Size Still Matters!*

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Abstract

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Key Words: cross-sectional stock returns, delisting, factor model, firm size.

Introduction

The size effect is first uncovered by Banz (1981), when he finds that the average returns of small stocks are much higher than those of larger stocks traded on the NYSE. This finding is further advocated by Fama and French (1992) in testing the joint roles of market beta, size, book-to-market ratio, leverage and earnings price ratio in explaining the average stock returns over the sample period of 1963-1990. Their study presents strong evidence on the predictive power of the size and the book-to-market variables for future stock returns, which becomes the foundation for the popular Fama and French three-factor model applied in many fields of finance.

Despite the empirical success, many researchers have challenged the validity and the robustness of the size and the book-to-market factors. For example, Kothari, Shanken, and Sloan (1995) point out a selection bias when constructing the book-to-market factor from COMPUSTAT. Loughran (1997) claims that Fama and French's (1992) findings are driven by two features of their data: January seasonal in the book-to-market ratio, and exceptionally low returns on small, young, growth stocks. He further shows that the size effect is absent for the non-January months. Similarly, Horowitz, Loughran and Savin (1999) apply three methods to test the effectiveness of size effect, and report no consistent relation between size and realized return. Perhaps, research from the "theoretical" side is more promising, linking size and book-to-market variables to firm fundamental risks and business cycle risks.

Given the diminishing explanatory power of the market factor, the need for a multi-factor model, such as the Fama and French model, is even greater in recent decades. This paper reexamines the disappearance of the size effect, and proposes a simple fix. If size is a proxy for certain risk factors that are not completely captured by the market factor, such a factor should be consistently significant as long as the general

structure and the pricing environment remain unchanged. Unfortunately, this is not the case. Reasons leading to a different significance level include fewer firms from the data base, and the abnormal return behavior before being delisted. But we do show that eliminating or reducing the delisting effect would allow us to restore the size effect in a rather robust way.

According to the life-cycle theory of firms (Mueller (1972)), a typical firm will experience five or six stages from existence or decline. Although the risk faced by a firm could be different in each stage, the risk in the last stage should be distinctively different from others since the firm is experiencing the ultimate death in that stage. In fact, this is not the kind of risk modeled in existing asset pricing models. Moreover, firms to be delisted usually experience even more fundamental changes in their financing or structures. Therefore, the risk and return relation could be very different in the last stage, which implies that we should not include information from the last episode in testing an asset pricing model. The unique return behavior during the delisting period has been discussed in some prior studies. For example, Shumway (1997) has constructed post delisting returns of a security from the over-the-counter information, and find that the overall size effect has dropped substantially. This evidence suggests a significant impact of delisted returns on the size effect, but it is unclear why the delisted returns should be considered. Vassalou and Xing (2004) claim that firm's default risk is also a component of the systematic risk, hence directly relates it to the equity return. Likewise, if firm returns in the dying episode is more related to financial distress costs, the behavior of individual stocks during the delisting period would be very different from that before delisting.

We hypothesize that the size variable might be a good proxy for risks occurred during the "normal" stages of the life-cycle of a firm. Unless we can effectively control for the risk factors occurred in the last stage, the effectiveness of the size effect might be

adversely affected. No financial distress occurs overnight, so there should be a period leading to the delisting decision. We then investigate whether the disappearance of size effect is driven by the pre-delisting performance of firms from the CRSP stock file. Such a focus can also be justified from a statistical perspective. In particular, returns during such extraordinary periods might be considered as outliers, which should be excluded.[1] A possible argument against our approach is the potential survivorship bias that might lead to high returns. Again, it is not a major concern in our setting because the delisted firms include both merged firms, which tend to do well, and financially distressed firms, which tend to do poorly. Therefore, in contrast to Shumway's (1997) approach of patching returns after delisting, we assume that these firms are experiencing a structure break, and propose to exclude data prior to the delist date in order to better investigate the significance of size effect.

Following Fama and French (1992), we replicate their findings of both strong size and book-to-market effects from cross-sectional regressions over the earlier sample period from 1963 to 1986. However, the size variable does not seem to explain cross-sectional return differences of individual stocks in the more recent sub-sample period of 1986-2011, which confirms recent findings in the literature. To resolve the issue, we define returns up to one year before the delist date for all delisted firms as the delisted returns in the following discussions. When running Fama-Macbeth regressions on the delisted sample, we find that the delisted return is positively related to the firm size in the recent sub-sample period. It is such a positive relation that offsets the original negative size effect, thus weakens the overall size premium for the full sample. Indeed, after excluding all delisted returns, we find that the negative size effect is rather strong in the overall sample period. The pattern continues even in the recent sub-sample period, as long as the sample is free of delisted returns. Therefore, the size effect is

[1]In general, deleting observations may potentially alter the return distribution. However, if we believe the structure in the last stage is different, this is not an issue.

still alive!

It is true that our definition of a delist period depends on ex-post information of delisting, which may subject to a forward-looking bias. From an economic perspective, however, this is not an issue just like estimating a structure break model. Our purpose here is to investigate a "true" economic relation conditioning on the true economic structure which is only known ex-post. Instead, we conduct a series of robustness study on above findings. First, we control for the possible non-linearity of the size variable, and our result suggests that firm size is still significant in explaining the cross-sectional return difference when the delisted sample is excluded. Second, prior studies have documented certain unique characteristics of ADR stocks (American Depositary Receipts), and there is an increasing number of ADRs nowadays. We construct a sub-sample test by excluding these ADR stocks from the full sample to see whether the size effect still holds. Likewise, previous studies have suggested that the observed size effect is concentrated mainly among smaller or younger firms. We construct a second sub-sample by focusing on NASDAQ firms. Again, running Fama-Macbeth cross-sectional regressions on both sub-samples, we continue to find significant size effect.

Firms are being delisted from their current stock exchanges for various reasons. About 97% cases are related to either the merger and acquisition activities or inability to meet the requirements of current stock exchanges. Therefore, we classify each delisted return into either the Merge group or the Drop group by assigning a dummy variable to each group respectively. Our evidence suggests that the Merge group return is positively related to firm size, while Drop group exhibits a negative size premium. This evidence suggests when a relatively large firm being acquired, it has a relatively large bargaining power, which results a high premium. Similarly, a relatively large firm is more difficult to restructure than small firms when they are close to bankruptcy, which tends to have high distress costs or lower returns. On average, the magnitude of

the positive effect from the Merge group is much larger than the negative effect of the Drop group, which leads to the overall positive size effect for the delisted sample.

Liu and Strong (2008) argue that rational investors would undoubtedly revise their investment weights based on the performance of each security, hence using equal- or value-weighted portfolios over a multi-period horizon would lead to biased results. They propose a buy-and-hold methodology to compute the decomposed portfolio returns, the weights of which rely on the stocks' performance over previous holding-period months. Their evidence suggests that size premium significantly disappears after employing this buy-and-hold strategy. We also construct the buy-and-hold decomposed portfolio returns, and find that the negative size premium remains solid as long as the delisted returns are adjusted.

In addition, we pursue a time-series investigation in a setting similar to Fama and French (1993). In particular, we construct a new set of SMB, HML and UMD factors free of delisted returns.[2] Regressing the Fama and French 48-industry portfolio returns on standard and new factors respectively, we find that the time-series prediction error is much smaller when using the newly constructed factors. In this sense, the new set of factors adjusted for delisting effect is more efficient in explaining stock returns. We also re-estimate Fama and French 48-industry portfolio returns after excluding all delisted returns, and re-perform the above tests. Again, the new factors turn to be better predictors.

