Some Features of the Three- and Four--factor Models for the Selected Portfolios of the Stocks

Listed on the Warsaw Stock Exchange, 2003–2007

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1. Introduction

The paper presents some initial results of the investigation of the standard multifactor models of portfolio returns for several types of sorted portfolios of the stocks listed on the Warsaw Stock Exchange (WSE). In this way the paper contributes to the understanding of the multifactor explanations of returns in the emerging markets, previously explored e.g. by Rouwenhorst [1999], van der Hart et al. [2003, 2005] and Jung et al. [2008]. First, we examine summary statistics of returns on the sorted portfolios as well as the magnitude of the size, value and momentum premiums. Next we check which models perform best in explaining the portfolio returns. Finally, we check if the models can identify some sources of profits of these portfolios.

2. Data, portfolio returns computation and summary statistics

The data set used to compute the factor and portfolio returns was prepared from the raw data obtained from the web pages of parkiet.com, bossa.pl, KDPW as well as from the Notoria database. The monthly 52-week Treasury bills yields were obtained from the money.pl web page.

The SMB and HML factor returns were computed according to the methodology described in Fama and French [1996]. All non-financial stocks with a positive book value listed on the Warsaw Stock Exchange (WSE) at the end of June of a given year were sorted into two groups: S (Small) and B (Big) if their capitalization on that day was, respectively, in the bottom or top five capitalization deciles of all stocks considered. In an independent sort all non-financial stocks with positive book value at the end of the previous December were sorted into three groups according to the value of their B/M (Book-to-Market) ratio, the ratio of the end-December book value to the end-December capitalization. These three B/M groups are: H (High), the stocks in the top three B/M ratio deciles, L (Low), the stocks in the bottom three B/M deciles and M, the stocks in the middle four B/M deciles. Next, six portfolios were obtained as the intersection of the S and B with H, M and L portfolios: S/H (the intersection of the portfolios S and H), S/M, S/L, B/H, B/M and B/L. Then the value-weighted monthly returns for these six intersection portfolios were computed from July of each year until next June when the procedure was repeated with the new end-June and end-December values. The value of the SMB factor in a given month was then computed as the difference of the average of S/H, S/M and S/L returns and the average of B/H, B/M and B/L returns in that month. The value of the HML factor in a given month was computed as the difference of the average of the B/H and S/H returns and the average of the B/L and S/L returns in that month.

The WML momentum factor returns and the ten momentum decile portfolios WLDx, x = 1…10, returns were computed according to the methodology of Jegadeesh and Titman (2001). At the end of each month all WSE stocks with the price above PLN0.50 were ranked into deciles according to their returns in the past six months. Then equal-weighted returns on these decile portfolios were computed for the next six months. Next the method of the overlapping portfolios was applied. For each month the return on a given decile portfolio was computed as the average of the returns for that decile for the six overlapping monthly rankings. The value for the WML factor was obtained as the difference between the WLD10 (winners decile) return and the WLD1 (losers decile) return.

To obtain the returns on the nine double-sort size-B/M portfolios SxBy, x = 1…3, y = 1…3, the same procedure as in the above calculation of the size and B/M portfolios for the factor returns was adopted, this time applied to the intersection of the three size portfolios S1, S2, S3 containing bottom three capitalization deciles stocks (S1), four middle capitalization deciles stocks (S2) and top three capitalization deciles stocks (S3) and similarly for the B1, B2, B3 portfolios with regard to the B/M ratio. So, the portfolio S1B1 contains stocks with the lowest size and lowest B/M ratio and S3B3 portfolio contains stocks with both the highest B/M value and the highest capitalization. The portfolio returns were value-weighted. In addition, the returns on nine SxBye portfolios were calculated in a similar way changing only the portfolio return calculation method from the value-weighted to the equal-weighted.

The returns on the nine double-sort B/M and C/P (BxCy, x = 1…3, y = 1…3) and nine double-sort B/M and E/P (BxEy, x = 1…3, y = 1…3) portfolios were obtained in the same way based on the end-December values of the B/M, C/P and E/P ratios for each stock, where C/P is the cash flow/price ratio, with the cash flow equal to net income plus depreciation, and E/P is the net income to capitalization ratio. The stocks were sorted again at the end of each June as in the HML-SMB procedure and after each sort the twelve monthly July to June returns were computed. As for the SxBy portfolios, the B1C1 and B1E1 portfolios contain stocks in the intersection of the lowest value B/M and lowest value C/P or E/P portfolios respectively.

