

Supplemental material for

Market Betas in Multi-factor Models

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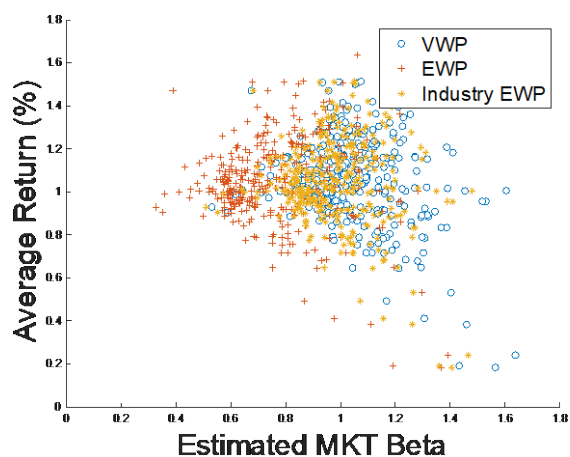
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This document contains additional figures and tables whose results are discussed in the paper but are not part of it.

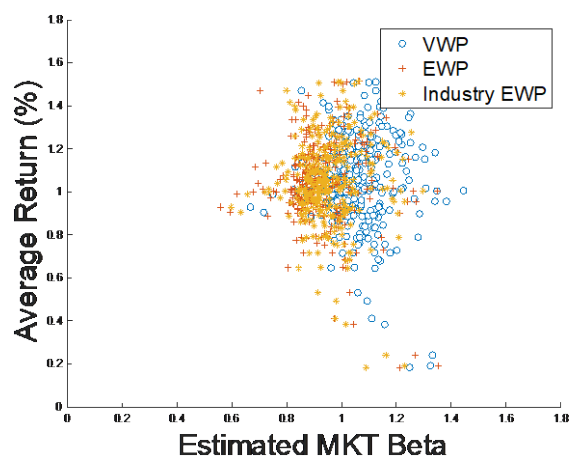
Figure 5A: Estimated MKT Betas Using RF-Excess Returns and Three Different Proxy Market Portfolios Without Intercept

The market betas are estimated using 330 portfolio returns over the one-month treasury bill rate (RF-excess returns) from January 1970 to December 2013. Three different proxy market portfolios are used: The value-weighted portfolio (VWP), the equally-weighted portfolio (EWP), and the industry EWP. The one-month treasury bill rate is used as a proxy risk-free return. The VWP returns and the EWP returns are computed using the data from the CRSP database. The Industry EWP returns are computed using the 30 Industry Fama-French portfolios. The one-month treasury bill rate, the five factors of Fama and French (2015), and the 330 portfolio returns are from Kenneth French's webpage. The five VW-PC factors (VW-PC5 factors) are obtained from the VW-excess returns on the 330 portfolios. The market betas are estimated by three different factor models with intercepts: the usual CAPM with a risk-free asset, the CAPM with the SMB, HML, RMW, and CMA factors (FF4 factors) of Fama and French (2015), and the CAPM augmented with the five VW-PC factors. The CAPM augmented with the FF4 factors is the same as the five-factor model of Fama and French. Note that the MKT betas are estimated with regression intercepts.

