

## **A Lottery Demand-Based Explanation of the Beta Anomaly**

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### **Internet Appendix**

Section IA-I provides details of the calculation of the variables used in the paper. Section IA-II examines the robustness of the beta anomaly. Section IA-III tests the robustness of the lottery demand phenomenon. Section IA-IV demonstrates the robustness of the ability of lottery demand to explain the beta anomaly. Section IA-V shows that the ability of lottery demand to explain the beta anomaly is robust in the extended (1931–2012) sample. Section IA-VI shows that the ability of a lottery demand factor to explain the beta anomaly is robust in the main (1963–2012) sample. Section IA-VII demonstrates that lottery patterns identified by previous work on lottery demand are robust when using MAX as the measure of lottery demand.

## IA-I Variables

In this Section, we describe in detail how each of the variables used in this paper is calculated. For variables calculated using 1 year's worth of daily data ( $\beta$ , COSKEW, TSKEW, DRISK, TRISK), we require a minimum of 200 valid daily return observations during the calculation period. For variables calculated using 1 month's worth of daily data (MAX, IVOL, ILLIQ), we require 15 valid daily return observations during the given month. For variables calculated using 5 years' worth of monthly data ( $\beta_{\text{TED}}$ ,  $\beta_{\text{VOLTED}}$ ,  $\beta_{\text{TBILL}}$ , and  $\beta_{\text{FLEV}}$ ), we require a minimum of 24 valid monthly return observations during the 5-year measurement period. If the data requirements for calculating the value of a variable for a stock  $i$  in a month  $t$  are not satisfied, the given stock-month observation is not included in empirical analyses that use the variable. Variables that are measured on a return scale (R, MAX, MOM, IVOL) are recorded as percentages.

*Market Beta ( $\beta$ ):* We calculate  $\beta$  using a 1-factor market model regression specification applied to 1 year of daily return data. The regression specification is

$$(IA-1) \quad r_{i,d} = a + b_1 \text{MKTRF}_d + e_{i,d},$$

where  $r_{i,d}$  and  $\text{MKTRF}_d$  are the excess returns of the stock and the market portfolio, respectively, on day  $d$ .  $\beta$  is taken to be the fitted value of the regression coefficient  $b_1$ . To calculate stock  $i$ 's month  $t$  value of  $\beta$ , the regression is fit using daily return data covering the 12-months up to and including the month for which  $\beta$  is being calculated (months  $t - 11$  through  $t$ , inclusive). Daily stock return data come from CRSP. Daily market excess return and risk-free security return data are taken from Kenneth French's data library at [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The stock excess return is calculated as the stock return minus the return on the risk-free security.

*Lottery Demand (MAX):* The month  $t$  value of MAX for any stock is calculated as the average of the 5 highest daily returns of the stock in the given month  $t$ . Daily stock return data come from CRSP.

*Monthly Stock Excess Return (R):* The monthly excess return of a stock (R) in month  $t + 1$  is calculated as the stock's month  $t + 1$  return, taken from the CRSP database, minus the month  $t + 1$  return of the risk-free security, taken from Kenneth French's data library. We adjust the monthly returns from CRSP for delisting according to Shumway (1997). Specifically, if a delisting return is provided in the CRSP database, we take the monthly return of the stock to be the delisting return. If no delisting return is available, then we determine the stock's monthly return based on the delisting code in CRSP. If the delisting code is 500 (reason unavailable), 520 (went to OTC), 551–573 or 580 (various reasons), 574 (bankruptcy), or 584 (does not meet exchange financial guidelines), we take the stock's return during the delisting month to be  $-30\%$ . If the delisting code has a value other than the previously mentioned values and there is no delisting return, we take the stock's return during the delisting month to be  $-100\%$ .

*Market Capitalization and Size (MKTCAP and SIZE):* We calculate the month  $t$  market capitalization (MKTCAP) of a stock as the month-end stock price times the number of shares outstanding, taken from CRSP and measured in millions of dollars. Since the distribution of MKTCAP is highly skewed, in statistical analyses that rely on the magnitude of market capitalization, we use the natural log of MKTCAP, which we denote SIZE.

*Book-to-Market Ratio (BM):* Following Fama and French (1992, 1993), we define the book-to-market ratio for the months  $t$  from June of year  $y$  through May of year  $y + 1$  to be the book value of equity of the stock, calculated using balance sheet data from Compustat for the fiscal year ending in calendar year  $y - 1$ , divided by the market capitalization of the stock at the end of calendar year  $y - 1$ . The book value of equity is defined as stockholders' equity plus balance sheet deferred taxes plus investment tax credit minus the book value of preferred stock. The book value of preferred stock is taken to be either the redemption value, the liquidating value, or the convertible value, taken as available in that order. For observations where the book value is negative, we deem the book-to-market ratio to be missing. We define our main measure of book-to-market ratio,  $BM$ , to be the natural log of the book-to-market ratio.

*Momentum (MOM):* To control for the medium-term momentum effect of Jegadeesh and Titman (1993), we define the month  $t$  momentum variable (MOM) to be the stock return during the 11-month period up to but not including the current month (months  $t - 11$  through  $t - 1$ , inclusive). MOM is calculated using monthly return data from CRSP. It is worth noting that this variable, used by Fama and French to calculate the momentum factor (UMD), is not actually used by Jegadeesh and Titman (1993), but similar variables are.

*Illiquidity (ILLIQ):* We define the month  $t$  illiquidity (ILLIQ) for a stock following Amihud (2002) as the average of the absolute value of the stock's return (taken as a decimal) divided by the dollar volume traded in the stock (in millions of dollars), calculated using daily data from month  $t$ . Following Gao and Ritter (2010), we adjust for institutional features of the way that volume on the NASDAQ is reported. Specifically, for stocks that trade on the NASDAQ, we divide the volume reported in CRSP by 2.0, 1.8, 1.6, and 1 for the periods prior to Feb. 2001, between Feb. 2001 and Dec. 2001, between Jan. 2002 and Dec. 2003, and during or subsequent to Jan. 2004, respectively. ILLIQ is defined as

$$(IA-2) \quad ILLIQ = \frac{\sum_{d=1}^n \frac{|r_d|}{VOLUME\$_d}}{n},$$

where  $r_d$  is the stock's return on day  $d$ ,  $VOLUME\$_d$  is the dollar volume traded in the stock on day  $d$ , and the summation is taken over all trading days in the given month.  $Volume\$_d$  is calculated as the last trade price times the number of shares traded, both on day  $d$ .

*Idiosyncratic Volatility (IVOL):* We calculate a stock's idiosyncratic volatility (IVOL) in month  $t$  following Ang, Hodrick, Xing, and Zhang (2006) as the standard deviation of the residuals from a Fama and French (1993) 3-factor regression of the stock's excess return on

the market excess return (MKTRF), size (SMB), and book-to-market ratio (HML) factors using daily return data from month  $t$ . The regression specification is

$$(IA-3) \quad r_{i,d} = a + b_1 \text{MKTRF}_d + b_2 \text{SMB}_d + b_3 \text{HML}_d + e_{i,d},$$

where  $\text{SMB}_d$  and  $\text{HML}_d$  are the returns of the size and book-to-market factors of Fama and French (1993), respectively, on day  $d$ .

*Co-Skewness (COSKEW)*: Following Harvey and Siddique (2000), we define the co-skewness (COSKEW) of a stock in any month  $t$  to be the estimated slope coefficient on the squared market excess return from a regression of the stock's excess return on the market's excess return and the squared market excess return using 1 year of daily data up to and including the month  $t$  (months  $t - 11$  through  $t$ , inclusive). Specifically, COSKEW is the estimated  $b_2$  coefficient from the regression specification

$$(IA-4) \quad r_{i,d} = a + b_1 \text{MKTRF}_d + b_2 \text{MKTRF}_d^2 + e_{i,d}.$$

*Total Skewness (TSKEW)*: We define the total skewness (TSKEW) of a stock in month  $t$  to be the skewness of the stock's daily returns calculated using 1 year of data up to and including the given month  $t$  (months  $t - 11$  through  $t$ , inclusive).

*Downside Beta (DRISK)*: Following Ang, Chen, and Xing (2006), we define downside beta (DRISK) of a stock in month  $t$  as the fitted slope coefficient from a 1-factor market model regression using daily returns from the past year (months  $t - 11$  through  $t$ , inclusive) from days when the market return was below the average daily market return during that year. The regression specification is given in equation (IA-1). DRISK is taken to be the fitted value of the coefficient  $b_1$ .

*Tail Beta (TRISK)*: Tail beta (TRISK) of a stock in a given month  $t$  is calculated as the fitted slope coefficient from a 1-factor market model regression using daily returns from the past year (months  $t - 11$  through  $t$ , inclusive) from days when the market return was in the bottom 10% of market returns during that year. The regression specification is given in equation (IA-1). TRISK is taken to be the fitted value of the coefficient  $b_1$ .

*TED Spread Sensitivity ( $\beta_{\text{TED}}$ )*: The month  $t$  TED spread sensitivity ( $\beta_{\text{TED}}$ ) of a stock is defined as the fitted slope coefficient from a regression of the stock's monthly excess returns on the TED spread using 5 years' worth of monthly data (months  $t - 59$  through  $t$ , inclusive). The TED spread is defined as the difference between the 3-month LIBOR and the yield on 3-month U.S. Treasury bills. The regression specification is

$$(IA-5) \quad R_{i,t} = a + b_1 \text{TED}_t + e_{i,t},$$

where  $R_{i,t}$  is the excess return of stock  $i$  during month  $t$  and  $\text{TED}_t$  is the TED spread at the end of month  $t$ . The 3-month LIBOR and U.S. Treasury bill yields are downloaded from Global Insight. Month-end TED spread data is available beginning in Jan. 1963, thus  $\beta_{\text{TED}}$  is only available beginning in Dec. 1967.

*TED Spread Volatility Sensitivity* ( $\beta_{VOLTED}$ ): The month  $t$  sensitivity to TED spread volatility ( $\beta_{VOLTED}$ ) of a stock is defined as the fitted slope coefficient from a regression of the stock's monthly excess returns on TED spread volatility using 5 years worth of monthly data (months  $t - 59$  through  $t$ , inclusive). The TED spread volatility for a given month is defined as the standard deviation of the daily TED spreads within the given month. The regression specification is

$$(IA-6) \quad R_{i,t} = a + b_1 VOLTED_t + e_{i,t},$$

where  $R_{i,t}$  is the excess return of stock  $i$  during month  $t$  and  $VOLTED_t$  is the TED spread volatility during month  $t$ . Daily TED spread data is available beginning in Jan. 1977, thus  $\beta_{VOLTED}$  is available beginning in Dec. 1981.

*Treasury Bill Sensitivity* ( $\beta_{TBILL}$ ): The month  $t$  sensitivity to U.S. Treasury bill rates ( $\beta_{TBILL}$ ) of a stock is defined as the fitted slope coefficient from a regression of the stock's monthly excess returns on the 3-month U.S. Treasury bill rate using 5 years' worth of monthly data (months  $t - 59$  through  $t$ , inclusive). The regression specification is

$$(IA-7) \quad R_{i,t} = a + b_1 TBILL_t + e_{i,t},$$

where  $R_{i,t}$  is the excess return of stock  $i$  during month  $t$  and  $TBILL_t$  is the yield on the 3-month U.S. Treasury bill at the end of month  $t$ . Yields on the 3-month U.S. Treasury bills are taken from the FRED database.

*Financial Sector Leverage Sensitivity* ( $\beta_{FLEV}$ ): The month  $t$  financial sector leverage sensitivity ( $\beta_{FLEV}$ ) of a stock is defined as the fitted slope coefficient from a regression of the stock's monthly excess returns on the month-end leverage of the financial sector (FLEV) using 5 years' worth of monthly data (months  $t - 59$  through  $t$ , inclusive). The regression specification is

$$(IA-8) \quad R_{i,t} = a + b_1 FLEV_t + e_{i,t},$$

where  $R_{i,t}$  is the excess return of stock  $i$  during month  $t$  and  $FLEV_t$  is the financial sector leverage at the end of month  $t$ . Financial sector leverage is defined as the total balance sheet assets of all financial sector firms divided by the total market value of equity of all financial sector firms. Firm-level balance sheet assets are taken from Compustat's quarterly database and aggregated to calculate the total balance sheet assets of all firms in the sector. Since the firm-level assets are reported quarterly, to obtain monthly firm-level assets, the month  $t$  balance sheet assets is taken to be the quarter-end assets for the fiscal quarter within which month  $t$  falls. Firm level market capitalization is simply MKTCAP, defined above, and is aggregated in the same manner. Financial sector firms are taken to be firms with Standard Industrial Classification (SIC) codes between 6000 and 6999, inclusive.

## IA-II The Beta Anomaly

In this section we demonstrate that the results of the univariate portfolio analysis examining the relation between market beta and future stock returns are robust.

### IA-II.A Alternative measures of beta

Scholes and Williams (1977) find that when trading is non-synchronous, the standard CAPM-regression method of estimating beta used in our primary calculation of market beta— $\beta$ , described in the main paper—may be biased. To adjust for this bias, Scholes and Williams (1977) propose calculating beta as the sum of estimated slope coefficients from separate regressions of the stock's excess return on each of the contemporaneous, 1-day lagged, and 1-day-ahead market excess return, divided by 1 plus two times the serial correlation of the market excess return. Thus, we define  $\beta_{SW}$  as

$$(IA-9) \quad \beta_{SW} = \frac{\hat{b}_1 + \hat{b}_2 + \hat{b}_3}{1 + 2\rho_m},$$

where  $\rho_m$  is the serial correlation of the market excess return,  $\hat{b}_1$ ,  $\hat{b}_2$ , and  $\hat{b}_3$  are the fitted slope coefficients from regression models

$$(IA-10) \quad r_{i,d} = a + b_1 r_{m,d-1} + e_{i,d},$$

$$(IA-11) \quad r_{i,d} = a + b_2 r_{m,d} + e_{i,d},$$

and

$$(IA-12) \quad r_{i,d} = a + b_3 r_{m,d+1} + e_{i,d}$$

and  $r_{i,d}$  and  $r_{m,d}$  are the excess returns of the stock  $i$  and the market, respectively, on day  $d$ .

Similarly, Dimson (1979) finds that for infrequently traded securities the standard estimates of beta may be biased, and shows that this bias can be addressed by estimating beta as the sum of the slope coefficients from a regression of stock excess returns on the contemporaneous market excess returns along with the market excess returns from each of the previous and next 5 days. Thus, following Dimson (1979), we define  $\beta_D$  as

$$(IA-13) \quad \beta_D = \sum_{k=-5}^{k=5} \hat{b}_k$$

where the  $\hat{b}_k$  represent the estimated slope coefficients from regression model

$$(IA-14) \quad R_{i,d} = a + \sum_{k=-5}^{k=5} b_k R_{m,d+k} + e_{i,d}.$$

Month  $t$  values of both  $\beta_{\text{SW}}$  and  $\beta_D$  are calculated using 1 year's worth of daily return data covering the months  $t - 11$  through  $t$  inclusive, with the requirement that there be at least 200 days of valid return observations upon which to perform the calculation.

Frazzini and Pedersen (2014) calculate market beta for month  $t$  as

$$(IA-15) \quad \beta_{\text{FP}} = 0.6\rho \frac{\sigma_i}{\sigma_m} + 0.4$$

where  $\rho$  is the correlation between 3-day log returns of the stock and 3-day log returns of the market, calculated using 5 years' (months  $t - 59$  through  $t$ , inclusive) worth of daily return data. Specifically, defining the 3-day log return on day  $d$  as  $r_{i,d}^{3d} = \sum_{j=0}^2 \ln(1 + r_{i,d-j})$ , where  $r_{i,d}$  is the stock's return on day  $d$ , the correlation  $\rho$  is calculated as the correlation between this measure calculated for the stock and for the market portfolio (using excess returns) on each day during the past 5 years. The objective of Frazzini and Pedersen (2014) in taking 3-day returns is to control for nonsynchronous trading. Five years of data are used because correlations tend to move slowly. A total of 750 days of valid stock returns are required when calculating  $\rho$ .  $\sigma_i$  and  $\sigma_m$  are the standard deviations of daily log stock returns and daily log market excess returns, respectively, using 1 year's worth of data covering the months  $t - 11$  through  $t$ , inclusive. At least 120 days of stock return data during the calculation period are required when calculating  $\sigma_i$ . The time period used for the calculation of the standard deviation is shorter because volatilities tend to change more quickly than correlations. Multiplication by 0.6 and the addition of 0.4 come from an effort to reduce outliers. More discussion of the calculation of  $\beta_{\text{FP}}$  can be found in Section 3.1 of Frazzini and Pedersen (2014).

The results of univariate decile portfolio analyses of the relation between market beta and future stock returns using each of the alternative measures of market beta are presented in Table IA1. The results are highly similar to those generated using the standard measure of market beta ( $\beta$ ) used in the main paper (Table 1 of the main paper, repeated in Table IA1 of this Internet Appendix to facilitate comparison). Regardless of the measure of beta, the average 1-month-ahead return difference between the decile 10 and decile 1 portfolios (High–Low portfolio) is negative but statistically insignificant. The FFC4 alpha of the High–Low portfolios relative to the Fama and French (1993) and Carhart (1997) 4-factor (FFC4) model are negative and statistically significant. This result indicates that the beta anomaly is robust to the use of alternative measures of market beta.

## IA-III Lottery Demand

In this section we show that the negative relation between lottery demand and future stock returns is robust.

### IA-III.A Alternative measures of lottery demand

We begin with univariate portfolio analyses examining the relation between lottery demand and future stock returns when lottery demand is measured using  $\text{MAX}(k)$ ,  $k \in \{1, 2, 3, 4, 5\}$ , where  $\text{MAX}(k)$  is defined as the average of the  $k$  highest daily returns of

the given stock within the given month  $t$ . In Table IA2 of this Internet Appendix we present the results of univariate decile portfolio analyses of the relation between lottery demand and 1-month-ahead stock returns using each of these measures of lottery demand as the sort variable. The table shows that the negative relation between lottery demand and future stock returns is strong regardless of which measure of lottery demand is used. The average monthly returns of the zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio range from  $-0.95\%$  for portfolios formed by sorting on MAX(1) to  $-1.15\%$  for portfolios sorted on MAX(5), with NW (1987)  $t$ -statistics of  $-3.91$  and  $-4.41$ , respectively. The FFC4 alphas for these portfolios range from  $-1.15\%$  to  $-1.40\%$  per month with  $t$ -statistics between  $-8.91$  and  $-9.12$ . The results indicate that the negative relation between lottery demand and future stock returns is robust regardless of the measure of lottery demand.

### IA-III.B Microstructure effect

We next investigate the possibility that the ability of lottery demand to predict future stock returns is driven by a microstructure effect. Since MAX is calculated using daily return data from month  $t$ , and portfolios are formed at the end of month  $t$ , it may be difficult to execute a trade on the last day of month  $t$  based on information not available until the close of the last trading day of the month. We therefore recalculate MAX using all but the last trading day of the given month  $t$  and repeat the univariate portfolio analysis using this measure of MAX. The results, presented in Table IA3, show that the negative relation between lottery demand and future stock returns persists when using this alternative approach to calculating MAX. The results demonstrate that the ability of lottery demand to predict the cross section of future stock returns is not driven by a microstructure effect.

