Sources of Momentum Returns: A Decomposition of the Explained and the Unexplained Risk Factors

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Abstract

In this paper, I examine the sources of momentum returns and uncover a list of intriguing features. I find that when the momentum returns are decomposed the contributions of the explained and the unexplained risk factors depend on the level of analysis, the risk factors used, and the lag structure of the risk factors. Further, I find that at the individual stock level, the total contribution of the lagged macroeconomic risk factors is 59 percent per month but that the total contribution of the contemporaneous macroeconomic risk factors at the portfolio level is only 9 percent per month. These new findings add important insights to the existing momentum theories.

Keywords: Decomposition, explained risk factors, unexplained risk factors, portfolio level, and individual stock level.
JEL Classification: G11, G12, G19.

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1 - Introduction

The early literature on momentum returns established that past winners outperform past losers and earn an average momentum return of 1 percent per month [Jegadeesh and Titman (1993)]. The subsequent studies have tried to find an explanation for the momentum phenomenon mostly through explained risk factors.[2] However, the literature is still unsettled as to what contributes to the momentum returns. Theoretically, if momentum is a form of compensation for firm or macro-level risk factors, then the effects of such factors on momentum return can be captured and measured. However, if investors' psychological biases or other immeasurable factors are significant drivers of momentum return, then behavioral models should capture such phenomena.

In this paper, I find that when the momentum returns are decomposed the contributions of the explained and the unexplained risk factors depend on certain stock characteristics. First is the level of analysis: at the portfolio or individual stock level. A portfolio-level analysis is defined as an analysis where the momentum returns are measured by using the conventional method as explained by Jegadeesh and Titman (1993), and then the risk factors are priced against the momentum returns. An individual-level analysis is defined as an analysis where the risk factors are first priced at the stock level, and then the momentum returns are measured with this risk-adjusted stock return by applying the conventional method. The second characteristic is the firm- or macroeconomic-type risk factors. The third characteristic is the lag structure of the risk factors, such as the contemporaneous or the lagged values. Earlier studies vary in their use of these three characteristics. For example, some studies examine the momentum returns at the portfolio level with contemporaneous firm-level factors, some at the portfolio level with contemporaneous macroeconomic risk factors, and others at the individual stock level with lagged macroeconomic risk factors. These differing views might be the reasons for the dispute over what contributes to the momentum returns. This is important because as pointed out by Lo and MacKinlay (1990), the process of examining data and models effects the likelihood of finding anomalies. And flaws in this process might give rise to misleading inferences.

[2] See among others, Jegadeesh and Titman (1993, 2001), Wang (2003), Chordia and Shivakumar (2002), Moskowitz and Grinblatt (1999) and Cooper et al., (2004), Sadka (2006), Lesmond et al., (2004), Avramov, et al., (2007), Kang and Li (2007))

In this study, I decompose the momentum returns and perform a comprehensive examination on their sources. I use portfolio and individual stock-level analyses, firm-level and macro-level risk factors, and the contemporaneous and lagged values of the risk factors. I find that the analysis at the individual stock level with the lagged structure of the macroeconomic risk factors more clearly shows the generation of the momentum returns. Further, I find that at the portfolio level, the total contribution of the lagged three factors of Fama and French (1996) is 5.60 percent per month, and the total contribution of the unexplained risk components is more than 94.40 percent per month. But the total contribution of the lagged macroeconomic variables is 12.84 percent per month, and the total contribution of the unexplained risk factors is 87.16 percent per month. With the simultaneous use of Fama and French's (1996) lagged three factors and the lagged macroeconomic factors, the total contribution of the explained risk factors is 13.78 percent per month and that of the unexplained risk factors is 86.22 percent per month.

At the individual stock level, the lagged macroeconomic risks factors contribute 58.56 percent per month, and the unexplained risk factors contribute 41.44 percent per month. Whereas the Fama-French lagged three factors contribute 46.11 percent per month, and the unexplained risk factors contribute 53.89 percent per month. By using both the lagged three factors and the lagged macroeconomic risk factors, the explained risk factors contribute 68 percent per month, and the unexplained risk factors contribute the remaining 32 percent. However, the contributions of the Fama-French contemporaneous three factors and the lagged macroeconomic risk factors are 47.43 percent and 31.11 percent per month respectively. These findings show that the momentum returns are the result of the lagged macroeconomic risk variables at the individual stock level. The results are robust during market downturns that imply that investors might require higher compensation for risk during recessions. The results are also consistent with earlier studies that claim the momentum returns are explained by the lagged macroeconomic risk variables [see, e.g., Chordia and Shivakumar (2002), Hwang (2011)].

In sum, the empirical results present a credible solution to the controversy among the momentum theories; the momentum returns are a result of both the explained risk factors and the unexplained risk factors. However, the stock-level characteristics such as the individual stock level, macroeconomic risk factors, and the lag values of the risk factors make important contributions to the generation of the momentum returns.

2 - Literature review

The studies on the risk-based models of momentum argue that momentum is a mere compensation for risks, and therefore these studies expect the returns to disappear once the common risk factors are priced in. These studies have tried to find an explanation for the phenomena with variables mostly related to the explained risk factors, such as the cross-sectional dispersion of the unconditional expected stock returns, macroeconomic factors, industry factors, market states, illiquidity, and the transaction costs [see Conrad and Kaul (1997), Moskowitz and Grinblatt (1999), Chordia and Shivakumar (2002), Wang (2003), Cooper et al. (2004), Sadka (2006), Lesmond et al. (2004), and Avramov et al. (2013)]. However, the conclusions of these empirical studies on what contributes to momentum returns remain controversial. For example, some studies show that the Fama-French three factors cannot explain momentum returns [see, e.g., Fama and French (1996), Grundy and Martin (2001), Chordia and Shivakumar (2002), and Hwang and Rubesam (2007)]. In contrast, Wang (2003) shows that the Fama-French three factors can explain most of the momentum returns when used on a conditional basis.

Some studies find that macroeconomic risk factors can explain momentum returns. For example, Chordia and Shivakumar (2002) find that momentum returns are explained once the predicted component, which is measured by the lagged macroeconomic risk variables, is accounted for. Moskowitz and Grinblatt (1999) find evidence that the individual momentum return in the study by Chordia and Shivakumar (2002) mainly comes from an industry's momentum profits. Cooper et al. (2004) argue that momentum returns are explained by the variables on the states of the market. Grundy and Martin (2001) use the Fama-French contemporaneous three factors at the individual stock level to suggest evidence that these factors cannot explain the momentum returns. Moskowitz and Grinblatt (1999) report that most of the momentum effect can be captured by industry factors when the effect is measured at the individual stock level. Kang and Li (2007) show that at the individual stock level, when the Fama-French lagged three factors and Chordia and Shivakumar's (2002) lagged macroeconomic variables are used as "missing factors", the momentum returns remain unexplained by the risk factors. Chichernea and Slezak (2008) use an EGARCH-M econometric model and show that when the momentum portfolios are formed based on the ranking of the raw returns, then the stock-specific returns are a statistically and economically significant source of the momentum profits.

The studies on risk-based models also find that the momentum returns remain unexplained by high information uncertainty and default risk in periods of high market volatility [see, e.g., Jiang et al. (2005), Zhang (2006), Avramov et al. (2007), Bhar and Malliaris (2011), Wang and Xu (2011), and Lee (2012)]. The question that follows is why these studies differ in terms of their conclusions when they use the same risk factors. This paper provides an explanation to that question.

3 - Data and methodology

3.1 Data

I collect monthly data from the Centre for Research in Security Prices (CRSP) on all of the stocks listed on the three US exchanges: NYSE, AMEX, and NASDAQ. The sample period is from January 1926 through December 2005. The total number of months within this sample period is 955, and the total number of stocks traded on all three of the stock exchanges is 22,277. These values result in a total of 21,385,920 observations. I first perform the empirical analysis on the entire sample period and then on ten-year subperiods. I follow the selection criteria used in the momentum literature: I use all of the stocks that are priced above $1, that have non-missing observations at the beginning of the holding period, and that have at least six consecutive months of return observations at the beginning of the holding period.