(a) CAPM



(b) CAPM with FF4 factors



(c) CAPM with VW-PC factors

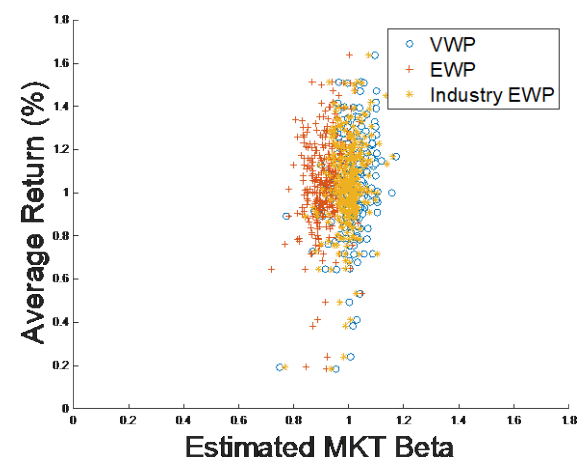
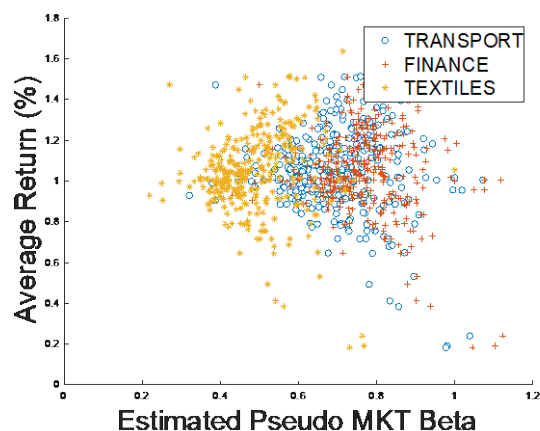


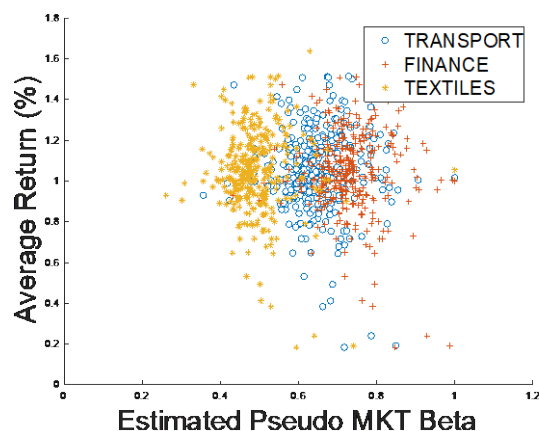
Figure 6A: Estimated Pseudo MKT Betas Using RF-Excess Returns and Three Different Industry-Specific Portfolios

The reported betas are estimated using 330 portfolio returns over the one-month treasury bill rate (RF-excess returns) from January 1970 to December 2013. We use a pseudo CAPM (PCAPM) that uses a pseudo market portfolio instead of the value-weighted portfolio. The pseudo market portfolios we experiment with are three industry-specific portfolios from the Fama-French 30 Industry portfolios: Transportation (TRANSPORT), Banking, Insurance, Real Estate, Trading (FINANCE), and Textiles. The one-month treasury bill rate, the five factors of Fama and French (2015), and the 330 portfolio returns are from Kenneth French's webpage. The five VW-PC factors (VW-PC5 factors) are obtained from the VW-excess returns on these 330 portfolios. The pseudo market betas are estimated from three different models: the PCAPM, the PCAPM augmented with the SMB, HML, RMW, and CMA factors (FF4 factors) of Fama and French (2015), and the PCAPM augmented with the five VW-PC factors. The CAPM augmented with the FF4 factors is the same as the five-factor model of Fama and French. The pseudo market betas are estimated with regression intercepts.

