Characterizing the Cross-section of Stock Returns in Korea: A Comprehensive Look at the Past Two Decades

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Abstract

This paper is an empirical investigation intended to provide a comprehensive picture of the determinants of the cross-sectional stock returns in Korea, employing the research design and empirical methodologies of Fama and French (1992, 1993), and taking into account recent critique of empirical asset pricing literature such as the low power of the test diagnostics and the bias induced by noise in prices. We do not find convincing empirical evidence supporting the Fama-French three factor model as a benchmark asset pricing model for risk-adjustment. We also find that the bias induced by noisy prices is substantial in mean returns of equally-weighted portfolios, consistent with the findings of Asparouhova, Bessembinder, and Kalcheva (2013) for the US stock returns.

Keywords: empirical asset pricing; liquidity; share turnover; Fama-Macbeth regression, GMM

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1. Introduction

Since Fama and French's (1992, 1993) comprehensive empirical investigation of the cross-sectional determinants of stock returns in the US, their three-factor model proposed in Fama and French (1993) has been widely regarded as a benchmark model of empirical asset pricing both in academia and financial industry. Empirical research on the Korean stock market also broadly followed this practice by using the Fama-French three-factor model as an empirical benchmark for risk-adjustment in various applications.

Despite its weak theoretical link to equilibrium asset pricing models, the empirically motivated Fama-French three-factor model provides a comprehensive description of various stock return anomalies discovered in the 1980s in a parsimonious three-factor framework in the US and other major stock markets, which is why it has been used widely as a benchmark asset pricing model for risk-adjustment.[1] It is not clear, however, whether there exists strong enough empirical evidence supporting the use of the Fama-French three factor model as an empirical benchmark in the Korean stock market.[2] While many studies examine the cross-sectional stock returns in Korea in the framework of Fama and French (1992, 1993), they provide fragmented empirical evidence due to different sample periods, sample firms, and

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[1] Empirical research over the past two decades produced a host of new anomalous patterns in cross-sectional stock returns that are not well described by the Fama-French three factor model, but there appears to be no consensus yet on a new empirical benchmark to replace the Fama-French three-factor model. See Fama and French (2008), Goyal (2011), Cochrane (2011), and Chen, Novy-Marx, and Zhang (2011), among others, for recent discussion on this topic.

[2] While earlier papers such as Gam (1997), Song and Lee (1997), Song (1999), and Kim and Kim (2000) provide empirical evidence in the Korean stock market broadly supportive of Fama and French (1992, 1993), Yun, Ku, Eom, and Hahn (2009) question the validity of using the Fama-French three-factor model as an empirical benchmark for risk adjustment in the Korean stock market.

methods of constructing factor portfolios, which makes comprehensive interpretation of empirical evidence difficult.[3]

This paper is an empirical investigation intended to provide a comprehensive picture of the determinants of the cross-sectional stock returns in Korea, employing the research design and empirical methodologies of Fama and French (1992, 1993). More specifically, without using the Fama-French three-factor model as a given benchmark, we attempt to provide a comprehensive description of the cross-sectional stock returns in Korea in the spirit of Fama and French (1992), and propose a parsimonious empirical benchmark for risk adjustment for the Korean stock market in the spirit of Fama and French (1993).

Following Fama and French (1992), we first examine which firm characteristics are significantly associated with the cross-sectional stock returns using the regression methodology of Fama and MacBeth (1973) at the firm (i.e., individual stock) level. Among firm characteristics based on financial ratios, we find the market value of equity, book-to-market ratio, and earnings-to-price ratio to be significant determinants of the cross-sectional stock returns in Korea for the full sample period (1992–2012). We also investigate whether two measures of liquidity, Amihud's (2002) measure of illiquidity and share turnover, recently argued to be important for cross-sectional stock returns in Korea, are also significant determinants of the cross-sectional returns. Both measures of liquidity show significant association with the cross-sectional stock returns in a univariate setting, but in the presence of financial ratio variables in the multivariate setting, only share turnover remains significant.

[3] As pointed out by Kim (2011, footnote 20 on p. 199), even the summary statistics of the factor portfolios (for example, means and correlations) vary across these papers, in some cases substantially.

Interpreting the observable firm characteristics found to be significant in the Fama-MacBeth regression as proxies for exposure to systematic risk, we construct three sets of factor mimicking portfolios following Fama and French (1993): the size and book-to-market factors constructed by two-way independent sorting on size (market value of equity) and book-to-market ratio, the size and earnings-to-price factors constructed by two-way independent sorting on size and earning-to-price ratio, and the size and turnover factors constructed by two-way independent sorting on size and share turnover. In calculating the returns on these factor portfolios, we pay attention to a recent finding of the bias in mean returns induced by noisy prices by Asparouhova, Bessembinder, and Kalcheva (2013, ABK hereafter). They argue that even for monthly frequency, this bias is substantial particularly when portfolio returns are equal-weighted. We find that this bias is also economically substantial and statistically significant in the Korean stock market, and accordingly, use value-weighted portfolio returns in this study as suggested by ABK (2013) who find that this bias is minimal for value-weighted returns. If equally weighted, then all six candidate factor portfolio mean returns are significantly positive, but when value-weighted, the significance of the size factor disappears while the book-to-market, earnings-to-price, and turnover factor portfolio returns remain significantly positive.

For cross-sectional estimation of the factor risk premium, we construct four sets of decile portfolios using the firm characteristics found to have significant association with the cross-sectional stock returns, namely the market value of equity, book-to-market ratio, earnings-to-price ratio, and share turnover ratio. Taking into account Lewellen, Shanken, and Nagel's (2010) recent critique, we focus on the pricing errors (alphas) rather than cross-sectional *R*-square measures for evaluating asset pricing model specifications. We also increase the dimensionality of test assets by adding ten industry portfolios to the set of test assets. Formal test diagnostics (GRS *F*-test and *J*-test) and the significance of the risk premium estimates suggest that there is no convincing empirical evidence supporting the use of Fama and French's (1993) three-factor model as a benchmark for risk-adjustment in Korea. In addition, we find that the turnover factor, interpreted as a proxy for liquidity risk, is significantly related to the cross-sectional stock returns, consistently through the sample period and regardless of how its risk premium is estimated.

The paper proceeds as follows. Section 2 describes data and investigates which firm characteristics are significantly associated with the cross-sectional stock returns using the Fama-MacBeth regressions at the firm level. In Section 3, we construct various factor portfolios using the firm characteristics found to be important determinants of the cross-sectional stock returns, and in Section 4, we select the candidates for priced risk factors by running a simple horserace between the factor portfolios in a time-series regression framework. In Section 5, we estimate the risk premiums for the selected factor portfolios using the cross-section of test portfolios and provide formal test diagnostics of asset pricing models. Section 6 provides concluding remarks.

2. The Cross-sectional Relationship at the Firm Level

2.1 Data and Sample Period

Monthly returns on common stocks of non-financial firms listed the Korea Stock Exchange, and the firms' accounting data are from WISEfn. To be included in the sample, a firm should have data on the market value of equity as of the end of April in year *t*, the ratios of book value to market value of equity, earnings-to-price, and book value of debt to market value of equity on fiscal year-end in year *t-1*.[4] Firms with negative book equity are excluded, and firms should also have monthly stock returns for at least 24 months up to April of year *t* for estimation of beta. CAPM beta for stocks are estimated as the sum of the beta estimates on contemporaneous and lagged market excess returns to account for non-synchronous trading (Dimson (1979)) using a 5-year window up to April each year. The full sample period in this study is from May 1992 to April 2012, covering the recent twenty years of the Korean stock market. As reported in Table 1, the number of firms included in this study ranges from 502 in 1992 to 624 in 2011, and they account for 87% of non-financial firms' total market capitalization on average.

2.2 Fama-MacBeth Regression at the Firm Level: Beta and Financial Ratios

We first examine the cross-sectional relationship between excess stock returns and firm characteristics in the Fama-MacBeth regression framework. The dependent variable is the cross-section of monthly stock returns in excess of the risk-free rate, and the independent variables are a constant, estimated beta, and the cross-section of the following firm characteristics: the log of the market value of equity (ln(ME)), the log of the ratio of the book value of equity to market value of equity (ln(B/M)), firm leverage (ln(Lev)) measured as the log of the ratio of the book value of total debt to market value of equity, the ratio of total earnings to market value of equity (E/P). ME is measured at the end of April in year *t*, and B/M, Lev, and E/P are all measured at each firm's fiscal year-end in year *t-1*. These cross-sectional regressions are run every month, and the sample averages of the coefficient

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[4] Fama and French (1993) construct and rebalance portfolios at the end of June every year, under the conservative assumption that by the end of June firms' annual accounting information for the previous fiscal year is available to public. In Korea, it would be conservative enough to assume that firms' accounting information for the fiscal year *t-1* is made public by the end of April in year *t*.

estimates and their associated *t*-statistics are reported in Table 2. Coefficient estimates significant at the 5% level are indicated in bold.

As reported in Panel A for the full sample period (1992 – 2012), each of the four firm characteristics has significant cross-sectional relationship with excess stock returns, while the estimated beta does not. This of course is in contrast to the prediction of the CAPM, and similar to the findings of Fama and French (1992) for the US stock market and previous empirical studies on the Korean stock market.[5] However, when examined in a multivariate setting, the significance of the leverage variable disappears, driven out by the presence of the book-to-market ratio in the set of independent variables.[6] In Fama and French (1992), both leverage and E/P are insignificant in the presence of size and book-to-market variables, but in Korea we find that book-to-market ratio does not drive out the significance of earnings-to-price ratio in the cross-sectional stock returns. While admittedly arbitrary, we also split the sample in half and report the subsample results in Panel B (1992 – 2002) and Panel C (2002 – 2012). While the significance of book-to-market ratio is present in both subsample periods, the significance of the coefficient estimates on firm size and earnings-to-price ratio disappears in the second half of the sample period and the magnitude of the coefficient estimates also declines substantially.

[5] For a comprehensive review of empirical asset pricing research on the Korean stock market, see Kim (2011).

[6] The coefficient estimate on ln(Lev) is 0.40 with a *t*-statistic of 2.85 in the presence of ln(ME) and E/P (6th row of Panel A), but the estimate decreases substantially to 0.18 with a *t*-statistic of 1.34 in the presence of ln(B/M) and E/P (7th row of Panel A).

2.3 Proxies for Liquidity: Share Turnover and Amihud's (2002) Illiquidity Measure

Having found three financial ratio variables to have significant cross-sectional relationship with excess stock returns, we also examine whether measures of liquidity, recently argued to be important for cross-sectional stock returns in Korea, are also significant determinants of the cross-sectional returns in the presence of firm size, book-to-market ratio, and earnings-to-price ratio. The first measure of liquidity is share turnover defined as follows.[7]

$$Turnover_s = \sum_{d=1}^{D_s} (\text{Number of shares traded})_d \, / \sum_{d=1}^{D_s} (\text{Number of shares outstanding})_d$$

The numerator is the sum of the number of shares traded in each day *d* in a given month *s*, and D_s is the number of trading days in month *s*. The denominator is the sum of the number of shares outstanding in each day *d* in a given month *s*. The turnover defined as above measures average daily turnover in month *s*. Turnover is measured for each stock at the end of April in year *t* as a 12-month average of daily share turnover and this turnover measure is matched with stock returns from May of year *t* to April of year *t+1* in the cross-sectional regression.

