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ABSTRACT

Using a measure of cashflow risk derived from analyst forecasts, I find that cashflow risk offers a partial explanation for the value – growth anomaly. In particular, the lowest asset growth portfolio has a higher earnings beta than the highest asset growth portfolio. Approximately cashflow risk measured by earnings beta carries a significant positive risk premium of 1.24% with a t-value of 3.51.

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I would like to express special thank to Prof. Mitchell Craig Warachka for his excellent study "Cashflow risk, systematic earnings revisions, and the cross-section of stock returns", Journal of Financial Economics 94 (2009) 448 – 468, which motivates the main idea of this thesis.

Further, I also wish to thank Prof. Tu Jun and Prof Joe Zhang Zhe in the Thesis Committee for their precious and contributive comments.

Chapter 1. INTRODUCTION

1.1. Background

Consistently explaining stock market movements over a long period of time have always been the mission of financial academics. In this study, using analyst earnings beta constructed by Z.Da and M.C.Warachka (2009), I confirm that cashflow risks measured by earnings betas offer a partial explanation for value premium. The thesis then examines the relation between earnings beta and growth anomaly with the aim of complementing the explanatory power of earnings beta.

Undoubtedly, the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965), and Black (1972) has occupied a prominent in academic finance. The central idea behind the model is to propose beta, which is the slope in the regression of the returns of an individual stock on the returns of the market. The expected rate of return on any stock is positively and linearly related to the stock's systematic risk (beta). In contrast, there have been scores of studies suggest that betas do not suffice to explain the cross-section of expected returns. The long-term historical patterns in average stock returns that can not be explained by CAPM are considered anomalies. Subsequent work examines that cross-sectional difference in average returns are determined by a number of other anomalies such as market capitalization (size effect), book-to-market (value effect), earnings/price (earnings effect), return reversals (prior return effect) and growth anomalies (growth in asset or capital investment). For instance, Banz (1981) shows that stocks with low market capitalization (small stocks) have abnormally high average returns. Fama and French (1992) and many other papers noted that positive abnormal returns seem to accrue to portfolios of stocks with high book-to-market ratio. Cohen, Gompers and Vuolteenaho (2002) find that more profitable firms have higher average returns. Titman, Wei and Xie (2004) and Cooper, Gulen and Schill (2008) show that firms that invest more or grow their total asset more earn lower subsequent risk-adjusted stock returns. This phenomenon is often referred to as the capital investment or asset growth anomaly.

Another approach, however, challenges that if stock returns can be predicted on the basis of the above historical factors then it is difficult to characterize stock markets as information ally efficient. Campbell and Shiller (1988a) posit that unexpected stock returns can be decomposed into changes in expected discount rates (DRs news) and changes in expected cashflows (CFs news). Fama (1990), Kothari and Shanken (1992), Campbell and Ammer (1993) and others regress aggregate stock returns on cash-flow proxies and find that cash-flow proxies well explain returns. Chen and Zhao (2007) report that cashflow news deprived from consensus cashflow forecasts are strongly positively correlated with stock return. Cashflow risk, hence, is an important element in systematic risk that determines stock return variation.

Z.Da and M.C.Warachka (2009), in particular, develops an earnings beta by using consensus analyst forecast revisions. Cashflow risk, captured by this earnings beta, explains cross-sectional variation in average returns, in other words, size premium, value premium and return reversals. The question “Can this cashflow risk measure continue to explain asset growth anomaly?” is the objective of the thesis.

1.2. The study details

Following Z.Da and M.C.Warachka (2009), I estimate the earnings betas for 10 book-to-market sorted portfolios. The results are similar for the same sample period from 1984 – 2005. Value stocks (high book-to-market ratio) have higher earnings betas of 1.28 and portfolio equal-weighted monthly return of 1.58%; while growth stocks (low book-to-market ratio) have lower earnings betas of 0.64 and portfolio equal-weighted monthly return of 1.07%. The return spread between value portfolio and growth portfolio is 0.51% per month (t-statistic =2.36). Differences between earnings betas of the extreme portfolios are highly significant with a t-value of 3.20

Following J.Cooper, H.Gulen and J.Schill (2008), I calculated year-on-year percentage change in total asset over the 1984 to 2005 period to form asset growth sorted portfolios. Lowest asset growth portfolio earns average returns of 1.61%; highest asset growth portfolio earns average returns of 0.62% per month. The return difference is 0.99% with t-statistic of 4.73. It is confirmed that a firm’s annual asset growth rate is strongly negatively correlated with stock returns.

Constructing earnings beta for each asset growth portfolio further validates the question. Accordingly, lowest asset growth deciles have higher earnings beta of 1.14; while highest asset growth deciles have lower earnings beta of 0.68. The difference is significant with a t-value of 2.89. This asset growth effect is also consistent through the sample period. Cross-sectional regression involving 20 portfolios of portfolio’s return premium on earnings betas confirm the economic importance of earnings betas.

Positive estimated coefficient of 1.24% with t-value of 3.51 in the Fama Macbeth regression of portfolio excess return on earnings betas indicates that higher earnings betas imply higher returns.

The study sheds light on a controversial issue whether stock characteristics are associated with returns out of systematic risks or mispricing. Titman, Wei and Xie (2004) and Cooper, Gulen and Schill (2008) attribute asset growth anomaly to investors' mis-reactions to information contained in asset expansion. In other words, it is debated that these characteristics predicting future returns are indicators of mispricing, instead of systematic risk factors. This study, on the other hand, proposes a measure of systematic risks that could partially explain asset growth anomaly.

The organization of the study is as follows. Section 1 gives an introduction of the background of cross-sectional return studies as well as a brief idea and flow of the thesis. Section 2 describes an overview of a number of literatures on the topic and the theoretical framework of the models being used. The methodology is explored in section 3. Section 4 then presents some empirical findings and robustness check, while section 5 concludes.

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Chapter 2. LITERATURE REVIEW

This study is related to the literature on return decomposition, cashflow innovation based on consensus earnings forecasts and firm growth anomalies.

