Conventional momentum and Residual momentum Analysis

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1. Introduction

1.1. Topic

Traditional momentum trading strategies are based on the total returns of stocks. For decades, traders have used momentum trading strategies to long 'winner stocks' that have strong price trends, and short 'loser stocks' that have poor performing price trends. It has been proved valuable in the long term in the US stock market. However, this trading strategy fails when facing the phenomenon of momentum crash.

When a momentum crash happens, the loser stocks massively outperform the winner stocks. This often occurs when the market is in a panic state when the market has large declines and high volatilities. When the market becomes panic, according to Geczy and Samonov (2013), the momentum stock portfolio has negative exposure to the new market state and leads to losses.

In 2011, Blitz, Huiji, and Martens propose the residual momentum strategy using the Fama and French three-factor model. Their study shows that residual momentum has a Sharpe ratio that is nearly double that of conventional momentum. The result is also supported by Hanauer and Windmueller (2019) in their study, which demonstrate residual momentum has better performance during the momentum crash.

1.2. Motivation

Our works want to study more about the momentum phenomenon and would like to explore more about it. More importantly, we would like to imitate the study by Blitz, Huiji, and Martens (2011) and compare outputs with total return momentum. Moreover, we would conduct some economic analysis behind it.

1.3. Hypothesis

- Information spread slowly across the public.
- Investors have slower reactions for idiosyncratic events than for common events.

1.4. Citations

- Residual Momentum

Our study would involve methodologies and formula used by Blitz, Huiji, and Martens (2011) for calculating residual returns.

- The idiosyncratic momentum anomaly

To calculate residual returns, we need to know how to calculate residual momentum first. Although there is no clear demonstration of residual momentum formula in Blitz's paper in 2011, we find it in the paper from Blitz, Hanauer, and Vidojevic (2018).

- Momentum crashes

Our works involve studies from Hanauer and Windmueller (2019) to have a clear understanding of the momentum crash phenomenon.

- Two centuries of price-return momentum

We would use analysis from Geczy, C. and M. Samonov (2016) to compare and analyze our replications of total return momentum and residual return momentum.

2. Data and methodology

2.1. Data

To be consistent with the momentum literature we cited and class content we learned, we use the data from the CRSP database, which consists of monthly stock returns from 1985 to 2018. Since calculations of residual returns and residual momentum involve Fama and French factors, we also use the F-F research data factors given in the class.

2.2. Methodology

To calculated the residual In residual momentum by Blitz, Huiji, and Martens(2011), residual returns are calculated every month as below:

$$r_{i,t} = \alpha_i + \beta_{1,i} RMRF_t + \beta_{2,i} SMB_t + \beta_{3,i} HML_t + \varepsilon_{i,t}$$

Where *ri,t* is the risk-free return of stock i in month t. *RMRFt, SMBt, and HMLt* represent market premium, value premium and size premium. *αi,β1, i, β2, i, and β3, i* are estimating parameters. Lastly, *εi,t* represents the residual return of stock i in month t.

By having the residual returns, we can use the formula given in The idiosyncratic momentum anomaly by Blitz, Hanauer, and Vidojevic (2018) to calculate the residual momentum:

$$IdiosyncraticMomentum_{i,t} = \frac{\sum_{t-12}^{t-2} e_{i,t}}{\sqrt{\sum_{t-12}^{t-2} (e_{i,t} - \bar{e}_i)^2}}$$

In the end, we create two portfolios to have objective comparisons between conventional momentum and residual momentum performances. One is an equally-weighted portfolio, where each stock in the portfolio is equally weighted, and the other is a value-weighted portfolio, where each stock in the portfolio is weighted by its market capitalization. By looking at two portfolios' cumulative returns, volatilities, and Sharpe Ratio, we can verify the results from Blitz, Huiji, and Martens (2011) to check whether residual momentum has better performances.

2.3. Python coding (details can be checked in our two py files)

<u>Step 1: Define helper functions</u>

We define three helper functions to help our calculations.

1. *Uni_sort_value_weight*: It is to create value-weighted portfolios through univariate sort.
2. *Uni_sort_equal_weight*: It is to create the equally-weighted portfolios.
3. *merge_with_FF*: It is to merge the above two portfolios data frames with Fama French 3 factor data.
4. *Summary_stats*: It is to summarize the total return momentum and residual return momentum in the end for comparison and visualizations.
5. *Sharpe_Ratio*: It is to Calculate Sharpe Ratio for individual assets.
6. *FF3f_regression*: It is to explore relationships between two portfolios excess returns and three beta coefficients.