The monthly market factor (MKT) return was computed as the difference of the value -weighted return on all non-financial WSE stocks for a given month minus the risk-free rate obtained as the monthly compounded rate implied by the yield on the 52-week Treasury bills taken from the last auction in the preceding month.

The results presented here are for the period from July 2003 to December 2007 for the total of 54 monthly observations. The relatively short period for which we estimate the models and the fact that a large part of this period was a market expansion period may introduce some bias into the results.

Tables 1A and 1B present basic statistics for the four factors. The SMB is the factor with the highest mean monthly return of almost 4.6% with the average MKT and HML factor returns of about 1.8–1.9% and the WML factor return of about 1.5%. Except SMB and MKT the factors display relatively low correlations. SMB and MKT are correlated at about 53%, which may influence the results of their joint application in the same model. The results demonstrate the existence of a large size premium on the WSE. The premiums on size, value and momentum factors are higher than those reported for a different period for emerging markets by Rouwenhorst (1999). The mean returns on the WLDx portfolios are much higher than the averages computed for the US stocks in Jegadeesh and Titman [2001].

Tables 1C–1G present the statistics for the double-sort and momentum portfolio returns. Among the size and B/M sorted value-weighted portfolios the S1B1 portfolio is the one with the highest mean monthly return of about 12%, while the S3B1 and S3B2 portfolios display the lowest average returns of about 1–2%. When we consider the equal-weighted size and B/M portfolios the results are similar but the average returns are different for the S1B2 and S1B3 portfolios. This suggests that the weighting method may influence the results. Among the B/M and C/P sorted portfolios the average returns are highest for the C1 portfolios, i.e. portfolios with stocks with the lowest C/P ratios. The statistics for the B/M and E/P sorted portfolios display a similar pattern. The returns on the momentum portfolios increase more or less monotonically from the lowest returns for the loser deciles WLD1-WLD4 of about 3% to the highest returns for the winners decile WLD10 of 4.88%.

3. Statistics of model alphas

For each group of the sorted portfolios, SxBy, SxBye, BxCy, BxEy and WLDx we estimate the following four types of factor models: CAPM (Equation 3.1 below), Fama and French three-factor model (Eq. 3.2), four-factor model (Eq. 3.3, Fama and French factors plus momentum) and another three-factor model (Eq. 3.4, four-factor model without the market factor):

$$R_t = \alpha + \beta_{MKT} MKT_t + \varepsilon_t \qquad \text{(Equation 3.1)}$$

$$R_t = \alpha + \beta_{MKT} MKT_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \varepsilon_t \quad \text{(Equation 3.2)}$$

$$R_t = \alpha + \beta_{MKT} MKT_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{WML} WML_t + \varepsilon_t \quad \text{(Equation 3.3)}$$

$$R_t = \alpha + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{WML} WML_t + \varepsilon_t \quad \text{(Equation 3.4)}$$

where MKT_t, SMB_t, and WML_t are the monthly factor returns and R_t are the risk-free rate adjusted returns for each sorted portfolio in the five portfolio groups in month t. Risk-free rate adjusted dependent portfolio returns are denoted by the final letter –R at the end of the dependent portfolio name, so for example S1B1R is the risk-free rate adjusted return on the portfolio S1B1. In sum we estimate 184 equations ($9 \times 4 + 10 = 46$ portfolios times 4 models).

We are interested in how well different models manage to explain the returns for each group of the sorted portfolios. To compare the models we count the number of the statistically significant alphas for each portfolio group and each model, and we compute, as is standard in the literature, the GRS statistic testing the hypothesis that all alphas in a given portfolio group are jointly zero [Gibbons et al., 1989]. The results are presented in Table 2. It must be kept in mind, however, that the number of observations is relatively low, and that the details of model specifications may introduce some bias into the computation of this statistic.

The SMB-HML-WML three-factor model is the best performing model, with the lowest number of significant non-zero alphas and the lowest GRS statistics, followed by the four-factor model. The Fama and French three-factor model performs slightly worse than the four-factor model while the CAPM clearly does not perform well, with many alphas statistically significant from zero in the individual equations as well as jointly as tested by the GRS statistic in the four of the five groups of portfolios.

There are some interesting observations to be noted here. First, the multifactor models seem to explain well the returns on the size and B/M value sorted portfolios, unlike the Fama and French (1996) results for the US market. Second, the models fail to explain the returns on the equal-weighted size and B/M sorted portfolios. Three, surprisingly, the CAPM, explains better than with other four portfolio groups the returns on the momentum-sorted portfolios. Next, in contrast to the Jegadeesh and Titman [2001] results, the Fama and French three-factor model explains fairly well the returns on the momentum-sorted WLDx portfolios.

