**FIRM-SPECIFIC INFORMATION AND STOCK RETURNS**

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**Abstract**

Our paper focuses on the controversial issue on whether greater stock return nonsynchronicity (or lower R2) reflects more or less firm-specific information in stock prices. Using the U.S. stocks from 1925 to 2016 in the asset pricing context, we gauge informativeness using (absolute) idiosyncratic volatility together with nonsynchronicity (relative idiosyncratic volatility). We relate these two prominent information measures to firm-specific return characteristics by considering return residual momentum, skewness, jumps and information signal formation as measured by information discreteness. We find that for the nonsynchronicity-sorted portfolios, the average return is significantly positive only in the highest quintile, but the difference in average returns between the extreme quintile portfolios becomes significantly positive once controlling for size and value. Most importantly, in every quintile of idiosyncratic volatility, the return differences between the extreme quintile portfolios are positive and significant. In addition, controlling for the two information measures shed on the stock performance related to firm-specific return characteristics found in the previous literature. The Fama-Macbeth regression results show that stock return nonsynchronicity explains cross-sectional returns differently in high-jump and low-jump periods.

*Key words: firm-specific information, market efficiency, asset pricing, portfolio, cross-sectional returns.*

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**1. Introduction**

According to efficient market hypothesis (EMH), all available information is adjusted fast and fully reflected into stock prices at any given time. The EMH predicts that stock prices are efficient and markets self-stabilizing. Thus it is impossible for investors to beat the market and earn excess returns. The extant literature has controversial views on the information implication of firm-specific return variation measured by relative idiosyncratic volatility (stock price nonsynchronicity). For example, Roll (1988) and Morck, Yeung and Yu (2000) observe the extent to which stocks move together depends on the relative amounts of firm-level and market-level information impounded into stock prices. Roll (1988) argues that greater idiosyncratic volatility, or lower R2 (higher stock nonsynchronicity) is likely explained by firm-specific news. In contrast, Jiang, Xu and Yao (2009), Aabo, Pantzalis and Park (2017) argue that absolute idiosyncratic volatility is not fully exposed to information incorporated in stock prices. More recently, Li, Rajgopal and Venkatachalam (2014) document that greater stock return variation measured by relative idiosyncratic volatility or R2 resembles noise rather than information.

A number of prior studies investigate the market efficiency implications of idiosyncratic volatility in the variety of contexts. Specifically, Li, Rajgopal and Venkatachalam (2014) investigate whether stock return variation captures firm-specific information or noise in the association with information environment variables and earnings quality. Aabo, Pantzalis and Park (2017) exaimne whether idiosyncratic volatility and R2 have similar associations with stock mispricing. In addition, Jin and Myers (2006) and An and Zhang (2013) study how stock price synchronicity and the crash risk (negative skewness) react under the influence of institutional investors. We deepen our understading of the previous conflict literature by exaiming idiosyncratic volatility in the cross-sectional relation to expected returns with other information proxies.

The objective of our paper is to investigate whether firm-specific information measured on absolute idiosyncratic volatility (IV) and stock price synchronicity (NSYNC) can explain cross-sectional returns. Though IV has been examined in asset-pricing context, we extensively study them together with three additional information proxies in wider scopes and over longer sample period. To achieve our aim, we conduct three tests. First, based on the value of each proxy, we form portfolios by sorting stocks into quintile portfolios. Then we examine the difference in holding period returns between the portfolio 5 and portfolio 1 that contain stocks with highest and lowest value of each information proxy, respectively. Second, to control for firm characteristic effects, we employ a portfolio-level double-sort procedure. In this procedure, we first sort by a firm characteristics and then sort again by each information proxy. Further, we also do conditional double-sorting on two information proxies to study their effect on holding period returns. Third, using Fama-Macbeth two-stage regressions, we investigate the explanatory power of each information proxy in the cross-sectional returns.

Our portfolio-sorting procedure shows two opposite findings of expected stock returns when sorting stocks based on IV and NSYNC. The adjusted returns of stocks ranked by NSYNC are positive but insignificant while those sorted by IV are significant negative returns. Specifically, the differences in portfolios ranked by IV are consistent with the prior literature. After controlling for firm characteristics, we find that firm size and book-to-market effects do not account much for the single-sorting return patterns. More importantly, the double-sorting portfolio return sorted on NSYNC become highly significant and positive among different levels of IV and other return characteristics.. This results can shed a light on the mixed results for the relationship between idiosyncratic volatility and stock returns in the previous literature. In addition, in Fama-Macbeth regressions, the coefficients of the interaction between NSYNC and jump periods are significantly positive, suggesting that firm-specific information captured by NSYNC might explain cross-sectional returns. Whereas, there is still a puzzling issue for IV with significant negative coefficient.

Our study contributes to the literature in several ways. First, this is the first study that systematically compares the performance of firm-specific return variation in short and medium term in asset pricing context. Second, our paper further examines the effects of firm characteristics on the relation between firm-specific information embedded in stock prices and expected returns. Specially, we examine the mutual effects between IV and NSYNC when controlling each other as well as other information proxies. Third, by using univariate and multivariate Fama-Macbeth regressions, we investigate how firm-specific return variation performs differently in explaining cross-sectional returns and in conjunction with stock price jump periods. Fourth, we extend the results of Fama-Macbeth in full sample period as well as three sub-sample periods.

The remainder of the paper is structured as follows. Section 2 reviews existing literature and develops hypothesis. Section 3 represents data and methodology. Section 4 reports the empirical results. Section 5 concludes.

**2. Literature review and hypothesis development**

Fama et al. (1969), Fama (1970) propose the efficient market hypothesis according to different types of information is reflected into stock prices which are classified in three relevant subcategories: historical prices (weak form efficiency); past prices and public information such as earnings announcements, stock splits, etc. (semi-strong form); and past prices, public information and private information (strong form).

**2.1. Historical prices**

The first type of relevant information in EMH test is information from historical price sequences used to forecast price movements. Investors might consistently earn higher than normal returns based on knowledge of historical prices and other trading information. Roll (1988) argues that only a relatively small proportion of stock price movements reflect public news announcements and speculates that traders acting on private information. Roll (1988) first observes low R2 from market model regression in the U.S., which suggests that much of the firm-specific information is incorporated into stock prices. Since Roll (1988), a growing literature has applied R2, a common measure of stock price synchronicity (inverse of nonsynchronicity), as a proxy for firm-specific information.

Stock prices are more efficient at capturing firm-specific information, and therefore the quality of the information environment is better. Morck, Yeung and Yu (2000) show that R2 is lower among developed countries with stronger property rights which promote trading on firm-specific information. They intuitively argue that lower R2 can be used as a measure of market efficiency. Durnev et al. (2003) also find that firms and industries with greater firm-specific return variation statistics exhibit higher association between current returns and future earnings, indicating more information about future earnings in current stock returns. Along similar streams, Wurgler (2000), Durnev, Morck and Yeung (2004) and Chen, Goldstein and Jiang (2006) find that the capital investments of firms and countries with greater firm-specific return variations are more sensitive to fluctuation in their stock prices. Hence, managers learn about firm-specific information from stock prices and reply on it when making their investment decisions.

The prior literature is often attributed to investor behavioural biases, of which investor underreacts to firm-specific information in the short-term but overreacts in long-term. One of the prominent behavioural phenomena, documented by Jegadeesh and Titman (1993) and known as the short-term effect of momentum strategies, is that stocks that have performed well in the short-term (3 to 12 months). While Jegadeesh and Titman (1993) use total stock returns in the momentum strategies, Grundy and Martin (2001), Gutierrez and Prinsky (2007), Blitz, Huij and Martens (2011) and Blitz et al. (2013) demonstrate that measuring momentum in residual returns exhibits greater risk-adjusted profits, thereby interpreting the residual as an indicator of firm-specific information. Supporting this, Da, Gurun and Warachka (2014), Rhee et al. (2016) utilize Information discreteness (ID) to proxy for the degree of investor underreaction and find that profits from the momentum strategy are aggregated in stocks with more continuous rather than discrete information. All these results propose a serious challenge to the weak form of the EMH and may help momentum investors in practice obtain better risk-adjusted performance.

**2.2. Public information**

Boudoukh et al. (2013) argue that a greater proportion of firm-specific stock price fluctuations in respond to identifiable public news announcements than did Roll (1988). Using advancements in the area of textual analysis, they are better able to identify relevant news of 1.9 million stories from 2000 to 2009. This gives more evidence of the strong link between public news and stock price movements and use this information to explain when stocks move idiosyncratically as opposed to with the market.

News public events and financial disclosure are two sources of public information. Morck, Yeung and Yu (2000) find no correlation between stock return volatility and a proxy of national accounting disclosure standards. In addition, International Financial Reporting Standards (IFRS) adoption enhances firm-specific return volatility and reduces cash risk, especially among firms in worse information environments, where IFRS likely improves disclosure quality (DeFond et al. 2014; Kim & Shi 2012). Moreover, the sudden news or the arrival of new information captured by jump process create discrete jumps in stock prices, which explains for the skewness and excess kurtosis that is attribute of high-frequency data of asset prices (Lobo 1999). Consistently with this reasoning, Lee (2012) reports that U.S. stock price jumps mostly occur shortly after public events such as Federal Reserve announcements or jobless claims.

Firms with opaque financial reports face a greater likelihood of crash risk when the negative firm-specific information is suddenly revealed to the public. Jin and Myers (2006) document positive association between firm-stock return variation and opacity information measures in a cross-country context. Their findings propose that different levels in security of investors’ property rights might explain cross-country differences in stock market R2. Consistently, Kim, Li and Zhang (2011); Hutton, Marcus and Tehranian (2009); An and Zhang (2013) utilise stock price synchronicity and negative conditional skewness to capture the likelihood of a stock price crash in any given week, captured by the actual occurrences of extreme negative (positive) events during a year in U.S. firms.

# Voluntary corporate disclosures in general carry public information when stock prices react to their announcements. To the extent that disclosures lower firm-specific information cost and enhance transparency, stocks of higher disclosing firms move more independently (Haggard, Martin & Pereira 2008). Further, the quality of corporate governance is positively correlated with firm-specific return variation (Ferreira & Laux 2007) but negatively to return skewness (Bae, Lim & Wei 2006), which reflects investor’s demand for information transparency. A similar interpretation examines how information is reflected stock prices as jumps (Lee 2011; Zhou & Zhu 2012b), implied skewness and kurtosis (Diavatopoulos et al. 2012) and stock return variation (Teoh, Yang & Zhang 2009) via earning announcements.

**2.3. Private information**

Stock prices not only reflect information in historical prices or public information announcements but also private information about firms’ fundamentals. The private information is quickly incorporated into stock prices by the act of insider trading, thereby leading to more informationally efficient prices (Carlton & Fischel 1983; Dye 1984).

Stock price nonsynchronicity is considered as another measure of the amount of private information in stock price. Chen, Goldstein and Jiang (2006) find a positive correlation between price nonsynchronicity and the investment sensitivity to stock prices. Moreover, Piotroski and Roulstone (2004) find that the intensity of insider trading activity in US firms increases the relative amount of firm-specific information influencing price then improve firm-specific return variation. Consistently, few papers (Durnev & Nain 2007; Fernandes & Ferreira 2008) find the linkage of the enforcement of insider trading law and firm-specific variation in developed, but not emerging countries, encouraging insider trading restrictions are disclosed in developing countries.

**2.4. Hypothesis development**

Roll (1988) observe the extent to which stocks move together depends on the relative amount of firm-level and market-level information impounded into stock prices. Jin and Myers (2006) document positive relations between stock nonsynchronicity and several measures of financial information opacity in a cross-country setting. Similarly, Durnev et al. (2003), Ferreira and Laux (2007) find comparable results in the U.S. context. That is, earnings opacity is higher, less firm-specific information is available and R2 is higher. Along similar lines, this R2-based efficiency proxy has been widely used in various empirical studies of corporate investment and emerging market development, e.g., Wurgler (2000), Durnev, et al. (2003), Durnev, Morck, and Yeung (2004), Jin and Myers (2006), and Chen, Goldstein, and Jiang (2006).

Based on the existing literature review, we argue that that if stocks are priced efficiently, then information is already incorporated and hence need not be considered. But this view of efficiency is static, not dynamic. If stock prices are continually revised to reflect new information, then efficiency is a process, and how stock prices become efficient should be examined in association with expected returns. Easley, Hvidkjaer and O'hara (2002) produce evidence that information does affect asset prices. They find that 10 percentage differences in the probability of information-based trading between two stocks leads to a difference in their expected returns of 2.5 percent per year. More specifically, there is the positive relationship between information and stock returns. Hence, we advance the following hypothesis regarding different information proxies’ impact on expected returns.

Hypothesis: More information captured by higher information proxies leads to higher expected returns.

**3. Data and methodology**

The data are obtained from the CRSP database and cover all domestic, primary stocks listed on the New York (NYSE), American (AMEX), and NASDAQ stock markets, excluding closed-end funds, Real Estate Investment Trusts (REITs), unit trusts, American Depository Receipts (ADRs), and foreign stocks. The sample starts from December 1925 when all data series of NYSE market began to December 2016. We use discrete returns filtered and screened following the conventional literature[[1]](#footnote-1).

*3.1. Measuring information proxies*

At the end of every month t, we compute the value of each firm-specific information proxy over the formation period of the previous 12 months excluding the most recent month (i.e., from t −12 to t−2). For five proxies except the residual return, we obtain these proxies based on daily returns, i.e. the starting date is from December 1926 (from January 1926 to November 1926). Only the residual return is estimated from monthly returns and its starting date is different, from May 1930.[[2]](#footnote-2)

According to Aabo, Pantzalis and Park (2017), the market efficiency implications of firm-specific return variation measured by absolute idiosyncratic volatility (or idiosyncratic volatility) and relative idiosyncratic volatility (stock nonsynchronicity). To measure idiosyncratic volatility (IV) and stock nonsynchronicity (NSYNC), at month t, we first compute residuals and R2 by running the following the [Fama–French (1993)](https://www.sciencedirect.com/science/article/pii/S0927539817301093#b26) three–factor model regression of daily returns for each stock *i* over the formation window:

(τ=1… T) (1)



where   is the daily return of stock *i*;  is the daily risk-free rate;



MKT, SMB and HML from Kenneth French’s Website[[3]](#footnote-3) ;

,, and  are the coefficients to be estimated; and  is the daily residual of stock *i* and T is the number of daily observations in the formation period.



We only use stocks with more than 187 daily observations (T >187) in the formation window of one-year period for Eq. (1)[[4]](#footnote-4). At month t, IV for stock *i* is measured as the standard deviation of the daily residuals (over the formation period (Ang et al. 2006; 2009). According to Morck, Yeung and Yu (2000) and Chen, Goldstein and Jiang (2006), NSYNC for stock *i* is defined as the logistic transformation of R2:



(2)



We compute the following proxies for return characteristics: residual returns (Blitz, Huij & Martens 2011; Gutierrez & Prinsky 2007), information discreteness (Da, Gurun & Warachka 2014), skewness (Kim, Li & Zhang 2011; An & Zhang 2013), stock price jumps (Pukthuanthong & Roll 2015). Appendix explains measurement of each of these variables.

