The Disappearance of the Small Firm Premium

by

Lanziying Luo
Bachelor of Economics, Southwestern University of Finance and Economics,2015

and

Chenguang Zhao

Bachelor of Science in Finance, Arizona State University, 2016

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Name: **Lanziying Luo, Chenguang Zhao**

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Supervisory Committee:

_____

Amir Rubin
Senior Supervisor
Professor

_____

Alexander Vedrashko
Second Reader
Associate Professor

Date Approved: _____

Abstract

The objective of this paper is to analyze the small firm premium in the US equity market during the period 1998 to 2017. We find the difference in returns between large-sized firms and small-sized firms tends to emerge after economic recessions. In addition, although we find a significant size premium over the entire period, the size premium does not exist in the years following the recent financial crisis, which may imply a structural change in the market.

Keywords: risk premium; small firm premium; abnormal return; size factor

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1. Introduction

The size premium has long been at the center of asset pricing model discussions, starting with Roll (1981), Reinganum (1981) and Banz (1981). According to asset pricing theory, small size firms are associated with higher systematic risk, and therefore yield higher returns. However, in recent years, there is evidence of a structural shift in the market. Large firms such as Facebook, Apple, Amazon, Netflix, and Google (FAANG) are the highest growing sector, which raises the question of whether the size premium still exists. This is contrary to the asset pricing model's intuition. For example, the EPS growth of FAANG in 2017 is, respectively, 54.3%, 10.8%, 25.5%, 180% and 35.4%, while EPS growth of S&P 500 is 17.1%.

Does this phenomenon in which large firms are the highest growing imply a challenge to prevailing asset pricing model, or the anecdotal evidence of FAANG firms not representative of the entire US equity market? This question is partially addressed in academic research (Section 2). For example, Grullon, Larkin, and Michaely (2018) test US product market, and find more industries concentration and less competition. They also find higher concentration level leads to a higher stock return in that industry. Gao, Ritter, and Zhu (2013) also present evidence on the consolidation phenomenon, small firms today prefer to get acquired by large firms rather than go IPO. However, these researches do not provide any asset-pricing implications about what this means for the size premium.

This study is aimed to use prevailing asset pricing models, namely, the CAPM and the Fama-French (1992), Fama-French (1993) and Carhart (1997) model, as well as

data of US equity market during the period 1998-2017 to test whether the size premium still exists. Four different methodologies are used in our research. We first use a common approach in which we partition firms to large/small on a yearly (bi-yearly, and every five years) and then measure these two portfolio alphas. We then compare the alphas to see whether large firms really underperformed small firms. This methodology implies that in general small firms perform better but mostly in the earlier part of the sample. We note that the Fama and French method to measure the premium is done by updating the portfolio on an annual basis (every end of June) and splitting to large and small only based on NYSE stocks, which could yield different results. The reason behind this is Fama and French use data from 1962-1989 but NASDAQ is quite small in beginning years when it was included in CRSP dataset in 1973. However, in our analysis, we sort firms' size by using all data derived from NYSE, AMEX and NASDAQ.

Our second methodology is to analyze the Fama-French accumulated SMB factor and observe its trend. We therefore compare this second method results to our first method. The third methodology is to straightforwardly use firm market value in a regression that controls for the other factors (apart from size). This method allows to control for firm and year fixed effect and see whether size has any time-varying effects after controlling for firm-specific attributes. The fourth methodology is to build both value-weighted and equal-weighted portfolios (rebalanced annually) and analyze using the calendar-time approach (without the size factor) whether large minus small firms provide a positive premium.

Through our results, we draw a conclusion that size premium has changed throughout the last 20 years. It exists and tends to emerge soon after an economic

recession but disappears after the financial crisis. Our evidence is that until 2008, a size premium exists in which small firms yield a premium compared to large firms. Interestingly, the higher returns seem to materialize immediately after periods of crises. However, after the last crisis in 2008 we have not found a return premium for small firms compared to large firms.

2. Literature Review

2.1 Debating of Small Size Premium

The size premium has been one of the best-known market anomalies. Reinganum (1981) and Banz (1981) reported that for U.S. stock market data prior to 1980 small-cap stocks had substantially higher returns compared to large-cap stocks. Roll (1981) provides a risk-based explanation for the firm size effect on returns. Fama and French (1992) use cross-sectional data to show that small sized firms had a significant explanatory power in stock realized return. Their central theme is that if an asset is priced rationally, variables related with average return must proxy for sensitivity as risk factors in a pricing model. Fama and French (1992) use data from 1963 to 1989 and find that firm size, leverage and book to value ratio have strong explanatory power.