The second measure of liquidity is an illiquidity measure proposed by Amihud (2002), defined as follows.

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[7] Brennan and Subrahmanyam (1995), Rouwenhorst (1999), Chordia Subrahmanyam and Anshuman (2001), among others, use share turnover as a measure of liquidity. But more recently, Baker and Wurgler (2006) use aggregate turnover as one of the components of their investor sentiment index, and Barinov (2013) argues that turnover is a proxy for firm-specific uncertainty. In Korea, Yun, Ku, Eom, and Hahn (2009) find share turnover to be a significant determinant of the cross-sectional stock returns in Korea.

$$Iliquidity_s = \frac{1}{D_s}\sum_{d=1}^{D_s}\frac{|R_d|}{VOL_d}$$

$|R_d|$ is the absolute value of stock return on day d, VOL_d is trading volume (in KRW) on day d, and D_s is the number of trading days in month s. The illiquidity defined as above measures average daily price impact of trading volume in month s, and the above illiquidity measure averaged over prior 6 months up to April of year t is matched with stock returns from May of year t to April of year $t+1$ in the cross-sectional regression.[8]

Table 3 reports the Fama-MacBeth cross-sectional regression results for these two liquidity measures. As reported in the first two rows of Panel A, both *Turnover* and *Illiquidity* are significant in their univariate relationship with the cross-sectional stock returns, and the signs of the coefficient estimates are also as expected. Stocks with lower *Turnover* (more illiquid) have higher returns, and stocks with higher *Illiquidity* have higher returns. But in the presence of the other three financial ratio variables in the regression, the significance of *Illiquidity* disappears, while *Turnover* remains significant even in the presence of the financial ratio variables. As reported in the last row of Panel A, firm size, book-to-market ratio, earnings-to-price ratio, and share turnover are all significant determinants of the cross-sectional stock returns for the full sample period. For subsample periods, Panel B and Panel C show that the significance of firm size and earnings-to-price ratio disappears in the second half, while book-to-market ratio and share turnover remain significant in both subsample periods. Overall, examining the cross-sectional relationship at the firm level indicates that

[8] We use Amihud's (2002) illiquidity measure averaged over prior 6 months to facilitate the comparison to prior research, such as Choe and Yang (2009) and Jang, Kang, and Lee (2012), who use the 6-month average illiquidity measure in the Korean stock market.

four measures of firm characteristics, namely market value of equity, book-to-market ratio, earnings-to-price ratio, and share turnover, are significant determinants for the cross-section of stock returns in Korea for the 1992 – 2012 period.

While this cross-sectional regression methodology of Fama and MacBeth (1973) is suitable for examining multivariate relationship at the firm level, in other words, to see whether a given firm characteristic has marginal effect on stock returns in the presence of other firm characteristics, it does not provide an estimate for the risk premium associated with a given firm characteristic. Hence, we proceed in the next section to construct factor portfolios in order to see whether these firm characteristics can be interpreted as proxies for exposure to priced risk factors.

3. Constructing Factor Portfolios

3.1 Proxies for the Market Portfolio and Risk-free Rate

As a proxy for the market portfolio return, we use value-weighted return including dividend on all common stocks listed on the Korea Stock Exchange. Figure 1 shows cumulative return on the KOSPI index, excluding dividend (KOSPI_X) and including dividend (KOSPI_D). It is clear from the figure that excluding the dividend component underestimates the market risk premium, particularly for the post-2000 sample period.[9] As a proxy for the risk-free rate, most widely used measures in Korea are 3-month CD yield and 1-year Monetary Stabilization Bond (MSB) yield. Figure 2 depicts the time-series of these

[9] Many studies on the Korean stock market, including some recent papers, simply use the change in the KOSPI index as a proxy for the market portfolio return, which does not account for the dividend component in returns. This of course underestimates the market risk premium and overestimates the (CAPM) alphas. The difference in mean returns between KOSPI_D and KOSPI_X is economically and statistically significant, at 0.12 % per month with a *t*-statistic of 4.98 for the 1992-2012 period.

yields for the sample period. As can be seen from the figure, the two yields move very closely together, except for several months in 1998 when the Asian financial crisis hit Korea. In the absence of a 1-month rate to proxy for the 1-month risk-free rate, the tradeoffs in selecting one over the other are time-to-maturity (3-month vs. 1-year) and default risk (banks vs. government). In this study, we use the 3-month CD yield (converted into monthly yield) as a proxy for the risk-free rate.[10]

3.2 Double-sorted Factor Portfolios

We construct several factor portfolios following a simple two-dimensional sorting of Fama and French (1993) using the firm characteristics found to be related to the cross-sectional returns as sorting criteria. First, we sort the sample firms into three groups (low 30%, medium 40%, high 30%) based on the market value of equity (ME at the end of April in year *t*), book-to-market ratio (B/M at the fiscal year-end in year *t-1*), earnings-to-price ratio (E/P at the fiscal year-end in year *t-1*), or turnover (averaged over a 12-month window ending in April in year *t*), independently for each criterion. Using firm size (ME) as one sorting criterion and one of the other three (B/M, E/P, or turnover) firm characteristics as the other sorting criterion, we construct 9 double-sorted portfolios (for each of the three two-criterion pairs), and calculate value-weighted monthly returns from May of year *t* to April of year *t+1*, rebalancing the portfolios at the end of April each year.[11] Denoting the 9 portfolios double-sorted based on ME and B/M as SL, SM, SH, ML, MM, MH, BL, BM, and BH, the return on

[10] Using the 1-year MSB yield does not change the main results.

[11] Given that the number of stocks in the sample is relatively small (ranging from 502 in 1992 to 624 in 2011), multidimensional sorting beyond a two-way sort would result in the number of stocks in a portfolio that is too small.

SMB is calculated as [(SL+SM+SH)/3-(BL+BM+BH)/3] and the return on HML is calculated as [(SH+MH+HH)/3-(SL+ML+BL)/3]. SMB_EP (SMB_T) and HML_EP (LMH_T) are defined similarly using EP ratio (turnover) instead of B/M as the second sorting criterion.[12]

Table 4 reports summary statistics of excess returns on the market portfolio (MKT) and 6 double-sorted factor portfolios.[13] As reported in Panel A, the book-to-market, earnings-to-price, and turnover factors show significantly positive mean returns and CAPM alphas, and their magnitudes are economically significant as well (alphas are 0.87%, 0.70%, and 1.39% per month for HML, HML_EP, and LMH_T, respectively). On the other hand, all of the three versions of the size factor (SMB, SMB_EP, SMB_T) have insignificant mean returns and alphas. The insignificance of the size factors' mean returns is graphically illustrated in Figure 3, which shows cumulative returns on the three size factors. While in the 1990s, the cumulative returns display a broadly upward trend, the upward trend mostly disappears in the 2000s. The results for the subsample periods in Table 4 show that the significance of the turnover factor is present in both subsamples, while the book-to-market and earnings-to-price factors are significant only in the second half of the sample period. Figure 4 illustrates this difference in the subsample periods; while the upward trend in cumulative returns is present

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[12] Since turnover has negative association with cross-sectional stock returns, we define the turnover factor (denoted LMH_T) as the return on low turnover stocks minus the return on high turnover stocks.

[13] The statistical insignificance of the market risk premium for this sample period in Korea is well known, as reported in many other studies in Korea. This is mainly due to unusually high interest rates in the first half of 1990s and high volatility in the market returns in the past two decades, partly due to several major economic events affecting the Korean stock market in a relatively short period of time such as the IMF bailout in 1998, the credit card crisis in 2003, and of course the 2008 global financial crisis.

in the entire sample periods for the turnover factor, the trend is present only in the second half for the book-to-market and earnings-to-price factors.

3.3 Value-weighted vs. Equal-weighted Returns: Bias in Mean Returns

We now turn to the issue of value-weighted vs. equal-weighted returns for factor portfolios. A recent paper by Asparouhova, Bessembinder, and Kalcheva (2013, ABK hereafter) show noisy prices, i.e., temporary deviations of trade prices from fundamental values, induce bias in differences of mean return estimates across portfolios, even when returns are measured at the monthly frequency. They find that in the presence of noise in prices, equal-weighted portfolio return difference is always biased, while the bias in value-weighed portfolio return difference is minimal.[14] Panel C of Table 4 shows that this bias is also present and substantial in the Korean stock market. The three size factors, whose mean returns and CAPM alphas are all insignificant when value-weighted, show sizable and significant mean returns and CAPM alphas when equal-weighted. The mean returns for the book-to-market and earnings-to-price factors (HML and HML_EP) increase by about 17% and 13%, respectively, when the portfolios returns are equally weighted. In contrast, the mean return and CAPM alpha for the turnover factor actually decrease when equal-weighted, suggesting that the bias induced by noisy prices is unlikely to affect the turnover factor. This result is not surprising since sorting by turnover does not involve any price variable, while this bias is induced by noise in prices.[15]

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[14] ABK (2013) find that this bias is present in estimates of mean returns to individual stocks and parameter estimates in return regressions, as well as in mean return differences across portfolios.

[15] ABK (2013) find that estimated biases in portfolio mean return differences are particularly substantial when firms are sorted on firm characteristics involving prices, such as market value of equity, share price, trading volume, and Amihud's (2002) illiquidity measure.

3.4 Momentum Factors

In contrast to the US and other major stock markets, previous studies found no momentum effect in Korea.[16] While we also find no momentum effect in Korea for the full sample period, we find the mean return and CAPM alpha to be sizable and significant for one of the momentum strategies in the second half of the sample period (2002 – 2012). Unlike the double-sorted factors in the previous section, which can be interpreted as the return on long/short strategies with annual rebalancing, the momentum strategy of Jegadeesh and Titman (1993) is a dynamic strategy that requires rebalancing every month. We examine various versions of momentum strategies widely examined in previous studies.

The momentum factors are formed by sorting the sample stocks on prior returns. For each portfolio formation month *t*, stocks are sorted (into quintiles or deciles) on their prior returns from month *t-1* to *t-J*, and the subsequent portfolio returns from month *t+1* to month *t+K* are calculated, allowing a 1-month gap between the ranking period (*J*) and the holding period (*K*). 3-1-3 corresponds to equal-weighted return on the long (winners) - short (losers) strategy with the ranking period *J=3* and holding period *K=3*. 6-1-3 and 6-1-6 are defined similarly.

Table 5 reports mean returns and CAPM alphas for six momentum strategies, and they are insignificant and even negative in many cases for the full sample period, consistent with previous findings. But the results for the subsamples show that negative mean returns

[16] In fact, most prior studies find the return on the momentum factor in Korea to be negative. For example, Jung and Kim (2011) find the average return to be -1.52% for the 1995 – 2008 period, and Kim, Kim, and Shin (2012, p. 199) "do not consider any factor models containing the momentum factor," in their study, arguing that "the momentum effect is not observed in Korea."

are mostly driven by the first half of the sample period, given that mean returns and CAPM alphas for all six cases are positive in the second half of the sample period. In two cases, 6-1-6 strategies in quintile and decile sortings, the mean returns and CAPM alphas are economically and statistically significant. For a quintile (decile) sorting, the mean return is 0.60% (1.05%) with a *t*-statistic of 2.18 (2.79), and the CAPM alpha is 0.60% (0.99%) with a *t*-statistic of 2.13 (2.63). The results suggest a need for more studies before we draw a conclusion on the existence of the momentum effect in Korea.