3.2. Trading strategies

3.2.1. Single-sort procedure

We employ the common procedure in the empirical literature (Grundy & Martin 2001; Gutierrez & Prinsky 2007; Jegadeesh & Titman 1993; Jegadeesh & Titman 2001; Blitz, Huij & Martens 2011). The methodology involves ex ante formation of portfolios over the past 12 months and holds these portfolios for K months (K= 1, 3, 6, 9, and 12).

The expected return in a given month t is the equally-weighted return of the component stocks across the K-period portfolios. This produces a time-series of monthly returns to the respective 5 and 1 portfolios for the holding period. Subsequently, the single-sort portfolio return in given month t is computed as the return difference between the 5 and 1 portfolios, averaged across K separate positions, each revised the weight on one of the K consecutive previous months from t−K to t−1. Newey and West’s (1987) correction of standard errors is applied for testing the average returns with t-statistics adjusted for autocorrelation and heteroskedasticity.

3.2.2. Controlling for firm characteristics

To control for market capitalization (SIZE) and book-to-market ratio (BM) effects, we employ a portfolio-level double-sort procedure. With the double-sort procedure, we first sort by a stock characteristic (SIZE, BM) and then sort again by each information proxy. Specifically, to control for SIZE, stocks are first formed into quantiles ranked on SIZE. SIZE breakpoint is the median market capitalization. The quantile with greater market capitalization stocks is defined as Big, and the other quantile, Small. Within each SIZE category, stocks are sorted again into quintiles according to each information proxy. And quintile 5 (1) contains the 20% stocks with the highest (lowest) value of each information proxy. The columns labelled SMB refers to the difference between the Small and Big quantiles across each quintile of information proxy.

We replicate this procedure for the BM control variable. However, stocks are first formed into tertiles ranked on BM ratios at the end of month t. The BM breakpoints for month t are the 30th and 70th percentiles. The top tertile with the highest value stocks is defined as High BM, the middle tertile, Middle BM, and the bottom tertile, Low BM. The columns labelled HML refers to the difference between the High BM and Low BM tertiles across each quintile of information proxy.

3.2.3. Conditional double-sorting on two information proxies

In order to examine how IV and NSYNC premiums vary across other information proxies, we employ double-sorting approach. We first sort by IV or NSYNC and then sort again by each other proxies. Similar as controlling for firm characteristics, we first ranked stocks in quintiles according to IV or NSYNC and then within each group from first sort, we further allocate stocks by the second proxy. Subsequently, the double-sort portfolio returns in given month t is computed as the difference in FF-3 alphas between the 5 and 1 portfolios. We hold portfolios for the subsequent 1 month. In contrast, we also examine how other proxies’ premiums vary across IV or NSYNC, we first sort by other proxies and then sort again by IV or NSYNC.

*3.3. Fama-MacBeth cross-sectional regressions*

We examine the relation between firm-specific information proxies and stock returns using a series of two-stage [Fama and Macbeth (1973)](http://www.sciencedirect.com/science/article/pii/S1062976905000748#bib16) regressions. In the first stage, for every month, we run the cross-sectional model by regressing firm excess returns onto each information proxy together a number of well-documented firm characteristics such as firm size and book-to-market ratios as in [Fama and French (1993)](http://www.sciencedirect.com/science/article/pii/S0304405X15001257#bib35), and other control variables. In the second stage, we use the time series of the regression coefficients and test whether the average coefficient on the lagged information measure is significantly different from zero.

We estimate the following model of i=1, 2…, n stocks for month t:

(5)



where is the excess return of stock i at month t.



stands for one or a number of the proxies: IV, NSYNC, RESIDUAL, NCSCKEW, JUMP, and ID and the other variables are as defined previously.



, are control variables. SIZE represents to logarithm of the market capitalization of firms in the previous month. BM is the logarithm of the ratio of book value of equity plus deferred taxes to market capitalization.



The statistical tests are t-tests over the time-series averages of the slope coefficients estimated in the monthly cross-sectional regressions based on above equations. Newey and West’s (1987) correction of standard errors is applied for computing t-test statistics. Moreover, the adjusted R2 of the cross-sectional regression is computed as a measure that defines the fraction of the cross-sectional variation of average excess holding returns captured by the model.

Next, we consider the performance of NSYNC and IV for the return differential between the high JUMP and low-JUMP periods. High JUMP is a dummy that takes a value of 1 if the jump value is higher than 40% value in the sample period or a value of 0 otherwise. For each month, we estimate the cross-sectional regressions of monthly excess returns on IV or NSYNC and the interaction term between IV or NSYNC and the dummy JUMP, and control variables.

**4. Empirical results**

4.1. Descriptive statistics

In Table 1, Panel A shows descriptive statistics for variables of interest. Residual return estimated market model regression of monthly returns is in slightly right skewed distribution when median is greater than mean in my sample. According to Fu (2009), the mean monthly IV estimated from monthly return is 14.17. Based on daily returns, our monthly mean IV only is 2.49 per month with a median of 2.28 per month. The minimum value of monthly nonsynchronicity (NSYNC) is approximate -2.32 and the maximum is 14.56, indicating the largest variation in the value of all proxies. While the values of ID range slightly from around -1 to 0.6, respectively. SKEW is winsorized at the 0.5 and 99.5 percentiles with a smaller mean with 0.36 and smaller variation than SKEW in my data. Stock returns have very slightly jump, as suggested by a mean JUMP of 0.003 and a median of 0.001 per 11 months.

Our research is focusing on the information proxies on stock returns, understanding how the proxies relate to each other is usually more important than understanding the proxies’ univariate characteristics. As a result, in addition to presenting univariate summary statistics, we also present the correlations between pairs of proxies used in the study. Panel B presents the correlation matrix: the Pearson and Spearman correlations. The Pearson correlation is mostly used to evaluate the linear relationship between two continuous variables, whilst the Spearman correlation is mostly used to evaluate the monotonic relationship between two continuous or ordinal variables. The Pearson (Spearman) correlation between IV and NSYNC is 0.362 (0.351), so that IV and NSYNC are not interchangeable measures of firm-specific return variation. SKEW has more negative correlation in the Pearson measure than in the Spearman measure. JUMP is highly correlated IV (Pearson = 0.62 and Spearman = 0.547) and positively correlated with other proxies for information and negatively with ID, excepting for RES, proposing that JUMP and IV might capture the same phenomenon. RES, ID, SKEW have relatively small correlation with each other (less than 0.1) and not consistent with other proxies, which implies these proxies capture different aspects of information. All the pairwise correlations are highly significant with p<0.0001.

[Insert Table 1]

4.2. Sing-sort results

We start our empirical investigation by comparing and distinguishing the cross-section of stock returns among the performances of six information proxies based on the single-sort strategy in U.S. stock markets. Table 2 reports both raw and risk-adjusted monthly portfolio returns of single-sort procedure for the holding period of 3 months[[5]](#footnote-5). The risk-adjusted returns labelled "" and "” are measured by Jensen’s alphas with respect to the CAPM or [Fama–French (1993)](https://www.sciencedirect.com/science/article/pii/S0927539817301093#b26) three-factor model. The t-statistics are calculated using Newey and West’s (1987) robust standard errors.



The first three columns of RES in Table 2 verify the existence of the momentum effect in my sample. Specifically, the first column shows that average returns, FF-3 alphas, increase from -0.21% per month from quintile 1 (the lowest RES stocks) to 0.41% per month for quintile 5 (the highest RES stocks). The difference in the FF-3 alphas between portfolio 5 and portfolio 1 is by 0.62% (t = 8.75) in the three months after portfolio formation. Over the longer sample period, our results for residual returns are generally consistent with Blitz, Huij and Martens (2011). The findings for 6-, 9- and 12-month holding period also reveal the consistence of the residual momentum in short-term and medium-term when residual returns are used to minimize the time-varying exposures to the Fama-French factors.

While Da, Gurun and Warachka (2014) only investigate double-sort portfolios to examine the importance of information discreteness to momentum, we examine single-sort procedure. Accordingly, the differences in the FF-3 alphas between portfolio 5 and portfolio 1 sorted by ID, SKEW, are 0.24, 0.16, respectively, which are significantly positive, while NSYNC is almost marginally significant. This is a preliminary evidence that high values of these information proxies are associated with higher average stock returns.

As for stocks sorted by IV, there is a puzzle in the asset pricing. Ang et al. (2006) find that, in the cross-section of stocks, stocks with high IV over a previous month have abysmally low average returns in the next month. Our results are consistent with Ang et al. findings but in longer holding periods of 3, 6 and 9 months after formation date. In particularly, the FF-3 alphas for quintile 5 tend to be lower than those for quintile 1. Particular, the difference in average returns held in 3 months between quintile 5 and 1 is -0.78% per month, with a robust t-statistic of -6.81. Similar to IV, stocks ranked by JUMP has a negative and significant expected returns with -0.54% per month in average returns.

In summary, there are two opposite findings of expected stock returns when sorting stocks based on different proxies. While the returns for stocks ranked by IV and JUMP are significantly negative, this can be explained by high positive correlation between IV and JUMP. While 5-1 portfolio adjusted returns of stocks ranked by NSYNC are positive but insignificant, we further test NSYNC by using double-sorting methodology.

[Insert Table 2]

*4.3. Controlling for firm characteristics*

In this section, we control for SIZE and BM variables to examine the interaction of each information proxy and firm characteristic (i.e. SIZE*,* BM). We construct each proxy as the equal-weighted average returns of 5-1 portfolios within only the Big and Small SIZE groups. For each proxy, we present the estimates of average returns (Panel A), CAPM alphas (Panel B), and FF-3 alphas (Panel C) with corresponding t-statistics in Table 3. All numbers are estimated with monthly data. The table covers the full sample period.

The Table 3 shows that in each SIZE quintile, the highest RES and SKEW quintiles have a higher average returns than the lowest ones. Particularly, we find consistent results that are positive and highly significant average returns at of 5-1 portfolios in RES and SKEW in all panels after having controlled for SIZE. Therefore, the firm size effect might be not driving the relationship between RES, SKEW and average portfolio returns.

In Panel A of Table 3, average returns of stocks sorted by IV and JUMP are negative and significant only among Small group, at -0.54% (t-statistic of 3.03), -0.3 (-2.55), respectively. Whereas in Panel B and C, CAPM alphas and FF-3 alphas are negative and highly significant in both SIZE groups, suggesting that firm size has not much impact on IV- and JUMP-sorted portfolio returns. Moreover, the 5-1 average returns sorted by NSYNC are actually insignificant in both SIZE levels in Panel A, but there are positively significant CAPM and FF-3 alphas in small and large stocks. Interestingly, ID only has positively significant average returns, CAPM and FF-3 alphas of 5-1 portfolios in small portfolios. It is plausible that firm-specific information captured by ID might impact on cross-sectional differences in 5-1 portfolio for Small stocks.

[Insert Table 3]

Next, we control for BM by first forming three tertiles sorted on book-to-market ratios at the end of month t. Table 4 presents the results for portfolios double-sorted on book-to-market ratios and the value of every proxy. It can be seen generally that high BM stocks have significantly higher average returns, CAPM alphas and FF-3 alphas in RES, NSYNC, ID and SKEW, which suggests that the effect of these proxies is stronger for high value stocks. Thus, the BM might be behind the relationship between holding period portfolio returns and information proxies.

There is also the similar trend for the 5-1 difference on FF-3 alphas in IV and JUMP. Interestingly, however, the differences in FF-3 alphas for portfolios sorted on BM and IV or JUMP are highly significant in Low and Medium BM tertiles, for example, at -1.33 and -1.45 for IV, -0.86 and -0.23 for JUMP, respectively in 3 month holding period. Hence, high BM ratios are not an effective factor to explain the relationship between IV, JUMP and FF-3 alphas.

[Insert Table 4]

*4.4. Conditional double-sorting results*

First, the double-sorting portfolio return sorted on NSYNC become highly significant among different levels of IV and other return characteristics. The results imply NSYNC might obtain firm-specific information to explain the cross-sectional return when conditioning on other factors. Moreover, stocks with low R2 (high NSYNC) has higher returns than those with high R2, which is in contrast with Hou, Peng and Xiong (2013) that stocks with lower R2 should exhibit more pronounced overreaction-driven price momentum. Only among the highest SKEW quintile, returns of high NSYNC quintiles are significantly positive, which represent the higher firm-specific variation from higher return skewness has information to explain future stock returns. Whereas, the patterns of high IV stocks are persistent with single-sort result. Specifically, this result is consistent with Ang et al. (2006) [Guo and Savickas (2010](https://www.sciencedirect.com/science/article/pii/S0378426610004176#b0060)) that stocks with high IV tend to have low returns after controlling by NSYNC or other information proxies.

[Insert Table 5]

Second, our controls are reversed to IV or NSYNC, we find that the residual momentum profits become insignificant. [Barberis et al. (1998)](https://www.sciencedirect.com/science/article/pii/S0927539811000041" \l "bb0015), [Daniel et al. (1998)](https://www.sciencedirect.com/science/article/pii/S0927539811000041" \l "bb0035), and [Hong and Stein (1999)](https://www.sciencedirect.com/science/article/pii/S0927539811000041" \l "bb0090) have built behavioural models that assigned to the price momentum effect to investors underreacting to new information and slow information diffusion. Our findings with the insignificant profits of residual momentum is not consistent with the gradual-information-diffusion hypothesis of [Hong and Stein (1999)](https://www.sciencedirect.com/science/article/pii/S0927539811000041#bb0090) which predicts that firm-specific information is disseminated slowly across the investing public. Da et al (2014) document a positive relation between IV and ID and suggest that discreteness information corresponds to high ID and high IV. Consistently, we obtain the differences of 5\_1 portfolios of ID stocks are highly significant and positive among high IV or NSYNC quintiles.

Hutton, Marcus and Tehranian (2009) and Jin and Myers (2006) include skewness and kurtosis as control variables in their examination of R2 and opacity. They find that R2 is negatively correlated with skewness, higher values of skewness implying higher values of NSYNC. The differences of 5\_1 portfolios sorted by SKEW are significantly positive across low IV quintiles but medium and high NSYNC. Interestingly, when controlling for IV, the differences of 5\_1 portfolio returns ranked by JUMP become insignificant at all, which is consistent with Pukthuanthong and Roll (2014) that there is no relation between JUMP and cross-section returns. The absence of a connection between jump prevalence and risk premiums also supports the inference that jumps are mostly idiosyncratic. However, when controlling for NSYNC, they become highly significant and negative.

[Insert Table 6]

In summary, relative idiosyncratic volatility (NSYNC) might be information proxy to explain the cross-sectional returns when conditioning on absolute volatility or other information measures.

**5. Fama-MacBeth cross-sectional regressions**

We now perform the traditional two-stage cross-sectional regressions proposed by [Fama and Macbeth (1973)](http://www.sciencedirect.com/science/article/pii/S1062976905000748#bib16). Table 5 reports from Fama-MacBeth cross-sectional regressions of monthly stock returns on firm-specific information proxies and firm characteristics (i.e., SIZE, BM) during the full sample period (Panel A) and other three sub-periods (Panel B, C, D). The results of univariate regressions are shown from Model 1 to Model 6 and multivariate regressions from Model 7 to Model 21.