This paper contributes to the empirical asset pricing literature in two important ways. First, we restore the Fama and French (1992)'s size effect, especially in the recent sub-sample period. This is important from an empirical perspective since the

[2]In order to avoid the so-called forward-looking bias from a practical perspective, we use the original Fama and French factor returns in the last year as the factor returns for these newly constructed factors instead.

size variable is widely used and could serve as an effective proxy for some missing risk factors. Second, we demonstrate the crucial impact of delisted returns on the relation between size and return of individual stocks. This finding not only proves the structural difference between the growth stage versus the decline stage of a firm in terms of risk, but also allows us to reconcile the debate on the existence of the size effect. Given the increasing trend of delisting activities in recent years and their special return behavior, future research should pay special attention to these delisted returns in related asset pricing tests. Otherwise, results might be biased or inconsistent.

The remainder of the paper is organized as follows. The next section motivates our approach in restoring the size effect and describes sample selection and illustrates research design. Section 2 discusses our main empirical results and their implications. Section 3 conducts robustness study. Finally, section 4 provides concluding comments.

1 Data and Methodology

1.1 The Importance of Delisting Period

The traditional Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1995) and Black (1972) is elegant, and predicts that the expected returns of individual stocks are determined solely by the covariance risk with the market portfolio. In reality, this is hardly the case due to Roll's critique and market imperfections. Empirical studies of the CAPM have discovered many anomalies, including the size effect that was first documented by Banz (1981). What is significant about the size effect is that small firms seem to earn much higher returns than large firms even after controlling for the market risk. Fama and French (1992, 1993) have made this idea popular by incorporating the size factor into a three-factor model.

Evidence in supporting the size effect has been increasingly mixed. After showing the strong evidence by Fama and French (1992), Barber and Lyon (1997) further demonstrate that the negative/positive relation between stock returns and size/book-to-market ratios is similar for both financial and nonfinancial firms. In addition, they claim that the possible survivorship bias in COMPUSTAT data is unlikely to affect such relations. Dijk (2011) also documents that the size effect is substantial and robust even in recent years. At the same time, however, many other studies find contradictory evidence against the size effect. Loughran (1997) suggests that Fama and French's (1992) result is driven by two features of their data: January seasonal in the book-to-market ratio, and exceptionally low returns on small, young, growth stocks. His findings suggest that the size effect no longer exists in non-January months. Kim (1997) also reexamines the results of Fama and French (1992) by filling in the missing data on COMPUSTAT with records from Moody's. After correcting the selection bias of the database, he argues that the size effect is barely significant. Knez and Ready (1997) conduct a robust check in analyzing premia of the size and book-to-market proxies. After trimming out one percent of the most extreme observations from each month, they see that the size effect disappears completely. Horowitz, Loughran and Savin (1999) apply three methods to test the effectiveness of size effect, and find no consistent relation between firm size and realized return. Daniel, Titman and Wei (2001) further examine the size effect using Japanese stock returns during 1975-1997, but find inconsistent evidence against Fama and French (1992).

From a theoretical perspective, size itself can never be a pricing factor (see Cochrane, 2001) since a priced risk factor can never be diversified away. Instead, size can only serve as a good proxy for other missing risk factors. As Berk (1997) first points out that, for two identical firms except for risk, the firm with high risk will have smaller market value than the firm with smaller risk if risk and return are related to each other.

This suggests that the size variable could potentially be a sufficient statistics for "all" the pricing factors. In other words, the size variable is usually to be more powerful in explaining the cross-sectional return differences than the CAPM beta at least over the early sample period. At the same time, Campbell (1991) also shows that surprises in return are not only determined by news on future discount factors but also by news about future cash flows. Since the size variable is more related to the former than the latter, the explanatory power of the size variable should be stable as long as the relative importance of the two factors unchanged.

As long as we believe the life-cycle theory of a firm, the relative significance of the two factors will be very different in different states of a firm's life-cycle, especially in the last stage. When a firm is in financial distress, cash flow news could outweigh the discount rate news, which might make the size variable less significant. More important, the kind of risks facing a firm in the growth stage versus in the dying stage could be very different. If most asset pricing models model the risk-return relation in the normal growth stage, the size variable might only be a sufficient statistics during the normal growth stage of a firm, which means that we should not expect the size variable to proxy for risks in both stages effectively. In aggregate, when the number of the delisted firms increases over time, the explanatory power of the size variable may be deteriorating.

A prior, the ability for the size variable to proxy for risk factors that investors care about during the normal growth stage of a firm may be different from that in the delisting period. In order to effectively evaluate the size effect, we propose to separate out the delisted period from the rest of the sample of a firm. In particular, this study reexamines whether the relation between size and stock return is pervasive and robust by taking a particular look at the behavior of stock returns before the delist date. No to lose generality, we define the delisting period as one year before the delisting date.

Results are generally stronger if using a longer delisting period.

Delisting activities have been increasing among stocks listed in all exchanges in recent years. A summary statistics about the delisting information from 1963-2011 is shown in Figure 1. As the figure shows, there is an apparent increasing trend in the percentage of delisted observations over time. The delisting ratio has increased from less than 1% in the 60's to over 10% in the past decade. In general, return distributions during delisting period are very different from those in the normal stage. When delisting becomes a pervasive phenomenon, cross-sectional return distribution might be affected. In turn, it will also affect what the size variable may proxy for during the delisting period. Hence, the so-called size effect may be different when close to the delist date. Consistent with this conjecture, Shumway (1997) applies over-the-counter information to calculate stock returns right after the firm is delisted instead. By including those delisting returns, he shows that the size effect is much weaker, which is mainly driven by the outperformance of small stocks after delisting. Similarly, Eisdorfer (2008a) claims that 40% of the momentum profits are generated by those delisting returns, especially among firms that finally went bankrupt.

Insert Figure 1 Approximately Here

Our view about delisting is somewhat different from these studies. If firms are likely subject to different types of risk in the delisting period due to structure changes, one should exclude the delisting period returns when investigating the general asset pricing relation. By doing so, we not only preserve the true pricing relation, but also might restore the real explanatory power of firm size. Different from existing studies, we propose a simple and practical approach to assess the size effect by focusing on returns under the "normal" structure of the investment environment. In particular, we

re-investigate how firm size explains cross-sectional stock return after excluding returns right before the delisting period.

1.2 Data description

Three data sets are used in this research. Book value of equity is from the COMPUSTAT industrial database. Trading information, including both daily and monthly stock returns, is from the Center for Research in Security Prices database (CRSP). Market portfolio return, SML, HML, UMD, and the risk-free rate are downloaded from Kenneth R. French's website. As a convention, we also focus on the Fama and French's 48-industry portfolio for the time-series study. Their returns are also obtained from the data library of Kenneth R. French.

Firm observations are selected into our sample when they appear on both the COMPUSTAT and the CRSP databases over the period from 1963 to 2011. The starting point of our sample is consistent with Fama and French (1992), because COMPUSTAT data prior to 1962 have serious selection bias. There are altogether 1,656,744 firm-month records for 14,392 individual firms in our sample. As a common practice, we drop financial institutions such as banks and insurance companies (firms with SIC codes from 6000 to 6999) due to their abnormally high leverages. All variables included in the regression are winsorized at the 0.5% level on both tails to avoid outliers. We also drop return observations with missing values in constructed control variables. The detailed construction of each variable is discussed below.