4. Pricing Factor Portfolios

So far, we identified several factor portfolios with significantly positive mean returns and CAPM alphas, but some of the factors' significance may be due to their correlation with other factors, given that they are not orthogonal to one another (see factor correlations reported in Panel B of Table 4). We now investigate whether pricing information contained in some factor portfolios are superfluous in the presence of other factor portfolios by running a simple horserace in a time-series regression framework as follows.

$$R_{p,t} = \alpha_p + \beta_p' F_t + e_{p,t}$$

The dependent variable $R_{p,t}$ is the return on a factor portfolio in month *t*, and F_t is the vector of returns on other factor portfolios in month *t*. Suppose the turnover factor portfolio return (LMH_T) is a dependent variable $R_{p,t}$ and the three Fama-French factor portfolio returns (MKT, SMB, and HML) are F_t. If the regression intercept α_p (pricing error) is insignificantly different from zero, then we can conclude the "risk premium" on the turnover factor is priced well by the Fama-French three factors, which implies that the turnover factor is superfluous in the presence of Fama-French three factors.

Table 6 reports coefficient estimates and associated *t*-statistics (in parentheses) for various regression specifications. As reported in Panel A, the alphas of the factor portfolios double-sorted on firm size and book-to-market ratio (SMB and HML) are all insignificant except for one case when SMB is priced by the market factor and two factor portfolios double-sorted on firm size and earnings-to-price ratio. Similarly, the alphas of the factor portfolios double-sorted on firm size and earnings-to-price ratio (SMB_EP and HML_EP) are insignificant in all specifications. On the other hand, Panel C reports that the alphas for the two factor portfolios double-sorted on firm size and share turnover (SMB_T and LMH_T) are all significantly different from zero except for one case. The overall results in Table 6 suggest that the book-to-market factor (HML) and the earnings-to-price factor (HML_EP) do not contain any pricing information that are not already in the market factor and two factor portfolios double-sorted on size and share turnover. But the pricing information contained in the turnover factor (LMH_T) is not subsumed by any other factor portfolios. Panel D reports the results for the momentum factor (6-1-6 decile sorting), and its alpha is insignificant in two of the three cases, suggesting that the momentum factor need not be considered as a separate pricing factor in the presence of the other factors considered in this study.

We also consider two more factor portfolios recently proposed as important determinants of the cross-sectional stock returns in Korea. One is innovations in the future money growth (Jung and Kim (2011)) and the other is a foreign ownership factor (Jung, Lee, and Park (2009)). Jung and Kim (2011) construct a factor portfolio designed to capture revisions in the expectation of future money growth, in a way similar to Vassalou (2003) who applies Lamont's (2001) idea of economic tracking portfolio to empirical asset pricing. We construct Jung and Kim's (2011) money growth factor (MG) corresponding to our sample period, and time-series regression results are reported in Panel A of Table 7.[17] In all three regression specifications, the pricing error (alpha) is insignificant, which suggests that the money growth factor need not be considered as a separate pricing factor since it is well priced by other factor portfolios.

Table 7 also reports the results for Jung, Lee, and Park's (2009) foreign ownership factor (FOF), which is meant to capture the difference in returns associated with different stock holdings between foreign and domestic investors, or more broadly investor heterogeneity.[18] As reported in Panel A of Table 7, the size and significance of the pricing error depends critically on whether the factor is value-weighted (FOF_VW) or equal-weighted (FOF_EW). The significance of the pricing error for this foreign ownership factor mostly disappears when the factor is value-weighted, and the size of the pricing error is also substantially reduced when it is priced by the market factor and two factors double-sorted on size and share turnover. Note that the factor portfolios used as independent variables in these regressions are all value-weighted, and ABK's (2013) finding of the bias in mean returns of equal-weighted portfolios suggests that the significance of the pricing error may be due to this bias. The results reported in Panel B of Table 7 show that this bias in the mean returns for the foreign ownership factor (FOF_EW) indeed seems substantial: when the factor portfolios

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[17] The money growth factor is constructed following Jung and Kim (2011). First, the growth rate of money supply (M1) from month *t* to *t+3* ($MON_{t,t+3}$) is regressed on a set of base asset returns in month *t* ($R_{t-1,t}$) and a set of control variables in month t-1 ($Z_{t-2,t-1}$) as follows: $MON_{t,t+3} = a + cR_{t-1,t} + dZ_{t-2,t-1} + \eta_{t,t+3}$. Then, using the coefficient estimates and the set of base asset returns, the future money growth factor (MG) is constructed as $MG_t = \hat{c}R_{t-1,t}$. For more details, refer to notes on Table 7.

[18] The foreign ownership factor (FOF) is constructed following Jung, Lee, and Park (2009). Sorting stocks based on foreign ownership into quintiles, FOF is the difference in returns between the lowest quintile portfolio and highest quintile portfolio, rebalanced annually. For more details, refer to notes on Table 7.

used as independent variables are also equal-weighted, the pricing error of the foreign ownership factor is relatively small and all insignificant.

5. Estimating the Factor Risk Premium in the Cross-section of Portfolio Returns

In this section, we estimate the risk premium of the factor portfolios in the cross-section of portfolio returns and also conduct two widely-used formal specification tests of asset pricing models, namely the *F*-test of Gibbons, Ross, and Shanken (1989) and the *J*-test using Hansen's (1982) Generalized Method of Moments (GMM).

Using four firm characteristics found to be significantly associated with cross-sectional stock returns, we construct four sets of decile portfolios sorted on firm size (ME), book-to-market ratio (B/M), earnings-to-price ratio (E/P) and share turnover (Turnover). Table 8 reports summary statistics of these portfolios, and details on portfolio construction are provided in table notes. As reported in Panel A of Table 8, these portfolios display substantial dispersion in mean returns (value-weighted). Lewellen, Nagel, and Shanken (2010) argue that high cross-sectional *R*-squared statistics provide only weak support for asset pricing models, and they also suggest confronting the models with a wide array of test portfolios to increase the dimensionality of cross-sectional returns. Taking onto account their critique and suggestion, we focus on the pricing errors (alphas) and include 10 industry portfolios in addition to these four sets of decile portfolios in the test assets.[19]

Table 9 reports coefficient estimates and their associated *t*-statistics (Shanken (1992)-corrected) from the Fama-MacBeth cross-sectional regression of portfolio excess returns on

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[19] The 10 industry classifications are as follows: energy, industrials, consumer discretionary, consumer staples, healthcare, financials, information technology, telecommunication services, and utilities.

their factor loadings (betas) for three alternative three-factor asset pricing model specifications.[20] The GRS *F*-statistic and its *p*-value (in parenthesis) are for the test of pricing errors (alphas) being jointly 0. Panel A reports the results for the three factor specification of Fama and French (1993). While the risk premium for the book-to-market factor (HML) is positive, it is insignificant in the case of 40 portfolios as test assets (left column) and marginally significant in the case of 50 portfolios as test assets (right column). Furthermore, the test of pricing errors (alphas) being jointly zero (GRS *F*-test) rejects the model in both cases with *p*-values of 0.04 and 0.01. When the size and earnings-to-price factors are used in place of the size and book-to-market factors, the risk premium on the earnings-to-price factor (HML_EP) is significantly positive, but the GRS *F*-test still rejects the model with *p*-values of 0.03 and 0.00. In contrast, when the size and turnover factors are used along with the market factor, reported in Panel C, the model is not rejected by the GRS *F*-test (*p*-values of 0.24 and 0.06), and the risk premium on the turnover factor is significantly positive and the magnitude of the estimates (1.25% and 1.10%) is also close to the sample mean of the factor portfolio return (1.33%). Moreover, unlike Panel A and Panel B where the risk premium estimates are negative for the market and size factors, they are all positive in Panel C.[21]

Table 10 reports coefficient estimates and their associated standard errors from Hansen's (1982) optimal GMM estimations of three alternative stochastic discount factor (SDF) specifications. The *J*-statistic and its *p*-value (in parenthesis) are for the test of

[20] For details of this estimation method, refer to a standard text book treatment such as Campbell, Lo, MacKinlay (1997) or Cochrane (2005).

[21] The testable predictions in this estimation are that the estimate for the constant term should be zero and the estimates for the factor portfolios should be positive and close to their sample means.

overidentifying restrictions.[22] As reported in Panel A, none of the parameters in the SDF specification of the Fama-French three factor model is significant, and the factors' risk premium estimates are insignificant as well. And the results are broadly similar when the book-to-market factor is replaced by the earnings-to-price factor, reported in Panel B. In contrast, all of the three parameters in the SDF specification are significant for the three-factor model including the turnover factor, reported in Panel C. Moreover, the risk premium estimates for the three factors are all positive, and for the turnover factor it is significant and close to its sample mean as well. Overall, the GMM results in Table 10 are broadly consistent with the Fama-MacBeth regression results in Table 9, suggesting that the three factor asset pricing model including the turnover factor describes the cross-sectional stock returns in Korea better than the Fama-French three-factor model. Turning to the results of the *J*-test, which is a formal diagnostic of efficient GMM estimation, all three specifications are not rejected, as indicated by their high *p*-values in Table 10. This failure to reject all three models is in contrast to the GRS *F*-test results where only one model is not rejected. This appears to be the result of a small sample size (240 months) relative to the size of the cross-section (41 or 51 assets) in the efficient GMM estimation (Cochrane (1996)).[23]

6. Concluding Remarks

Taking an empirical approach of Fama and French (1992, 1993), this study investigates the determinants of cross-sectional stock returns in Korea. We also take into account recent

[22] For details of this estimation method, refer to a standard text book treatment such as Campbell, Lo, MacKinlay (1997) or Cochrane (2005).

[23] Reducing the number of test portfolios may alleviate this problem, but it will lead to another problem of the low power of the specification tests arising from the low dimensional factor structure in test portfolios returns. Appendix provides more details on this issue.

critique of empirical asset pricing literature such as the low dimensional factor structure in test portfolio returns (Lewellen, Nagel, and Shanken (2010)) and the bias induced by noise in prices (ABK (2013)) when designing our empirical tests and interpreting the results.

The main findings can be summarized as follows. For the sample period of the past two decades (1992 – 2012), we do not find convincing empirical evidence supporting the Fama-French three factor model as a benchmark asset pricing model for risk-adjustment. The estimated factor risk premium and the GRS *F*-test of joint pricing error suggest that a three-factor model with the market, size, and turnover factors perform better than the Fama-French three-factor model in describing the cross-sectional stock returns in Korea. We also find that the bias induced by noisy prices is substantial in mean returns of equally-weighted portfolios, consistent with the findings of ABK (2013) for the US stock returns. The effect of this bias is substantial enough to change the economic and statistical significance of the estimated risk premium for factor portfolios, suggesting that researchers exercise caution in designing factor portfolios and interpreting results.

The obvious limitation of this study is that our approach is empirical in nature, and therefore, we do not provide an economic explanation of systematic risks underlying the cross-sectional variation of stock returns in Korea. Instead, we present a comprehensive description of the empirical determinants of the cross-sectional stock returns in Korea for the past two decades, by examining in a common data set some of the various firm characteristics and factor portfolios so as to improve our understanding of recent empirical findings and suggest a direction for further study.