In full sample period (Panel A), the coefficients of IV and NSYNC are not statistically significant among univariate regressions. Whereas there are highly significant and positive RES, SKEW, JUMP coefficients with 0.164 (t-statistic of 34.18), 0.012 (15.32) and 0.245 (2.17) in Model 4, 5 and 6, respectively, generally consistent with RES- and SKEW-portfolio sorting results, except for JUMP. Model 7 to Model 12 report the relation between the stock returns and six information proxies in combination with SIZE and BM. The results indicate that when we control for both firm characteristics, the IV coefficient is positive and becomes marginally significant with 0.002 (1.76) in Model 7, while ID and NSYNC variables are still insignificant. And the positive coefficients of RES, SKEW and JUMP are statistically significant. In the Model 13 to Model 20, we report bivariate and multivariate regression results using combination with more than two proxies and together with SIZE and BM. Then the coefficients of IV and NSYNC turn to significantly positive when combining with RES, 0.002 (2.24) and 0.001 (2.03), respectively. More interestingly, the estimates from Model 17 show that the coefficient on NSYNC x Dj is significantly positive. The results imply that NSYNC has the stronger predictive power of stock returns in conjunction with JUMP.

In Panel B, C, D, the results of 21 models are slightly different among in three sub-periods. Specially, IV coefficients are positively significant in both univariate and multivariate tests in Panel B, but completely insignificant in middle period Panel C and become significant only in combination with other proxies in Panel D. There is a similar trend for NSYNC, which indicates that the correlation between stock returns and IV, NSYNC slightly depends on the time-varying periods. Specifically, the coefficients on NSYNC x Dj is significantly positive only during the first sub-period 1925-1963. Interesting, the results of ID almost remain consistently with the results of full period in Panel B and D, but they become positive and highly significant in Panel C. It means that more discrete information (high ID) will lead to higher stock returns in the middle sub-period from 1964 to 1990.

[Insert Table 7]

**6. Conclusion**

In an efficient market, stock prices are continually adjusting to reflect new information. The association between information and expected returns has become a recent subject of debate in the literatures. Thus, we have investigated the role of firm-specific information captured by six information proxies in affecting cross-sectional returns.

To study the debate, we use various theories to measure six proxies, i.e. stock price synchronicity (Morck, Yeung & Yu 2000), idiosyncratic volatility (Ang et al. 2006), residual returns (Blitz, Huij & Martens 2011; Gutierrez & Prinsky 2007), information discreteness (Da, Gurun & Warachka 2014), skewness (Kim, Li & Zhang 2011; An & Zhang 2013), stock price jump (Pukthuanthong & Roll 2015). Specifically, we have daily and monthly stock returns data in U.S. market to compute all proxies over the formation period from December 1925 to December 2016. We then put them into a standard asset-pricing framework with three tests.

The single-sort procedure shows two opposite results of expected stock returns when sorting stocks based on different proxies. While average returns of 5-1 portfolios ranked by NSYNC, ID, SKEW, and RES are positive and significant, the reversal for portfolios ranked by IV and JUMP. The results of double-sorted portfolios based on two information proxies are more persistent for each RES, IV, NSYNC and ID conditional on other proxies, which reaffirm the relationship between firm-specific information measured by these proxies and stock returns. In the control for firm characteristics, we find average returns and risk-adjusted returns are significant with the same signs in both SIZE stocks among five proxies, except for ID. It is plausible that firm-specific information captured by ID might impact on average returns for Small stocks. For BM control, generally high BM stocks have significantly higher average returns, CAPM alphas and FF-3 alphas in RES, NSYNC, ID and SKEW, which suggests that the effect of these proxies is stronger for high value stocks. Hence, the BM might be behind the relationship between expected returns and these information proxies. In contrast, the difference FF-3 alphas for portfolios sorted on BM and IV or JUMP are highly significant in Low and Medium BM stocks, suggesting that high BM ratios are not effective factor to explain the relationship between IV, JUMP and FF-3 alphas.

Our analysis shows robust results by using Fama-Macbeth two-stage regressions, we statistically estimate regression coefficients and test their significance levels. The results of RES and SKEW are statistically significant positive during the whole period and sub-periods, which can interpret that firm-specific information captured by RES and SKEW can explain the cross-sectional returns. As for IV, ID and NSYNC, the coefficients become significantly positive when combining with other information proxies or control variables in multivariate tests. In addition, JUMP coefficients are only positively significant univariate tests or in control with RES and NSYNC. Both signs of IV and JUMP coefficients are consistent with single- and double-sort results, which presents that whether IV and JUMP capture firm-specific information is still a puzzle. According to our sub-sample period regressions, except RES, other proxies are mostly affected by time-varying periods, especially in the second and third periods.

In summary, our study provides a broader picture in asset pricing literature by comparing the performances of six information proxies in relation to expected stock returns. Our results show mixed findings on the effects of each proxy in univariate and multivariate tests. Moreover, we expect to extend our study by adding PIN for testing with various proxies of information at firm-specific levels in U.S. market.

Table 1. Descriptive Statistics

At month t, Residual return (RES) is the average residual return over the past 12 excluding the most recent month (i.e., from t −12 to t −2) standardized by the standard deviation of the residual returns over the same period. Idiosyncratic volatility (IV) is measured as the standard deviation of the residuals after estimating Eq. [(1)](http://www.sciencedirect.com/science/article/pii/S0304405X08001542" \l "fd1) using daily excess returns over the past 11 months. Stock Price Nonsynchronicity (NSYNC) is the logistic transformation of R2 based on FF3F model regressions of daily returns over an 11 month period. Information discreteness (ID) is determined by the sign of daily returns underlying the cumulative raw returns during past 11 months. SKEW is the conditional skewness of firm-specific daily returns from month t-11 to t-1. Stock Price Jump (JUMP) is extracted from discontinuous component of realized volatility within each month then accumulated 11 months from t-11 to t-1. Daily returns are winsorized at the 1st and 99th percentiles over the full sample. The data period is from December 1925 to December 2016.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Panel A.** Descriptive Statistics | | | | | | | | | | |
| **Variable** | **N** | **Mean** | **StdDev** | **Min** | **Q1** | **Median** | **Q3** | **Max** |
| **RES** | 1,300,794 | 0.160% | 0.103% | -2.034% | 0.092% | 0.141% | 0.206% | 2.769% |
| **IV** | 3,174,462 | 2.490 | 1.158 | 0.000 | 1.580 | 2.282 | 3.237 | 7.163 |
| **ID** | 3,169,674 | -0.057 | 0.100 | -1.000 | -0.101 | -0.047 | 0.004 | 0.600 |
| **NSYNC** | 3,174,471 | 2.543 | 1.526 | -2.319 | 1.415 | 2.456 | 3.591 | 14.556 |
| **JUMP** | 3,179,392 | 0.003 | 0.008 | -0.029 | -0.001 | 0.001 | 0.006 | 0.093 |
| **SKEW** | 3,169,682 | 0.360 | 0.571 | -1.732 | 0.100 | 0.307 | 0.556 | 3.598 |

**Panel B.** Correlation Matrix (Pearson Correlations are shown above the Diagonal with Spearman below)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **IV** | **NSYNC** | **RES** | **ID** | **JUMP** | **SKEW** |
| **IV** | 1 | 0.362 | -0.104 | 0.052 | 0.620 | -0.029 |
| **NSYNC** | 0.351 | 1 | -0.072 | -0.141 | 0.280 | 0.134 |
| **RES** | -0.122 | -0.079 | 1 | -0.026 | -0.059 | 0.072 |
| **ID** | 0.018 | -0.086 | -0.004 | 1 | -0.025 | -0.056 |
| **JUMP** | 0.547 | 0.274 | -0.063 | -0.044 | 1 | 0.016 |
| **SKEW** | 0.063 | 0.112 | 0.082 | 0.080 | 0.100 | 1 |

Table 2. Single-sort Portfolio Returns

This table reports the average monthly returns for J&K strategies and using individual stock’s past average value of IV, NSYNC, RES, ID, SKEW and JUMP. The table reports the single-sort strategy profits based on individual stocks’ performance of past 12 month excluding the most recent month and hold for 1 and 3 months. We exclude stocks during the months that their price is below $1 to reduce microstructure concerns in holding periods. All portfolio returns are equally-weighted. Portfolio 1 (5) is the portfolio of stocks with the lowest (highest) value of each proxy. The row “5-1” refers to the difference in monthly returns between portfolio 5 and portfolio 1. The Alpha columns report Jensen's alpha with respect to the CAPM or Fama-French (1993) three-factor model. Number in the parentheses are the t-statistics are calculated using Newey and West’s (1987) robust standard errors. \*\*\*, \*\*, \* denote significance at the 1%, 5% and 10% levels, respectively. The sample period is December 1925 to December 2016.

**Panel A. K=1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **RES** | | | **IV** | | | **NSYNC** | | | **ID** | | | **JUMP** | | | **SKEW** | | | |
|  | **Raw** |  |  | **Raw** |  |  | **Raw** |  |  | **Raw** |  |  | **Raw** |  |  | | **Raw** |  |  | |
| 1 | 0.77\*\*\* | -0.12 | -0.22\*\*\* | 1.04\*\*\* | 0.27\*\*\* | 0.22\*\*\* | 1.02\*\*\* | -0.05 | -0.09 | 0.75\*\*\* | -0.19\*\* | -0.28\*\*\* | 1.09\*\*\* | 0.21\*\*\* | 0.15\*\*\* | | 0.95\*\*\* | 0.09 | 0.03 | |
|  | (3.93) | (-1.35) | (-2.98) | (7.38) | (5.03) | (4.64) | (4.75) | (-0.67) | (-1.56) | (3.60) | (-2.07) | (-4.50) | (6.23) | (3.48) | (3.41) | | (5.51) | (1.43) | (0.56) | |
| 2 | 0.97\*\*\* | 0.08 | -0.03 | 1.15\*\*\* | 0.26\*\*\* | 0.19\*\*\* | 1.08\*\*\* | 0.07 | -0.01 | 1.00\*\*\* | 0.05 | -0.04 | 1.06\*\*\* | 0.19\*\*\* | 0.12\*\*\* | | 0.99\*\*\* | 0.03 | -0.07 | |
|  | (4.91) | (0.90) | (-0.42) | (6.44) | (3.93) | (3.91) | (5.11) | (0.88) | (-0.29) | (4.98) | (0.69) | (-0.78) | (6.15) | (3.25) | (3.08) | | (4.81) | (0.32) | (-1.63) | |
| 3 | 1.10\*\*\* | 0.24\*\*\* | 0.15\*\* | 1.17\*\*\* | 0.20\*\* | 0.12\*\* | 0.99\*\*\* | 0.05 | -0.05 | 1.12\*\*\* | 0.19\*\*\* | 0.10\*\* | 1.05\*\*\* | 0.13\* | 0.05 | | 0.97\*\*\* | -0.02 | -0.12\*\* | |
|  | (5.86) | (2.80) | (2.20) | (5.65) | (2.50) | (2.49) | (4.87) | (0.58) | (-1.13) | (5.78) | (2.60) | (2.25) | (5.57) | (1.87) | (1.08) | | (4.49) | (-0.20) | (-2.55) | |
| 4 | 1.20\*\*\* | 0.35\*\*\* | 0.26\*\*\* | 0.99\*\*\* | -0.03 | -0.13\*\* | 0.95\*\*\* | 0.10 | -0.02 | 1.15\*\*\* | 0.24\*\*\* | 0.15\*\*\* | 1.02\*\*\* | 0.04 | -0.07 | | 1.05\*\*\* | 0.07 | -0.03 | |
|  | (6.67) | (4.31) | (3.98) | (4.24) | (-0.23) | (-2.29) | (4.93) | (1.00) | (-0.30) | (6.06) | (3.07) | (3.36) | (4.67) | (0.42) | (-1.26) | | (4.92) | (0.78) | (-0.59) | |
| 5 | 1.37\*\*\* | 0.51\*\*\* | 0.45\*\*\* | 0.67\*\*\* | -0.36\*\* | -0.52\*\*\* | 0.98\*\*\* | 0.24\*\* | 0.13\* | 1.01\*\*\* | 0.09 | -0.00 | 0.86\*\*\* | -0.17 | -0.32\*\*\* | | 1.09\*\*\* | 0.22\*\*\* | 0.14\*\* | |
|  | (7.78) | (6.41) | (6.61) | (2.58) | (-2.54) | (-6.26) | (5.63) | (2.45) | (1.94) | (5.04) | (0.97) | (-0.04) | (3.44) | (-1.34) | (-4.47) | | (5.89) | (2.75) | (2.55) | |
| 5-1 | 0.60\*\*\* | 0.63\*\*\* | 0.67\*\*\* | -0.37\*\* | -0.63\*\*\* | -0.74\*\*\* | -0.02 | 0.25\*\* | 0.16 | 0.27\*\*\* | 0.28\*\*\* | 0.28\*\*\* | -0.28\*\* | -0.42\*\*\* | -0.54\*\*\* | | 0.14\*\*\* | 0.13\*\*\* | 0.12\*\*\* | |
|  | (7.52) | (8.08) | (8.50) | (-2.19) | (-4.35) | (-7.51) | (-0.12) | (2.24) | (1.56) | (4.01) | (4.18) | (4.11) | (-2.19) | (-3.68) | (-6.51) | | (2.83) | (2.86) | (2.61) | |