1.3 Research design

To ensure that accounting information is known before explaining returns, Fama and French (1992) match accounting data for fiscal yearends in calendar year $t-1$

with returns from July of year t to June of year $t+1$. In particular, a firm's market capitalization at December of year $t-1$ is used to compute its book-to-market ratio[3], and market capitalization at June of year t is used as a measure of its size. We employ the same matching strategies, and apply log size and the log book-to-market ratio for better distribution. Similarly, we follow Fama and French (1992) to estimate the beta measure. First, the pre-ranking beta for each individual firm is estimated by regressing its 24 to 60 monthly returns preceding July of year t (as available) on the market portfolio returns. Stocks are then sorted every June into portfolios based on NYSE size and pre-ranking beta. With ten size and ten pre-ranking beta deciles, we obtain the 100 size-beta sorted portfolios, and estimate post-ranking betas by fitting the market model to each equal-weighted portfolio's monthly returns. The portfolio beta would be reassigned to all individual stocks in this portfolio at a yearly basis, which would be used in the regression analysis and referred to as beta.

Delisting decisions made by stock exchanges do not occur suddenly. A stock can be delisted due to merger and acquisition, or deterioration in a firm's operation. To mitigate the impact of such fundamental changes in the risk structure of firms, we define one year before a stock's delisting dates as the delisting period, and separate the corresponding returns from the overall sample when testing the size effect. Given that Mergers and Dropped are the two main reasons for being delisted from their current exchanges, our choice of one year being the delisting period is consistent with the average duration of merger and financial distress. Napier (1989) suggests that a merger or acquisition usually takes more than one year from the initial discussion. Kennedy and Shaw (1991) claim that the median length of time between filing of the last annual report not disclosing bankruptcy concerns and the formal bankruptcy filing is about 12 months. Therefore, in balanceing the sample size and our ability to exclude

[3]Book value is measured as the common equity plus balance-sheet deferred taxes.

the special effect occurred during the delisting period, we define the one-year period before the delisting date as delisting period. After all, our results will be conservative if we can show much stronger size effect without the delisting period return information.

In order to ensure the robustness of our results, we divide the overall testing period into two sub-sample periods to study the possible changes in the size effect overtime. We further employ different sub-samples to see whether our findings are consistent. For instance, we separate ADRs and NASDAQ stocks from the overall sample due to their unique characteristics. Likewise, we use the delist code for each firm to classify the delisted firm into either a Merge firm or a Drop firm. If a firm is delisted due to merger and acquisition, we define a merger dummy variable to be equal to one. If a firm is delisted due to inability to meet the requirements of its current stock exchange or other negative shocks, we set the drop dummy variable equal to one. Therefore, we are able to examine whether the size effect differs among firms with different reasons of delisting. In all above empirical studies, we use the Fama-Macbeth regression with robust standard deviation estimates.

We also construct a decomposed multi-period buy-and-hold return following Liu and Strong (2008), who argue that size premium significantly shrinks after applying this strategy. By sorting all stocks according to their size every 12 months, we could directly investigate the size premium by comparing the return difference between the smallest group and the largest group. If we are able to restore the size effect after excluding delisted returns from the ordinary buy-and-hold portfolio returns, our argument on the effect of delisting continues to hold with solid evidence.

In addition to the cross-sectional evidence on the size effect, the Fama and French's three-factor model are useful and popular in capturing the time-series variations in security returns. As a result, we also test our hypothesis in a similar time-series setting.

We follow Fama and French (1993) to re-construct the standard SMB, HML and UMD factors without the delisted returns. From a practical perspective, we also employ a moving window approach to simulate a real situation where investors can apply our newly constructed factors. Our starting period is 1963-1986, which is the first half of the overall testing period. We then move forward by expanding the sample period by one year in every time-series regression analysis up to 2011. For comparison, we apply two sets of factors as independent variables: one set is composed of the original SMB, HML and UMD factors downloaded from Kenneth R. French's website, and the other set is our delisting adjusted factors. Since delisting decision is not observable beforehand, a second set of factors are constructed over, say 1963-1987 period, by concatenating returns from our newly built SMB, HML and UMD factors over 1963-1986 with the corresponding returns from standard SMB, HML and UMD for 1987. This is a conservative approach in adjusting for the delisting effect. To assess the performance of the delisting adjusted factors, we examine the intercepts from regressing each Fama and French 48-industry portfolio returns on the two sets of factors respectively in addition to the market factor. If the factors capture the pricing effects of the underlying risk factors, the regression intercept of each portfolio should be close to zero. Therefore, we directly compare the average of the absolute intercept estimates under the two cases. Likewise, we contrast the average absolute differences between other major factor loadings using the two sets of factors to illustrate the importance of controlling for the delisting effect in practice.

We also re-estimate Fama and French 48-industry portfolio returns after excluding all delisted returns, and re-perform the above tests. If the prediction error further shrinks or the loading of SMB becomes larger in pricing, we can conclude that delisted returns have brought noise in traditional time-series regressions as well.

2 Main test results

2.1 Descriptive data and preliminary analyses

Table 1 provides a summary of the sample data. Consisting of 1.65 million observations, our sample has a close size to other related studies under similar testing periods. A preliminary comparison of Panel A and Panel B indicates that the delisted sample is about 7% out of the whole sample, while having much more extreme returns in both direction. As shown in Table 1, the statistics at 10% and 90% percentiles for the delisted sample are of higher magnitudes than those for the overall sample. Consistently, the volatility is much larger for the delisted sample as well. These preliminary statistics are in line with our prior expectation that delisted returns tend to reflect the abnormality introduced by upcoming fundamental changes in the firm's risk profile, thus become either extremely small or large compared to ordinary returns.

Insert Table 1 Approximately Here

In Panel C, we classify different groups of delisted firms by the first digit of their delist codes, according related definitions from CRSP. Alternatively, we exhibit a distribution of delisted firms based on the reasons why they are being delisted from their current stock exchanges during 1963-2011. Note that the all active stocks would have a delist code of 100 at the last date of their CRSP records. Consequently, we see 2,680 observations under 100 category because they are all active stocks on December 2011, but they would not be regarded as delisted firms. Basically, Mergers and Dropped become the two main delisting reasons, which constitute approximately 97% of all delistings. Since Mergers and Dropped occur with similar likelihoods, survivorship bias may not be an issue if disregarding returns during delisting period. Moreover, the delistings under all categories have greatly increased in recent years, and this upward trend is

consistent with that in Figure 1. Given that such a delisted group becomes a major component of our sample, we find it necessary to take a closer look into the its special return behavior, if any.

Given the potential distinctive difference between delisted returns and ordinary stock returns, we find it reasonable and intuitive to consider the two groups separately. If the delisted returns contain extreme or abnormal characteristics, the inclusion of these observations might lead to biased results. Before getting to the empirical analysis, we firstly conduct a simple check upon the uniqueness of delisted returns by plotting delisted returns and ordinary returns against market returns respectively, as shown by Figure 2 below. We construct the equal-weighted portfolio return for each group at a monthly basis, employing the same scaling as the market return.

Insert Figure 2 Approximately Here

Clearly, we see that most of the average returns for ordinary stocks fall on the 45 degree line against market returns, indicating that ordinary stocks approximately resemble the overall market characteristics. By contrast, the average delisted returns greatly deviate from the 45 degree line, the majority of which are either above or below market returns. This is consistent with our summary statistics that delisted returns do contain extreme characters, which should be separated from the overall sample for cross-sectional analyses.