(a) PCAPM



(b) PCAPM with FF4 factors



(c) PCAPM with five VW-PC factors

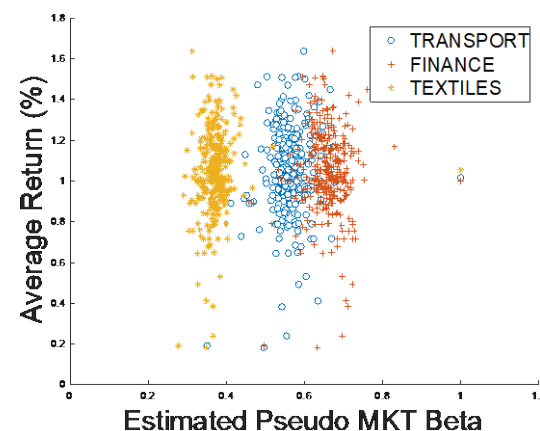


Table 1A. Summary Statistics from Estimated MKT Betas Without Intercepts

The MKT betas (the betas of the MKT factor) are estimated from three different models: the CAPM with a risk-free asset (one-factor model using the MKT factor as the sole factor), the CAPM augmented with the SMB, HML, RMW, and CMA factors (FF4 factors) of Fama and French (2015), and the CAPM augmented with five VW-PC factors (CAPM plus VW-PC5). The CAPM augmented with the FF4 factors is the same as the five-factor model of Fama and French (the FF5 model). The one-month treasury bill rate is used for the proxy risk-free return. For each of the three models, the response variables are RF-excess returns on individual stocks or 180 test portfolios. The Panel (a) reports the rejection frequencies of the hypothesis that the MKT beta equals one ($\beta_{MKT,i} = 1$) for an individual asset i at a 5% significance level. The t -statistics are computed with the White heteroskedasticity robust OLS standard errors. Panels (b) and (c) report the cross-sectional standard deviations and the root mean square error of the estimated MKT betas that are computed by $[N^{-1}\sum_{i=1}^N(\hat{\beta}_{MKT,i} - \bar{b})^2]^{1/2}$ and $[N^{-1}\sum_{i=1}^N(\hat{\beta}_{MKT,i} - 1)^2]^{1/2}$, respectively, where $\bar{b} = N^{-1}\sum_{i=1}^N\hat{\beta}_{MKT,i}$. The one-month treasury bill rate, the five factors of Fama and French (2015), and 330 portfolio returns are from Kenneth French's webpage. Out of the 330 portfolios, 180 portfolios are used as test portfolios while 150 portfolios are used as the base portfolios from which the five VW-PC factors (VW-PC5 factors) are extracted. The data on individual stock returns are drawn from the CRSP database. The returns include dividends from common stocks traded in the NYSE, NASDAQ, and AMEX, excluding REITs and ADRs.

	N	T	CAPM	FF5	CAPM plus VW-PC5
Panel (a) Rejection frequency of the hypothesis that MKT beta equal 1 (at 5% level)					
Individual Stock Returns 1970-1980	1224	132	37%	24%	23%
Individual Stock Returns 1981-1991	1856	132	35%	28%	21%
Individual Stock Returns 1992-2002	1877	132	51%	28%	22%
Individual Stock Returns 2003-2013	2062	132	42%	31%	22%
Test Portfolio Returns 1970-1980	180	132	50%	33%	31%
Test Portfolio Returns 1981-1991	180	132	63%	43%	23%
Test Portfolio Returns 1992-2002	180	132	71%	36%	18%
Test Portfolio Returns 2003-2013	180	132	66%	48%	26%
Panel (b) Dispersion (Standard deviation) of the estimated MKT betas					
Individual Stock Returns 1970-1980	1224	132	0.393	0.323	0.310
Individual Stock Returns 1981-1991	1856	132	0.380	0.374	0.368
Individual Stock Returns 1992-2002	1877	132	0.587	0.526	0.472
Individual Stock Returns 2003-2013	2062	132	0.562	0.515	0.471
Test Portfolio Returns 1970-1980	180	132	0.179	0.108	0.093
Test Portfolio Returns 1981-1991	180	132	0.144	0.095	0.078
Test Portfolio Returns 1992-2002	180	132	0.293	0.159	0.112
Test Portfolio Returns 2003-2013	180	132	0.250	0.185	0.117
Panel (c) Root Mean Square Error of the estimated MKT betas					
Individual Stock Returns 1970-1980	1224	132	0.448	0.329	0.310
Individual Stock Returns 1981-1991	1856	132	0.381	0.374	0.369
Individual Stock Returns 1992-2002	1877	132	0.620	0.526	0.475
Individual Stock Returns 2003-2013	2062	132	0.613	0.517	0.474
Test Portfolio Returns 1970-1980	180	132	0.190	0.113	0.094
Test Portfolio Returns 1981-1991	180	132	0.146	0.097	0.078
Test Portfolio Returns 1992-2002	180	132	0.305	0.159	0.113
Test Portfolio Returns 2003-2013	180	132	0.268	0.195	0.121