2.1. Return Decomposition

Developing a framework that relates stock prices, stock returns and dividends has always been of foremost importance to academic research. Gordon model (1962) derives D/P= r – g under the assumption that dividends D will grow at a constant rate g and discount rate r will never change. The dividend-price ratio model of Campbell and Shiller (1988), referred to as a dynamic version of Gordon model, fills a significant gap by permitting an analysis of the variation through time in the dividend-price ratio in relation to predictable changes in discount rates and dividend growth rates. This model explains the log dividend-price ratio as an expected value of all future one-period "growth-adjusted discount rates" ($r_{t+j} - \Delta d_{t+j}$):

$$\delta_t = \log(\frac{D_t}{P_t}) = E_t \sum_{j=0}^{\infty} \rho^j (r_{t+j} - \Delta d_{t+j}) - \frac{k}{1-\rho}$$

Using price-dividend ratio as a standard framework, Campbell (1991) interprets unexpected stock returns by breaking them into "news about future dividend" and "news about future returns". Unexpected stock returns are decomposed into:

$$r_{t+1} - E_t r_{t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta d_{t+j+1} - (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j r_{t+j+1} \qquad (1)$$

$$= N_{CF,t+1} - N_{DR,t+1}$$

where r_{t+1} is the log stock return, ρ is a constant close to but lower than 1, d_t is the log dividend paid, Δd_t denotes dividend growth rate, N_{CF} is the cashflow components and N_{DR} is the discount rate component. Further details of decomposition are provided in the Appendix.

There is a substantial body of research measuring the relative importance of cashflow and discount rates news for aggregate portfolio returns in equation (1). Vuolteenaho (2002) concludes that information about future cashflow is the dominant factor driving firm level stock returns. Campbell and Ammer (1993) and Campbell and Vuolteenaho (2004a) find that although DR news dominates the CF news the return predictability is small. Using consensus cashflow forecasts, Chen and Zhao (2007) finds that CF news is more important than DF news in driving stock returns at the firm, portfolio, and aggregate levels. Accordingly, this study focuses on the expected cashflow news components.

2.2 Cashflow Innovations

Among literature to estimate cashflow components (CF) in equation (1), many works use different methods. Earlier researches use proxies for actual realizations of cashflow changes such as future growth rate of industrial production (Fama (1990), Schwert (1990)). Since realized cashflow is claimed to have limited explanatory power, ex post cashflow measure problems are reduced by using returns measured over relatively long intervals. Kothari and Shanken (1992) incorporate dividend yield and the growth rate of investment as proxies for initial expectations of dividend growth. In more recent studies, Hecht and Vuolteenaho (2006), Vuolteenaho (2008) compute cashflow innovations by using vector auto regression model (VAR).

Another growing literature uses analyst forecasts to study the nature of asset valuation. Easton, Taylor, Shroff and Sougiannis (2002) estimate internal rate of return based on current book equity and short-term earnings forecasts. Chen and Zhao (2007) choose to match the forward-looking CF news (computed from analyst forecasts) with stock return; while Pastor, Sinha and Swaminathan (2008) calculate free cashflow to equity as the product of annual earnings forecast and the plowback rate. The common path of literature to infer earnings expectation from analyst forecasts is as follows:

In the year t+1 and t+2: earnings forecasts are obtained directly from I/B/E/S

In the year t+3 to t+5: $FE_t = FE_{t-1}(1+LTG_t)$ (FE: Forecast earning, LTG_t is a assumed-to-be five-year earnings growth rate; both provided by I/B/E/S)

In the year t+6 onwards, the steady-state growth rate g_t is used. g_t for years onwards is computed differently in different papers. Pastor, Sinha and Swaminathan (2006) assume the steady-state growth rate equal to long-run nominal GDP growth rate. Z.Da and M.C. Warachka (2009) assumes that expected earnings growth converges to an economy-wide steady-state growth rate, which is the cross-sectional average of LTG_t. For the ease of comparison, the same approach is used in this thesis.

2.3. Measures of Growth Anomalies

Measures of firm growth, complicated or simple are much investigated and debated by the literature. Lakonishok, Shleifer and Vishny (1994) argue that firm growth should be examined both as market's expectation of future growth and as past growth of these firms. Therefore, they propose growth in sales (GS) to proxy for past growth and ratio of expected cashflow-to-price (C/P) and expected earnings-to-price (E/P) to proxy for expected growth. An alternative approach is to use consensus long-term earnings growth forecast (LTG_t), motivated by La Porta (1993). In recent studies, Cooper, Gulen and Schill (2008) uses year-on-year percentage change in total assets (Compustat Data item 6) to calculate firm asset growth. Titman, Wei and Xie (2004), on the other hand, use abnormal capital investment (CI_t), which is firm's capital expenditure (Compustat Data item 128) scaled by its sales (Data12), to capture asset growth. Lyandres, Sun and Zhang (2008) uses Investment-to-Assets (change in property, plant and equipment plus change in inventories divided by lagged total assets). Regardless of different methods of measures, several studies have documented that companies that increase capital investments or grow their total assets subsequently earn substantially lower risk-adjusted returns. Cooper, Gulen and Schill (2008) conclude a strong negative correlation between a firm's asset growth and subsequent abnormal return. Using alternative growth rates variables, they prove that asset growth effect remains significant. Growth anomaly certainly possesses a predictive power towards cross-sectional stock returns.

Following Cooper, Gulen and Schill (2008), I use total asset growth to test for the explanatory role of earnings beta. Two alternative anomaly variables that link to growth: Investment-to-Assets (I/A) based on past growth and long-term growth forecast (LTG) based on future growth are included to confirm the evidence.

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Chapter 3. METHODOLOGY

3.1. Data Description

3.1.1 Data from Institutional Brokers Estimate System (I/B/E/S):

All US-firms from the Summary Statistic Unadjusted file of I/B/E/S from 1984 to 2005[1] are originally included in the sample. The Summary Statistic file, which is updated every third Thursday of the month, contains summary statistics of EPS estimates that have not been adjusted for stock splits. Each firm-month observation should have an actual earning of previous fiscal periods ($A0_t$), a one-year ($A1_t$) and a two-year (A2t) consensus earnings-per-share forecast and long-term growth forecast (LTG_t). $A0_{t,}$ $A1_t$, $A2_t$ are denominated in dollars per share, with the t subscript denoting when a forecast is calculated (I/B/E/S Statistical Period variable (STATPERS)). LTG_t represents an annualized percentage growth rate. LTG_t has no fixed maturity date but pertain to the next three to five years.

[1] To ensure a reasonable number of observations each year.

