Internet Appendix: "Aggregation, Capital Heterogeneity, and the Investment CAPM" (for Online Publication Only)

Andrei S. Gonçalves[*]
University of North Carolina

Chen Xue[†]
University of Cincinnati

Lu Zhang[‡]
Ohio State and NBER

October 2018

Abstract

This online appendix provides supplementary results for our manuscript "Aggregation, Capital Heterogeneity, and the Investment CAPM."

[*]Kenan-Flagler Business School, University of North Carolina, 4101 McColl Building, 300 Kenan Center Drive, Chapel Hill, NC 27599. Tel: (919) 962-3179. E-mail: Andrei_Goncalves@kenan-flagler.unc.edu.

[†]Lindner College of Business, University of Cincinnati, 405 Lindner Hall, Cincinnati OH 45221. Tel: (513) 556-7078. E-mail: xuecx@ucmail.uc.edu.

[‡]Fisher College of Business, The Ohio State University, 760A Fisher Hall, 2100 Neil Avenue, Columbus OH 43210; and NBER. Tel: (614) 292-8644. E-mail: zhanglu@fisher.osu.edu.

1 Supplementary Results with Testing Deciles from All-but-micro Breakpoints and Equal-weighted Returns

In the main text, we report the detailed results with the 40 testing deciles based on NYSE breakpoints and value-weighted returns. In this appendix, we report a parallel set of results with the 40 testing deciles based on all-but-micro breakpoints and equal-weighted returns.

Table A3 reports descriptive statistics for the 40 testing deciles formed on book-to-market, prior 11-month returns, asset growth, and return on equity with all-but-micro breakpoints and equal-weighted returns. We exclude microcaps from our sample, sort the remaining stocks into deciles, and calculate equal-weighted returns. For the all-but-micro sample, Table A2 reports descriptive statistics for firm-level accounting variables that appear in the calculation of the fundamental returns.

Table A4 shows GMM estimation and tests for the physical capital model estimated at the portfolio level and the benchmark two-capital model estimated at the firm level, with 40 equal-weighted testing deciles. Table A5 reports comparative statics on the benchmark two-capital model estimated at the firm level, with equal-weighted testing deciles. Table A6 reports GMM estimation and tests for the two-capital model estimated at the portfolio level and the physical capital model estimated at the firm level, with equal-weighted testing deciles.

Table A7 shows correlations between stock and fundamental returns using the all-but-micro sample and equal-weighted deciles. Table A8 reports the variation of equal-weighted factor premiums across the market states in the all-but-micro sample. Table A9 reports the higher moments of stock and fundamental returns for the 40 equal-weighted testing deciles.

2 Supplementary Results with the No-large-M&A Sample

This section shows the results from estimating the benchmark two-capital model at the firm level in the no-large-M&A sample. In particular, we construct the no-large-M&A sample by excluding firms with sizeable M&As, in which the target assets are at least 15% of the acquirer assets. The 15%

cutoff follow Whited (1992). We identify M&As via the SDC dataset and Compustat (item AQC).

3 Supplementary Results with Imputed Costs of Debt

We measure the pre-tax cost of debt, r^B_{it+1}, as the ratio of total interest and related expenses (Compustat annual item XINT) divided by total debt (item DLTT plus item DLC, zero if missing). This measure is different from the imputed cost of debt used in prior work (Liu, Whited, and Zhang 2009; Liu and Zhang 2014). The basic idea is to impute credit ratings for firms with no credit ratings data in Compustat and then assign the corporate bond returns for a given credit rating to all the firms with the same imputed credit rating.[1]

The descriptive statistics of the new cost of debt measure are not far from those of the imputed cost of debt measure from the prior work. Table 2 in the manuscript reports that the new cost of debt measure, r^B_{it+1}, has a mean of 8.74%, a cross-sectional standard deviation of 5.77%, a median of 7.98%, and a 25 and 75 percentiles of 5.65% and 10.54%, respectively. For comparison, the imputed cost of debt measure has a mean of 7.02%, a cross-sectional standard deviation of 10.44%, a median of 8.22%, and a 25 and 75 percentiles of 0.75% and 14.32%, respectively (untabulated). As such, the new cost of debt measure is higher on average but less volatile than the imputed measure.

4 An Extended Two-capital Model with Adjustment Costs on the Working Capital Investment

In this section, we examine an extended two-capital model with adjustment costs on working capital. We lay out the model in Section 4.1 and present its estimation results in Section 4.2.

[1]Specifically, an ordered probit model for credit ratings is first estimated on firms with credit ratings data. The fitted value is used to calculate the cutoff value for each rating. For firms without credit ratings, their scores are computed with the coefficients from the ordered probit model, and their credit ratings are imputed by applying the cutoff values of different credit ratings. The corporate bond returns for a given credit rating are assigned to the firms with the same rating. The explanatory variables in the ordered probit model include: interest coverage, operating income after depreciation plus interest expense over interest expense; the operating margin, operating income before depreciation over sales; long-term leverage, long-term debt over assets; total leverage, long-term debt plus debt in current liabilities plus short-term borrowing over assets; the natural logarithm of the market value of equity deflated to 1973 by the consumer price index; as well as the market beta and residual volatility from the market regression estimated for each firm in each calendar year with at least 200 daily returns from CRSP. One leading and one lagged values of the market return are used to account for nononsynchronous trading.

4.1 The Model

We build on the benchmark two-capital model described in Section 2 in the main text. However, we assume that the adjustment costs function depends on working capital and their investment. For simplicity, we adopt the quadratic functional form, which is separate in the two capital inputs:

$$\Phi_{it} \equiv \Phi(I_{it}, K_{it}, \triangle W_{it}, W_{it}) = \Phi^K(I_{it}, K_{it}) + \Phi^W(\triangle W_{it}, W_{it}) = \frac{a}{2}\left(\frac{I_{it}}{K_{it}}\right)^2 K_{it} + \frac{b}{2}\left(\frac{\triangle W_{it}}{W_{it}}\right)^2 W_{it}, \tag{A1}$$

The first-order conditions with respect to I_{it} and K_{it+1} are identical to those in the benchmark model. However, the first-order conditions for $\triangle W_{it}$ and W_{it+1} become:

$$q_{it}^W = 1 + (1-\tau_t)\frac{\partial \Phi_{it}}{\partial \triangle W_{it}} \tag{A2}$$

$$q_{it}^W = E_t\left[M_{t+1}\left[(1-\tau_{t+1})\left[\frac{\partial \Pi_{it+1}}{\partial W_{it+1}} - \frac{\partial \Phi_{it+1}}{\partial W_{it+1}}\right] + q_{it+1}^W\right]\right] \tag{A3}$$

Combining the two equations yields $E_t[M_{t+1} r_{it+1}^W] = 1$, in which r_{it+1}^W is given by:

$$r_{it+1}^W \equiv \frac{1 + (1-\tau_{t+1})\left[\gamma_W \frac{Y_{it+1}}{W_{it+1}} + b\left(\frac{\triangle W_{it+1}}{W_{it+1}}\right) + \frac{b}{2}\left(\frac{\triangle W_{it+1}}{W_{it+1}}\right)^2\right]}{1 + (1-\tau_t) b \left(\frac{\triangle W_{it}}{W_{it}}\right)}. \tag{A4}$$

We first use $P_{it+1} + B_{it+2} = q_{it+1} K_{it+2} + q_{it+1}^W W_{it+2}$ to rewrite:

$$P_{it} + B_{it+1} = E_t[M_{t+1}(P_{it+1} + D_{it+1})] + B_{it+1} \tag{A5}$$

$$= E_t[M_{t+1}(q_{it+1} K_{it+2} + q_{it+1}^W W_{it+2} - B_{it+2} + D_{it+1})] + B_{it+1} \tag{A6}$$

Using the definition of $D_{it+1} \equiv (1-\tau_{t+1})(\Pi_{it+1} - \Phi_{it+1}) - I_{it+1} - J_{it+1} + B_{it+2} - r_{it+1}^B B_{it+1} + \tau_{t+1}\delta_{it+1} K_{it+1} + \tau_{t+1}(r_{it+1}^B - 1) B_{it+1}$ to rewrite the right hand side yields:

$$\begin{aligned} P_{it} + B_{it+1} = {} & E_t[M_{t+1}[(1-\tau_{t+1})(\Pi_{it+1} - \Phi_{it+1}) + \tau_{t+1}\delta_{it+1} K_{it+1} + q_{it+1}^K K_{it+2} - I_{it+1}]] \\ & + E_t[M_{t+1}(q_{it+1}^W W_{it+2} - \triangle W_{it+1})] - B_{it+1} E_t[M_{t+1}[r_{it+1}^B - \tau_{t+1}(r_{it+1}^B - 1)]] + B_{it+1} \end{aligned} \tag{A7}$$

The constant returns to scale for Π_{it} and the first-order condition for B_{it+1} then imply:

$$P_{it} + B_{it+1} = E_t\left[M_{t+1}\left[K_{it+1}(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial K_{it+1}} - \frac{\Phi^K_{it+1}}{K_{it+1}}\right) + \tau_{t+1}\delta_{it+1}K_{it+1} + q_{it+1}[(1-\delta_{it+1})K_{it+1} + I_{it+1}] - I_{it+1}\right]\right]$$
$$+E_t\left[M_{t+1}\left[W_{it+1}(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial W_{it+1}} - \frac{\Phi^W_{it+1}}{W_{it+1}}\right) + q^W_{it+1}(W_{it+1} + \triangle W_{it+1}) - \triangle W_{it+1}\right]\right]. \quad \text{(A8)}$$

Using the first-order condition for I_{it} and equation (A2) to rewrite the right hand side yields:

$$P_{it} + B_{it+1} = E_t\left[M_{t+1}\left[K_{it+1}(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial K_{it+1}} - \frac{\Phi^K_{it+1}}{K_{it+1}} + \frac{I_{it+1}}{K_{it+1}}\frac{\partial \Phi_{it+1}}{\partial I_{it+1}}\right) + \tau_{t+1}\delta_{it+1}K_{it+1} + q_{it+1}(1-\delta_{it+1})K_{it+1}\right]\right]$$
$$+E_t\left[M_{t+1}\left[W_{it+1}(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial W_{it+1}} - \frac{\Phi^W_{it+1}}{W_{it+1}} + \frac{\triangle W_{it+1}}{W_{it+1}}\frac{\partial \Phi_{it+1}}{\partial \triangle W_{it+1}}\right) + q^W_{it+1}W_{it+1}\right]\right]. \quad \text{(A9)}$$

The constant returns to scale for Φ_{it} mean that $\Phi^K_{it} = I_{it}\partial\Phi^K_{it}/\partial I_{it} + K_{it}\partial\Phi^K_{it}/\partial K_{it}$ and $\Phi^W_{it} = \triangle W_{it}\partial\Phi^W_{it}/\partial\triangle W_{it} + W_{it}\partial\Phi^W_{it}/\partial W_{it}$. As such, equation (A9) becomes:

$$\begin{aligned} P_{it} + B_{it+1} &= K_{it+1}E_t\left[M_{t+1}\left[(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial K_{it+1}} - \frac{\partial \Phi_{it+1}}{\partial K_{it+1}}\right) + \tau_{t+1}\delta_{it+1} + q^K_{it+1}(1-\delta_{it+1})\right]\right] \\ &\quad +W_{it+1}E_t\left[M_{t+1}\left[(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial W_{it+1}} - \frac{\partial \Phi_{it+1}}{\partial W_{it+1}}\right) + q^W_{it+1}\right]\right] \quad \text{(A10)} \\ &= q_{it}K_{it+1} + q^W_{it}W_{it+1}, \quad \text{(A11)} \end{aligned}$$

in which the last equality follows from the first-order condition for K_{it+1} and equation (A3). Finally,

$$\begin{aligned} w^B_{it}r^{Ba}_{it+1} + (1-w^B_{it})r^S_{it+1} &= \frac{B_{it+1}}{P_{it}+B_{it+1}}[r^B_{it+1} - (r^B_{it+1}-1)\tau_{t+1}] + \frac{P_{it}}{P_{it}+B_{it+1}}\frac{(P_{it+1}+D_{it+1})}{P_{it}} \\ &= \frac{B_{it+1}[r^B_{it+1} - (r^B_{it+1}-1)\tau_{t+1}] + q_{it+1}K_{it+2} + q^W_{it+1}W_{it+2} - B_{it+2} + D_{it+1}}{P_{it}+B_{it+1}}. \quad \text{(A12)} \end{aligned}$$

Using the definition of D_{it+1} yields:

$$w^B_{it}r^{Ba}_{it+1} + (1-w^B_{it})r^S_{it+1} = \frac{(1-\tau_{t+1})(\Pi_{it+1} - \Phi_{it+1}) + \tau_{t+1}\delta_{it+1}K_{it+1} + q_{it+1}K_{it+2} + q^W_{it+1}W_{it+2} - I_{it+1} - \triangle W_{it+1}}{P_{it}+B_{it+1}} \quad \text{(A13)}$$