Kothari, Shanken, and Slogan (1995) claim that data Fama and French used requires firms listed on both CRSP and Compustat, but this causes Fama and French's results being overstated because of Compustat's well-known tendency to backfill accounting data.

2.2 Prevailing critiques of the small-size firm premium

2.2.1 Questioning size-related anomalies

Jonathan Berk (1995), by defining expected return as firms' cash flow generation ability relative to its market value, uses $E[r_i] = E\left[\log\left(\frac{c_i}{p_i}\right)\right]$ to represent expected returns. He then shows the regression between excess return and market value of the firm as $\varepsilon_i = \eta + \gamma \log(p_i) + \zeta_i$. He argues that since $\gamma = \frac{cov(\log p, \varepsilon)}{var(\log p)}$ and

$\text{cov}(\log p, \varepsilon)$ is negative, large-size firms' should have a negative abnormal return, and then, if it exists, it means that risk and price are two sides of the coin, and smaller firms should have a higher return just due to them being risky. Therefore, he questions the empirical anomaly definition. As such, he argues that it is misleading to refer to the size effect as an anomaly. Rather, he basically claims that the small size premium should exist if the CAPM does not capture all systematic risk. In essence, the size premium implies that the CAPM is not a "complete" asset pricing model.

Our research is not contrary to Berk's reasoning. Berk questions the soundness of treating small size premium as abnormal, but our research, by comparing the excess return of large size and small size, finds out that in recent years small size premium becomes less significant. There are two possibilities for this evidence. First, it is possible that the other three factors (size, value, momentum) are sufficient to explain abnormal return so there is less place for the size to capture other things as predicted by the Berk claim. A second possibility is there was a structural change in the economy that leads to a period in which large firms outperformed small firms, but this would not consistent in the future. The future will tell which of these two explanations is more descriptive of the data. According to the first possibility, we should not expect a size premium in the future; according to the second possibility, the size premium exists, and we should expect the size effect to re-emerge.

2.2.2 More concentrated product industry

As just discussed, one explanation for the reduced size effect, is that larger corporations have recently gained a considerably large market power. Grullon, Larkin, and Michaely (2018) dig it deeper and point out that a change in the concentration index

can significantly explain the profit growth of product corporations in the US. This profit change would also have a positive effect on stock return. They compared the abnormal return of three periods, 1972-1986, 1987-2000 and 2001-2014 and, interestingly, argue that this positive relation between concentration level and stock return is much more significant in 2001-2014 than in 1972-1986 and 1987-2000. Specifically, a zero-investment strategy longing firms in industries with the largest increase in concentration level while shorting firms in industries with the largest decrease in concentration level would generate an excess return of 8.2% yearly. This means a considerable portion of the gain is accrued to shareholders in concentrated industries.

2.2.3 More M&A targeted to small-size firms

Gao, Ritter, and Zhu (2013), through researching IPO volumes in recent decades, find that IPO number has declined a lot due to the economy of scale. They argue that the fundamental reason is a decline in small size firm profitability due to change in technology innovation and globalization. Hence, small size private firms are more willing to choose being acquired instead of going to public. They also compare small companies excess return with market and with the style-matched seasoned firm. This comparison indicates that small companies IPOs have underperformed their style-matched firms. Though they define small size firms using a cut-off of $50 million (2009 purchasing power), which is not in the same format of us, their research is in line with our discovery because large-size firms grab potential growth opportunity by acquiring small size firms in which the general public cannot invest in.

3. Data

3.1 Data Period and Source

All data collected from this research is from the period of 1998-2017. We pick this time period because it includes an exact two decades of information, including two important periods: the 2002 dot-com bubble, and the 2008 financial crisis. Importantly, the entire period is after the documentation of the size effect, as well as the popularity of the Fama and French (1993) and Carhart (1997) model, which we use thorough the study. Our main data source consists of merged data from dataset of CRSP all firms monthly file as well as Fama-French 3 factors and Carhart momentum factors data.

3.2 CRSP firms monthly file

We use the monthly return file of CRPS. All firms that are listed on NYSE, Amex, and NASDAQ are included. For each firm we extract the following information: stock price, shares outstanding, and holding period stock return.