3.1.2 Data from Center of Research in Securities Price (CRSP) and Standard and Poor's COMPUSTAT:

Relevant accounting data from COMPUSTAT/CRSP Merge and price/return data from CRSP are then merged into the I/B/E/S sample. I include non-negative Book Equity (Compustat Data item 60), non-missing Total Asset (Data 6), Gross property, plant and equipment (Compustat Data item 7), Inventories (Compustat Data item 3). Some variables require 3 years of accounting data. Matching analyst forecasts and book equity requires that the book equity is public information when analyst forecasts are released.

Firms should have non-missing price, return and valid market equity figures when portfolios are formed. To avoid potential data errors and extreme outliers, I winsorize book-to-market ratios at 99^{th} percentile and 1^{st} percentile. For stock delisting, I follow Shumway (1997) and assign a return of -0.3 to firms delisted for performance-related reasons (delisting code is 500 or in [520,584]). Otherwise, I assume a zero delisting return. Share splits are also accounted for using the split factor in CRSP.

The Appendix provides exact formulas for all the variables used in my test.

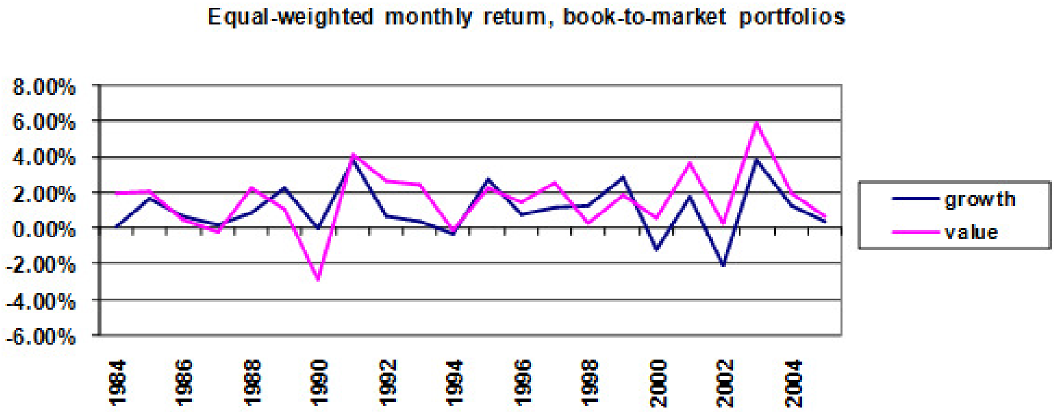
3.1.3 Portfolio Formation:

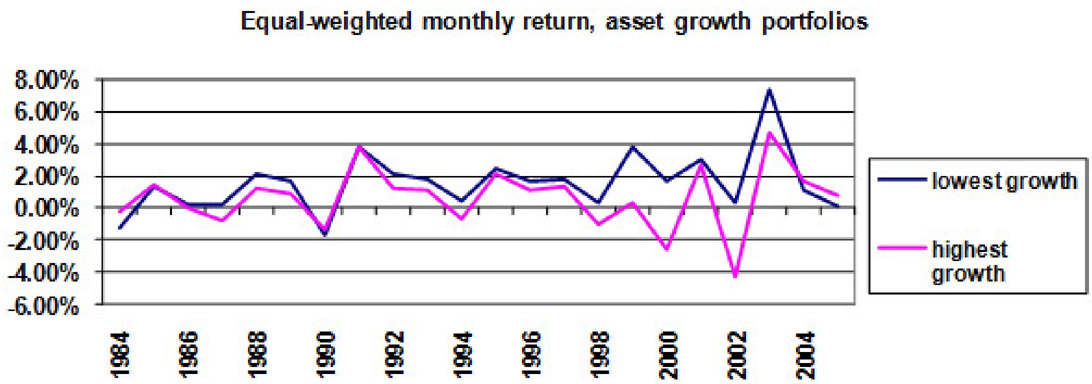
At the end of June each year t, stocks are allocated into deciles based on book-to-market and asset growth rates. Two extra portfolios include investment-to-asset (I/A) and expected growth in earning portfolios. Following Fama French (1996), portfolios are formed from July of year t to June of year t+1. The portfolios are held for 1 year and then rebalanced. In particular, book-to-market portfolios are formed based on BE/ME at the end of each June using NYSE breakpoints. The book equity (BE) used in June of year t is the book equity for the fiscal year ending in calendar year t-1. Market equity (ME) is price times shares outstanding at the end of December in year t-1. Asset growth portfolios are formed based on asset growth rates (Cooper, Gulen and Schill (2008)). Asset growth in June of year t is the calculated as the asset growth (percentage change) from the fiscal year end in calendar year t-2 to the fiscal year end in calendar year t-1:

$$ASSETG_t = \frac{Data6_{t-1} - Data6_{t-2}}{Data6_{t-1}} \qquad (2a)$$

Equal-weighted monthly portfolio returns are computed for each portfolio. Figure 1 reports monthly equal-weighted return for book-to-market deciles 1 and 10 and asset growth deciles 1 and 10 over the period 1984 -2005. For book-to-market portfolios, over 22 sample year, the spread between value (high bm) and growth (low bm) is positive in 17 years and negative in 5 years. Whereas among asset growth portfolios, over 22 year-sample, the spread between lowest asset growth and highest asset growth is positive in all but 2 years. Low growth firms outperformed high growth firms in almost all of the years in the sample period.

Figure 1. Time series of monthly equal-weighted returns for book-to-market and asset growth portfolios in the sample period 1984 – 2005. Growth refers to firms in the lowest book-to-market deciles, while value refers to firms in the highest book-to-market deciles. Lowest growth refers to firms in the lowest asset growth deciles, while highest growth refers to firms in the highest asset growth deciles.