Step 2: Prepare the CRSP file

We load the 'CRSP_Monthly_2018.csv' and format the data. In this step, we conduct some data cleaning and keep only stocks from NYSE, AMEX, and NASDAQ. Moreover, we create the monthly date variable and change the 'RET' variable type from object to number.

Step3: Calculate the residual returns and residual momentum

We apply two mathematical formulas above into python coding. We first load the Fama French factors from the 'F-F_Research_Data_Factors_2018.csv' and align the dates of the factors with the returns. After getting factors and excess returns as NumPy arrays, we calculate betas. In the end, we obtain residuals from t-2 to t-12 from the regression and use them to calculate the residual momentum. We output the residual momentum as 'rmom12_2_1980_2017.csv', which can be checked in our folder.

Step 4: Calculate Total Return Momentums

We calculate the conventional momentum score based on cumulative returns over the past 12 months, from the CRSP file we have prepared in step 2. Therefore, we have residual momentum and total return momentum ready in hands.

Step5: Sort and form portfolios

In this step, since we have already had the equality-weighted portfolio and the value-weighted portfolio, we sort total return momentum and residual momentum on both of them. In the end, we have four variables: each of the two portfolios would have two momentum variables respectively.

Step6: Comparision and data visualizations

We use the *Summary_stats* we defined in step 1 to summarize the conventional momentum and residual momentum of two portfolios and compare their monthly cumulative returns in log scale, volatilities, and Sharpe ratios under these two trading strategies.

Step7: Regression analysis

Beside directly compare returns, volatilizes and Sharpe ratios, we also conduct the regression analysis between two portfolio excess returns and beta_mkt, beta_size and beta_hml to further explore coefficients changes under conventional and residual momentum trading strategies.

3. Performance Evaluations

3.1. Monthly Cumulative Return (in log scale) -Exhibit 1

Based on the **Exhibit 1**, if the portfolio were equally weighted, cumulative returns calculated using residual momentum shows significant strength over time (returns are rather similar when the economy was experiencing recovery post-recession in 1984). Furthermore, if the portfolio were value-weighted, conventional momentum dominates its residual counterpart through the 1980-2017 timeline.

3.2. Volatility – Exhibit 2

Though returns seem to have very distinctive results between the two methodologies when applying different weighting methodologies, volatility, on the other hand, follows quite similar results. Regardless of which weighting method to use, conventional momentum would yield material risk during recession. For example, during the economic meltdown in 2008 and Dotcom bubble in 2000, the resulting volatility were respectively 5 and 3 times higher when applying the conventional momentum method.

3.3. Sharpe Ratio – Exhibit 3

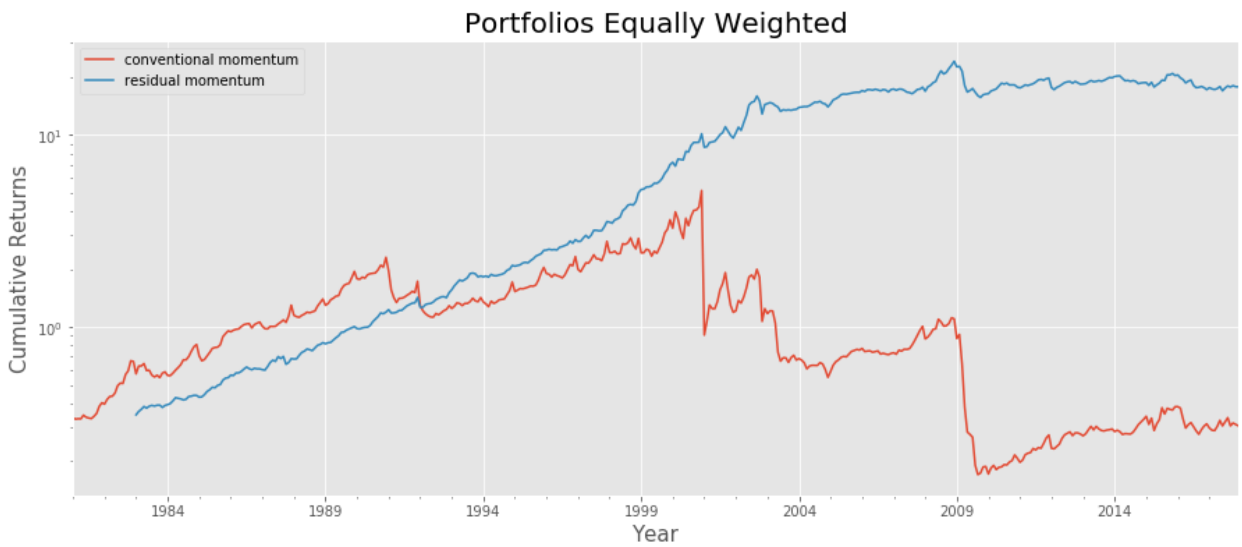
Knowing that the return and risk results vary materially between each weighting method (when using conventional and residual momentum), the Sharpe ratio fluctuates over the time. In chart 3.3, when portfolios are equally weighted, residual momentum methodology is able to generate stronger risk adjusted returns during an economic boom. However, during recession and under unstable economic conditions, both methodologies are mostly identical in risk adjusted returns. Meanwhile, if the portfolio were to be value weighted, conventional method is only better off prior to 1990. Post 1990, both methods have again been generating rather similar outcomes with conventional method edging slightly over residual method during economic recovery and vice versa.