2.2 Main findings

Following Fama and French (1992), we firstly conduct monthly Fama-Macbeth regressions based on the overall sample, without distinguishing delisted observations from ordinary returns. Average slopes and Newey-West adjusted T-statistics are summa-

rized in Panel A of Table 2. Then we exclude all delisted returns and redo the above tests based on the remaining sample, expecting to roughly capture the impact of the delisted sample. All results are summarized in Panel B of Table 2.

Insert Table 2 Approximately Here

As shown in Panel A, the overall size effect is insignificant, which is mainly driven by its disappearance in the recent sub-sample period. Consistent with Fama and French (1992), we see that the correlation between firm size and stock return is rather strong during 1963-1986. Similarly, book-to-market ratio is significantly positive while beta is indefinite. Additionally, all coefficient statistics are very close to Fama and French (1992). Therefore, our evidence is in support of the strong size effect in the first half of the testing period. This significant correlation between stock return and firm size, however, significantly mitigates during 1986-2011. Although the T-statistics for beta and book-to-market ratio do not experience much change, the significance of firm size drastically drops. With T-statistics as of 0.14 during 1986-2011, size effect is barely observable in recent years, let alone to say its direction or any explanatory power in cross-sectional stock returns. Note that we also apply beta, size and book-to-market ratio one at each time to further observe their explanatory power. Likewise, firm size is rather significant during 1963-1986, while its T-value is only -0.57 during 1986-2011. Moreover, its coefficient changes from -0.149 to -0.028, implying that the magnitude of size effect greatly diminishes as well.

Given the inconsistent evidence upon size effect across different testing periods, we then exclude the delisted returns up to one year before delist date from the overall sample and re-perform monthly Fama-Macbeth regressions. Recall that Figure 1 shows an increasing trend of delistings in recent years, which coincides the distinctive disappearance of size effect during 1986-2011 in Panel A of Table 1. Therefore, returns

before delist date might indicate certain abnormalities in risk profiles, thus become unexplained by firm size and mitigate the real size effect during 1986-2011. By excluding all delisted returns, we expect to remove this potentially abnormal component from the sample and illustrate a better picture of how firm size captures the ordinary cross-sectional variation in stock returns.

After we exclude the delisted sample, size effect is restored and turns to be consistently strong. As shown in Panel B, T-statistics for firm size is rather solid, which also remains stable across different testing period and regression specifications. Although our delisted sample is only about 7% of the whole sample, including it or not does bring huge impact upon the explanatory power of firm size. Compared to that in Panel A, size effect in Panel B remains significantly negative during 1963-1986, which also gets restored during 1986-2011 with very similar coefficient and T-statistics as in the first sub-period. Alternatively, the explanatory power of firm size has not experienced great changes overtime after we adjust such delisting effect. This evidence is in support of our prior hypothesis that delisted returns would introduce certain noise that disguises the real size effect.

As a closer look into the special size premium from delisted returns, we re-perform Fama-Macbeth regressions with all explanatory variables based on the overall sample, along with a delist dummy to differentiate delisted returns from ordinary returns. This delist dummy would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date, and zero otherwise. We also add an interaction term of firm size and delist dummy to directly capture the incremental size premium from delisted returns. In this interaction term, we scale each firm size by subtracting the monthly average sample size, thus better reflects the incremental change in size effect. The results are summarized in Table 3 below.

Insert Table 3 Approximately Here

Table 3 clearly shows the recent opposite size premium from delisted returns. In contrary to the traditional negative size effect, the interaction term of delist dummy and firm size is significantly positive, especially during 1986-2011. This evidence suggests that delisted return tends to increase with firm size, and their positive correlation becomes stronger in recent years. Furthermore, our result suggests that the coefficient of this interaction term is much larger than that of firm size alone across all testing periods. Therefore, the incremental positive size premium from delisted returns could totally offset the original negative correlation between firm size and stock return if combing together, leading to the overall insignificant size effect in Panel A of Table 2. Note that the magnitude of size effect alone is relatively smaller during 1986-2011, implying that the original size effect in recent years becomes more volatile to the offsetting premium from the delisted sample. As a result, size effect greatly drops in recent years. Overall, Table 3 shows consistent results with Table 2, indicating that the unique association between delisted returns and firm size does exist. The traditional negative size effect would be restored after we control for this delisting effect. More robustness check would be provided in Section 5 to test such findings.

3 Robustness results

To further test our findings of the positive size premium from delisted returns, we would perform a series of robustness checks in this section. Firstly, we take the nonlinearity of firm size into consideration. Perez-Quiros and Timmermann (2000) adopts a non-linear model to investigate the association between firm size and stock returns. Their evidence is in line with the theory that small firms display the highest degree of asymmetry in their risk across recession and expansion states, which translates

into a higher volatility of their expected stock returns. Consequently, we add the square of firm size into our regression specification to control for its potential non-linear characteristics, and re-estimate the monthly Fama-Macbeth regressions following Fama and French (1992). The results are summarized in Table 4.

Insert Table 4 Approximately Here

Similar to prior results, beta seems indefinite while book-to-market ratio is consistently strong in Panel A. Size effect also appears significantly negative across all time periods after we control for the delisting effect. Moreover, the absolute coefficient of firm size during 1986-2011 changes from -0.084 to -1.002, so the consideration of non-linear firm size improves the original negative size effect in recent years. The interaction term of delist dummy and firm size remains positive and experience very little change after adding the square of firm. In short, these results are in line with our prior evidence of the negative size effect after disentangling the delisting effect. Additionally, the square of firm size is rather significant overtime, especially in recent years. Given that size effect alone also gets improved across all sub-sample period, the non-linear characteristics of firm size seem pretty efficient and intuitive in explaining the cross-sectional return variation after 1986. Future researchers may take this consideration into similar studies.

Next, we would build different sub-samples to test the unanimity of our findings. Prior studies have addressed many distinctive characteristics of ADRs in major stock exchanges. For instance, Patro (2000) finds that ADR returns have significant risk exposures to the returns on the world market portfolio and their respective home market portfolios. Ejara and Ghosh (2004) argue that ADR IPOs are significantly less underpriced than comparable US IPOs. Therefore, we find it reasonable to separate ADRs from the overall sample to see whether size effect still holds after controlling

for both the delisting effect and ADR characteristics. In fact, prior studies are rather unclear upon whether to include ADRs in the sample, so we find it necessary to do a robustness check based on including ADRs or not. Consistent to Table 3, we add the delist dummy and the interaction term in regression specification to separate the delisting effect. The regression results are summarized in Table 5.

Insert Table 5 Approximately Here

Likewise, size effect remains rather strong after we exclude all ADRs, as long as the delisting effect is adjusted. The coefficient of firm size is negative overtime, implying that the traditional negative size effect still exists. Note that the magnitude of size coefficient significantly drops by almost 50% in recent year, which changes from -0.138 to -0.075. Meanwhile, the T-value for firm size is only -1.76 during 1986-2011, implying that size effect for US stocks does experience a regime change lately. These results are still in line with our previous results in Table 2 and Table 3. Moreover, the interaction term becomes significantly positive in the second sample period with relatively larger magnitude, hence the offsetting size premium also exists. Note that book-to-market ratio is strong while beta is rather week, which all have similar statistics to those in prior tables.