3.2 Variables Used

I use the two variables commonly used in the momentum studies: the Fama and French's (1996) three factors and Chordia and Shivakumar's (2002) macroeconomic risk factors. The Fama-French three factors[3] are the return on the CRSP value-weighted market index in excess of the one-month Treasury bill rate (Mkt-Rf), the small-minus-big size factor (SMB), and the high-minus-low book-to-market ratio factor (HML). The macroeconomic risk factors are the dividend yield (DIV), which is the total dividend payment accrued to the CRSP value-weighted market index over the past 12 months divided by the current price level of the market index; the short rate (YLD), which is the yield on the three-month Treasury bill; the term premium

[3] The data are available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

(TERM), which is the yield spread of a ten-year Treasury bond over a three-month Treasury bill; and the default premium (DEF), which is the yield spread between Moody's Baa and Aaa rated bonds.[4] These two sets of variables have been used as contemporaneous and lagged values.

3.3 Statistical Properties of the Data

In Panel A of Table 1, column 1 shows the four moments of each of the seven variables that this study uses; while columns 2 through 6 show the descriptive statistics for the Fama-French three factors, and the last four columns show those of the four macroeconomic risk variables. The table shows that the distribution of the variables is not normal. For example, the four moments of the variable Mkt-Rf are 0.64, 5.46, 0.22, and 10.81 respectively. These values imply that the distribution of the Mkt-Rf is positively skewed and leptokurtic. This result is consistent with the findings of Kang and Li (2007) who find that for a sample period of 1926 through 2002, the four moments of the Mkt-Rf are 0.62, 5.52, 0.22, and 10.54 respectively. Similar to Kang and Li (2007), we find that among the Fama-French three factors, the SMB has the heaviest right tail with a skewness of 2.22 and a high peak with a kurtosis of 25.20. The distribution of the HML is skewed to the right (skewness=1.86) and leptokurtic (kurtosis=18.49).

Consistent with the Fama-French three factors, the macroeconomic risk variables are not normally distributed either. The DIV with a positive skewness of 1.63 and a kurtosis of 7.98 has a fat right tail and a sharply peaked variable. The distribution of the YLD also deviates from the normal distribution with the four moments of 3.74, 3.14, 0.87, and 3.49 respectively. These findings are also similar to the findings reported by Kang and Li (2007). They find that the skewness and kurtosis of the YLD are 0.95 and 4.00 respectively. The TERM has a fat left tail (skewness of -0.03) and is very close to a mesokurtic distribution (kurtosis=3.26). The third and fourth moments of the DEF are 1.12 and 4.13 respectively. These values imply that the variable has a heavy right tail and a slightly peaked distribution.

[4] The data on the macroeconomic variables comes from the Federal Reserve data in the Wharton Research Data Services (WRDS).

Table 1: Summary Statistics

This table shows the summary statistics of the Fama-French three factors and the four macroeconomic variables from July 1926 through December 2005 (955 months). The Mkt-Rf is the monthly return on CRSP value-weighted market index in excess of the one-month Treasury bill rate; and the SMB, and the HML are the small-minus-big size factor and the high-minus-low book-to-market- ratio factor respectively. The macroeconomic factors are the dividend yield (DIV), short rate (YLD), term premium (TERM), and the default premium (DEF). The DIV is defined as the total dividend payment accrued to the CRSP value-weighted market index over the past 12 months divided by the current price level of the index. The YLD is the yield on the three-month Treasury bill. The TERM is defined as the yield spread between a ten-year Treasury bond and a three-month Treasury bill, and the DEF is the yield spread between Moody's Baa and Aaa rated bonds. Panel A shows the descriptive statistics of all of these common factors while Panel B shows the correlations among the variables.

	MKT_RF	**RM**	**SMB**	**HML**	**DIV**	**YLD**	**TERM**	**DEF**
Mean	0.647	0.951	0.241	0.406	4.233	3.714	1.529	0.923
Std. Dev.	5.467	5.456	3.362	3.593	1.379	3.143	1.403	0.379
Skewness	0.220	0.186	2.220	1.868	1.637	0.877	-0.037	1.129
Kurtosis	10.809	10.782	25.207	18.499	7.989	3.493	3.265	4.131
	MKT_RF	**RM**	**SMB**	**HML**	**DIV**	**YLD**	**TERM**	**DEF**
MKT_RF	1.000	0.999	0.351	0.320	-0.134	-0.080	0.077	0.102
RM		1.000	0.349	0.321	-0.148	-0.033	0.051	0.115
RF			-0.055	0.013	-0.292	0.983	-0.541	0.262
SMB			1.000	0.225	-0.010	-0.058	0.095	0.134
HML				1.000	0.002	-0.005	0.036	0.045
DIV					1.000	-0.318	0.228	0.254
YLD						1.000	-0.557	0.242
TERM							1.000	0.362
DEF								1.000

Panel B of Table 1 shows the correlations among the Fama-French three factors and the macroeconomic risk variables. As apparent from the table, the Mkt_Rf is positively related with the SMB, HML, and the DEF but is negatively related to all of the other variables. The SMB and HML have a mostly positive correlation with the other variables. However, the correlations among the DIV, YLD, and the TERM and those with the other variables are mixed. Nevertheless, among the four macroeconomic risk variables only the DEF has a positive correlation with all of the other variables.

3.4 Method

3.4.1 Measuring momentum returns

Following Jegadeesh and Titman (2001), I measure the momentum returns at the portfolio level as the following: for each month *t*, I rank all of the NYSE, NASDAQ, and AMEX stocks from the monthly CRSP database with returns for months *t-5* through *t-1* (the formation period) by decile portfolios according to their compounded returns during the formation period. The winner and loser portfolios are the equally weighted portfolios of the 10 percent stocks with the lowest and highest returns over the previous formation period respectively. The momentum strategy longs the winner portfolio and shorts the loser portfolio and holds these positions for the following holding period (*t+1 through t+6).* Therefore, at *t**, the momentum returns are calculated as the difference between the returns from the winner and the loser portfolios. The equation is as follows:

$$MR_{t^*} = R_{t^*}^{WP} - R_{t^*}^{LP} \quad (1)$$

3.4.2 Decomposing momentum returns at the portfolio level

At the portfolio level, I measure the momentum returns by using the following equations for the contemporaneous and lagged values of the variables:

$$MR_{t^*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j f_{t^*} + \varepsilon_{t^*} \quad (2)$$

and $$MR_{t^*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j f_{t^*-1} + \varepsilon_{t^*} \quad (3)$$

where $MR_{t^*,6x6}$ is the momentum return generated by using the conventional method of Jegadeesh and Titman (2001) with a *JxK=6x6* strategy, and f_{t^*} and f_{t^*-1} are the vectors respectively for the common components as the contemporaneous and the lagged values of the risk factors where the risks factors are the Fama-French three factors and the macroeconomic risk factors. The β_j (*j*=1,….,n) is the vector for the risk factors, and α and ε_{t^*} are the constant and the residuals respectively. The $E(\varepsilon_{t^*}) = 0$, $Cov(\varepsilon_{t^*}, f_{t^*}) = 0$, and $\varepsilon_{t^*} \sim iid\ (0,\sigma^2)$. I decompose equations (2) and (3) into the explained and the unexplained risk components: $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ and $\alpha + \varepsilon_{t^*}$. The total contribution of each of the explained and the unexplained components are determined by using the following two equations:

$\frac{MR^{ER}}{MR^{ER} + MR^{UR}}$ for the explained risk components and (4)

$\frac{MR^{UR}}{MR^{ER} + MR^{UR}}$ for the unexplained risk components (5)

3.4.3 Decomposing the momentum returns at the individual stock level

For the individual stock level, I use an alternative risk-adjusted momentum strategy: I regress the returns of the individual stocks against the common risk factors and then measure the momentum returns based on the estimated explained and the unexplained risk components. The equations for the contemporaneous and lagged risk factors are as follows:

$$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_t + \varepsilon_{it},$$

(6)

$$R_{it} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} f_{t-1} + \varepsilon_{it}$$