### IA-III.C Lagged MAX

We next examine whether implementing a lag between the time at which MAX is measured and the time at which the portfolios are formed has an effect on the relation between MAX and future stock returns. At the end of each month  $t$ , we repeat the univariate portfolio analysis using values of MAX calculated as of the end of month  $t - 1$  (MAX $_{t-1}$ ), instead of month  $t$ , as the sort variable. We also use the average value of MAX in months  $t - 1$  and  $t$  as the sort variable.

Table IA4 presents the FFC4 alphas of the decile portfolios generated by these analyses. The results show that FFC4 alphas of the High–Low portfolio formed by sorting on each of MAX $_{t-1}$ , as well as on the average of MAX $_{t-1}$  and MAX $_t$ , are negative and highly statistically significant, with alphas of  $-0.70\%$  and  $-1.18\%$  per month, respectively, and  $t$ -statistics in excess of 4.5 in magnitude.



## IA-IV Relation between the Beta Anomaly and Lottery Demand

In this section, we present the results of empirical analyses designed to examine the robustness of the main result of the paper. Specifically, these analyses all demonstrate that lottery demand plays an important role in producing the beta anomaly.

### IA-IV.A Orthogonal Components of $\beta$ and MAX

In Section B of the main paper, we discuss, but do not present, the results of univariate portfolio analyses using the orthogonal components of  $\beta$  and MAX as the sort variables. In this section, we discuss these analyses in more detail. The results are presented in Table IA5 of this Internet Appendix.

The portion of  $\beta$  that is orthogonal to MAX, denoted  $\beta_{\perp \text{MAX}}$ , is calculated as the intercept term plus the residual from a cross-sectional regression of  $\beta$  on MAX.  $\text{MAX}_{\perp \beta}$  is calculated analogously by taking the intercept plus the residual from a cross-sectional regression of MAX on  $\beta$ . At the end of each month  $t$ , we calculate  $\beta_{\perp \text{MAX}}$  and  $\text{MAX}_{\perp \beta}$  using month  $t$  values of  $\beta$  and MAX, and use the resulting orthogonal components to sort stocks into univariate portfolios whose 1-month-ahead (month  $t + 1$ ) excess returns are then examined.

The results, reported in Table IA5, show that the High–Low  $\beta_{\perp \text{MAX}}$  portfolio generates a positive but insignificant average monthly return of 0.13%, compared to a negative and insignificant return of  $-0.35\%$  for the High–Low  $\beta$  portfolio. More importantly, the FFC4 and FFC4+PS alphas of the High–Low  $\beta_{\perp \text{MAX}}$  portfolio of 0.05% and 0.08%, respectively, per month are statistically indistinguishable from 0. Furthermore, the abnormal returns of each of the  $\beta_{\perp \text{MAX}}$  decile portfolios are statistically indistinguishable from 0, with decile 2 being the one exception. The results indicate that the abnormal returns of the portfolios formed by sorting on  $\beta$  are largely a manifestation of the relation between MAX and  $\beta$ , since the beta anomaly is not detected when only the portion of  $\beta$  that is orthogonal to MAX is used to form the portfolios.

The results of the univariate portfolio analysis of the relation between  $\text{MAX}_{\perp \beta}$  and 1-month-ahead excess stock returns indicate that  $\text{MAX}_{\perp \beta}$  has a strong negative cross-sectional relation with future stock returns since the  $-1.19\%$  average monthly return of the High–Low  $\text{MAX}_{\perp \beta}$  portfolio is highly statistically significant with a  $t$ -statistic of  $-6.72$ . Similarly, the FFC4 and FFC4+PS alphas of the High–Low  $\text{MAX}_{\perp \beta}$  portfolio are  $-1.44\%$  ( $t$ -statistic =  $-10.62$ ) and  $-1.42\%$  ( $t$ -statistic =  $-9.14$ ), respectively, per month. Furthermore, the abnormal returns of the portfolios decrease nearly monotonically across deciles of  $\text{MAX}_{\perp \beta}$ . Consistent with previous analyses (Table 3, Panel C), the results indicate that the negative relation between MAX and future stock returns is not driven by the relation between MAX and  $\beta$ , since the univariate portfolio analysis results generated using  $\text{MAX}_{\perp \beta}$  as the sort variable are very similar to those from the analysis sorting on MAX.

## IA-IV.B Alternative portfolio formation methodologies

We continue by presenting the results of a bivariate independent-sort portfolio analysis of the relations between each of  $\beta$  and MAX and future stock returns. Each month  $t$ , all stocks are grouped into deciles based on independent ascending sorts of both  $\beta$  and MAX. The intersections of each of the decile groups are used to form 100 portfolios.

Table IA6 presents the time-series averages of the 1-month-ahead (month  $t + 1$ ) equal-weighted excess returns for each of the portfolios. The section labeled High–Low  $\beta$  (MAX) shows the average returns (R) and FFC4 alphas (FFC4  $\alpha$ ) of the portfolio that is long the  $\beta$  (MAX) decile 10 portfolio and short the  $\beta$  (MAX) decile 1 portfolio within the given decile of MAX ( $\beta$ ). The results show that the beta anomaly disappears after controlling for MAX since the FFC4 alpha of the High–Low  $\beta$  portfolio in each decile of MAX is economically small and statistically indistinguishable from 0. The lottery demand effect, however, persists after controlling for beta since the average return and alpha of the High–Low MAX portfolio in each  $\beta$  decile is negative and statistically significant. The bivariate independent-sort portfolio analysis demonstrates that the main result of the paper, namely the important role that lottery demand plays in generating the beta anomaly, persists regardless of the portfolio sorting methodology.

We proceed by examining whether the beta anomaly exists in value-weighted portfolios after controlling for the effect of lottery demand. The details of this analysis are identical to those of the equal-weighted dependent-sort portfolio analysis whose results are shown in Panel A of Table 3 of the main paper with the exception that the portfolios used in the present analysis are value-weighted instead of equal-weighted. The results of the value-weighted bivariate dependent-sort portfolio analysis, presented in Panel A of Table IA7 of this Internet Appendix, show that the beta anomaly is not detected after controlling for lottery demand since the FFC4 alphas of the High–Low  $\beta$  portfolios in all deciles of MAX are economically small and statistically indistinguishable from 0.

We then repeat the value-weighted analysis, this time sorting first on  $\beta$  and then on MAX. The details of this analysis are identical to those of the equal-weighted dependent-sort portfolio analysis whose results are shown in Panel C of Table 3 of the main paper with the exception that the portfolios used in the present analysis are value-weighted instead of equal-weighted. The results of the value-weighted bivariate dependent-sort portfolio analysis, presented in Panel B of Table IA7 show that the negative relation between lottery demand and future stock returns persists after controlling for beta using value-weighted portfolios. The average return and FFC4 alpha of the High–Low MAX portfolio within each  $\beta$  decile is negative and statistically significant.

Finally we repeat the bivariate independent-sort portfolio analysis whose results are shown in Table IA6, this time using value-weighted portfolios instead of equal-weighted portfolios. The results of this analysis are presented in Table IA8. The table shows that after controlling for MAX, the FFC4 alphas of the High–Low  $\beta$  portfolios are statistically indistinguishable from 0 in all MAX deciles. Thus, the beta anomaly is once again not detected after controlling for lottery demand when using a value-weighted independent-sort portfolio analysis. The High–Low MAX portfolio in each  $\beta$  decile generates a negative and statistically average return (with the exception of  $\beta$  decile 10) and FFC4 alpha, indicating

that the lottery demand effect persists after controlling for the effect of market beta in value-weighted portfolios.

### IA-IV.C Alternative measures of lottery demand

Having shown that the main result is not sensitive to the portfolio formation methodology, we examine whether it is sensitive to the measurement of lottery demand. Specifically, we examine whether using  $\text{MAX}(k)$ ,  $k \in \{1, 2, 3, 4, 5\}$ , where  $\text{MAX}(k)$  is defined as the average of the  $k$  highest daily returns of the given stock in the given month, generates similar results.

Table IA9 presents the results of bivariate dependent-sort portfolio analyses examining the ability of lottery demand to explain the beta anomaly using  $\text{MAX}(k)$ ,  $k \in \{1, 2, 3, 4, 5\}$ , as the first sort variable. For each measure of lottery demand, the table presents the average 1-month-ahead excess return for the average equal-weighted  $\text{MAX}$  decile portfolio within each  $\beta$  decile, as well as the average return and FFC4 alpha for the portfolio that is long the  $\beta$  decile 10 portfolio and short the  $\beta$  decile 1 portfolio in the average lottery demand decile. The results of the table demonstrate that, regardless of which measure of lottery demand is used, the beta anomaly is not detected after controlling for lottery demand. The main result of the paper, therefore, is not sensitive to the measure of lottery demand.

### IA-IV.D Frazzini and Pedersen (2014) measure of beta

Our next tests examine whether lottery demand explains the beta anomaly when  $\beta_{\text{FP}}$  (the measure of beta used by Frazzini and Pedersen (2014), defined in Section IA-II.A) is used as the measure of market beta.

In Table IA10 we present the results of bivariate dependent-sort portfolio analyses using  $\beta_{\text{FP}}$  and  $\text{MAX}$  as the sort variables. The methodology used in these analyses is identical to that used to generate Table 3 of the main paper except that  $\beta_{\text{FP}}$  is used as the measure of market beta instead of  $\beta$ . The results in Panel A demonstrate that the High–Low  $\beta_{\text{FP}}$  portfolio in each  $\text{MAX}$  decile fails to generate a statistically significant average return or FFC4 alpha. Panel B shows that the High–Low  $\text{MAX}$  portfolio in each  $\beta_{\text{FP}}$  decile generates a negative and highly statistically significant average return and FFC4 alpha.

Table IA11 shows the results of a bivariate independent-sort portfolio analysis using  $\beta_{\text{FP}}$  and  $\text{MAX}$  as the sort variables. The methodology used in this analysis is identical to that used to generate Table IA6 of this Internet Appendix except that  $\beta_{\text{FP}}$  is used as the measure of market beta instead of  $\beta$ . The results are very similar to those generated when using  $\beta$ . Within each  $\text{MAX}$  decile, the High–Low  $\beta_{\text{FP}}$  portfolio generates an insignificant average return and FFC4 alpha. However, the High–Low  $\text{MAX}$  portfolio in each  $\beta_{\text{FP}}$  decile generates a negative a statistically significant average return and FFC4 alpha.

Finally, we repeat the univariate portfolio analyses using the orthogonal components of beta and lottery demand presented in Table IA6 of this Internet Appendix, this time using  $\beta_{\text{FP}}$  instead of  $\beta$  as the measure of market beta. The results of these analyses, shown in Table IA12 are consistent with all of the other analyses. A univariate portfolio analysis

using the component of  $\beta_{FP}$  that is orthogonal to MAX ( $\beta_{FP \perp MAX}$ ) generates an average High–Low portfolio return and FFC4 alpha that are economically small and statistically indistinguishable from 0. The High–Low MAX $_{\perp \beta_{FP}}$  portfolio, however, produces a large, negative, and statistically significant average return and alpha.

The results in this subsection demonstrate that the important role that lottery demand plays in producing the beta anomaly is robust when beta is measured following Frazzini and Pedersen (2014).

## IA-IV.E Microstructure Effect

In this section we investigate the possibility that the ability of lottery demand to explain the beta anomaly is driven by a microstructure effect. Specifically, since both  $\beta$  and MAX are calculated using daily return data from month  $t$ , and portfolios are formed at the end of month  $t$ , it may be difficult to execute a trade on the last day of month  $t$  based on information not available until the close of the last trading day of the month. We address this issue in two ways. First, we lag  $\beta$  by 1 month. Specifically, we use  $\beta$  calculated at the end of month  $t - 1$  to form portfolio at the end of month  $t$ . The results of the bivariate dependent-sort portfolio analysis using MAX as the first sort variable and 1-month-lagged  $\beta$  as the second sort variable are shown in Table IA13. They demonstrate that our main result is not driven by a microstructure issue associated with  $\beta$ .

We also recalculate MAX using all but the last trading day of the given month  $t$  and repeat the bivariate dependent-sort portfolio analysis using this measure of MAX. The results, presented in Table IA14, show that the main result holds using this alternative measure of MAX. The ability of lottery demand to explain the beta anomaly is not driven by a microstructure effect.

In unreported tests, we find that the results remain very similar when the bivariate portfolios are formed by sorting first on MAX calculated excluding the last trading day of month  $t$  and  $\beta$  calculated as of the end of month  $t - 1$ .

## IA-V Extended Sample Period

In the main paper, following Frazzini and Pedersen (2014), our analyses focused on the period from 1963 through 2012. In this section, we extend the sample period to replicate that of Baker and Wurgler (2014), who examine the beta anomaly over the longer sample period of 1931 through 2012. Specifically, the sample we use in this section covers portfolio formation months  $t$  (return months  $t + 1$ ) from Dec. 1930 (Jan. 1931) through Nov. 2012 (Dec. 2012). In addition to extending the sample period, we further follow Baker and Wurgler (2014) by using a measure of beta, which we denote  $\beta_{5Y}$ , calculated as the sum of the estimated slope coefficients from a regression of excess stock returns on the contemporaneous excess returns of the market portfolio and the 1-month-lagged excess returns of the market portfolio using 60 months of return data. We require a minimum of 24 monthly return observations to calculate  $\beta_{5Y}$ . The extended sample for portfolio formation month  $t$  contains all U.S.-based common stocks listed on the NYSE, AMEX, or NASDAQ in the CRSP database with a month-end stock price of at least \$5.

## IA-V.A Univariate portfolios

We begin our examination of the extended sample by demonstrating that the beta anomaly is strong during the 1931 through 2012 period. Here, we follow Baker and Wurgler (2014) and focus on the returns of value-weighted portfolios.

Panel A of Table IA15 presents the results of a univariate decile portfolio analysis of the relation between  $\beta_{5Y}$  and 1-month-ahead excess stock returns. The implementation of this analysis is identical to that used to generate Table 1 of the main paper except that we use  $\beta_{5Y}$  instead of  $\beta$  as the sort variable and the returns are for value-weighted portfolios. The table shows that the average value of  $\beta_{5Y}$  increases (by construction) from 0.32 for the first  $\beta_{5Y}$  decile portfolio to 2.58 for the 10th decile portfolio. The average portfolio excess returns exhibit no discernible pattern across the deciles of  $\beta_{5Y}$ . The High–Low  $\beta_{5Y}$  portfolio generates a statistically insignificant average return of 0.15% per month ( $t$ -statistic = 0.61).

More importantly, Panel A of Table IA15 demonstrates a strong negative relation between  $\beta_{5Y}$  and abnormal returns relative to the FFC4 model.<sup>15</sup> The High–Low  $\beta_{5Y}$  portfolio generates an economically large and negative FFC4 alpha of  $-0.48\%$  per month that is highly statistically significant with a  $t$ -statistic of  $-2.84$ . The alpha of the High–Low  $\beta_{5Y}$  portfolio is even larger in magnitude than that of the High–Low  $\beta$  portfolio ( $-0.35\%$  per month,  $t$ -statistic =  $-2.50$ , see Table 1 of the main paper) examined in the main paper. Also consistent with previous analyses, both the low- and high- $\beta_{5Y}$  portfolios generate significant abnormal returns. The  $\beta_{5Y}$  decile 1 portfolio generates positive FFC4 alpha of  $0.14\%$  per month ( $t$ -statistic =  $1.96$ ) and the  $\beta_{5Y}$  decile 10 portfolio generates a negative alpha of  $-0.34\%$  per month ( $t$ -statistic =  $-2.84$ ).

When the FMAX factor is appended to the FFC4 model, however, the results change dramatically. The alpha of the High–Low  $\beta_{5Y}$  portfolio relative to the FFC4+FMAX model of  $0.38\%$  per month is now positive and statistically significant with a  $t$ -statistic of  $2.85$ . Thus, inclusion of the FMAX factor reverses the beta anomaly. The table shows that this result is primarily driven by the high- $\beta_{5Y}$  portfolio, which generates a positive and statistically significant alpha of  $0.29\%$  per month ( $t$ -statistic =  $2.85$ ), compared to  $-0.34\%$  per month ( $t$ -statistic =  $-2.84$ ) when using the FFC4 model without the FMAX factor. As in the previous analyses, the alpha of the  $\beta_{5Y}$  decile 1 portfolio relative to the FFC4+FMAX model of  $-0.09\%$  per month ( $t$ -statistic =  $-1.32$ ) is statistically indistinguishable from 0.

The results in Table IA15, Panel A demonstrate that the importance of lottery demand in generating the beta anomaly—the main result of this paper—is robust when using the extended sample period and methodology employed by Baker and Wurgler (2014).

In Table IA15, Panel B we briefly examine the lottery demand phenomenon over the extended sample period. The results demonstrate that the negative relation between lottery demand and future stock returns is robust. The High–Low MAX portfolio generates an average return and FFC4 alpha of  $-0.60\%$  ( $t$ -statistic =  $-2.56$ ) and  $-1.15\%$  ( $t$ -statistic =

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<sup>15</sup>Since the *PS* factor data are only available beginning in Jan. 1968, we employ only the FFC4 model in analyses of the extended sample.

−6.90), respectively, per month during the 1931 through 2012 period. Furthermore, the alphas of the MAX-sorted portfolios decrease monotonically across the deciles of MAX.

To examine the robustness of these results, we repeat the analyses of the relation between each of  $\beta_{5Y}$  and MAX in the extended sample, this time using equal-weighted instead of value-weighted portfolios. Table IA16 shows that all of the results presented in Table IA15 are robust to the use of equal-weighted portfolios.

## IA-V.B Bivariate portfolios

To further examine the role of lottery demand in producing the beta anomaly in the extended sample, we use a bivariate dependent-sort portfolio analysis with MAX as the first sort variable and  $\beta_{5Y}$  as the second sort variable. This analysis mimics that of Table 3, Panel A of the main paper, once again with the exceptions that we use the extended sample,  $\beta_{5Y}$  instead of  $\beta$  as the measure of beta, and value-weighted instead of equal-weighted portfolios.

The results of the bivariate dependent-sort portfolio analysis using MAX as the first sort variable and  $\beta_{5Y}$  as the second sort variable are presented in Panel A of Table IA17. In the average MAX decile, the High–Low  $\beta_{5Y}$  portfolio generates a positive and statistically significant average return of 0.43% per month ( $t$ -statistic = 2.30). This indicates that when the portfolio is constrained to be neutral to lottery demand, a portfolio that is long high-beta stocks and short low-beta stocks generates a positive and statistically significant average return. Exposure to the market and other factors, however, explain this premium, since the FFC4 alpha of the High–Low  $\beta_{5Y}$  portfolio in the average MAX decile of 0.05% per month is statistically insignificant with a  $t$ -statistic of 0.35. Furthermore, in each decile of MAX, the FFC4 alpha of the High–Low  $\beta_{5Y}$  portfolio is statistically indistinguishable from 0. The results of the bivariate portfolio analysis therefore confirm the role of lottery demand in producing the beta anomaly in the extended sample.

Finally, we repeat the bivariate dependent-sort portfolio analysis, this time sorting first on  $\beta_{5Y}$  and then on MAX. The results of this analysis, shown in Panel B of Table IA17, demonstrate that the lottery demand phenomenon remains strong after controlling for beta in the extended sample. Within each decile of  $\beta_{5Y}$ , the average returns and FFC4 alpha of the High–Low MAX portfolio are negative, economically large, and highly statistically significant. In the average  $\beta_{5Y}$  decile, the High–Low MAX portfolio generates an average return of −1.00% per month ( $t$ -statistic = −6.13) and FFC4 alpha of −1.40% per month ( $t$ -statistic = −10.63).