3.4. Regression analysis

Based on our regression results, we conclude that regardless of the way portfolio were weighted by stocks, three beta coefficients mostly have smaller absolute values under residual momentum than under conventional momentum. It confirms with our finding of their volatilely comparisons. Moreover, if we further look at the relationship between winner – loser stock returns, we can find three beta coefficient values are much smaller than those under conventional momentum. This finding is in accord with Blitz's conclusion that residual momentum has smaller time-varying factor exposures.

In conclusion, we successfully replicate and verify the calculations and comparisons from prior literature.

Exhibit 1 - Monthly Cumulative Return (in log scale)



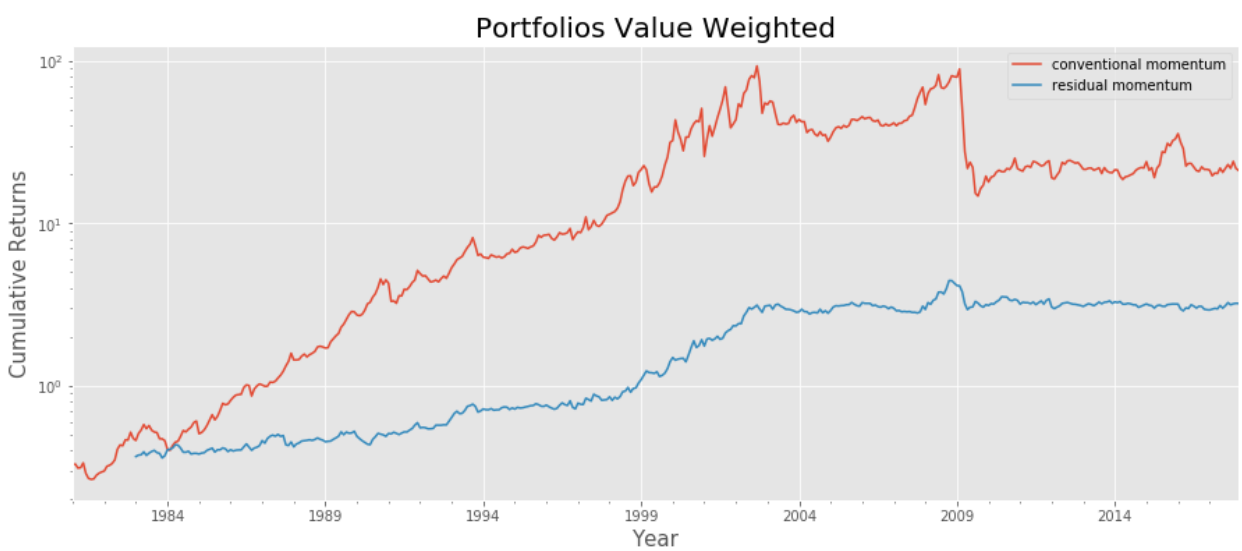
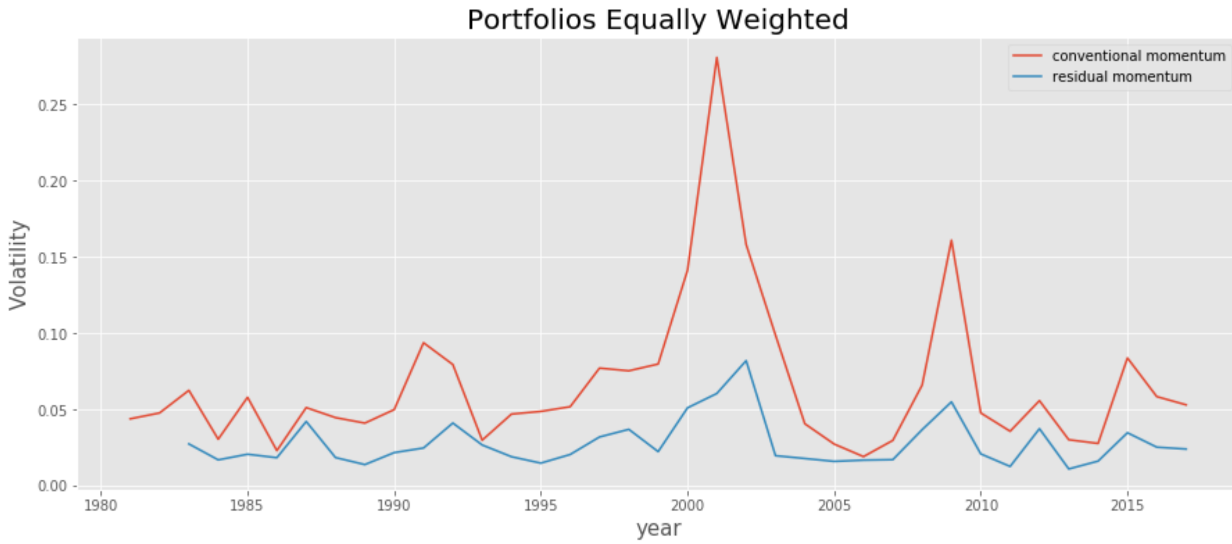