Using the constant returns to scale for Π_{it+1} yields:

$$w_{it}^{B} r_{it+1}^{Ba} + (1-w_{it}^{B}) r_{it+1}^{S} = \frac{K_{it+1}(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial K_{it+1}} - \frac{\Phi_{it+1}^{K}}{K_{it+1}}\right) + \tau_{t+1}\delta_{it+1}K_{it+1} + q_{it+1}(I_{it+1} + (1-\delta_{it+1})K_{it+1}) - I_{it+1}}{P_{it} + B_{it+1}}$$
$$+ \frac{W_{it+1}(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial W_{it+1}} - \frac{\Phi_{it+1}^{W}}{W_{it+1}}\right) + q_{it+1}^{W}(W_{it+1} + \triangle W_{it+1}) - \triangle W_{it+1}}{P_{it} + B_{it+1}} \tag{A14}$$

Using the constant returns for Φ_{it+1} and the first-order conditions for I_{it} and $\triangle W_{it}$, we obtain:

$$w_{it}^{B} r_{it+1}^{Ba} + (1-w_{it}^{B}) r_{it+1}^{S} = \frac{K_{it+1}}{q_{it}K_{it+1} + q_{it}^{W}W_{it+1}}\left[(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial K_{it+1}} - \frac{\partial \Phi_{it+1}}{\partial K_{it+1}}\right) + \tau_{t+1}\delta_{it+1} + (1-\delta_{it+1})q_{it+1}\right]$$
$$+ \frac{W_{it+1}}{q_{it}K_{it+1} + q_{it}^{W}W_{it+1}}\left[(1-\tau_{t+1})\left(\frac{\partial \Pi_{it+1}}{\partial W_{it+1}} - \frac{\partial \Phi_{it+1}}{\partial W_{it+1}}\right) + q_{it+1}^{W}\right] \tag{A15}$$
$$= \frac{q_{it}K_{it+1}}{q_{it}K_{it+1} + q_{it}^{W}W_{it+1}} r_{it+1}^{K} + \frac{q_{it}^{W}W_{it+1}}{q_{it}K_{it+1} + q_{it}^{W}W_{it+1}} r_{it+1}^{W}. \tag{A16}$$

4.2 Estimation Results

We continue to test the moment condition given by:

$$E[r_{pt+1}^{S} - r_{pt+1}^{F}] = 0, \tag{A17}$$

in which r_{pt+1}^{S} is the stock return of testing portfolio p, and r_{pt+1}^{F} is portfolio p's fundamental return:

$$r_{it+1}^{F} = \frac{w_{it}^{K} r_{it+1}^{K} + (1-w_{it}^{K}) r_{it+1}^{W} - w_{it}^{B} r_{it+1}^{Ba}}{1-w_{it}^{B}}, \tag{A18}$$

except that the working capital investment return is now given by equation (A4).

Table A12 reports GMM estimation and tests of the extended two-capital model. The table shows that many estimates of the adjustment costs parameter, b, for working capital are insignificant, including six out of seven estimates with equal-weighted deciles and three out of seven with value-weighted deciles. In particular, in the joint estimation of value and momentum, the b estimate is 3.1, with a standard error of zero, with value-weights, but is 1.1, with a standard error of 0.66, with equal-weights. With all 40 testing deciles, b is never significant: 0.4 with a standard error of 0.96 with value-weights and 0.07 with a standard error of 0.58 with equal-weights. The marginal product parameter, γ, and the adjustment costs parameter, a, for physical capital are largely similar to those in the benchmark estimation without b as a separate parameter.

The mean absolute errors, m.a.e., and average absolute high-minus-low errors, $\overline{|e_{\text{H–L}}|}$, are also largely comparable. In particular, when estimating value and momentum jointly, the m.a.e. is 0.63% per annum, and $\overline{|e_{\text{H–L}}|}$ 1.22% with value-weights, and the errors are 0.66% and 0.75%, respectively, with equal-weights. These errors are largely comparable those in the benchmark estimation without working capital adjustment costs. When all 40 testing deciles are included in the joint estimation, the m.a.e. is 1.27%, and $\overline{|e_{\text{H–L}}|}$ 2.07% with value-weights, and with equal-weights the errors are 0.91% and 2.24%, respectively. These errors are again largely comparable with those in the benchmark estimation. Finally, Figure A10 reports detailed individual pricing errors by plotting average predicted stock returns against average realized stock returns. Similar to the benchmark estimation, the scatter points are all largely aligned with the 45-degree line. As such, adding the extra parameter, b, does not yield a significant improvement in the model's performance. The evidence lends support to our modeling choice of setting $b = 0$ in the benchmark estimation for parsimony.

5 Supplementary Results on Out-of-sample Tests

Table A13 reports pooled panel forecasting regressions of 1-year-ahead investment-to-physical capital and annual sales growth in the full sample from June 1967 to December 2017. Table A14 reports the properties of the deciles formed on the expected return estimates from the two-capital model estimated at the firm level, the physical capital model estimated at the portfolio level, and the q-factor model, all with all-but-micro breakpoints and equal-weighted returns.

Figure A11 reports the time series of the recursively estimated parameters from July 1985 to December 2017. Figure A12 reports the 1-step-ahead Model Fits via recursive estimation with all-but-micro breakpoints and equal-weighted returns.

References

Fama, Eugene F. and Kenneth R. French, 1997, Industry costs of equity, *Journal of Financial Economics* 43, 153–193.

Liu, Laura Xiaolei, Toni M. Whited, and Lu Zhang, 2009, Investment-based expected stock returns, *Journal of Political Economy* 117, 1105–1139.

Liu, Laura Xiaolei, and Lu Zhang, 2014, A neoclassical interpretation of momentum, *Journal of Monetary Economics* 67, 109–128.

Thompson, Samuel B., 2011, Simple formulas for standard erros that cluster by both firm and time, *Journal of Financial Economics* 99, 1–10.

Table A1 : Descriptive Properties of Testing Deciles, All-but-micro Breakpoints and Equal-weighted Returns, January 1967–June 2017

For each decile and the high-minus-low decile (H−L), we report its average return in excess of the 1-month Treasury bill rate, $\overline{R}$, and its t-value adjusted for heteroscedasticity and autocorrelations, $t_{\overline{R}}$. Testing deciles are formed with all-but-micro breakpoints and equal-weighted returns.

	L	2	3	4	5	6	7	8	9	H	H−L
	Panel A: The book-to-market (Bm) deciles										
$\overline{R}$	0.27	0.38	0.53	0.58	0.64	0.72	0.75	0.73	0.75	0.92	0.66
$t_{\overline{R}}$	0.89	1.47	2.21	2.57	2.87	3.47	3.69	3.53	3.65	4.10	2.89
	Panel B: The momentum (R^{11}) deciles										
$\overline{R}$	−0.01	0.41	0.53	0.53	0.57	0.64	0.71	0.77	1.00	1.18	1.20
$t_{\overline{R}}$	−0.04	1.60	2.35	2.51	2.94	3.36	3.68	3.70	4.06	3.72	4.05
	Panel C: The asset growth (I/A) deciles										
$\overline{R}$	0.71	0.78	0.80	0.72	0.76	0.74	0.66	0.62	0.48	0.19	−0.52
$t_{\overline{R}}$	2.79	3.93	4.23	3.91	3.83	3.88	3.12	2.76	1.91	0.65	−3.42
	Panel D: The return on equity (Roe) deciles										
$\overline{R}$	0.14	0.34	0.52	0.52	0.63	0.63	0.73	0.76	0.84	1.07	0.93
$t_{\overline{R}}$	0.40	1.22	2.44	2.64	3.17	3.01	3.67	3.57	3.89	4.38	4.16

Table A2 : Descriptive Statistics of Firm-level Accounting Variables in the Fundamental Return, the All-but-micro Sample, June 1967–December 2016

For all the components in the fundamental return, we report the time series averages of cross-sectional statistics, including mean, standard deviation (σ), percentiles (5, 25, 50, 75, and 95), and pairwise correlations. The statistics are computed after the 2.5–97.5% winsorization at the portfolio formation for the variables except for the market leverage, w^B_{it}. I_{it}/K_{it} is time-t physical investment-to-physical capital, $\triangle W_{it}/W_{it}$ is the time-t ratio of working capital investment divided by working capital. Y_{it+1}/K_{it+1} is the sales-to-physical capital in time $t+1$. Y_{it+1}/W_{it+1} is the sales-to-working capital in time $t+1$. $K_{it+1}/(K_{it+1}+W_{it+1})$ is the fraction of physical capital in total capital. δ_{it+1} is the rate of physical capital depreciation. r^B_{it+1} is the pre-tax cost of debt in percent per annum. While the sample for the fundamental returns is from January 1967 to December 2016, the accounting variables underlying the fundamental returns can come from the fiscal year ending in as early as 1966 and as late as 2018.

Panel A: Mean, standard deviation, and percentiles

	Mean	σ	5	25	50	75	95
I_{it}/K_{it}	0.35	0.39	0.02	0.13	0.23	0.42	1.14
$\triangle W_{it}/W_{it}$	0.16	0.30	−0.21	−0.01	0.10	0.24	0.81
Y_{it+1}/K_{it+1}	6.44	7.30	0.44	1.83	4.32	7.75	22.36
Y_{it+1}/W_{it+1}	3.28	1.89	1.05	1.97	2.84	4.05	7.35
$Y_{it+1}/(K_{it+1}+W_{it+1})$	1.55	0.89	0.34	0.91	1.44	2.00	3.55
$K_{it+1}/(K_{it+1}+W_{it+1})$	0.44	0.25	0.10	0.24	0.38	0.64	0.90
w^B_{it}	0.25	0.20	0.00	0.07	0.21	0.38	0.61
δ_{it+1}	0.17	0.10	0.04	0.10	0.14	0.21	0.40
r^B_{it+1}	8.57	5.09	1.38	6.10	7.85	9.98	20.34

Panel B: Cross-sectional correlations

	$\frac{I_{it+1}}{K_{it+1}}$	$\frac{\triangle W_{it}}{W_{it}}$	$\frac{\triangle W_{it+1}}{W_{it+1}}$	$\frac{Y_{it+1}}{K_{it+1}}$	$\frac{Y_{it+1}}{W_{it+1}}$	$\frac{Y_{it+1}}{K_{it+1}+W_{it+1}}$	$\frac{K_{it+1}}{K_{it+1}+W_{it+1}}$	w^B_{it}	δ_{it+1}	r^B_{it+1}
I_{it}/K_{it}	0.41	0.36	0.13	0.23	−0.09	0.09	−0.24	−0.22	0.37	0.06
I_{it+1}/K_{it+1}		0.28	0.32	0.38	−0.03	0.21	−0.32	−0.33	0.58	0.18
$\triangle W_{it}/W_{it}$			0.04	0.11	−0.09	0.00	−0.11	−0.10	0.13	0.03
$\triangle W_{it+1}/W_{it+1}$				0.11	0.21	0.16	0.03	−0.13	0.12	0.15
Y_{it+1}/K_{it+1}					0.05	0.65	−0.67	−0.30	0.54	0.04
Y_{it+1}/W_{it+1}						0.47	0.47	0.18	−0.22	0.05
$Y_{it+1}/(K_{it+1}+W_{it+1})$							−0.43	−0.24	0.28	0.11
$K_{it+1}/(K_{it+1}+W_{it+1})$								0.49	−0.61	−0.03
w^B_{it}									−0.41	−0.02
δ_{it+1}										0.07

Table A3 : Empirical Distribution of the Absolute Residual from the Capital Accumulation Equation As a Percentage of Physical Capital, June 1967–December 2016

The residual from the capital accumulation equation is $K_{it+1} - (1 - \delta_{it})K_{it}$ (K_{it} is net property, plant, and equipment [Compustat annual item PPENT], and δ_{it} the capital depreciation rate [item DP minus item AM, zero if missing, scaled by item PPENT]) minus capital expenditures (item CAPX) plus sales of property, plant, and equipment (item SPPE, zero if missing). We show the empirical distribution (different percentiles) of the absolute value of the residual as a percentage of net property, plant, and equipment for six different samples: (i) the full sample; (ii) the subsample without mergers and acquisitions (M&A); (iii) the subsample with only M&A; (iv) the subsample with only M&A and its transaction value greater than or equal to 5% of the acquiring firm's total book assets (item AT); (v) the subsample with only M&A and its transaction value greater than or equal to 10% of the acquiring firm's assets; and (vi) the subsample with only M&A and its transaction value greater than or equal to 15% of the acquiring firm's assets. We identify M&A transactions from the Securities Data Company (SDC) dataset, supplemented with Compustat (item AQC, acquisitions). SDC and Compustat are merged on an acquiring firm's CUSIP number.