**Panel B. K=3**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | RES | | | IV | | | NSYNC | | | ID | | | JUMP | | | SKEW | | | |
|  | **Raw** |  |  | **Raw** |  |  | **Raw** |  |  | **Raw** |  |  | **Raw** |  |  | | **Raw** |  |  | |
| **1** | 0.78\*\*\* | -0.11 | -0.21\*\*\* | 1.03\*\*\* | 0.26\*\*\* | 0.21\*\*\* | 1.01\*\*\* | -0.05 | -0.09 | 0.79\*\*\* | -0.15\* | -0.24\*\*\* | 1.09\*\*\* | 0.21\*\*\* | 0.15\*\*\* | | 0.94\*\*\* | 0.08 | 0.02 | |
|  | (3.96) | (-1.23) | (-3.06) | (7.27) | (4.84) | (4.46) | (4.73) | (-0.66) | (-1.60) | (3.80) | (-1.67) | (-4.05) | (6.23) | (3.48) | (3.41) | | (5.46) | (1.33) | (0.41) | |
| **2** | 0.95\*\*\* | 0.05 | -0.05 | 1.14\*\*\* | 0.25\*\*\* | 0.18\*\*\* | 1.05\*\*\* | 0.05 | -0.03 | 1.01\*\*\* | 0.07 | -0.02 | 1.06\*\*\* | 0.19\*\*\* | 0.12\*\*\* | | 0.97\*\*\* | 0.02 | -0.08\* | |
|  | (4.84) | (0.67) | (-0.89) | (6.38) | (3.87) | (3.81) | (4.99) | (0.65) | (-0.64) | (5.04) | (0.91) | (-0.45) | (6.15) | (3.25) | (3.08) | | (4.74) | (0.23) | (-1.81) | |
| **3** | 1.15\*\*\* | 0.26\*\*\* | 0.15\*\*\* | 1.15\*\*\* | 0.19\*\* | 0.11\*\* | 1.00\*\*\* | 0.06 | -0.05 | 1.11\*\*\* | 0.19\*\*\* | 0.10\*\* | 1.05\*\*\* | 0.13\* | 0.05 | | 0.96\*\*\* | -0.01 | -0.12\*\* | |
|  | (6.08) | (3.21) | (2.64) | (5.58) | (2.38) | (2.33) | (4.88) | (0.64) | (-1.04) | (5.76) | (2.61) | (2.31) | (5.57) | (1.87) | (1.08) | | (4.51) | (-0.15) | (-2.48) | |
| **4** | 1.23\*\*\* | 0.37\*\*\* | 0.28\*\*\* | 0.99\*\*\* | -0.03 | -0.14\*\* | 0.96\*\*\* | 0.11 | -0.01 | 1.11\*\*\* | 0.21\*\*\* | 0.12\*\*\* | 1.02\*\*\* | 0.04 | -0.07 | | 1.04\*\*\* | 0.07 | -0.03 | |
|  | (6.79) | (4.69) | (4.44) | (4.20) | (-0.26) | (-2.35) | (4.93) | (1.09) | (-0.14) | (5.85) | (2.71) | (2.73) | (4.67) | (0.42) | (-1.26) | | (4.87) | (0.78) | (-0.60) | |
| **5** | 1.32\*\*\* | 0.46\*\*\* | 0.41\*\*\* | 0.70\*\*\* | -0.32\*\* | -0.48\*\*\* | 0.99\*\*\* | 0.26\*\* | 0.14\*\* | 0.99\*\*\* | 0.08 | -0.02 | 0.86\*\*\* | -0.17 | -0.32\*\*\* | | 1.10\*\*\* | 0.24\*\*\* | 0.16\*\*\* | |
|  | (7.50) | (5.96) | (6.22) | (2.69) | (-2.28) | (-5.80) | (5.70) | (2.57) | (2.19) | (4.93) | (0.79) | (-0.34) | (3.44) | (-1.34) | (-4.47) | | (5.97) | (2.95) | (2.95) | |
| **5-1** | 0.54\*\*\* | 0.57\*\*\* | 0.62\*\*\* | -0.40\*\* | -0.63\*\*\* | -0.78\*\*\* | -0.01 | 0.25\*\* | 0.17 | 0.22\*\*\* | 0.25\*\*\* | 0.24\*\*\* | -0.28\*\* | -0.42\*\*\* | -0.54\*\*\* | | 0.19\*\*\* | 0.18\*\*\* | 0.16\*\*\* | |
|  | (7.55) | (8.10) | (8.75) | (-2.05) | (-3.72) | (-6.81) | (-0.05) | (2.30) | (1.64) | (2.93) | (3.18) | (3.09) | (-2.19) | (-3.68) | (-6.51) | | (3.59) | (3.32) | (3.13) | |

Table 3. Double-sort Portfolio Returns on SIZE and Information Proxy

This table reports the average monthly returns for double-sort strategy based on NSYNC, IV, RES, SKEW, JUMP, and ID using monthly market capitalization (SIZE) and individual stocks’ past value of each proxy. First, we control for Size by first forming two portfolios ranked on Size. Size breakpoint is the median market capitalization. Then, within each size portfolio, we sort stocks into quintiles ranked on each information proxy. The row “5-1” refers to the difference in monthly average returns, CAPM alphas and FF-3 alphas between portfolio 5 and portfolio 1 in Panel A, B and C, respectively. We use data over the previous month for SIZE and individual stocks’ performance of past 12 month excluding the most recent month for each proxy then hold all portfolios for 3 months. We exclude stocks during the months that their price is below $1 to reduce microstructure concerns in holding periods. Number in the parentheses are the t-statistics are calculated using Newey and West’s (1987) robust standard errors. \*\*\*, \*\*, \* denote significance at the 1%, 5% and 10% levels, respectively. The sample period is December 1925 to December 2016.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **RES** | | | **IV** | | | **NSYNC** | | | | **ID** | | | | **JUMP** | | | | **SKEW** | | | |
|  | **Small** | **Big** | **SMB** | **Small** | **Big** | **SMB** | | **Small** | **Big** | **SMB** | | **Small** | **Big** | **SMB** | | **Small** | **Big** | **SMB** | | **Small** | **Big** | **SMB** | |
| ***Panel A. Raw return*** | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | 0.93\*\*\* | 0.79\*\*\* | 0.15 | 1.13\*\*\* | 0.99\*\*\* | 0.14\* | | 0.90\*\*\* | 1.00\*\*\* | -0.10 | | 0.64\*\*\* | 1.02\*\*\* | -0.38\*\*\* | | 1.05\*\*\* | 1.08\*\*\* | -0.03 | | 0.95\*\*\* | 0.95\*\*\* | 0.00 | |
|  | (4.35) | (4.08) | (1.54) | (7.00) | (7.28) | (1.85) | | (3.56) | (4.72) | (-1.16) | | (2.88) | (5.23) | (-4.03) | | (5.51) | (6.38) | (-0.46) | | (4.70) | (5.80) | (0.00) | |
| **5** | 1.44\*\*\* | 1.17\*\*\* | 0.27\*\*\* | 0.71\*\*\* | 0.90\*\*\* | -0.19\* | | 1.00\*\*\* | 0.99\*\*\* | 0.01 | | 1.00\*\*\* | 0.98\*\*\* | 0.02 | | 0.80\*\*\* | 0.98\*\*\* | -0.18\* | | 1.06\*\*\* | 1.14\*\*\* | -0.08 | |
|  | (7.41) | (6.97) | (3.16) | (2.64) | (3.63) | (-1.82) | | (5.48) | (6.64) | (0.12) | | (4.50) | (5.33) | (0.20) | | (3.10) | (4.27) | (-1.90) | | (5.46) | (6.44) | (-1.17) | |
| **5-1** | 0.51\*\*\* | 0.38\*\*\* | 0.13 | -0.54\*\*\* | -0.10 | -0.43\*\*\* | | 0.15 | 0.05 | 0.11 | | 0.33\*\*\* | -0.02 | 0.35\*\*\* | | -0.30\*\* | -0.12 | -0.18\*\* | | 0.17\*\* | 0.20\*\*\* | -0.03 | |
|  | (5.92) | (4.12) | (1.33) | (-3.03) | (-0.56) | (-3.46) | | (1.11) | (0.38) | (0.97) | | (4.05) | (-0.32) | (4.03) | | (-2.55) | (-1.19) | (-2.05) | | (2.53) | (3.45) | (-0.36) | |
| ***Panel B.*** | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | 0.06 | -0.12 | 0.17\* | 0.38\*\*\* | 0.24\*\*\* | 0.14\* | | -0.20\* | -0.06 | -0.14\* | | -0.28\*\* | 0.06 | -0.34\*\*\* | | 0.20\*\* | 0.20\*\*\* | -0.00 | | 0.08 | 0.09\* | -0.01 | |
|  | (0.49) | (-1.39) | (1.83) | (4.42) | (4.35) | (1.91) | | (-1.73) | (-0.89) | (-1.66) | | (-2.38) | (0.97) | (-3.66) | | (2.06) | (3.75) | (-0.03) | | (0.78) | (1.82) | (-0.10) | |
| **5** | 0.59\*\*\* | 0.32\*\*\* | 0.27\*\*\* | -0.30\* | -0.21\* | -0.10 | | 0.27\*\* | 0.25\*\*\* | 0.02 | | 0.08 | 0.06 | 0.02 | | -0.21 | -0.09 | -0.12 | | 0.22\*\* | 0.25\*\*\* | -0.04 | |
|  | (5.35) | (4.77) | (3.22) | (-1.91) | (-1.96) | (-0.92) | | (2.36) | (3.58) | (0.21) | | (0.68) | (0.85) | (0.27) | | (-1.43) | (-0.98) | (-1.29) | | (2.12) | (3.82) | (-0.55) | |
| **5-1** | 0.54\*\*\* | 0.43\*\*\* | 0.10 | -0.75\*\*\* | -0.41\*\*\* | -0.34\*\*\* | | 0.46\*\*\* | 0.30\*\*\* | 0.16 | | 0.35\*\*\* | 0.01 | 0.34\*\*\* | | -0.44\*\*\* | -0.28\*\*\* | -0.16\* | | 0.18\*\*\* | 0.18\*\*\* | 0.01 | |
|  | (6.50) | (4.82) | (1.12) | (-4.79) | (-2.70) | (-2.80) | | (4.23) | (2.76) | (1.46) | | (4.33) | (0.16) | (3.97) | | (-4.11) | (-3.04) | (-1.76) | | (2.85) | (2.96) | (0.07) | |
| ***Panel C.*** | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | -0.11 | -0.16\* | 0.05 | 0.27\*\*\* | 0.20\*\*\* | 0.07 | | -0.34\*\*\* | -0.08 | -0.25\*\*\* | | -0.42\*\*\* | 0.01 | -0.43\*\*\* | | 0.07 | 0.17\*\*\* | -0.10\* | | -0.06 | 0.07 | -0.13\*\* | |
|  | (-1.20) | (-1.95) | (0.69) | (4.13) | (4.07) | (1.17) | | (-4.82) | (-1.32) | (-4.38) | | (-5.20) | (0.27) | (-5.53) | | (1.17) | (3.63) | (-1.75) | | (-0.96) | (1.54) | (-2.16) | |
| **5** | 0.48\*\*\* | 0.29\*\*\* | 0.19\*\*\* | -0.50\*\*\* | -0.26\*\*\* | -0.24\*\* | | 0.13\* | 0.20\*\*\* | -0.08 | | -0.06 | 0.02 | -0.08 | | -0.39\*\*\* | -0.14\*\* | -0.25\*\*\* | | 0.10 | 0.20\*\*\* | -0.10 | |
|  | (5.64) | (4.66) | (2.82) | (-4.92) | (-3.76) | (-2.56) | | (1.74) | (3.56) | (-1.03) | | (-0.89) | (0.36) | (-1.37) | | (-4.44) | (-2.33) | (-3.17) | | (1.57) | (3.99) | (-1.63) | |
| **5-1** | 0.59\*\*\* | 0.45\*\*\* | 0.14 | -0.85\*\*\* | -0.48\*\*\* | -0.37\*\*\* | | 0.46\*\*\* | 0.28\*\* | 0.18\* | | 0.34\*\*\* | 0.01 | 0.33\*\*\* | | -0.51\*\*\* | -0.32\*\*\* | -0.19\*\* | | 0.21\*\*\* | 0.15\*\*\* | 0.07 | |
|  | (7.17) | (4.96) | (1.58) | (-6.57) | (-4.20) | (-3.08) | | (4.39) | (2.50) | (1.72) | | (4.27) | (0.17) | (3.79) | | (-5.52) | (-4.18) | (-2.04) | | (3.65) | (2.63) | (0.93) | |