(7)

where R_{it} is the return of each stock at time *t*, f_t and f_{t-1} are two vectors of the factors as contemporaneous and lagged values of the risk factors respectively, β_{ij} is the vector for the risk factors, and α_i and ε_{it} are the

constant and the residual respectively. Once the regression is run, equation (7) is then decomposed into two components: the estimated explained risk component ($\sum_{j=1}^{n} \hat{\beta}_{ij} f_t$) and the estimated unexplained risk component ($\hat{\alpha}_{i\,t} + \hat{\varepsilon}_{it}$). I then construct portfolios based on these two components. For example, the stocks are ranked based on $\sum_{j=1}^{n} \hat{\beta}_{ij} f_t$ by using the information on the past *J* months and are formed into decile portfolios. The lowest portfolios (loser) are short and the highest portfolios (winner) are long, and the positions are held for the subsequent *K* holding months. Hence at time *t**, the momentum return is defined as

$$MR_{t^*}^{ER} = MR_{t^*}^{\sum_{i=1}^{j} \hat{\beta}_{ij} f_j} = R_{t^*}^{WP\ \sum_{i=1}^{j} \hat{\beta}_{ij} f_j} - R_{t^*}^{LP\ \sum_{i=1}^{j} \hat{\beta}_{ij} f_j} \quad (8)$$

where $MR_{t^*}^{ER}$ is the difference between the winner and loser portfolios sorted based on the estimated common factors, and $R_{t^*}^{WP\ \sum_{i=1}^{j} \hat{\beta}_{ij} f_j}$ and $R_{t^*}^{LP\ \sum_{i=1}^{j} \hat{\beta}_{ij} f_j}$ are the winner and loser portfolios respectively. In a similar manner, the momentum returns are measured by ranking the stocks by $\hat{\alpha}_i + \hat{\varepsilon}_{it}$, and at time *t** the momentum return is defined as

$$MR_{t^*}^{UR} = MR_{t^*}^{\alpha_i + \varepsilon_{it}} = R_{t^*}^{WP\ \alpha_i + \varepsilon_{it}} - R_{t^*}^{LP\ \alpha_i + \varepsilon_{it}} \quad (9)$$

where $MR_{t^*}^{UR}$ is the difference between the winner and loser portfolios sorted by the estimated alpha and the residual (unexplained), and $R_{t^*}^{WP\ \alpha_i + \varepsilon_{it}}$ and $R_{t^*}^{LP_t\ \alpha_i + \varepsilon_{it}}$ are the winner and loser portfolios respectively. These alternative momentum strategies are formed by first estimating the parameter on the individual stock that requires the use of a 60-month window with a minimum of 24 observations. The momentum literature commonly uses a 60-month window to calculate the parameter estimates to safeguard against the potential problem of the non-constancy of the estimates (β_i) in a long sample period.

In this study, I use this parameter because for the NYSE, AMEX, and NASDAQ data set, the exclusion of the securities with less than 60 observations drastically reduces the number of observations.[5] Therefore, for each month *t*, regression (9) is run for all of the NYSE, AMEX, and NASDAQ stocks with monthly returns on the CRSP database. The momentum returns thus generated are defined as "momentum returns with restricted observations (MR_{t*}^{Res})". I decompose equations (6) and (7) into the explained and the unexplained components: $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ and $\alpha + \varepsilon_{t*}$. The contribution of each of the explained and unexplained components is determined by using equations (8) and (9).

4 - Empirical results on the contribution of factors in generating momentum returns

4.1 Measuring momentum returns

4.1.1 Momentum returns

Table 2 reports the momentum returns for the entire sample period from 1926 through 2005 and for the different ten-year subperiods. During the entire sample, the momentum returns are 0.90 percent per month; and in the different subperiods, the momentum returns are on average 1 percent per month. This finding is consistent with the findings of Jegadeesh and Titman (1993). Of the different subperiods, the momentum returns are the highest in the 1986–1995 subperiod at 1.50 percent per month. This finding could be because the US market experienced a healthy financial decade in the 1990s. The lowest is in the 1936–1945 subperiod at -0.18 percent per month. This finding is attributable to the aftermath of the US stock market crash in the 1930s.

Table 2: Winner, Loser, and Momentum Portfolios and Returns

The following table reports the monthly returns for the winner, loser, and momentum portfolios formed on the past six-month returns and held for the following six months: the *JxK =6x6* strategy. The sample period is January

[5] The literature also uses the restriction of at least 24 observations, see for example, Chordia and Shivakumar (2002).

1926 through December 2005 for the monthly returns of 22,277 stocks. In each month *t* for all of the NYSE, AMEX, and NASDAQ stocks with returns from *t-5* through *t-1* on the monthly CRSP database, the stocks are ranked into decile portfolios according to their returns during the formation period. I skip a month *t* between the formation and the holding period. The decile portfolios are formed monthly by equally weighting all of the firms in that decile ranking. The winners and losers are the equally weighted portfolios of the 10 percent of the stocks with the lowest and the highest returns over the previous six months respectively. A long position is taken in the winner portfolio and a short position in the loser portfolio, and these positions are held for the following holding (K) months (*t+1 to t+6*). The momentum portfolio is the zero-cost portfolio that buys the winner portfolio and short sells the loser portfolio. This portfolio is measured by the difference between the winner and the loser portfolios. The column "Decile portfolio size" reports the average size of the decile portfolio during each subperiod. The column titled "% > 0"gives the percentage of winners minus losers that are positive. The last column reports the size of each subperiod. The estimates are reported in percentages, the numbers in bold represent significance at the 5 percent level, and t-statistics are given in parenthesis. The table shows the momentum return when excluding the penny stocks from the sample.

Momentum Return Excluding Penny Stocks						
Subperiod	**Loser**	**Winner**	**Momentum**	**Decile Portfolio Size**	**Percentage > 0**	**No. of Months**
1926–2005	0.73	1.63	**0.90**	206	71.35%	949
	-5.34	-13.09	-12.34			
1926–1935	0.81	1.53	0.73	36	59.17%	109
	-1.12	-2.49	-1.87			
1936–1945	1.97	1.79	-0.18	43	51.67%	120
	-4.54	-4.25	(-0.799)			
1946–1955	0.64	1.54	**0.90**	71	80.00%	120
	-2.68	-6.64	-9.68			
1956–1965	0.37	1.41	**1.05**	108	85.00%	120
	-1.69	-7.21	-10.83			
1966–1975	0.18	1.08	**0.90**	196	65.00%	120
	-0.43	-2.99	-4.10			
1976–1985	0.96	2.28	**1.32**	217	77.50%	120
	-3.79	-8.39	-8.89			
1986–1995	-0.04	1.46	**1.50**	418	84.17%	120
	-0.14	-5.76	-10.12			
1996–2005	1.01	1.96	**0.96**	538	68.33%	120
	-2.81	-5.51	-4.86			

4.2 Portfolio level analysis

4.2.1 Portfolio level: Contributions of the Fama-French three factors and the unexplained risk factors

Panel A of Table 3 shows the proportionate contributions of the explained and the unexplained risk factors in generating momentum returns at the portfolio level. Equations (2) and (3) are used to derive the empirical results where *f* is the vector of the Fama-French three factors. In Panel A of Table 3, column 1 shows the different subperiods examined in this study, column 2 reports the momentum returns across different subperiods, and columns 3 through 7 represent the proportionate contributions of the explained and the unexplained risk components in isolation. Column 8, titled "Total", summarizes the total contribution of all of the components, column 9 shows the total contribution of the explained risk components, and column 10 represents the total contribution of the unexplained risk components.

Panel A of Table 3 shows that during the entire sample period from 1926 to 2005, the contribution of α (alpha) is 5.14 percent and the contribution of $\hat{\varepsilon}_t$ (residual) is 95.92 percent in generating the total momentum returns of 0.90 percent. Among the Fama-French three factors, the HML contributes the highest percentage at 0.29 while the contribution of the SMB is the lowest at only -1.43 percent. The total contribution of the two types of risk components, $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$, (explained risk) contributes 1.13[6] percent while $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ (unexplained risk) contributes 98.87 percent.

[Insert Table 3 here]

In the 1936–1945 subperiod, the contribution of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ is the highest at 11.35 percent, and $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ contributes the lowest at 89 percent. Among the Fama-French three factors, the contribution of the Mkt-Rf is the highest in the 1936–1945 subperiod at 1.63 percent. For

[6] For the ease of calculation and the measurement of the relative weights, the absolute value of the aggregate contribution of the components is scaled to 100 percent.