3.3 Fama-French-Carhart 4 factors

To get an abnormal return, we use monthly Fama-French 3 factors data and Carhart momentum factor. These include Market excess return (Market Return minus Risk-Free Return), SMB (Small minus Big), HML (High minus Low) and PR1YR (Prior one-year Momentum). We also download separately the risk-free return to generate the excess monthly return for each stock.

3.4 Data

We define size by market value (the price of share times number of shares outstanding). We expect that the time frame chosen for rebalancing portfolio based on

size may affect our result significantly, so we decide to sort firms to large in small over different years periods. We sort firms yearly, bi-yearly and every five years by their market value in the t-1 month of the comparing periods. For example, for a five-year period, we decide a firm's size by ranking its market value in t-1 month and then measure monthly alpha for a five-year period from t to t+60 months. Then we mark firms that range in the top 30% and bottom 30% as large and small. Notably, our yearly sorting is essentially a pure cross-sectional way as done by Fama and French.

4. Methodology

We use four methodologies to examine the size premium. The first methodology is to use the four Fama-French-Carhart factors to get a particular alpha of large size firms and small size firms, respectively. Then we test the significance of the difference between these two groups' alphas over the years, under different rebalancing periods (1 year, 2 years, and 5 years). The second methodology is to descriptively analyze the SMB factor of Fama French, which in general should yield similar results to the one-year rebalancing of method one if NASDAQ firms behave similarly to the NYSE firms. The third methodology is to use the logarithm of market value as an explanatory variable along with other 3 factors to check the relation between size and return. To control firm-fixed effect and year-fixed effect, we also include dummy variables of years and firms in this regression. The fourth methodology is the calendar approach that generates a long-short zero investment portfolio, which longs top-30% -size firms while shorts bottom-30%-size firms, in both value-weighted and equal-weighted ways. Then we run regressions of return from both portfolios with CAPM model and Fama-French factors.

4.1 Methodology One – Difference in the mean of abnormal return

For every frim, we run a regression of

$$E[R_s] - r_f = \alpha + \beta_s^{Mkt}\left(E[R_{Mkt}] - r_f\right) + \beta_s^{HML}E[R_{HML}] + \beta_s^{PR1YR}E[R_{PR1YR}]$$

Since we subtract the SMB factor from this regression, the size factor would be absorbed into alpha (abnormal return).

By sorting firms into groups, we partition firm into large in small based on different rebalancing choices: each year, every two years, and every five years. We then

check the abnormal return (alpha) in the following one year, two years, and five years – which by definition correspond to 12, 24, and 60 monthly observation for each firm-period analysis. We use t-test to check the difference between means of alphas of large firms and small firms as below:

$$\begin{cases} \mathrm{E}(\alpha_{large}) = \dfrac{\sum_{i=large} \alpha_i}{N_{large}} \\ E(\alpha_{small}) = \dfrac{\sum_{i=small} \alpha_i}{N_{small}} \\ MeanDiff = E(\alpha_{large}) - E(\alpha_{small}) \end{cases}$$

Table 1 shows t-test result of this methodology. Panel A provides that 15 out of 20 years, mean differences are negative, indicating a small size premium. However, only 4 out of these 15 negative mean differences are significant. That is acceptable, because the relation between expected return and realized return may not be significant every year, similar to the case in which high market beta firms may not outperform low market beta firms every year. However, note that five the years leading to the crises show positive mean differences, which are significant. Notably, 4 out of 5 positive mean differences are significant. This result shows the size-premium is quite unstable.

Another notable common feature for Panel A is that most of the size premium emerge soon after economic recessions. Significant numbers show up in 2001, 2002 and 2003 which are years just following 2001's recession as well as in 2009 and 2010 which are following 2008's recession.

In order to observe influence caused by including time-series feature, we repeat this process by sorting and rebalancing every two years. Panel B of Table 1 shows results for two years rebalancing and finds that 5 out of 10 the mean differences are negative

(reflecting a small size premium), of which three are significant. However, only 2 out of 5 positive mean differences are significant. Overall, the evidence of a small size premium in two years rebalancing is weak.

Panel C of Table 1 shows results when rebalancing takes place every 5 years. That long-period rebalancing means we follow the growth of firms over long period. Hence, one important contribution of our analysis is that we distinguish between different ways in which the size premium can be perceived. If we rebalance every year, we basically rely on cross-sectional explanatory power; but with longer rebalancing periods, we rely more on the effect of size for a given firm over time. In essence, there is a difference between investing in small size firms for long period because they have high potential growth rate and investing in a small size companies and quitting immediately when its size becomes large (for example, after a year). When we take 5 years to adjust size of firms, we get only one of the four alphas being negative and significant. Namely, results are quite different than before. In Panel C, from 1998-2002, a significant size premium exists but in 2008-2012 period it gets reversed.