4. Results of the three-factor SMB-HML-WML models

Since the SMB-HML-WML three-factor model was the best performing one of the four models considered above, in this section we present the results of this model for the five groups of the sorted portfolios. We check if the factors manage to capture the behavior of the same characteristic in the sorted portfolios and observe how the factors not included in the dependent portfolio characteristics explain the behavior of their returns.

Tables 3A and 3B display the Eq. 3.4 estimation results for the, respectively, value-weighted and equal-weighted size and B/M sorted portfolios. In both groups of portfolios the SMB and HML factors capture the changes in the size and B/M ranks of the portfolios. The HML coefficients increase from the B1 to the B3 portfolios and the SMB coefficients increase from the S3 to the S1 portfolios. The same pattern was observed by Fama and French [1996]. The WML coefficients do not show a clear pattern, although they seem to have higher values for the small stock portfolios (except S1B2).

Tables 3C and 3D present the results for the BxCy (B/M and C/P double-sort) and the BxEy (B/M and E/P double-sort). Since the HML factor is one of the explanatory variables and both groups of portfolios are sorted by B/M we expect the level of the HML coefficient to increase in models with higher Bx values. We find that this is indeed the case for the BxEy returns, while the results for BxCy are more mixed. In both groups the SMB coefficients are highest for the C1 and E1 portfolios, which shows that the smallest stocks are the most overvalued. Similar pattern can be observed for the WML coefficient (except B1Cy portfolios) which could mean that the most overvalued stocks have the strongest momentum.

Table 3E presents the results of the estimation of the Equation 3.4 for the momentum sorted portfolios. The WML factor seems to capture fairly well the dynamics of these portfolios especially of the extreme ones, WLD1 (losers) and WLD10 (winners), although the WLD1 coefficient fails to achieve statistical significance. The coefficients for SMB and HML do not show a clear pattern, perhaps with the exception of being slightly higher for the extreme WLD portfolios. This could mean that the smaller stocks are represented more in the extreme market movements, both positive and negative, and that the same holds for the undervalued stocks. Such pattern is similar to the one documented by the Fama and French model estimation by Jegadeesh and Titman [2001] for the US market for the SMB factor and different for the HML factor, which had lowest loadings for the extreme momentum portfolios.

5. Conclusion

We have investigated and compared three- and four-factor models of the selected portfolios of the stocks listed on the Warsaw Stock Exchange in the July 2003—December 2007 period. There are several interesting findings. There is a large size premium on the Polish stock market. Further, the portfolios of stocks with both the lowest size and B/M ratio achieve highest average monthly returns among the examined portfolios. Of the four factor models tested, the three-factor size, value and momentum model seems to capture better than other models the returns on the sorted portfolios constructed in this paper. In contrast to the results from the US market the momentum returns are explained quite well by the standard three-factor Fama and French model.

Further research could extend these findings in several directions. The portfolio returns could be examined in more detail together with more information on the characteristics of the portfolio components. Other sorted portfolios as well as some other factors could be constructed. More extensive application of the results to the practical portfolio strategies could be developed. Since the models used domestic factors only, their results could be compared to the models including international and global factors (see e.g. [Griffin, 2002; Moerman, 2005]).

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Tables 1A–G

Summary statistics for the portfolio returns: MKT, SMB, HML and WML factors (Table 1A an 1B), SxBy (Table 1C), SxBye (Table 1D), BxCy (Table 1E), BxEy (Table 1F), x = 1…3, y = 1…3, and WLDx, x = 1…10 (Table 1G). The data are from the period July 2003-December 2007, 54 monthly observations.

Table 1A

Variable	Mean	Std. Dev.	Min	Max
MKT	.0189901	.0613944	–.115867	.174366
SMB	.0458667	.0955067	–.089481	.310498
HML	.0184889	.0804375	–.344105	.16741
WML	.015562	.0729275	–.1691989	.2605359