Now we choose stocks listed in NASDAQ to examine the positive size premium of delisted returns. We choose NASDAQ because firms in this stock exchange tend to be smaller and younger than those in NYSE and AMEX. Many previous studies have argued that small and young firms provide the main momentum of size effect. Loughran (1997) particularly emphasizes the uniqueness of small and young firms in his work. For instance, he claims that only NASDAQ firms are not affected by January effect in size, so stock listed in NASDAQ exhibit more solid size effect. As a result, we now consider only NASDAQ firms instead of the whole sample, and perform similar

tests as in Table 5. By looking into relatively small and young firms, we try to test whether the delisting effect co-exists with the particular momentum from those stocks. The regression results are summarized in Table 6.

Insert Table 6 Approximately Here

As shown in Table 6, the statistics of all explanatory variables exhibit certain noticeable characteristics comparing to those of the overall sample in prior table. For instance, the coefficient of firm size during 1986-2011 is -0.191 for NADSDAQ stocks, which is much larger than -0.084, the same character for the overall sample in Table 3. This is in line with Loughran (1997)'s evidence of the solid size effect for small and young firms. Additionally, the magnitude of the interaction term during 1986-2011 turns to be larger than earlier years, while this coefficient is always smaller in all previous settings. However, the delisting premium still appears stronger for small and young firms. Moreover, both size and the interaction term do not change much across all testing periods, indicating that small and young firms have consistently stable size effect and delisted premium. Basically, the NASDAQ sample is in line with our prior evidence of the strong size effect after controlling delist effect during 1986-2011. With delist dummy and the interaction term in the regression specification, we could observe the strong negative size effect, as well as the positive incremental size premium from delist returns.

As a further look into the delisting effect, we consider the reason why a stock gets delisted from its current exchange as well. As shown in Panel C of Table 1, Mergers and Dropped are the two main reasons for firms being delisted. Given that Merger usually indicates good improvements while Drop signals deteriorating facts, we find it intuitive to distinguish such two types of returns because firms to be merged are likely to benefit from this opportunity, while those to be dropped might suffer from

the bad financing. Berger, Saunders, Scalise and Udell (1998) find that 6,369 out of 7,916 merging banks invested 3.702% of their gross total assets in small business loans the year before the merger. That is to say, large firms to be delisted due or mergers or acquisitions tend to earn higher returns due to their bigger pool of investments, thus a positive size premium might exist. Consequently, we classify stock returns into either Merge group or Drop group due to their delist codes in CRSP. In particular, we introduce two dummies: Delist_merge and Delist_drop. Delist_merge would take the value of 1 when the monthly stock return falls in the one-year period before firm's delist date and get delisted due to Mergers or Exchanges, and zero otherwise. If the delist codes indicate Dropped or Liquidations, Delist_drop would take the value of 1 and zero for all other observations. We also include the interaction terms of adjusted firm size and the above two delist dummies respectively to test whether the incremental size premium is the same for firms delisted for different reasons. All results are summarized in Table 7.

Insert Table 7 Approximately Here

In Table 7, firm size turns to be significantly negative across the overall testing period after we control for the delisting effect. As for the incremental size premium from firms of different delisting reasons, we observe an intuitive pattern: the overall incremental size premium is positive for delisted returns in Merge group, and negative for those in Drop group. This is reasonable because firms to be merged or acquired usually have better financing and prospects. Hence, they should be more attractive to investors when the firm size increases, because the pool of profits becomes larger as well. Eisdorfer (2008b) provides evidence in support of investors' risk-shifting incentives to invest in risky projects when available projects become riskier. Despite the risk involved with the big change in firm structure, investors would still invest in portfolios with high

potential profits. Hence, delisted returns for firms to be merged or acquired are boosted. Note that although the coefficient of Merge_size is significantly negative in recent years, Delist_merge has a very strong positive coefficient with much larger magnitude during the same period. That is to say, the positive size effect from the delisted Merge group is mainly driven by the level premium instead of the incremental premium.

Large firms to be dropped from their current stock exchanges, however, do not have higher returns likewise. This is in line with our expectation that firms to be delisted due to inability to meet requirements of their stock exchanges tend to have bad financial conditions, making them less desirable to investors. This negative correlation is mainly driven by the sample observations in recent years, which is consistent with our prior evidence of the increasing dropped firms after 1986.

In all of the above tests, we employ equal- or value-weighted portfolio returns following prior studies. However, Liu and Strong (2008) argue that using fixed weighted portfolio returns is unrealistic because it isolates the real investor wealth effect. Rational investors should adjust their portfolio weights according to the past performance of each security, instead of rebalancing the initial weights every period. As a result, Liu and Strong (2008) proposes a buy-and-hold method to decompose portfolio returns, who adjust weights of each security depending upon its performance over previous holding-period months. Their evidence suggests that size effect is merely the result of employing the traditional rebalance method, which totally disappears across the buy-and-hold returns. Therefore, we construct 10 size-classified portfolios following Liu and Strong (2008), and test whether size effect could be restored by controlling the delist effect under the buy-and-hold setting. The average portfolio returns sorted by size are summarized in Table 8.

Insert Table 8 Approximately Here

Panel A is merely the replication of Liu and Strong (2008)'s investigation into size effect, and we use 1951-2003 as testing period as well. Likewise, we find that size premium is unclear across buy-and-hold portfolios, especially during 1977-2003. This coincides with our prior illustrations that size effect significantly drops in recent years. After we exclude all delisted returns, however, size premium for small firms turns to be significantly positive across 1951-2003. That is to say, Liu and Strong (2008)'s buy-and-hold portfolio returns are also subject to the special premium from delisted returns. After adjusting this delisting effect, the real size premium is still robust.

If delisted returns do impose opposite size premium, an adjustment of such observations in the time-series settings should also improve the traditional pricing power. Following Fama and French (1993), we reconstruct stock-market factors related to size, book-to-market ratio and momentum with all delisted returns removed. Alternatively, we subtract the abnormal component of stock returns, expecting to improve the pricing power of those traditional factors. We will compare two sets of factors: one is the traditional factors achieved from Kenneth. R. French's website, and the other set would be our newly built factors with the delisting effect adjusted. To better capture the increasing delists in recent years, we apply a moving window methodology, which starts from 1963-1986 and would add one year to this period for every regression analysis up to 2011. The very last year of every testing period for the new set of factors is always filled with the traditional factors, because the delist information is ex-post. We cannot control for the delisting effect for the current year because we would not know whether a firm would be delisted in a 12-month period. As a result, we turn to the standard traditional factors as a compliment for the last year of every testing period. We then regress Fama and French 48-industry portfolio returns on both standard and new factor respectively, the related regression results of which are reported in Panel A of Table 9. We also re-estimate the traditional 48-industry portfolio returns follow-

ing the instructions shown in Kenneth R. French's website, except that we exclude all delisted returns before estimation. Similarly, we regress those newly estimated portfolio returns on the same two groups of factors. If the prediction error further shrinks or SMB becomes stronger in pricing, we could conclude that delisted returns have brought certain noise in the traditional time-series regressions. Those results are provided in Panel B of Table 9.

Insert Table 9 Approximately Here

Panel A of Table 9 firstly reports the average absolute intercepts for both sets of factors, which are also known as the prediction errors. As the table shows, prediction error from the newly built factors is significantly smaller than that under the traditional regressions, indicating that our adjustment of the delisting effect has improved the pricing power of the traditional four-factor model. This is also consistent with our prior analyses that delisted returns right before the delist date do introduce certain non-explanatory noise in the overall sample. We also compare the difference between the absolute market premium and size factor to capture the change brought by controlling the delisting effect. Likewise, the new SMB receives more loadings than the traditional one, implying that firm size becomes more efficient in security pricing after we subtract the noise brought by delisted returns.