One of the main findings in this study that deserves further investigation is the significant and robust cross-sectional relationship between share turnover and stock returns. As a simple measure of trading activity, share turnover has been widely interpreted as one of the proxies for liquidity, but more recently, the negative cross-sectional relation between turnover and stock returns has been also interpreted as the effect of investor sentiment (Baker and Wurgler (2006)) or firm-specific uncertainty (Barinov (2013)). Examining the economic nature of the relationship between share turnover and stock returns is beyond the scope of this paper and we leave the question for future research.

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Appendix

In this Appendix, we provide additional results that shed light on why the *J*-test fails to reject all three asset pricing model specifications considered. One potential reason for the failure to reject by the *J*-test could be due to the low dimensional factor structure in test portfolio returns, as pointed out by Nagel (2013). He argues that formal goodness-of-fit specification tests such as the GRS *F*-test or *J*-test may have little power to reject a false model when the magnitudes of the pricing errors are small due to the low dimensional factor structure in test portfolio returns. Figure A.1 and Figure A.2 display the pricing errors of the test portfolios which are used form the GRS *F*-test statistics and *J*-test statistics, respectively. The overall magnitudes of the pricing errors for the *J*-test are not much smaller than those for the GRS *F*-test. Unlike the high *p*-values for the *J*-tests that lead to a failure to reject, the *p*-values for the *F*-tests are quite small, as reported in Table 10. The substantial differences in the *p*-values and similar magnitudes of the pricing errors between the *F*- tests and *J*-tests suggest that the low dimensional factor structure in test portfolios is unlikely to be the reason for a failure to reject by the *J*-tests.

Another potential problem with the *J*-tests arises when the sample size (*T*) is small relative to the number of test portfolios (*N*), as pointed out by Cochrane (1996, 2005). He argues that when *N* is more than roughly 1/10 of *T*, the optimal weighting matrix of GMM tends to become unstable and near singular, placing a far more weights on unreasonable linear combination of moments. Given that *T* and *N* in our sample are 240 and 41 (or 51), this problem may affect the results. Figure A.3 shows the weights given to the test portfolios corresponding to the smallest eigenvalue of the optimal weighting matrix. The linear combination of test portfolios using these weights receives a lot more attention in the efficient GMM estimation (see Cochrane (1996, pp 591 – 593) for a detailed analytical explanation). But as shown in Figure A.3, the weights include unreasonably large long and short positions in a small number of portfolios. Thus, the failure to reject by the *J*-tests for all asset pricing model specifications is likely due to the problem with the optimal weighting matrix.

Table 1
Summary Statistics of Firms Listed on the Korea Stock Exchange (KSE)

This table reports the number of firms listed on KSE at the end of April each year from 1992 to 2011. For the construction of a proxy for the market portfolio, all common stocks of the firms listed on KSE are included. For Fama-MacBeth regressions at the firm-level, and for the construction of double-sorted factor portfolios and various decile test portfolios, financial firms, firms with negative book value of equity, and firms without at least 24 monthly stock returns up to April of each year are excluded from the sample.

Year	Total number of Firms	Number of financial firms	Number of new lists	Number of delists	Number of firms with negative BE	Number of sample firms with estimated beta	MV of sample firms as a percentage of total MV of all non-financial firms
1992	672	87	8	5	27	502	97%
1993	677	87	7	2	40	525	98%
1994	684	89	13	6	46	525	95%
1995	686	95	24	22	39	521	96%
1996	715	96	34	5	35	532	94%
1997	764	107	51	2	38	547	84%
1998	778	107	19	5	67	545	87%
1999	728	80	4	54	106	531	82%
2000	719	76	23	32	92	532	69%
2001	712	70	17	24	83	530	78%
2002	689	64	21	44	38	558	82%
2003	697	60	19	11	21	587	85%
2004	689	60	13	21	12	592	89%
2005	672	55	13	30	10	585	86%
2006	682	55	17	7	3	598	85%
2007	688	54	15	9	3	601	87%
2008	703	54	22	7	5	615	87%
2009	715	54	20	8	11	619	86%
2010	716	55	22	21	8	622	87%
2011	728	56	28	16	9	624	88%

Table 2
Average Slopes from Fama-MacBeth Regressions: Monthly Regressions of Stock Returns on Beta and Firm Characteristics (Financial Ratios)

This table reports regression coefficients with the associated *t-statistics* (in parentheses) from the Fama-MacBeth regressions for the sample periods May 1992 to April 2012 (Panel A), May 1992 to April 2002 (Panel B), and May 2002 to April 2012 (Panel C). The dependent variable is the cross-section of monthly stock returns in excess of the risk-free rate, and the independent variables are a constant and the cross-section of firm characteristics listed in the table. Each stock's beta is estimated using monthly stock returns for 5-year window up to April of year *t*. The log of the market value of equity ln(ME) is measured at the end of April of year *t*. B/M is the ratio of the book value of equity to market value of equity, and firm leverage (Lev) is measured as the ratio of the book value of total debt to market value of equity. If earnings are positive, E/P is the ratio of total earnings to market value of equity and E/P dummy is 0. If earnings are negative, E/P is 0 and E/P dummy is 1. B/M, Lev, and E/P are all measured at each firm's fiscal year-end in year *t-1*. Coefficient estimates significant at the 5% level are in bold.

Panel A: 1992 - 2012

Beta	ln(ME)	ln(B/M)	ln(Lev)	E/P	E/P Dummy
-0.16					
(-0.58)					
	-0.50				
	(-2.95)				
		1.11			
		(5.27)			
			0.55		
			(3.43)		
				3.00	0.47
				(4.00)	(1.18)
	-0.36		**0.40**	**2.33**	
	(-2.40)		(2.85)	(3.24)	
		0.92	0.18	**1.43**	
		(5.96)	(1.34)	(2.02)	
	-0.31	**0.87**		**1.74**	
	(-2.07)	(4.80)		(2.49)	

Panel B: 1992 - 2002

	ln(ME)	ln(B/M)		E/P	
	-0.69	**0.68**		1.89	
	(-2.54)	(2.20)		(1.89)	

Panel C: 2002 - 2012

	ln(ME)	ln(B/M)		E/P	
	-0.17	**0.59**		0.87	
	(-1.52)	(3.61)		(1.04)	

Table 3
Average Slopes from Fama-MacBeth Regressions: Monthly Regressions of Stock Returns on Firm Characteristics and Liquidity Measures

This table reports regression coefficients with the associated *t-statistics* (in parentheses) from the Fama-MacBeth regressions for the sample periods May 1992 to April 2012 (Panel A), May 1992 to April 2002 (Panel B), and May 2002 to April 2012 (Panel C). The dependent variable is the cross-section of monthly stock returns in excess of the risk-free rate, and the independent variables are a constant and the cross-section of firm characteristics listed in the table. The log of the market value of equity ln(ME) is measured at the end of April of year *t*. B/M is the ratio of the book value of equity to market value of equity, and E/P is the ratio of total earnings to market value of equity for firms with positive earnings. B/M and E/P are all measured at each firm's fiscal year-end in year *t-1*. Turnover is measured for each stock at the end of April in year *t* as a 12-month average of daily share turnover. Illiquidity is Amihud's (2002) illiquidity measure averaged over 6-month window ending in April of year *t*. Coefficient estimates significant at the 5% level are in bold.

Panel A: 1992 - 2012

ln(ME)	ln(B/M)	E/P	Turnover	Illiquidity
			-1.54	
			(-2.62)	
				0.01
				(2.30)
-0.23	**0.61**	0.58		0.00
(-1.53)	(-4.10)	(0.85)		(0.74)
-0.24		0.80		0.00
(-1.63)		(1.21)		(1.19)
	0.62	0.28		0.00
	(4.84)	(0.41)		(1.30)
-0.43	**0.63**	**1.38**	**-1.64**	
(-2.92)	(3.63)	(2.11)	(-3.14)	

Panel B: 1992 - 2002

ln(ME)	ln(B/M)	E/P	Turnover	Illiquidity
-0.46	**0.46**	0.63		0.00
(-1.64)	(1.99)	(0.58)		(1.47)
-0.69	**0.68**	1.89	**-2.00**	
(-2.54)	(2.20)	(1.89)	(-2.01)	

Panel C: 2002-2012

ln(ME)	ln(B/M)	E/P	Turnover	Illiquidity
0.00	**0.76**	0.53		0.00
(-0.02)	(4.07)	(0.64)		(0.10)
-0.17	**0.59**	0.87	**-1.27**	
(-1.52)	(3.61)	(1.04)	(-4.16)	

Table 4
Summary Statistics of Market and Double-Sorted Factor Portfolios

This table reports average returns, CAPM alphas (in Panel A), and correlations (in Panel B) of various factor portfolios. MKT denotes the value-weighted return (including dividend) of all stocks listed on the KSE in excess of risk-free rate (91-day CD yield). For construction of double-sorted factor portfolios, we sort the sample firms into three groups (low 30%, medium 40%, high 30%)) based on the market value of equity (ME at the end of April in year *t*), book-to-market ratio (B/M at the fiscal year-end in year *t-1*), earnings-to-price ratio (E/P at the fiscal year-end in year *t-1*), or turnover (averaged over 12-month window ending in April in year *t*) *t*, independently for each criterion. Using firm size (ME) as one sorting criterion and one of the other three (B/M, E/P, or turnover) firm characteristics as the other sorting criterion, we construct 9 double-sorted portfolios (for each of the three two-criterion pairs) and calculate value-weighted monthly returns from May of year *t* to April of year *t+1*, rebalancing the portfolios at the end of April each year. Denoting the 9 portfolios double-sorted based on ME and B/M as SL, SM, SH, ML, MM, MH, BL, BM, and BH, the return on SMB is calculated as [(SL+SM+SH)/3-(BL+BM+BH)/3] and the return on HML is calculated as [(SH+MH+HH)/3-(SL+ML+BL)/3]. SMB_EP (SMB_T) and HML_EP (LMH_T) are defined in the same way using EP ratio (turnover) instead of B/M as the second sorting criterion. *T-statistics* are in parentheses and estimates significant at the 5% level are in bold.