Table 1B

	MKT	SMB	HML	WML
MKT	1.0000			
SMB	0.5284	1.0000		
HML	0.0415	–0.2056	1.0000	
WML	0.1962	0.0697	0.0726	1.0000

Table 1C

Variable	Mean	Std. Dev.	Min	Max
S1B1	.1214617	.3170489	–.196693	1.453284
S1B2	.1015283	.3243485	–.265463	1.987453
S1B3	.0789501	.1412254	–.151522	.4966
S2B1	.0430587	.1313752	–.139406	.676463
S2B2	.0422144	.0942339	–.130009	.321584
S2B3	.0477205	.1065587	–.189125	.431589
S3B1	.0101153	.0553128	–.129336	.172809
S3B2	.0238041	.0761782	–.126019	.187452
S3B3	.0491334	.1081339	–.108555	.569263

Table 1D

Variable	Mean	Std. Dev.	Min	Max
S1B1e	.1234368	.303907	–.211891	1.642188
S1B2e	.0699164	.1539957	–.172273	.818574
S1B3e	.0909918	.134794	–.111528	.447832
S2B1e	.0404884	.1063385	–.169482	.419764
S2B2e	.0454783	.1017496	–.156116	.414467
S2B3e	.0554528	.1125551	–.185815	.448426
S3B1e	.0173988	.0622726	–.142145	.209775
S3B2e	.0296217	.0742858	–.115437	.295778
S3B3e	.0478836	.0899346	–.114215	.262609

Table 1E

Variable	Mean	Std. Dev.	Min	Max
B1C1	.0837832	.1966491	–.159085	1.103491
B1C2	.0321315	.083324	–.141524	.355332
B1C3	.0394412	.1299478	–.172062	.416997
B2C1	.0919644	.2001436	–.228117	.942062
B2C2	.0301299	.0679057	–.141158	.189438
B2C3	.0444562	.0879026	–.115323	.266961
B3C1	.0809526	.1510624	–.156345	.46271
B3C2	.0433141	.1094123	–.159445	.382509
B3C3	.0711254	.1094773	–.139542	.372047

Table 1F

Variable	Mean	Std. Dev.	Min	Max
B1E1	.0993106	.2434005	–.14179	1.50948
B1E2	.0311761	.0857953	–.160337	.331655
B1E3	.0306531	.0961323	–.165621	.22617
B2E1	.089873	.1970825	–.161495	.988909
B2E2	.0295115	.0731885	–.167492	.188385
B2E3	.0448604	.0852832	–.118656	.272266
B3E1	.0882791	.1466108	–.112596	.461641
B3E2	.0533345	.1143344	–.218363	.380714
B3E3	.0656988	.1002833	–.111607	.356384

Table 1G

Variable	Mean	Std. Dev.	Min	Max
WLD1	.0332245	.0957244	–.1746846	.2699828
WLD2	.0336348	.0792692	–.1421888	.2458335
WLD3	.0309259	.070058	–.1508203	.2074489
WLD4	.0324065	.0687397	–.1505034	.1866025
WLD5	.0371336	.0704095	–.1331997	.1919769
WLD6	.043415	.0798833	–.1216261	.2350019
WLD7	.0409601	.0757864	–.1181151	.2137256
WLD8	.0436359	.0841401	–.1082829	.2251726
WLD9	.0466748	.0935655	–.1453704	.2319699
WLD10	.0487865	.1139847	–.1600548	.3304455

Table 2

The number of non-zero alphas and the GRS statistics with p-values for the various factor models in the five groups of risk-free rate adjusted sorted portfolio returns: BxCyR, BxEyR, SxByR, SxByeR x = 1…3, y = 1…3, and WLDxR, x = 1…10. The data are from the period July 2003-December 2007, 54 monthly observations.

Table 2

Dependent portfolio groups (–R = risk-free rate adjusted)	Factor model	Number of sorted portfolios in a group	Weighting method: VW = value-weighted EW = equal-weighted	Number of non-zero alphas significant at 10%	GRS	GRS p-value
BxCyR (double-sort B/M and C/P)	MKT_t	9	VW	4	2.22	0.04
	MKT_t, SMB_t, HML_t			1	1.02	0.44
	SMB_t, HML_t, WML_t			0	0.84	0.58
	MKT_t, SMB_t, HML_t, WML_t			1	0.92	0.52
BxEyR (double-sort B/M and E/P)	MKT_t	9	VW	6	2.53	0.02
	MKT_t, SMB_t, HML_t			2	1.14	0.36
	SMB_t, HML_t, WML_t			1	0.99	0.46
	MKT_t, SMB_t, HML_t, WML_t			1	1.03	0.43
SxByR (double-sort size and B/M)	MKT_t	9	VW	6	2.44	0.02
	MKT_t, SMB_t, HML_t			2	1.27	0.28
	SMB_t, HML_t, WML_t			2	1.06	0.41
	MKT_t, SMB_t, HML_t, WML_t			2	1.57	0.16
SxByeR (double-sort size and B/M)	MKT_t	9	EW	6	3.64	0.00
	MKT_t, SMB_t, HML_t			3	2.13	0.05
	SMB_t, HML_t, WML_t			1	1.87	0.08
	MKT_t, SMB_t, HML_t, WML_t			2	2.08	0.05
WLDxR (Momentum)	MKT_t	10	EW	5	1.63	0.13
	MKT_t, SMB_t, HML_t			0	1.40	0.21
	SMB_t, HML_t, WML_t			0	1.31	0.26
	MKT_t, SMB_t, HML_t, WML_t			1	1.30	0.26