Once again, to examine the robustness of our results, we repeat the bivariate portfolio analyses of the extended sample, this time using equal-weighted instead of value-weighted portfolios. The results, presented in Table IA18, show that the ability of lottery demand to explain the beta anomaly and the failure of beta to explain the lottery demand phenomenon in the extended sample are robust to the use of equal-weighted portfolios.

## IA-VI Lottery Demand Factor

In this section we demonstrate that the ability of the FMAX factor to capture the returns of the High–Low  $\beta$  portfolio are robust.

### IA-VI.A Frazzini and Pedersen (2014) measure of beta

We begin by examining whether the ability of the FMAX factor to explain the returns associated with the beta anomaly is robust when  $\beta_{FP}$  (the measure of beta used by Frazzini and Pedersen (2014), defined in Section IA-II.A) is used as the measure of market beta. In Table IA19 we present the alphas of the  $\beta_{FP}$ -sorted decile portfolios, as well as the High–Low  $\beta_{FP}$  portfolio, relative to the FFC4, FFC4+PS, FFC4+FMAX, and FFC4+PS+FMAX factor models. The results show that when models that exclude the FMAX factor are used, the High–Low  $\beta_{FP}$  portfolio generates negative, economically important, and highly statistically significant abnormal returns. When the FMAX factor is included in the model, the abnormal returns of the High–Low  $\beta_{FP}$  portfolio are small and statistically indistinguishable from 0. Furthermore, when FMAX is included in the factor model, the abnormal returns of each of the  $\beta_{FP}$  decile portfolios are statistically indistinguishable from 0. The results demonstrate that the ability of the FMAX factor to capture the returns associated with the beta anomaly is robust when beta is measured following Frazzini and Pedersen (2014).

### IA-VI.B Alternative FMAX factor definitions

In our next tests of the robustness of the ability of the FMAX factor to explain the returns associated with the beta anomaly, we generate alternative versions of the lottery demand factor. Specifically, we define  $FMAX(k)$  to be the lottery demand factor generated using  $MAX(k)$  as the measure of lottery demand, where  $MAX(k)$  is defined as the average of the  $k$  highest daily stock returns in the given month  $t$ . All other aspects of the procedure used to generate the  $FMAX(k)$  factors are the same as those used to generate the FMAX factor. We then examine the ability of the alternative versions of the lottery demand factor to explain the returns of the BAB factor.

Table IA20 presents the results of factor analyses of the BAB factor returns using the FFC4 model augmented with the  $FMAX(k)$  factor for  $k \in \{1, 2, 3, 4, 5\}$ . The results demonstrate that the ability of the lottery demand factor to capture the returns of the BAB factor is robust. Regardless of which version of the lottery demand factor is used, the alpha of the BAB factor is statistically indistinguishable from 0.

### IA-VI.C Alternative BAB factor definitions

Our next tests examine whether differences in the samples or beta calculation methodologies used in this paper and in Frazzini and Pedersen (2014) are driving the ability of the FMAX factor to explain the returns of the BAB factor. In addition to calculating beta as discussed in Section IA-II.A of this Internet Appendix, Frazzini and Pedersen (2014) include all stocks in their sample whereas we exclude stocks with market

prices of less than \$5 per share. To examine the possibility that these differences affect our results, we generate an alternative BAB factor using the exact methodology followed by Frazzini and Pedersen (2014) to generate the BAB factor, but applied to our sample and using our measure of beta ( $\beta$ ).<sup>16</sup> We denote this factor the *BAB\_\$5* factor. We then repeat the analyses whose results are presented in Table 6 of the main paper using the *BAB\_\$5* factor instead of the original BAB factor.

The results of these analyses are presented in Table IA21 of this Internet Appendix. Panel A shows that the alpha of the *BAB\_\$5* factor is significantly positive when calculated using models that do not include the FMAX factor, but when FMAX is included in the factor model, the abnormal returns of the *BAB\_\$5* factor are economically small and statistically indistinguishable from 0. Panel B shows that the alpha of the FMAX factor is negative and statistically significant regardless of whether the *BAB\_\$5* factor is included in the factor model. These results indicate that it is not a difference in samples or the approach to calculating beta that is driving the ability of the FMAX factor to capture the returns associated with the beta anomaly.

## IA-VII MAX Measures Lottery Demand

In this section we demonstrate that using MAX as a measure of lottery demand generates results that are economically similar to results of previous work on lottery demand using other measures.

### IA-VII.A Persistence of MAX

We begin by investigating the persistence of lottery demand by examining the  $k$ -month transition matrices of stocks among MAX-sorted portfolios. Table 10 of the main paper presents the 1-month MAX decile portfolio transition matrix, which shows that stocks with high (low) values of MAX in month  $t$  have a strong tendency to have a high (low) value of MAX in month  $t + 1$ . In Table IA22 we present the 2-, 3-, 6-, and 12-month transition matrices for MAX-sorted portfolios. Panel A shows that 30% (65%) of stocks in the month  $t$  high-MAX portfolio remain in high-MAX portfolio (the top 3 deciles of MAX), and 38% (68%) of stocks in the low-MAX portfolio remain in the low-MAX portfolio (the bottom 3 deciles of MAX) 2 months in the future. Panel B shows that 29% (64%) of stocks in the month  $t$  high-MAX portfolio remain in high-MAX portfolio (the top 3 deciles of MAX), and 37% (67%) of stocks in the low-MAX portfolio remain in the low-MAX portfolio (the bottom 3 deciles of MAX) 3 months in the future. Panel C shows that 26% (61%) of stocks in the month  $t$  high-MAX portfolio remain in high-MAX portfolio (the top 3 deciles of MAX), and 35% (66%) of stocks in the low-MAX portfolio remain in the low-MAX portfolio (the bottom 3 deciles of MAX) 6 months in the future. Finally, Panel D shows that 23% (57%) of stocks in the month  $t$  high-MAX portfolio remain in high-MAX

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<sup>16</sup>The details of the construction of the BAB factor are presented in Section 3.2 and equations (16) and (17) of Frazzini and Pedersen (2014).



portfolio (the top 3 deciles of MAX), and 33% (63%) of stocks in the low-MAX portfolio remain in the low-MAX portfolio (the bottom 3 deciles of MAX) 12 months in the future. The results demonstrate that at lags of up to at least 12-months, MAX exhibits high persistence.

## **IA-VII.B January Effect**

Previous work (Kumar et al. (2011), Doran et al. (2011)) has shown that the lottery effect is stronger in January than in other months. In this subsection, we demonstrate that our results corroborate those results. In Table IA23 we show that the returns of the High–Low MAX portfolio are nearly twice as large in January as they are in other months. Thus, consistent with previous work, when using MAX as the measure of lottery demand, the lottery demand effect is substantially stronger in Januaries than in other months.

We next check whether our main result, the ability of lottery demand to explain the beta anomaly, persists in both Januaries and in non-Januaries. In Table IA24 we show FFC4+FMAX alphas for portfolios sorted on  $\beta$ . In both Januaries and non-Januaries, the FFC4+FMAX alpha of the High–Low  $\beta$  is actually positive. The results therefore demonstrate that the FMAX factor explains the beta anomaly in both Januaries and non-Januaries.

## **IA-VII.C Low-Price, High-Idiosyncratic Volatility, and High-Idiosyncratic Skewness Stocks**

Han and Kumar (2013) demonstrate that the lottery demand phenomenon is strongest among stocks with low price, high idiosyncratic volatility, and high idiosyncratic skewness. We therefore examine whether the lottery demand effect using MAX as the measure of lottery, and the beta anomaly, are stronger among such stocks. Each month  $t$ , we define 2 groups of stocks, the first (second) set containing stocks in the bottom (top) quintile of price, the top (bottom) quintile of idiosyncratic volatility (IVOL), and the top (bottom) quintile of idiosyncratic skewness (*ISKEW*). We then repeat our portfolio analyses using each of these groups of stocks.

The results of the portfolio analyses are shown in Table IA25. Panel A demonstrates that the beta anomaly and lottery demand phenomenon are strong among the first set of stocks. Comparing Panel A and Panel B, which shows results for the second set of stocks, we see that the beta anomaly and lottery demand effect are much stronger among low-price, high-idiosyncratic volatility, and high-idiosyncratic skewness stocks than among high-price, low-idiosyncratic volatility, and low-idiosyncratic skewness stocks, consistent with the results of Han and Kumar (2013). Panels C and D demonstrate that for both sets of stocks, the beta anomaly does not exist after controlling for lottery demand.

## **IA-VII.D Time-Varying Lottery Demand**

In addition to variation in the lottery phenomenon among different types of stocks, Kumar (2009), Kumar et al. (2011), and Doran et al. (2011) show that time-variation in lottery demand plays a role in the relation between lottery demand and expected stock

returns. To examine whether this result holds using MAX as the measure of lottery demand, each month  $t$ , we define aggregate lottery demand to be the average (equal-weighted or value-weighted) value of MAX across all stocks. Figure IA1 plots the time series of both measures of aggregate lottery demand and demonstrates that aggregate lottery demand is highly time-varying. We then examine the month  $t + 1$  returns of the MAX-sorted portfolio in periods of above and below median aggregate lottery demand. The results in Table IA26 demonstrate that the abnormal returns of the High–Low MAX portfolio are much more negative in months following high aggregate lottery demand than in months following low aggregate lottery demand.

## **IA-VII.E Economic State**

Kumar (2009) demonstrates that lottery demand varies with economic state. We therefore examine whether the ability of lottery demand to explain the beta anomaly also varies with economic states. We split our sample into subperiods corresponding to non-recession and recession states based on the Chicago Fed National Activity Index (CFNAI). We take months where the 3-month moving average CFNAI is below  $-0.7$  to be recession states and months where the 3-month moving average CFNAI is greater than  $-0.7$  to be non-recession states. We then repeat our bivariate portfolio analyses using the subset of months  $t + 1$  corresponding to each of these economic states. The results of these analyses, presented in Table IA27, demonstrate that regardless of economic state, the ability of lottery demand to explain the beta anomaly persists.

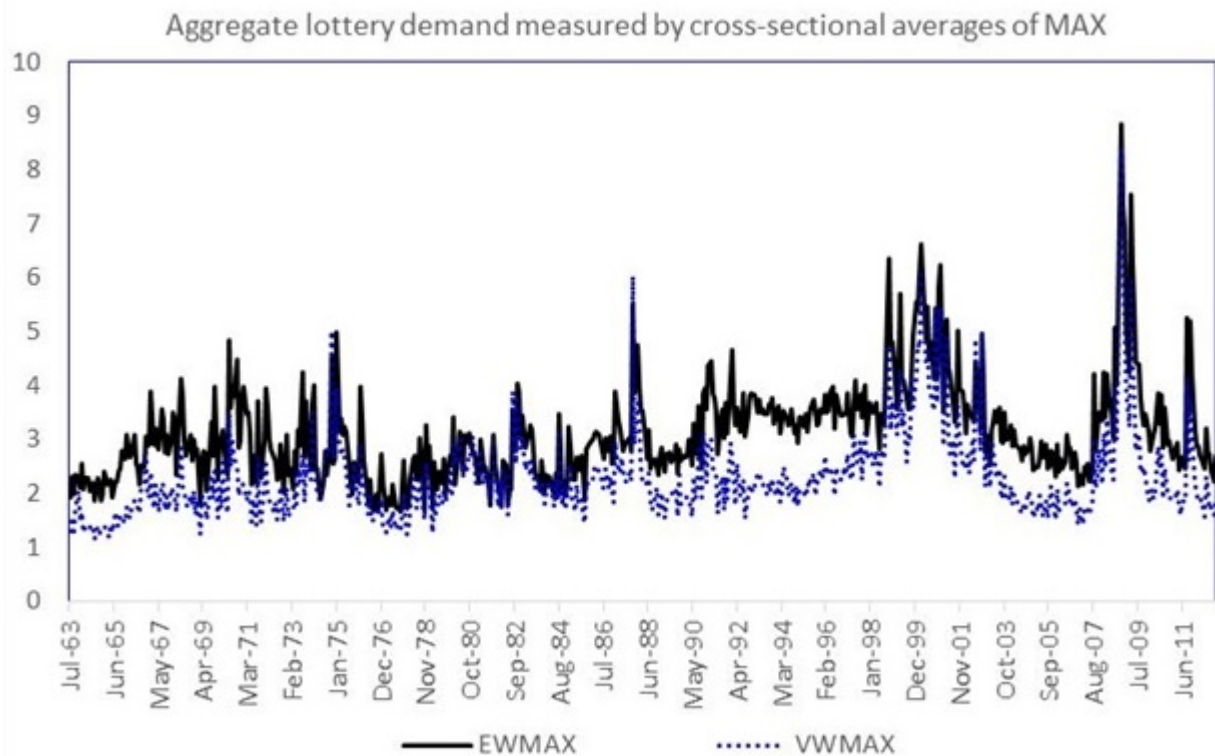
## **IA-VII.F Investor Attention**

Finally, we examine what draws retail investors’ attention to lottery stocks. Kumar (2009) shows that, overall, lottery stocks have low analyst coverage. However, if we focus only on the stocks that are owned by retail investors, which tend to have low analyst coverage in general, one would suspect that stocks with relatively high analyst coverage (conditional on being widely owned by retail investors) grab more attention from retail investors. We therefore test the hypothesis that the beta anomaly and lottery demand effects are stronger among stocks with high analyst coverage than among stocks with low analyst coverage, conditional on the stock being owned primarily by retail investors. To test this hypothesis, we examine only stocks in the bottom quintile of INST. We then sort all such “retail” stocks into quintiles based on analyst coverage (CVRG), and call stocks in the lowest (highest) quintile of CVRG low-investor attention (high-investor attention) stocks. Finally, we use univariate portfolio analyses to examine the strength of the beta anomaly and the lottery demand effect among low-investor attention and high-investor attention stocks (conditional on the stock being a retail stock).

The results of these analyses, shown in Table IA28, demonstrate that, consistent with our expectations, the beta anomaly and the lottery demand effect are stronger among the high-investor attention stocks than among low-investor attention stocks. The results therefore indicate that analyst coverage helps retail investors identify lottery stocks.

**Figure IA1: Time-Series of Aggregate Lottery Demand**

The plot below shows the time-series of aggregate lottery demand. Aggregate lottery demand in any month  $t$  is measured as the equal-weighted (EWMAX) or value-weighted (VWMAX) average value of MAX across all stocks in the sample in month  $t$ .



**Table IA1: Univariate Portfolios Sorted on Alternative Measures of Market Beta**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on one of the measures of beta.  $\beta$  is the standard CAPM regression-based measure of beta,  $\beta_{\text{SW}}$  is calculated following Scholes and Williams (1977),  $\beta_D$  is calculated following Dimson (1979), and  $\beta_{\text{FP}}$  is calculated following Frazzini and Pedersen (2014). The table presents the time-series means of the monthly equal-weighted portfolio betas, 1-month-ahead excess returns (R), and FFC4 alphas (FFC4  $\alpha$ ) for each of the decile portfolios. Excess returns and alphas are reported in percentages per month. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha, are shown in parentheses. The sample covers the months  $t$  (return months  $t + 1$ ) from July (Aug.) 1963 through Nov. (Dec.) 2012 and includes all U.S.-based publicly traded common stocks with share price of at least \$5 at the end of month  $t$ .

Sort Variable	Value	Low 1	2	3	4	5	6	7	8	9	High 10	High–Low
$\beta$	$\beta$	-0.00	0.25	0.42	0.56	0.70	0.84	1.00	1.19	1.46	2.02	
R	0.69	0.78 (3.74)	0.78 (3.90)	0.77 (3.74)	0.81 (3.54)	0.73 (3.42)	0.71 (2.90)	0.65 (2.66)	0.51 (2.26)	0.35 (1.58)	-0.35 (0.89)	(-1.13)
FFC4 $\alpha$	0.22	0.24 (2.22)	0.16 (2.77)	0.11 (2.31)	0.10 (1.59)	-0.02 (1.69)	-0.05 (-0.30)	-0.11 (-0.80)	-0.18 (-1.83)	-0.29 (-2.20)	-0.51 (-2.22)	(-2.50)
$\beta_{\text{SW}}$	$\beta_{\text{SW}}$	0.00	0.30	0.48	0.63	0.78	0.94	1.10	1.31	1.59	2.18	
R	0.63	0.77 (3.38)	0.77 (4.05)	0.76 (3.83)	0.79 (3.41)	0.75 (3.34)	0.75 (2.98)	0.68 (2.85)	0.55 (2.33)	0.35 (1.67)	-0.28 (0.87)	(-0.90)
FFC4 $\alpha$	0.14	0.23 (1.44)	0.16 (2.82)	0.08 (2.39)	0.08 (1.22)	0.02 (1.32)	0.00 (0.25)	-0.05 (-0.01)	-0.15 (-0.88)	-0.30 (-2.04)	-0.44 (-2.45)	(-2.27)
$\beta_D$	$\beta_D$	-0.21	0.26	0.50	0.69	0.88	1.07	1.29	1.55	1.91	2.74	
R	0.51	0.66 (2.53)	0.73 (3.39)	0.75 (3.59)	0.82 (3.47)	0.80 (3.51)	0.81 (3.27)	0.80 (3.14)	0.66 (2.78)	0.25 (2.02)	-0.25 (0.66)	(-0.96)
FFC4 $\alpha$	-0.06	0.09 (-0.74)	0.12 (1.25)	0.08 (1.77)	0.12 (1.33)	0.09 (1.94)	0.10 (1.50)	0.08 (1.92)	-0.03 (1.50)	-0.41 (-0.42)	-0.35 (-3.82)	(-2.12)
$\beta_{\text{FP}}$	$\beta_{\text{FP}}$	0.64	0.76	0.83	0.88	0.93	0.99	1.04	1.11	1.20	1.41	
R	0.83	0.81 (4.19)	0.80 (3.90)	0.79 (3.62)	0.80 (3.50)	0.75 (3.40)	0.73 (3.12)	0.70 (2.82)	0.64 (2.63)	0.63 (2.35)	-0.20 (2.12)	(-1.30)
FFC4 $\alpha$	0.22	0.18 (3.44)	0.13 (3.24)	0.13 (2.33)	0.12 (2.70)	0.06 (2.41)	0.02 (1.30)	-0.02 (0.36)	-0.06 (-0.33)	-0.08 (-1.13)	-0.31 (-1.09)	(-2.67)

**Table IA2:**

**Univariate Portfolios Sorted on Alternative Measures of Lottery Demand**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on one of the measures of lottery demand. The measures of lottery demand are  $\text{MAX}(k)$ ,  $k \in \{1, 2, 3, 4, 5\}$ , where  $\text{MAX}(k)$  is defined as the average of the  $k$  highest daily returns of the given stock within the given month. The table presents the time-series means of the monthly equal-weighted portfolio average lottery demand values, 1-month-ahead excess returns (R), and FFC4 alphas (FFC4  $\alpha$ ) for each of the decile portfolios. Excess returns and alphas are reported in percentages per month. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha, are shown in parentheses.