Table 4. Double-sort Portfolio Returns on BM and Information Proxy

This table reports the average monthly returns for double-sort strategy based on IV, NSYNC, RES, SKEW, JUMP, and ID using monthly book-to-market ratio and individual stocks past average value of every proxy. First, we control for BM by first forming two portfolios ranked on book-to-market ratios. BM breakpoints are the 30th and 70th percentiles. Then, within each BM portfolio, we sort stocks into quintiles ranked on each information proxy. The row “5-1” refers to the difference in monthly average returns, CAPM alphas and FF-3 alphas between portfolio 5 and portfolio 1 in Panel A, B and C, respectively. We use data over the previous month for Size and individual stocks’ performance of past 12 month excluding the most recent month for each proxy then hold all portfolios for 3 months. We exclude stocks during the months that their price is below $1 to reduce microstructure concerns in holding periods. Number in the parentheses are the t-statistics are calculated using Newey and West’s (1987) robust standard errors. \*\*\*, \*\*, \* denote significance at the 1%, 5% and 10% levels, respectively. The sample period is December 1925 to December 2016.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **RES** | | | | **IV** | | | | **NSYNC** | | | | **ID** | | | | **JUMP** | | | | **SKEW** | | | |
|  | **Lo BM** | **Med** | **Hi BM** | **HML** | **Lo BM** | **Med** | **Hi BM** | **HML** | **Lo BM** | **Med** | **Hi BM** | **HML** | **Lo BM** | **Med** | **Hi BM** | **HML** | **Lo BM** | **Med** | **Hi BM** | **HML** | **Lo BM** | **Med** | **Hi BM** | **HML** |
| ***Panel A. Raw return*** | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | 0.54\*\*\* | 0.84\*\*\* | 1.36\*\*\* | 0.83\*\*\* | 0.98\*\*\* | 1.11\*\*\* | 1.34\*\*\* | 0.36\*\*\* | 0.91\*\*\* | 1.09\*\*\* | 1.49\*\*\* | 0.58\*\*\* | 0.51\*\* | 1.00\*\*\* | 1.41\*\*\* | 0.90\*\*\* | 0.88\*\*\* | 1.11\*\*\* | 1.48\*\*\* | 0.60\*\*\* | 0.73\*\*\* | 1.02\*\*\* | 1.43\*\*\* | 0.71\*\*\* |
|  | (2.71) | (4.52) | (6.86) | (7.09) | (6.37) | (8.28) | (9.52) | (3.77) | (4.06) | (5.47) | (7.25) | (4.20) | (2.30) | (5.00) | (6.90) | (7.55) | (4.68) | (6.65) | (8.28) | (5.61) | (3.84) | (6.18) | (8.16) | (5.99) |
| **5** | 1.23\*\*\* | 1.37\*\*\* | 1.70\*\*\* | 0.47\*\*\* | 0.05 | 0.94\*\*\* | 1.78\*\*\* | 1.73\*\*\* | 0.40\*\* | 1.03\*\*\* | 1.59\*\*\* | 1.19\*\*\* | 0.51\*\* | 1.03\*\*\* | 1.60\*\*\* | 1.08\*\*\* | 0.28 | 1.02\*\*\* | 1.80\*\*\* | 1.52\*\*\* | 0.84\*\*\* | 1.13\*\*\* | 1.61\*\*\* | 0.77\*\*\* |
|  | (6.53) | (8.21) | (9.53) | (3.86) | (0.18) | (3.79) | (7.21) | (13.05) | (2.05) | (6.20) | (8.95) | (10.82) | (2.40) | (5.36) | (8.28) | (9.55) | (1.10) | (4.36) | (7.64) | (11.54) | (4.19) | (6.14) | (8.80) | (7.47) |
| **5-1** | 0.69\*\*\* | 0.53\*\*\* | 0.34\*\*\* | -0.35\*\*\* | -1.07\*\*\* | -0.20 | 0.32\* | 1.39\*\*\* | -0.63\*\*\* | -0.14 | 0.05 | 0.68\*\*\* | 0.03 | 0.03 | 0.20\*\* | 0.18 | -0.68\*\*\* | -0.08 | 0.24\* | 0.92\*\*\* | 0.05 | 0.11 | 0.16\*\* | 0.10 |
|  | (6.61) | (5.83) | (4.19) | (-3.40) | (-4.86) | (-0.97) | (1.66) | (8.89) | (-3.60) | (-0.97) | (0.35) | (4.03) | (0.24) | (0.34) | (2.41) | (1.52) | (-4.45) | (-0.62) | (1.89) | (6.93) | (0.56) | (1.52) | (2.48) | (0.97) |
| ***Panel B.*** | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | -0.51\*\*\* | 0.03 | 0.56\*\*\* | 1.07\*\*\* | 0.09 | 0.31\*\*\* | 0.56\*\*\* | 0.47\*\*\* | -0.26\*\*\* | 0.01 | 0.43\*\*\* | 0.69\*\*\* | -0.53\*\*\* | 0.01 | 0.48\*\*\* | 1.01\*\*\* | -0.13\* | 0.19\*\* | 0.60\*\*\* | 0.73\*\*\* | -0.28\*\*\* | 0.11 | 0.57\*\*\* | 0.84\*\*\* |
|  | (-4.51) | (0.24) | (3.88) | (8.85) | (1.23) | (4.14) | (6.62) | (5.16) | (-2.83) | (0.06) | (3.84) | (4.96) | (-4.58) | (0.06) | (3.88) | (8.48) | (-1.77) | (2.30) | (5.72) | (6.90) | (-3.43) | (1.44) | (5.41) | (7.23) |
| **5** | 0.27\*\*\* | 0.44\*\*\* | 0.85\*\*\* | 0.59\*\*\* | -1.06\*\*\* | -0.13 | 0.80\*\*\* | 1.86\*\*\* | -0.47\*\*\* | 0.25\*\* | 0.83\*\*\* | 1.31\*\*\* | -0.53\*\*\* | 0.06 | 0.68\*\*\* | 1.21\*\*\* | -0.84\*\*\* | -0.05 | 0.82\*\*\* | 1.66\*\*\* | -0.16 | 0.20\* | 0.73\*\*\* | 0.89\*\*\* |
|  | (2.62) | (4.01) | (6.69) | (4.93) | (-6.50) | (-0.93) | (4.83) | (14.09) | (-3.74) | (2.31) | (6.68) | (12.02) | (-4.95) | (0.57) | (5.88) | (10.97) | (-5.66) | (-0.36) | (5.40) | (12.54) | (-1.62) | (1.93) | (6.56) | (8.92) |
| **5-1** | 0.78\*\*\* | 0.41\*\*\* | 0.30\*\*\* | -0.48\*\*\* | -1.29\*\*\* | -0.48\*\*\* | 0.11 | 1.41\*\*\* | -0.32\* | 0.18 | 0.37\*\* | 0.69\*\*\* | 0.03 | 0.06 | 0.23\*\*\* | 0.20\* | -0.80\*\*\* | -0.23\*\* | 0.13 | 0.93\*\*\* | 0.05 | 0.09 | 0.14\*\* | 0.09 |
|  | (7.71) | (4.44) | (3.38) | (-4.96) | (-6.18) | (-2.67) | (0.61) | (8.89) | (-1.95) | (1.33) | (2.53) | (4.02) | (0.28) | (0.65) | (2.61) | (1.68) | (-5.46) | (-2.01) | (1.07) | (6.93) | (0.50) | (1.17) | (2.18) | (0.79) |
| ***Panel C.*** | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | -0.54\*\*\* | -0.19\*\* | 0.24\*\* | 0.77\*\*\* | 0.11 | 0.16\*\*\* | 0.31\*\*\* | 0.21\*\*\* | -0.09 | -0.11 | 0.12 | 0.21\*\* | -0.51\*\*\* | -0.13\* | 0.22\*\* | 0.73\*\*\* | -0.07 | 0.06 | 0.33\*\*\* | 0.41\*\*\* | -0.19\*\*\* | -0.02 | 0.29\*\*\* | 0.49\*\*\* |
|  | (-6.22) | (-2.18) | (2.33) | (7.87) | (1.59) | (2.63) | (5.36) | (2.99) | (-1.22) | (-1.37) | (1.45) | (2.22) | (-5.62) | (-1.75) | (2.39) | (7.43) | (-1.22) | (0.92) | (4.93) | (5.32) | (-3.16) | (-0.28) | (4.36) | (6.12) |
| **5** | 0.26\*\*\* | 0.25\*\*\* | 0.55\*\*\* | 0.29\*\*\* | -1.06\*\*\* | -0.24\*\* | 0.53\*\*\* | 1.59\*\*\* | -0.53\*\*\* | 0.12 | 0.63\*\*\* | 1.15\*\*\* | -0.50\*\*\* | -0.08 | 0.41\*\*\* | 0.91\*\*\* | -0.83\*\*\* | -0.19\*\* | 0.51\*\*\* | 1.34\*\*\* | -0.17\*\* | 0.04 | 0.47\*\*\* | 0.64\*\*\* |
|  | (3.21) | (3.04) | (6.61) | (2.98) | (-9.05) | (-2.57) | (4.62) | (13.50) | (-5.38) | (1.39) | (7.33) | (11.83) | (-7.05) | (-1.28) | (5.86) | (11.05) | (-7.85) | (-2.44) | (5.20) | (11.97) | (-2.36) | (0.58) | (6.59) | (7.95) |
| **5-1** | 0.80\*\*\* | 0.44\*\*\* | 0.31\*\*\* | -0.48\*\*\* | -1.33\*\*\* | -0.45\*\*\* | 0.08 | 1.40\*\*\* | -0.56\*\*\* | 0.15 | 0.48\*\*\* | 1.03\*\*\* | 0.06 | 0.05 | 0.23\*\*\* | 0.16 | -0.86\*\*\* | -0.23\*\*\* | 0.08 | 0.94\*\*\* | -0.03 | 0.06 | 0.15\*\* | 0.18\* |
|  | (7.71) | (4.64) | (3.57) | (-4.79) | (-8.63) | (-3.78) | (0.55) | (9.08) | (-3.88) | (1.17) | (3.49) | (7.13) | (0.57) | (0.58) | (2.59) | (1.40) | (-7.18) | (-2.83) | (0.74) | (7.18) | (-0.31) | (0.97) | (2.52) | (1.75) |

Table 5. Portfolio returns sorted on IV and NSYNC Controlling for RES, ID, SKEW and JUMP

This table reports the average monthly returns for double-sort strategy controlling RES, ID, SKEW and JUMP. The row “5-1” refers to the difference in monthly average returns sorted by IV and NSYNC, CAPM alphas and FF-3 alphas between portfolio 5 and portfolio 1 in Panel A, B, respectively. We use individual stocks’ performance of past 12 month excluding the most recent month for each proxy then hold all portfolios for 1 month. We exclude stocks during the months that their price is below $1 to reduce microstructure concerns in holding periods. Number in the parentheses are the t-statistics are calculated using Newey and West’s (1987) robust standard errors. \*\*\*, \*\*, \* denote significance at the 1%, 5% and 10% levels, respectively. The sample period is December 1925 to December 2016.

**Panel A. Portfolio returns sorted on IV**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **IV** | | | | | | | | | | | |
|  |  | **\_1** | | **\_2** | | **\_3** | | **\_4** | | **\_5** | | **H\_L** | |
| **RES** | **1** | 0.15\*\* | | 0.22\*\*\* | | 0.20\*\*\* | | 0.09 | | -0.35\*\*\* | | -0.51\*\*\* | |
|  | (2.49) | | (3.20) | | (2.83) | | (1.29) | | (-3.87) | | (-4.51) | |
| **2** | 0.20\*\*\* | | 0.11\* | | 0.05 | | -0.13\* | | -0.49\*\*\* | | -0.68\*\*\* | |
|  | (3.48) | | (1.92) | | (0.83) | | (-1.87) | | (-4.95) | | (-6.02) | |
| **3** | 0.26\*\*\* | | 0.10\* | | -0.03 | | -0.30\*\*\* | | -0.48\*\*\* | | -0.74\*\*\* | |
|  | (4.59) | | (1.88) | | (-0.50) | | (-4.01) | | (-4.88) | | (-6.42) | |
| **4** | 0.25\*\*\* | | 0.16\*\*\* | | 0.04 | | -0.22\*\*\* | | -0.54\*\*\* | | -0.79\*\*\* | |
|  | (4.66) | | (2.62) | | (0.68) | | (-3.08) | | (-5.60) | | (-7.23) | |
| **5** | 0.26\*\*\* | | 0.25\*\*\* | | 0.16\*\* | | -0.11 | | -0.46\*\*\* | | -0.71\*\*\* | |
|  | (4.30) | | (4.02) | | (2.42) | | (-1.50) | | (-4.71) | | (-6.38) | |
|  |  | |  | |  | |  | |  | |  | |
| **ID** | **1** | 0.15\* | | 0.06 | | -0.20\*\* | | -0.63\*\*\* | | -0.98\*\*\* | | -1.13\*\*\* | |
|  | (1.91) | | (0.87) | | (-2.50) | | (-6.82) | | (-8.49) | | (-8.17) | |
| **2** | 0.21\*\*\* | | 0.15\*\*\* | | 0.11\* | | -0.20\*\*\* | | -0.56\*\*\* | | -0.77\*\*\* | |
|  | (3.72) | | (2.60) | | (1.77) | | (-2.84) | | (-5.75) | | (-6.73) | |
| **3** | 0.23\*\*\* | | 0.19\*\*\* | | 0.14\*\* | | 0.09 | | -0.19\*\* | | -0.42\*\*\* | |
|  | (4.33) | | (3.25) | | (2.49) | | (1.44) | | (-2.17) | | (-4.09) | |
| **4** | 0.22\*\*\* | | 0.24\*\*\* | | 0.31\*\*\* | | 0.11 | | -0.13 | | -0.34\*\*\* | |
|  | (4.01) | | (4.26) | | (5.36) | | (1.62) | | (-1.51) | | (-3.44) | |
| **5** | 0.15\*\* | | 0.15\*\* | | 0.10 | | -0.07 | | -0.42\*\*\* | | -0.57\*\*\* | |
|  | (2.32) | | (2.19) | | (1.39) | | (-0.93) | | (-4.25) | | (-5.12) | |
|
| **SKEW** | **1** | 0.22\*\*\* | | 0.12\*\* | | 0.05 | | -0.09 | | -0.23\*\*\* | | -0.45\*\*\* | |
|  | (3.86) | | (2.30) | | (0.92) | | (-1.52) | | (-3.07) | | (-4.89) | |
| **2** | 0.17\*\*\* | | 0.09\* | | -0.00 | | -0.25\*\*\* | | -0.39\*\*\* | | -0.56\*\*\* | |
|  | (3.30) | | (1.73) | | (-0.08) | | (-3.44) | | (-3.87) | | (-4.84) | |
| **3** | 0.14\*\*\* | | 0.16\*\*\* | | -0.04 | | -0.42\*\*\* | | -0.49\*\*\* | | -0.64\*\*\* | |
|  | (3.00) | | (2.91) | | (-0.71) | | (-4.99) | | (-4.45) | | (-5.18) | |
| **4** | 0.27\*\*\* | | 0.21\*\*\* | | 0.10 | | -0.19\*\* | | -0.69\*\*\* | | -0.95\*\*\* | |
|  | (4.97) | | (3.50) | | (1.51) | | (-2.27) | | (-6.64) | | (-7.95) | |
| **5** | 0.31\*\*\* | | 0.29\*\*\* | | 0.31\*\*\* | | 0.13\* | | -0.38\*\*\* | | -0.69\*\*\* | |
|  | (5.15) | | (4.37) | | (4.48) | | (1.71) | | (-4.39) | | (-7.10) | |
|  |  | |  | |  | |  | |  | |  | |
| **JUMP** | **1** | 0.23\*\*\* | | 0.24\*\*\* | | 0.22\*\*\* | | 0.21\*\*\* | | -0.11 | | -0.34\*\*\* | |
|  | (4.03) | | (4.33) | | (3.76) | | (3.69) | | (-1.64) | | (-4.03) | |
| **2** | 0.29\*\*\* | | 0.21\*\*\* | | 0.20\*\*\* | | 0.12\*\* | | -0.22\*\*\* | | -0.50\*\*\* | |
|  | (5.13) | | (3.97) | | (3.80) | | (2.39) | | (-3.22) | | (-5.94) | |
| **3** | 0.21\*\*\* | | 0.14\*\*\* | | 0.15\*\*\* | | 0.09 | | -0.33\*\*\* | | -0.53\*\*\* | |
|  | (3.73) | | (2.78) | | (2.68) | | (1.50) | | (-4.11) | | (-5.46) | |
| **4** | 0.15\*\* | | 0.09 | | 0.03 | | -0.21\*\*\* | | -0.54\*\*\* | | -0.69\*\*\* | |
|  | (2.35) | | (1.50) | | (0.57) | | (-2.84) | | (-5.88) | | (-6.77) | |
| **5** | -0.04 | | -0.21\*\* | | -0.44\*\*\* | | -0.63\*\*\* | | -0.44\*\*\* | | -0.40\*\*\* | |
|  | (-0.56) | | (-2.51) | | (-5.29) | | (-6.47) | | (-3.28) | | (-3.02) | |
|  |  | |  | |  | |  | |  | |  | |
|  | |  | |  | |  | |  | |  | |  | |