Table 3: Decomposition at the Portfolio Level
Momentum Return and the Proportionate Contributions of the Fama-French Factors and the Unexplained Risk Factors: Ten-Year Subperiod Results

The following table reports the proportionate contribution of the contemporaneous and the lagged Fama-French three factors in generating the momentum returns at the portfolio level. The momentum returns are estimated based on the *JxK= 6x6* strategy described in Table 2 that excludes penny stocks. Thereafter the momentum returns are regressed on the Fama-French three factors for each subperiod separately. The estimated coefficients of the regression are then decomposed into the explained risk components that are the sum of the product of the estimated coefficients and the factors $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ (for lagged which is $\sum_{j=1}^{n} \hat{\beta}_j f_{t-1^*}$) and the unexplained risk components $\hat{\alpha} + \hat{\varepsilon}_{t^*}$. The "Total" column gives the total contribution of all of the factors that result in the momentum returns. Panel A shows the percentage contribution of the Fama-French three factors when used to capture their simultaneous effect on the momentum returns. Panel B shows the proportionate contributions of these factors when used as lagged variables. The numbers are reported in percentages.

Panel A: Proportionate Contributions of Contemporaneous Fama-French Factors and Stock-specific Factors									
Subperiod	**Momentum Return$_{6x6}$**	α	**Mkt-Rf**	**SMB**	**HML**	ε_t	**Total**	$\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$	$\hat{\alpha} + \hat{\varepsilon}_{t^*}$
1926–2005	0.9	5.14	-0.02	-1.43	0.29	95.92	100	1.13	98.87
1926–1935	0.73	12.69	-2.18	0.7	-1.54	90.32	100	2.85	97.15
1936–1945	-0.18	-2.67	1.63	-16.51	0.19	117.37	100	11.35	88.65

1946–1955	0.9	-53.34	0	2.62	-2.06	152.79	100	0.56	99.44
1956–1965	1.05	-50.33	-8.48	-0.37	9.87	149.31	100	1.02	98.98
1966–1975	0.9	51.87	27.06	10.74	31.12	-20.79	100	68.92	31.08
1976–1985	1.32	134.69	-3.5	-18.02	-2.54	-10.64	100	16.24	83.76
1986–1995	1.5	65.59	0.2	2.64	-11.81	43.38	100	7.61	92.39
1996–2005	0.96	-41	0.55	6.54	9.27	124.63	100	16.36	83.64
Panel B: Proportionate Contribution of Lagged Fama–French Factors and Stock-specific Factors									
Subperiod	**Momentum Return$_{6x6}$**	α	**Mkt-Rf** $_{t-1}$	**SMB** $_{t-1}$	**HML** $_{t-1}$	ε_t	**Total**	$\sum_{j=1}^{n} \hat{\beta}_j f_{t-1*}$	$\hat{\alpha} + \hat{\varepsilon}_{t*}$
1926–2005	0.9	22.17	-5.37	-1.16	0.22	84.14	100	5.60	94.40
1926–1935	0.73	12.35	-9.15	-7.65	3.12	101.34	100	10.74	89.26
1936–1945	-0.18	-3.5	-4.88	4.93	2.71	100.74	100	2.76	97.24
1946–1955	0.9	-51.47	-2.96	-9.82	13.45	150.79	100	0.67	99.33
1956–1965	1.05	-51.59	-22.15	-0.39	19	155.13	100	3.31	96.69
1966–1975	0.9	52.63	-19.53	9.28	31.53	26.09	100	21.28	78.72

1976–1985	1.32	134.6	4.84	-13.82	-21.44	-4.18	100	18.91	81.09
1986–1995	1.5	66.99	-1.1	-2.36	4.93	31.53	100	1.47	98.53
1996–2005	0.96	-42.58	7.07	16.42	-15.46	134.54	100	8.03	91.97

the contributions of the Fama-French three factors, on average the contribution of the Mkt-Rf is positive, and its highest contribution is 27.06 percent in the 1966–1975 subperiod. The contributions of the SMB and the HML in different subperiods vary from very low to negative.

Panel B of Table 3 reports the proportionate contributions of the explained and the unexplained risk components in generating the momentum returns at the portfolio level when the Fama-French lagged three factors are considered to be the explained risk factors. Using equation (3), the table shows that during the entire sample period, the total contribution of the explained risk components $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ is 5.60 percent while the total contribution of the unexplained risk components, $\hat{\alpha} + \hat{\varepsilon}_{t^*}$, is 94.40 percent. The contribution of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ is the highest in the 1966–1975 subperiod at 21.28 percent while $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ is the lowest at 78.72 percent. On average, the unexplained risk factors contribute more than 80 percent.

4.2.2 Portfolio level: Contributions of the macroeconomic risk factors and the unexplained risk factors

Panel A of Table 4 shows the contributions of the macroeconomic risk factors and the unexplained risk factors in generating the momentum returns at the portfolio level. During the entire sample period, the total contribution of α (alpha) is 17.28 percent, and the total contribution of $\hat{\varepsilon}_t$ (residual) is 73.65 percent in generating the total momentum returns of 0.90 percent. For the four macroeconomic variables, the contribution of the TERM is the highest at 8.8 percent followed by the contribution of the DIV at 1 percent. The contributions of the other two variables, the YLD and the DEF, are negative. The total contribution of the explained macroeconomic risk factors, $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$, is 8.97 percent while the total contribution of the unexplained risk factors, $\hat{\alpha} + \hat{\varepsilon}_{t^*}$, is 91.03 percent. In different subperiods, the contributions of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ range from 4.12 percent to 35.35 percent.

Notably, during market upturns, the contribution of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ is comparatively higher than that of its counterpart in the economic downturns. For example, in the 1966–1975 and 1996–2005 subperiods, the contributions of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ are 18.79 percent and 35.35 percent respectively. But, the contributions of the unexplained risk factors are on average more than 90 percent in different subperiods. In particular the contributions of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ are low during market downturns. In the 1966–1975 and 1995–2005 subperiods, the contributions of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ are 81.21 percent and 64.65 percent respectively. For the four macroeconomic variables, the contributions of the TERM and the DIV are on average positive.

Panel B of Table 4 reports the contributions of the lagged macroeconomic risk factors and the unexplained risk factors in generating momentum returns at the portfolio level. The table shows that during the entire sample period, the contribution of the explained risk factors, $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ increased to 12.84 percent while the contribution of the unexplained risk components, $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ declined to 87.16 percent. Among the four macroeconomic variables, the contributions of the DIV, YLD, and the TERM are 6.68 percent, 0.15 percent, and 11.91 percent respectively, while the contribution of the DEF is negative at -5.91 percent. In different subperiods, the contributions of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ vary with the business cycle and range from 4.25 percent to as high as 54.61 percent. Consistent with the earlier findings, the contributions of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ are low during market downturns. For example, in the 1966–1975 and 1996–2005 subperiods, the contributions of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ are 60.32 percent and 45.39 percent respectively. Among the four macroeconomic risk factors, the contributions of the DIV, YLD, and the TERM are on average positive and significant

Table 4: Decomposition at the Portfolio Level

Momentum Return and the Proportionate Contributions of the Macroeconomic Variables and Unexplained Risk Factors: Ten-Year Subperiod Results

The following table reports the proportionate contributions of the contemporaneous macroeconomic risk factors and the lagged macroeconomic risk factors in generating the momentum return at the portfolio level. The momentum returns are estimated based on the *JxK= 6x6* strategy described in Table 2 that excludes penny stocks. Thereafter, the momentum returns are regressed on the macroeconomic variables for each subperiod separately. The estimated coefficients of the regression are then decomposed into the explained risk components that are the sum of the product of the estimated coefficients and the factors $\sum_{j=1}^{n} \hat{\beta}_j f_{t*}$ (the lagged is $\sum_{j=1}^{n} \hat{\beta}_j f_{t-1*}$) and the unexplained risk components $\hat{\alpha} + \hat{\varepsilon}_{t*}$. The "Total" column shows the total contribution of all of the factors that result in the momentum returns. Panel A shows the percentage contributions of the macroeconomic variables when used to capture the simultaneous effect on the momentum returns. Panel B reports the proportionate contributions of these factors when used as lagged variables. The numbers are reported in percentages.