Sort		Low									High	
Variable	Value	1	2	3	4	5	6	7	8	9	10	High–Low
MAX(5)	MAX(5)	0.66	1.25	1.69	2.09	2.49	2.91	3.41	4.04	4.98	7.62	
	R	0.74 (4.07)	1.00 (4.95)	0.96 (4.59)	0.94 (4.25)	0.90 (3.84)	0.82 (3.29)	0.80 (2.93)	0.67 (2.29)	0.36 (1.10)	-0.40 (-1.11)	-1.15 (-4.41)
	FFC4 $\alpha$	0.27 (3.01)	0.42 (5.90)	0.35 (5.89)	0.30 (5.18)	0.23 (3.95)	0.12 (2.20)	0.08 (1.53)	-0.07 (-1.50)	-0.38 (-6.05)	-1.14 (-10.43)	-1.40 (-8.95)
MAX(4)	MAX(4)	0.78	1.45	1.95	2.38	2.81	3.28	3.83	4.54	5.60	8.63	
	R	0.73 (4.05)	0.98 (4.99)	0.92 (4.43)	0.97 (4.35)	0.90 (3.78)	0.83 (3.36)	0.81 (2.94)	0.68 (2.35)	0.35 (1.07)	-0.40 (-1.10)	-1.13 (-4.35)
	FFC4 $\alpha$	0.26 (2.93)	0.40 (6.18)	0.33 (5.42)	0.33 (5.45)	0.22 (3.61)	0.13 (2.34)	0.08 (1.49)	-0.05 (-0.95)	-0.39 (-6.35)	-1.12 (-10.64)	-1.38 (-8.98)
MAX(3)	MAX(3)	0.91	1.70	2.24	2.70	3.18	3.71	4.34	5.15	6.37	9.98	
	R	0.73 (4.14)	0.94 (4.76)	0.95 (4.54)	0.96 (4.28)	0.89 (3.76)	0.87 (3.46)	0.81 (2.97)	0.65 (2.21)	0.36 (1.12)	-0.38 (-1.07)	-1.11 (-4.30)
	FFC4 $\alpha$	0.26 (3.01)	0.36 (5.74)	0.33 (5.52)	0.32 (5.33)	0.21 (3.58)	0.17 (3.02)	0.08 (1.55)	-0.08 (-1.66)	-0.37 (-6.03)	-1.10 (-10.74)	-1.36 (-9.12)
MAX(2)	MAX(2)	1.09	2.00	2.57	3.09	3.64	4.26	4.99	5.96	7.43	11.99	
	R	0.71 (4.06)	0.92 (4.68)	0.93 (4.40)	0.99 (4.43)	0.90 (3.76)	0.90 (3.50)	0.79 (2.89)	0.65 (2.22)	0.35 (1.09)	-0.34 (-0.97)	-1.05 (-4.14)
	FFC4 $\alpha$	0.23 (2.74)	0.34 (5.54)	0.31 (5.37)	0.34 (5.72)	0.23 (3.95)	0.18 (3.26)	0.06 (1.09)	-0.08 (-1.54)	-0.37 (-6.18)	-1.05 (-10.57)	-1.28 (-8.91)
MAX(1)	MAX(1)	1.35	2.33	2.98	3.61	4.27	5.03	5.95	7.17	9.11	15.77	
	R	0.72 (4.14)	0.89 (4.54)	0.94 (4.44)	0.93 (4.12)	0.94 (3.86)	0.87 (3.42)	0.76 (2.70)	0.61 (2.10)	0.36 (1.13)	-0.23 (-0.67)	-0.95 (-3.91)
	FFC4 $\alpha$	0.23 (2.89)	0.31 (5.10)	0.32 (5.59)	0.28 (4.87)	0.26 (4.36)	0.16 (3.28)	0.02 (0.44)	-0.11 (-2.25)	-0.36 (-5.97)	-0.93 (-10.40)	-1.15 (-8.95)

**Table IA3: Univariate Portfolios Sorted on MAX Excluding Last Trading Day**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on values of MAX calculated as the average of the 5 highest daily returns in the month  $t$  on days excluding the last trading day of the month. The table presents the time-series means of the monthly 1-month-ahead excess returns (R) and FFC4 alphas (FFC4  $\alpha$ ) for each of the equal-weighted decile portfolios. Excess returns and alphas are reported in percentages per month. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha, are shown in parentheses.

<b>Value</b>	Low 1	2	3	4	5	6	7	8	9	High 10	High–Low
R	0.72 (3.85)	0.94 (4.60)	0.92 (4.38)	0.88 (3.96)	0.89 (3.80)	0.77 (3.13)	0.78 (2.89)	0.68 (2.32)	0.44 (1.36)	-0.23 (-0.63)	-0.95 (-3.72)
FFC4 $\alpha$	0.24 (2.65)	0.36 (5.00)	0.30 (5.20)	0.24 (4.32)	0.22 (3.70)	0.08 (1.42)	0.07 (1.35)	-0.07 (-1.52)	-0.30 (-4.67)	-0.96 (-8.81)	-1.20 (-7.61)

**Table IA4: Univariate Portfolios Sorted on Lagged Values of MAX**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on MAX calculated as of the end of month  $t - 1$  (Panel A) or the average value of MAX calculated at the end of month  $t - 1$  and  $t$  (Panel B). The table presents the FFC4 alphas (in percentages per month) for decile portfolios formed by sorting on each of the values of lottery demand. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero alpha are shown in parentheses.

**Panel A. Portfolios Sorted on  $\text{MAX}_{t-1}$**

	Low									High	
<b>Value</b>	1	2	3	4	5	6	7	8	9	10	High–Low
FFC4 $\alpha$	0.27	0.21	0.20	0.13	0.12	0.05	-0.02	-0.03	-0.20	-0.43	-0.70
	(2.94)	(2.94)	(3.24)	(2.46)	(2.26)	(1.01)	(-0.43)	(-0.47)	(-3.09)	(-4.59)	(-4.59)

**Panel B. Portfolios Sorted on Average of  $\text{MAX}_{t-1}$  and  $\text{MAX}_t$**

	Low									High	
<b>Value</b>	1	2	3	4	5	6	7	8	9	10	High–Low
FFC4 $\alpha$	0.32	0.40	0.26	0.24	0.19	0.12	0.04	-0.08	-0.31	-0.86	-1.18
	(3.53)	(5.82)	(4.18)	(3.98)	(3.27)	(2.23)	(0.62)	(-1.51)	(-4.65)	(-8.04)	(-7.31)

**Table IA5: Univariate portfolios sorted on  $\beta_{\perp\text{MAX}}$  and  $\text{MAX}_{\perp\beta}$**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on the portion of  $\beta$  that is orthogonal to MAX ( $\beta_{\perp\text{MAX}}$ , Panel A) or the portion of MAX that is orthogonal to  $\beta$  ( $\text{MAX}_{\perp\beta}$ , Panel B). The table presents the time-series means of the monthly equal-weighted sort variable values, 1-month-ahead excess returns (R), FFC4 alphas (FFC4  $\alpha$ ), and FFC4+PS alphas (FFC4+PS  $\alpha$ ) for each of the decile portfolios. Excess returns and alphas are reported in percentages per month. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return, alpha, or factor sensitivity, are shown in parentheses.

**Panel A. Portfolios Sorted on  $\beta_{\perp\text{MAX}}$**

Value	$\beta_{\perp\text{MAX}}$ 1 (Low)	$\beta_{\perp\text{MAX}}$ 2	$\beta_{\perp\text{MAX}}$ 3	$\beta_{\perp\text{MAX}}$ 4	$\beta_{\perp\text{MAX}}$ 5	$\beta_{\perp\text{MAX}}$ 6	$\beta_{\perp\text{MAX}}$ 7	$\beta_{\perp\text{MAX}}$ 8	$\beta_{\perp\text{MAX}}$ 9	$\beta_{\perp\text{MAX}}$ 10 (High)	High–Low $\beta_{\perp\text{MAX}}$
$\beta_{\perp\text{MAX}}$	-0.02	0.31	0.47	0.60	0.73	0.85	0.99	1.16	1.40	1.90	
R	0.45 (2.01)	0.70 (3.43)	0.71 (3.36)	0.71 (3.21)	0.74 (3.17)	0.79 (3.21)	0.77 (2.99)	0.73 (2.66)	0.61 (2.00)	0.58 (1.56)	0.13 (0.50)
FFC4 $\alpha$	-0.11 (-1.12)	0.16 (2.11)	0.11 (1.58)	0.05 (0.90)	0.05 (0.91)	0.07 (1.23)	0.02 (0.40)	-0.03 (-0.56)	-0.09 (-1.17)	-0.06 (-0.49)	0.05 (0.25)
FFC4+PS $\alpha$	-0.12 (-1.09)	0.16 (1.90)	0.12 (1.59)	0.05 (0.82)	0.03 (0.52)	0.06 (0.95)	0.00 (-0.01)	-0.04 (-0.67)	-0.08 (-1.06)	-0.04 (-0.31)	0.08 (0.36)

**Panel B. Portfolios Sorted on  $\text{MAX}_{\perp\beta}$**

Value	$\text{MAX}_{\perp\beta}$ 1 (Low)	$\text{MAX}_{\perp\beta}$ 2	$\text{MAX}_{\perp\beta}$ 3	$\text{MAX}_{\perp\beta}$ 4	$\text{MAX}_{\perp\beta}$ 5	$\text{MAX}_{\perp\beta}$ 6	$\text{MAX}_{\perp\beta}$ 7	$\text{MAX}_{\perp\beta}$ 8	$\text{MAX}_{\perp\beta}$ 9	$\text{MAX}_{\perp\beta}$ 10 (High)	High–Low $\text{MAX}_{\perp\beta}$
$\text{MAX}_{\perp\beta}$	-0.03	0.57	0.91	1.24	1.57	1.94	2.38	2.94	3.81	6.44	
R	0.90 (3.75)	0.91 (4.21)	0.89 (4.19)	0.85 (3.83)	0.90 (3.92)	0.82 (3.36)	0.77 (3.00)	0.61 (2.24)	0.43 (1.49)	-0.29 (-0.88)	-1.19 (-6.72)
FFC4 $\alpha$	0.35 (3.85)	0.34 (5.77)	0.31 (5.68)	0.25 (4.92)	0.27 (5.19)	0.14 (2.97)	0.07 (1.41)	-0.11 (-2.22)	-0.33 (-6.11)	-1.09 (-11.99)	-1.44 (-10.62)
FFC4+PS $\alpha$	0.32 (3.08)	0.32 (4.95)	0.31 (5.03)	0.25 (4.32)	0.27 (5.05)	0.17 (3.17)	0.06 (1.21)	-0.12 (-2.12)	-0.33 (-5.68)	-1.11 (-10.79)	-1.42 (-9.14)



**Table IA6: Bivariate Independent-Sort Portfolio Analysis -  $\beta$  and MAX**

The table below presents the results of a bivariate independent-sort portfolio analysis of the relation between future stock returns and each of  $\beta$  and MAX after controlling for the other. At the end of each month  $t$ , all stocks in the sample are independently sorted into decile groups based on an ascending sort of each of  $\beta$  and MAX. The intersections of these decile groups are used to form 100 portfolios. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for each of the portfolios. The column (row) labeled MAX Avg. ( $\beta$  Avg.) presents the average portfolio excess return, across all deciles of MAX ( $\beta$ ) and within the given decile of  $\beta$  (MAX). The section labeled High–Low  $\beta$  Portfolios (High–Low MAX Portfolios) presents results for portfolios that are long the 10th  $\beta$  (MAX) decile portfolio and short the first  $\beta$  (MAX) decile portfolio within each decile of MAX ( $\beta$ ). The rows (columns) labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low portfolios, respectively. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.		
$\beta$ 1 (Low)	0.61	0.94	0.94	1.05	0.96	0.93	0.86	0.71	0.66	-0.20	0.75	-0.81	-1.31
												(-2.75)	(-5.43)
$\beta$ 2	0.71	1.00	0.95	0.92	0.77	0.97	1.00	0.68	0.47	-0.20	0.73	-0.92	-1.23
												(-3.98)	(-5.95)
$\beta$ 3	0.77	0.94	1.00	0.92	0.83	0.88	0.78	0.85	0.44	-0.55	0.69	-1.32	-1.57
												(-5.41)	(-6.97)
$\beta$ 4	0.92	1.03	0.92	0.88	1.00	0.75	0.65	0.75	0.24	-0.37	0.68	-1.28	-1.60
												(-5.60)	(-7.43)
$\beta$ 5	1.00	0.98	1.04	1.08	0.95	0.73	0.79	0.66	0.34	-0.26	0.73	-1.26	-1.48
												(-4.68)	(-5.91)
$\beta$ 6	1.10	1.04	1.00	0.93	0.96	0.78	0.70	0.59	0.24	-0.43	0.69	-1.50	-1.82
												(-5.74)	(-6.93)
$\beta$ 7	0.90	1.14	0.95	0.77	0.89	0.88	0.87	0.56	0.35	-0.22	0.71	-1.19	-1.48
												(-3.82)	(-5.29)
$\beta$ 8	1.38	1.10	0.94	0.82	0.85	0.81	0.85	0.72	0.41	-0.40	0.75	-1.75	-2.20
												(-5.54)	(-6.39)
$\beta$ 9	1.45	0.87	0.97	0.88	0.84	0.73	0.80	0.54	0.22	-0.45	0.69	-1.94	-2.11
												(-4.36)	(-5.05)
$\beta$ 10 (High)	0.33	1.36	1.32	1.25	0.93	0.78	0.66	0.79	0.28	-0.65	0.71	-1.05	-1.58
												(-1.83)	(-2.70)
$\beta$ Avg.	0.92	1.04	1.00	0.95	0.90	0.82	0.80	0.69	0.37	-0.37		-1.30	-1.64
												(-6.59)	(-9.94)
<b>High–Low <math>\beta</math> Portfolios</b>													
R	-0.19	0.40	0.36	0.16	-0.05	-0.16	-0.20	0.07	-0.38	-0.42	-0.03		
	(-0.35)	(1.05)	(0.94)	(0.47)	(-0.15)	(-0.51)	(-0.60)	(0.23)	(-1.15)	(-1.09)	(-0.13)		
FFC4 $\alpha$	0.00	-0.03	0.02	0.05	-0.29	-0.30	-0.30	0.02	-0.38	-0.31	-0.15		
	(0.00)	(-0.08)	(0.04)	(0.16)	(-0.96)	(-1.12)	(-1.18)	(0.06)	(-1.61)	(-1.02)	(-0.76)		

**Table IA7: Value-Weighted Bivariate Portfolio Analyses -  $\beta$  and MAX**

The table below presents the results of bivariate dependent-sort portfolio analyses of the relation between future stock returns and each of  $\beta$  (Panel A) and MAX (Panel B) after controlling for the other. At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of the control variable (MAX in Panel A,  $\beta$  in Panel B). Within each control variable group, decile portfolios based on an ascending sort of the predictive variable ( $\beta$  in Panel A, MAX in Panel B) are created. The table presents the time-series averages of the value-weighted 1-month-ahead excess returns for each of the portfolios. The column labeled MAX Avg. ( $\beta$  Avg.) presents the average portfolio excess return, across all deciles of MAX ( $\beta$ ) and within the given decile of  $\beta$  (MAX). The section labeled High–Low  $\beta$  Portfolios (High–Low MAX Portfolios) in Panel A (Panel B) presents results for portfolios that are long the 10th  $\beta$  (MAX) decile portfolio and short the first  $\beta$  (MAX) decile portfolio within each decile of MAX ( $\beta$ ). The rows labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low portfolios, respectively. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

**Panel A. Sort By MAX then  $\beta$**

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.
$\beta$ 1 (Low)	0.48	0.54	0.58	0.65	0.28	0.49	0.61	0.35	0.41	-0.26	0.41
$\beta$ 2	0.61	0.80	0.68	0.41	0.42	0.67	0.55	0.53	0.39	-0.28	0.48
$\beta$ 3	0.69	0.48	0.49	0.50	0.51	0.47	0.32	0.37	0.41	-0.10	0.42
$\beta$ 4	0.67	0.69	0.62	0.48	0.75	0.31	0.59	0.43	0.16	-0.01	0.47
$\beta$ 5	0.67	0.66	0.66	0.59	0.51	0.44	0.50	0.41	0.18	-0.06	0.45
$\beta$ 6	0.57	0.70	0.59	0.58	0.48	0.48	0.76	0.44	0.15	-0.09	0.47
$\beta$ 7	0.56	0.81	0.50	0.51	0.55	0.50	0.63	0.34	0.03	-0.06	0.44
$\beta$ 8	0.76	0.79	0.43	0.53	0.44	0.57	0.76	0.20	-0.03	-0.36	0.41
$\beta$ 9	0.76	0.70	0.65	0.47	0.62	0.45	0.52	0.43	0.48	-0.10	0.50
$\beta$ 10 (High)	0.91	0.77	0.48	0.41	0.63	0.40	0.66	0.48	0.10	-0.50	0.43
<b>High–Low <math>\beta</math> Portfolios</b>											
R	0.44 (2.10)	0.23 (1.05)	-0.10 (-0.49)	-0.24 (-1.01)	0.35 (1.30)	-0.09 (-0.34)	0.05 (0.15)	0.13 (0.35)	-0.31 (-0.75)	-0.23 (-0.50)	0.02 (0.10)
FFC4 $\alpha$	0.17 (0.79)	0.11 (0.53)	-0.18 (-0.87)	-0.25 (-1.02)	0.34 (1.21)	-0.03 (-0.10)	0.03 (0.09)	0.12 (0.36)	-0.25 (-0.71)	-0.12 (-0.33)	-0.01 (-0.04)

Table IA7: Value-Weighted Bivariate Dependent Sort Portfolio Analyses -  $\beta$  and MAX - continued

Panel B. Sort By  $\beta$  then MAX

	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$	$\beta_5$	$\beta_6$	$\beta_7$	$\beta_8$	$\beta_9$	$\beta_{10}$	$\beta_{Avg.}$
MAX 1 (Low)	0.48	0.50	0.74	0.91	0.67	0.77	0.61	0.71	0.41	0.54	0.63
MAX 2	0.62	0.72	0.54	0.69	0.65	0.53	0.38	0.55	0.65	0.28	0.56
MAX 3	0.51	0.70	0.59	0.64	0.61	0.58	0.32	0.74	0.48	0.50	0.57
MAX 4	0.62	0.77	0.61	0.59	0.68	0.59	0.66	0.20	0.60	0.66	0.60
MAX 5	0.80	0.84	0.44	0.38	0.42	0.58	0.48	0.64	0.46	0.62	0.57
MAX 6	0.66	0.39	0.53	0.78	0.39	0.59	0.59	0.61	0.30	0.74	0.56
MAX 7	0.50	0.44	0.54	0.33	0.37	0.59	0.76	0.50	0.27	-0.03	0.43
MAX 8	0.59	0.35	0.24	0.39	0.64	0.38	0.66	0.50	0.20	0.31	0.43
MAX 9	0.11	0.52	0.56	0.20	0.40	0.18	0.27	0.44	-0.02	0.00	0.27
MAX 10 (High)	-0.10	0.04	0.04	0.06	0.11	-0.19	0.08	-0.25	-0.41	-0.73	-0.14
High-Low MAX Portfolios											
R	-0.58 (-1.93)	-0.47 (-2.18)	-0.70 (-2.98)	-0.85 (-3.69)	-0.56 (-2.30)	-0.97 (-3.33)	-0.54 (-1.68)	-0.96 (-3.30)	-0.83 (-2.34)	-1.27 (-3.67)	-0.77 (-4.17)
FFC4 $\alpha$	-1.07 (-3.93)	-0.87 (-4.43)	-0.92 (-4.15)	-1.16 (-5.37)	-0.83 (-3.57)	-1.14 (-4.12)	-0.71 (-2.32)	-1.31 (-5.15)	-1.22 (-3.45)	-1.44 (-4.28)	-1.07 (-7.22)