4.2 Methodology Two – Feature of accumulated SMB factor

Figure 1 shows the trend of accumulated standardized SMB factor. The standardized monthly size factor is defined as the monthly size factor minus the mean of monthly size factor (over the entire sample) divided by the standard deviation of the size factor (over the entire sample period). An increase of accumulated SMB factor return would indicate the existence of size premium while a decreasing of accumulated SMB factor return would indicate a reversed size premium (large firms perform better). A quite obvious feature of Figure 1 is SMB factor was negative in the beginning of 2000 and

gradually climbed up to be positive until 2005. Since then, size premium did not change too much until 2008. From early 2009 to late 2011, size premium increased a lot, but it became zero or even slightly negative after 2012 (indicated by a decreasing accumulated SMB factor). One interesting summary of this is the strong SMB resilience after recessions, for instance, the resilience after 2000 and 2009. This is consistent with what we find in Panel A of Table 1.

4.3 Methodology Three – Regression with the logarithm of market value

In our methodology one, the size factor is not in controlled form, so in essence it should be captured by the alpha. Thus, the analysis does not really control for size effect, but rather lets size effect enter indirectly into alpha. To improve the robustness of our research, we also run regressions in a straightforward way, in which we use the logarithm of market value as a new explanatory variable as below:

$$E[R] - r = \alpha + \sum \beta_s D_s + \beta^{Mkt}\left(E[R_{Mkt}] - r_f\right) + \beta^{HML}E[R_{HML}] + \beta^{PR1YR}E[R_{PR1YR}] + \beta^{size}Log(Market\ Value) \quad (1)$$

$$E[R] - r = \alpha + \sum_{t=1998}^{2017} \beta_t D_t + \sum \beta_s D_s + + \beta^{Mkt}\left(E[R_{Mkt}] - r_f\right) + \beta^{HML}E[R_{HML}] + \beta^{PR1YR}E[R_{PR1YR}] + \beta^{size}Log(Market\ Value) \quad (2)$$

Where: $\sum_{t=1998}^{2017} \beta_t D_t = \beta_1 D_{1998+} \beta_2 D_{1999+} + \cdots + \beta_{20} D_{2017}$,

$$D_t = 1\ if\ year = t;\ 0\ if\ year \neq t$$

$$\sum \beta_s\ D_s = \beta_1 D_1 + \beta_2 D_2 + \cdots + \beta_{number\ of\ firms} D_{number\ of\ firms}$$

$$D_s = 1\ if\ firm = s;\ 0\ if\ firm \neq s$$

Regression (1) contains Fama-French-Carhart factors model (without size factor), logarithm of firms' market value, and firms dummy variables. Regression (2) contains Fama-French-Carhart factors model (without size factor), logarithm of firms' market

value, firms dummy variables and years dummy variables. The difference between regression (1) and (2) is that (1) does not waive out time series effect while (2) does. We measure firms' size end of year and run the regression with return data of the following year. Plus, we do not separate firms by size percentile group. In other words, all firms are included in this regression. We assign same β for all firms and check sign and significance of β for different factors. Table 2 shows that β^{Size} is negative and significant, no matter before or after we control time fixed effect by adding year dummies ($-.0224049^{***}$, $-.0224676^{***}$). This indicates the existence of size premium. Notably, adjusted R-square has increased from 0.0928 to 0.0952 after adding year dummies variables, which means controlling time fixed effect does help increasing explanatory power of regression.

4.4 Methodology Four – Size premium in the long-short portfolio

We next use the calendar time portfolio approach to see if we can actually receive trading profits by investing in small firms. The advantage of this approach is well understood in the literature, as it eliminates correlation in returns which may occur because of clustering of events, such as IPO waves.