Panel A: Proportionate Contribution of Contemporaneous Macroeconomic Factors and Stock-specific Factors										
Subperiod	**Momentum Return$_{6x6}$**	α	DIV	YLD	TERM	DEF	ε_t	Total	$\sum_{j=1}^{n} \hat{\beta}_j f_{t*}$	$\hat{\alpha} + \hat{\varepsilon}_{t*}$
1926–1995	0.9	17.28	0.99	-0.73	8.8	-0.1	73.65	100	8.97	91.03
1926–1935	0.73	12.84	20.61	-37.54	19.08	4.4	80.61	100	6.55	93.45
1936–1945	-0.18	-1.04	5.74	-0.86	0.39	2.71	93.05	100	7.98	92.02
1946–1955	0.9	-56.38	1.24	-6.59	11.18	1.48	149.08	100	7.31	92.69
1956–1965	1.05	15.76	-0.46	-1.68	0.36	5.9	80.13	100	4.12	95.88
1966–1975	0.9	58.75	29.2	14.3	-62.74	-10.61	70.26	100	18.79	81.21
1976–1985	1.32	125.22	-2.45	1.5	-0.01	-9.9	-14.37	100	8.92	91.08
1986–1995	1.5	65.04	-4.35	-0.11	1.55	7.39	30.49	100	4.48	95.52
1996–2005	0.96	12.35	21	30.9	-11.48	-5.07	52.3	100	35.35	64.65

Panel B: Proportionate Contribution of Lagged Macroeconomic Factors and Stock-specific Factors

Subperiod	Momentum Return$_{6x6}$	α	DIV $_{t-1}$	YLD $_{t-1}$	TERM $_{t-1}$	DEF $_{t-1}$	ε_t	Total	$\sum_{j=1}^{n} \hat{\beta}_j f_{t-1*}$	$\hat{\alpha} + \hat{\varepsilon}_{t*}$
1926–1995	0.9	16.59	6.68	0.15	11.91	-5.91	70.47	100	12.84	87.16
1926–1935	0.73	12.39	11.56	-1.67	18.93	0.57	58.22	100	29.39	70.61
1936–1945	-0.18	-0.86	3.25	6.6	-14.41	-0.09	105.51	100	4.25	95.75
1946–1955	0.9	-58.01	-0.59	25.65	-5.14	0.71	137.39	100	20.63	79.37
1956–1965	1.05	15.74	17.09	2.46	2.27	-1.09	63.52	100	20.73	79.27
1966–1975	0.9	54.42	36.44	1.4	2.05	-0.21	5.9	100	39.68	60.32
1976–1985	1.32	124.43	-6.85	-1.36	16	-31.84	-0.38	100	16.24	83.76
1986–1995	1.5	65.36	-2.74	0.09	-1.46	-5.84	44.58	100	8.30	91.70
1996–2005	0.96	-64.03	174.2	-114.6	-37.83	32.872	109.44	100	54.61	45.39

4.2.3 Portfolio level: Simultaneous Contributions of the Fama-French three factors, the macroeconomic risk factors, and the unexplained risk factors

For robustness I use both the Fama-French three factors and the macroeconomic risk factors simultaneously in equation (2): $MR_{t^*,6x6} = \alpha + \sum_{j=1}^{n} \beta_j f_{t^*} + \varepsilon_{t^*}$. Table 5 reports the proportionate contributions of these factors when controlled for simultaneously and the total contribution of the unexplained risk factors in generating the momentum returns at the portfolio level. During the entire sample period, the total contribution of α (alpha) is 12.82 percent and the total contribution of $\hat{\varepsilon}_t$ (residual) is 57.57 percent in generating the momentum returns of 0.90 percent. The total contribution of the unexplained risk factors, $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ is 80.44 percent.

The total contribution of the explained risk factors of both the Fama-French three factors and the macroeconomic risk factors, $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$, is 20 percent. Of the Fama-French three factors and the four macroeconomic variables, the contributions of the Mkt-Rf, DIV, TERM, and the DEF are positive at 2.26 percent, 18.7 percent, 34.09 percent, and 4.07 percent respectively. In the different subperiods, the contributions of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ range from 3 percent to 81 percent and are more pronounced during economic downturns. In the 1966–1975 and 1996–2005 subperiods, the contributions of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ are 50.06 percent and 80.79 percent respectively, whereas in the other subperiods the contributions are on average 20 percent. However, the contributions of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ are on average more than 80 percent in different subperiods, except in the 1996–2005 subperiod when the contribution is as low as 20 percent.

Table 5: Decomposition at the Portfolio Level: Momentum Returns and Simultaneous Proportionate Contributions of the Contemporaneous Fama-French Three Factors, the Macroeconomic Variables, and the Unexplained Risk Factors: Ten-Year Subperiod Results

The following table reports the proportionate contributions of the Fama-French contemporaneous three factors and the macroeconomic risk factors in generating the momentum returns at the portfolio level. The momentum returns are estimated based on the *JxK= 6x6* strategy described in Table 2 that excludes penny stocks. Thereafter the momentum returns are regressed on the macroeconomic variables for each subperiod separately. The estimated coefficients of the regression are then decomposed into the explained risk components that are the sum of the product of the estimated coefficients and the factors $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ and the unexplained risk components $\hat{\alpha} + \hat{\varepsilon}_{t^*}$. The "Total" column shows the total contribution of all of the factors that result in momentum returns. Panel A shows the percentage contributions of the macroeconomic variables when used to capture the simultaneous effect on the momentum returns. Panel B reports the proportionate contributions of these factors when used as lagged variables. The numbers are reported in percentages.

Simultaneous Contributions of the Contemporaneous Fama-French Three Factors and the Macroeconomic Factors													
Period	**MR_{6x6}**	α	**Mkt-Rf**	**SMB**	**HML**	**DIV**	**YLD**	**TERM**	**DEF**	ε_t	**Total**	$\sum_{j=1}^{n} \hat{\beta}_j f_{t-1^*}$	$\hat{\alpha}+\hat{\varepsilon}_{t^*}$
1926–2005	0.9	12.82	2.26	-2.05	-1.13	18.7	-38.82	34.09	4.07	57.57	100	19.56	80.44
1926–1935	0.73	12.4	-5.42	0.59	-2.87	10.1	-2.78	21.56	-6.24	72.66	100	14.94	85.06
1936–1945	-0.18	-2.48	0.61	-16.29	0.19	0.24	-1.34	0.11	1.88	117.09	100	11.3	88.7
1946–1955	0.9	-53.15	0	2.88	-0.83	-7.78	0.86	-1	3.4	155.64	100	2.35	97.65
1956–1965	1.05	-49.87	1.36	-1.5	7.09	-13.77	-2.75	3.92	-0.97	156.48	100	5.85	94.15
1966–1975	0.9	67.28	25.44	-1.25	-10.29	4.9	-2.98	12.69	11.32	-107.01	100	50.06	49.94
1976–1985	1.32	134.92	-1.61	-6.18	-2.32	-0.63	-214.59	255.31	2.78	-67.65	100	32.75	67.25
1986–1995	1.5	66.24	-2.59	-0.74	-9.25	-1.23	3.76	3.18	-0.74	41.37	100	6.6	93.4
1996–2005	0.96	-72.8	0.28	6.07	9.23	157.79	-90.71	-23.01	21.13	92.01	100	80.79	19.21

Table 6 shows the contributions of the lagged Fama-French three factors and the lagged macroeconomic risk factors when controlled for simultaneously and the contribution of the unexplained risk factors in generating the momentum returns at the portfolio level. The table shows that when the lagged factors are taken into account the contribution of α (alpha) is 26.59 percent, and the contribution of $\hat{\varepsilon}_t$ (residual) is 77.71 percent. The contribution of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ increases to 86.22 percent, and the contribution of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ declines to 13.78 percent. Among the different risk factors, the SMB, DIV, TERM, and the DEF contribute 0.97 percent, 32.19 percent, 1.32 percent, and 4.16 percent respectively. In different subperiods, the contributions of $\sum_{j=1}^{n} \hat{\beta}_j f_{t^*}$ range from 3 percent to 82.16 percent and are prominent during market downturns. However, the contributions of $\hat{\alpha} + \hat{\varepsilon}_{t^*}$ are on average more than 80 percent in different subperiods.

In sum, the above findings show that the contributions of the lagged Fama-French and the lagged macroeconomic risk factors are high compared to the contemporaneous risk factors. The results are robust during market upturns. A reverse trend is observed when these risk factors are considered simultaneously, which could be due to the opposite effects of the Fama-French three factors and the macroeconomic risk factors on the momentum returns.