Panel A: Average Return and CAPM Alpha

	MKT	SMB	HML	SMB_EP	HML_EP	SMB_T	LMH_T
			Sample period: 1992-2012				
Mean	0.35	-0.10	**0.89**	0.47	**0.70**	0.73	**1.33**
	(0.60)	(0.18)	(2.91)	(0.86)	(2.52)	(1.41)	(3.42)
CAPM Alpha		-0.02	**0.87**	0.54	**0.70**	0.81	**1.39**
		(0.04)	(2.86)	(1.00)	(2.50)	(1.63)	(3.69)
			Sample period: 1992-2002				
Mean	-0.04	0.58	0.36	0.89	0.74	1.55	**1.78**
	(0.04)	(0.60)	(0.75)	(0.93)	(1.55)	(1.76)	(2.88)
CAPM Alpha		0.57	0.36	0.88	0.74	1.54	**1.78**
		(0.61)	(0.76)	(0.95)	(1.55)	(1.83)	(2.90)
			Sample period: 2002-2012				
Mean	0.74	-0.79	**1.42**	0.05	**0.66**	-0.10	0.87
	(1.24)	(1.43)	(3.73)	(0.10)	(2.26)	-(0.19)	(1.86)
CAPM Alpha		-0.70	**1.40**	0.13	**0.65**	0.02	**1.14**
		(1.27)	(3.65)	(0.23)	(2.20)	(0.04)	(2.73)

Panel B: Correlation

	MKT	SMB	HML	SMB_EP	HML_EP	SMB_T	LMH_T
MKT		-0.24	0.09	-0.21	0.02	-0.27	-0.26
SMB			-0.08	0.91	-0.14	0.91	-0.39
HML				0.19	0.32	0.17	0.27
SMB_EP					-0.15	0.90	-0.31
HML_EP						-0.02	0.27
SMB_T							-0.09

Table 4 Continued

Panel C: VW vs. EW Factor Risk Premium: 1992 - 2012

	SMB	HML	SMB_EP	HML_EP	SMB_T	LMH_T
	Value-weighted Return					
Mean	-0.10	**0.89**	0.47	**0.70**	0.73	**1.33**
	(0.18)	(2.91)	(0.86)	(2.52)	(1.41)	(3.42)
CAPM Alpha	-0.02	**0.87**	0.54	**0.70**	0.81	**1.39**
	(0.04)	(2.86)	(1.00)	(2.50)	(1.63)	(3.69)
	Equal-weighted Return					
Mean	**1.15**	**1.04**	**1.37**	**0.79**	**1.80**	**1.16**
	(2.31)	(3.66)	(3.11)	(3.27)	(3.83)	(3.32)
CAPM Alpha	**1.22**	**1.02**	**1.42**	**0.79**	**1.87**	**1.23**
	(2.53)	(3.61)	(3.28)	(3.26)	(4.11)	(3.69)

Table 5
Summary Statistics of Momentum Factors

This table reports the average returns and CAPM alphas with associated *t-statistics* (in parentheses) for momentum factors formed by sorting sample stocks on prior returns. For each portfolio formation month *t*, stocks are sorted (into quintiles or deciles) on their prior returns from month *t-1* to *t-J*, and the subsequent portfolio returns from month *t+1* to month *t+K* are calculated (allowing 1-month gap between ranking period (*J*) and holding period (*K*)). 3-1-3 corresponds to equal-weighted return on the long (winners)-short (losers) strategy with ranking period *J=3* and holding period *K=3*. 6-1-3 and 6-1-6 are defined similarly.

	Quintile Sorting			Decile Sorting		
	3-1-3	6-1-3	6-1-6	3-1-3	6-1-3	6-1-6
			Sample Period: 1992-2012			
Mean	0.08	-0.20	-0.13	0.00	-0.42	-0.30
	(0.17)	(0.32)	(0.27)	(0.01)	(0.50)	(0.45)
CAPM alpha	0.13	-0.14	-0.08	0.06	-0.35	-0.24
	(0.29)	(0.23)	(0.18)	(0.09)	(0.42)	(0.37)
			Sample Period: 1992-2002			
Mean	-0.12	-0.90	-0.86	-0.32	-1.66	-1.64
	(0.14)	(0.77)	(0.98)	(0.27)	(1.05)	(1.29)
CAPM alpha	-0.13	-0.91	-0.86	-0.33	-1.67	-1.65
	(0.15)	(0.80)	(1.00)	(0.29)	(1.08)	(1.32)
			Sample Period: 2002-2012			
Mean	0.27	0.51	**0.60**	0.33	0.82	**1.05**
	(0.90)	(1.34)	(2.18)	(0.81)	(1.65)	(2.79)
CAPM alpha	0.25	0.48	**0.60**	0.25	0.74	**0.99**
	(0.84)	(1.26)	(2.13)	(0.61)	(1.48)	(2.63)

Table 6
Pricing Double-Sorted Factor Portfolios and Momentum Factor

This table reports coefficient estimates and their associated *t-statistics* in the following time-series regression: $R_{p,t} = \alpha_p + \beta_p' F_t + e_{p,t}$. $R_{p,t}$ is the return on a factor portfolio in month *t*, and F_t is the vector of returns on other factor portfolios in month *t*. For construction of double-sorted factor portfolios, we sort the sample firms into three groups (low 30%, medium 40%, high 30%) based on the market value of equity (ME at the end of April in year *t*), book-to-market ratio (B/M at the fiscal year-end in year *t-1*), earnings-to-price ratio (E/P at the fiscal year-end in year *t-1*), or turnover (averaged over 12-month window ending in April in year *t*) *t*, independently for each measure. Using firm size (ME) as one sorting criterion and one of the other three (B/M, E/P, or turnover) firm characteristics as the other sorting criterion, we construct 9 double-sorted portfolios (for each of the three two-criterion pairs) and calculate value-weighted monthly returns from May of year *t* to April of year *t+1*, rebalancing the portfolios at the end of April each year. Denoting the 9 portfolios double-sorted based on ME and B/M as SL, SM, SH, ML, MM, MH, BL, BM, and BH, the return on SMB is calculated as [(SL+SM+SH)/3-(BL+BM+BH)/3] and the return on HML is calculated as [(SH+MH+HH)/3-(SL+ML+BL)/3]. SMB_EP (SMB_T) and HML_EP (LMH_T) are defined in the same way using EP ratio (turnover) instead of B/M as the second sorting criterion. MOM is the return on the 6-1-6 momentum factor. Coefficient estimates significant at the 5% level are in bold.

Panel A: Pricing Factor Portfolios formed on ME and B/M

Dependent Variable	Factor Loadings on Independent Variables					
	Alpha	MKT	SMB_EP	HML_EP	SMB_T	LMH_T
SMB	**-0.51**	-0.05	**0.92**	-0.02		
	(-2.16)	(-1.78)	(32.72)	(-0.32)		
	-0.10	**-0.09**			**0.92**	**-0.49**
	(-0.62)	(-4.92)			(47.50)	(-18.98)
HML	0.52	**0.08**	**0.15**	**0.39**		
	(1.82)	(2.39)	(4.40)	(5.99)		
	0.35	**0.14**			**0.16**	**0.28**
	(1.19)	(4.06)			(4.31)	(5.76)

Panel B: Pricing Factor Portfolios formed on ME and E/P

Dependent Variable	Factor Loadings on Independent Variables					
	Alpha	MKT	SMB	HML	SMB_T	LMH_T
SMB_EP	0.16	-0.01	**0.91**	**0.46**		
	(0.87)	(-0.63)	(42.97)	(12.26)		
	0.26	-0.03			**0.92**	**-0.34**
	(1.25)	(-1.29)			(34.61)	(-9.67)
HML_EP	0.45	-0.02	**-0.06**	**0.28**		
	(1.66)	(-0.65)	(-2.00)	(5.13)		
	0.38	0.05			0.02	**0.21**
	(1.37)	(1.58)			(0.58)	(4.56)

Table 6 Continued

Panel C: Pricing Factor Portfolios formed on ME and Turnover

Dependent Variable	Factor Loadings on Independent Variables					
	Alpha	MKT	SMB	HML	SMB_EP	HML_EP
SMB_T	**0.48**	**-0.07**	**0.84**	**0.41**		
	(2.70)	(-3.68)	(40.62)	(11.10)		
	0.21	**-0.08**			**0.85**	**0.21**
	(0.97)	(-3.26)			(32.64)	(4.22)
LMH_T	**1.08**	**-0.27**	**-0.33**	**0.34**		
	(3.40)	(-7.40)	(-8.71)	(5.13)		
	1.30	**-0.23**			**-0.25**	**0.31**
	(3.81)	(-5.92)			(-6.06)	(3.94)

Panel D: Pricing Factor Portfolio formed on Momentum for 2002 - 2012

Dependent Variable	Factor Loadings on Independent Variables							
	Alpha	MKT	SMB	HML	SMB_EP	HML_EP	SMB_T	LMH_T
MOM	0.57	0.06	**-0.17**	**0.21**				
(6-1-6)	(1.54)	(1.04)	(-2.66)	(2.36)				
	0.78	0.07			-0.09	**0.34**		
	(2.13)	(1.20)			(-1.45)	(2.88)		
	0.61	**0.19**					-0.08	**0.33**
	(1.70)	(3.08)					(-1.34)	(4.34)

Table 7
Pricing Money Growth and Foreign Ownership Factors

The money growth factor is constructed following Jung and Kim (2011). First, the growth rate of money supply (M1) from month *t* to *t+3* ($MON_{t,t+3}$) is regressed on a set of base asset returns in month *t* ($R_{t-1,t}$) and a set of control variables in month t-1 ($Z_{t-2,t-1}$) as follows: $MON_{t,t+3} = a + cR_{t-1,t} + dZ_{t-2,t-1} + \eta_{t,t+3}$. Then, using the coefficient estimates and the set of base asset returns, the future money growth factor (MG) is constructed as $MG_t = \hat{c}R_{t-1,t}$. The set of base asset returns include the excess returns on a market portfolio proxy, 10 industry portfolios, and 6 portfolios formed as intersections of ME (small 50% and big 50%) and B/M (low 30%, medium 40%, and high 30%) criterion. The foreign ownership factor (FOF) is constructed following Jung, Lee, and Park (2009): at the end of April in year t, stocks are sorted based on foreign ownership into quintiles, and the value-weighted (equal-weighted) returns are calculated for each quintile portfolio from May of year *t* to April of year *t+1*. Rebalancing the portfolio at the end of April each year, FOF_EW (FOF_VW) is the difference between the EW (VW) returns on the lowest quintile portfolio and highest quintile portfolio. Panel A reports the time-series regression coefficient estimates and their associated t-statistics (in parentheses) in which value-weighted returns on the factor portfolios are used as independent variables. Panel B reports the time-series regression coefficient estimates and their associated t-statistics (in parentheses) in which equal-weighted returns on the factor portfolios are used as independent variables. Coefficient estimates significant at the 5% level are in bold. The sample period for MG is from June 1995 to April 2012, and for FOF is from May 1999 to April 2012.

Panel A: Indendent variables are value-weighted returns

Dependent Variable	Factor Loadings on Independent Variables							
	Alpha	MKT	SMB	HML	SMB_EP	HML_EP	SMB_T	LMH_T
MG	-0.06	**0.03**	**0.10**	0.02				
	(0.79)	(3.01)	(9.84)	(1.09)				
	-0.08	**0.02**			**0.09**	-0.03		
	(0.96)	(2.55)			(8.56)	(1.58)		
	-0.07	0.02					**0.09**	**-0.04**
	(0.77)	(1.95)					(8.00)	(2.90)
FOF_VW	-0.77	**0.18**	**0.88**	**0.52**				
	(1.77)	(3.01)	(13.35)	(5.66)				
	-0.97	**0.15**			**0.84**	**0.33**		
	(2.19)	(2.58)			(12.85)	(3.01)		
	-0.22	0.09					**0.80**	**-0.38**
	(0.49)	(1.30)					(11.49)	(4.62)
FOF_EW	**0.99**	0.04	**0.61**	**0.11**				
	(3.91)	(1.08)	(16.02)	(2.09)				
	0.81	0.02			**0.53**	-0.11		
	(2.88)	(0.66)			(12.91)	(1.57)		
	0.91	0.04					**0.57**	**-0.17**
	(3.33)	(0.91)					(13.88)	(3.35)

Table 7 Continued

Panel B: Indendent variables (other than the market) are equal-weighted returns

Dependent Variable	Factor Loadings on Independent Variables							
	Alpha	MKT	SMB	HML	SMB_EP	HML_EP	SMB_T	LMH_T
FOF_EW	-0.21	**0.11**	**0.84**	**0.31**				
	(0.97)	(4.00)	(21.70)	(5.99)				
	-0.10	**0.07**			**0.81**	0.08		
	(0.40)	(2.07)			(18.38)	(1.20)		
	-0.06	0.05					**0.82**	**-0.23**
	(0.30)	(1.85)					(22.58)	(5.47)

Table 8
Summary Statistics of Decile Portfolios Formed on Various Firm Characteristics

This table reports summary statistics of four sets of portfolios formed by sorting stocks into deciles at the end of April in year *t* based on one of the following criteria: ME (measured at the end of April of year *t*), B/M (the ratio of the book value of equity to market value of equity measured at each firm's fiscal year-end in year *t-1*), E/P (the ratio of total earnings to market value of equity for firms with positive earnings measured at each firm's fiscal year-end in year *t-1*), and Turnover (measured for each stock at the end of April in year *t* as a 12-month average of daily share turnover). Portfolios are rebalanced at the end of April each year, and the value-weighted returns are calculated from May of year *t* to April of year *t+1*. The sample period is from May 1992 to April 2012.