**Table IA8: Value-Weighted Bivariate Independent-Sort Portfolio Analysis -  $\beta$  and MAX**

The table below presents the results of a bivariate independent-sort portfolio analysis of the relation between future stock returns and each of  $\beta$  and MAX after controlling for the other. At the end of each month  $t$ , all stocks in the sample are independently sorted into ascending groups based on an ascending sort of each of  $\beta$  and MAX. The intersections of these decile groups are used to form 100 portfolios. The table presents the time-series averages of the value-weighted 1-month-ahead excess returns for each of the portfolios. The column (row) labeled MAX Avg. ( $\beta$  Avg.) presents the average portfolio excess return, across all deciles of MAX ( $\beta$ ) and within the given decile of  $\beta$  (MAX). The section labeled High–Low  $\beta$  Portfolios (High–Low MAX Portfolios) presents results for portfolios that are long the 10th  $\beta$  (MAX) decile portfolio and short the first  $\beta$  (MAX) decile portfolio within each decile of MAX ( $\beta$ ). The rows (columns) labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low portfolios, respectively. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.		
$\beta$ 1 (Low)	0.64	0.57	0.69	0.77	0.48	0.54	0.80	0.31	0.56	-0.11	0.53	-0.76	-1.23
												(-2.14)	(-3.89)
$\beta$ 2	0.68	0.70	0.69	0.48	0.30	0.63	0.52	0.34	0.34	-0.06	0.46	-0.72	-1.02
												(-2.54)	(-3.54)
$\beta$ 3	0.61	0.67	0.55	0.52	0.45	0.73	0.26	0.58	0.05	-0.10	0.43	-0.72	-0.99
												(-2.40)	(-3.41)
$\beta$ 4	0.90	0.69	0.62	0.51	0.63	0.44	0.29	0.47	0.10	-0.16	0.45	-1.05	-1.40
												(-3.62)	(-4.92)
$\beta$ 5	0.76	0.78	0.57	0.46	0.48	0.31	0.61	0.52	0.23	-0.10	0.46	-0.85	-1.14
												(-2.87)	(-3.93)
$\beta$ 6	1.02	0.57	0.52	0.64	0.51	0.43	0.48	0.30	0.20	-0.32	0.44	-1.32	-1.57
												(-3.75)	(-4.28)
$\beta$ 7	0.84	0.60	0.45	0.37	0.57	0.54	0.77	0.58	0.35	-0.05	0.50	-0.98	-1.15
												(-2.43)	(-2.74)
$\beta$ 8	1.06	0.94	0.57	0.47	0.46	0.45	0.69	0.49	0.32	-0.17	0.53	-1.14	-1.63
												(-3.35)	(-4.02)
$\beta$ 9	1.42	0.57	0.72	0.35	0.64	0.52	0.66	0.08	-0.06	-0.24	0.47	-1.72	-1.87
												(-3.47)	(-3.95)
$\beta$ 10 (High)	0.48	1.06	1.01	1.04	0.53	0.31	0.53	0.52	0.20	-0.22	0.55	-0.79	-1.34
												(-1.40)	(-2.17)
$\beta$ Avg.	0.84	0.72	0.64	0.56	0.51	0.49	0.56	0.42	0.23	-0.15		-1.01	-1.33
												(-4.66)	(-6.88)
<b>High–Low <math>\beta</math> Portfolios</b>													
R	-0.09	0.49	0.26	0.23	0.02	-0.24	-0.26	0.20	-0.36	-0.08	0.02		
	(-0.15)	(1.21)	(0.71)	(0.66)	(0.07)	(-0.75)	(-0.67)	(0.56)	(-0.90)	(-0.18)	(0.15)		
FFC4 $\alpha$	0.18	0.03	0.15	0.28	-0.18	-0.30	-0.18	0.21	-0.26	0.08	0.00		
	(0.28)	(0.09)	(0.36)	(0.83)	(-0.50)	(-0.92)	(-0.59)	(0.69)	(-0.83)	(0.22)	(0.04)		

**Table IA9: Bivariate Portfolio Analyses - Alternative Measures of Lottery Demand**

The table below presents the results of bivariate dependent-sort portfolio analyses of the relation between future stock returns and  $\beta$  after controlling for several different measures of lottery demand. The measures of lottery demand are  $\text{MAX}(k)$ ,  $k \in \{1, 2, 3, 4, 5\}$ , where  $\text{MAX}(k)$  is defined as the average of the  $k$  highest daily returns of the given stock within the given month. At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of  $\text{MAX}(k)$ . Within each  $\text{MAX}(k)$  group, decile portfolios based on an ascending sort of  $\beta$  are created. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for the average  $\text{MAX}(k)$  portfolio within each of the  $\beta$  deciles. The columns labeled R and FFC4  $\alpha$  present the average returns and FFC4 alphas, respectively, for portfolios that are long the 10th  $\beta$  decile portfolio and short the first  $\beta$  decile in the average  $\text{MAX}(k)$  decile. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

<b>Lottery Demand Measure</b>											<b>High–Low <math>\beta</math> Portfolios</b>	
	Low $\beta$ 1	$\beta$ 2	$\beta$ 3	$\beta$ 4	$\beta$ 5	$\beta$ 6	$\beta$ 7	$\beta$ 8	$\beta$ 9	High $\beta$ 10	R	FFC4 $\alpha$
MAX(5)	0.70	0.69	0.67	0.68	0.67	0.70	0.66	0.65	0.70	0.68	-0.02 (-0.10)	-0.14 (-0.85)
MAX(4)	0.73	0.68	0.67	0.66	0.67	0.72	0.66	0.63	0.70	0.66	-0.07 (-0.29)	-0.18 (-1.07)
MAX(3)	0.74	0.68	0.70	0.65	0.69	0.70	0.66	0.61	0.69	0.67	-0.07 (-0.33)	-0.21 (-1.20)
MAX(2)	0.73	0.72	0.71	0.64	0.69	0.70	0.65	0.66	0.66	0.63	-0.10 (-0.45)	-0.24 (-1.37)
MAX(1)	0.75	0.71	0.73	0.66	0.68	0.72	0.67	0.64	0.65	0.58	-0.17 (-0.70)	-0.31 (-1.77)

**Table IA10: Bivariate Portfolio Analyses -  $\beta_{FP}$  and MAX**

The table below presents the results of bivariate dependent-sort portfolio analyses of the relation between future stock returns and each of  $\beta_{FP}$  (Panel A) and MAX (Panel B) after controlling for the other. At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of the control variable (MAX in Panel A,  $\beta_{FP}$  in Panel B). Within each control variable group, decile portfolios based on an ascending sort of the predictive variable ( $\beta_{FP}$  in Panel A, MAX in Panel B) are created. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for each of the portfolios. The column labeled MAX Avg. ( $\beta_{FP}$  Avg.) presents the average portfolio excess return, across all deciles of MAX ( $\beta_{FP}$ ) and within the given decile of  $\beta_{FP}$  (MAX). The section labeled High–Low  $\beta_{FP}$  Portfolios (High–Low MAX Portfolios) in Panel A (Panel B) presents results for portfolios that are long the 10th  $\beta_{FP}$  (MAX) decile portfolio and short the first  $\beta_{FP}$  (MAX) decile portfolio within each decile of MAX ( $\beta_{FP}$ ). The rows labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low portfolios, respectively. Excess returns and alphas are reported in percentages per month. The rows labeled  $\beta_{MKTFR}$ ,  $\beta_{SMB}$ ,  $\beta_{HML}$ , and  $\beta_{UMD}$  present factor sensitivities for the High–Low portfolios. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return, alpha, or factor sensitivity, is equal to 0.

**Panel A. Sort By MAX then  $\beta_{FP}$**

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.
$\beta_{FP}$ 1 (Low)	0.74	0.86	0.93	1.00	0.95	0.93	0.95	0.89	0.52	-0.01	0.78
$\beta_{FP}$ 2	0.82	0.97	1.04	0.96	1.02	0.88	0.90	0.81	0.49	-0.25	0.76
$\beta_{FP}$ 3	0.78	1.01	0.98	0.90	0.84	0.85	0.90	0.83	0.57	0.18	0.79
$\beta_{FP}$ 4	0.75	1.05	0.82	0.97	1.03	0.83	0.77	0.85	0.50	-0.12	0.75
$\beta_{FP}$ 5	0.81	0.97	1.03	0.91	0.75	0.93	0.87	0.81	0.59	-0.24	0.74
$\beta_{FP}$ 6	0.91	0.95	1.04	0.89	1.02	0.82	0.70	0.63	0.43	-0.17	0.72
$\beta_{FP}$ 7	1.03	1.06	0.97	0.80	0.92	0.84	0.73	0.72	0.49	-0.07	0.75
$\beta_{FP}$ 8	0.77	1.09	1.05	1.02	0.85	0.87	0.85	0.80	0.41	-0.23	0.75
$\beta_{FP}$ 9	0.92	1.04	0.91	0.89	0.96	0.76	0.87	0.64	0.32	-0.44	0.69
$\beta_{FP}$ 10 (High)	0.89	1.03	1.02	0.94	1.00	0.82	0.86	0.74	0.54	-0.25	0.76
<b>High–Low <math>\beta_{FP}</math> Portfolios</b>											
R	0.15 (1.16)	0.17 (1.49)	0.09 (0.66)	-0.06 (-0.42)	0.05 (0.34)	-0.11 (-0.72)	-0.09 (-0.49)	-0.15 (-0.88)	0.02 (0.11)	-0.23 (-0.96)	-0.02 (-0.14)
FFC4 $\alpha$	0.09 (0.66)	0.05 (0.39)	0.00 (0.03)	-0.12 (-0.85)	-0.05 (-0.35)	-0.15 (-1.02)	-0.08 (-0.52)	-0.19 (-1.21)	0.00 (-0.01)	-0.22 (-0.97)	-0.07 (-0.73)

Table IA10: Bivariate Dependent Sort Portfolio Analyses -  $\beta_{\text{FP}}$  and MAX - continued

Panel B. Sort By  $\beta_{\text{FP}}$  then MAX

	$\beta_{\text{FP}}$ 1	$\beta_{\text{FP}}$ 2	$\beta_{\text{FP}}$ 3	$\beta_{\text{FP}}$ 4	$\beta_{\text{FP}}$ 5	$\beta_{\text{FP}}$ 6	$\beta_{\text{FP}}$ 7	$\beta_{\text{FP}}$ 8	$\beta_{\text{FP}}$ 9	$\beta_{\text{FP}}$ 10	$\beta_{\text{FP}}$ Avg.
MAX 1 (Low)	0.73	0.72	0.74	0.91	0.93	0.94	0.90	0.95	0.93	1.01	0.88
MAX 2	0.87	0.94	1.02	1.00	0.97	1.10	1.04	0.99	0.96	0.93	0.98
MAX 3	0.97	1.02	0.97	0.99	1.07	1.04	1.02	0.99	0.83	0.96	0.99
MAX 4	0.96	1.04	0.86	0.92	0.88	0.82	0.89	0.90	0.88	0.76	0.89
MAX 5	0.97	0.98	1.02	0.91	0.83	0.96	0.84	0.89	0.99	0.95	0.93
MAX 6	0.85	0.92	0.90	0.81	0.96	0.74	0.70	0.83	0.84	0.71	0.83
MAX 7	0.99	0.83	0.89	0.77	0.83	0.79	0.78	0.74	0.65	0.84	0.81
MAX 8	0.89	0.93	0.81	0.85	0.90	0.85	0.55	0.59	0.53	0.46	0.74
MAX 9	0.87	0.64	0.78	0.65	0.53	0.49	0.59	0.47	0.10	0.20	0.53
MAX 10 (High)	0.17	0.05	-0.03	0.12	0.13	-0.25	-0.10	-0.36	-0.30	-0.53	-0.11
High-Low MAX Portfolios											
High-Low	-0.55 (-2.42)	-0.67 (-3.23)	-0.78 (-3.37)	-0.79 (-2.93)	-0.80 (-3.35)	-1.19 (-4.84)	-1.01 (-3.49)	-1.32 (-4.95)	-1.23 (-4.37)	-1.55 (-5.03)	-0.99 (-4.61)
FFC4 $\alpha$	-0.91 (-5.04)	-0.96 (-5.98)	-1.00 (-5.46)	-1.00 (-4.50)	-0.99 (-6.06)	-1.53 (-8.06)	-1.33 (-6.11)	-1.52 (-7.29)	-1.44 (-6.24)	-1.71 (-6.53)	-1.24 (-8.97)

**Table IA11: Bivariate Independent-Sort Portfolio Analysis -  $\beta_{FP}$  and MAX**

The table below presents the results of a bivariate independent-sort portfolio analysis of the relation between future stock returns and each of  $\beta_{FP}$  and MAX after controlling for the other. At the end of each month  $t$ , all stocks in the sample are independently sorted into decile groups based on an ascending sort of each of  $\beta_{FP}$  and MAX. The intersections of these decile groups are used to form 100 portfolios. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for each of the portfolios. The column (row) labeled MAX Avg. ( $\beta_{FP}$  Avg.) presents the average portfolio excess return, across all deciles of MAX ( $\beta_{FP}$ ) and within the given decile of  $\beta_{FP}$  (MAX). The section labeled High–Low  $\beta_{FP}$  Portfolios (High–Low MAX Portfolios) presents results for portfolios that are long the 10th  $\beta_{FP}$  (MAX) decile portfolio and short the first  $\beta_{FP}$  (MAX) decile portfolio within each decile of MAX ( $\beta_{FP}$ ). The rows (columns) labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low portfolios, respectively. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.		
$\beta_{FP}$ 1 (Low)	0.81	0.89	0.97	1.02	0.99	0.87	0.98	0.99	0.73	0.00	0.83	-0.80	-1.17
												(-2.89)	(-4.96)
$\beta_{FP}$ 2	0.74	1.03	1.08	0.89	1.01	0.98	0.86	0.91	0.45	-0.07	0.79	-0.82	-1.09
												(-3.40)	(-5.51)
$\beta_{FP}$ 3	0.80	0.99	0.87	0.98	0.93	0.89	0.95	0.73	0.60	-0.12	0.76	-0.92	-1.14
												(-3.62)	(-5.78)
$\beta_{FP}$ 4	0.92	1.00	0.94	0.95	0.93	0.80	0.76	0.83	0.37	0.06	0.76	-0.86	-1.05
												(-2.80)	(-4.07)
$\beta_{FP}$ 5	0.98	0.96	1.05	0.98	0.81	0.91	0.85	0.84	0.55	0.11	0.80	-0.87	-1.07
												(-3.32)	(-5.71)
$\beta_{FP}$ 6	0.92	1.12	1.07	0.78	0.91	0.84	0.71	0.83	0.47	-0.24	0.74	-1.16	-1.50
												(-4.60)	(-7.82)
$\beta_{FP}$ 7	0.88	1.10	1.06	0.93	0.95	0.76	0.79	0.64	0.55	-0.05	0.76	-0.93	-1.26
												(-3.21)	(-5.93)
$\beta_{FP}$ 8	1.00	1.04	1.03	0.91	0.93	0.83	0.76	0.73	0.50	-0.24	0.75	-1.23	-1.42
												(-4.52)	(-6.26)
$\beta_{FP}$ 9	0.85	1.19	0.81	0.93	0.99	0.79	0.93	0.67	0.32	-0.22	0.72	-1.07	-1.31
												(-3.87)	(-5.63)
$\beta_{FP}$ 10 (High)	0.78	1.00	1.23	0.95	1.01	0.89	0.86	0.75	0.47	-0.32	0.76	-1.10	-1.38
												(-3.60)	(-5.87)
$\beta$ Avg.	0.87	1.03	1.01	0.93	0.95	0.86	0.84	0.79	0.50	-0.11		-0.98	-1.24
												(-4.18)	(-8.19)
<b>High–Low <math>\beta_{FP}</math> Portfolios</b>													
R	-0.03	0.11	0.27	-0.08	0.02	0.02	-0.12	-0.24	-0.25	-0.32	-0.06		
	(-0.13)	(0.85)	(1.39)	(-0.49)	(0.10)	(0.12)	(-0.62)	(-1.33)	(-1.06)	(-0.78)	(-0.51)		
FFC4 $\alpha$	-0.05	0.01	0.15	-0.16	-0.08	-0.03	-0.11	-0.29	-0.30	-0.20	-0.11		
	(-0.30)	(0.06)	(0.87)	(-1.04)	(-0.55)	(-0.23)	(-0.60)	(-1.77)	(-1.36)	(-0.80)	(-0.86)		



**Table IA12: Univariate Portfolios Sorted on  $\beta_{FP \perp MAX}$  and  $MAX_{\perp \beta_{FP}}$**

The table below presents the time-series averages of monthly average sort variable values, 1-month-ahead excess returns (R), and FFC4 alphas (FFC4  $\alpha$ ) for decile portfolios formed by sorting on each of the portion of  $\beta_{FP}$  that is orthogonal to MAX ( $\beta_{FP \perp MAX}$ ) and the portion of MAX that is orthogonal to  $\beta_{FP}$  ( $MAX_{\perp \beta_{FP}}$ ). Excess returns and alphas are reported in percentages per month.  $t$ -statistics testing the null hypothesis that the average excess return or alpha is equal to 0, adjusted following NW (1987) using 6 lags, are in parentheses.

Sort		Low									High	
Variable	Value	1	2	3	4	5	6	7	8	9	10	High-Low
$\beta_{FP \perp MAX}$	$\beta_{FP \perp MAX}$	0.60	0.72	0.79	0.84	0.89	0.95	1.00	1.07	1.16	1.36	
R	0.76	0.77 (3.66)	0.80 (3.59)	0.74 (3.56)	0.80 (3.24)	0.77 (3.38)	0.69 (3.23)	0.76 (2.69)	0.69 (2.94)	0.71 (2.56)	-0.05 (2.49)	(-0.39)
FFC4 $\alpha$	0.15	0.13 (2.38)	0.14 (2.46)	0.07 (2.40)	0.11 (1.52)	0.09 (2.12)	-0.01 (1.97)	0.05 (-0.25)	-0.03 (1.06)	0.00 (-0.51)	-0.15 (0.04)	(-1.48)
$MAX_{\perp \beta_{FP}}$	$MAX_{\perp \beta_{FP}}$	-1.19	-0.19	0.42	1.00	1.60	2.28	3.11	4.24	6.04	12.39	
R	0.80	0.89 (4.13)	0.94 (4.35)	0.88 (4.47)	0.95 (4.01)	0.94 (4.10)	0.87 (3.82)	0.68 (3.30)	0.53 (2.49)	0.01 (1.79)	-0.79 (0.02)	(-4.04)
FFC4 $\alpha$	0.27	0.29 (3.48)	0.32 (4.46)	0.24 (5.78)	0.26 (4.71)	0.24 (4.78)	0.10 (4.59)	-0.07 (1.99)	-0.22 (-1.39)	-0.74 (-3.76)	-1.01 (-8.66)	(-8.57)

**Table IA13: Bivariate Portfolio Analyses - Lagged  $\beta$  and MAX**

The table below presents the results of a bivariate dependent-sort portfolio analysis of the relation between future stock returns lagged values of  $\beta$  after controlling for MAX. At the end of each month  $t$ , all stocks in the sample are sorted into ascending decile groups based on an ascending sort of MAX. Within each MAX group, decile portfolios based on an ascending sort of  $\beta$  measured as of the end of month  $t - 1$  are formed. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for each of the portfolios. The column labeled MAX Avg. presents the average portfolio excess return, across all deciles of MAX and within the given decile of lagged  $\beta$ . The section labeled High–Low  $\beta$  Portfolios presents results for portfolios that are long the 10th lagged  $\beta$  decile portfolio and short the first lagged  $\beta$  decile portfolio within each decile of MAX. The rows labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low lagged  $\beta$  portfolios, respectively. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return, alpha, or factor sensitivity, is equal to 0.