Table 6: Decomposition at the Portfolio Level: Momentum Returns and Simultaneous Proportionate Contributions of the Lagged Fama-French Three Factors, the Macroeconomic Variables Simultaneously, and the Unexplained Risk Factors: Ten-Year Subperiod Results

The following table reports the proportionate contributions of the Fama-French contemporaneous three factors and the macroeconomic risk factors in generating the momentum returns at the portfolio level. The momentum returns are estimated based on the *JxK= 6x6* strategy described in Table 2 that excludes penny stocks. Thereafter the momentum returns are regressed on the macroeconomic variables for each subperiod separately. The estimated coefficients of the regression are then decomposed into the explained risk components that are the sum of the product of the estimated coefficients and the factors $\sum_{j=1}^{n} \hat{\beta}_j f_{t-1^*}$ and the unexplained risk components $\hat{\alpha} + \hat{\varepsilon}_{t^*}$. The "Total" column shows the total contribution of all of the factors that result in momentum returns. Panel A shows the percentage contributions of the macroeconomic variables when used to capture the simultaneous effect on the momentum returns. Panel B reports the proportionate contributions of these factors when used as lagged variables. The numbers are reported in percentages.

Simultaneous Contributions of the Lagged Fama-French Three Factors and the Macroeconomic Factors

Subperiod	MR_{6x6}	α	Mkt-Rf	SMB	HML	DIV	YLD	TERM	DEF	ε_t	Total	$\sum_{j=1}^{n} \hat{\beta}_j f_{t-1}$*	$\hat{\alpha} + \hat{\varepsilon}_t$*
1926–2005	0.9	26.59	-16.16	0.97	-10.36	32.19	-28.79	1.32	4.16	77.71	100	13.78	86.22
1926–1935	0.73	12.46	-16.74	-7.03	3.52	27.16	-68.13	48.1	3.15	97.51	100	8.31	91.69
1936–1945	-0.18	-2.8	-8.57	6.78	2.91	1.47	-6.9	6.23	-18.27	119.15	100	12.32	87.68
1946–1955	0.9	-53.15	0	2.88	-0.83	-7.78	0.86	-1	3.4	155.64	100	2.35	97.65
1956–1965	1.05	-53.4	-17.71	-0.38	18.64	-9.81	-3.76	2.87	-0.3	163.85	100	8.64	91.36
1966–1975	0.9	191.44	-100.26	8.73	-78.1	51.93	-35.92	-4.61	7.37	-39.59	100	49.84	50.16
1976–1985	1.32	132.73	8.7	-19.11	-17.29	-2.2	1.82	2.98	-7.4	-0.22	100	19.70	80.30
1986–1995	1.5	67.07	-0.29	-0.87	4.14	-4.24	-0.53	1.6	7.27	25.85	100	7.08	92.92
1996–2005	0.96	-81.64	5.58	16.77	-15.87	200.97	-117.74	-45.6	38.05	99.48	100	82.16	17.84

4.3 Individual stock level analysis

4.3.1 Individual stock level: Contributions of the Fama-French three factors and the unexplained risk factors

Panel A of Table 7 shows the proportionate contributions of the contemporaneous Fama-French three factors and the unexplained risk factors in generating the momentum returns. Column 1 shows the subperiods, column 2 shows the momentum returns generated by the conventional method $MR_{t^*}^{UR}$, column 3 shows the momentum returns generated by the unexplained risk factors, column 4 shows the momentum returns generated by the Fama-French three factors, and column 5 sums the momentum returns generated by these two risk factors: ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$). Column 6 shows the percentage contributions of the unexplained risk factors $MR_{t^*}^{UR}$ in generating the momentum returns, column 7 shows the percentage contributions of the explained risk factors $MR_{t^*}^{ER}$ to the total momentum returns, and column 9 sum ups the total contributions of all of the components.

As is evident from Panel A of Table 7, during the entire sample period the total of the momentum returns generated by both the explained and the unexplained risk factors is 0.80 percent per month (9.6 percent per annum). The contribution of the unexplained risk factors to generate this 0.80 percent total is 52.57 percent, which is slightly higher than the 47.43 percent of the Fama-French three factors. In different subperiods, the total of the momentum returns generated by the explained and unexplained risk factors, ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) ranges from as low as 0.26 percent per month to as high as 1.23 percent per month. The contributions of $MR_{t^*}^{UR}$ in different subperiods vary from 5.22 percent to 88.46 percent. Notably the contributions of $MR_{t^*}^{UR}$ are high during the market upturns in the 1956–1965, 1966–1975, and 1986-1995 subperiods. These contributions are 66.67 percent, 73.83 percent, and 88.46 percent respectively. But, the contributions of the Fama-French three factors $MR_{t^*}^{ER}$ in different subperiods range from 11.54 percent to 94.78 percent. It is evident that the contributions of $MR_{t^*}^{ER}$ are high during market downturns.

In Panel B of Table 7 gives the empirical results of the contributions of the different risk factors when the lagged Fama-French three factors are used. The table shows that during the entire sample period, the total momentum returns generated by the unexplained risk factors $MR_{t^*}^{UR}$ is 0.45 percent per month (5.4 percent per annum), and the total momentum returns generated by the explained risk factors $MR_{t^*}^{ER}$ is 0.39 percent per month. The total contribution of $MR_{t^*}^{UR}$ during the entire sample period is 53.89 whereas the total contribution of $MR_{t^*}^{ER}$ is 46.11 percent. These findings suggest that the momentum returns are generated both by the explained and the unexplained risk factors. In different subperiods, the total momentum returns generated by both of the risk factors ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) range from 0.51 percent per month to 1.13 percent per month. When measuring the relative contribution of $MR_{t^*}^{UR}$ in different subperiods, it is evident that the contribution of $MR_{t^*}^{UR}$ varies across business cycles and is high during market upturns. For example, in the 1946–1955, 1956–1965, 1966–1976, and 1976–1985 subperiods, the total momentum returns are 84.42 percent, 82.08 percent, 62.98 percent, and 79.65 percent respectively. However, the contributions of the Fama-French lagged three factors vary from 15.58 percent to 92.16 percent in different subperiods. But, the contributions of $MR_{t^*}^{ER}$ are higher during the market downturns in the 1926–1935, 1936–1945, and 1996–2005 subperiods at 84.62 percent, 82.28 percent, and 92.16 percent respectively.

Table 7: Decomposition at the Individual Stock Level: Momentum Returns and the Proportionate Contributions of the Fama-French Factors and the Unexplained Risk Factors: Ten-Year Subperiod Results

The following table reports the proportionate contributions of the momentum returns generated from the unexplained risk factors and the Fama-French three factors. The momentum returns (restricted) require a minimum of 24 observations. The table shows the percentage contributions of the two sources of momentum returns. The "Total" column shows the total contribution of all of the factors that result in momentum returns. The numbers in columns 6 and 7 in Panels A and B represent the percentage contributions of MR_{t*}^{UR} and MR_{t*}^{ER} when compared to MR_{t*}^{Res}. Panel A shows the percentage contributions of the Fama French three factors when used as contemporaneous variables, and Panel B shows the same when the lagged Fama-French variables are used. The numbers are reported in percentages.

Panel A: Contributions of Contemporaneous Fama-French and Unexplained Risk Factors								**Panel B: Contributions of Lagged Fama-French and Unexplained Risk Factors**							
Subperiod	MR_{t*}^{Res}	MR_{t*}^{UR}	MR_{t*}^{ER}	*Sum of* MR_{t*}^{UR} *and MR*	*% Contribution of* MR_{t*}^{UR}	*% Contribution of* MR_{t*}^{ER}	**Total**	**Subperiod**	MR_{t*}^{Res}	MR_{t*}^{UR}	MR_{t*}^{ER}	*Sum of* MR_{t*}^{UR} *and MR*	*% Contribution of* MR_{t*}^{UR}	*% Contribution of* MR_{t*}^{ER}	**Total**
1926 –	0.78	0.42	0.37	0.80	52.57	47.43	100	**1926 –**	0.77	0.45	0.39	0.84	53.89	46.11	100

2005								**2005**							
1926 – 1935	-0.01	0.92	0.21	1.13	81.42	18.58	100	**1926 – 1935**	-0.01	0.16	0.88	1.04	15.38	84.62	100
1936 – 1945	-0.2	-0.2	0.35	0.55	36.36	63.64	100	**1936 – 1945**	-0.2	-0.07	0.33	0.40	17.72	82.28	100
1946 – 1955	0.88	0.71	0.52	1.23	57.72	42.28	100	**1946 – 1955**	0.88	0.84	0.16	1.00	84.42	15.58	100
1956 – 1965	0.93	0.75	0.38	1.13	66.67	33.33	100	**1956 – 1965**	0.93	0.87	0.19	1.06	82.08	17.92	100
1966 – 1975	0.76	0.55	0.20	0.75	73.83	26.17	100	**1966 – 1975**	0.76	0.57	0.34	0.91	62.98	37.02	100
1976 – 1985	1.2	0.7	0.69	1.39	50.54	49.46	100	**1976-1985**	1.2	0.9	0.23	1.13	79.65	20.35	100
1986 – 1995	1.4	0.23	-0.03	0.26	88.46	11.54	100	**1986-1995**	1.4	0.2	0.38	0.58	34.48	65.52	100
1996 – 2005	0.79	-0.03	0.55	0.58	5.22	94.78	100	**1996-2005**	0.79	-0.04	0.47	0.51	7.84	92.16	100