Sorting	Panel A: Average Value-weighted Monthly Returns (in Percent)									
Criterion	Low	2	3	4	5	6	7	8	9	High
ME	2.27	1.49	1.29	1.27	1.09	0.85	0.92	0.93	1.06	1.42
B/M	1.36	1.11	1.11	1.15	1.67	1.59	1.78	1.42	1.64	1.84
E/P	1.03	1.40	0.66	1.16	1.25	1.35	1.76	1.80	1.65	1.75
Turnover	1.80	1.20	1.24	0.96	1.04	1.20	1.23	0.86	-0.04	0.24

Sorting	Panel B: Average Market Value of Equity (in 100 million KRW)									
Criterion	Low	2	3	4	5	6	7	8	9	High
ME	107	199	286	391	533	746	1,137	1,962	5,151	45,534
B/M	15,827	15,070	8,880	4,987	3,190	2,722	2,079	1,870	1,230	660
E/P	4,849	7,915	8,733	12,234	10,059	9,925	5,413	2,864	2,242	1,924
Turnover	5,123	5,411	9,721	10,975	7,129	6,170	5,518	3,667	2,035	695

Sorting	Panel C: Average Book-to-Market Ratio									
Criterion	Low	2	3	4	5	6	7	8	9	High
ME	2.62	2.22	2.25	2.09	1.92	1.79	1.63	1.60	1.38	1.06
B/M	0.36	0.67	0.91	1.13	1.37	1.64	1.94	2.35	3.00	5.16
E/P	1.41	1.46	1.42	1.47	1.60	1.71	1.78	1.93	2.03	2.79
Turnover	2.06	2.00	2.10	1.97	1.86	1.80	1.90	1.78	1.66	1.43

Sorting	Panel D: Average Earnings-to-Price Ratio									
Criterion	Low	2	3	4	5	6	7	8	9	High
ME	0.92	0.28	0.39	0.16	0.20	0.17	0.19	0.13	0.10	0.09
B/M	0.15	0.11	0.12	0.13	0.16	0.18	0.19	0.23	0.21	0.89
E/P	0.02	0.04	0.06	0.07	0.09	0.11	0.14	0.17	0.22	1.36
Turnover	0.17	0.20	0.20	0.20	0.14	0.15	0.41	0.21	0.23	0.44

Sorting	Panel E: Average Turnover Ratio									
Criterion	Low	2	3	4	5	6	7	8	9	High
ME	0.44	0.41	0.39	0.36	0.31	0.29	0.28	0.23	0.22	0.16
B/M	0.44	0.40	0.37	0.33	0.30	0.29	0.28	0.25	0.21	0.22
E/P	0.42	0.31	0.28	0.28	0.24	0.23	0.21	0.20	0.22	0.26
Turnover	0.03	0.06	0.09	0.12	0.16	0.21	0.27	0.37	0.54	1.22

Table 9
Estimating Risk Premium and Evaluating Pricing Errors: Fama-MacBeth Regression

This table reports coefficient estimates and their associated *t-statistics* (Shanken (1992)-corrected) from Fama-MacBeth cross-sectional regression of portfolio excess returns on their factor loadings (betas) for three alternative three-factor asset pricing model specifications. GRS *F-statistic* and its *p*-value (in parenthesis) are for the test of pricing errors (alphas) being jointly 0. Factor loadings are estimated from time series regression (full-sample) for each portfolio. Test assets are four sets of decile portfolios (40 portfolios), formed by sorting stocks into deciles at the end of April in year *t* based on one of the following criteria: ME (measured at the end of April of year *t*), B/M (the ratio of the book value of equity to market value of equity measured at each firm's fiscal year-end in year *t-1*), E/P (the ratio of total earnings to market value of equity for firms with positive earnings measured at each firm's fiscal year-end in year *t-1*), and Turnover (measured for each stock at the end of April in year *t* as a 12-month average of daily share turnover). Portfolios are rebalanced at the end of April each year, and the value-weighted returns are calculated from May of year *t* to April of year *t+1*. The results with 50 portfolios as test assets include 10 industry portfolios as well as the four sets of decile portfolios. The sample period is from May 1992 to April 2012.

	40 Portfolios as Test Assets				50 Portfolios as Test Assets			
Panel A: Fama-French Three-Factor Model								
	Constant	MKT	SMB	HML	Constant	MKT	SMB	HML
Risk Premium	**2.05**	-1.43	-0.21	0.46	0.95	-0.29	-0.28	0.23
Corrected *t*-value	(2.04)	(1.22)	(0.35)	(1.10)	(1.52)	(0.78)	(0.35)	(1.91)
GRS *F*-Statistic (*p*-value)	1.49 (0.04)				1.65 (0.01)			
Panel B: Size-EP Three-Factor Model								
	Constant	MKT	SMB_EP	HML_EP	Constant	MKT	SMB_EP	HML_EP
Risk Premium	1.83	-1.25	-0.20	**0.98**	0.79	-0.18	-0.31	**0.78**
Corrected *t*-value	(1.84)	(1.07)	(0.33)	(2.26)	(0.84)	(0.28)	(0.09)	(2.84)
GRS *F*-Statistic (*p*-value)	1.52 (0.03)				1.78 (0.00)			
Panel C: Size-Turnover Three-Factor Model								
	Constant	MKT	SMB_T	LMH_T	Constant	MKT	SMB_T	LMH_T
Risk Premium	-0.99	1.67	0.76	**1.25**	-0.69	1.38	0.62	**1.10**
Corrected *t*-value	(0.88)	(1.28)	(1.32)	(2.55)	(1.04)	(1.44)	(1.46)	(2.45)
GRS *F*-Statistic (*p*-value)	1.17 (0.24)				1.40 (0.06)			

Table 10
Estimating Risk Premium and Evaluating Pricing Errors: GMM/SDF Estimation

This table reports coefficient estimates and their associated standard errors from Hansen's (1982) optimal Generalized Method of Moments (GMM) estimations of three alternative Stochastic Discount Factor (SDF) specifications. *J-statistic* and its *p*-value (in parenthesis) are for the test of overidentifying restrictions. Test assets are four sets of decile portfolios (40 portfolios), formed by sorting stocks into deciles at the end of April in year *t* based on one of the following criteria: ME (measured at the end of April of year *t*), B/M (the ratio of the book value of equity to market value of equity measured at each firm's fiscal year-end in year *t-1*), E/P (the ratio of total earnings to market value of equity for firms with positive earnings measured at each firm's fiscal year-end in year *t-1*), and Turnover (measured for each stock at the end of April in year *t* as a 12-month average of daily share turnover). Portfolios are rebalanced at the end of April each year, and the value-weighted returns are calculated from May of year *t* to April of year *t+1*. The results with 50 portfolios as test assets include 10 industry portfolios as well as the four sets of decile portfolios. The monthly gross return on three-month CD is also included in estimation. The sample period is from May 1992 to April 2012.

	Panel A: Fama-French Three-Factor Model							
	40 Portfolios and CD as Test Assets				50 Portfolios and CD as Test Assets			
SDF	Constant	MKT	SMB	HML	Constant	MKT	SMB	HML
Parameters	1.001	-0.007	-0.002	-0.015	1.000	-0.004	0.003	-0.008
Standard Error	0.017	0.006	0.013	0.013	0.014	0.006	0.007	0.013
Risk Premium		0.57	-0.06	0.36		0.39	-0.30	0.20
Standard Error		0.50	0.50	0.29		0.46	0.47	0.28
J-statistic (p-value)	33.48 (0.63)				43.03 (0.64)			
	Panel B: Size-EP Three-Factor Model							
	40 Portfolios and CD as Test Assets				50 Portfolios and CD as Test Assets			
SDF	Constant	MKT	SMB_EP	HML_EP	Constant	MKT	SMB_EP	HML_EP
Parameters	1.017	-0.004	-0.002	**-0.044**	0.999	-0.002	0.003	-0.028
Standard Error	0.022	0.006	0.007	0.017	0.019	0.006	0.007	0.016
Risk Premium		0.32	-0.16	**0.82**		0.21	-0.39	0.54
Standard Error		0.49	0.48	0.31		0.46	0.46	0.29
J-statistic (p-value)	31.92 (0.71)				43.42 (0.62)			
	Panel C: Size-Turnover Three-Factor Model							
	40 Portfolios and CD as Test Assets				50 Portfolios and CD as Test Assets			
SDF	Constant	MKT	SMB_T	LMH_T	Constant	MKT	SMB_T	LMH_T
Parameters	1.094	**-0.025**	**-0.024**	**-0.043**	1.097	**-0.020**	**-0.022**	**-0.045**
Standard Error	0.033	0.008	0.009	0.009	0.028	0.007	0.008	0.008
Risk Premium		0.90	0.86	**1.09**		0.49	0.79	**1.25**
Standard Error		0.55	0.49	0.31		0.52	0.47	0.27
J-statistic (p-value)	27.03 (0.89)				40.66 (0.73)			

Figure 1
Cumulative Return on the KOSPI index:
Excluding Dividend (KOSPI_X) vs. Including Dividend (KOSPI_D)

This figure illustrates cumulative returns on the KOSPI stock market index, excluding dividend (KOSPI_X) and including dividend (KOSPI_D) from January 1990 to April 2012. The index level as of the beginning of January 1990 is set to 1000.