Tables 3A–E

The results of the estimation of the three-factor model $R_t = \alpha = \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + \varepsilon_t$, where R_t are risk-free rate adjusted monthly returns on the SxBy (SxByR, Table 3A), SxBye (SxByeR, Table 3B), BxCy (BxCyR, Table 3C), BxEy (BxEyR, Table 3D), x = 1...3, y = 1...3, and WLDx, x = 1...10 (WLDxR, Table 3E) portfolios. The tables present the regression coefficients and intercepts as well as F statistics for the individual equations, together with p-values below. All standard errors are estimated using the Newey-West correction for heteroskedasticity and autocorrelation. The data are from the period July 2003—December 2007, 54 monthly observations. The coefficient significance at 1%, 5% and 10% level is denoted by ***, ** and * respectively.

Table 3A

Coef.	S1B1R	S1B2R	S1B3R
β_{SMB}	1.782364*** 0.000	2.153122** 0.045	1.047396*** 0.000
β_{HML}	–1.895158*** 0.000	.2598159 0.661	.7669345*** 0.000
β_{WML}	.5023488 0.237	.100349 0.824	.4232407*** 0.001
α	.062776*** 0.001	–.0077502 0.811	.0059867 0.522
F statistic	16.68 0.00	2.16 0.1045	27.44 0.00
	S2B1R	S2B2R	S2B3R
β_{SMB}	.7722324*** 0.000	.6945843*** 0.000	.8322597*** 0.000
β_{HML}	–.0670548 0.852	.5933607*** 0.000	.5451796*** 0.004
β_{WML}	.2270807 0.108	.1258242 0.116	.19245 0.208
α	.0011884 0.947	–.0067291 0.497	–.0076838 0.460
F statistic	6.77 0.00	17.40 0.00	9.68 0.00
	S3B1R	S3B2R	S3B3R
β_{SMB}	.2642886*** 0.000	.3437068*** 0.002	.4089971*** 0.001
β_{HML}	.095714 0.224	.1059727 0.548	.6216541** 0.018
β_{WML}	.247824*** 0.000	.1131314 0.399	.1688472* 0.065
α	–.0117895* 0.072	.000163 0.989	.0120963 0.350
F statistic	11.83 0.00	3.77 0.0163	14.26 0.00

Table 3B

Coef.	S1B1eR	S1B2eR	S1B3eR
β_{SMB}	1.300102*** 0.000	.8555031*** 0.000	1.020838*** 0.000
β_{HML}	–1.243874* 0.069	.2584932 0.249	.6534262*** 0.000
β_{WML}	.6709173** 0.024	.8214289* 0.059	.5240134*** 0.000
α	.072206 0.109	.0089584 0.553	.019777** 0.041
F statistic	16.92 0.00	5.54 0.0023	35.23 0.00
	S2B1eR	S2B2eR	S2B3eR
β_{SMB}	.648406*** 0.000	.7806397*** 0.000	.8709518*** 0.000
β_{HML}	.1269825 0.445	.6087284*** 0.000	.6392114*** 0.000
β_{WML}	.0648265 0.566	.1410401* 0.069	.2053474 0.239
α	.0032351 0.863	–.0079331 0.418	–.0036654 0.738
F statistic	9.34 0.00	14.44 0.00	9.89 0.00
	S3B1eR	S3B2eR	S3B3eR
β_{SMB}	.3894527*** 0.000	.4607244*** 0.000	.4402836*** 0.000
β_{HML}	.1990697** 0.028	.3376014*** 0.007	.5544756*** 0.001
β_{WML}	.2172807** 0.012	.1200153 0.332	.0660167 0.437
α	–.0116825 0.131	–.0037762 0.669	.0122537 0.197
F statistic	12.78 0.00	5.92 0.0016	23.19 0.00

