 0.003 (3.21) | -0.029 (-3.72) | -0.079 (-4.45) | 0.231 | 24.568 | 0.051 | 4.006 | 2.198 | 1.617 |

Table IA7: Liquidity premium from equal-weighted portfolio betas

This table presents the estimated coefficients from cross-sectional regressions of the LCAPM for 10 equal-weighted portfolios using daily data during 2002-2012. The odd and even lines of each panel report the estimation results when κ is fixed as the average daily turnover rate and is treated as the free parameter, respectively. Numbers in parentheses are t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

| | Constant (.01) | $E(c^p)$ (.01) | β^{1p} (.01) | β^{2p} (.01) | β^{3p} (.01) | β^{4p} (.01) | $\beta^{net,p}$ (.01) |
|---|----------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------------|
| <i>Panel A. Illiquidity portfolios</i> | | | | | | | |
| 1 | -0.02*** (-9.12) | 4.55 | | | | | 0.05*** (9.52) |
| 2 | -0.02*** (-10.93) | -117.88*** (-10.69) | | | | | 0.05*** (9.60) |
| 3 | -0.07*** (-12.19) | 4.55 | -0.79 (-1.02) | | | | 0.88 (1.16) |
| 4 | -0.07*** (-12.23) | 17.03*** (3.26) | -0.85 (-1.10) | | | | 0.95 (1.24) |
| 5 | -0.01*** (-8.94) | 4.55 | 0.03 (0.24) | 5.95 (0.10) | -4.41 (-0.15) | 1.87 (0.22) | |
| 6 | -0.02*** (-10.54) | -110.54*** (-10.52) | -0.02 (-0.14) | 3.23 (0.05) | -15.11 (-0.52) | 3.41 (0.40) | |
| <i>Panel B. Tracking Error Portfolios(Regression)</i> | | | | | | | |
| 1 | -0.02*** (-8.86) | 4.73 | | | | | 0.04*** (7.77) |
| 2 | -0.02*** (-10.67) | -91.99*** (-9.78) | | | | | 0.05*** (8.00) |
| 3 | -0.08*** (-12.56) | 4.73 | -7.85*** (-3.50) | | | | 7.87*** (3.55) |
| 4 | -0.08*** (-12.49) | 32.59*** (5.87) | -7.79*** (-3.46) | | | | 7.81*** (3.51) |
| 5 | -0.01*** (-8.30) | 4.73 | 0.01 (0.05) | -22.89 (-0.28) | -6.25 (-0.20) | -5.41 (-0.69) | |
| 6 | -0.02*** (-10.14) | -95.43*** (-10.02) | 0.01 (0.10) | -7.78 (-0.09) | -3.12 (-0.10) | -5.12 (-0.66) | |
| <i>Panel C. Tracking Error Portfolios(Standard Deviation)</i> | | | | | | | |
| 1 | -0.02*** (-7.63) | 4.74 | | | | | 0.04*** (6.70) |
| 2 | -0.02*** (-9.65) | -154.65*** (-9.69) | | | | | 0.04*** (6.64) |
| 3 | -0.07*** (-11.82) | 4.74 | 1.43 (1.14) | | | | -1.31 (-1.06) |
| 4 | -0.07*** (-11.90) | 9.64 (1.36) | 1.51 (1.20) | | | | -1.38 (-1.12) |
| 5 | -0.01*** (-7.59) | 4.74 | 0.05 (1.04) | 4.50 (0.15) | 3.76 (0.38) | -0.40 (-0.10) | |
| 6 | -0.02*** (-9.72) | -145.11*** (-9.83) | 0.06 (1.18) | -4.08 (-0.14) | 3.30 (0.34) | -0.45 (-0.11) | |

Table IA8: Liquidity premium from individual betas estimated from equal-weighted market variables

This table presents the estimated coefficients from cross-sectional regressions of the LCAPM for individual securities using daily data during 2002-2012. When estimating individual betas, we use the equal-weighted market returns and illiquidity. The odd and even lines of each panel report the estimation results when κ is fixed as the average daily turnover rate and is treated as the free parameter, respectively. Numbers in parentheses are t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

| | Constant (.01) | $E(c^i)$ (.01) | β^{1i} (.01) | β^{2i} (.01) | β^{3i} (.01) | β^{4i} (.01) | $\beta^{net,i}$ (.01) |
|---|----------------------|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------------|
| 1 | -0.01*** (-13.76) | 5.50 | | | | | 0.03*** (16.76) |
| 2 | -0.01*** (-13.76) | -0.81 (-0.40) | | | | | 0.03*** (16.76) |
| 3 | -0.04*** (-25.40) | 5.50 | 0.03 (1.41) | | | | 0.04** (2.46) |
| 4 | -0.04*** (-25.03) | 14.68*** (6.54) | 0.02 (0.86) | | | | 0.05*** (2.94) |
| 5 | -0.01*** (-11.56) | 5.50 | 0.03*** (15.60) | -0.04*** (-3.58) | -0.05*** (-5.63) | -0.02 (-0.51) | |
| 6 | -0.01*** (-13.17) | -4.25** (-2.11) | 0.03*** (15.70) | -0.04*** (-3.56) | -0.05*** (-5.62) | -0.02 (-0.65) | |