In this methodology, both value-weighted and equal-weighted zero-investment portfolios, which long top 30% size firms while short bottom 30% size firms in the same time, have been constructed. Then we run regressions of this portfolio's return within CAPM, Fama-French-Carhart Factors models without size factor, and Fama-French-Carhart models with size factor, separately. All of these three models will yield an abnormal return which cannot be explained by the respective model. Then, through checking the sign and significance of these abnormal returns (α), we can understand

whether a small size premium exists. The reason why we run three regressions is we want to see how alpha changes after adding new factors, i.e., how do the risk factors contribute to return. We would like to highlight that if factors are independent and relevant to return, after adding more factors, alpha should decrease. Specifically, we rebalance portfolios every year in this methodology and the regressions we run are the following:

$$R_{port} = R_{large} - R_{small} = \alpha + \beta_s^{Mkt}\left(E[R_{Mkt}] - r_f\right)$$

$$R_{port} = \alpha + \beta_s^{Mkt}\left(E[R_{Mkt}] - r_f\right) + \beta_s^{HML}E[R_{HML}] + \beta_s^{PR1YR}E[R_{PR1YR}]$$

$$R_{port} = \alpha + \beta_s^{Mkt}\left(E[R_{Mkt}] - r_f\right) + \beta_s^{HML}E[R_{HML}] + \beta_s^{PR1YR}E[R_{PR1YR}] + \beta_s^{SMB}E[R_{SMB}]$$

Panel A of Table 3 shows the 3 regressions results under the value-weighted return specification. We can see that across the three regressions, the long – short portfolio yields a significantly negative alpha, implying a small size premium. Additionally, we find alpha is decreasing after we add new factors, this means these factors have good independence and relevance features. Besides, SMB coefficient is significantly negative. This result perfectly matches our anticipation and shows the existence of the small size premium. Besides, when size factor gets controlled, adjusted R-square becomes much larger in long-short, which indicates including size factor can increase explanatory power.

Interestingly, Table 3 also shows that small firms have a smaller (Mkt-R_f) beta in every regression in this methodology. This is an evident sign that CAMP is not sufficient to explain all systematic risk, in line with Fama and French (1992).

Another information we get from methodology one and methodology two is that size premium is relevant to economic recessions. So, in order to check the 2008 Financial Crisis's influence on size premium, we also run the same three regressions before and after 2008 separately. Panel B of Table 3 shows us that portfolio's alphas are significant before the Crisis but become insignificant after the Crisis. Since size premium is included in alphas of CAPM and Fama-French-Carhart Factors Model (without the size factor), this means size premium should not be significant. However, interestingly, β^{SMB} in Fama-French-Carhart 4 factors model is still significant. A possible explanation is that the selected factors could not completely capture all the variation in expected returns.

In equal-weighted specification, we discover new results. Panel C of Table 3 shows us same significant level of alphas and SMB coefficients as in Panel A. This proves that a size premium existence during the 20 years period. However, in Panel D where we compare conditions before and after the crisis, the alpha and β^{SMB} in Fama-French-Carhart Factors model with the size factor included are negative and significant before 2008, but insignificant after 2008. Also, since alphas are not significant, we have the confidence to argue that Fama-French-Carhart Factors model have explained well of portfolios' return. Therefore, we draw a conclusion that size premium exists before the crisis but the evidence of it in the last decade is very limited.

5. Conclusion

Using four different methodologies, we analyze the small-size premium. We do not have sufficient information to understand the reason behind recent changes, but we do provide some evidence that makes future research worthwhile. First, we find that the small-size premium tends to be highest after periods of recession, i.e., after the recession of 2001 and after the financial crises of 2008. Second, the small size premium tends to be predominant in a cross-sectional regression – if we balance portfolio every year, the results of a premium are stronger than if we balance every two or five years. Third, the premium does seem to exist also in the time-series (methodology three), after we control for firm fixed-effects. Fourth, apart from a short period immediately after the crises, it is rather evident in the data that the size premium in the last 10 years has basically been zero.

Appendices

Table 1. *The table provides descriptive information on abnormal returns generated by estimating annual regressions based on monthly return and factor data. The estimated regression is:* $E[R_s] - r_s = \alpha + \beta_s^{Mkt}\left(E[R_{Mkt}] - r_f\right) + \beta_s^{HML}E[R_{HML}] + \beta_s^{PR1YR}E[R_{PR1YR}]$*, where the size factor (SMB) is not included in the estimation. Numbers below in Panel A, Panel B and Panel C are mean of alpha (intercept) of this regression correspond to one-year, two-years and five-years rebalancing periods. Since SMB factor is not in the regression, alpha does absorb SMB. A positive mean difference indicates large-size firms perform better while a negative mean difference indicates small-size firms perform better. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.*

Panel A: The significance of alpha (rebalance yearly)