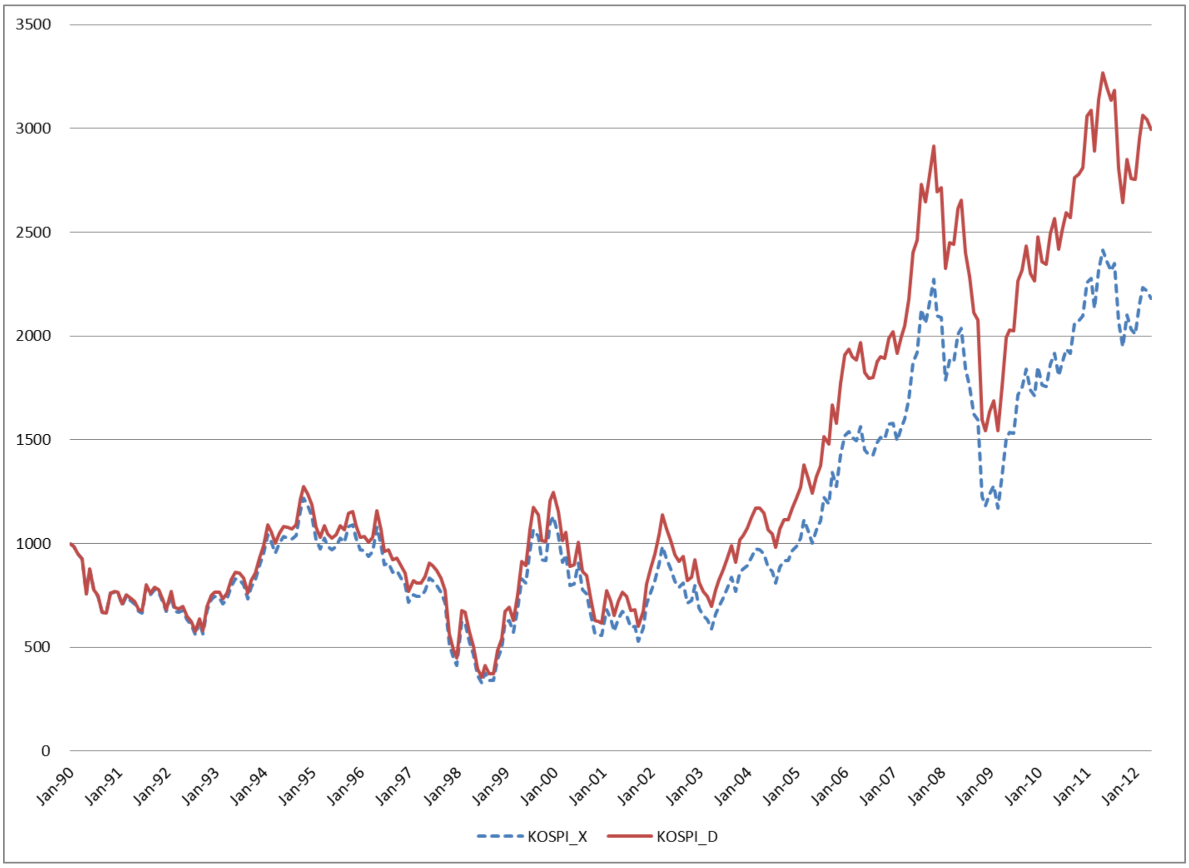

Figure 2
3-Month CD Yield and 1-Year Monetary Stabilization Bond Yield

This figure illustrates the yields on 3-month CD and 1-year Monetary Stabilization Bond (MSB) from May 1992 to April 2012.

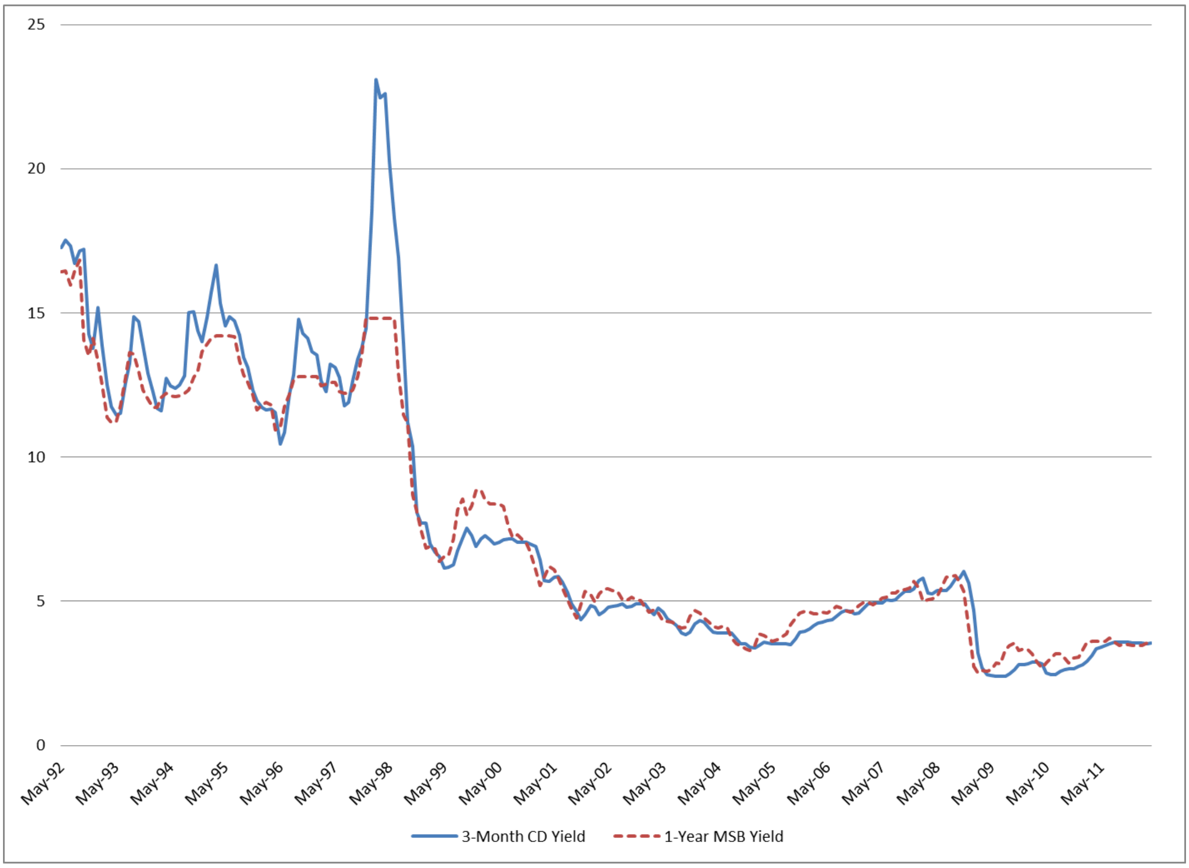

Figure 3
Cumulative Returns on VW Factor Portfolios:
Size double-sorted with B/M, E/P and Turnover

This figure illustrates cumulative returns on three double-sorted factor portfolios from May 1992 to April 2012. SMB is a factor portfolio sorted on the market value of equity and book-to-market ratio, SMB_EP on the market value of equity and earnings-to-price ratio, and SMP_T on the market value of equity and turnover ratio. For construction of double-sorted factor portfolios, we sort the sample firms into three groups (low 30%, medium 40%, high 30%)) based on the market value of equity (ME at the end of April in year *t*), book-to-market ratio (B/M at the fiscal year-end in year *t-1*), earnings-to-price ratio (E/P at the fiscal year-end in year *t-1*), or turnover (averaged over 12-month window ending in April in year *t*) *t*, independently for each criterion. Using firm size (ME) as one sorting criterion and one of the other three (B/M, E/P, or turnover) firm characteristics as the other sorting criterion, we construct 9 double-sorted portfolios (for each of the three two-criterion pairs) and calculate value-weighted monthly returns from May of year *t* to April of year *t+1*, rebalancing the portfolios at the end of April each year. Denoting the 9 portfolios double-sorted based on ME and B/M as SL, SM, SH, ML, MM, MH, BL, BM, and BH, the return on SMB is calculated as [(SL+SM+SH)/3-(BL+BM+BH)/3] and the return on HML is calculated as [(SH+MH+HH)/3-(SL+ML+BL)/3]. SMB_EP (SMB_T) and HML_EP (LMH_T) are defined in the same way using EP ratio (turnover) instead of B/M as the second sorting criterion.

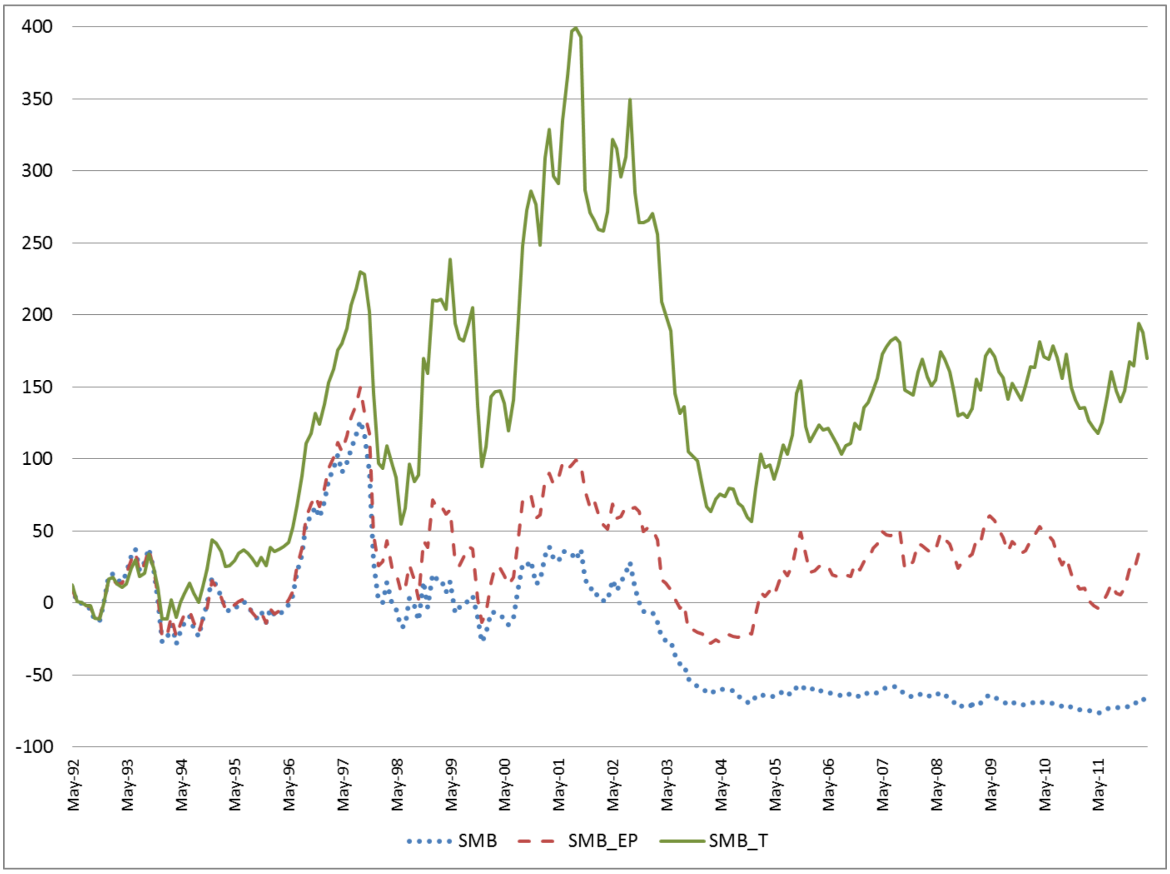

Figure 4
Cumulative Returns on Value-weighted Factor Portfolios: B/M, E/P, and Turnover double-sorted with Size

This figure illustrates cumulative returns on three double-sorted factor portfolios from May 1992 to April 2012. HML is a factor portfolio sorted on the market value of equity and book-to-market ratio, HML_EP on the market value of equity and earnings-to-price ratio, and LMH_T on the market value of equity and turnover ratio. For construction of double-sorted factor portfolios, we sort the sample firms into three groups (low 30%, medium 40%, high 30%)) based on the market value of equity (ME at the end of April in year *t*), book-to-market ratio (B/M at the fiscal year-end in year *t-1*), earnings-to-price ratio (E/P at the fiscal year-end in year *t-1*), or turnover (averaged over 12-month window ending in April in year *t*) *t*, independently for each criterion. Using firm size (ME) as one sorting criterion and one of the other three (B/M, E/P, or turnover) firm characteristics as the other sorting criterion, we construct 9 double-sorted portfolios (for each of the three two-criterion pairs) and calculate value-weighted monthly returns from May of year *t* to April of year *t+1*, rebalancing the portfolios at the end of April each year. Denoting the 9 portfolios double-sorted based on ME and B/M as SL, SM, SH, ML, MM, MH, BL, BM, and BH, the return on SMB is calculated as [(SL+SM+SH)/3-(BL+BM+BH)/3] and the return on HML is calculated as [(SH+MH+HH)/3-(SL+ML+BL)/3]. SMB_EP (SMB_T) and HML_EP (LMH_T) are defined in the same way using EP ratio (turnover) instead of B/M as the second sorting criterion.