3.1.4 Earnings forecast characteristics

Z.Da and M.C.Warachka (2009) also develops a simple measurement of earning growth in $A1_t$ and $A2_t$ in comparison with LTG_t. As LTG_t represents an annualized percentage growth rates, the annualized growth rates from the previous realised earning $A0_t$ to one-year-ahead $A1_t$ and two-year-ahead $A2_t$ are calculated as

$$\text{Future Value} = \text{Present Value}*(1 + i)^n$$

(i: growth rate, n: number of periods)

Earning forecasts of individual stocks are aggregated annually before calculating annualized percentage growth rates $A1_{t,\%}$ and $A2_{t,\%}$

$$A1_{t,\%} = \frac{A1_t - A0_t}{|A0_t|}$$

$$A2_{t,\%} = \sqrt{1 + \frac{A2_t - A0_t}{|A0_t|}} - 1 \qquad (2b)$$

Table 1 summarizes characteristics of "short-term" earning forecast and long-term earning forecasts of the sample across time and across portfolio. Panel A presents time series statistics of the sample; while panel B presents a cross-sectional analysis of the sample. On average, there are approximately 2000 stocks in each month sample. The sample comprises of relatively large size firms, due to the fact that all firms must have earning forecast and long-term forecast data from I/B/E/S. The average asset growth rate over the period is 22.7%. The average book-to-market ratio is 0.61. The average long-term growth of the sample is 15.30%. Size and total asset of firms increase over time. Cross-sectional variations across different portfolios are reported in Panel B. It is documented that high book-to-market firms (value) tend to have lower asset growth rate; while low book-to-market firms (growth) have higher asset growth rate. This is consistent with the findings of many studies, such as Anderson and Garcia-Feijoo (2006), Cooper, Gulen and Schill (2008). Highest asset growth firms are not the largest firms in the sample, with an average of capitalization of 1865.75 MM$, but are larger the lowest growth rate firms, which have an average capitalization of 1520.37 MM$. As for forecast earning characteristics, consistent with Z. Da M.C. Warachka (2009), growth stocks are forecasted to have higher long-term earning growth than value stocks; similarly, high growth stocks also have higher long-term earning growth than low growth stocks.

Table 1. Firm and Forecasts Characteristics.

Table I – Panel A reports time-series summary statistic (annually), and panel B reports cross-sectional summary statistics (across portfolios) of accounting ratios and forecast characteristics of our sample. BM represents book-to-market ratio. Asset growth rate is calculated following equation (2a). Size and total asset of firms are reported in millions of dollars. $A1_{t,\%}$ and $A2_{t,\%}$ are annualized percentage growth rate defined in equation (2b), respectively, using an actual earning of previous fiscal periods ($A0_t$), a one-year ($A1_t$) and a two-year (A2t) consensus earnings-per-share. LTG_t denotes long-term growth forecast for the next three to five years.

Panel A. Average characteristics by year

Year	No. of stock	BM	Asset Growth	Size (MM$)	Asset (MM$)	A1t,%	A2t,%	LTG
1984	1331	0.72	18.3%	902.56	2813.12	21.0%	20.3%	14.8%
1985	1546	0.74	17.7%	1042.26	3026.37	9.2%	14.1%	14.5%
1986	1651	0.70	18.7%	1295.74	3334.02	12.7%	16.9%	14.1%
1987	1724	0.64	20.8%	1599.29	3710.70	21.1%	22.1%	13.7%
1988	1731	0.69	21.0%	1618.07	3912.62	27.2%	21.4%	13.8%
1989	1802	0.70	19.5%	1546.34	4253.13	14.3%	14.9%	13.7%
1990	1896	0.65	18.8%	1647.71	4581.07	9.2%	14.1%	13.7%
1991	1857	0.70	16.7%	1707.50	4538.27	7.8%	14.8%	13.8%
1992	1902	0.69	14.3%	1768.73	4558.93	17.3%	20.0%	13.8%
1993	2077	0.59	14.1%	1899.24	4767.70	19.7%	20.6%	14.1%
1994	2312	0.54	18.5%	1943.53	4945.75	17.9%	19.5%	14.7%
1995	2554	0.56	21.9%	2029.90	4935.04	18.2%	19.0%	15.2%
1996	2805	0.56	24.3%	2255.02	4927.23	14.2%	16.8%	15.7%
1997	3034	0.53	28.7%	2647.89	5165.77	15.2%	18.1%	16.6%
1998	3226	0.49	33.3%	3074.16	5409.49	9.8%	16.3%	17.5%
1999	3210	0.52	34.2%	3178.10	5896.59	10.5%	17.6%	17.4%
2000	2807	0.58	32.3%	3493.48	7414.38	16.6%	19.7%	17.8%
2001	2555	0.60	41.2%	4120.48	8780.88	0.6%	11.5%	18.2%
2002	2577	0.57	32.4%	4074.74	8974.02	11.5%	19.9%	17.7%
2003	2656	0.60	16.7%	4040.51	9652.92	15.0%	18.1%	15.7%
2004	2649	0.57	16.0%	4730.50	10834.01	22.3%	20.2%	15.2%
2005	2616	0.48	19.8%	5381.11	12366.35	15.8%	16.7%	15.0%
Mean	2296	0.61	22.7%	2545.31	5854.47	14.9%	17.8%	15.3%

Panel B. Average characteristics by portfolio

	BM	Asset growth	Size (MM$)	Asset (MM$)	A1t,%	A2t,%	LTG
Value	1.38	13.57%	983.47	6414.88	25.88%	28.40%	13.18%
2	0.95	17.93%	1308.73	6812.2	17.24%	20.50%	13.15%
3	0.79	18.93%	1574.38	6895.85	12.72%	15.74%	12.85%
4	0.68	19.08%	1745.24	6284.83	11.20%	14.67%	12.83%
5	0.59	18.72%	2072.48	6647.76	13.37%	15.70%	13.59%
6	0.51	24.37%	2477.78	6957.42	13.22%	15.93%	14.76%
7	0.43	24.54%	2913.31	7061.94	14.73%	17.48%	15.99%
8	0.35	26.84%	3359.75	5315.14	14.30%	17.47%	17.30%
9	0.28	30.29%	4562.06	6014.21	16.12%	19.09%	18.96%
Growth	0.19	38.63%	5975.29	4120.75	19.38%	21.90%	21.76%
Low-Growth	0.71	-17.97%	1520.37	3095.10	92.48%	63.63%	16.50%
2	0.70	-3.10%	2624.65	5267.03	22.62%	23.29%	13.48%
3	0.67	1.52%	3486.72	7512.53	14.97%	16.35%	12.53%
4	0.64	4.92%	3238.76	7033.42	12.32%	14.53%	12.72%
5	0.61	8.36%	3557.53	7987.67	12.01%	14.51%	13.51%
6	0.58	12.25%	3169.44	7772.70	11.98%	14.79%	14.45%
7	0.54	17.31%	3281.40	8667.74	11.83%	15.19%	15.61%
8	0.51	24.94%	2623.44	5863.75	11.82%	16.06%	16.94%
9	0.50	40.62%	2044.28	4903.41	12.45%	17.63%	18.30%
High-Growth	0.49	142.48%	1865.75	3573.08	15.63%	23.22%	21.67%