Years	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Big-size	-0.0130	0.0070	0.0044	0.0145	0.0047	0.0060	0.0053	-0.0006	0.0138	0.0023
Small-size	-0.0019	0.0171	0.0256	0.0262	0.0215	0.0356	0.0044	-0.0114	-0.4639	-0.0090
Difference (big-small)	**-0.0111**	**-0.0100**	**-0.0212^{***}**	**-0.0117**	**-0.0168**	**-0.0296^{***}**	**0.0009**	**0.0108^{***}**	**0.4777^{**}**	**0.0113^{***}**
Degrees of freedom	5659	5451	5358	4884	4497	4238	4204	4235	4253	4412
t-value	-0.822	-1.272	-4.068	-0.869	-1.092	-3.402	0.355	6.324	1.720	4.132
Years	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Big-size	0.0107	0.0012	0.0043	-0.0063	0.0028	-0.0059	-0.0051	-0.0024	-0.0016	0.0093
Small-size	-0.0172	0.0146	0.0251	-0.0050	0.0041	-0.0046	-0.0047	-0.0046	-0.0004	0.0206
Difference (big-small)	**0.0278^{***}**	**-0.0134^{**}**	**-0.0208^{***}**	**-0.0013**	**-0.0013**	**-0.0013**	**-0.0004**	**0.0022**	**-0.0012**	**-0.0113**
Degrees of freedom	4290	4104	4121	4166	4165	4184	4333	4435	4461	4484
t-value	8.935	-2.315	-2.983	-0.526	-0.281	-0.264	-0.302	0.766	-0.583	-0.946

Panel B: The significance of alpha (rebalance bi-yearly)

Years	**1998-99**	**2000-01**	**2002-03**	**2004-05**	**2006-07**
Big-size	0.0021	0.0218	0.0051	0.0010	-0.0023
Small-size	0.0103	0.0400	0.0218	-0.0011	-0.0061
Difference (big-small)	$\mathbf{-0.0082}^{**}$	$\mathbf{-0.0183}^{***}$	**-0.0167**	**0.0021**	$\mathbf{0.0037}^{*}$
Degrees of freedom	6110	5559	4691	4508	4701
t-value	-2.214	-4.725	-1.223	1.327	1.868
Years	**2008-09**	**2010-11**	**2012-13**	**2014-15**	**2016-17**
Big-size	0.0069	-0.0016	0.0002	-0.0045	-0.0014
Small-size	-0.0060	0.0153	0.0018	-0.0074	-0.0018
Difference (big-small)	$\mathbf{0.0130}^{***}$	$\mathbf{-0.0169}^{***}$	**-0.0016**	**0.0029**	**0.0005**
Degrees of freedom	4456	4415	4461	4676	4787
t-value	4.793	-2.660	-0.379	1.083	0.255

Panel C: The significance of alpha (rebalance every five years)

Years	1998-02	2003-07	2008-12	2013-17
Big-size	0.0057	-0.0019	0.0029	-0.0004
Small-size	0.0145	-0.0029	-0.0057	-0.0013
Difference (big-small)	$\mathbf{-0.0089}^{***}$	**0.0010**	$\mathbf{0.0086}^{***}$	**0.0009**
Degrees of freedom	7001	5594	5314	5495
t-value	-3.831	0.157	4.444	0.302

Table 2. *The table provides the coefficients and intercepts of regressions with firm-cluster and firm-absorb function. Two columns of the table compare results with and without year dummies. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.*

	Without year dummy	**With year dummy**
Alphas	$.1300932^{***}$	$.1011214^{***}$
Mkt-R_f	1.024542^{***}	1.029779^{***}
HML	$-.1260469^{***}$	$-.1597881^{***}$
UMD	$-.1545533^{***}$	$-.1371686^{***}$
Log-size	$\mathbf{-.0224049}^{***}$	$\mathbf{-.0224676}^{***}$
Observations	1,646,194	1,646,194
Adj. clusters	19,069	19,069
Adj. R-squared	**0.0928**	**0.0952**

Table 3. *The table provides calendar time portfolio regression results. Panel A-B are of value-weighted portfolio and Panel C-D are of equal-weighted portfolio. Portfolio of Large and Small are formed at the end of year t-1 based on whether the market value of equity above 70% or below 30% of market cap of all firms. The table provides CAPM model results, the Fama-French and Carhart model without and with the size factor (SMB). Firms' sizes are sorted yearly by market value in the t-1 month of the observing year. Three portfolios are generated, including large-size portfolio, small-size portfolio, and large-minus-small portfolio in both value-weighted and equal-weighted specifications. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.*

Panel A: alpha and beta of regressions (1998-2017, value-weighted)