Percentile	1	5	10	25	50	75	90	95	99
All	0.00	0.00	0.00	0.38	2.52	10.28	31.50	57.45	201.74
No M&A	0.00	0.00	0.00	0.17	1.57	7.09	23.08	43.23	133.65
With M&A	0.00	0.15	0.48	1.86	6.36	19.85	53.35	94.59	322.62
Target/Acquier assets $\geq$ 5%	0.00	0.53	1.51	5.45	16.12	41.46	96.59	165.92	597.64
Target/Acquier assets $\geq$ 10%	0.00	0.79	2.15	8.42	24.56	59.91	131.69	223.22	877.06
Target/Acquier assets $\geq$ 15%	0.01	0.98	2.84	11.47	32.68	75.81	163.25	281.91	1075.64

Table A4 : GMM Estimation and Tests, the Physical Capital Model Estimated at the Portfolio Level and the Benchmark Two-capital Model Estimated at the Firm Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

This table uses the 40 testing deciles formed on book-to-market (Bm), prior 11-month returns (R^{11}), asset growth (I/A), and return on equity (Roe), separately and jointly (Bm and R^{11}, I/A and Roe, and all 40 deciles together). The testing deciles are formed with all-but-micro breakpoints and equal-weighted returns. d.f. is the degrees of freedom in the GMM test of overidentification. γ_K is the technological parameter on the marginal product of physical capital as a fraction of sales-to-physical capital, Y_{it+1}/K_{it+1}. γ is the technological parameter on the marginal product of total capital as a fraction of sales-to-total capital, $Y_{it+1}/(K_{it+1}+W_{it+1})$. a is the adjustment costs parameter of physical capital. $[\gamma]$, $[\gamma_K]$, and $[a]$ are the standard errors of the point estimates. $\overline{|\alpha|}$ is the mean absolute alpha across the testing portfolios, $\overline{|\alpha_{\text{H–L}}|}$ is the average absolute high-minus-low alpha, and p is the p-value of the overidentification test across a given set of testing portfolios. γ, γ_K, $[\gamma]$, $[\gamma_K]$, and p-values are in percent, and $\overline{|\alpha|}$ and $\overline{|\alpha_{\text{H–L}}|}$ are in percent per annum.

Panel A: The physical capital model estimated at the portfolio level

	d.f.	γ_K	$[\gamma_K]$	a	$[a]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	25.09	5.85	15.03	5.54	3.83	3.25	0.12
R^{11}	8	12.84	1.29	1.34	0.61	1.28	0.12	21.03
I/A	8	14.50	1.43	2.16	0.52	2.62	0.51	0.00
Roe	8	11.44	1.11	0.00	0.03	3.00	0.36	0.00
Bm-R^{11}	18	14.23	1.43	3.19	0.57	4.06	12.49	0.00
I/A-Roe	18	13.41	1.27	1.57	0.39	3.11	2.46	0.00
Bm-R^{11}-I/A-Roe	38	13.98	1.33	2.55	0.38	3.57	6.84	0.00

Panel B: The benchmark two-capital model estimated at the firm level

	d.f.	γ	$[\gamma]$	a	$[a]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	16.74	2.09	3.93	0.60	0.71	0.56	35.21
R^{11}	8	16.46	1.94	3.02	1.20	0.69	0.63	15.30
I/A	8	17.07	1.74	2.07	0.51	0.67	0.55	0.79
Roe	8	14.63	2.22	6.38	0.01	0.65	1.68	61.18
Bm-R^{11}	18	16.50	2.06	3.74	0.45	0.83	1.23	0.00
I/A-Roe	18	16.76	1.79	2.08	0.48	0.75	1.58	0.00
Bm-R^{11}-I/A-Roe	38	16.72	1.94	3.08	0.36	0.93	2.14	0.00

Table A5 : Comparative Statics, the Benchmark Two-capital Model Estimated at the Firm Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

This table reports the investment CAPM alphas from three comparative statics: $\overline{I_{it}/K_{it}}$, $\overline{I_{it+1}/K_{it+1}}$, and $\overline{Y_{it+1}/(K_{it+1}+W_{it+1})}$. In the experiment denoted $\overline{I_{it}/K_{it}}$, I_{it}/K_{it} is set to be its cross-sectional average at period t across all the firms. The parameters from the benchmark GMM estimation (with all 40 Bm, R^{11}, I/A, and Roe deciles together) are used to reconstruct the fundamental returns, with all the other characteristics unchanged. The other experiments are designed analogously. The alpha is the average difference between portfolio stock returns and reconstructed fundamental returns. The "Benchmark" rows report the benchmark model's alphas.

	L	2	3	4	5	6	7	8	9	H	H−L
	Panel A: The book-to-market (Bm) deciles										
Benchmark	−1.53	−1.35	0.06	−0.39	−0.62	1.32	1.26	1.56	1.32	1.96	3.49
$\overline{I_{it}/K_{it}}$	−18.10	−13.20	−9.67	−7.05	−3.89	−0.28	3.21	8.11	13.36	27.20	45.29
$\overline{I_{it+1}/K_{it+1}}$	9.33	7.23	7.16	4.78	2.71	2.26	0.19	−4.20	−8.69	−22.55	−31.87
$\overline{Y_{it+1}/(K_{it+1}+W_{it+1})}$	0.20	0.76	2.23	2.19	1.40	2.53	1.31	−0.01	−2.13	−4.06	−4.26
	Panel B: The momentum (R^{11}) deciles										
Benchmark	0.32	0.48	0.13	−1.13	−1.05	−0.88	−1.06	−0.98	0.05	0.84	0.51
$\overline{I_{it}/K_{it}}$	1.21	1.05	1.67	1.12	1.50	1.05	−0.64	−3.00	−5.46	−11.12	−12.33
$\overline{I_{it+1}/K_{it+1}}$	−8.96	−3.14	−2.64	−3.46	−3.09	−1.87	0.10	2.70	8.11	14.97	23.93
$\overline{Y_{it+1}/(K_{it+1}+W_{it+1})}$	−1.74	−0.12	−0.25	−1.45	−1.29	−0.81	−0.41	0.37	2.19	3.65	5.39
	Panel C: The asset growth (I/A) deciles										
Benchmark	−1.76	−0.85	−0.40	−0.44	1.55	2.17	1.56	0.90	0.83	0.04	1.80
$\overline{I_{it}/K_{it}}$	8.52	9.96	9.74	6.73	5.19	2.95	−1.20	−5.01	−9.78	−17.84	−26.36
$\overline{I_{it+1}/K_{it+1}}$	−8.78	−8.66	−7.41	−5.43	−1.40	0.66	2.65	4.58	7.40	9.11	17.90
$\overline{Y_{it+1}/(K_{it+1}+W_{it+1})}$	−2.90	−1.41	−1.56	−1.03	1.27	2.57	2.45	2.21	1.87	0.42	3.31
	Panel D: The return on equity (Roe) deciles										
Benchmark	−1.78	−0.28	0.79	−0.36	0.07	−1.16	−1.32	−1.27	−0.31	0.97	2.75
$\overline{I_{it}/K_{it}}$	2.72	4.62	5.75	3.29	0.56	−2.50	−4.75	−6.60	−7.99	−8.46	−11.18
$\overline{I_{it+1}/K_{it+1}}$	−9.31	−6.98	−4.84	−4.07	−0.65	0.77	3.04	4.46	7.25	10.69	20.00
$\overline{Y_{it+1}/(K_{it+1}+W_{it+1})}$	−5.80	−3.37	−1.61	−1.71	0.27	0.06	1.08	1.86	3.38	5.45	11.25

Table A6 : GMM Estimation and Tests, the Two-capital Model Estimated at the Portfolio Level and the Physical Capital Model Estimated at the Firm Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

This table uses the 40 testing deciles formed on book-to-market (Bm), prior 11-month returns (R^{11}), asset growth (I/A), and return on equity (Roe), separately and jointly (Bm and R^{11}, I/A and Roe, and all 40 deciles together). The testing deciles are formed with all-but-micro breakpoints and equal-weighted returns. d.f. is the degrees of freedom in the GMM test of overidentification. γ_K is the technological parameter on the marginal product of physical capital as a fraction of sales-to-physical capital, Y_{it+1}/K_{it+1}. γ is the technological parameter on the marginal product of total capital as a fraction of sales-to-total capital, $Y_{it+1}/(K_{it+1}+W_{it+1})$. a is the adjustment costs parameter of physical capital. $[\gamma]$, $[\gamma_K]$, and $[a]$ are the standard errors of the point estimates. $\overline{|\alpha|}$ is the mean absolute alpha across the testing portfolios, $\overline{|\alpha_{\text{H–L}}|}$ is the average absolute high-minus-low alpha, and p is the p-value of the overidentification test across a given set of testing portfolios. γ, γ_K, $[\gamma]$, $[\gamma_K]$, and p-values are in percent, and $\overline{|\alpha|}$ and $\overline{|\alpha_{\text{H–L}}|}$ are in percent per annum.

Panel A: The two-capital model estimated at the portfolio level								
	d.f.	γ	$[\gamma]$	a	$[a]$	$\overline{\vert\alpha\vert}$	$\overline{\vert\alpha_{\text{H–L}}\vert}$	p
Bm	8	27.79	4.19	9.74	3.65	2.88	5.51	0.06
R^{11}	8	21.60	2.66	3.44	1.15	0.60	1.40	10.76
I/A	8	21.94	2.25	2.83	0.71	1.82	1.57	0.02
Roe	8	19.96	2.48	1.60	1.33	1.50	5.26	0.00
Bm-R^{11}	18	22.36	2.51	4.23	0.97	2.06	5.15	0.00
I/A-Roe	18	21.21	2.20	2.50	0.55	1.68	3.32	0.00
Bm-R^{11}-I/A-Roe	38	21.87	2.31	3.42	0.62	1.93	4.07	0.00
Panel B: The physical capital model estimated at the firm level								
	d.f.	γ_K	$[\gamma_K]$	a	$[a]$	$\overline{\vert\alpha\vert}$	$\overline{\vert\alpha_{\text{H–L}}\vert}$	p
Bm	8	4.89	0.81	3.78	0.31	1.37	3.36	0.19
R^{11}	8	5.94	0.51	0.45	0.33	0.50	0.42	33.41
I/A	8	6.28	0.59	1.67	0.24	1.69	0.04	0.05
Roe	8	5.12	0.69	3.06	0.48	1.60	2.03	0.02
Bm-R^{11}	18	6.17	0.55	1.21	0.31	2.60	11.92	0.00
I/A-Roe	18	6.04	0.60	1.88	0.27	2.01	2.93	0.00
Bm-R^{11}-I/A-Roe	38	6.14	0.57	1.51	0.17	2.37	7.84	0.00

Table A7 : Correlations between Stock Returns and Fundamental Returns, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

Panel A reports the firm-level (all-but-micro) and portfolio-level correlations between the stock returns of various leads and lags and fundamental returns, r_{it}^{F}. The column denoted r_{it}^{S} reports contemporaneous correlations, and the column r_{it-3}^{S} the correlations between three-month-lagged stock returns and fundamental returns. Other columns are defined analogously. Portfolio-level correlations are calculated with the 40 portfolios formed on book-to-market, prior 11-month returns, asset growth, and return on equity with all-but-micro breakpoints and equal-weighted returns. The correlations are time series averages of cross-sectional correlations, and their p-values are calculated as the Fama-MacBeth p-values adjusted for autocorrelations of up to 12 lags. Panel B reports for each of the 40 deciles and the high-minus-low decile, the time series contemporaneous correlations between the stock and fundamental returns. The p-values are those of the slopes from regressing the stock returns on the contemporaneous fundamental returns, adjusted for autocorrelations of up to 12 lags. The correlations that are significant at the 1%, 5%, and 10% levels are denoted with three stars, two stars, and one star, respectively. The results are based on the parameter values from estimating the benchmark model on all the 40 equal-weighted testing deciles jointly.

Panel A: Correlations with the fundamental returns, r_{it}^{F}

	r_{it-60}^{S}	r_{it-36}^{S}	r_{it-24}^{S}	r_{it-12}^{S}	r_{it-3}^{S}	r_{it}^{S}	r_{it+3}^{S}	r_{it+12}^{S}	r_{it+24}^{S}	r_{it+36}^{S}	r_{it+60}^{S}
Firms	−0.01	−0.02***	−0.02**	0.04***	0.11***	0.12***	0.10***	0.03***	−0.01**	−0.01	0.00
Portfolios	0.21***	0.24***	0.19***	0.21***	0.31***	0.33***	0.33***	0.25***	0.18***	0.23***	0.21***

Panel B: Contemporaneous correlations between the stock and fundamental returns across the testing deciles

	L	2	3	4	5	6	7	8	9	H	H−L
Bm	0.39***	0.27**	0.25*	0.15	0.17	0.16*	0.18**	0.11	0.14	0.18**	0.40***
R^{11}	0.24**	0.14	0.10	0.03	0.09	0.03	0.14	0.18**	0.26***	0.37***	0.22***
I/A	0.23**	0.13*	−0.04	0.14	0.11	0.09	0.13	0.10	0.08	0.31***	0.34***
Roe	0.31**	0.17	0.14*	0.05	0.01	0.11	0.14	0.08	0.08	0.21**	0.31**

Table A8 : Market States and Factor Premiums, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

For each month t, we categorize the market state as Up (Down) if the value-weighted market returns from month $t-N$ to $t-1$, with $N = 12, 24$, or 36, are nonnegative (negative). The table reports the high-minus-low decile returns averaged across Up (Down) states. r^S denotes the stock return, and r^F the fundamental returns. Both are in percent per annum. The t-values are adjusted for heteroscedasticity and autocorrelations of up to 12 lags. The results are based on the parameter values from estimating the benchmark model on the 40 equal-weighted testing deciles jointly.