3.2. Model Development

3.2.1 Expected earnings:

Z.Da and M.C.Warachka(2009), Frankel and Lee (1998) and Pastor, Sinha and Swaminathan (2007) infer the growing of expected earning from analyst forecasts based on a three-stage growth model. For the first two years, earning forecast (X) is obtained explicitly from I/B/E/S

First stage: from year t+1 to year t+5 (j=0,1,2,3,4)

$$\begin{aligned} X_{t,t+1} &= A1_t \\ X_{t,t+2} &= A2_t \\ X_{t,t+3} &= A2_t(1+LTG_t) \\ X_{t,t+4} &= X_{t,t+3}(1+LTG_t) \\ X_{t,t+5} &= X_{t,t+4}(1+LTG_t) \end{aligned} \qquad (3)$$

Second stage: from year t+6 to year t+10 (j=5,6,7,8,9)

$$X_{t,t+j+1} = X_{t,t+j}[1+LTG_t + \frac{j-4}{5}(g_t - LTG_t)$$

Third stage ($j \geq 10$): expected earnings growth converges to g_t

($X_{t,t+j}$ denotes the expectation of earning about time t+j, produced at time t. The steady-state growth rate g_t is computed as the cross-sectional average of LTG_t)

3.2.2 Expected Book value

Cashflow and earnings are related to one another through the clean-surplus accounting identity (Earnings that are not paid to shareholders as dividends increase book equity).

$$B_{t+1} = B_t + X_{t+1} - D_{t+1} \qquad (4)$$

Cashflow payout is assumed to be equal to a fixed portion φ of the ending-period value. Following Z.Da and M.C.Warachka(2009), I set φ equal to 5%. The evolution of book value can be computed as

$$B_{t,t+j+1} = (B_{t,t+j} + X_{t,t+j+1})(1-\varphi)$$

3.2.3 Using expected earning and book value to calculate cashflow innovation

The objective is to calculate the CF components in equation (1). Following Vuolteenaho (2002), stock return decomposition (1) is rewritten as:

$$r_{t+1} - E_t[r_{t+1}] = (E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j e_{t+j+1} - (E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j r_{t+j+1} \qquad (5)$$

Comparing (1) and (5) gives:

$$N_{CF,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j e_{t+j+1} \qquad (6)$$

where e_{t+j+1} replaces Δd_{t+j+1}; $e_{t+j+1} \equiv \log(1+\frac{X_{t+j+1}}{B_{t+j}})$ is the log return on book equity. Details are given in Appendix A2.

Based on the evolution of book value and earnings in section (b), the expected log return on book equity $e_{t,t+j+1}$ (the expectation of e_{t+j+1} at time t) is computed as

$$e_{t,t+j+1} = \begin{cases} \log(1+\frac{X_{t,t+j+1}}{B_{t,t+j}}), 0 \le j \le 9 \\ \log(1+\frac{g_t}{1-\varphi}), j \ge 10 \end{cases} \qquad (7)$$

$$E_t\sum_{j=0}^{\infty}\rho^j e_{t+j+1} = \sum_{j=0}^{\infty}\rho^j e_{t,t+j+1} = \sum_{j=0}^{9}\rho^j \log(1+\frac{X_{t,t+j+1}}{B_{t,t+j}}) + \frac{\rho^{10}}{1-\rho}\log(1+\frac{g_t}{1-\varphi}) \qquad (8)$$

As earning forecasts are updated over monthly horizon δ. Cashflow innovation over monthly horizon δ is computed as:

$$N_{CF,t+\delta} = \sum_{j=0}^{\infty}\rho^j e_{t+\delta,t+j+1} - \sum_{j=0}^{\infty}\rho^j e_{t,t+j+1} \qquad (9)$$

Cashflow innovation over monthly horizon δ is now computable by plugging (8) into (9)[2]

3.2.4 Aggregate variables

Empirically, in order to reduce the noise associated with individual stocks, cashflow innovation in equation (9) are estimated from aggregate expected earning and aggregate expected book value at portfolio and market level[3].

Specifically, expected earnings (accounted for the number of their outstanding shares) and book value is aggregated across firms at portfolio-level and market-level. The portfolio's LTG_t is computed as the simple average of these long-term forecasts within a portfolio, whereas market's level LTG_t is the market-level average.

Portfolio-level	Market-level
$A1_t^i = \sum_{k=1}^{m} A1_t^k N_t^k$	$A1_t^M = \sum_{k=1}^{M} A1_t^k N_t^k$
$A2_t^i = \sum_{k=1}^{m} A2_t^k N_t^k$	$A2_t^M = \sum_{k=1}^{M} A2_t^k N_t^k$
$B_{t,t+j}^i = \sum_{k=1}^{m} B_{t,t+j}^k$	$B_{t,t+j}^M = \sum_{k=1}^{M} B_{t,t+j}^k$
$ltg_t^i = Mean(\sum_{k=1}^{m} ltg_t^k)$	$ltg_t^M = Mean(\sum_{k=1}^{M} ltg_t^k)$

M denotes the number of stock in the market, m denotes the number of stocks in a portfolio, i and M superscripts denote the i[th] portfolio and the market, respectively. N_t^k denotes the number of shares outstanding at time t for firm k.

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[2] Firm-specific superscripts are suppressed for notational simplicity

[3] Zhi D. and Warachka M. (2009) argues that the resulting portfolio-level and market-level cashflow corresponds to the trading strategy that invests one dollar in each stock within a portfolio.

3.2.5 Earnings beta

Following Z.Da and M.C.Warachka (2009), I calculate cashflow innovation of three growth stage. Earnings betas (β_{CF}^{i}) are estimated from the regression of the three-growth-state cashflow innovation on market level cashflow innovation.

$$N_{CF,t+\delta}^{i} = \alpha_{CF}^{i} + \beta_{CF}^{i} N_{CF,t+\delta}^{M} + \varepsilon_{t+\delta}^{i} \qquad (10)$$

Or else, the composite earnings betas (β_{CF}^{i}) equal the sum of $\beta_{CF}^{i,1} + \beta_{CF}^{i,2} + \beta_{CF}^{i,3}$

Stage1: $$N_{CF,t+\delta}^{i,1} = \sum_{j=0}^{4} \rho^{j} e_{t+\delta,t+j+1} - \sum_{j=0}^{4} \rho^{j} e_{t,t+j+1}$$