Table 2A. Summary Statistics from Estimated VWP Betas Without Intercepts

The VWP betas (the betas of the VWP return) are estimated from three different models: the CAPM without risk-free assets (one-factor model using the VWP return as the sole factor), the CAPM augmented with the SMB, HML, RMW, and CMA factors (FF4 factors) of Fama and French (2015), and the CAPM augmented with five VW-PC factors (CAPM plus VW-PC5). For each of the three models, the response variables are RF-excess returns on individual stocks or 180 test portfolios. The Panel (a) reports the rejection frequencies of the hypothesis that the VWP beta equals one ($\beta_{VWP,i} = 1$) for an individual asset i at a 5% significance level. The t -statistics are computed with the White heteroskedasticity robust OLS standard errors. Panels (b) and (c) report the cross-sectional standard deviations and the root mean square error of the estimated VWP betas that are computed by $[N^{-1}\sum_{i=1}^N(\hat{\beta}_{VWP,i} - \bar{b}_{VWP})^2]^{1/2}$ and $[N^{-1}\sum_{i=1}^N(\hat{\beta}_{VWP,i} - 1)^2]^{1/2}$, respectively, where $\bar{b}_{VWP} = N^{-1}\sum_{i=1}^N\hat{\beta}_{VWP,i}$. The five factors of Fama and French (2015) and 330 portfolio returns are from Kenneth French's webpage. Out of the 330 portfolios, 180 portfolios are used as test portfolios while 150 portfolios are used as the base portfolios from which the five VW-PC factors (VW-PC5 factors) are extracted. The data on individual stock returns are drawn from the CRSP database. The returns include dividends from common stocks traded in the NYSE, NASDAQ, and AMEX, excluding REITs and ADRs.

	N	T	CAPM	FF5	CAPM plus VW-PC5
Panel (a) Rejection frequency of the hypothesis that VWP beta equal 1 (at 5% level)					
Individual Stock Returns 1970-1980	1224	132	37%	23%	21%
Individual Stock Returns 1981-1991	1856	132	34%	28%	23%
Individual Stock Returns 1992-2002	1877	132	51%	29%	23%
Individual Stock Returns 2003-2013	2062	132	41%	32%	22%
Test Portfolio Returns 1970-1980	180	132	49%	31%	28%
Test Portfolio Returns 1981-1991	180	132	55%	42%	44%
Test Portfolio Returns 1992-2002	180	132	70%	40%	28%
Test Portfolio Returns 2003-2013	180	132	66%	46%	27%
Panel (b) Dispersion (Standard deviation) of the estimated VWP betas					
Individual Stock Returns 1970-1980	1224	132	0.392	0.318	0.307
Individual Stock Returns 1981-1991	1856	132	0.374	0.354	0.347
Individual Stock Returns 1992-2002	1877	132	0.589	0.513	0.460
Individual Stock Returns 2003-2013	2062	132	0.553	0.513	0.473
Test Portfolio Returns 1970-1980	180	132	0.177	0.107	0.093
Test Portfolio Returns 1981-1991	180	132	0.137	0.088	0.075
Test Portfolio Returns 1992-2002	180	132	0.289	0.156	0.110
Test Portfolio Returns 2003-2013	180	132	0.249	0.186	0.120
Panel (c) Root Mean Square Error of the estimated VWP betas					
Individual Stock Returns 1970-1980	1224	132	0.442	0.319	0.307
Individual Stock Returns 1981-1991	1856	132	0.376	0.361	0.359
Individual Stock Returns 1992-2002	1877	132	0.619	0.513	0.468
Individual Stock Returns 2003-2013	2062	132	0.593	0.514	0.477
Test Portfolio Returns 1970-1980	180	132	0.185	0.107	0.093
Test Portfolio Returns 1981-1991	180	132	0.137	0.096	0.100
Test Portfolio Returns 1992-2002	180	132	0.303	0.157	0.123
Test Portfolio Returns 2003-2013	180	132	0.258	0.191	0.120