4.3.2 Individual stock level: Contributions of the macroeconomic risk factors and the unexplained risk factors

Panel A of Table 8 reports the proportionate contributions of the contemporaneous macroeconomic risk factors and the unexplained risk factors in generating the momentum returns. As shown in Panel A of Table 8, the total momentum returns generated by the two risk factors ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) are 0.23 percent per month (2.76 percent per annum). The contribution of $MR_{t^*}^{UR}$ is 68.89 percent, whereas the contribution of $MR_{t^*}^{UR}$ is 31.11 percent. In different subperiods, the total momentum returns generated by the two risk sources range from 0.24 to 2.16 percent per month. The contributions of $MR_{t^*}^{UR}$ in different subperiods vary from 8.70 percent per month to 88.57 percent per month. It is evident that the contribution of $MR_{t^*}^{UR}$ is the highest in the 1996–2005 subperiod at 88.57 percent. On the contrary, the contributions of $MR_{t^*}^{ER}$ are on average more than 60 percent in different subperiods and are higher during the market upturns of the 1956–1965, 1966–1975, and 1986–1995 subperiods at 83.33 percent, 73.33 percent and 91.30 percent respectively.

Panel B of Table 8 shows the contributions of the lagged macroeconomic risk factors and the unexplained risk factors in generating the momentum returns at the individual stock level. In the entire sample period, the total momentum returns generated by the two types of risk factors ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) are 0.37 percent. The contribution of $MR_{t^*}^{UR}$ is 41.44 percent, while the contribution of $MR_{t^*}^{ER}$ is 58.56 percent. These contributions imply that the momentum returns are compensation for the macroeconomic risk, and that the effect is higher when the lagged macroeconomic risk factors are used. In different subperiods, the total momentum returns generated by the macroeconomic risks factors range from -0.29 percent to 0.29 percent per month. The contributions of $MR_{t^*}^{ER}$ are 71.43 percent and 77.78 percent in the 1956–1965 and 1986–1995 subperiods respectively.

Table 8: Decomposition at the Individual Stock Level: Momentum Return and the Proportionate Contributions of the Macroeconomic Risk Factors and the Unexplained Risk Factors: Ten-Year Subperiod Results

The following table reports the proportionate contributions of the momentum returns generated from the unexplained risk factors and the macroeconomic factors. The momentum returns (restricted) are generated by using a 60-month window and a minimum of 24 observations. The table shows the percentage contributions of the two sources of the momentum returns. The "Total" column shows the total contribution of all of the factors that result in a momentum return. The numbers in columns 6 and 7 in Panels A and B represent the percentage contributions of $MR_{t^*}^{UR}$ and $MR_{t^*}^{ER}$ when compared to $MR_{t^*}^{Res}$. The table shows the percentage contributions of the macroeconomic factors in generating the momentum returns.

Panel A: Contributions of the Contemporaneous Macroeconomic risk and the Unexplained Risk Factors								**Panel B: Contributions of the Lagged Macroeconomic risk and the Unexplained Risk Factors**							
Subperiod	$MR_{t^*}^{Res}$	$MR_{t^*}^{UR}$	$MR_{t^*}^{ER}$	*Sum of* $MR_{t^*}^{UR}$ *and* $MR_{t^*}^{ER}$	*% Contribution of* $MR_{t^*}^{UR}$	*% Contribution of* $MR_{t^*}^{ER}$	**Total**	**Subperiod**	$MR_{t^*}^{Res}$	$MR_{t^*}^{UR}$	$MR_{t^*}^{ER}$	*Sum of* $MR_{t^*}^{UR}$ *and* $MR_{t^*}^{ER}$	*% Contribution of* $MR_{t^*}^{UR}$	*% Contribution of* $MR_{t^*}^{ER}$	**Total**
1926 – 2005	0.78	-0.16	-0.07	0.23	68.89	31.11	100	**1926 – 2005**	0.77	-0.155	0.22	0.374	41.44	58.56	100
1926 –	-0.01	-0.2	-1.09	1.29	15.50	84.50	100	**1926 –**	-0.01	-0.2	0.25	0.45	44.44	55.56	100

1935								**1935**							
1936 – 1945	-0.2	-1.35	-0.81	2.16	62.50	37.50	100	**1936 – 1945**	-0.2	-1.35	1.45	2.8	48.21	51.79	100
1946 – 1955	0.88	0.25	-0.28	0.53	47.17	52.83	100	**1946 – 1955**	0.88	0.25	-0.18	0.43	58.14	41.86	100
1956 – 1965	0.93	-0.04	0.2	0.24	16.67	83.33	100	**1956 – 1965**	0.93	-0.04	0.1	0.14	28.57	71.43	100
1966 – 1975	0.76	0.08	0.22	0.3	26.67	73.33	100	**1966 – 1975**	0.76	0.08	0.07	0.15	53.33	46.67	100
1976 – 1985	1.2	-0.29	0.39	0.68	42.65	57.35	100	**1976 – 1985**	1.2	-0.29	0.29	0.58	50.00	50.00	100
1986 - 1995	1.4	-0.02	0.21	0.23	8.70	91.30	100	**1986 – 1995**	1.4	-0.02	0.07	0.09	22.22	77.78	100
1996 - 2005	0.79	0.31	0.04	0.35	88.57	11.43	100	**1996 – 2005**	0.79	0.31	-0.29	0.60	51.67	48.33	100

But, the contributions of $MR_{t^*}^{UR}$ are on average more than 40 percent in different subperiods.

4.3.3 Individual stock level: Contributions of the Fama-French three factors, the macroeconomic risk factors, and the unexplained risk factors

For robustness I consider both the Fama-French three factors and the macroeconomic factors simultaneously. Table 9 shows the empirical results. Panel A of Table 9 shows that when the Fama-French contemporaneous three factors and the contemporaneous macroeconomic risk factors are used simultaneously with the unexplained risk factors, the total returns generated by the two risk factors, ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) are 0.049 percent per month (0.588 percent per annum). The contribution of $MR_{t^*}^{UR}$ is 69.39 percent, and the contribution of $MR_{t^*}^{ER}$ is 30.61 percent. In different subperiods, the total momentum returns generated by ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) range from 0.08 percent to 0.52 percent. The contributions of $MR_{t^*}^{UR}$ are on average more than 40 percent, with the highest at 63.64 percent in the 1996–2005 subperiod. But, the contributions of $MR_{t^*}^{ER}$ are on average more than 60 percent in different subperiods, with its highest in the 1936–1945 subperiod at 87.50 percent.

Panel B of Table 9 shows the contributions of the Fama-French lagged three factors and the lagged macroeconomic risk factors when they are used simultaneously with the unexplained risk factors. The table gives the total momentum returns for ($MR_{t^*}^{UR} + MR_{t^*}^{ER}$) as 0.25 percent per month (3 percent per annum). The contribution of $MR_{t^*}^{UR}$ declines to 32 percent compared to when the contemporaneous variables are used, while the contribution of $MR_{t^*}^{ER}$ increases to 68 percent. In different subperiods, the contributions of $MR_{t^*}^{UR}$ vary from 27.27 percent to 95.24 percent. However, the contributions of $MR_{t^*}^{ER}$ are on average

Table 9: Decomposition at the Individual Stock Level: Momentum Return and Simultaneous Proportionate Contributions of the Fama-French Factors, the Macroeconomic Risk Factors, and the Unexplained Risk Factors:

Ten-Year Subperiod Results

The following table reports the proportionate contributions of the momentum returns generated from the unexplained risk factors and both the Fama-French factors and the macroeconomic factors simultaneously. The momentum returns (restricted) are generated by using a 60-month window and a minimum of 24 observations. The table shows the percentage contributions of the two alternative momentum returns. The "Total" column shows the total contribution of all of the factors that result in the momentum returns. The numbers in columns 6 and 7 in Panels A and B represent the percentage contributions of MR_t^{UR} and MR_t^{ER} when compared to MR_t^{Res}. The table shows the percentage contributions of the Fama-French three factors and macroeconomic factors simultaneously in generating the momentum returns.