Exhibit 2 – Volatility



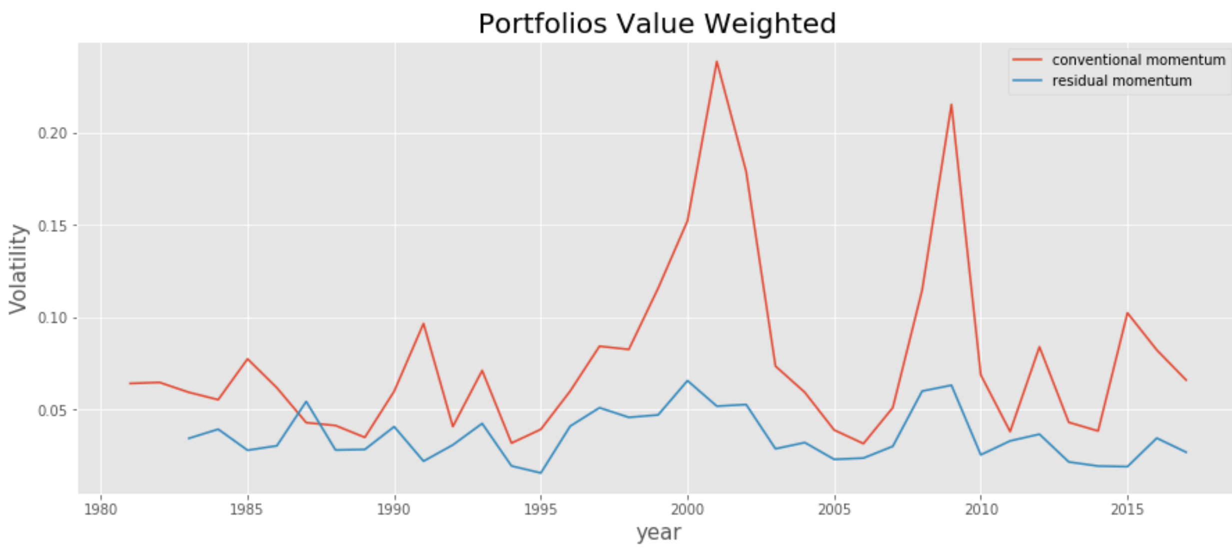
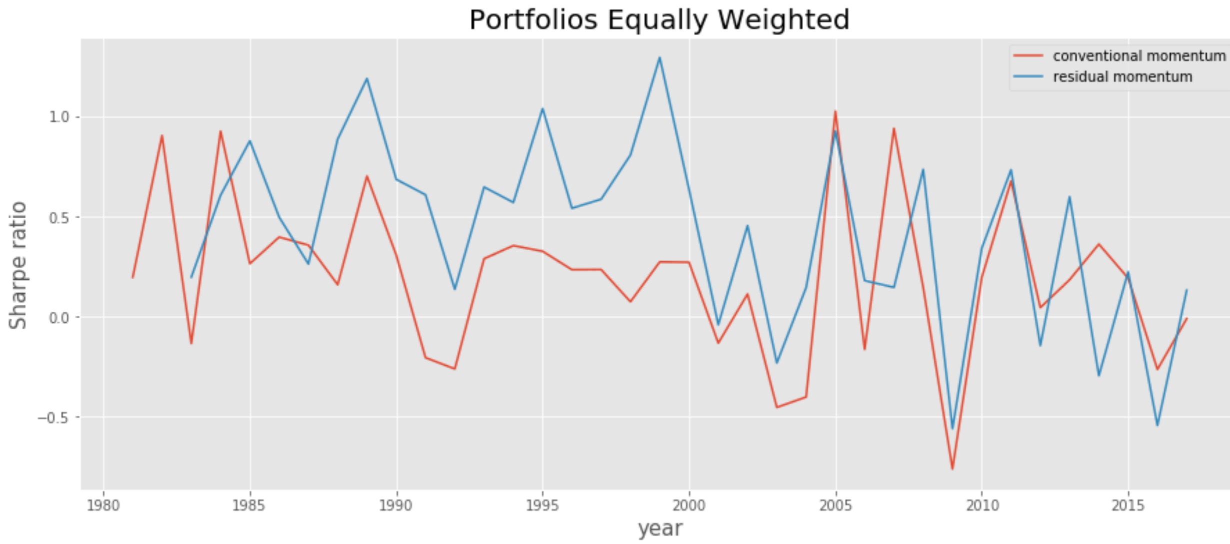