**Panel B. Portfolio returns sorted on NSYNC**

|  |
| --- |
|  |
|  |  | |  | | **NSYNC** | |  | |  | |  | |
|  | **1** | | **2** | | **3** | | **4** | | **5** | | **H\_L** | |
| **RES** | **1** | -0.07 | | 0.08 | | 0.08 | | 0.07 | | 0.19\*\* | | 0.25\*\* | |
|  | (-0.88) | | (1.20) | | (1.21) | | (0.98) | | (2.33) | | (2.49) | |
| **2** | -0.16\*\* | | -0.07 | | -0.07 | | -0.02 | | 0.11 | | 0.27\*\*\* | |
|  | (-2.34) | | (-1.34) | | (-1.14) | | (-0.30) | | (1.51) | | (2.75) | |
| **3** | -0.15\*\* | | -0.16\*\*\* | | -0.15\*\* | | -0.03 | | 0.10 | | 0.25\*\* | |
|  | (-2.24) | | (-2.85) | | (-2.29) | | (-0.49) | | (1.21) | | (2.42) | |
| **4** | -0.17\*\* | | -0.04 | | -0.08 | | -0.08 | | 0.17\*\* | | 0.35\*\*\* | |
|  | (-2.47) | | (-0.64) | | (-1.36) | | (-1.04) | | (2.17) | | (3.46) | |
| **5** | 0.02 | | 0.04 | | -0.01 | | 0.01 | | 0.13\* | | 0.11 | |
|  | (0.34) | | (0.58) | | (-0.09) | | (0.07) | | (1.67) | | (1.08) | |
|
| **ID** | **1** | -0.25\*\*\* | | -0.36\*\*\* | | -0.36\*\*\* | | -0.35\*\*\* | | -0.07 | | 0.18\* | |
|  | (-3.25) | | (-4.74) | | (-4.51) | | (-4.19) | | (-0.79) | | (1.65) | |
| **2** | -0.08 | | -0.05 | | -0.04 | | -0.07 | | 0.04 | | 0.12 | |
|  | (-1.33) | | (-0.86) | | (-0.72) | | (-1.02) | | (0.47) | | (1.20) | |
| **3** | 0.01 | | 0.08 | | 0.18\*\*\* | | 0.06 | | 0.19\*\* | | 0.18\* | |
|  | (0.09) | | (1.50) | | (3.08) | | (0.89) | | (2.50) | | (1.88) | |
| **4** | -0.02 | | 0.15\*\* | | 0.17\*\*\* | | 0.19\*\*\* | | 0.32\*\*\* | | 0.34\*\*\* | |
|  | (-0.29) | | (2.56) | | (2.83) | | (3.02) | | (4.16) | | (3.45) | |
| **5** | -0.17\*\* | | -0.01 | | -0.01 | | -0.01 | | 0.17\*\* | | 0.34\*\*\* | |
|  | (-2.07) | | (-0.08) | | (-0.19) | | (-0.16) | | (2.17) | | (3.33) | |
|  |  | |  | |  | |  | |  | |  | |
| **SKEW** | **1** | -0.01 | | -0.02 | | 0.02 | | 0.03 | | 0.08 | | 0.09 | |
|  | (-0.23) | | (-0.28) | | (0.28) | | (0.38) | | (1.04) | | (0.99) | |
| **2** | -0.11 | | -0.08 | | -0.12\*\* | | -0.06 | | 0.02 | | 0.13 | |
|  | (-1.59) | | (-1.30) | | (-1.97) | | (-0.86) | | (0.22) | | (1.17) | |
| **3** | -0.18\*\*\* | | -0.12\*\* | | -0.19\*\*\* | | -0.11 | | 0.02 | | 0.20\* | |
|  | (-2.81) | | (-2.07) | | (-2.90) | | (-1.49) | | (0.19) | | (1.95) | |
| **4** | -0.07 | | -0.05 | | -0.07 | | -0.10 | | 0.09 | | 0.16 | |
|  | (-0.95) | | (-0.78) | | (-1.07) | | (-1.40) | | (1.11) | | (1.49) | |
| **5** | -0.02 | | 0.07 | | 0.18\*\*\* | | 0.13\* | | 0.37\*\*\* | | 0.39\*\*\* | |
|  | (-0.26) | | (1.04) | | (2.70) | | (1.71) | | (4.67) | | (3.86) | |
|  |  | |  | |  | |  | |  | |  | |
| **JUMP** | **1** | -0.05 | | 0.09\* | | 0.14\*\* | | 0.28\*\*\* | | 0.34\*\*\* | | 0.38\*\*\* | |
|  | (-0.74) | | (1.77) | | (2.53) | | (4.79) | | (4.80) | | (4.19) | |
| **2** | 0.02 | | 0.08 | | 0.07 | | 0.18\*\*\* | | 0.26\*\*\* | | 0.24\*\* | |
|  | (0.34) | | (1.60) | | (1.45) | | (2.94) | | (3.59) | | (2.48) | |
| **3** | -0.09 | | 0.01 | | 0.03 | | 0.09 | | 0.24\*\*\* | | 0.33\*\*\* | |
|  | (-1.33) | | (0.18) | | (0.54) | | (1.33) | | (3.60) | | (3.44) | |
| **4** | -0.22\*\*\* | | -0.18\*\*\* | | -0.16\*\* | | -0.01 | | 0.12 | | 0.34\*\*\* | |
|  | (-2.92) | | (-2.73) | | (-2.37) | | (-0.18) | | (1.58) | | (3.13) | |
| **5** | -0.39\*\*\* | | -0.60\*\*\* | | -0.41\*\*\* | | -0.19\*\* | | -0.09 | | 0.30\*\* | |
|  | (-4.52) | | (-7.09) | | (-4.60) | | (-1.99) | | (-0.84) | | (2.40) | |
|  | |  | |  | |  | |  | |  | |  | |
|  | |  | |  | |  | |  | |  | |  | |

Table 6. Portfolio returns sorted on RES, ID, SKEW and JUMP Controlling for IV and NSYNC

This table reports the average monthly returns for double-sort strategy controlling IV or NSYNC. The row “5-1” refers to the difference in monthly average returns sorted by other proxies, CAPM alphas and FF-3 alphas between portfolio 5 and portfolio 1 in Panel A, B, respectively. We use individual stocks’ performance of past 12 month excluding the most recent month for each proxy then hold all portfolios for 1 month. We exclude stocks during the months that their price is below $1 to reduce microstructure concerns in holding periods. Number in the parentheses are the t-statistics are calculated using Newey and West’s (1987) robust standard errors. \*\*\*, \*\*, \* denote significance at the 1%, 5% and 10% levels, respectively. The sample period is December 1925 to December 2016.

**Panel A. Controlling for IV**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | | | | | | |  | | |  | | | | | | | | |
|  |  | **NSYNC** | | | | | | |  | | **RES** | | | | | | | | **ID** | | | | | | | |
|  |  | \_1 | \_2 | \_3 | \_4 | \_5 | H\_L |  | | \_1 | | | \_2 | \_3 | \_4 | \_5 | H\_L | \_1 | | \_2 | | \_3 | \_4 | \_5 | H\_L |
| **IV** | 1 | 0.03 | 0.16\*\*\* | 0.22\*\*\* | 0.30\*\*\* | 0.39\*\*\* | 0.37\*\*\* |  | | 0.16\*\*\* | | | 0.21\*\*\* | 0.25\*\*\* | 0.24\*\*\* | 0.25\*\*\* | 0.09 | 0.23\*\*\* | | 0.24\*\*\* | | 0.25\*\*\* | 0.21\*\*\* | 0.17\*\*\* | -0.06 |
|  |  | (0.48) | (3.02) | (3.84) | (4.57) | (5.31) | (4.09) |  | | (2.69) | | | (3.65) | (4.69) | (4.55) | (4.46) | (1.63) | (3.46) | | (4.08) | | (4.51) | (4.08) | (2.93) | (-0.79) |
|  | 2 | -0.14\* | 0.10 | 0.22\*\*\* | 0.33\*\*\* | 0.38\*\*\* | 0.52\*\*\* |  | | 0.22\*\*\* | | | 0.17\*\*\* | 0.15\*\*\* | 0.13\*\* | 0.26\*\*\* | 0.04 | 0.20\*\*\* | | 0.19\*\*\* | | 0.16\*\*\* | 0.26\*\*\* | 0.10 | -0.10 |
|  |  | (-1.81) | (1.62) | (3.70) | (5.39) | (5.28) | (4.67) |  | | (3.66) | | | (3.04) | (2.59) | (2.11) | (4.37) | (0.66) | (3.09) | | (3.32) | | (2.98) | (4.78) | (1.61) | (-1.28) |
|  | 3 | -0.15\* | 0.11\* | 0.10 | 0.24\*\*\* | 0.31\*\*\* | 0.46\*\*\* |  | | 0.16\*\* | | | 0.02 | 0.09 | 0.15\*\* | 0.18\*\*\* | 0.02 | -0.03 | | 0.16\*\*\* | | 0.13\*\* | 0.23\*\*\* | 0.12\* | 0.15\*\* |
|  |  | (-1.75) | (1.69) | (1.63) | (3.57) | (4.48) | (3.93) |  | | (2.42) | | | (0.38) | (1.57) | (2.36) | (3.12) | (0.33) | (-0.47) | | (2.80) | | (2.39) | (4.06) | (1.75) | (1.97) |
|  | 4 | -0.39\*\*\* | -0.28\*\*\* | -0.18\*\* | -0.04 | 0.15\* | 0.54\*\*\* |  | | -0.05 | | | -0.14\*\* | -0.21\*\*\* | -0.15\*\* | -0.13\* | -0.07 | -0.47\*\*\* | | -0.23\*\*\* | | 0.03 | 0.01 | -0.07 | 0.40\*\*\* |
|  |  | (-4.33) | (-4.05) | (-2.47) | (-0.57) | (1.79) | (4.38) |  | | (-0.64) | | | (-2.17) | (-2.98) | (-2.04) | (-1.78) | (-0.99) | (-5.32) | | (-3.40) | | (0.39) | (0.13) | (-1.01) | (4.56) |
|  | 5 | -0.84\*\*\* | -0.71\*\*\* | -0.46\*\*\* | -0.28\*\*\* | -0.23\*\* | 0.61\*\*\* |  | | -0.48\*\*\* | | | -0.52\*\*\* | -0.48\*\*\* | -0.63\*\*\* | -0.49\*\*\* | -0.00 | -1.08\*\*\* | | -0.62\*\*\* | | -0.32\*\*\* | -0.23\*\* | -0.40\*\*\* | 0.68\*\*\* |
|  |  | (-8.14) | (-7.32) | (-4.69) | (-2.79) | (-1.97) | (4.82) |  | | (-4.94) | | | (-5.26) | (-5.09) | (-6.79) | (-4.91) | (-0.06) | (-9.93) | | (-5.73) | | (-3.39) | (-2.55) | (-4.32) | (7.18) |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **SKEW** | | | | | | | |  | | **JUMP** | | | | | |
|  | \_1 | \_2 | \_3 | \_4 | \_5 | H\_L |  | \_1 | | \_2 | | \_3 | \_4 | \_5 | H\_L |
| 1 | 0.20\*\*\* | 0.16\*\*\* | 0.16\*\*\* | 0.23\*\*\* | 0.35\*\*\* | 0.15\*\*\* |  | 0.20\*\*\* | | 0.26\*\*\* | | 0.23\*\*\* | 0.24\*\*\* | 0.16\*\*\* | -0.04 |
|  | (3.37) | (3.14) | (3.06) | (4.41) | (5.75) | (2.89) |  | (3.65) | | (4.89) | | (4.33) | (4.60) | (3.15) | (-0.81) |
| 2 | 0.07 | 0.10\* | 0.19\*\*\* | 0.26\*\*\* | 0.30\*\*\* | 0.23\*\*\* |  | 0.22\*\*\* | | 0.17\*\*\* | | 0.25\*\*\* | 0.14\*\*\* | 0.14\*\* | -0.07 |
|  | (1.19) | (1.94) | (3.56) | (4.32) | (5.04) | (4.56) |  | (3.62) | | (3.06) | | (4.78) | (2.66) | (2.42) | (-1.50) |
| 3 | 0.00 | 0.13\*\* | 0.11\* | 0.17\*\*\* | 0.22\*\*\* | 0.22\*\*\* |  | 0.14\*\* | | 0.16\*\*\* | | 0.14\*\* | 0.16\*\*\* | 0.03 | -0.11\*\* |
|  | (0.00) | (2.14) | (1.75) | (2.81) | (3.76) | (3.72) |  | (2.54) | | (2.70) | | (2.28) | (2.85) | (0.50) | (-2.11) |
| 4 | -0.24\*\*\* | -0.19\*\*\* | -0.16\*\* | -0.11 | -0.01 | 0.23\*\*\* |  | -0.21\*\*\* | | -0.15\*\* | | -0.09 | -0.07 | -0.19\*\*\* | 0.02 |
|  | (-3.49) | (-2.87) | (-2.24) | (-1.56) | (-0.18) | (3.49) |  | (-3.17) | | (-2.31) | | (-1.24) | (-1.06) | (-2.60) | (0.38) |
| 5 | -0.39\*\*\* | -0.47\*\*\* | -0.58\*\*\* | -0.45\*\*\* | -0.72\*\*\* | -0.34\*\*\* |  | -0.58\*\*\* | | -0.47\*\*\* | | -0.49\*\*\* | -0.57\*\*\* | -0.46\*\*\* | 0.11 |
|  | (-4.05) | (-4.73) | (-5.75) | (-4.64) | (-7.59) | (-3.87) |  | (-6.19) | | (-5.12) | | (-5.40) | (-6.01) | (-4.03) | (1.23) |