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.
$\beta$ 1 (Low)	0.51	1.03	0.96	0.99	0.96	0.87	0.91	0.73	0.46	-0.07	0.73
$\beta$ 2	0.61	0.96	0.92	0.94	0.79	0.90	0.80	0.83	0.53	-0.26	0.70
$\beta$ 3	0.60	0.86	0.89	0.82	0.97	0.83	0.73	0.74	0.36	-0.14	0.67
$\beta$ 4	0.64	0.85	0.92	1.00	0.93	0.77	0.74	0.72	0.52	-0.09	0.70
$\beta$ 5	0.61	0.92	1.00	0.98	0.95	0.73	0.78	0.64	0.27	-0.07	0.68
$\beta$ 6	0.73	1.05	0.94	0.97	0.93	0.85	0.87	0.59	0.67	-0.35	0.72
$\beta$ 7	0.78	0.95	0.95	0.95	0.93	0.76	0.81	0.64	0.20	-0.33	0.66
$\beta$ 8	0.82	1.11	1.02	0.71	0.80	0.85	0.82	0.61	0.28	-0.45	0.66
$\beta$ 9	1.01	1.15	0.96	0.85	0.78	0.65	0.79	0.62	0.32	-0.52	0.66
$\beta$ 10 (High)	1.10	1.06	1.03	0.97	0.91	0.77	0.71	0.70	0.25	-0.82	0.67
<b>High–Low <math>\beta</math> Portfolios</b>											
R	0.59 (3.09)	0.02 (0.12)	0.07 (0.33)	-0.02 (-0.11)	-0.05 (-0.22)	-0.10 (-0.37)	-0.19 (-0.62)	-0.02 (-0.08)	-0.21 (-0.62)	-0.75 (-1.90)	-0.07 (-0.30)
FFC4 $\alpha$	0.25 (1.67)	-0.23 (-1.50)	-0.14 (-0.74)	-0.24 (-1.19)	-0.21 (-1.12)	-0.18 (-0.85)	-0.25 (-1.04)	-0.02 (-0.09)	-0.16 (-0.56)	-0.60 (-1.96)	-0.18 (-1.10)

**Table IA14: Bivariate Portfolio Analyses -  $\beta$  and MAX Excluding Last Day**

The table below presents the results of a bivariate dependent-sort portfolio analysis of the relation between future stock returns and  $\beta$  after controlling for MAX, where MAX is calculated as the average of the 5 highest daily returns of the stock in the given month, excluding the last trading day of the month. At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of this alternative measure of MAX. Within each MAX group, decile portfolios based on an ascending sort of  $\beta$  are created. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for each of the portfolios. The column labeled MAX Avg. presents the average portfolio excess return, across all deciles of MAX and within the given decile of  $\beta$ . The section labeled High–Low  $\beta$  Portfolios presents results for portfolios that are long the 10th  $\beta$  decile portfolio and short the first  $\beta$  decile portfolio within each decile of MAX. The rows labeled R and FFC4  $\alpha$  present the average return and FFC4 alpha of the High–Low  $\beta$  portfolios, respectively. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.
$\beta$ 1 (Low)	0.49	0.87	0.93	0.86	0.82	0.88	0.89	0.86	0.49	0.04	0.71
$\beta$ 2	0.59	0.91	0.86	0.98	0.85	0.93	0.84	0.72	0.52	-0.22	0.70
$\beta$ 3	0.54	0.83	0.93	0.88	0.86	0.83	0.68	0.67	0.55	-0.15	0.66
$\beta$ 4	0.61	0.97	0.93	0.87	1.00	0.72	0.77	0.67	0.57	0.13	0.72
$\beta$ 5	0.58	0.86	0.94	0.93	0.94	0.71	0.76	0.72	0.37	-0.08	0.67
$\beta$ 6	0.78	0.98	0.84	0.94	0.95	0.88	0.87	0.65	0.53	-0.26	0.72
$\beta$ 7	0.78	0.87	0.87	0.95	0.82	0.74	0.80	0.61	0.40	-0.44	0.64
$\beta$ 8	0.82	1.23	0.96	0.77	0.87	0.79	0.69	0.66	0.25	-0.31	0.67
$\beta$ 9	0.97	0.98	0.94	0.78	0.86	0.59	0.70	0.70	0.37	-0.38	0.65
$\beta$ 10 (High)	1.07	0.90	1.02	0.83	0.92	0.67	0.80	0.51	0.32	-0.60	0.64
<b>High–Low <math>\beta</math> Portfolios</b>											
R	0.58 (2.82)	0.03 (0.18)	0.09 (0.44)	-0.03 (-0.15)	0.10 (0.38)	-0.21 (-0.80)	-0.09 (-0.29)	-0.35 (-1.14)	-0.17 (-0.50)	-0.64 (-1.54)	-0.07 (-0.31)
FFC4 $\alpha$	0.24 (1.45)	-0.23 (-1.48)	-0.14 (-0.72)	-0.28 (-1.43)	-0.08 (-0.36)	-0.26 (-1.13)	-0.16 (-0.67)	-0.38 (-1.61)	-0.11 (-0.39)	-0.50 (-1.49)	-0.19 (-1.11)

**Table IA15: Univariate Portfolios - Extended Sample**

At the end of each month  $t$ , all stocks are sorted into ascending  $\beta_{5Y}$  (Panel A) or MAX (Panel B) decile portfolios. Panel A (Panel B) of the table below presents the time-series means of the monthly value-weighted portfolio average  $\beta_{5Y}$  (MAX) values, 1-month-ahead excess returns (R), FFC4 alphas (FFC4  $\alpha$ ), and FFC4+PS alphas (FFC4+PS  $\alpha$ ) for each of the decile portfolios. The column in Panel A (Panel B) labeled High–Low  $\beta_{5Y}$  (High–Low MAX) presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio. The sample covers the months  $t$  (return months  $t+1$ ) from Dec. (Jan.) 1930 (1931) through Nov. (Dec.) 2012 and includes all U.S.-based publicly traded common stocks with share price of at least \$5 at the end of month  $t$ . Excess returns and alphas are reported in percentages per month.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha are shown in parentheses.

**Panel A. Portfolios Sorted on  $\beta_{5Y}$**

Value	$\beta_{5Y}$ 1 (Low)	$\beta_{5Y}$ 2	$\beta_{5Y}$ 3	$\beta_{5Y}$ 4	$\beta_{5Y}$ 5	$\beta_{5Y}$ 6	$\beta_{5Y}$ 7	$\beta_{5Y}$ 8	$\beta_{5Y}$ 9	$\beta_{5Y}$ 10 (High)	High–Low $\beta_{5Y}$
$\beta_{5Y}$	0.32	0.59	0.77	0.93	1.09	1.25	1.43	1.64	1.94	2.58	
R	0.59 (4.24)	0.58 (3.77)	0.67 (4.21)	0.71 (4.09)	0.64 (3.24)	0.74 (3.51)	0.67 (2.97)	0.73 (2.86)	0.75 (2.71)	0.74 (2.29)	0.15 (0.61)
FFC4 $\alpha$	0.14 (1.96)	0.05 (0.77)	0.10 (1.63)	0.05 (0.84)	-0.04 (-0.66)	-0.03 (-0.48)	-0.19 (-2.77)	-0.17 (-2.15)	-0.21 (-2.02)	-0.34 (-2.84)	-0.48 (-2.84)
FFC4+FMAX $\alpha$	<b>-0.09</b> <b>(-1.32)</b>	-0.20 (-3.02)	-0.07 (-1.24)	-0.05 (-0.75)	-0.11 (-1.56)	-0.08 (-1.09)	-0.09 (-1.06)	0.02 (0.26)	0.09 (0.92)	<b>0.29</b> <b>(2.85)</b>	<b>0.38</b> <b>(2.85)</b>

**Panel B. Portfolios Sorted on MAX**

Value	MAX 1 (Low)	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10 (High)	High–Low MAX
MAX	0.86	1.38	1.78	2.13	2.49	2.87	3.31	3.88	4.70	6.89	
R	0.72 (5.26)	0.74 (4.77)	0.67 (3.98)	0.74 (4.03)	0.76 (3.95)	0.67 (3.18)	0.75 (3.09)	0.62 (2.44)	0.44 (1.49)	0.12 (0.40)	-0.60 (-2.56)
FFC4 $\alpha$	0.27 (3.53)	0.19 (3.26)	0.06 (1.13)	0.06 (1.03)	0.03 (0.57)	-0.12 (-1.81)	-0.13 (-1.88)	-0.30 (-4.03)	-0.60 (-6.34)	-0.89 (-6.89)	-1.15 (-6.90)

**Table IA16: Equal-Weighted Univariate Portfolios - Extended Sample**

At the end of each month  $t$ , all stocks are sorted into ascending  $\beta_{5Y}$  (Panel A) or MAX (Panel B) decile portfolios. Panel A (Panel B) of the table below presents the time-series means of the monthly equal-weighted portfolio average  $\beta_{5Y}$  (MAX) values, 1-month-ahead excess returns (R), FFC4 alphas (FFC4  $\alpha$ ), and FFC4+PS alphas (FFC4+PS  $\alpha$ ) for each of the decile portfolios. The column in Panel A (Panel B) labeled High–Low  $\beta_{5Y}$  (High–Low MAX) presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio. The sample covers the months  $t$  (return months  $t+1$ ) from Dec. (Jan.) 1930 (1931) through Nov. (Dec.) 2012 and includes all U.S.-based publicly traded common stocks with share price of at least \$5 at the end of month  $t$ . Excess returns and alphas are reported in percentages per month.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha are shown in parentheses.

**Panel A. Portfolios Sorted on  $\beta_{5Y}$**

Value	Low									High	High–Low
	$\beta_{5Y}$ 1	$\beta_{5Y}$ 2	$\beta_{5Y}$ 3	$\beta_{5Y}$ 4	$\beta_{5Y}$ 5	$\beta_{5Y}$ 6	$\beta_{5Y}$ 7	$\beta_{5Y}$ 8	$\beta_{5Y}$ 9	$\beta_{5Y}$ 10	$\beta_{5Y}$
$\beta_{5Y}$	0.32	0.59	0.77	0.93	1.09	1.25	1.43	1.64	1.94	2.58	
R	0.69 (4.52)	0.80 (4.91)	0.90 (4.89)	0.93 (4.68)	0.94 (4.37)	0.99 (4.24)	0.93 (3.80)	0.99 (3.72)	0.96 (3.39)	0.85 (2.55)	0.16 (0.68)
FFC4 $\alpha$	0.14 (1.84)	0.20 (3.07)	0.18 (3.18)	0.15 (2.73)	0.11 (1.91)	0.08 (1.55)	-0.06 (-1.05)	-0.04 (-0.66)	-0.14 (-1.63)	-0.34 (-3.43)	-0.48 (-3.09)
FFC4+FMAX $\alpha$	<b>-0.09</b> <b>(-1.23)</b>	-0.03 (-0.47)	-0.03 (-0.61)	-0.04 (-0.83)	-0.04 (-0.71)	-0.05 (-0.93)	-0.08 (-1.25)	0.05 (0.68)	0.06 (0.71)	<b>0.11</b> <b>(1.22)</b>	<b>0.20</b> <b>(1.57)</b>

**Panel B. Portfolios Sorted on MAX**

Value	Low									High	High–Low
	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX
MAX	0.86	1.38	1.78	2.13	2.49	2.87	3.31	3.88	4.70	6.89	
R	0.95 (6.20)	1.07 (6.36)	1.08 (5.82)	1.10 (5.40)	1.10 (5.12)	1.04 (4.50)	0.98 (3.93)	0.86 (3.31)	0.73 (2.46)	0.06 (0.21)	-0.89 (-4.50)
FFC4 $\alpha$	0.43 (6.07)	0.46 (7.23)	0.40 (7.16)	0.30 (6.53)	0.25 (5.21)	0.12 (2.58)	0.00 (0.07)	-0.19 (-3.57)	-0.43 (-7.22)	-1.07 (-12.60)	-1.50 (-13.10)

**Table IA17: Bivariate Portfolios - Extended Sample**

Panel A (Panel B) of the table below presents the results of bivariate dependent-sort portfolio analyses of the relation between future stock returns and  $\beta_{5Y}$  (MAX) after controlling for MAX ( $\beta_{5Y}$ ). At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of the control variable (MAX in Panel A,  $\beta_{5Y}$  in Panel B). Within each control variable group, decile portfolios based on an ascending sort of the  $\beta_{5Y}$  (Panels A) or MAX (Panel B) are created. The table presents the time-series averages of the value-weighted 1-month-ahead excess returns for each of the resulting portfolios. The column labeled MAX Avg. ( $\beta_{5Y}$  Avg.) in Panel A (Panel B) presents results for the average MAX ( $\beta_{5Y}$ ) decile within the given  $\beta_{5Y}$  (MAX) decile. The section labeled High–Low  $\beta_{5Y}$  Portfolios (High–Low MAX Portfolios) in Panel A (Panel B) shows average returns (R) and FFC4 alphas (FFC4  $\alpha$ ) for the zero-cost portfolio that is long the  $\beta_{5Y}$  (MAX) decile 10 portfolio and short the  $\beta$  decile 1 portfolio within each decile of MAX ( $\beta_{5Y}$ ). The sample covers the months  $t$  (return months  $t + 1$ ) from Dec. (Jan.) 1930 (1931) through Nov. (Dec.) 2012 and includes all U.S.-based publicly traded common stocks with share price of at least \$5 at the end of month  $t$ . Excess returns and alphas are reported in percentages per month.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha are shown in parentheses.

**Panel A. Portfolios Sorted on MAX then  $\beta_{5Y}$**

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.
$\beta_{5Y}$ 1 (Low)	0.67	0.78	0.57	0.61	0.63	0.47	0.52	0.46	0.07	-0.14	0.46
$\beta_{5Y}$ 2	0.83	0.69	0.63	0.82	0.73	0.52	0.77	0.50	0.15	0.10	0.57
$\beta_{5Y}$ 3	0.71	0.66	0.61	0.80	0.72	0.73	0.82	0.62	0.67	0.13	0.65
$\beta_{5Y}$ 4	0.82	0.82	0.70	0.83	0.84	0.72	0.76	0.70	0.33	0.45	0.70
$\beta_{5Y}$ 5	0.70	0.87	0.76	0.72	0.73	0.73	0.89	0.68	0.50	0.00	0.66
$\beta_{5Y}$ 6	0.89	0.92	0.85	0.53	0.67	0.69	0.68	0.79	0.63	-0.24	0.64
$\beta_{5Y}$ 7	0.78	0.76	0.73	0.62	0.93	0.82	0.69	0.52	0.55	0.29	0.67
$\beta_{5Y}$ 8	0.89	0.99	0.90	0.78	0.72	0.76	0.88	0.62	0.98	0.29	0.78
$\beta_{5Y}$ 9	1.21	0.99	0.87	1.00	1.02	0.80	1.01	0.59	0.68	0.18	0.83
$\beta_{5Y}$ 10 (High)	1.26	1.18	1.21	0.89	1.16	0.91	0.94	0.76	0.66	-0.09	0.89
<b>High–Low <math>\beta_{5Y}</math> Portfolios</b>											
R	0.59 (2.66)	0.40 (1.97)	0.65 (3.01)	0.28 (1.16)	0.52 (1.98)	0.44 (1.74)	0.42 (1.51)	0.30 (1.07)	0.59 (1.78)	0.05 (0.16)	0.43 (2.30)
FFC4 $\alpha$	0.06 (0.28)	-0.01 (-0.03)	0.19 (1.04)	-0.15 (-0.63)	0.20 (0.81)	0.28 (1.04)	0.14 (0.54)	-0.04 (-0.16)	0.23 (0.73)	-0.37 (-1.31)	<b>0.05</b> <b>(0.35)</b>

Table IA17: Bivariate Portfolios - Extended Sample - continued

Panel B. Portfolios Sorted on $\beta_{5Y}$ then MAX											
	$\beta_{5Y}$ 1	$\beta_{5Y}$ 2	$\beta_{5Y}$ 3	$\beta_{5Y}$ 4	$\beta_{5Y}$ 5	$\beta_{5Y}$ 6	$\beta_{5Y}$ 7	$\beta_{5Y}$ 8	$\beta_{5Y}$ 9	$\beta_{5Y}$ 10	$\beta_{5Y}$ Avg.
MAX 1 (Low)	0.61	0.77	0.93	1.07	0.93	1.06	1.04	1.40	1.36	1.35	1.05
MAX 2	0.75	0.87	0.94	0.87	0.97	1.02	0.95	0.83	1.02	1.03	0.93
MAX 3	0.74	0.58	0.74	0.82	0.83	0.70	0.72	1.04	0.91	1.17	0.82
MAX 4	0.69	0.70	0.63	0.83	0.79	0.91	0.70	0.71	0.92	0.90	0.78
MAX 5	0.55	0.75	0.83	0.90	0.63	0.83	0.86	0.79	0.89	0.69	0.77
MAX 6	0.51	0.56	0.77	0.68	0.65	0.60	0.80	0.64	0.82	0.97	0.70
MAX 7	0.50	0.50	0.75	0.56	0.66	0.72	0.82	0.62	0.56	0.54	0.62
MAX 8	0.67	0.57	0.76	0.58	0.89	0.84	0.71	0.77	0.56	0.51	0.69
MAX 9	0.30	0.17	0.68	0.55	0.52	0.59	0.33	0.42	0.63	0.21	0.44
MAX 10 (High)	-0.06	0.04	0.09	0.17	0.32	0.30	-0.04	0.11	-0.11	-0.30	0.05
High-Low MAX Portfolios											
R	-0.67 (-2.68)	-0.73 (-3.34)	-0.84 (-3.59)	-0.90 (-3.65)	-0.61 (-2.47)	-0.76 (-2.80)	-1.08 (-4.02)	-1.28 (-4.26)	-1.47 (-5.99)	-1.65 (-5.55)	-1.00 (-6.13)
FFC4 $\alpha$	-1.27 (-6.02)	-1.18 (-5.44)	-1.30 (-6.29)	-1.38 (-6.89)	-1.01 (-4.28)	-1.23 (-4.67)	-1.33 (-4.98)	-1.68 (-6.22)	-1.65 (-6.60)	-2.01 (-6.58)	-1.40 (-10.63)

**Table IA18: Equal-Weighted Bivariate Portfolios - Extended Sample**

Panel A (Panel B) of the table below presents the results of bivariate dependent-sort portfolio analyses of the relation between future stock returns and  $\beta_{5Y}$  (MAX) after controlling for MAX ( $\beta_{5Y}$ ). At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of the control variable (MAX in Panel A,  $\beta_{5Y}$  in Panel B). Within each control variable group, decile portfolios based on an ascending sort of the  $\beta_{5Y}$  (Panels A) or MAX (Panel B) are created. The table presents the time-series averages of the equal-weighted 1-month-ahead excess returns for each of the resulting portfolios. The column labeled MAX Avg. ( $\beta_{5Y}$  Avg.) in Panel A (Panel B) presents results for the average MAX ( $\beta_{5Y}$ ) decile within the given  $\beta_{5Y}$  (MAX) decile. The section labeled High–Low  $\beta_{5Y}$  Portfolios (High–Low MAX Portfolios) in Panel A (Panel B) shows average returns (R) and FFC4 alphas (FFC4  $\alpha$ ) for the zero-cost portfolio that is long the  $\beta_{5Y}$  (MAX) decile 10 portfolio and short the  $\beta$  decile 1 portfolio within each decile of MAX ( $\beta_{5Y}$ ). The sample covers the months  $t$  (return months  $t + 1$ ) from Dec. (Jan.) 1930 (1931) through Nov. (Dec.) 2012 and includes all U.S.-based publicly traded common stocks with share price of at least \$5 at the end of month  $t$ . Excess returns and alphas are reported in percentages per month.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha are shown in parentheses.