Stage2: $$N_{CF,t+\delta}^{i,2} = \sum_{j=5}^{9} \rho^{j} e_{t+\delta,t+j+1} - \sum_{j=5}^{9} \rho^{j} e_{t,t+j+1}$$

Stage3: $$N_{CF,t+\delta}^{i,3} = \sum_{j=10}^{\infty} \rho^{j} e_{t+\delta,t+j+1} - \sum_{j=10}^{\infty} \rho^{j} e_{t,t+j+1}$$

$$\beta_{CF}^{i,1} = \mathrm{cov}(N_{CF,t+\delta}^{i,1}, N_{CF,t+\delta}^{M}) \big/ \mathrm{var}(N_{CF,t+\delta}^{M})$$
$$\beta_{CF}^{i,2} = \mathrm{cov}(N_{CF,t+\delta}^{i,2}, N_{CF,t+\delta}^{M}) \big/ \mathrm{var}(N_{CF,t+\delta}^{M})$$
$$\beta_{CF}^{i,3} = \mathrm{cov}(N_{CF,t+\delta}^{i,3}, N_{CF,t+\delta}^{M}) \big/ \mathrm{var}(N_{CF,t+\delta}^{M})$$

$$\beta_{CF}^{i} = \beta_{CF}^{i,1} + \beta_{CF}^{i,2} + \beta_{CF}^{i,3}$$

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Chapter 4. Empirical Findings

4.1. Results

4.1.1 Earnings betas across portfolios

Table 2 reports the earnings betas across book-to-market and asset growth portfolios. Equal-weighted monthly portfolio returns decrease monotonically along descending sorted book-to-market portfolios and ascending sorted asset growth portfolios. In particular, the highest book-to-market portfolio earns monthly average return of 1.58%, and the lowest book-to-market portfolio earns returns of 1.07%. The return spread between value portfolio and growth portfolio is 0.51% per month (t-statistic = 2.36). The lowest asset growth portfolio earns average returns of 1.61% and highest asset growth portfolio earns monthly average returns of 0.62%. The return spread between lowest asset growth and highest asset growth portfolio is 0.99% per month (t-statistic =4.73). The returns variations among extreme deciles are highly significant.

To conduct the time series regression of portfolio-level cashflow on market-level cashflow, tests for stationary of the monthly cashflow innovation N_{CF}^{i} using

Augmented Dick-Fuller (ADF) with one-lag and a constant are included. Results are also reported in Table 2. Significant negative t-value of the ADF tests in all 20 portfolios compared to critical value of -3.99 at 1% confidence level strongly rejects the hypothesis that portfolio-level cashflow innovation has a unit-root, and therefore, the series is stationary.

Estimated earnings betas are also reported in Table 2. Durbin-Watson statistic is included to check for the presence of autocorrelation in the regression analysis. Accordingly, Durbin-Watson statistic d between 1.5 and 2.5 of all 20 portfolios but one indicates independence of observations (reject the presence of autocorrelation). Following Z.Da and M.C. Warachka (2009), I compute Newey-West t-statistic with 12 lags to adjust for any possible autocorrelation in the error terms. Highly significant t-value confirms the explanatory power of earnings betas. Consistent with the findings in the model paper, value stocks have significantly higher earnings beta β_{CF}^{i} than growth stock, β_{CF}^{i} of 1.28 versus 0.64, with a t-value of 3.20 . Furthermore, low asset growth stock have significantly higher beta than high asset growth stock, β_{CF}^{i} of 1.14 versus 0.68, with a t-value of 2.89. Across book-to-market portfolios, the higher the bm ratio of the portfolios, the higher the earnings betas. On the contrary, the lower the asset growth portfolios, the higher the earnings betas. Value stocks and lower asset growth have higher cashflow risks; while growth stock and higher asset growth have lower cashflow risks.

Three-stage growth earnings betas ($\beta_{CF}^{i,1}, \beta_{CF}^{i,2}, \beta_{CF}^{i,3}$) are also reported. $\beta_{CF}^{i,1}$ refers to the first five-year stage, $\beta_{CF}^{i,2}$ corresponds to the second five-year stage and $\beta_{CF}^{i,3}$ equals a constant of 0.61 (As a firm's expected accounting return converges to an economy-wide steady-state growth rate g_t in the third stage, $\beta_{CF}^{i,3}$ is a constant, which does not capture cross-sectional variation of returns). $\beta_{CF}^{i,3}$ and $\beta_{CF}^{i,2}$ parallel with the pattern of composite earnings beta β_{CF}^{i} .

In summary, consistent with Z.Da and M.C.Warachka (2009), I find that earnings betas do explain value premium. Cashflow risk, captured by earnings beta, provides explanation for value premium. Furthermore, the lowest asset growth portfolio has a significant higher earnings beta than the highest asset growth portfolio, there is sufficient evidence to conclude that cashflow risk, captured by earnings beta, also explains asset growth anomaly.

Table 2. Earnings betas

At the end of June each year t over 1984 to 2005, stocks are allocated into deciles based on book-to-market ratios and asset growth rates. Monthly equal-weighted returns are calculated for each portfolio. Portfolio-level cashflow innovation N_{CF}^{i} is regressed on market-level cashflow innovation N_{CF}^{M} following Equation (10) to estimate composite earnings betas β_{CF}^{i}. $\beta_{CF}^{i,1}$ refers to earnings betas in the first five-year stage, $\beta_{CF}^{i,2}$ refers to earnings betas in the second five-year stage. Newey-West formula with 12 lags is used to compute t-statistic. ADF test is also included to test for stationary of portfolio-level cashflow innovation series, with a critical value of -3.99 at 1% confidence level. Durbin-Watson d is calculated to account for autocorrelation. The range between 1.5 and 2.5 is used to estimate Durbin-Watson statistics.