**Panel B. Controlling for NSYNC**

|  |
| --- |
|  |
|  |  | | **IV** | | | | | | | | | | | **RES** | | | | | | | | | | | **ID** | | | | | | | | |
|  |  | | **\_1** | | **\_2** | **\_3** | | **\_4** | | **\_5** | | **H\_L** | | **\_1** | | **\_2** | | **\_3** | | **\_4** | | **\_5** | **H\_L** | | **\_1** | | **\_2** | | **\_3** | | **\_4** | **\_5** | **H\_L** |
| **NSYNC** | **1** | | 0.10\* | | 0.07 | -0.02 | | -0.12 | | -0.51\*\*\* | | -0.61\*\*\* | | -0.02 | | -0.17\*\* | | -0.18\*\* | | -0.10 | | 0.02 | 0.04 | | -0.17\*\* | | -0.01 | | -0.04 | | -0.02 | -0.21\*\*\* | -0.04 |
|  | | (1.74) | | (1.05) | (-0.35) | | (-1.45) | | (-4.91) | | (-5.15) | | (-0.30) | | (-2.42) | | (-2.57) | | (-1.59) | | (0.26) | (0.51) | | (-2.23) | | (-0.10) | | (-0.56) | | (-0.25) | (-2.63) | (-0.51) |
| **2** | | 0.22\*\*\* | | 0.17\*\*\* | 0.15\*\* | | -0.09 | | -0.59\*\*\* | | -0.81\*\*\* | | 0.06 | | -0.05 | | -0.05 | | -0.10\* | | 0.06 | -0.00 | | -0.34\*\*\* | | -0.04 | | 0.06 | | 0.16\*\*\* | 0.06 | 0.40\*\*\* |
|  | | (3.89) | | (2.81) | (2.46) | | (-1.39) | | (-6.36) | | (-6.87) | | (0.97) | | (-0.88) | | (-0.93) | | (-1.71) | | (1.05) | (-0.01) | | (-4.84) | | (-0.59) | | (1.06) | | (2.97) | (0.83) | (4.58) |
| **3** | | 0.32\*\*\* | | 0.23\*\*\* | 0.01 | | -0.23\*\*\* | | -0.68\*\*\* | | -0.99\*\*\* | | 0.05 | | -0.04 | | -0.17\*\*\* | | -0.05 | | -0.07 | -0.12\* | | -0.44\*\*\* | | -0.04 | | 0.09 | | 0.16\*\*\* | -0.06 | 0.38\*\*\* |
|  | | (5.14) | | (3.98) | (0.13) | | (-3.30) | | (-7.20) | | (-8.29) | | (0.77) | | (-0.73) | | (-2.78) | | (-0.77) | | (-1.08) | (-1.75) | | (-5.75) | | (-0.77) | | (1.49) | | (2.82) | (-1.03) | (4.73) |
| **4** | | 0.35\*\*\* | | 0.28\*\*\* | 0.02 | | -0.33\*\*\* | | -0.52\*\*\* | | -0.87\*\*\* | | 0.04 | | -0.07 | | -0.03 | | -0.05 | | 0.02 | -0.02 | | -0.33\*\*\* | | -0.14\* | | 0.15\*\* | | 0.18\*\*\* | 0.01 | 0.34\*\*\* |
|  | | (5.08) | | (4.60) | (0.26) | | (-4.02) | | (-4.72) | | (-6.73) | | (0.56) | | (-0.96) | | (-0.45) | | (-0.73) | | (0.30) | (-0.24) | | (-3.88) | | (-1.78) | | (2.17) | | (2.76) | (0.11) | (3.96) |
| **5** | | 0.39\*\*\* | | 0.34\*\*\* | 0.20\*\*\* | | -0.16 | | -0.21\* | | -0.60\*\*\* | | 0.19\*\* | | 0.17\*\* | | 0.07 | | 0.05 | | 0.14\* | -0.04 | | -0.09 | | 0.09 | | 0.17\*\* | | 0.25\*\*\* | 0.19\*\*\* | 0.28\*\*\* |
|  | | (5.11) | | (4.87) | (2.59) | | (-1.62) | | (-1.78) | | (-4.53) | | (2.25) | | (2.34) | | (0.91) | | (0.71) | | (1.73) | (-0.64) | | (-0.96) | | (1.18) | | (2.17) | | (3.14) | (2.65) | (3.41) |
|  |  | |  | | |  | |  | |  | |  | |  | |  | |  | |  | | |  | |  | |  | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **SKEW** | | | | | | | **JUMP** | | | | | | |
|  | **\_1** | | **\_2** | **\_3** | **\_4** | **\_5** | **H\_L** | **\_1** | | **\_2** | **\_3** | **\_4** | **\_5** | **H\_L** |
| **1** | -0.02 | | -0.10 | -0.18\*\*\* | -0.09 | -0.06 | -0.05 | 0.00 | | -0.00 | -0.03 | -0.05 | -0.37\*\*\* | -0.38\*\*\* |
|  | (-0.30) | | (-1.54) | (-2.70) | (-1.20) | (-0.81) | (-0.65) | (0.04) | | (-0.06) | (-0.56) | (-0.69) | (-4.20) | (-4.80) |
| **2** | -0.04 | | -0.05 | -0.02 | -0.03 | 0.04 | 0.08 | 0.17\*\*\* | | 0.05 | 0.03 | -0.02 | -0.32\*\*\* | -0.49\*\*\* |
|  | (-0.66) | | (-0.87) | (-0.34) | (-0.47) | (0.59) | (1.16) | (2.97) | | (0.94) | (0.55) | (-0.34) | (-4.26) | (-6.45) |
| **3** | -0.04 | | -0.19\*\*\* | -0.10 | -0.11\* | 0.16\*\* | 0.20\*\*\* | 0.20\*\*\* | | 0.04 | 0.02 | -0.11\* | -0.47\*\*\* | -0.67\*\*\* |
|  | (-0.72) | | (-2.94) | (-1.58) | (-1.70) | (2.53) | (3.10) | (3.51) | | (0.88) | (0.41) | (-1.65) | (-5.62) | (-7.57) |
| **4** | 0.02 | | -0.11 | -0.15\* | -0.02 | 0.14\*\* | 0.12\* | 0.28\*\*\* | | 0.17\*\*\* | 0.00 | -0.20\*\*\* | -0.42\*\*\* | -0.71\*\*\* |
|  | (0.28) | | (-1.56) | (-1.94) | (-0.34) | (2.07) | (1.79) | (4.27) | | (2.75) | (0.05) | (-2.71) | (-4.57) | (-7.41) |
| **5** | 0.08 | | 0.08 | 0.03 | 0.07 | 0.37\*\*\* | 0.28\*\*\* | 0.27\*\*\* | | 0.24\*\*\* | 0.17\*\* | 0.00 | -0.13 | -0.39\*\*\* |
|  | (1.13) | | (0.92) | (0.35) | (0.90) | (4.69) | (4.21) | (3.69) | | (3.46) | (2.43) | (0.06) | (-1.13) | (-3.49) |

Table 7. Fama\_Macbeth Cross-sectional Regressions

Fama-MacBeth cross-sectional regressions of monthly stock returns on information proxies and firm characteristics for the period December 1925 to December 2016. Information proxies are NSYNC, RESIDUAL, NCSCKEW, JUMP, and ID and firm characteristics are SIZE (market capitalization), BM (book-to-market equity ratio). Number in the parentheses are the t-statistics are calculated using Newey and West’s (1987) robust standard errors. \*\*\*, \*\*, \* denote significance at the 1%, 5% and 10% levels, respectively.

*Panel A. Full sample period, 1925-2016*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | **Intercept** | **IV** | **ID** | **NSYNC** | **RES** | **SKEW** | **JUMP** | **IV\*Dj** | **NSYNC**  **\*Dj** | **SIZE** | **BM** | **ADJRSQ** |
| **1** | 0.006\*\*\* | 0.001 |  |  |  |  |  |  |  |  |  | 0.026 |
|  | (3.50) | (1.26) |  |  |  |  |  |  |  |  |  |  |
| **2** | 0.009\*\*\* |  | 0.015 |  |  |  |  |  |  |  |  | 0.012 |
|  | (4.66) |  | (1.62) |  |  |  |  |  |  |  |  |  |
| **3** | 0.008\*\*\* |  |  | -0.000 |  |  |  |  |  |  |  | 0.022 |
|  | (2.92) |  |  | (-0.21) |  |  |  |  |  |  |  |  |
| **4** | -0.018\*\*\* |  |  |  | 0.164\*\*\* |  |  |  |  |  |  | 0.042 |
|  | (-7.92) |  |  |  | (34.18) |  |  |  |  |  |  |  |
| **5** | 0.004\*\* |  |  |  |  | 0.012\*\*\* |  |  |  |  |  | 0.007 |
|  | (2.05) |  |  |  |  | (15.32) |  |  |  |  |  |  |
| **6** | 0.008\*\*\* |  |  |  |  |  | 0.245\*\* |  |  |  |  | 0.013 |
|  | (3.84) |  |  |  |  |  | (2.17) |  |  |  |  |  |
| **7** | -0.001 | 0.002\* |  |  |  |  |  |  |  | 0.001\*\* | 0.004\*\*\* | 0.044 |
|  | (-0.16) | (1.76) |  |  |  |  |  |  |  | (2.03) | (5.80) |  |
| **8** | 0.013\*\*\* |  | 0.016 |  |  |  |  |  |  | -0.000 | 0.004\*\*\* | 0.037 |
|  | (2.69) |  | (1.65) |  |  |  |  |  |  | (-0.67) | (5.99) |  |
| **9** | 0.015\* |  |  | -0.001 |  |  |  |  |  | -0.000 | 0.003\*\*\* | 0.049 |
|  | (1.88) |  |  | (-1.45) |  |  |  |  |  | (-0.83) | (4.97) |  |
| **10** | -0.008 |  |  |  | 0.167\*\*\* |  |  |  |  | -0.001\*\* | 0.003\*\*\* | 0.067 |
|  | (-1.55) |  |  |  | (34.80) |  |  |  |  | (-2.54) | (5.12) |  |
| **11** | -0.002 |  |  |  |  | 0.012\*\*\* |  |  |  | 0.001\* | 0.004\*\*\* | 0.031 |
|  | (-0.35) |  |  |  |  | (16.18) |  |  |  | (1.76) | (5.30) |  |
| **12** | 0.005 |  |  |  |  |  | 0.259\*\* |  |  | 0.000 | 0.004\*\*\* | 0.033 |
|  | (1.05) |  |  |  |  |  | (2.56) |  |  | (1.14) | (5.46) |  |
| **13** | -0.024\*\*\* | 0.003\*\*\* |  |  | 0.167\*\*\* |  |  |  |  |  |  | 0.067 |
|  | (-13.06) | (2.95) |  |  | (34.93) |  |  |  |  |  |  |  |
| **14** | -0.019\*\*\* | 0.002\*\* |  |  | 0.168\*\*\* |  |  |  |  | -0.000 | 0.004\*\*\* | 0.085 |
|  | (-5.15) | (2.24) |  |  | (35.28) |  |  |  |  | (-1.07) | (5.95) |  |
| **15** | 0.001 | 0.001 |  |  |  |  | 0.151\* |  |  | 0.001\* | 0.003\*\*\* | 0.046 |
|  | (0.28) | (1.13) |  |  |  |  | (1.94) |  |  | (1.81) | (5.66) |  |
| **16** | 0.001 | 0.001 |  |  |  |  | 0.127 | 0.000 |  | 0.001\* | 0.003\*\*\* | 0.047 |
|  | (0.35) | (0.92) |  |  |  |  | (1.27) | (0.65) |  | (1.80) | (5.68) |  |
| **17** | 0.011 |  |  | -0.001 |  |  | 0.217\*\* |  | 0.001\*\* | -0.000 | 0.003\*\*\* | 0.057 |
|  | (1.49) |  |  | (-1.53) |  |  | (2.31) |  | (2.15) | (-0.13) | (5.32) |  |
| **18** | -0.021\*\*\* |  |  | 0.001\*\* | 0.164\*\*\* |  |  |  |  |  |  | 0.063 |
|  | (-7.31) |  |  | (2.03) | (34.91) |  |  |  |  |  |  |  |
| **19** | 0.000 |  |  | -0.001 | 0.167\*\*\* |  |  |  |  | -0.001\*\*\* | 0.003\*\*\* | 0.089 |
|  | (0.05) |  |  | (-1.44) | (35.27) |  |  |  |  | (-3.04) | (4.99) |  |
| **20** | -0.019\*\*\* |  |  |  | 0.165\*\*\* |  | 0.353\*\*\* |  |  |  |  | 0.054 |
|  | (-8.43) |  |  |  | (34.60) |  | (3.25) |  |  |  |  |  |
| **21** | -0.011\*\* |  |  |  | 0.167\*\*\* |  | 0.248\*\*\* |  |  | -0.001\*\* | 0.003\*\*\* | 0.074 |
|  | (-2.31) |  |  |  | (35.01) |  | (2.60) |  |  | (-2.09) | (5.45) |  |

*Panel B. First sub-period 1925 to 1963*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | **Intercept** | **IV** | **ID** | **NSYNC** | **RES** | **SKEW** | **JUMP** | **IV\*Dj** | **NSYNC\*Dj** | **SIZE** | **BM** | **ADJRS** |
| **1** | 0.004\* | 0.004\* |  |  |  |  |  |  |  |  |  | 0.031 |
|  | (1.67) | (1.77) |  |  |  |  |  |  |  |  |  |  |
| **2** | 0.010\*\*\* |  | -0.019 |  |  |  |  |  |  |  |  | 0.021 |
|  | (2.98) |  | (-0.90) |  |  |  |  |  |  |  |  |  |
| **3** | 0.010\*\* |  |  | 0.000 |  |  |  |  |  |  |  | 0.032 |
|  | (2.02) |  |  | (0.18) |  |  |  |  |  |  |  |  |
| **4** | -0.009\*\* |  |  |  | 0.111\*\*\* |  |  |  |  |  |  | 0.047 |
|  | (-2.46) |  |  |  | (14.87) |  |  |  |  |  |  |  |
| **5** | 0.008\*\* |  |  |  |  | 0.009\*\*\* |  |  |  |  |  | 0.009 |
|  | (2.30) |  |  |  |  | (5.99) |  |  |  |  |  |  |
| **6** | 0.010\*\*\* |  |  |  |  |  | 0.732\*\* |  |  |  |  | 0.023 |
|  | (3.03) |  |  |  |  |  | (2.11) |  |  |  |  |  |
| **7** | -0.018\*\* | 0.007\*\* |  |  |  |  |  |  |  | 0.002\*\*\* | 0.003 | 0.054 |
|  | (-2.40) | (2.48) |  |  |  |  |  |  |  | (3.07) | (1.54) |  |
| **8** | 0.008 |  | -0.020 |  |  |  |  |  |  | 0.000 | 0.004\*\* | 0.046 |
|  | (1.15) |  | (-0.94) |  |  |  |  |  |  | (0.38) | (2.12) |  |
| **9** | 0.002 |  |  | 0.000 |  |  |  |  |  | 0.001 | 0.002 | 0.062 |
|  | (0.12) |  |  | (0.28) |  |  |  |  |  | (0.90) | (1.29) |  |
| **10** | -0.007 |  |  |  | 0.113\*\*\* |  |  |  |  | -0.000 | 0.003 | 0.073 |
|  | (-1.01) |  |  |  | (14.36) |  |  |  |  | (-0.35) | (1.57) |  |
| **11** | -0.003 |  |  |  |  | 0.009\*\*\* |  |  |  | 0.001\*\* | 0.003 | 0.032 |
|  | (-0.38) |  |  |  |  | (6.36) |  |  |  | (2.13) | (1.48) |  |
| **12** | -0.002 |  |  |  |  |  | 0.887\*\* |  |  | 0.001\*\* | 0.003 | 0.044 |
|  | (-0.25) |  |  |  |  |  | (2.57) |  |  | (2.32) | (1.58) |  |
| **13** | -0.016\*\*\* | 0.004\* |  |  | 0.113\*\*\* |  |  |  |  |  |  | 0.079 |
|  | (-6.77) | (1.77) |  |  | (14.88) |  |  |  |  |  |  |  |
| **14** | -0.024\*\*\* | 0.005\* |  |  | 0.113\*\*\* |  |  |  |  | 0.001 | 0.003 | 0.101 |
|  | (-3.27) | (1.77) |  |  | (14.67) |  |  |  |  | (1.30) | (1.65) |  |
| **15** | -0.015\*\* | 0.005\* |  |  |  |  | 0.501\* |  |  | 0.002\*\*\* | 0.003 | 0.059 |
|  | (-2.04) | (1.75) |  |  |  |  | (1.70) |  |  | (2.96) | (1.45) |  |
| **16** | -0.014\*\* | 0.004 |  |  |  |  | 0.257 | 0.002 |  | 0.002\*\* | 0.003 | 0.061 |
|  | (-1.83) | (1.27) |  |  |  |  | (0.64) | (1.25) |  | (2.92) | (1.49) |  |
| **17** | -0.01 |  |  | 0.000 |  |  | 0.786\*\* |  | 0.001\* | 0.002\*\* | 0.003 | 0.081 |
|  | (-0.86) |  |  | (0.37) |  |  | (2.29) |  | (1.75) | (2.33) | (1.51) |  |
| **18** | -0.011\*\* |  |  | 0.001 | 0.111\*\*\* |  |  |  |  |  |  | 0.078 |
|  | (-2.33) |  |  | (0.98) | (15.10) |  |  |  |  |  |  |  |
| **19** | -0.011 |  |  | 0.001 | 0.113\*\*\* |  |  |  |  | 0.000 | 0.003 | 0.107 |
|  | (-0.82) |  |  | (0.43) | (14.84) |  |  |  |  | (0.02) | (1.42) |  |
| **20** | -0.009\*\*\* |  |  |  | 0.112\*\*\* |  | 0.667\* |  |  |  |  | 0.070 |
|  | (-2.69) |  |  |  | (15.15) |  | (1.94) |  |  |  |  |  |
| **21** | -0.012\* |  |  |  | 0.112\*\*\* |  | 0.688\*\* |  |  | 0.000 | 0.003\* | 0.091 |
|  | (-1.96) |  |  |  | (14.79) |  | (2.03) |  |  | (0.57) | (1.73) |  |