N	MKT	r^S	t_S	r^F	t_F	r^S	t_S	r^F	t_F
		Panel A: Book-to-market, Bm				Panel B: Momentum, R^{11}			
12	Down	12.29	4.53	7.25	2.62	2.45	0.22	19.09	5.81
12	Up	7.87	2.69	5.00	2.82	20.22	6.98	14.67	11.37
24	Down	12.31	2.72	6.51	3.42	−7.63	−0.61	17.14	4.04
24	Up	8.28	3.00	5.34	2.87	20.35	6.87	15.43	11.38
36	Down	11.77	2.51	7.25	3.89	−9.98	−1.06	13.16	6.46
36	Up	8.37	2.99	5.21	2.79	20.83	6.84	16.14	10.60
		Panel C: Asset growth, I/A				Panel D: Return on equity, Roe			
12	Down	−13.87	−5.34	−8.36	−2.27	5.46	0.88	8.20	2.91
12	Up	−5.51	−3.18	−9.51	−6.76	13.96	5.65	9.62	7.31
24	Down	−16.00	−5.12	−5.10	−1.49	2.75	0.34	9.20	2.63
24	Up	−5.91	−3.40	−9.98	−6.26	13.64	5.82	9.31	6.95
36	Down	−11.04	−4.28	−3.17	−1.03	0.04	0.01	8.64	3.25
36	Up	−6.79	−3.69	−10.34	−6.39	14.15	5.75	9.41	6.87

Table A9 : Higher Moments of Stock Returns and Fundamental Returns, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

For each decile, we report volatility, σ, skewness, S_k, and kurtosis, K_u, of its stock returns, r^S, and fundamental returns, r^F. For each high-minus-low decile, the volatility and skewness significantly different from zero and the kurtosis significantly different from three at the 1%, 5%, and 10% levels are denoted with three, two stars, and one star, respectively. The significance is based on 5,000 block bootstrapped samples (each with 60 months). The results are based on parameters from estimating the benchmark model on the 40 equal-weighted deciles jointly.

		L	2	3	4	5	6	7	8	9	H	H−L
		Panel A: Book-to-market, Bm										
σ	r^S	0.26	0.23	0.22	0.21	0.21	0.20	0.19	0.19	0.19	0.22	$0.21^{\star\star\star}$
	r^F	0.07	0.07	0.07	0.05	0.06	0.05	0.06	0.06	0.08	0.13	$0.13^{\star\star\star}$
S_k	r^S	0.06	0.05	0.10	0.04	0.10	0.20	0.21	0.17	0.11	0.54	0.39
	r^F	−1.51	−2.22	−1.69	−0.27	−0.28	−0.54	0.30	0.54	0.56	0.13	0.30
K_u	r^S	3.19	3.02	3.43	3.24	3.70	3.81	4.00	4.47	3.98	6.51	$4.91^{\star\star\star}$
	r^F	6.15	9.72	7.77	2.64	2.56	2.88	3.13	2.78	3.73	3.66	3.64
		Panel B: Momentum, R^{11}										
σ	r^S	0.30	0.23	0.21	0.19	0.18	0.18	0.18	0.20	0.24	0.33	$0.30^{\star\star\star}$
	r^F	0.12	0.08	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.07	$0.13^{\star\star\star}$
S_k	r^S	1.48	0.31	0.30	0.06	0.08	0.05	0.18	0.06	0.45	1.05	−0.67
	r^F	−0.71	−0.29	0.13	0.05	0.05	0.10	0.21	0.07	−0.19	−0.49	0.57
K_u	r^S	9.27	4.69	4.15	3.74	3.81	3.69	3.96	3.42	4.46	6.78	$11.09^{\star\star\star}$
	r^F	5.00	3.42	3.63	3.37	3.43	3.99	3.55	2.76	3.66	3.88	$4.56^{\star\star}$
		Panel C: Asset growth, I/A										
σ	r^S	0.24	0.19	0.18	0.17	0.18	0.18	0.20	0.21	0.23	0.26	$0.13^{\star\star\star}$
	r^F	0.10	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.07	0.10	$0.12^{\star\star\star}$
S_k	r^S	0.61	0.35	0.28	0.10	0.00	0.07	−0.02	0.07	0.14	0.09	0.03
	r^F	−0.74	0.07	0.33	0.40	1.18	0.26	−0.31	−0.14	−0.23	−0.79	−0.26
K_u	r^S	4.81	4.24	4.01	4.09	3.95	3.71	3.92	3.52	3.50	3.25	3.28
	r^F	5.70	2.77	3.01	3.42	6.08	2.39	2.78	3.36	3.33	3.22	2.87
		Panel D: Return on equity, Roe										
σ	r^S	0.31	0.25	0.20	0.18	0.18	0.19	0.19	0.20	0.20	0.24	$0.21^{\star\star\star}$
	r^F	0.12	0.09	0.07	0.06	0.05	0.06	0.06	0.05	0.06	0.06	$0.12^{\star\star\star}$
S_k	r^S	1.17	0.60	0.32	−0.02	−0.06	−0.20	−0.17	0.02	0.00	0.04	$-1.91^{\star}$
	r^F	−0.10	−0.64	−0.36	0.34	0.17	0.01	−0.10	−0.01	−0.33	−0.41	0.17
K_u	r^S	8.18	5.22	4.07	3.55	3.53	3.45	3.51	3.72	3.44	3.51	$16.84^{\star\star}$
	r^F	4.65	5.62	3.89	3.53	3.05	2.91	3.20	3.07	3.18	3.01	$4.38^{\star\star\star}$

Table A10 : GMM Estimation and Tests, the Benchmark Two-capital Model Estimated at the Firm Level in the No-large-M&A Sample, June 1967–December 2016

This table uses the no-large-M&A sample, excluding firms with sizeable M&As with the target assets at least 15% of the acquirer assets. We identify M&As via the SDC dataset and Compustat (item AQC). The testing deciles are formed on book-to-market (Bm), prior 11-month returns (R^{11}), asset growth (I/A), and return on equity (Roe), separately and jointly (Bm and R^{11}, I/A and Roe, and all 40 deciles together). d.f. is the degrees of freedom in the overidentification test. γ is the technological parameter on the marginal product of total capital as a fraction of sales-to-total capital, $Y_{it+1}/(K_{it+1}+W_{it+1})$. a is the adjustment costs parameter of physical capital. $[\gamma]$ and $[a]$ are the standard errors of the point estimates. $\overline{|\alpha|}$ is the mean absolute alpha across a given set of testing portfolios, $\overline{|\alpha_{\text{H–L}}|}$ is the average absolute high-minus-low alpha, and p is the p-value of the overidentification test. γ, $[\gamma]$, and p are in percent, and $\overline{|\alpha|}$ and $\overline{|\alpha_{\text{H–L}}|}$ are in percent per annum.

Panel A: NYSE breakpoints and value-weighted returns								
	d.f.	γ	$[\gamma]$	a	$[a]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	18.48	2.01	3.89	0.73	1.48	0.81	0.75
R^{11}	8	16.75	2.47	5.94	0.00	0.71	0.51	60.19
I/A	8	17.42	1.74	1.54	0.70	0.75	0.50	57.64
Roe	8	17.55	2.44	6.56	0.01	0.82	1.71	1.91
Bm-R^{11}	18	18.39	2.02	3.74	0.61	1.28	1.16	0.05
I/A-Roe	18	17.30	1.76	1.56	0.66	1.04	1.33	0.00
Bm-R^{11}-I/A-Roe	38	18.09	1.90	2.89	0.52	1.32	2.81	0.00
Panel B: All-but-micro breakpoints and equal-weighted returns								
	d.f.	γ	$[\gamma]$	a	$[a]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	17.18	2.23	5.88	0.00	0.58	0.12	96.00
R^{11}	8	16.98	2.02	3.71	1.77	0.44	0.40	23.18
I/A	8	17.47	1.74	2.28	0.61	0.79	0.53	0.17
Roe	8	16.79	2.16	5.61	0.01	0.62	1.51	21.69
Bm-R^{11}	18	17.19	2.09	4.11	0.48	0.66	0.63	0.00
I/A-Roe	18	17.14	1.79	2.25	0.59	0.83	1.81	0.00
Bm-R^{11}-I/A-Roe	38	17.31	1.97	3.43	0.43	0.90	2.41	0.00

Table A11 : GMM Estimation and Tests, the Benchmark Two-capital Model Estimated at the Firm Level with Imputed Costs of Debt, June 1967–December 2016

This table uses the 40 testing deciles formed on book-to-market (Bm), prior 11-month returns (R^{11}), asset growth (I/A), and return on equity (Roe), separately and jointly (Bm and R^{11}, I/A and Roe, and all 40 deciles together). d.f. is the degrees of freedom in the GMM test of overidentification. γ is the technological parameter on the marginal product of total capital as a fraction of sales-to-total capital, $Y_{it+1}/(K_{it+1}+W_{it+1})$. a is the adjustment costs parameter of physical capital. $[\gamma]$ and $[a]$ are the standard errors of the point estimates. $\overline{|\alpha|}$ is the mean absolute alpha across a given set of testing portfolios, $\overline{|\alpha_{\text{H–L}}|}$ is the average absolute high-minus-low alpha, and p is the p-value of the overidentification test. γ, $[\gamma]$, and p are in percent, and $\overline{|\alpha|}$ and $\overline{|\alpha_{\text{H–L}}|}$ in percent per annum.

	d.f.	γ	$[\gamma]$	a	$[a]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Panel A: NYSE breakpoints and value-weighted returns								
Bm	8	17.21	2.15	3.58	0.74	1.16	0.12	0.16
R^{11}	8	15.31	2.46	5.83	0.01	0.83	0.03	48.43
I/A	8	17.01	1.95	1.79	0.73	0.87	2.85	0.59
Roe	8	16.10	2.46	5.63	0.00	0.86	0.54	7.64
Bm-R^{11}	18	17.44	2.19	3.26	0.55	1.18	0.68	0.00
I/A-Roe	18	16.87	1.98	1.72	0.66	1.10	2.62	0.00
Bm-R^{11}-I/A-Roe	38	17.28	2.10	2.73	0.47	1.23	1.92	0.00
Panel B: All-but-micro breakpoints and equal-weighted returns								
	d.f.	γ	$[\gamma]$	a	$[a]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	16.41	2.25	3.58	0.64	0.53	0.52	47.92
R^{11}	8	15.90	2.29	3.23	1.37	0.76	0.23	6.07
I/A	8	16.53	2.04	2.19	0.53	0.50	1.01	15.56
Roe	8	15.94	1.95	2.91	2.88	0.65	2.86	0.36
Bm-R^{11}	18	16.13	2.27	3.50	0.42	0.72	0.67	0.00
I/A-Roe	18	16.28	2.06	2.22	0.48	0.65	1.84	0.00
Bm-R^{11}-I/A-Roe	38	16.25	2.17	3.01	0.34	0.81	1.74	0.00

Table A12 : GMM Estimation and Tests, the Extended Two-capital Model with Working Capital Adjustment Costs Estimated at the Firm Level, June 1967–December 2016

This table reports GMM estimation and tests for the 40 testing deciles formed on book-to-market (Bm), prior 11-month returns (R^{11}), asset growth (I/A), and return on equity (Roe), separately and jointly (Bm and R^{11}, I/A and Roe, and all 40 deciles together). d.f. is the degrees of freedom in the GMM test of overidentification. γ is the technological parameter on the joint marginal product of total capital as a fraction of sales-to-total capital, $Y_{it+1}/(K_{it+1} + W_{it+1})$. a is the adjustment costs parameter of physical capital, and b is that of working capital. $[\gamma]$, $[a]$, and $[b]$ are the standard errors of the point estimates of these parameters. $\overline{|\alpha|}$ is the mean absolute alpha across a given set of testing portfolios, $\overline{|\alpha_{\text{H–L}}|}$ is the average absolute high-minus-low alpha, and p is the p-value of the overidentification test. γ, $[\gamma]$, and p are in percent, and $\overline{|\alpha|}$ and $\overline{|\alpha_{\text{H–L}}|}$ in percent per annum.