Compared to Panel A, the difference of the prediction error between the traditional and new factors becomes larger in Panel B, hence the pricing power is further improved by subtracting the abnormal delist returns from the traditional industry portfolio returns. Meanwhile, the magnitude of the new SMB exceeds that of its traditional counterpart as well, suggesting the firm size becomes a better explanatory variable after controlling for the delisting effect. We now plot the time-varying absolute intercepts for

both groups in Figure 3, to better illustrate how our newly built factor does improve the pricing error.

Insert Figure 3 Approximately Here

As can see from the graph, the time-series pricing error of the newly built factors is consistently lower than that of the traditional factors. That is to say, the smaller absolute intercept reported in Table 9 is not driven by certain extreme figures. Instead, our new set of factors performs marginally better than the traditional set in a consistently stable pattern, implying that the overall explanatory power could be improved through controlling for the delisting effect. All results are in line with our expectation that noise brought by delist returns also weakens the pricing power of traditional asset pricing model.

We re-perform the annual moving window regressions of the two sets of factors using the 10 buy-and-hold size portfolio returns constructed following Liu and Strong(2008). The results are summarized in Table 10. Our findings again suggest that pricing error mitigates after adjusting the delisting effect for traditional factors. Likewise, the loading of the new SMB factor exceeds that of the traditional factor, implying that firm size could better explain the cross-sectional return variations after excluding the abnormal delisted observations.

Insert Table 10 Approximately Here

4 Conclusions

There has been counter evidence against the size effect first documented by Banz (1981) and Stattman (1980), and popularized by Fama and French (1992). Despite

the theoretical inconsistency of the size factor to be the priced risk factor as argued by Cochrane (2001), size could serve as a good proxy for the priced risk factors (see Berk, 1996). If this is the case, it seems to be at odds for the size effect to disappear in recent decades. In this study, we reexamine size effect by simultaneously considering the delisting effect of a firm.

Firms may subject to different risks during financial distress compared to those in a normal growth stage. We therefore hypothesize that the size variable may serve as a better proxy for risks during a normal growth of a firm. Under such a hypothesis, we test the size effect by focusing on returns right before the delist date. When investigating the sample period from 1963 to 2011, we notice that the size effect gradually drops as time goes by. This coincides with the increasing delisting activities in all major stock exchange in recent years. In fact, we find that return during the delisting period seems to be positively related to firm size, which counters the general size effect in the overall sample. This is especially significant in recent years when delisting occurs more frequently. After we exclude all delisted returns from the sample, the traditional negative size effect is rather robust.

Our study not only shows the importance of the size effect in approximating for risk factors in empirical studies, but also illustrate the very different return and risk behavior in the delisting period. Therefore, future research in asset pricing should pay more attention to the delisting behavior of returns. At the very least, one should consider using the adjusted Fama and French factors in practice.

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Table 1: Descriptive Statistics

This table reports the summary statistics for stocks that are listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. Return is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. Delist code is a 3-digit integer code., which either (1) indicates that a security is still trading or (2) provides a specific reason for delisting in CRSP. Panel A provides the descriptive statistics for the overall sample. Panel B provides the descriptive statistis for the delisted sample, which consists of stock returns up to one-year period before their delist dates. Panel C provides a classification of all individual delisted firms according to their delist codes. All variables are winsorized at 0.5% to avoid the outliers.

Panel A: The whole sample

Variable	Obs	Mean	Std. Dev.	10%	90%
Return	1656744	1.167	15.442	-15.033	17.647
Beta	1667887	1.347	0.332	0.934	1.820
Size	1666068	11.502	2.160	8.786	14.388
Book-to-Market	1667887	-0.359	1.090	-1.618	0.769
Individual firms	14392				

Panel B: The delisted sample

Variable	Obs	Mean	Std. Dev.	10%	90%
Return	107156	0.760	23.302	-23.913	23.529
Beta	116523	1.415	0.313	1.062	1.820
Size	116316	10.660	2.080	8.060	13.513
Book-to-Market	116523	-0.308	1.194	-1.690	0.934
Individual firms	10614				

Panel C: Distribution of the delist codes

Delist code	Implication	1963-2011	1963-1986	1986-2011
100	Active	2681	1	2680
200	Mergers	5636	1309	4327
300	Exchanges	396	155	241
400	Liquidations	123	84	39
500	Dropped	3941	520	3421
600	Expirations	1	0	1
900	Became Foreign	0	0	0
	Total	12778	2069	10709

Table 2: Sub-period means of slopes from monthly FM cross-sectional regressions

This table reports the average coefficients in the monthly Fama-MacBeth cross-sectional regressions for stocks listed at listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. The dependent variable is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. T-value is shown in the brackets under each coefficient. Panel A provides the regression results for the overall sample. Panel B provides the regression results for the sample excluding all stock returns up to one year before their delist dates. The T-statistics are calculated based on the Newey-Wesst standard errors. All variables are winsorized at 0.5% to avoid the outliers.

Panel A: Regression estimates based on the whole sample

	7/1963-12/2011				7/1963-6/1986				7/1986-12/2011			
Intercept	1.113	2.102	1.259	1.882	1.113	2.958	1.429	2.803	1.113	1.331	1.10527	1.051
	(4.33)	(2.99)	(5.11)	(3.84)	(3.11)	(2.66)	(3.87)	(3.93)	(3.05)	(1.56)	(0.3298)	(1.67)
Beta	0.061			-0.023	0.215			-0.039	-0.077			-0.008
	(0.21)			(-0.10)	(0.52)			(-0.13)	(-0.19)			(-0.02)
Size		-0.085		-0.054		-0.149		-0.120		-0.028		0.006
		(-1.92)		(-1.43)		(-2.01)		(-1.99)		(-0.57)		(0.14)
Book-to-market			0.329	0.240			0.414	0.250			0.253	0.230
			(6.11)	(4.70)			(4.62)	(2.87)			(4.29)	(4.03)

Panel B: Regression estimates based on the sample excluding delisted returns

	7/1963-12/2011				7/1963-6/1986				7/1986-12/2011			
Intercept	0.956	2.681	1.267	2.528	1.038	3.040	1.384	2.979	0.882	2.357	1.160	2.120
	(3.80)	(3.91)	(5.20)	(5.43)	(3.00)	(2.77)	(3.75)	(4.19)	(2.46)	(2.79)	(3.58)	(3.50)
Beta	0.189			-0.031	0.242			-0.075	0.141			0.009
	(0.67)			(-0.13)	(0.59)			(-0.24)	(0.36)			(0.03)
Size		-0.133		-0.108		-0.160		-0.136		-0.108		-0.082
		(-3.09)		(-3.05)		(-2.22)		(-2.34)		(-2.22)		(-1.99)
Book-to-market			0.302	0.187			0.388	0.218			0.224	0.160
			(5.62)	(3.77)			(4.29)	(2.54)			(3.89)	(2.99)

Table 3: Size effect controlled by delisting effect

This table reports the average coefficients in the monthly Fama-MacBeth cross-sectional regressions for stocks listed at listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. The dependent variable is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. Delist_dummy would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date, and zero otherwise. Delist_size is Delist_dummy times firm size scaled by the average size of all stocks each month. T-value is shown in the brackets under each coefficient. The T-statistics are calculated based on the Newey-Wesst standard errors. All variables are winsorized at 0.5