*Panel C. Second sub-period 1964 to 1990*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | **Intercept** | **IV** | **ID** | **NSYNC** | **RES** | **SKEW** | **JUMP** | **IV\*Dj** | **NSYNC\*Dj** | **SIZE** | **BM** | **ADJRSQ** |
| **1** | 0.004 | 0.001 |  |  |  |  |  |  |  |  |  | 0.038 |
|  | (1.47) | (0.36) |  |  |  |  |  |  |  |  |  |  |
| **2** | 0.008\*\* |  | 0.039\*\*\* |  |  |  |  |  |  |  |  | 0.014 |
|  | (2.20) |  | (2.84) |  |  |  |  |  |  |  |  |  |
| **3** | 0.004 |  |  | 0.000 |  |  |  |  |  |  |  | 0.021 |
|  | (0.84) |  |  | (0.30) |  |  |  |  |  |  |  |  |
| **4** | -0.023\*\*\* |  |  |  | 0.174\*\*\* |  |  |  |  |  |  | 0.041 |
|  | (-5.52) |  |  |  | (31.23) |  |  |  |  |  |  |  |
| **5** | 0.001 |  |  |  |  | 0.011\*\*\* |  |  |  |  |  | 0.007 |
|  | (0.14) |  |  |  |  | (10.48) |  |  |  |  |  |  |
| **6** | 0.005 |  |  |  |  |  | 0.144 |  |  |  |  | 0.015 |
|  | (1.27) |  |  |  |  |  | (0.74) |  |  |  |  |  |
| **7** | 0.005 | 0.001 |  |  |  |  |  |  |  | 0.000 | 0.004\*\*\* | 0.056 |
|  | (0.85) | (0.32) |  |  |  |  |  |  |  | (0.01) | (4.53) |  |
| **8** | 0.017\* |  | 0.041\*\*\* |  |  |  |  |  |  | -0.001 | 0.005\*\*\* | 0.046 |
|  | (1.69) |  | (2.94) |  |  |  |  |  |  | (-1.04) | (4.33) |  |
| **9** | 0.016 |  |  | -0.001 |  |  |  |  |  | -0.001 | 0.004\*\*\* | 0.058 |
|  | (1.00) |  |  | (-0.84) |  |  |  |  |  | (-0.83) | (3.96) |  |
| **10** | -0.007 |  |  |  | 0.179\*\*\* |  |  |  |  | -0.001\* | 0.004\*\*\* | 0.075 |
|  | (-0.65) |  |  |  | (33.75) |  |  |  |  | (-1.89) | (3.89) |  |
| **11** | -0.003 |  |  |  |  | 0.011\*\*\* |  |  |  | 0.000 | 0.004\*\*\* | 0.040 |
|  | (-0.25) |  |  |  |  | (12.59) |  |  |  | (0.48) | (3.72) |  |
| **12** | 0.006 |  |  |  |  |  | 0.082 |  |  | -0.000 | 0.004\*\*\* | 0.041 |
|  | (0.67) |  |  |  |  |  | (0.58) |  |  | (-0.13) | (4.20) |  |
| **13** | -0.028\*\*\* | 0.002 |  |  | 0.177\*\*\* |  |  |  |  |  |  | 0.077 |
|  | (-10.37) | (1.23) |  |  | (34.01) |  |  |  |  |  |  |  |
| **14** | -0.012\*\* | 0.001 |  |  | 0.179\*\*\* |  |  |  |  | -0.001\*\* | 0.004\*\*\* | 0.096 |
|  | (-2.13) | (0.53) |  |  | (34.81) |  |  |  |  | (-2.35) | (4.59) |  |
| **15** | 0.006 | 0.000 |  |  |  |  | 0.034 |  |  | -0.000 | 0.004\*\*\* | 0.057 |
|  | (1.12) | (0.17) |  |  |  |  | (0.35) |  |  | (-0.17) | (4.44) |  |
| **16** | 0.006 | 0.000 |  |  |  |  | 0.103 | -0.000 |  | -0.000 | 0.004\*\*\* | 0.058 |
|  | (1.09) | (0.24) |  |  |  |  | (0.87) | (-0.83) |  | (-0.16) | (4.44) |  |
| **17** | 0.013 |  |  | -0.001 |  |  | 0.056 |  | 0.000 | -0.001 | 0.004\*\*\* | 0.065 |
|  | (0.95) |  |  | (-0.93) |  |  | (0.53) |  | (0.87) | (-0.72) | (4.23) |  |
| **18** | -0.027\*\*\* |  |  | 0.002\* | 0.175\*\*\* |  |  |  |  |  |  | 0.062 |
|  | (-5.16) |  |  | (1.94) | (32.19) |  |  |  |  |  |  |  |
| **19** | -0.001 |  |  | -0.001 | 0.179\*\*\* |  |  |  |  | -0.002\*\* | 0.004\*\*\* | 0.098 |
|  | (-0.06) |  |  | (-0.59) | (34.78) |  |  |  |  | (-1.98) | (3.98) |  |
| **20** | -0.024\*\*\* |  |  |  | 0.175\*\*\* |  | 0.276 |  |  |  |  | 0.055 |
|  | (-6.10) |  |  |  | (32.76) |  | (1.49) |  |  |  |  |  |
| **21** | -0.009 |  |  |  | 0.179\*\*\* |  | 0.081 |  |  | -0.001\* | 0.004\*\*\* | 0.082 |
|  | (-0.90) |  |  |  | (34.28) |  | (0.61) |  |  | (-1.94) | (4.16) |  |

Panel D. *Third sub-period 1991 to 2016*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | **Intercept** | **IV** | **ID** | **NSYNC** | **RES** | **SKEW** | **JUMP** | **IV\*Dj** | **NSYNC\*Dj** | **SIZE** | **BM** | **ADJRSQ** |
| 1 | 0.009\*\*\* | 0.000 |  |  |  |  |  |  |  |  |  | 0.012 |
|  | (2.95) | (0.24) |  |  |  |  |  |  |  |  |  |  |
| 2 | 0.010\*\*\* |  | 0.009 |  |  |  |  |  |  |  |  | 0.006 |
|  | (3.53) |  | (0.59) |  |  |  |  |  |  |  |  |  |
| 3 | 0.011\*\*\* |  |  | -0.001 |  |  |  |  |  |  |  | 0.017 |
|  | (2.88) |  |  | (-1.01) |  |  |  |  |  |  |  |  |
| 4 | -0.019\*\*\* |  |  |  | 0.182\*\*\* |  |  |  |  |  |  | 0.039 |
|  | (-5.40) |  |  |  | (22.14) |  |  |  |  |  |  |  |
| 5 | 0.006\* |  |  |  |  | 0.014\*\*\* |  |  |  |  |  | 0.007 |
|  | (1.97) |  |  |  |  | (10.30) |  |  |  |  |  |  |
| 6 | 0.010\*\*\* |  |  |  |  |  | 0.084 |  |  |  |  | 0.004 |
|  | (3.21) |  |  |  |  |  | (1.00) |  |  |  |  |  |
| 7 | 0.004 | 0.001 |  |  |  |  |  |  |  | 0.000 | 0.003\*\*\* | 0.027 |
|  | (0.54) | (0.41) |  |  |  |  |  |  |  | (1.16) | (4.19) |  |
| 8 | 0.011\*\* |  | 0.009 |  |  |  |  |  |  | 0.000 | 0.003\*\*\* | 0.022 |
|  | (2.18) |  | (0.63) |  |  |  |  |  |  | (0.24) | (3.93) |  |
| 9 | 0.021\*\* |  |  | -0.002\* |  |  |  |  |  | -0.001 | 0.003\*\*\* | 0.033 |
|  | (2.20) |  |  | (-1.88) |  |  |  |  |  | (-1.11) | (3.40) |  |
| 10 | -0.009\* |  |  |  | 0.185\*\*\* |  |  |  |  | -0.001\*\* | 0.003\*\*\* | 0.054 |
|  | (-1.74) |  |  |  | (22.51) |  |  |  |  | (-2.11) | (3.41) |  |
| 11 | -0.000 |  |  |  |  | 0.014\*\*\* |  |  |  | 0.001\* | 0.003\*\*\* | 0.022 |
|  | (-0.05) |  |  |  |  | (10.35) |  |  |  | (1.82) | (4.07) |  |
| 12 | 0.006 |  |  |  |  |  | 0.098 |  |  | 0.000 | 0.003\*\*\* | 0.019 |
|  | (1.30) |  |  |  |  |  | (1.16) |  |  | (1.13) | (3.71) |  |
| 13 | -0.026\*\*\* | 0.003\*\*\* |  |  | 0.185\*\*\* |  |  |  |  |  |  | 0.050 |
|  | (-7.19) | (2.89) |  |  | (22.44) |  |  |  |  |  |  |  |
| 14 | -0.023\*\*\* | 0.002\* |  |  | 0.186\*\*\* |  |  |  |  | -0.000 | 0.003\*\*\* | 0.065 |
|  | (-3.76) | (1.91) |  |  | (22.92) |  |  |  |  | (-0.07) | (4.26) |  |
| **15** | 0.005 | 0.000 |  |  |  |  | 0.080 |  |  | 0.000 | 0.003\*\*\* | 0.028 |
|  | (0.68) | (0.16) |  |  |  |  | (1.42) |  |  | (1.10) | (4.15) |  |
| **16** | 0.005 | 0.000 |  |  |  |  | 0.081 | 0.000 |  | 0.000 | 0.003\*\*\* | 0.028 |
|  | (0.69) | (0.13) |  |  |  |  | (1.33) | (0.11) |  | (1.10) | (4.15) |  |
| **17** | 0.020\*\* |  |  | -0.002\* |  |  | 0.072 |  | 0.000 | -0.000 | 0.003\*\*\* | 0.036 |
|  | (2.14) |  |  | (-1.94) |  |  | (0.86) |  | (1.10) | (-0.93) | (3.56) |  |
| **18** | -0.020\*\*\* |  |  | 0.000 | 0.182\*\*\* |  |  |  |  |  |  | 0.055 |
|  | (-4.97) |  |  | (0.33) | (22.77) |  |  |  |  |  |  |  |
| **19** | 0.008 |  |  | -0.002\*\* | 0.185\*\*\* |  |  |  |  | -0.002\*\*\* | 0.003\*\*\* | 0.071 |
|  | (0.81) |  |  | (-2.37) | (22.77) |  |  |  |  | (-3.35) | (3.29) |  |
| **20** | -0.019\*\*\* |  |  |  | 0.183\*\*\* |  | 0.263\*\*\* |  |  |  |  | 0.043 |
|  | (-5.45) |  |  |  | (22.24) |  | (3.32) |  |  |  |  |  |
| **21** | -0.011\*\* |  |  |  | 0.185\*\*\* |  | 0.181\*\* |  |  | -0.001 | 0.003\*\*\* | 0.057 |
|  | (-2.28) |  |  |  | (22.62) |  | (2.36) |  |  | (-1.58) | (3.57) |  |

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**APPENDIX**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | | **Definition** | **Data** | **Reference** |
| Residual returns | RES | In order to have a sufficient number of return observations to obtain accurate estimates for stock exposures to the market, size and value, we use a 36 month window to estimate monthly residuals from Eq.  [(1)](https://www.sciencedirect.com/science/article/pii/S0927539817301093#fd1), i.e. over the period from m−36 to m−1.  Once obtaining the monthly residual returns, at month t, we calculate the residual return over the formation window of 11 monthly observations standardized by the standard deviation of the residual returns over the same period[[6]](#footnote-6). Since the standardised residual return yields an improved measure of the extent to which a given firm-specific return volatility is actually news, as opposed to noise (Gutierrez & Prinsky 2007; Blitz, Huij & Martens 2011). | Monthly returns | Blitz, Huij and Martens (2011) |
| Information discreteness | ID | where PRETis defined as the cumulative raw returns during the formation period;  sgn(PRET) is denoted for the sign of PRET and equals +1 if PRET > 0 and -1 if PRET < 0;  *%neg* and *%pos* are defined as the percentages of days with negative and positive stock returns during the formation period, respectively.  Similar to IV and NSYNC, only stocks with more than 187 daily observations in the formation window of one-year period are included in our analysis. | Daily returns | Da, Gurun and Warachka (2014) |
| Return skewness | SKEW | where is the daily return of stock i;  is the average firm-specific daily return in the formation period; T is the number of daily observations. | Daily returns | Kim et al. (2011)  An and Zhang (2013) |
| Stock price jumps | JUMP | To document stock price jumps (JUMP) and their features, we use the bipower variation measure (hereafter BNS) developed by Barndorff-Nielsen and Shephard (2004); (Barndorff-Nielsen & Shephard 2006). Barndorff-Nielsen & Shephard show that the realized volatility can, in turn, be divided into continuous and discontinuous (jump) components. The BNS method is used in high-frequency data context to document the importance of incorporating jumps in security prices, including studies of stock prices (Andersen, Bollerslev & Diebold 2007; Zhou & Zhu 2012a; Liao 2012), bond prices and interest rates (Dungey, McKenzie & Smith 2009; Zhou & Zhu 2012a) and currencies (Chan, Powell & Treepongkaruna 2014).  More recently, Pukthuanthong and Roll (2015) compute the BNS jump statistic using daily data within each available calendar month to investigate the extent of cross-country jump dependence, which is a critical issue for international investors. Similarly, we use daily data for valid observations, jumps are identified on a monthly basis and stocks must have at least ten valid returns within a given month. | Daily returns | Barndorff-Nielsen and Shephard (2004); (Barndorff-Nielsen & Shephard 2006)  Pukthuanthong and Roll (2015) |

1. We also employ several return filtering procedures for daily and monthly returns, as followed by Ince and Porter (2003). In particular, any monthly return above 300% that is reversed within one month is set to missing. And if

   Rt or Rt−1 is greater than 300%, and (1 + Rt) × (1 + Rt−1) − 1 < 50%, then both Rt and Rt−1 are set to “missing.” For daily returns, if Rt or Rt−1> 100% and (1 + Rt−1)(1+ Rt) - 1 < 20%, then both Rt and Rt−1are set equal to a missing value. Additionally, any daily return greater than 200% is treated as missing. [↑](#footnote-ref-1)
2. We did try to use daily data for estimating residual returns but they are really volatile and the results are not significant. Following Blitz, Huij & Martens (2011), we estimated residual returns from monthly daily. [↑](#footnote-ref-2)
3. <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/> [↑](#footnote-ref-3)
4. Following AHXZ (2006), we run the regression for all stocks on AMEX, NASDAQ, and the NYSE over the formation period, with more than 17 daily observations per month. [↑](#footnote-ref-4)
5. We also find consistent results of both total and risk-adjusted monthly returns for other holding periods of 6, 9, 12 months. [↑](#footnote-ref-5)
6. The residual return is estimated from monthly returns with 36 month rolling window, then average for 12 months, so its starting date is from May 1930. [↑](#footnote-ref-6)