	Panel A: NYSE breakpoints and value-weighted returns									
	d.f.	γ	$[\gamma]$	a	$[a]$	b	$[b]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	14.05	2.38	2.86	0.00	3.07	0.00	0.52	0.03	92.76
R^{11}	8	12.08	2.78	8.14	0.00	0.01	0.01	0.66	0.02	72.98
I/A	8	17.58	1.78	1.53	0.71	0.50	0.82	0.81	2.23	0.19
Roe	8	14.33	2.67	5.76	0.00	2.61	0.02	0.85	0.29	17.78
Bm-R^{11}	18	16.22	2.91	3.32	0.60	2.16	0.90	1.08	2.13	0.10
I/A-Roe	18	17.46	1.80	1.61	0.65	0.33	0.82	1.08	2.43	0.00
Bm-R^{11}-I/A-Roe	38	17.89	1.95	2.79	0.49	0.48	0.91	1.28	2.11	0.00
	Panel B: All-but-micro breakpoints and equal-weighted returns									
	d.f.	γ	$[\gamma]$	a	$[a]$	b	$[b]$	$\overline{\lvert\alpha\rvert}$	$\overline{\lvert\alpha_{\text{H–L}}\rvert}$	p
Bm	8	17.03	2.21	3.53	0.68	0.92	1.36	0.53	0.22	32.21
R^{11}	8	12.76	2.89	3.20	1.39	2.58	0.55	0.30	0.47	54.58
I/A	8	17.24	1.73	1.83	0.77	0.34	0.84	0.63	0.36	2.44
Roe	8	15.29	2.18	5.53	0.05	1.02	0.18	0.57	1.93	21.74
Bm-R^{11}	18	15.77	2.31	3.49	0.44	1.62	1.02	0.68	0.72	0.00
I/A-Roe	18	16.80	1.86	2.04	0.57	0.05	0.57	0.75	1.64	0.00
Bm-R^{11}-I/A-Roe	38	16.81	1.89	3.03	0.45	0.09	0.59	0.93	2.27	0.00

Table A13 : Pooled Panel Forecasting Regressions, June 1967–December 2017

Panel A shows monthly pooled panel regressions of 1-year-ahead investment-to-physical capital, I_{t+1}/K_{t+1}, on current log Tobin's Q, $\log(Q_t)$, sales-to-total capital, $Y_t/(K_t+W_t)$, and investment-to-physical capital, I_t/K_t. Panel B shows monthly pooled panel regressions of 1-year-ahead annual sales growth on the quarter-to-quarter sales growth of the prior four quarters. Tobin's Q is the market equity (price per share times the number of shares outstanding from CRSP) plus long-term debt (Compustat annual item DLTT) and short-term debt (item DLC) scaled by book assets (item AT), all from the most recent fiscal year ending at least four months ago. We allow the industry fixed effects on the intercept with the Fama-French (1997) 48 industries. Excluding four financial industries (banks, insurance, real estate, and trading) leaves us 44 industries. The t-values, denoted $[t]$, are calculated with the standard errors clustered by both firm and time per Thompson (2011). The goodness-of-fit, R^2, is in percent. We estimate the panel regressions in two ways. In "WLS" we use weighted least squares on the full sample with a firm's relative market equity (the firm's market equity divided by the market's median equity in the same period) as its weight. In "OLS" we use ordinary least squares on the all-but-micro sample.

Panel A: Forecasting investment-to-capital, I_{t+1}/K_{t+1}

	WLS			OLS		
	Slope	$[t]$	R^2	Slope	$[t]$	R^2
$\log(Q_t)$	0.12	10.41	47.44	0.16	31.53	28.23
$Y_t/(K_t+W_t)$	0.03	9.55		0.03	12.38	
I_t/K_t	0.26	19.86		0.25	27.50	
Industry fixed effects	Yes			Yes		

Panel B: Forecasting annual sales growth, Y_{t+1}/Y_t

	WLS			OLS		
	Slope	$[t]$	R^2	Slope	$[t]$	R^2
g^Y_{q-1}	0.49	30.04	18.87	0.58	26.85	19.88
g^Y_{q-2}	0.15	17.62		0.18	8.79	
g^Y_{q-3}	0.06	8.47		0.08	5.57	
g^Y_{q-4}	0.15	12.17		0.08	3.18	
Industry fixed effects	Yes			Yes		

Table A14 : Deciles Formed on the Expected Return Estimates, All-but-Micro Sample and Equal-weighted Returns, July 1992–December 2017

This table reports the average excess return of a given expected return decile for the h-month holding period, in which $h = 1$, 6, and 12. The t-values adjusted for heteroscedasticity and autocorrelations are reported in the rows beneath the corresponding estimates. The deciles are formed on the expected return estimates with all-but-micro breakpoints and equal-weighted returns.

h	L	2	3	4	5	6	7	8	9	H	H−L
		Panel A: The two-capital model estimated at the firm level									
1	0.46	0.67	0.76	0.94	0.81	0.84	0.86	0.86	0.86	0.95	0.49
	1.30	2.48	3.01	3.38	3.14	3.37	3.62	3.89	3.54	3.43	2.77
6	0.51	0.77	0.76	0.88	0.83	0.82	0.91	0.85	0.82	0.90	0.39
	1.51	2.85	3.00	3.22	3.32	3.30	3.90	3.86	3.53	3.29	2.33
12	0.59	0.82	0.78	0.86	0.83	0.83	0.90	0.84	0.80	0.86	0.27
	1.79	3.15	2.99	3.21	3.34	3.43	3.95	3.85	3.49	3.08	1.74
		Panel B: The physical capital model estimated at the portfolio level									
1	0.71	0.79	0.82	0.74	0.72	0.82	0.85	0.81	0.84	0.89	0.18
	2.14	2.63	3.03	2.76	3.08	3.32	3.37	3.49	3.54	3.46	0.87
6	0.73	0.84	0.77	0.79	0.77	0.82	0.83	0.81	0.82	0.85	0.12
	2.18	2.86	2.89	3.01	3.19	3.50	3.58	3.43	3.57	3.50	0.61
12	0.76	0.86	0.82	0.82	0.80	0.80	0.82	0.81	0.80	0.80	0.03
	2.45	3.12	3.20	3.25	3.22	3.39	3.51	3.44	3.52	3.44	0.20
		Panel C: The q-factor model									
1	0.67	0.85	0.89	0.86	0.86	0.78	0.84	0.79	0.82	0.81	0.14
	1.82	3.13	3.65	3.74	3.65	3.70	3.41	3.00	3.02	2.48	0.63
6	0.70	0.88	0.87	0.82	0.87	0.79	0.81	0.82	0.81	0.81	0.11
	1.95	3.31	3.72	3.47	3.87	3.49	3.29	3.22	3.10	2.58	0.45
12	0.69	0.80	0.87	0.82	0.86	0.81	0.81	0.85	0.87	0.84	0.15
	1.97	3.08	3.83	3.50	3.89	3.50	3.30	3.39	3.27	2.72	0.65

Figure A1 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Physical Capital Model Estimated at the Portfolio Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H." Panel A fits the Bm and R^{11} deciles jointly, and Panel B fits all the 40 equal-weighted deciles together.

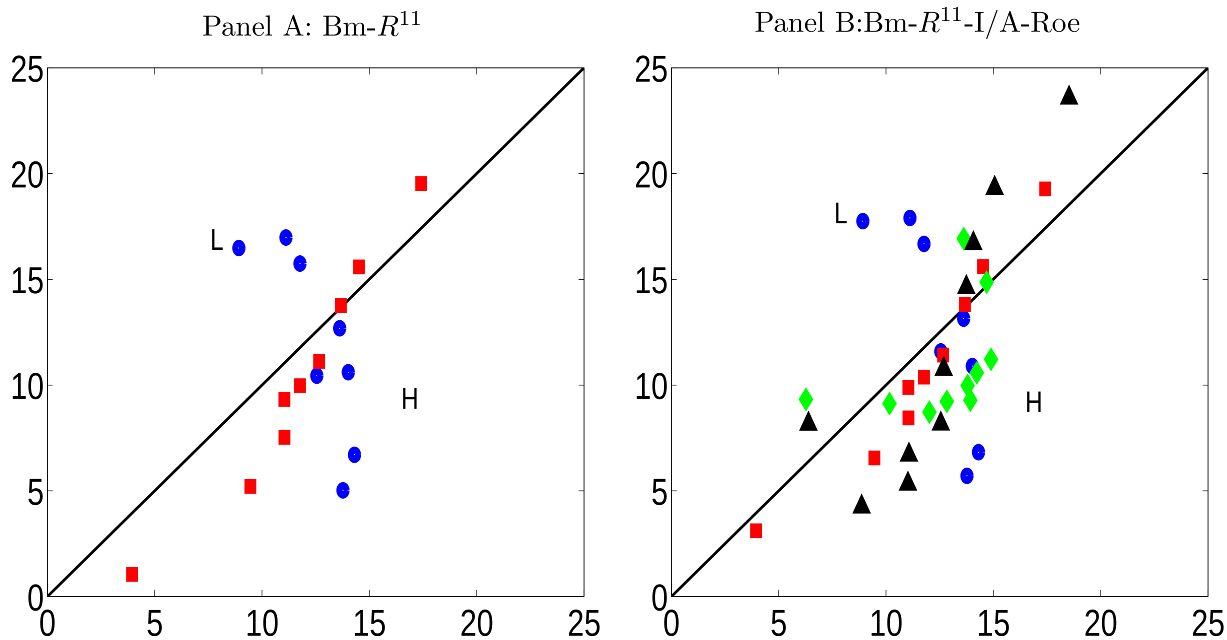


Figure A2 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Benchmark Two-capital Model Estimated at the Firm Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H." Panel A fits the Bm and R^{11} deciles jointly, and Panel B fits all the 40 equal-weighted deciles together.

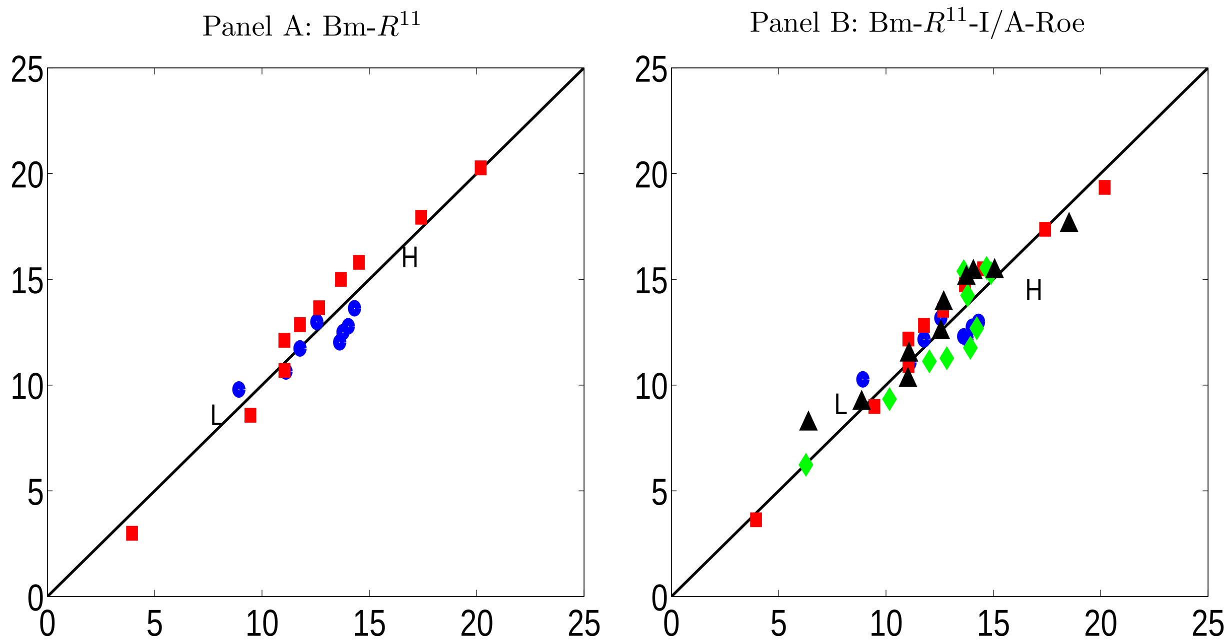


Figure A3 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Two-capital Model Estimated at the Portfolio Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H." Panel A fits the Bm and R^{11} deciles jointly, and Panel B fits all the 40 equal-weighted deciles together.