	7/1963-12/2011	7/1963-6/1986	7/1986-12/2011
Intercept	2.616	3.005	2.266
	(5.52)	(4.24)	(3.59)
Beta	-0.067	-0.073	-0.061
	(-0.29)	(-0.24)	(-0.18)
Size	-0.109	-0.138	-0.084
	(-3.05)	(-2.36)	(-1.97)
Book-to-market	0.233	0.244	0.223
	(4.58)	(2.79)	(3.96)
Delist_dummy	0.203	0.587	-0.144
	(0.46)	(0.68)	(-0.56)
Delist_size	1.178	1.467	0.917
	(2.96)	(1.76)	(14.60)

Table 4: Size effect controlled by delisting effect(Non-linear size adjusted)

This table reports the average coefficients in the monthly Fama-MacBeth cross-sectional regressions for stocks listed at listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. The dependent variable is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. Size square is the square of firm size. Delist_dummy would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date, and zero otherwise. Delist_size is Delist_dummy times firm size scaled by the average size of all stocks each month. T-value is shown in the brackets under each coefficient. The T-statistics are calculated based on the Newey-Wesst standard errors. All variables are winsorized at 0.5% to avoid the outliers.

	7/1963-12/2011	7/1963-6/1986	7/1986-12/2011
Intercept	6.225	4.965	7.361
	(5.58)	(3.15)	(4.78)
Beta	0.018	-0.062	0.090
	(0.07)	(-0.20)	(0.25)
Size	-0.757	-0.486	-1.002
	(-4.16)	(-2.07)	(-3.79)
Book-to-market	0.221	0.235	0.210
	(4.32)	(2.65)	(3.71)
Size_square	0.027	0.015	0.039
	(3.90)	(1.76)	(3.70)
Delist_dummy	0.205	0.568	-0.123
	(0.46)	(0.63)	(-0.49)
Delist_size	1.250	1.529	0.999
	(2.98)	(1.74)	(16.70)

Table 5: Size effect controlled by delisting effect(Excluding American Depositary Receipts)

This table reports the average coefficients in the monthly Fama-MacBeth cross-sectional regressions for stocks listed at listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. All American Depositart Receipts are excluded. The dependent variable is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. Delist_dummy would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date, and zero otherwise. Delist_size is Delist_dummy times firm size scaled by the average size of all stocks each month. T-value is shown in the brackets under each coefficient. The T-statistics are calculated based on the Newey-Wesst standard errors. All variables are winsorized at 0.5% to avoid the outliers.

	7/1963-12/2011	7/1963-6/1986	7/1986-12/2011
Intercept	2.607	3.024	2.231
	(5.51)	(4.21)	(3.60)
Beta	-0.049	-0.067	-0.034
	(-0.22)	(-0.22)	(-0.10)
Size	-0.105	-0.138	-0.075
	(-2.91)	(-2.35)	(-1.76)
Book-to-market	0.326	0.297	0.353
	(5.04)	(2.96)	(4.22)
Delist_dummy	0.200	0.597	-0.157
	(0.46)	(0.69)	(-0.60)
Delist_size	1.203	1.474	0.958
	(3.00)	(1.76)	(14.70)

Table 6: Size effect controlled by delisting effect(NASDAQ stocks only)

This table reports the average coefficients in the monthly Fama-MacBeth cross-sectional regressions for stocks listed at listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. Only NASDAQ stocks are included. The dependent variable is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. Delist_dummy would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date, and zero otherwise. Delist_size is Delist_dummy times firm size scaled by the average size of all stocks each month. T-value is shown in the brackets under each coefficient. The T-statistics are calculated based on the Newey-Wesst standard errors. All variables are winsorized at 0.5% to avoid the outliers.

	7/1963-12/2011	7/1963-6/1986	7/1986-12/2011
Intercept	3.704	4.251	3.468
	(5.96)	(4.62)	(4.38)
Beta	-0.075	-0.273	0.010
	(-0.27)	(-0.82)	(0.03)
Size	-0.193	-0.196	-0.191
	(-4.09)	(-2.23)	(-3.43)
Book-to-market	0.278	0.311	0.264
	(4.34)	(2.08)	(4.07)
Delist_dummy	-0.226	0.955	-0.736
	(-0.76)	(1.69)	(-2.56)
Delist_size	1.059	0.866	1.143
	(12.92)	(6.35)	(11.78)

Table 7: Size effect controlled by delisting effect(Two main delisting reasons)

This table reports the average coefficients in the monthly Fama-MacBeth cross-sectional regressions for stocks listed at listed in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011. The dependent variable is the monthly stock return. Beta, Size, and Book-to-Market are estimated following Fama and French (1992). Beta is the post-ranking estimates based on portfolios sorted by size and pre-ranking beta at June year t. Size is the nature logrithm of market capitalization at June year t. Book-to-market is the nature logrithm of book equity value of the fiscal year ended in year t-1 divided by market capitalization at December year t-1. Delist_merge would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date due to mergers or acquisitions, and zero otherwise. Merge_size is Delist_merge times firm size scaled by the average size of all stocks each month. Delist_drop would take the value of 1 for monthly stock returns falling in the one-year period before firm's delist date due to dropped or liquidations, and zero otherwise. Drop_size is Delist_drop times firm size scaled by the average size of all stocks each month.T-value is shown in the brackets under each coefficient. The T-statistics are calculated based on the Newey-Wesst standard errors. All variables are winsorized at 0.5% to avoid the outliers.

	7/1963-12/2011	7/1963-6/1986	7/1986-12/2011
Intercept	2.550	2.986	2.157
	(5.43)	(4.21)	(3.49)
Beta	-0.050	-0.078	-0.026
	(-0.22)	(-0.25)	(-0.08)
Size	-0.107	-0.136	-0.081
	(-2.99)	(-2.33)	(-1.91)
Book-to-market	0.213	0.236	0.192
	(4.27)	(2.74)	(3.50)
Delist_merge	2.042	1.229	2.775
	(4.43)	(1.34)	(14.40)
Merge_size	0.251	0.702	-0.155
	(0.60)	(0.81)	(-2.21)
Delist_drop	-4.945	-1.212	-8.313
	(-7.39)	(-2.13)	(-13.88)
Drop_size	-0.372	0.279	-0.956
	(-2.46)	(1.78)	(-5.36)

Table 8: Average buy-and-hold portfolio returns following Liu and Strong (2008) with delisted effect adjusted

This table reports the average portfolio returns during July 1951 and December 2003. The buy-and-hold decomposed portfolio is constructed following Liu and Strong(2008). Panel A provides the average portfolio returns of the ten size deciles for the overall sample. Panel B provides the same results with delisted returns adjusted for related individual stocks. The T-statistics are also provided.