Table 3C

Coef.	B1C1R	B1C2R	B1C3R
β_{SMB}	1.031506*** 0.000	.5109406*** 0.000	.666233*** 0.000
β_{HML}	–.3506973 0.447	.1417053 0.299	.5177129*** 0.007
β_{WML}	.3448587* 0.063	.1905058 0.109	.5034184*** 0.006
α	.0334322 0.318	–.0010448 0.934	–.0126794 0.348
F statistic	10.20 0.00	17.18 0.00	15.20 0.00
	B2C1R	B2C2R	B2C3R
β_{SMB}	1.309361*** 0.000	.4755313*** 0.000	.662524*** 0.000
β_{HML}	.7252037*** 0.004	.3356096*** 0.000	.4121834*** 0.000
β_{WML}	.5672144 0.228	.1248176* 0.074	.2263233* 0.062
α	.0055166 0.674	–.0039851 0.661	–.001231 0.900
F statistic	14.72 0.00	15.28 0.00	34.62 0.00
	B3C1R	B3C2R	B3C3R
β_{SMB}	1.067959*** 0.000	.8080667*** 0.000	.6925866*** 0.000
β_{HML}	.5704057*** 0.003	.3930839*** 0.002	.6787268*** 0.000
β_{WML}	.7753498*** 0.000	–.0895151 0.339	.36366*** 0.001
α	.0052001 0.683	–.0037805 0.723	.016994 0.128
F statistic	27.15 0.00	15.86 0.00	21.15 0.00

Table 3D

Coef.	B1E1R	B1E2R	B1E3R
β_{SMB}	1.071667*** 0.000	.5470532*** 0.000	.5977539*** 0.000
β_{HML}	–.577967 0.373	.120771 0.409	.3468267** 0.024
β_{WML}	.3188371 0.169	.2417527** 0.041	.2569227 0.101
α	.0517245 0.230	–.004067 0.751	–.0113311 0.310
F statisic	6.66 0.00	16.19 0.00	20.50 0.00
	B2E1R	B2E2R	B2E3R
β_{SMB}	1.311292*** 0.000	.4904894*** 0.000	.6440178*** 0.000
β_{HML}	.7141643*** 0.007	.3437314*** 0.000	.4211628*** 0.000
β_{WML}	.5905178 0.160	.0883462 0.308	.1989098 0.107
α	.003178 0.785	–.0048722 0.668	.0002826 0.975
F statistic	13.49 0.00	10.69 0.00	26.54 0.00
	B3E1R	B3E2R	B3E3R
β_{SMB}	1.12782*** 0.000	.8362141*** 0.000	.600865*** 0.000
β_{HML}	.6738153*** 0.000	.5658029*** 0.000	.6430241*** 0.000
β_{WML}	.6198081*** 0.000	.2703298** 0.041	.1675082 0.304
α	.0102896 0.278	–.0038444 0.711	.019487* 0.082
F statistic	36.65 0.00	27.09 0.00	15.71 0.00

Table 3E

Coef.	WLD1R	WLD2R	WLD3R	WLD4R	WLD5R	WLD6R	WLD7R	WLD8R	WLD9R	WLD10R
β_{SMB}	.7206729*** 0.000	.6579224*** 0.000	.5680419*** 0.000	.5450607*** 0.000	.5513052*** 0.000	.6268922*** 0.000	.5556614*** 0.000	.6324658*** 0.000	.6949858*** 0.000	.7206729*** 0.000
β_{HML}	.4093623*** 0.002	.371734*** 0.000	.2685822*** 0.000	.3324937*** 0.000	.3359465*** 0.000	.3680126*** 0.000	.3630514*** 0.000	.3437079*** 0.000	.4826167*** 0.000	.4093623*** 0.002
β_{WML}	−.238274 0.137	.1501299** 0.018	.075565 0.167	.1389027*** 0.003	.1798112*** 0.006	.2192203*** 0.005	.1383591 0.113	.2471758** 0.012	.2619665** 0.021	.761726*** 0.000
α	−.0078476 0.478	−.0099077 0.169	−.0054266 0.512	−.0050592 0.493	−.001319 0.858	.0002894 0.968	.0024516 0.772	.0002689 0.973	−.0023582 0.803	−.0078476 0.478
F statistic	15.98 0.00	45.43 0.00	33.70 0.00	52.91 0.00	63.72 0.00	51.44 0.00	26.21 0.00	47.54 0.00	28.18 0.00	66.41 0.00