	Large	**Small**	**Long large and Short Small**
CAPM			
Alpha	-0.0003	0.0056^{*}	-0.0059^{*}
Mkt-R_f	1.0006^{***}	0.9811^{***}	0.0195
Observations	240	240	240
Adj. R-squared	0.993	0.423	-0.004
Fama-French and Carhart without size			
Alpha	-0.0002	0.0076^{**}	-0.0078^{**}
Mkt-R_f	0.9974^{***}	0.863^{***}	0.1344^{*}
HML	-0.0086	-0.3701^{***}	0.3616^{***}
UMD	-0.0065	-0.2274^{***}	0.2209^{***}
Observations	240	240	240
Adj. R-squared	0.993	0.463	0.063
Fama-French and Carhart 4 Factors			
Alpha	-0.0002	0.0067^{**}	-0.007^{***}
Mkt-R_f	1.0015^{***}	0.677^{***}	0.3244^{***}
HML	-0.0124	-0.1932^{**}	0.1808^{**}
UMD	-0.0047	-0.3107^{***}	0.306^{***}
SMB	-0.019^{**}	0.8771^{***}	-0.8961^{***}
Observations	240	240	240
Adj. R-squared	0.994	0.632	0.372

Panel B: The Financial Crisis impact to portfolio returns (value-weighted)

	Before Crisis (1998-2007)			After Crisis (2008-2018)		
	Large	**Small**	**Long large and Short Small**	**Large**	**Small**	**Long large and Short Small**
CAPM						
Alpha	0.0004*	0.0129**	−0.0124**	−0.0010**	-0.0016	0.0006
Mkt-R_f	0.9955***	1.0326***	-0.0371	1.0073***	0.9475***	0.0598
Observations	120	120	120	120	120	120
Adj. R-squared	0.997	0.328	-0.008	0.990	0.679	0.001
Fama-French and Carhart without size						
Alpha	0.0004	0.0176***	−0.0172***	−0.0011***	-0.0015	0.0004
Mkt-R_f	0.9985***	0.7369***	0.2617*	1.0078***	0.8586***	0.1492**
HML	0.0072	−0.6118***	0.6190***	−0.0561***	−0.1987**	0.1425
UMD	0.0007	−0.1993*	0.2000*	−0.0259***	−0.3074***	0.2815***
Observations	120	120	120	120	120	120
Adj. R-squared	0.997	0.380	0.072	0.991	0.742	0.177
Fama-French and Carhart 4 Factors						
Alpha	0.0004*	0.0146***	−0.0142***	−0.0011***	-0.0016	0.0005
Mkt-R_f	0.9992***	0.6515***	0.3476***	1.0157***	0.8001***	0.2156***
HML	0.0032	-0.0986	0.1019	−0.0519***	−0.2297**	0.1778**
UMD	0.0021	−0.3704***	0.3725***	−0.0255***	−0.3110***	0.2855***
SMB	-0.0082	1.0710***	−1.0793***	−0.0474***	0.3511***	−0.3985***
Observations	120	120	120	120	120	120
Adj. R-squared	0.997	0.618	0.431	0.992	0.763	0.267

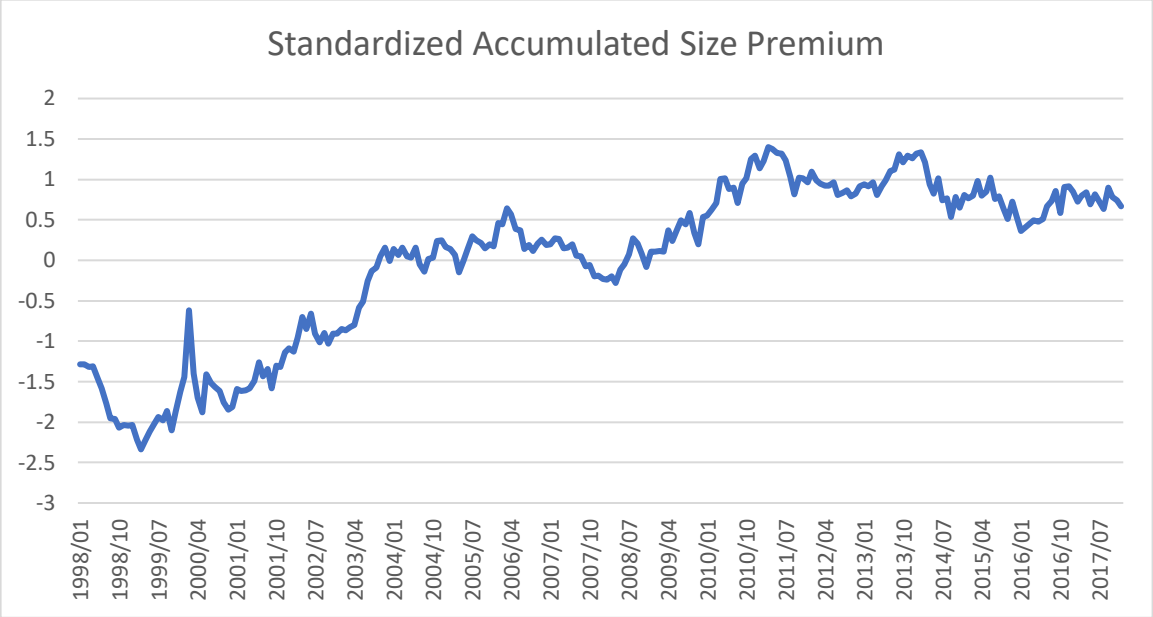
Panel C: alpha and beta of regressions (1998-2017, equal-weighted)