**Panel A. Portfolios Sorted on MAX then  $\beta_{5Y}$**

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	MAX Avg.
$\beta_{5Y}$ 1 (Low)	0.80	0.90	0.83	0.85	0.84	0.79	0.64	0.64	0.39	-0.19	0.65
$\beta_{5Y}$ 2	0.88	0.89	0.88	0.92	0.94	0.90	0.93	0.67	0.49	0.17	0.77
$\beta_{5Y}$ 3	0.74	0.89	0.90	0.98	1.03	0.93	0.93	0.82	0.85	0.11	0.82
$\beta_{5Y}$ 4	0.85	1.00	1.09	1.15	1.05	1.03	0.88	0.90	0.66	0.23	0.88
$\beta_{5Y}$ 5	0.92	0.98	1.09	1.07	1.05	1.01	1.07	0.88	0.83	0.16	0.91
$\beta_{5Y}$ 6	1.00	1.18	1.08	1.09	1.02	1.10	0.94	0.96	0.76	-0.05	0.91
$\beta_{5Y}$ 7	0.86	1.04	1.12	1.11	1.14	1.15	0.92	0.85	0.75	0.22	0.92
$\beta_{5Y}$ 8	0.94	1.18	1.19	1.09	1.12	1.13	1.25	0.96	0.90	0.19	1.00
$\beta_{5Y}$ 9	1.24	1.24	1.26	1.36	1.30	1.12	1.23	1.02	0.72	0.10	1.06
$\beta_{5Y}$ 10 (High)	1.31	1.42	1.45	1.46	1.51	1.29	1.02	0.84	0.90	-0.31	1.09
<b>High–Low <math>\beta_{5Y}</math> Portfolios</b>											
R	0.50 (2.27)	0.52 (2.72)	0.62 (3.14)	0.61 (2.75)	0.68 (3.23)	0.50 (2.38)	0.37 (1.63)	0.21 (0.82)	0.51 (1.87)	-0.11 (-0.40)	0.44 (2.63)
FFC4 $\alpha$	0.00 (-0.02)	0.12 (0.70)	0.16 (0.96)	0.15 (0.67)	0.30 (1.62)	0.17 (0.95)	0.07 (0.37)	-0.11 (-0.51)	0.07 (0.30)	-0.40 (-1.41)	<b>0.05</b> <b>(0.39)</b>



Table IA18: Equal-Weighted Bivariate Portfolios - Extended Sample - continued

Panel B. Portfolios Sorted on  $\beta_{5Y}$  then MAX

	$\beta_{5Y}$ 1	$\beta_{5Y}$ 2	$\beta_{5Y}$ 3	$\beta_{5Y}$ 4	$\beta_{5Y}$ 5	$\beta_{5Y}$ 6	$\beta_{5Y}$ 7	$\beta_{5Y}$ 8	$\beta_{5Y}$ 9	$\beta_{5Y}$ 10	$\beta_{5Y}$ Avg.
MAX 1 (Low)	0.66	0.91	0.96	0.95	1.07	1.09	1.11	1.40	1.51	1.61	1.13
MAX 2	0.92	1.02	1.06	1.17	1.16	1.34	1.17	1.26	1.37	1.44	1.19
MAX 3	0.87	0.95	0.99	1.17	1.17	1.12	1.08	1.28	1.35	1.29	1.13
MAX 4	0.83	0.94	0.96	1.15	1.04	1.27	1.10	1.16	1.20	1.08	1.07
MAX 5	0.83	0.95	1.03	1.20	0.89	1.17	1.19	1.17	1.17	0.96	1.06
MAX 6	0.79	0.84	1.02	1.01	0.99	0.91	1.09	1.10	1.02	0.92	0.97
MAX 7	0.72	0.81	0.93	1.01	0.97	0.94	0.93	0.89	0.86	0.66	0.87
MAX 8	0.73	0.76	0.87	0.81	0.95	1.12	0.89	0.90	0.65	0.72	0.84
MAX 9	0.54	0.58	0.91	0.53	0.82	0.76	0.63	0.61	0.63	0.24	0.62
MAX 10 (High)	0.00	0.26	0.28	0.27	0.37	0.20	0.00	0.06	-0.19	-0.51	0.08
High-Low MAX Portfolios											
R	-0.65 (-3.18)	-0.66 (-3.56)	-0.68 (-3.88)	-0.68 (-3.50)	-0.70 (-4.00)	-0.89 (-4.48)	-1.11 (-5.69)	-1.34 (-6.10)	-1.70 (-8.44)	-2.12 (-8.18)	-1.05 (-8.01)
FFC4 $\alpha$	-1.23 (-7.58)	-1.11 (-7.14)	-1.12 (-7.92)	-1.10 (-7.47)	-1.09 (-6.56)	-1.30 (-7.65)	-1.47 (-7.78)	-1.65 (-8.62)	-1.97 (-10.35)	-2.43 (-10.02)	-1.45 (-15.22)

**Table IA19: Alphas for  $\beta_{\text{FP}}$  Portfolios**

At the end of each month  $t$ , all stocks are sorted into ascending  $\beta_{\text{FP}}$  decile portfolios. The table below presents alphas (in percentages per month) relative to several different factor models (indicated in the first column of the table) for the 1-month-ahead returns generated by each of the equal-weighted  $\beta_{\text{FP}}$  decile portfolios, as well as for the portfolio that is long the high- $\beta_{\text{FP}}$  portfolio and short the low- $\beta_{\text{FP}}$  portfolio (High–Low  $\beta_{\text{FP}}$  column).  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero alpha, are shown in parentheses.

	Low $\beta_{\text{FP}}$ 1	$\beta_{\text{FP}}$ 2	$\beta_{\text{FP}}$ 3	$\beta_{\text{FP}}$ 4	$\beta_{\text{FP}}$ 5	$\beta_{\text{FP}}$ 6	$\beta_{\text{FP}}$ 7	$\beta_{\text{FP}}$ 8	$\beta_{\text{FP}}$ 9	High $\beta_{\text{FP}}$ 10	High–Low $\beta_{\text{FP}}$
FFC4 $\alpha$	0.22 (3.44)	0.18 (3.24)	0.13 (2.33)	0.13 (2.70)	0.12 (2.41)	0.06 (1.30)	0.02 (0.36)	-0.02 (-0.33)	-0.06 (-1.13)	-0.08 (-1.09)	-0.31 (-2.67)
FFC4+PS $\alpha$	0.23 (3.31)	0.19 (3.26)	0.14 (2.28)	0.15 (2.97)	0.11 (1.94)	0.05 (0.97)	0.01 (0.19)	-0.05 (-1.01)	-0.08 (-1.41)	-0.07 (-0.88)	-0.29 (-2.49)
FFC4+FMAX $\alpha$	<b>0.09</b> <b>(1.46)</b>	0.05 (0.99)	0.02 (0.46)	0.03 (0.66)	0.03 (0.56)	0.00 (-0.08)	-0.02 (-0.45)	-0.03 (-0.70)	-0.05 (-0.76)	<b>0.02</b> <b>(0.21)</b>	<b>-0.07</b> <b>(-0.68)</b>
FFC4+PS+FMAX $\alpha$	<b>0.09</b> <b>(1.43)</b>	0.06 (1.18)	0.04 (0.63)	0.05 (1.05)	0.01 (0.21)	-0.02 (-0.38)	-0.04 (-0.67)	-0.07 (-1.41)	-0.08 (-1.23)	<b>0.01</b> <b>(0.11)</b>	<b>-0.08</b> <b>(-0.74)</b>

**Table IA20: BAB and Alternative Lottery Demand Factors**

The table below presents the FFC4+FMAX alphas and factor sensitivities for the BAB factor using several different variations of the FMAX factor. The column labeled  $\alpha$  presents the alpha (in percentages per month) for each of the factor models. The columns labeled  $\beta_f$ ,  $f \in \{\text{MKTRF}, \text{SMB}, \text{HML}, \text{UMD}, \text{PS}, \text{FMAX}(k), k \in \{1, 2, 3, 4, 5\}\}$  present the sensitivities of the BAB factor returns to the given factor. The BAB factor is taken from Lasse H. Pedersen's Web site. The different versions of the lottery factor are created using the factor creation procedure of Fama and French (1993), taking  $\text{MAX}(k)$ , defined as the average of the  $k$  highest daily returns of the given stock in the given month, as the measure of lottery demand. The factor created using  $\text{MAX}(k)$  as the measure of lottery demand is denoted  $\text{FMAX}(k)$ . The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the coefficient is equal to 0. The column labeled  $M$  indicates the number of monthly returns used to fit the factor model. The column labeled Adj.  $R^2$  presents the adjusted  $R^2$  of the factor model regression.

Specification	$\alpha$	$\beta_{\text{MKTRF}}$	$\beta_{\text{SMB}}$	$\beta_{\text{HML}}$	$\beta_{\text{UMD}}$	$\beta_{\text{FMAX}(5)}$	$\beta_{\text{FMAX}(4)}$	$\beta_{\text{FMAX}(3)}$	$\beta_{\text{FMAX}(2)}$	$\beta_{\text{FMAX}(1)}$	$M$	Adj. $R^2$
FFC4+FMAX(5)	0.17 (1.23)	0.29 (8.22)	0.31 (5.46)	0.21 (3.49)	0.17 (4.39)	-0.55 (-11.84)					584	46.95%
FFC4+FMAX(4)	0.17 (1.27)	0.29 (8.29)	0.35 (6.19)	0.22 (3.50)	0.17 (4.15)		-0.57 (-11.82)				584	47.20%
FFC4+FMAX(3)	0.18 (1.37)	0.29 (8.34)	0.36 (6.25)	0.22 (3.48)	0.16 (4.04)			-0.58 (-11.66)			584	47.35%
FFC4+FMAX(2)	0.20 (1.45)	0.29 (8.35)	0.38 (6.48)	0.21 (3.39)	0.15 (3.94)				-0.60 (-11.57)		584	47.37%
FFC4+FMAX(1)	0.21 (1.58)	0.29 (8.41)	0.38 (6.33)	0.20 (3.32)	0.14 (3.62)					-0.64 (-11.41)	584	47.51%

**Table IA21: Alphas and Factor Sensitivities for BAB\_\$5 and FMAX Factors**

The table below presents the alphas and factor sensitivities for the BAB\_\$5 factor (Panel A) and the FMAX factor (Panel B) using several factor models. The column labeled  $\alpha$  presents the alpha (in percentages per month) relative to each of the factor models. The columns labeled  $\beta_f$ ,  $f \in \{\text{MKTRF}, \text{SMB}, \text{HML}, \text{UMD}, \text{PS}, \text{FMAX}, \text{BAB\_}\$5\}$  present the sensitivities of the BAB\_\$5 (Panel A) or FMAX (Panel B) factor returns to the given factor. BAB\_\$5 factor returns are generated by the exact same procedure used by Frazzini and Pedersen (2014) to generate the BAB factor, but using the sample and measure of beta ( $\beta$ ) used throughout this study. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the coefficient is equal to 0. The column labeled  $M$  indicates the number of monthly returns used to fit the factor model. The column labeled Adj.  $R^2$  presents the adjusted  $R^2$  of the factor model regression.

**Panel A. Sensitivities of BAB\_\$5 Factor**

Specification	$\alpha$	$\beta_{\text{MKTRF}}$	$\beta_{\text{SMB}}$	$\beta_{\text{HML}}$	$\beta_{\text{UMD}}$	$\beta_{\text{PS}}$	$\beta_{\text{FMAX}}$	$M$	Adj. $R^2$
FFC4	0.30 (3.38)	0.21 (6.75)	0.07 (1.56)	0.29 (5.68)	0.07 (2.22)			593	29.60%
FFC4+PS	0.32 (3.44)	0.22 (6.99)	0.09 (1.85)	0.30 (5.90)	0.09 (2.57)	0.03 (1.03)		540	33.08%
FFC4+FMAX	<b>0.10</b> <b>(1.30)</b>	0.33 (12.62)	0.24 (7.25)	0.13 (3.77)	0.07 (3.31)		-0.29 (-10.66)	593	49.67%
FFC4+PS+FMAX	<b>0.14</b> <b>(1.60)</b>	0.33 (12.31)	0.24 (7.01)	0.15 (4.15)	0.08 (3.59)	0.01 (0.69)	-0.28 (-9.77)	540	51.27%

**Panel B. Sensitivities of FMAX Factor**

Specification	$\alpha$	$\beta_{\text{MKTRF}}$	$\beta_{\text{SMB}}$	$\beta_{\text{HML}}$	$\beta_{\text{UMD}}$	$\beta_{\text{PS}}$	$\beta_{\text{BAB\_}\$5}$	$M$	Adj. $R^2$
FFC4	-0.67 (-5.12)	0.43 (8.36)	0.58 (6.39)	-0.53 (-4.59)	-0.02 (-0.19)			593	62.14%
FFC4+PS	-0.65 (-4.60)	0.42 (8.17)	0.56 (5.51)	-0.54 (-4.72)	-0.03 (-0.41)	-0.06 (-1.00)		540	62.36%
FFC4+BAB_\$5	-0.37 (-3.15)	0.63 (13.95)	0.65 (9.78)	-0.24 (-3.03)	0.06 (0.99)		-0.99 (-10.02)	593	72.93%
FFC4+PS+BAB_\$5	-0.34 (-2.54)	0.64 (13.68)	0.64 (8.74)	-0.25 (-2.98)	0.05 (0.87)	-0.03 (-0.71)	-0.98 (-9.59)	540	72.59%

Table IA22:

**2-, 3-, 6-, and 12-Month Transition Matrices for MAX-Sorted Portfolios**

At the end of each month  $t$ , all stocks are sorted into ascending MAX decile portfolios. For each month  $t$  MAX decile, the table presents the time-series averages of the percentage of stocks in the given month  $t$  MAX decile portfolio that fall in each month  $t + 2$  (Panel A),  $t + 3$  (Panel B),  $t + 6$  (Panel C), and  $t + 12$  (Panel D) MAX decile portfolio.

**Panel A. 2-Month Transition Probabilities**

	MAX <sub><math>t+2</math></sub> 1	MAX <sub><math>t+2</math></sub> 2	MAX <sub><math>t+2</math></sub> 3	MAX <sub><math>t+2</math></sub> 4	MAX <sub><math>t+2</math></sub> 5	MAX <sub><math>t+2</math></sub> 6	MAX <sub><math>t+2</math></sub> 7	MAX <sub><math>t+2</math></sub> 8	MAX <sub><math>t+2</math></sub> 9	MAX <sub><math>t+2</math></sub> 10
MAX <sub><math>t</math></sub> 1 (Low)	38%	19%	11%	8%	6%	5%	4%	3%	3%	3%
MAX <sub><math>t</math></sub> 2	19%	21%	16%	12%	9%	7%	5%	4%	4%	3%
MAX <sub><math>t</math></sub> 3	12%	16%	17%	14%	12%	9%	7%	6%	4%	3%
MAX <sub><math>t</math></sub> 4	8%	12%	15%	15%	13%	11%	9%	7%	5%	4%
MAX <sub><math>t</math></sub> 5	6%	9%	12%	14%	14%	13%	11%	9%	7%	5%
MAX <sub><math>t</math></sub> 6	5%	7%	10%	12%	13%	13%	13%	11%	9%	6%
MAX <sub><math>t</math></sub> 7	4%	6%	8%	10%	12%	13%	14%	14%	12%	9%
MAX <sub><math>t</math></sub> 8	3%	4%	6%	8%	10%	12%	14%	15%	15%	12%
MAX <sub><math>t</math></sub> 9	3%	4%	4%	6%	8%	10%	13%	16%	19%	18%
MAX <sub><math>t</math></sub> 10 (High)	3%	3%	3%	4%	5%	7%	10%	14%	21%	30%

**Panel B. 3-Month Transition Probabilities**

	MAX <sub><math>t+3</math></sub> 1	MAX <sub><math>t+3</math></sub> 2	MAX <sub><math>t+3</math></sub> 3	MAX <sub><math>t+3</math></sub> 4	MAX <sub><math>t+3</math></sub> 5	MAX <sub><math>t+3</math></sub> 6	MAX <sub><math>t+3</math></sub> 7	MAX <sub><math>t+3</math></sub> 8	MAX <sub><math>t+3</math></sub> 9	MAX <sub><math>t+3</math></sub> 10
MAX <sub><math>t</math></sub> 1 (Low)	37%	19%	11%	8%	6%	5%	4%	3%	3%	3%
MAX <sub><math>t</math></sub> 2	19%	21%	16%	12%	9%	7%	6%	4%	4%	3%
MAX <sub><math>t</math></sub> 3	12%	16%	16%	14%	12%	9%	7%	6%	4%	3%
MAX <sub><math>t</math></sub> 4	8%	12%	15%	15%	13%	11%	9%	7%	5%	4%
MAX <sub><math>t</math></sub> 5	6%	9%	12%	14%	14%	13%	11%	9%	7%	5%
MAX <sub><math>t</math></sub> 6	5%	7%	10%	12%	13%	13%	13%	11%	9%	6%
MAX <sub><math>t</math></sub> 7	4%	6%	8%	10%	12%	13%	14%	13%	12%	9%
MAX <sub><math>t</math></sub> 8	4%	4%	6%	8%	10%	12%	14%	15%	15%	12%
MAX <sub><math>t</math></sub> 9	3%	4%	4%	6%	8%	10%	13%	16%	18%	18%
MAX <sub><math>t</math></sub> 10 (High)	3%	3%	4%	4%	5%	7%	10%	15%	20%	29%

Table IA22: 2-, 3-, 6-, and 12-Month Transition Matrices for MAX-Sorted Portfolios - continued