Book-to-Market Portfolio

	Value	2	3	4	5	6	7	8	9	Growth	(1-10)
Monthly return	1.58%	1.53%	1.47%	1.43%	1.32%	1.38%	1.20%	1.28%	1.18%	1.07%	0.51%
ADF test t-value	*-18.08*	*-20.10*	*-17.57*	*-18.00*	*-17.47*	*-17.98*	*-17.69*	*-18.46*	*-15.90*	*-15.10*	*(2.36)*
$\beta_{CF}^{i,1}$	0.41	0.32	0.23	0.22	0.23	0.11	0.12	0.11	0.02	-0.004	
$\beta_{CF}^{i,2}$	0.27	0.22	0.17	0.18	0.18	0.13	0.14	0.15	0.07	0.031	
Earnings betas (β_{CF}^{i})	**1.28**	**1.15**	**1.01**	**1.01**	**1.02**	**0.85**	**0.87**	**0.87**	**0.70**	**0.64**	**0.64**
Newey West t-value	*(16.78)*	*(7.78)*	*(15.79)*	*(13.61)*	*(10.93)*	*(12.08)*	*(10.43)*	*(12.85)*	*(9.86)*	*(4.98)*	***(3.20)***
Durbin-Watson d	*1.954*	2.496	*1.967*	*2.143*	*1.976*	*2.203*	*2.343*	*2.328*	*1.862*	*1.952*	

Asset-Growth Portfolio

	Low	2	3	4	5	6	7	8	9	High	(1-10)
Monthly return	1.61%	1.64%	1.55%	1.42%	1.43%	1.50%	1.36%	1.27%	1.04%	0.62%	0.99%
ADF test t-value	-17.06	*-22.42*	*-17.94*	*-17.43*	*-17.95*	*-17.43*	*-16.47*	*-17.58*	*-16.75*	*-16.04*	*(4.73)*
$\beta_{CF}^{i,1}$	0.26	0.35	0.23	0.18	0.22	0.18	0.20	0.13	0.15	-0.009	
$\beta_{CF}^{i,2}$	0.27	0.29	0.19	0.16	0.17	0.16	0.15	0.12	0.13	0.078	
Earnings betas (β_{CF}^{i})	**1.14**	**1.25**	**1.03**	**0.95**	**1.00**	**0.94**	**0.96**	**0.86**	**0.89**	**0.68**	**0.46**
Newey West t-value	*(11.51)*	*(5.33)*	*(8.14)*	*(11.68)*	*(12.52)*	*(11.59)*	*(10.03)*	*(10.04)*	*(10.53)*	*(4.05)*	***(2.89)***
Durbin-Watson d	*2.047*	2.713	*2.152*	*2.096*	*2.259*	*2.148*	*1.970*	*2.064*	*2.027*	*1.995*	

4.1.2 Cross-sectional regression

In this section, I perform Fama and Macbeth (1973) cross-sectional regressions. The regression pulls over β_{CF}^{i} of 20 portfolios to act as independent variables. The dependent variable is excess return of realized return of a particular portfolio $r_{t+\delta}^{i}$ over the risk free rate rf_t by the same monthly horizon

$$r_{t+\delta}^{i} - rf_t = \lambda_0 + \lambda_1 \beta_{CF}^{i} + \varepsilon_{t+\delta}^{i} \qquad (11)$$

Firstly, I chose to conduct the rolling Fama-Macbeth cross-sectional regression. The idea is to estimate the cross-sectional regression in equation (11) for each month in the sample period and compute the sample mean of the estimated slope coefficients.

For each month, 20 monthly excess returns $r_{t+\delta}^{i} - rf_t$ are regressed onto to a constant and estimated betas. In this approach, the betas to be used in each monthly cross-sectional regression are estimated using data from the period preceding each month and are referred to as "rolling" betas. Averaging the coefficient gets overall estimates:

$$\hat{\lambda}_0 = E(\lambda_{0,t})$$

$$\hat{\lambda}_1 = E(\lambda_{1,t})$$

Adjusted R-Squared is the average of the adjusted R-Squared from each month regression. Standard errors are computed following usual expressions. Results are included in Panel A of Table 3.

$$\sigma(\hat{\lambda}_0) = \frac{\sigma(\lambda_{0,t})}{\sqrt{T}}$$

$$\sigma(\hat{\lambda}_1) = \frac{\sigma(\lambda_{1,t})}{\sqrt{T}}$$

Another approach is to run cross-sectional regressions by month for all 20 portfolios. Then, GMM (Generalized Methods of Moments) is applied following Cochrane (2001), suggested by Z.Da and M.C Warachka (2009), to derive standard errors formula that correct for autocorrelation and heroskedacity in OLS regression. Newey West adjustment with 12 lags is used to correct for standard errors. This works because Newey-West adjustments give the same variance as GMM procedure[4]. Panel B of Table 3 describes the result.

Table 3. Fama Macbeth cross-sectional regression

Table 3 reports the results of cross-sectional regression in equation (11) on 20 portfolios, $r^i_{t+\delta} - rf_t = \lambda_0 + \lambda_1 \beta^i_{CF} + \varepsilon^i_{t+\delta}$. Panel A presents the mean of the results of running equation (11) over each month of the sample period, β^i_{CF} in each monthly cross-sectional regression are estimated using data from the previous preceding each month. Panel B presents results using GMM procedure to correct for standard error. The reported t-values are computed using Newey West adjustment with 12 lags.

Panel A. Basic two-staged Fama Macbeth approach

	EstType	Estimate	StdErr	tValue	Probt
Intercept λ_0	Rolling Cross-sectional Regression	-0.00149	0.0788	-0.30	0.7682
λ_1		0.01148	0.0467	3.85	0.0002
ADJ-R^2		18.5%	0.218	13.23	<.0001

Panel B. Fama Macbeth regression with GMM standard errors.

	EstType	Estimate	StdErr	tValue	Probt
Intercept λ_0	GMM Esti	-0.00235	0.0033	-0.72	0.4703
λ_1		0.01239	0.0035	3.51	0.0005
ADJ-R^2		18.9%	0.0142	13.31	<.0001

[4] Cochrane (2001), Asset Pricing book, page 240 - 243

Both approaches prove that slope coefficient λ_1 is positive and significantly different from 0, with t-value of conventional two-staged FM regression of 3.85 and t-value computed using GMM standard errors of 3.51. There is sufficient evidence to conclude that higher earnings betas imply higher returns. Adjusted R-squared of 18.9% indicates that nearly one-fifth of the cross-sectional variation in the growth – value premium is attributed to cashflow risks measured by analyst forecasts. The adjusted R-squared, which is lower than the adjusted R-squared reported by Z.Da and M.C Warachka (2009) (of 55.1%), is due to the fact that equation (11) are only regressed on 20 portfolios of asset growth and book-to-market ratio, which referred only to growth – value effect. However, there is still sufficient empirical evidence to conclude that cashflow risk measured using analyst forecast revision partially explain the cross-sectional variation in the value premium and asset growth anomaly. Although the unexplained returns variation may be attributable to other factors including mispricing as suggested in many other studies, systematic risks play an important explanatory role in growth – value premium.