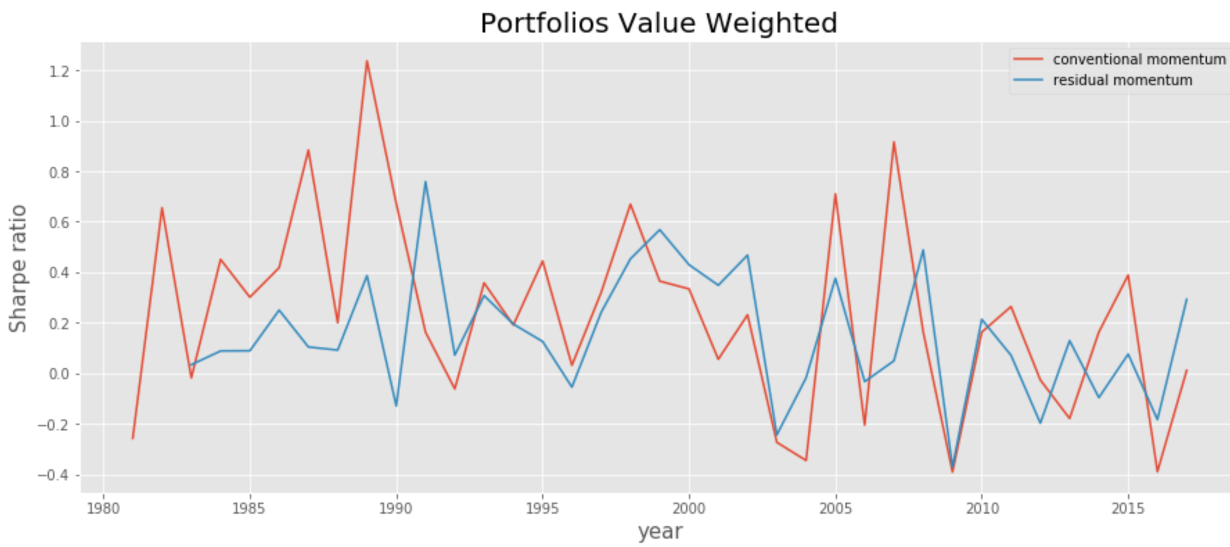


Exhibit 3 – Sharpe Ratio





Reference

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