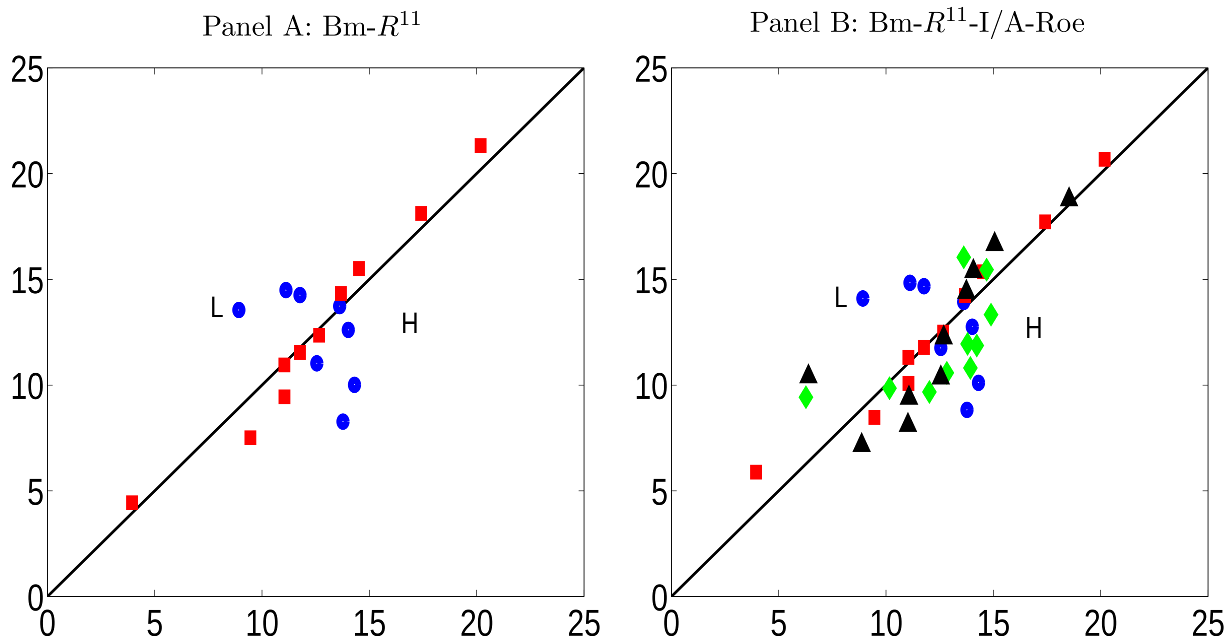


Figure A4 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Physical Capital Model Estimated at the Firm Level, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H." Panel A fits the Bm and R^{11} deciles jointly, and Panel B fits all the 40 equal-weighted deciles together.

Panel A: Bm-R^{11} Panel B: Bm-R^{11}-I/A-Roe

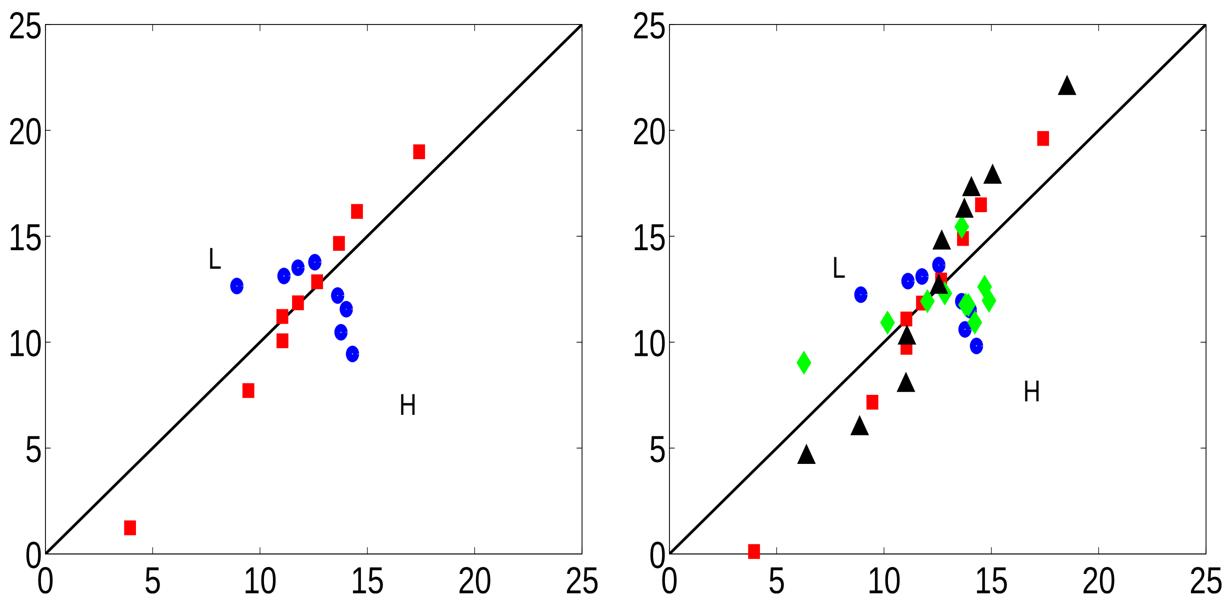


Figure A5 : Event-time Dynamics of the Stock and Fundamental Returns of the High and Low Deciles, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

For 36 months after the portfolio formation, we plot the stock returns, r^S_{it+1}, and the fundamental returns, r^F_{it+1}, for the high and low deciles formed on book-to-market, prior 11-month returns, asset growth, and return on equity. Both stock and fundamental returns are in percent per annum. The blue solid lines represent the low deciles, and the red broken lines the high deciles. The fundamental returns are based on the parameters from estimating the two-capital model at the firm level on the 40 equal-weighted deciles jointly.

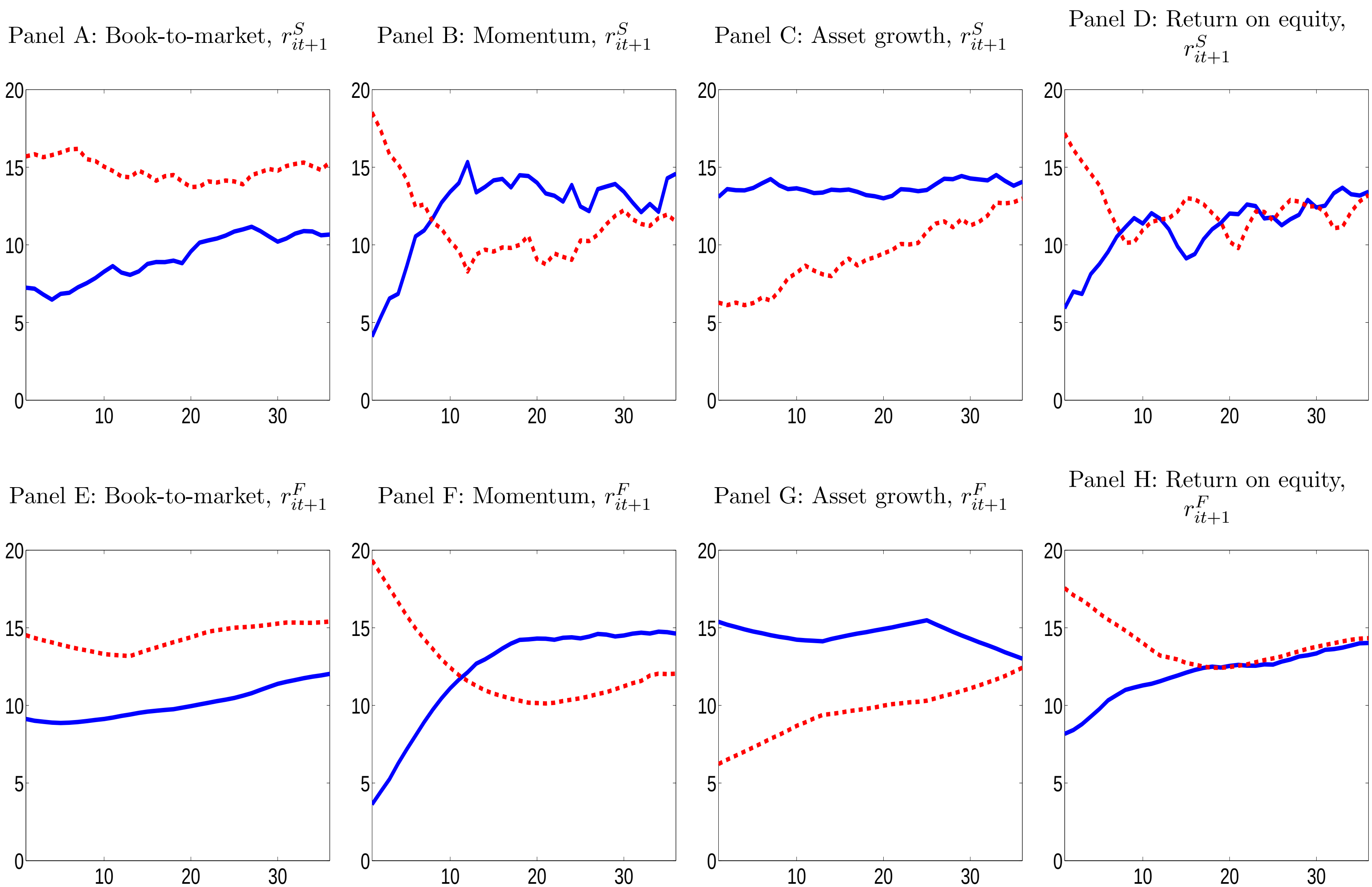


Figure A6 : Event-time Dynamics of the Marginal Q Growth the High and Low Deciles, June 1967–December 2016

For 36 months after the portfolio formation, we plot the marginal q growth, $q_{it+1}/q_{it} - 1$, for the high and low deciles formed on book-to-market, prior 11-month returns, asset growth, and return on equity. The marginal q growth is in percent per annum. The blue solid lines represent the low deciles, and the red broken lines the high deciles. Marginal q is constructed on the adjustment costs parameter, a, from estimating the two-capital model at the firm level on the 40 testing deciles jointly. Both value-weighted (vw) and equal-weighted (ew) results are reported.

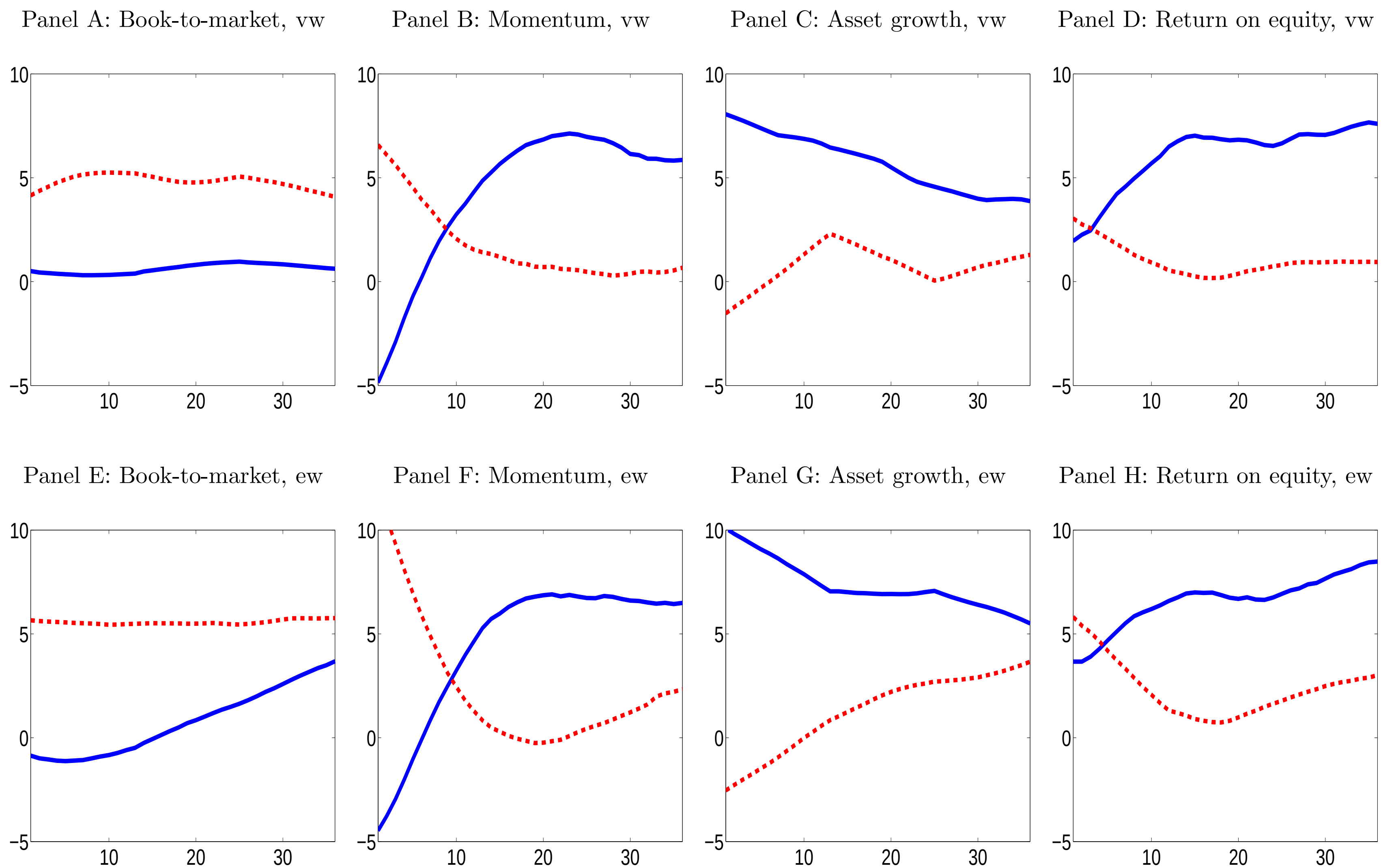


Figure A7 : Time Series of the Stock and Fundamental Returns of the Factor Premiums, All-but-micro Breakpoints and Equal-weighted Returns, June 1967–December 2016

The blue solid lines represent the value-weighted stock returns of the high-minus-low deciles, and the red broken lines the corresponding fundamental returns. Both returns are in percent per annum. Stock returns outliers are indicated with their values and the corresponding months.