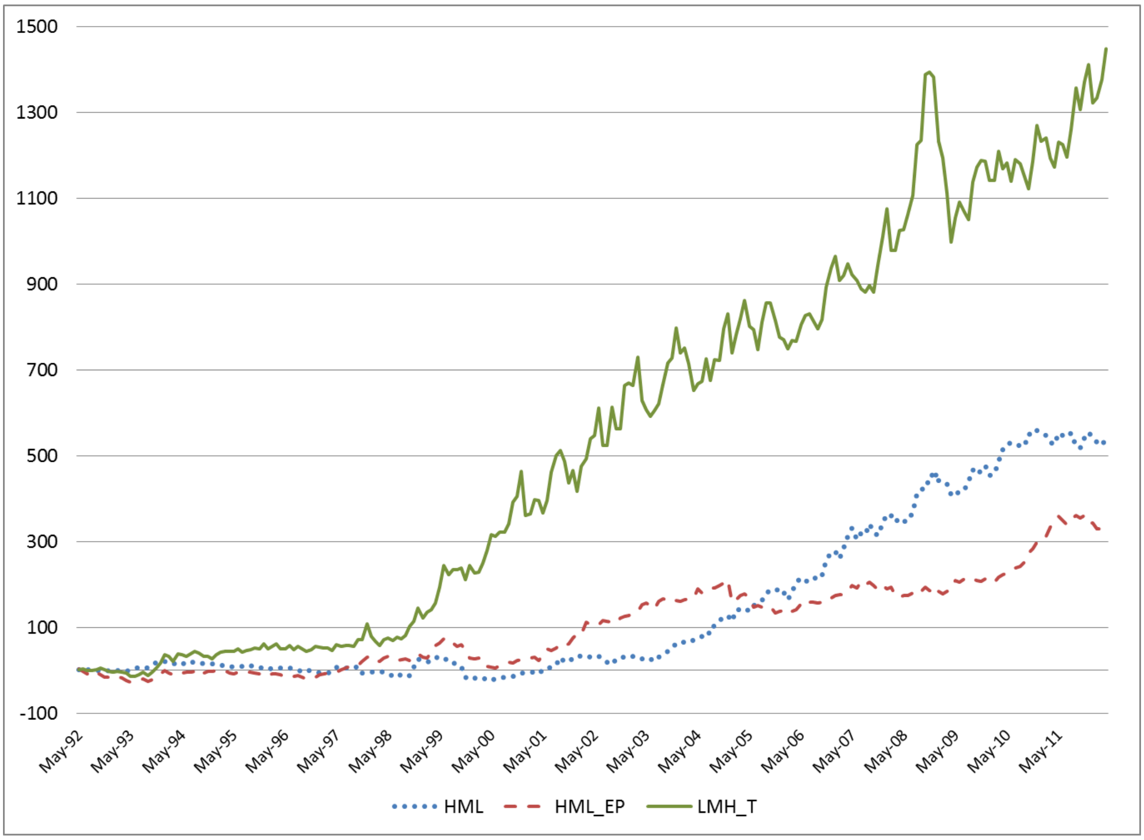

Figure A.1
Pricing Errors from Fama-MacBeth Cross-sectional Regression

The pricing errors of the 40 test portfolios estimated from Fama-MacBeth cross-sectional regressions for three 3-factor asset pricing model specifications are depicted in this figure.

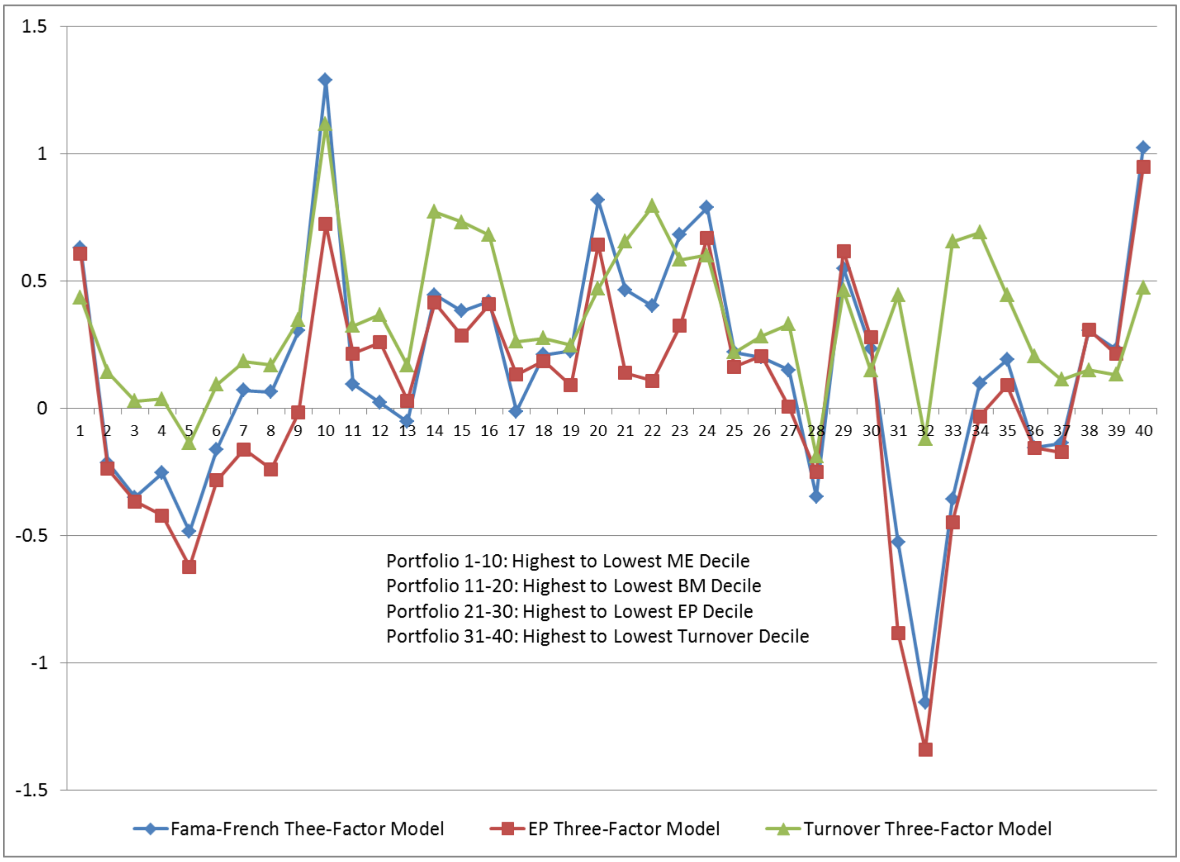

Figure A.2
Pricing Errors from GMM/SDF Estimation: Optimal Weighting Matrix

The pricing errors of the 41 test portfolios from GMM/SDF estimations for three 3-factor asset pricing model specifications are depicted in this figure.

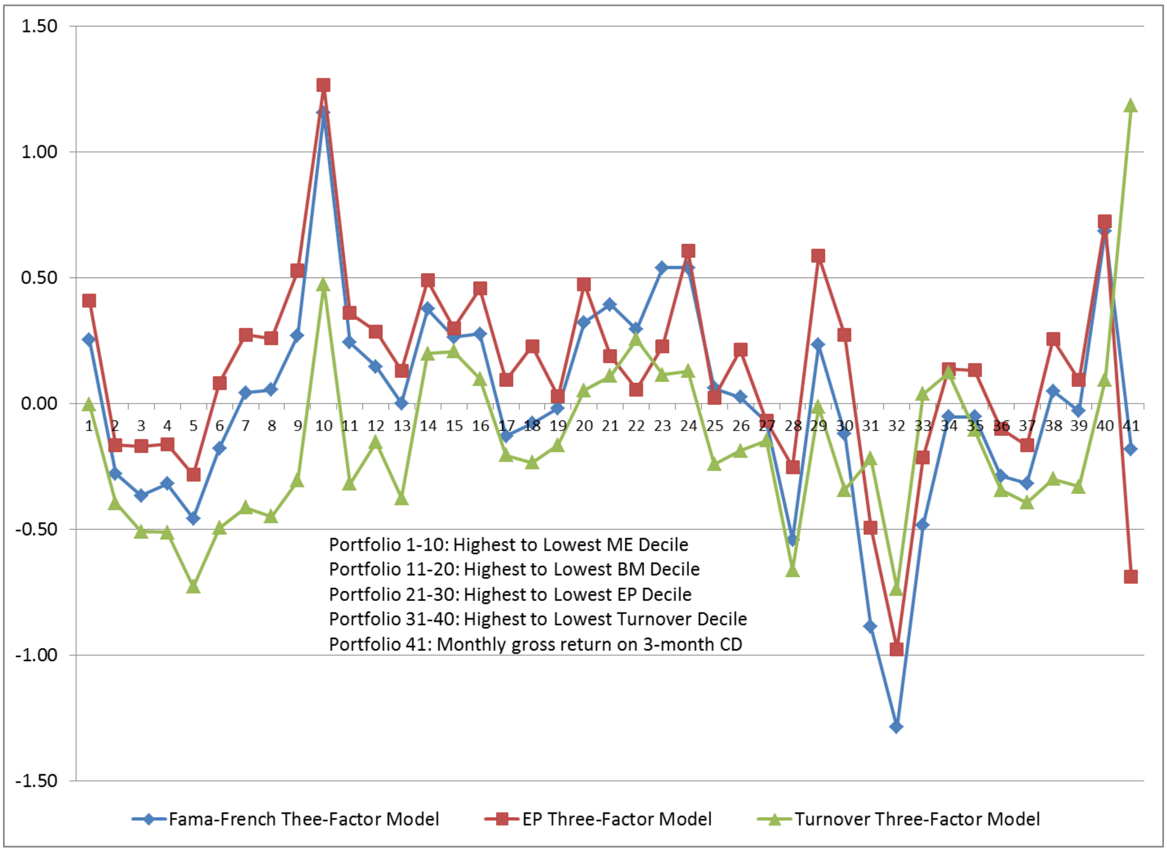

Figure A.3
Weights (eigenvector) of the portfolio corresponding to the smallest eigenvalue of S

The portfolio weights (elements of the eigenvector scaled to sum to 1) corresponding to the smallest eigenvalue of the optimal weighting matrix S from GMM'SDF estimations for three 3-factor asset pricing model specifications are depicted in this figure.