	Large	**Small**	**Long large and Short Small**
CAPM			
Alpha	0.0	0.0058^{**}	-0.0057^{**}
Mkt-R_f	1.1437^{***}	0.933^{***}	0.210^{***}
Observations	240	240	240
Adj. R-squared	0.91	0.48	0.05
Fama-French and Carhart without size			
Alpha	0.0004	0.0079^{***}	-0.0074^{***}
Mkt-R_f	1.1163^{***}	0.8040^{***}	0.3123^{***}
HML	-0.0005	-0.2585^{**}	0.2579^{***}
UMD	-0.0741^{**}	-0.2857^{**}	0.2116^{***}
Observations	240	240	240
Adj. R-squared	0.912	0.533	0.135
Fama-French and Carhart 4 Factors			
Alpha	0.0001	0.0072^{***}	-0.0071^{***}
Mkt-R_f	1.0325^{***}	0.6500^{***}	0.3825^{***}
HML	0.0792^{***}	-0.1119	0.1911^{**}
UMD	-0.1115^{**}	-0.3546^{**}	0.2431^{***}
SMB	0.3951^{***}	0.7263^{***}	-0.3312^{***}
Observations	240	240	240
Adj. R-squared	0.967	0.677	0.203

Panel D: The Financial Crisis impact to portfolio returns (equal-weighted)

	Before Crisis (1998-2007)			After Crisis (2008-2018)		
	Large	**Small**	**Long large and Short Small**	**Large**	**Small**	**Long large and Short Small**
CAPM						
Alpha	0.0014	0.0114**	−0.0100**	-0.0014	0.0002	-0.0016
Mkt-R_f	1.1276***	0.9611***	0.1665*	1.1629***	0.9194***	0.2435***
Observations	120	120	120	120	120	120
Adj. R-squared	0.875	0.386	0.016	0.942	0.658	0.148
Fama-French and Carhart without size						
Alpha	0.0019	0.0157***	-0.0138***	-0.0012	0.0004	-0.0016
Mkt-R_f	1.1050***	0.7301***	0.3748***	1.1113***	0.8068***	0.3045***
HML	-0.0240	−0.3953**	0.3713***	-0.0172	−0.2023**	0.1851**
UMD	-0.0433	−0.2571***	0.2137***	−0.1312***	−0.3655***	0.2343***
Observations	120	120	120	120	120	120
Adj. R-squared	0.875	0.436	0.095	0.954	0.752	0.273
Fama-French and Carhart 4 Factors						
Alpha	0.0007	0.0131***	−0.0125***	−0.0013*	0.0003	-0.0016
Mkt-R_f	1.0699***	0.6577***	0.4123***	1.0496***	0.7566***	0.2930***
HML	0.1868***	0.0407	0.1461	-0.0500	−0.2289**	0.1789**
UMD	−0.1136***	−0.4025***	0.2889***	−0.1349***	−0.3686***	0.2336***
SMB	0.4398***	0.9098***	−0.4700***	0.3708***	0.3015***	0.0693
Observations	120	120	120	120	120	120
Adj. R-squared	0.964	0.670	0.217	0.977	0.767	0.270

Figure 1. *The size premium over time. The figure depicts the standardized accumulated size factor of monthly data. The standardized monthly size factor is defined as the monthly size factor minus the mean monthly size factor (over the entire sample) divided by the standard deviation of the size factor (over the entire sample period).*



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