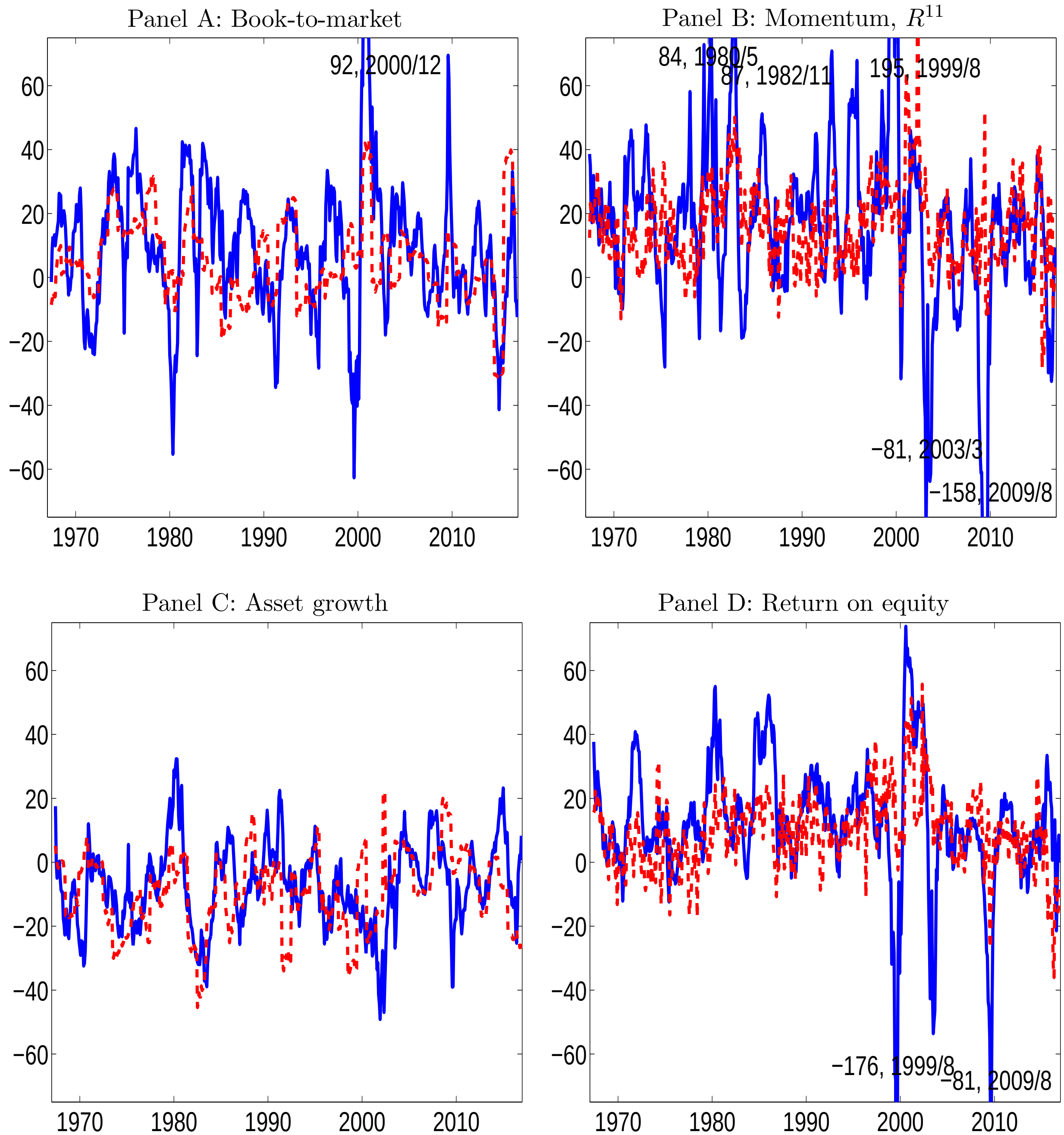
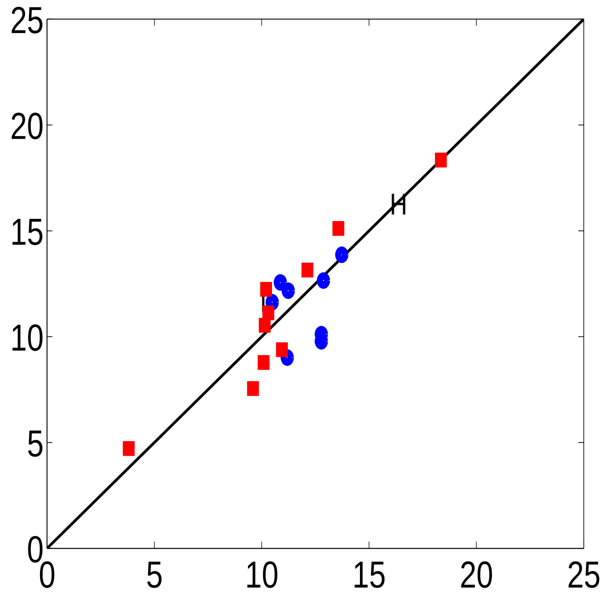


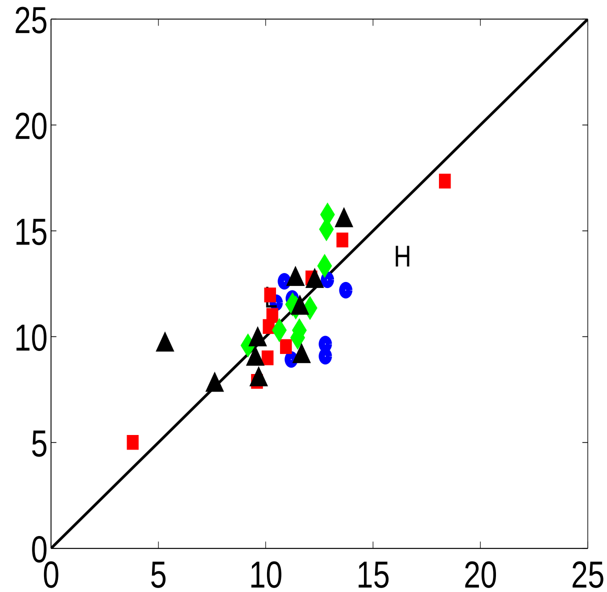
Figure A8 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Benchmark Two-capital Model Estimated at the Firm Level in the No-large-M&A Sample, June 1967–December 2016

This table uses the no-large-M&A sample, in which firms with sizeable M&As with the target assets at least 15% of the acquirer assets are excluded. We identify M&As via the SDC dataset and Compustat (item AQC). Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H." Panels A and C fit the Bm and R^{11} deciles jointly, and Panel B and D all the 40 deciles jointly.

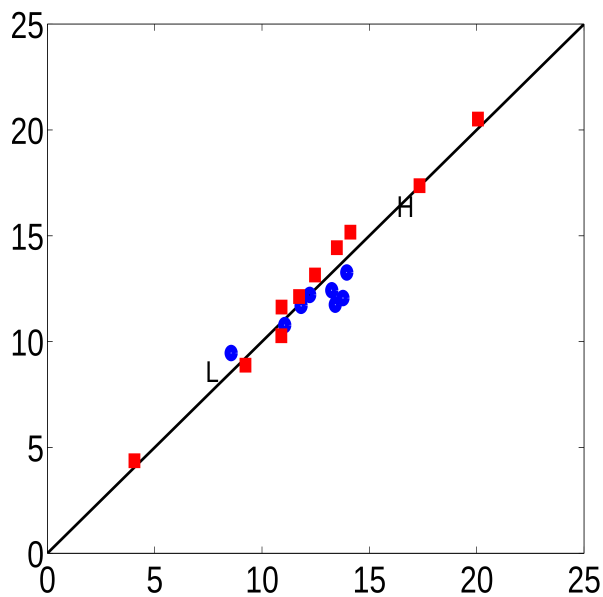
Panel A: Bm-R^{11}, NYSE breakpoints and value-weighted returns



Panel B: Bm-R^{11}-I/A-Roe, NYSE breakpoints and value-weighted returns



Panel A: Bm-R^{11}, all-but-micro breakpoints and equal-weighted returns



Panel B: Bm-R^{11}-I/A-Roe, all-but-micro breakpoints and equal-weighted returns

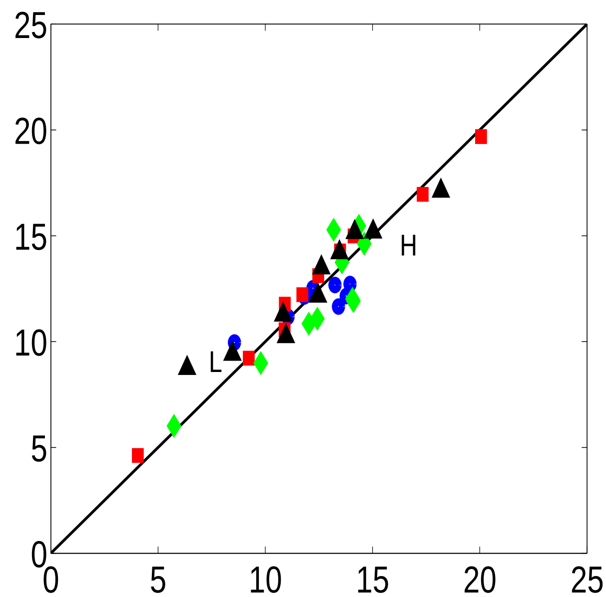
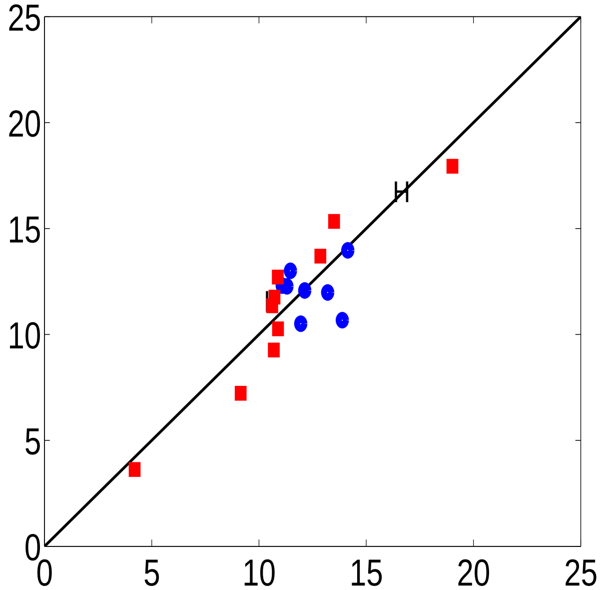


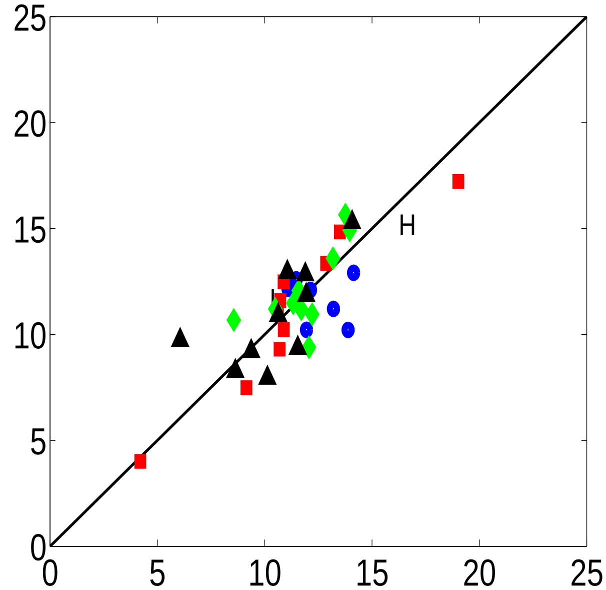
Figure A9 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Benchmark Two-capital Model Estimated at the Firm Level with Imputed Costs of Debt, June 1967–December 2016

Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H." Panels A and C fit the Bm and R^{11} deciles jointly, and Panel B and D fits all the 40 deciles together.