Panel C. 6-Month Transition Probabilities

	$\text{MAX}_{t+6} 1$	$\text{MAX}_{t+6} 2$	$\text{MAX}_{t+6} 3$	$\text{MAX}_{t+6} 4$	$\text{MAX}_{t+6} 5$	$\text{MAX}_{t+6} 6$	$\text{MAX}_{t+6} 7$	$\text{MAX}_{t+6} 8$	$\text{MAX}_{t+6} 9$	$\text{MAX}_{t+6} 10$
$\text{MAX}_t 1$ (Low)	35%	19%	12%	8%	6%	5%	5%	4%	3%	3%
$\text{MAX}_t 2$	19%	20%	16%	12%	9%	7%	6%	4%	4%	3%
$\text{MAX}_t 3$	12%	16%	16%	14%	12%	9%	7%	6%	4%	3%
$\text{MAX}_t 4$	8%	12%	14%	15%	13%	11%	9%	7%	5%	4%
$\text{MAX}_t 5$	7%	10%	12%	14%	14%	13%	11%	9%	7%	5%
$\text{MAX}_t 6$	5%	8%	10%	12%	13%	13%	12%	11%	9%	6%
$\text{MAX}_t 7$	5%	6%	8%	10%	12%	13%	13%	13%	12%	8%
$\text{MAX}_t 8$	4%	5%	6%	8%	10%	12%	14%	15%	14%	12%
$\text{MAX}_t 9$	3%	4%	5%	6%	8%	10%	13%	16%	18%	17%
$\text{MAX}_t 10$ (High)	3%	3%	4%	4%	6%	8%	11%	15%	20%	26%

Panel D. 12-Month Transition Probabilities

	$\text{MAX}_{t+12} 1$	$\text{MAX}_{t+12} 2$	$\text{MAX}_{t+12} 3$	$\text{MAX}_{t+12} 4$	$\text{MAX}_{t+12} 5$	$\text{MAX}_{t+12} 6$	$\text{MAX}_{t+12} 7$	$\text{MAX}_{t+12} 8$	$\text{MAX}_{t+12} 9$	$\text{MAX}_{t+12} 10$
$\text{MAX}_t 1$ (Low)	33%	18%	12%	9%	7%	6%	5%	4%	4%	3%
$\text{MAX}_t 2$	19%	19%	15%	12%	9%	7%	6%	5%	4%	3%
$\text{MAX}_t 3$	12%	16%	16%	14%	12%	9%	8%	6%	5%	3%
$\text{MAX}_t 4$	9%	13%	14%	14%	13%	11%	9%	7%	6%	4%
$\text{MAX}_t 5$	7%	10%	12%	14%	13%	12%	11%	9%	7%	5%
$\text{MAX}_t 6$	6%	8%	10%	12%	13%	13%	12%	11%	9%	6%
$\text{MAX}_t 7$	5%	6%	8%	10%	12%	13%	13%	13%	11%	8%
$\text{MAX}_t 8$	4%	5%	7%	9%	10%	12%	13%	14%	14%	11%
$\text{MAX}_t 9$	4%	4%	5%	7%	9%	11%	13%	15%	17%	16%
$\text{MAX}_t 10$ (High)	3%	4%	4%	5%	6%	9%	11%	15%	19%	23%

**Table IA23: Univariate Portfolios Sorted on MAX in January and Non-January**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on values of MAX. The table presents the time-series means of the monthly 1-month-ahead excess returns for each of the value-weighted decile portfolios for portfolio holding months in January and not in January. Excess returns are reported in percentages per month. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return are shown in parentheses.

<b>Months</b>	MAX 1 (Low)	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10 (High)	High–Low MAX
January	0.07 (0.25)	-0.30 (-0.75)	-0.20 (-0.50)	0.16 (0.60)	-0.34 (-1.43)	0.18 (0.64)	0.15 (0.28)	-0.19 (-0.68)	-1.06 (-1.91)	-1.56 (-3.56)	-1.63 (-2.65)
Non-January	0.19 (1.83)	0.18 (2.30)	0.04 (0.68)	0.08 (1.22)	0.04 (0.59)	-0.04 (-0.62)	0.07 (0.79)	-0.22 (-2.33)	-0.37 (-2.69)	-0.65 (-3.75)	-0.83 (-3.45)

**Table IA24: FFC4+FMAX Alphas for Univariate Portfolios Sorted on  $\beta$  in January and Non-January**

At the end of each month  $t$ , all stocks are sorted into ascending decile portfolios based on values of  $\beta$ . The table presents the time-series means of the monthly 1-month-ahead FFC4+FMAX alphas for each of the value-weighted decile portfolios for portfolio holding months in January and not in January. Alphas are reported in percentages per month. The column labeled High–Low presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero alpha are shown in parentheses.

<b>Months</b>	Low									High	High–Low
	$\beta$ 1	$\beta$ 2	$\beta$ 3	$\beta$ 4	$\beta$ 5	$\beta$ 6	$\beta$ 7	$\beta$ 8	$\beta$ 9	$\beta$ 10	$\beta$
January	-0.30 (-0.97)	-0.96 (-3.30)	-1.16 (-3.63)	-1.25 (-3.83)	-1.13 (-3.17)	-0.17 (-0.58)	-0.51 (-2.27)	0.08 (0.21)	0.69 (1.96)	0.67 (1.79)	0.97 (2.60)
Non-January	-0.08 (-0.75)	-0.04 (-0.43)	-0.15 (-1.59)	-0.16 (-2.12)	0.00 (0.01)	-0.16 (-2.32)	-0.08 (-0.94)	-0.01 (-0.07)	-0.06 (-0.50)	0.26 (1.77)	0.33 (1.57)



**Table IA25: Stocks with High and Low Price, Idiosyncratic Volatility, and Idiosyncratic Skewness**

The table below presents the results of univariate and bivariate dependent-sort portfolio analyses of the relation between future stock returns and each of  $\beta$  and MAX using stocks with low price, high idiosyncratic volatility, and high idiosyncratic skewness (Panels A and C) and separately stocks with high price, low idiosyncratic volatility, and low idiosyncratic skewness (Panels B and D). Stocks with low (high) price, high (low) idiosyncratic volatility, and high (low) idiosyncratic skewness are defined as those in the bottom (top) quintile of stock price and the top (bottom) quintile of both idiosyncratic volatility and idiosyncratic skewness. Panels A and B present the results of univariate portfolio analyses for each set of stocks, using each of  $\beta$  and MAX as the sort variable. Panels C and D present the results of bivariate dependent-sort portfolio analyses for each set of stocks using MAX as the first sort variable and  $\beta$  as the second sort variable. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

**Panel A. Univariate Portfolios Using Low Price, High Idiosyncratic Volatility, and High Idiosyncratic Skewness Stocks**

Sort Variable	Low									High	High-Low	
	1	2	3	4	5	6	7	8	9	10	R	FFC4 $\alpha$
$\beta$	0.24 (0.65)	-0.15 (-0.39)	0.07 (0.16)	-0.06 (-0.17)	-0.12 (-0.26)	-0.60 (-1.38)	-0.13 (-0.30)	-0.14 (-0.32)	-0.37 (-0.75)	-0.79 (-1.38)	-1.03 (-2.14)	-1.00 (-2.48)
MAX	0.96 (2.41)	0.32 (0.76)	0.26 (0.60)	0.07 (0.15)	0.25 (0.59)	-0.30 (-0.77)	-0.13 (-0.30)	-0.61 (-1.29)	-1.02 (-2.09)	-1.99 (-3.75)	-2.95 (-6.15)	-3.33 (-7.39)

**Panel B. Univariate Portfolios Using High Price, Low Idiosyncratic Volatility, and Low Idiosyncratic Skewness Stocks**

Sort Variable	Low									High	High-Low	
	1	2	3	4	5	6	7	8	9	10	R	FFC4 $\alpha$
$\beta$	0.46 (2.53)	0.36 (1.80)	0.32 (1.56)	0.47 (2.12)	0.69 (3.37)	0.46 (2.13)	0.42 (2.11)	0.56 (2.33)	0.55 (2.60)	0.64 (2.37)	0.19 (0.78)	-0.08 (-0.33)
MAX	0.22 (1.19)	0.64 (3.01)	0.66 (3.35)	0.63 (3.08)	0.65 (3.17)	0.58 (2.60)	0.47 (2.28)	0.47 (2.18)	0.38 (1.64)	0.34 (1.46)	0.12 (0.59)	0.04 (0.18)

**Table IA25: Stocks with High and Low Price, Idiosyncratic Volatility, and Idiosyncratic Skewness - continued**

**Panel C. Bivariate Portfolios Using Low Price, High Idiosyncratic Volatility, and High Idiosyncratic Skewness Stocks**

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10
$\beta$ 1 (Low)	0.99	0.59	-0.39	0.19	1.01	0.60	0.44	-0.96	0.50	-1.36
$\beta$ 2	0.90	0.58	0.90	0.39	0.37	-0.43	0.36	0.03	-1.35	-1.48
$\beta$ 3	1.71	0.56	0.02	-0.24	0.13	-0.72	-0.96	-1.05	-0.50	-0.87
$\beta$ 4	1.14	0.19	-0.32	0.07	0.22	0.16	-0.38	0.73	-1.11	-2.26
$\beta$ 5	1.38	0.52	0.15	0.11	0.36	-0.01	-0.63	-0.30	-0.42	-2.88
$\beta$ 6	0.54	0.52	-0.53	-0.13	-0.29	-0.52	0.80	-0.80	-1.92	-2.14
$\beta$ 7	0.24	0.04	1.19	0.03	0.97	-0.83	0.06	-1.70	-1.58	-2.40
$\beta$ 8	1.02	0.50	1.23	-0.28	0.20	-1.12	-0.27	-0.39	-2.09	-3.41
$\beta$ 9	0.75	-0.03	-0.04	0.97	-0.39	0.15	-0.50	-0.18	-0.80	-1.64
$\beta$ 10 (High)	0.76	-0.18	0.20	-0.41	0.11	-0.25	-0.29	-1.16	-0.97	-1.87
<b>High–Low <math>\beta</math> Portfolios</b>										
R	-0.23 (-0.33)	-0.77 (-1.19)	0.59 (0.89)	-0.60 (-1.02)	-0.90 (-1.49)	-0.85 (-1.09)	-0.74 (-1.11)	-0.20 (-0.24)	-1.47 (-1.77)	-0.52 (-0.54)
FFC4 $\alpha$	-0.23 (-0.31)	-0.95 (-1.59)	0.62 (0.90)	-0.25 (-0.42)	-1.17 (-1.91)	-0.78 (-1.01)	-0.43 (-0.56)	-0.09 (-0.13)	-1.38 (-1.65)	-0.37 (-0.36)

**Panel D. Bivariate Portfolios Using High Price, Low Idiosyncratic Volatility, and Low Idiosyncratic Skewness Stocks**

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10
$\beta$ 1 (Low)	0.54	0.96	0.94	1.04	0.87	0.91	0.90	0.85	0.51	-0.18
$\beta$ 2	0.62	0.98	0.82	0.94	0.88	0.95	0.86	0.80	0.39	-0.28
$\beta$ 3	0.64	0.94	0.96	0.92	0.87	0.85	0.62	0.69	0.52	-0.15
$\beta$ 4	0.70	0.96	0.93	0.88	1.04	0.73	0.78	0.60	0.46	-0.06
$\beta$ 5	0.72	0.91	0.96	1.09	0.90	0.75	0.78	0.66	0.27	-0.14
$\beta$ 6	0.79	1.11	0.91	1.01	0.98	0.85	0.85	0.65	0.55	-0.30
$\beta$ 7	0.84	0.96	1.03	0.96	0.80	0.90	0.87	0.57	0.27	-0.42
$\beta$ 8	0.84	1.12	0.99	0.86	0.86	0.79	0.82	0.67	0.29	-0.33
$\beta$ 9	1.05	1.19	1.02	0.89	0.91	0.74	0.81	0.73	0.47	-0.54
$\beta$ 10 (High)	1.17	1.11	1.07	1.04	0.83	0.78	0.73	0.73	0.24	-0.64
<b>High–Low <math>\beta</math> Portfolios</b>										
R	0.63 (3.19)	0.15 (0.81)	0.13 (0.68)	-0.01 (-0.03)	-0.04 (-0.16)	-0.13 (-0.48)	-0.17 (-0.54)	-0.12 (-0.37)	-0.27 (-0.78)	-0.47 (-1.16)
FFC4 $\alpha$	0.30 (1.92)	-0.08 (-0.48)	-0.10 (-0.47)	-0.21 (-1.03)	-0.23 (-1.10)	-0.20 (-0.91)	-0.24 (-1.00)	-0.18 (-0.70)	-0.22 (-0.76)	-0.34 (-1.02)

### Table IA26: Time-Varying Lottery Demand

At the end of each month  $t$ , all stocks are sorted into ascending MAX decile portfolios. The table presents the FFC4 alphas for the 1-month-ahead equal-weighted portfolio returns for each of the decile portfolios for months  $t$  corresponding to high aggregate lottery demand and low aggregate lottery demand. Aggregate lottery demand in any month  $t$  is calculated as the cross-sectional equal-weighted (Panel A) or value-weighted (Panel B) average value of MAX across all stocks in the sample. Months with above-median (below-median) aggregate lottery demand are considered high (low) aggregate lottery demand months. Alphas are reported in percentages per month. The column labeled High–Low MAX presents results for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero alpha are shown in parentheses.

Table IA26 (continued)

Panel A. Equal-Weighted Average MAX as Aggregate Lottery Demand

Value	MAX 1 (Low)	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10 (High)	High-Low MAX
Above Median Aggregate Lottery Demand											
FFC4 $\alpha$	0.41 (3.11)	0.28 (2.62)	0.05 (0.61)	0.14 (1.17)	-0.09 (-0.79)	-0.07 (-0.52)	-0.07 (-0.52)	-0.49 (-3.12)	-0.77 (-3.73)	-1.18 (-4.60)	-1.60 (-4.61)
Below Median Aggregate Lottery Demand											
FFC4 $\alpha$	0.12 (0.80)	0.28 (3.09)	0.12 (1.49)	0.07 (0.86)	0.12 (1.41)	0.03 (0.36)	0.20 (2.11)	-0.19 (-1.83)	-0.33 (-2.39)	-0.68 (-3.72)	-0.80 (-2.95)

Panel B. Value-Weighted Average MAX as Aggregate Lottery Demand

Value	MAX 1 (Low)	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10 (High)	High-Low MAX
Above Median Aggregate Lottery Demand											
FFC4 $\alpha$	0.32 (2.17)	0.24 (2.16)	0.08 (0.93)	0.25 (2.31)	-0.02 (-0.17)	0.09 (0.74)	0.14 (1.03)	-0.31 (-1.93)	-0.55 (-2.47)	-0.97 (-3.37)	-1.29 (-3.29)
Below Median Aggregate Lottery Demand											
FFC4 $\alpha$	0.18 (1.47)	0.22 (3.09)	0.04 (0.48)	-0.05 (-0.70)	0.02 (0.30)	-0.14 (-1.62)	0.07 (0.71)	-0.27 (-2.60)	-0.45 (-3.64)	-0.78 (-4.55)	-0.96 (-4.12)

**Table IA27: Bivariate Portfolio Analyses in Different Economic States**

At the end of each month  $t$ , all stocks in the sample are sorted into decile groups based on an ascending sort of MAX. Within each MAX decile group, decile portfolios based on an ascending sort of  $\beta$  are created. The table presents the average 1-month-ahead excess returns of the average MAX portfolio within each decile of  $\beta$ , as well as the average return (R) and FFC4  $\alpha$  for portfolios that are long the 10th  $\beta$  decile portfolio and short the first  $\beta$  decile in the average MAX decile. Results are presented for subsets of months corresponding to different economic states. Economic state is measured using the Chicago Fed National Activity Index (CFNAI). Non-recession months are defined as return months  $t + 1$  in which the 3-month moving average CFNAI (average in months  $t - 1$ ,  $t$ , and  $t + 1$ ) is greater than  $-0.7$ . Recession months are defined as months in which the 3-month moving average CFNAI is less than  $-0.7$ . Panel A (Panel B) shows results for equal-weighted (value-weighted) portfolios. Excess returns and alphas are reported in percentages per month. The numbers in parentheses are  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis that the mean monthly return or alpha is equal to 0.

**Panel A. Equal-Weighted Portfolios**

<b>Economic State</b>	Low										High	<b>High–Low</b>	
	$\beta$ 1	$\beta$ 2	$\beta$ 3	$\beta$ 4	$\beta$ 5	$\beta$ 6	$\beta$ 7	$\beta$ 8	$\beta$ 9	$\beta$ 10		R	FFC4 $\alpha$
Non-Recession	0.74	0.70	0.64	0.64	0.57	0.60	0.56	0.52	0.54	0.51		-0.23 (-0.98)	-0.31 (-1.65)
Recession	0.53	0.78	0.88	1.00	1.12	1.23	1.09	1.18	1.35	1.35		0.81 (0.99)	0.66 (1.25)

**Panel B. Value-Weighted Portfolios**

<b>Economic State</b>	Low										High	<b>High–Low</b>	
	$\beta$ 1	$\beta$ 2	$\beta$ 3	$\beta$ 4	$\beta$ 5	$\beta$ 6	$\beta$ 7	$\beta$ 8	$\beta$ 9	$\beta$ 10		R	FFC4 $\alpha$
Non-Recession	0.49	0.49	0.46	0.45	0.40	0.45	0.44	0.38	0.42	0.40		-0.09 (-0.39)	-0.09 (-0.45)
Recession	0.13	0.56	0.34	0.75	0.75	0.71	0.37	0.48	0.70	0.31		0.19 (0.22)	0.18 (0.29)

**Table IA28: Investor Attention, the Beta Anomaly, and Lottery Demand**

At the end of each month  $t$ , we take all stocks that are in the bottom tercile of institutional ownership (INST) to be low INST stocks. We then sort all low INST stocks into terciles based on an ascending sort of analyst coverage (CVRG). We consider stocks in the top (bottom) tercile of CVRG to be stocks with high (low) investor attention. We then perform univariate portfolio analyses with  $\beta$  or MAX as the sort variable, using only high or low investor attention stocks. The table presents the equal-weighted average 1-month-ahead excess returns for each of the decile portfolios formed by sorting on  $\beta$  or MAX using the low investor attention or high investor attention stocks. The columns labeled High–Low present average returns (R) and FFC4 alphas (FFC4  $\alpha$ ) for a zero-cost portfolio that is long the decile 10 portfolio and short the decile 1 portfolio.  $t$ -statistics, adjusted following NW (1987) using 6 lags, testing the null hypothesis of a zero mean excess return or alpha are shown in parentheses.

Investor Attention	Low 1	2	3	4	5	6	7	8	9	High 10	High–Low R	FFC4 $\alpha$
Portfolios Sorted on $\beta$												
Low	0.71	0.72	0.67	0.63	0.62	0.47	0.37	0.50	0.02	-0.31	-1.02 (-2.46)	-1.09 (-3.36)
High	0.49	0.62	0.73	0.49	0.49	0.36	0.11	0.00	-0.71	-1.11	-1.61 (-2.65)	-1.48 (-3.31)
Portfolios Sorted on MAX												
Low	0.80	1.00	0.79	1.01	0.96	0.63	0.41	0.38	-0.24	-1.35	-2.15 (-5.91)	-2.21 (-7.97)
High	0.70	0.66	0.81	0.74	0.44	0.45	0.00	-0.14	-0.53	-1.66	-2.35 (-4.46)	-2.44 (-6.84)