Panel A: Simultaneous Contributions of the Contemporaneous Fama-French Factors, the Macroeconomic Risk Factors, and Unexplained Risk Factors								**Panel B: Simultaneous Contributions of the Lagged Fama-French Factors, the Macroeconomic Risk Factors, and the Unexplained Risk Factors**							
Subperiod	MR_t^{Res}	MR_t^{UR}	MR_t^{ER}	*Sum of* MR_t^{UR} *and* MR_t^{ER}	*% Contribution of* MR_t^{UR}	*% Contribution of* MR_t^{ER}	**Total**	**Subperiod**	MR_t^{Res}	MR_t^{UR}	MR_t^{ER}	*Sum of* MR_t^{UR} *and* MR_t^{ER}	*% Contribution of* MR_t^{UR}	*% Contribution of* MR_t^{ER}	**Total**
1926–2005	0.78	0.03	0.02	0.05	69.39	30.61	100	**1926–2005**	0.77	0.	0.17	0.25	32.00	68.00	100
1926–1935	-0.01	-0.01	0.21	0.22	4.55	95.45	100	**1926–1935**	-0.01	0.59	-0.27	0.86	68.60	31.40	100
1936–1945	-0.2	0.01	-0.07	0.08	12.50	87.50	100	**1936–1945**	-0.20	-1.55	1.57	3.12	49.68	50.32	100
1946–1955	0.88	0.29	-0.23	0.52	55.77	44.23	100	**1946–1955**	0.88	0.33	-0.27	0.60	55.00	45.00	100
1956–1965	0.93	-0.05	0.08	0.13	38.46	61.54	100	**1956–1965**	0.93	0.04	0.04	0.08	50.00	50.00	100
1966–1975	0.76	0.26	-0.24	0.50	52.00	48.00	100	**1966–1975**	0.76	0.2	-0.01	0.21	95.24	4.76	100
1976–1985	1.20	-0.16	0.23	0.39	41.03	58.97	100	**1976-1985**	1.20	-0.31	0.27	0.58	53.45	46.55	100
1986–1995	1.40	-0.16	0.29	0.45	35.56	64.44	100	**1986-1995**	1.40	-0.06	0.16	0.22	27.27	72.73	100
1996–2005	0.79	0.07	-0.04	0.11	63.64	36.36	100	**1996-2005**	0.79	0.46	-0.39	0.85	54.12	45.88	100

more than 50 percent in different subperiods, and its highest is in the 1986–1995 subperiod at 72.73 percent per month.

In sum, the contributions of the lagged macroeconomic factors are on average over 50 percent in different subperiods. This result is robust when both the Fama-French lagged three factors and the lagged macroeconomic risk factors are considered simultaneously. The results are also robust across business cycles. This finding clearly shows that the momentum returns are compensation for the lagged macroeconomic variables and that the investors require a higher premium for the risk associated with a recession.

5 - Conclusion

In this paper, I examine the sources of the momentum returns and the relative contributions of the explained and the unexplained risk factors in generating those returns. I show that when the factors are decomposed into the explained and the unexplained risk factors, the momentum returns are influenced by the lag structure of the macroeconomic variables at the individual stock level. Further, I show that at the portfolio level, the contributions of both the Fama-French contemporaneous and lagged three factors are on average 1.13 percent, while the contributions of the unexplained risk factors are on average more than 98.87 percent. Whereas the contributions of the lagged macroeconomic variables are on average 13 percent while the unexplained risk factors contribute 87 percent. At the individual stock level, however, the contributions of both the Fama-French contemporaneous and lagged three factors increase on average to more than 40 percent per month, and the contributions of the lagged macroeconomic risk factors are on average 58.56 percent per month. These results are robust when both of the risk factors are used simultaneously and are higher during market downturns. These findings imply that the momentum returns are compensation for the risk that is mostly related to macroeconomic factors and that investors require a higher premium to hold stocks during a recession.

Earlier studies differ in terms of their conclusions on what contributes to the momentum returns. Chordia and Shivakumar (2002) show that lagged macroeconomic risk factors can explain momentum returns. I add to the literature by showing that the momentum returns are contributed by both the explained and the unexplained risk factors; however, the lag structure of the macroeconomic risk factors at the individual stock level has a significant

impact on the generation of the momentum returns. These results provide important guidance for formulating theoretical models on momentum portfolios. A tantalizing question still remains to be investigated: Will behavioral models provide an analogous conclusion on the sources of the momentum returns?

References

Avramov, D., S. Cheng and A. Hameed, 2013. Time-varying momentum payoffs and illiquidity. Working paper, http://papers.ssrn.com/abstract2289745

Avramov, D., T. Chordia, G. Jostova and A. Philipov, 2007. Momentum and credit rating. *Journal of Finance*, 62(5), 2503-2520.

Bhar, R. and A. G. Malliaris, 2011. Dividends, momentum, and macroeconomic variables as determinants of the US equity premium across economic regimes. *Review of Behavioral Finance*, 3(1), 27-53.

Chen N. F., R. Roll and S. A. Ross, 1986. Economic forces and the stock market. *Journal of Business*, 59, 383-403.

Conrad, J. and G. Kaul, 1997. An anatomy of trading strategies. *Review of Financial Studies*, 11(3), 489-519.

Chichernea, D. and L. S. Slezak, 2008. Is idiosyncratic risk a source of momentum? Working Paper, http://papers.ssrn.com/abstract1108234

Chordia, T. and L. Shivakumar, 2002. Momentum, business cycle and time-varying expected returns. *Journal of Finance*, 57, 985-1019.

Cooper, M., R. C. Gutierrez and A. Hameed, 2004. Market states and momentum. *Journal of Finance*, 59(3), 1345-1365.

Fama, E. and K. French, 1996. Multifactor explanations of asset pricing anomalies. *Journal of Finance*, 51, 55-84.

Griffin, J. M., S. Ji and J. S. Martin, 2003. Momentum investing and business cycle risk: Evidence from pole to pole. *Journal of Finance*, 53, 2515-2547.

Grundy, B. D. and J. S. Martin, 2001. Understanding the nature of risks and the sources of rewards to momentum investing. *Review of Financial Studies*, 14, 29-78.

Hwang, H. 2011. Business cycle and momentum payoffs. Working Paper, SSRN, http://papers.ssrn./abstract 1925933

Hwang, S. and A. Rubesam, 2007. The disappearance of momentum. Working Paper, SSRN, http://papers.ssrn.com/abstract 968176

Jegadeesh, N. and S. Titman, 1993. Returns to buying winners and selling losers: Implications for stock market efficiency. *Journal of Finance*, 48, 65-91.

Jegadeesh, N. and S. Titman, 2001. Profitability of momentum strategies: An evaluation of alternative explanations. *Journal of Finance*, 56, 699-720.

Jiang, G., C. M. C. Lee and G. Yi Zhang, 2005. Information uncertainty and expected stock returns. *Review of Accounting Studies*, 10, 185-221.

Kang, Q. and C. Li, 2007. Can a risk-based factor generate momentum? Working Paper, http://papers.ssrn.com/abstract=971204.

Lee, N., 2012. Firm ratings, momentum investment strategies, and market crisis: Evidence from US and Taiwan markets. *Financial Market and Portfolio Management*, 26 (4), 449-468.

Lesmond, D. A., M. J. Schill and C. Zhou, 2004. The illusory nature of momentum profits. *Journal of Financial Economics*, 71, 349-380.

Lo, A.W., and A. C. Mackinlay, 1990. Data-snopping biases in tests of financial asset pricing models. *The Review of Financial Studies*, 3(3), 431-467.

Moskowitz, T. and M. Grinblatt, 1999. Do industries explain momentum? *Journal of Finance*, 54, 1249-1290.

Sadka, R., 2006. Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk. *Journal of Financial Economics*, 80 (2), 309-349.

Wang, K. Q., 2003. Asset pricing with conditioning information: A new test. *Journal of Finance*, 58, 161-196.

Wang, K.Q. and J. Xu, 2011. Market volatility and momentum. Working paper, SSRN, http://papers.ssrn.com/abstract=1342719

Zhang, X. F., 2006. Information uncertainty and stock returns. *Journal of Finance*, 61(1), 105-136.