Panel A: Regression estimates based on the whole sample

Size_sort	Overall		1951-1977		1977-2003	
	Return	T-stat	Return	T-stat	Return	T-stat
Small	1.28	4.96	1.22	4.97	1.35	4.96
2	1.21	4.86	1.13	5.10	1.30	4.72
3	1.14	4.84	1.09	5.10	1.19	4.65
4	1.16	5.05	1.10	5.31	1.22	4.87
5	1.16	5.32	1.06	5.42	1.25	5.28
6	1.09	5.34	1.05	5.54	1.14	5.20
7	1.08	5.45	0.98	5.34	1.19	5.57
8	1.06	5.48	0.98	5.52	1.14	5.47
9	1.03	5.82	0.90	5.60	1.16	6.05
Large	0.92	5.38	0.80	5.14	1.04	5.61
Small-Large	0.36	1.82	0.42	2.30	0.30	1.41

Panel B: Regression estimates based on the sample excluding delisted returns

Size_sort	Overall		1951-1977		1977-2003	
	Return	T-stat	Return	T-stat	Return	T-stat
Small	1.41	5.38	1.23	4.96	1.59	5.77
2	1.15	4.53	1.08	4.84	1.22	4.33
3	1.09	4.56	1.07	4.94	1.11	4.27
4	1.09	4.67	1.04	4.97	1.14	4.46
5	1.09	4.98	1.03	5.23	1.15	4.81
6	1.03	5.00	1.01	5.32	1.06	4.75
7	1.03	5.09	0.96	5.20	1.09	5.02
8	1.03	5.28	0.97	5.44	1.09	5.17
9	1.01	5.64	0.90	5.57	1.11	5.74
Large	0.91	5.32	0.80	5.14	1.02	5.51
Small-Large	0.50	2.48	0.43	2.32	0.57	2.62

Table 9: Regressions of excess FF 48 industry portfolio retuns on excess market return, SMB, HML, and UMD

This table reports the absolute average coefficients in the annual moving window regressions for the four-factor model during July 1963 and December 2011. Following the instructions in Kenneth R. French's website, we reconstruct a new set of SMB, HML and UMD factors without returns up to one year before firm's delist date. We apply a moving window methodology, which starts from 1963-1986 and would add one year to this period for every regression analysis up to 2011. The very last year of every testing period for the new set of factors is always filled with the traditional factors, because the delist information is ex-post. The absolute difference between the loadings of the old and new factors are shown in Panel A. We also re-estimate Fama and French 48-industry portfolio returns after excluding all returns up to one year before firm's delist date, and apply the above two sets for the regression estimation. The absolute difference between the loadings of the old and new factors are shown in Panel B.

Panel A: Traditional 48-industry portfolio

	Traditional factors	New factors	Difference	T-stat
Absolute alpha_Mean	0.214	0.198	0.016	8.771
Absolute market premium_Mean	1.039	1.031	0.008	3.508
Absolute SMB_Mean	0.350	0.354	-0.004	-1.341
Panel B: Adjusted 48-industry portfolio				
	Traditional factors	New factors	Difference	T-stat
Absolute alpha_Mean	0.227	0.190	0.037	17.535
Absolute market premium_Mean	1.034	1.024	0.010	4.617
Absolute SMB_Mean	0.367	0.371	-0.004	-1.425

Table 10: Regressions of excess decomposed buy-and-hold portfolio retuns on excess market return, SMB, HML, and UMD

This table reports the average coefficients in the annual moving window regressions for the four-factor model during July 1963 and June 2003. The independent variable is the buy-and-hold decomposed portfolio return estimated by Liu and Strong (2008). Following the instructions in Kenneth R. French's website, we reconstruct a new set of SMB, HML and UMD factors without returns up to one year before firm's delist date. We apply a moving window methodology, which starts from 1963-1983 and would add one year to this period for every regression analysis up to 2003. The very last year of every testing period for the new set of factors is always filled with the traditional factors, because the delist information is ex-post. The absolute difference between the loadings of the old and new factors are shown in the table.

	Traditional factors	New factors	Difference	T-stat
Absolute alpha_Mean	-0.117	-0.034	-0.083	-33.018
Absolute market premium_Mean	0.914	0.923	-0.008	-3.466
Absolute SMB_Mean	0.696	0.675	0.021	5.914

Figure 1: Time-series plot of proportion of delists during 07/1963-12/2011

The proportion of delists is defined as the number of individual firms delisted from their current exchanges each month scaled by the total monthly observations . The figure plots the proportion of delistes in the NYSE, AMEX, or NASDAQ during July 1963 and December 2011.

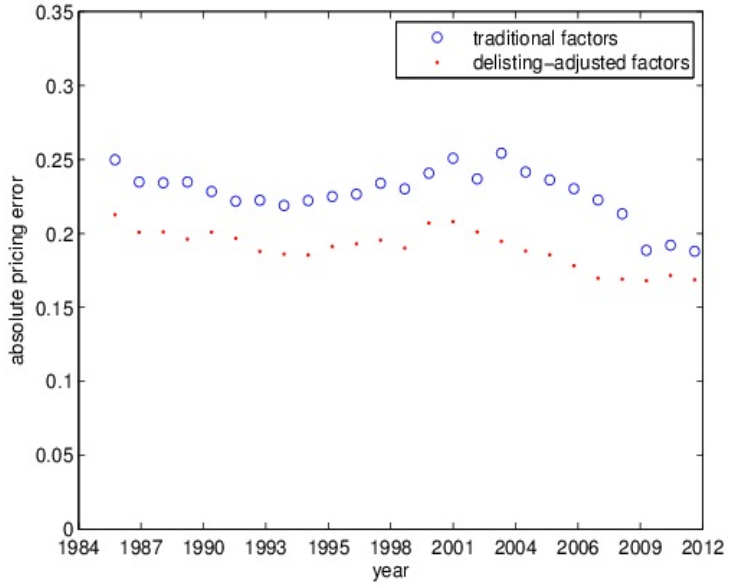

Figure 2: Time-series plot of market return and average return during 07/1963-12/2011

We build equal-weighted portfolios based on delisted returns and non-delisted returns every month. Delisted returns are defined as stock returns up to one year before their delisting dates. All other returns are definied as non-delisted returns. Market returns are achieved from Kenneth R. French's website. The figure plots the average delisted returns and non-delisted returns against market returns during July 1963 and December 2011.

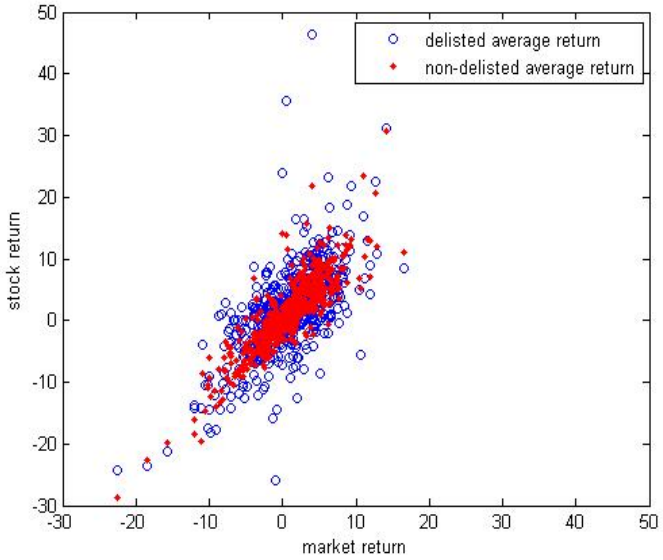

Figure 3: Pricing error under delisting-adjusted 48 portfolio returns

We re-estimate Fama and French 48-industry portfolio returns after excluding all returns up to one year before firmąś delisting date, and apply the two sets for the regression estimation.The figure plots the absolute intercepts of traditional factors and delisting-adjusted factors starts from 1963-1986 , with one year added to this period for every regression analysis up to 2011.