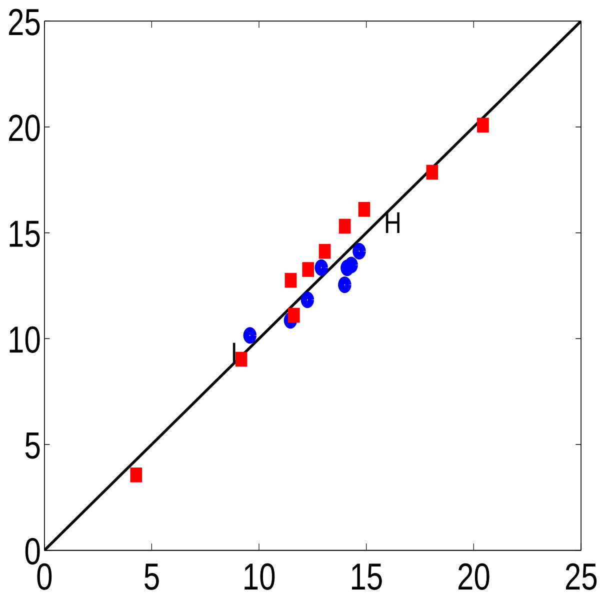
Panel A: Bm-R^{11}, NYSE breakpoints and value-weighted returns



Panel B: Bm-R^{11}-I/A-Roe, NYSE breakpoints and value-weighted returns



Panel A: Bm-R^{11}, all-but-micro breakpoints and equal-weighted returns



Panel B: Bm-R^{11}-I/A-Roe, all-but-micro breakpoints and equal-weighted returns

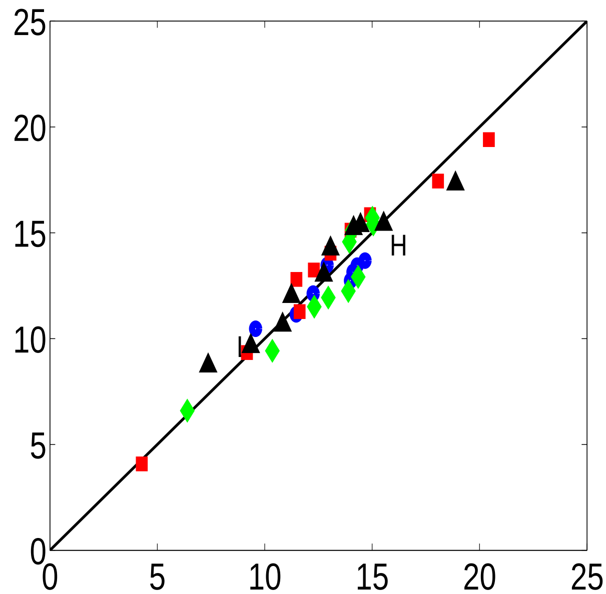
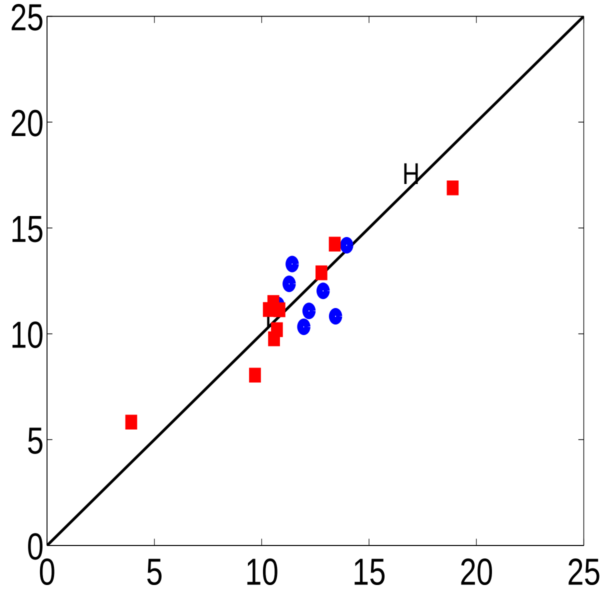


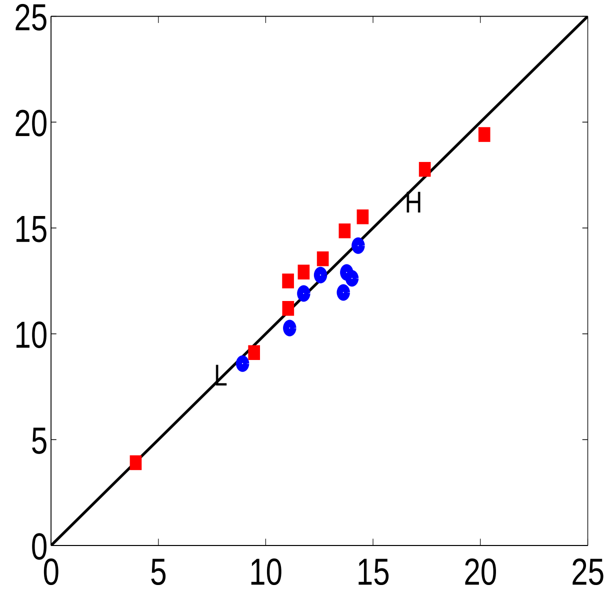
Figure A10 : Average Predicted Stock Returns versus Average Realized Stock Returns, The Extended Two-capital Model with Working Capital Adjustment Costs Estimated at the Firm Level, June 1967–December 2016

Both average predicted and realized stock returns are in percent per annum. The book-to-market (Bm) deciles (except for the two extreme deciles) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The lowest Bm decile is denoted "L," and the highest Bm decile "H." Panels A and B fit the Bm and R^{11} deciles jointly, and Panels C and D fit all the 40 deciles together.

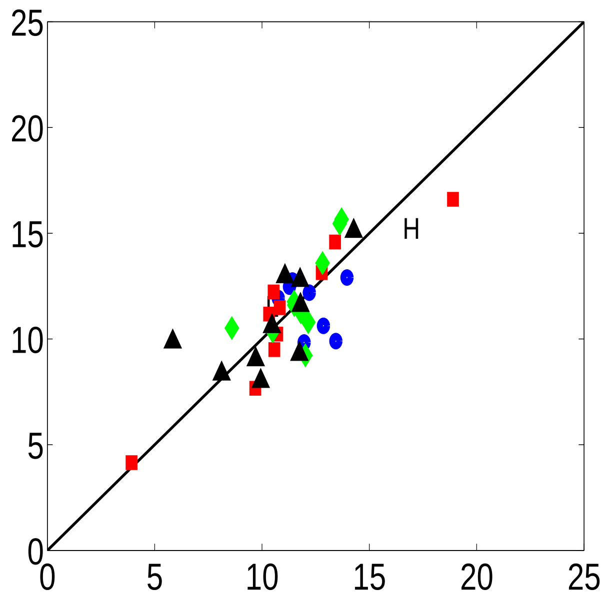
Panel A: Bm-R^{11}, NYSE breakpoints and value-weighted returns



Panel B: Bm-R^{11}, all-but-micro breakpoints and equal-weighted returns



Panel C: Bm-R^{11}-I/A-Roe, NYSE breakpoints and value-weighted returns



Panel D: Bm-R^{11}-I/A-Roe, all-but-micro breakpoints and equal-weighted returns

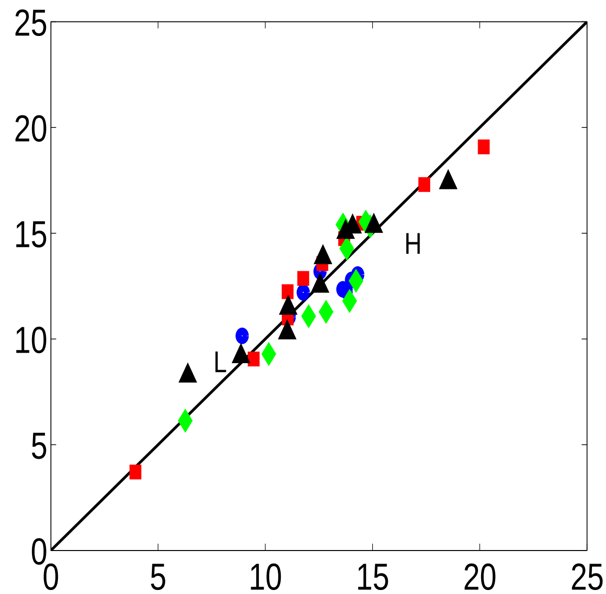
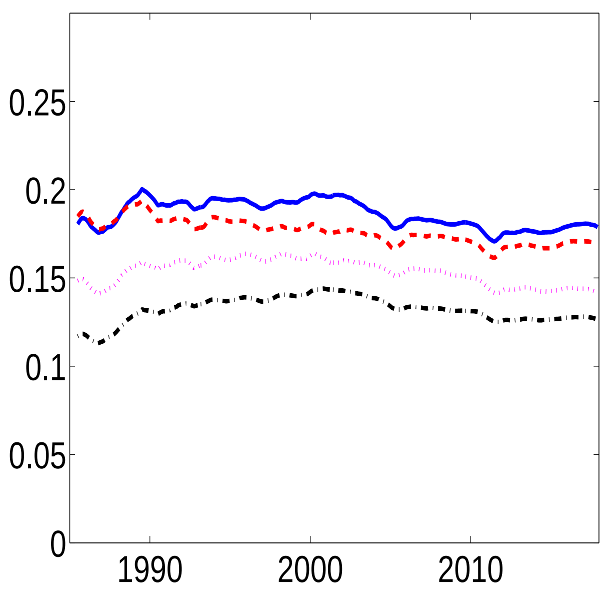


Figure A11 : Time Series of Recursively Estimated Parameter Values, July 1985–December 2017

In the benchmark two-capital model, the marginal product parameter, γ, is the sum of that for physical capital, γ_K, and that for working capital, γ_W. In the physical capital model, the marginal product parameter is γ_K. In both panels, a denotes the adjustment costs parameter for physical capital. The blue solid lines are for the two-capital model estimated at the firm level with value-weighted testing deciles, the red broken lines the two-capital model estimated at the firm level with equal-weighted deciles, the black dashdot lines the physical capital model estimated at the portfolio level with value-weighted deciles, and the purple dotted lines the physical capital model estimated at the portfolio level with equal-weighted deciles. Recursive estimation means that we add one month to the estimation window at a time to obtain the time series of the parameter estimates.

Panel A: The marginal product parameter, γ, in the two-capital model, or γ_K in the physical capital model



Panel B: The adjustment costs parameter, a

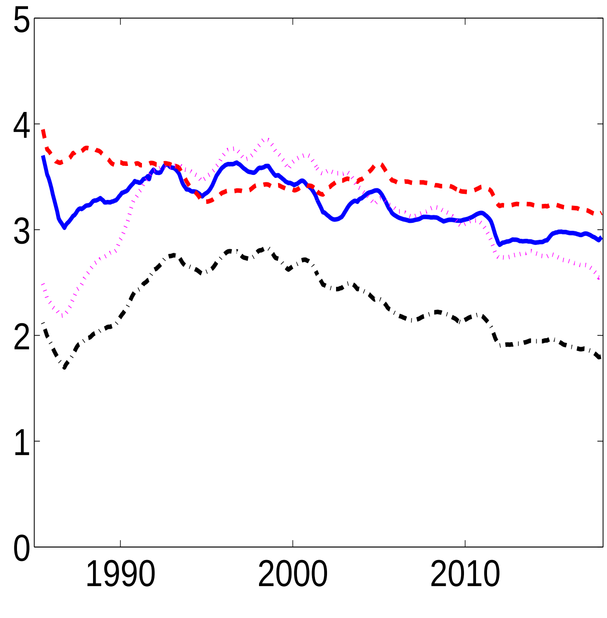


Figure A12 : The 1-period-ahead Model Fits via Recursive Estimation, All-but-micro Breakpoints and Equal-weighted Returns, July 1985–December 2016

Both average predicted (y-axis) and average realized stock returns (x-axis) are in percent per annum. The book-to-market (Bm) deciles (except for the two extremes) are in blue circles, the momentum (R^{11}) deciles in red squares, the asset growth (I/A) deciles in green diamonds, and the return on equity (Roe) deciles in black triangles. The low Bm decile is denoted "L," and the high Bm decile "H."

Panel A: The q-factor model

Panel B: The physical capital model estimated at the portfolio level

Panel C: The two-capital model estimated at the firm level