4.2. Robustness check: Alternative measures of growth

I examine if growth anomaly effect remains strong when we use alternative measure of growth to form portfolios. To proxy for growth, we use Investment-to-asset (I/A) ratio based on past growth proposed by Lyandres, Sun and Zhang (2008) and expected long-term growth (LTG) based on future forecast of earnings proposed by La Porta (1996)

Investment-to-Assets (I/A) portfolios are formed at the end of June each year t following Lyandres, Sun and Zhang (2008). I/A is the annual change in gross property, plant and equipment (COMPUSTAT Data item 7) plus the annual change in inventories (COMPUSTAT Data item 3) divided by lagged total assets (COMPUSTAT Data item 6). Accordingly, property, plant and equipment represent long-lived assets for the operations over many years such as buildings, machinery, furniture, and other equipment. Inventories represent short-lived assets within a normal operating cycle such as merchandise, raw materials, supplies and work in progress.

$$I / A = \frac{\Delta PPEGT_t + \Delta INVT_t}{AT_{t-1}}$$

Expected earnings growth rates portfolios are also formed at the end of June of each year t on the basis of ranked analysts' expected growth in earnings (LTG) in December of year t-1, released by I/B/E/S, following La Porta (1993).

Results are reported in Table 4. The conclusion is robust that low growth portfolios have higher earnings betas, while high growth portfolios have lower earnings betas. Although the results are not as consistent across portfolios as in the case of growth measured by asset expansion, the difference between lowest growth portfolios and highest growth portfolios are statistically significant. Lowest long-term growth portfolio has an earnings beta of 1.14; while highest forecast long-term growth portfolio has an earnings beta of 0.70. Similarly, lowest I/A portfolio has a significant higher earnings beta of 1.30 in comparison to 0.76 for the highest I/A portfolio.

It is confirmed that earnings betas do explain growth anomaly. Earnings betas have a more consistent predictive power for growth measured by asset growth than growth measured by future forecast long-term growth in earnings or by Investment-to-Asset ratios

Table 4. Alternative measure of Growth

This table gives the earnings betas estimated from equation (10) $N^i_{CF,t+\delta} = \alpha^i_{CF} + \beta^i_{CF} N^M_{CF,t+\delta} + \varepsilon^i_{t+\delta}$. At the end of June each year t over 1984 -2005, stocks are allocated into deciles based on expected long-term growth (LTG) and Investment-to-asset (I/A). LTG is taken from I/B/E/S. I/A is measured as change in property, plant and equipment plus change in inventories, divided by lagged total assets. LTG and I/A refers to alternative measures of growth. Monthly equal-weighted returns are calculated for each portfolio. Newey-West formula with 12 lags is used to compute t-statistic.

Panel A reports earnings betas of expected long-term growth deciles. Panel B reports earnings betas of Investment-to-Asset deciles.

Panel A: Expected Long-term Growth (LTG)

	Low	2	3	4	5	6	7	8	9	High	(1-10)
Monthly return	1.37%	1.40%	1.35%	1.36%	1.33%	1.40%	1.21%	1.35%	1.16%	1.19%	0.18%
Earnings beta	**1.14**	**0.82**	**0.98**	**0.95**	**1.08**	**0.93**	**0.93**	**0.86**	**0.87**	**0.70**	**0.44**
Newey West t-value	*(5.18)*	*(11.01)*	*(5.18)*	*(7.21)*	*(7.58)*	*(9.55)*	*(16.28)*	*(10.48)*	*(12.09)*	*(3.00)*	

Panel B: Investment-to-Asset (I/A)

	Low I/A	2	3	4	5	6	7	8	9	High I/A	(1-10)
Monthly return	1.51%	1.53%	1.56%	1.45%	1.49%	1.49%	1.26%	1.29%	1.16%	0.70%	0.81%
Earnings beta	**1.30**	**0.93**	**1.10**	**0.82**	**1.07**	**0.94**	**0.61**	**1.01**	**0.91**	**0.76**	**0.54**
Newey West t-value	*(8.05)*	*(4.68)*	*(7.19)*	*(6.87)*	*(10.49)*	*(7.47)*	*(2.53)*	*(10.14)*	*(7.16)*	*(4.28)*	

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Chapter 5. CONCLUSION

Expected returns are determined by systematic risks. Using earnings betas developed from analyst forecast revisions to measure systematic cashflow risks, it is concluded that systematic cashflow risk provides explanation for value – growth anomaly. Value stocks (high book-to-market ratio) have higher earnings betas; while growth stocks (low book-to-market ratio) have lower earnings betas. Earnings betas are also higher for low asset growth portfolios and lower for high asset growth portfolios. Positive estimated coefficient of betas on realized returns confirms that higher earnings betas imply higher returns. Specifically, cashflow risk measured by earnings betas carries a significant positive risk premium of 1.24%.

Many studies tie risk factors to expected returns, whilst others argue that stock return characteristics reflect mispricing. The explanatory power of earnings betas validates that the cross-section of returns can be attributed to systematic risk. Systematic cashflow risks do explain growth anomaly.

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APPENDIX A

A1. The Campbell-Shiller (1988a) - Campbell (1991) Return Decomposition Model:

The realized log stock return is defined as:

$$r_t = \log[(P_t + D_t)/(P_{t-1})] = \log(P_t + D_t) - \log(P_t)$$

$$= \log(1 + \frac{P_t}{D_t}) + \log(\frac{D_t}{D_{t-1}}) + \log(\frac{D_{t-1}}{P_{t-1}}) \qquad \text{(A1)}$$

r_t = log(cum dividend) stock return at time t

P_t = real price of stock at time t; p_t = log stock price at time t

D_t = real dividend paid at time t; d_t = log dividend at time t

Substituting the log-dividend price ratio $\delta_t = \log(D_t) - \log(P_t)$ and log dividend growth $\Delta d_t = \log(D_t) - \log(D_{t-1})$ into (A1) yields:

$$r_t = \log(\exp(-\delta_t) + 1) + \Delta d_t + \delta_{t-1}$$

r_t can be approximated by first-order of Taylor expansion around $\hat{\delta}$ as:

$$r_t \approx k + \delta_t - \rho\delta_{t+1} + \Delta d_t \qquad \text{(A2)}$$

where k is a constant, ρ <1 is a constant error approximation term.

$$k \equiv \log(\exp(-\hat{\delta}) + 1) + \rho\hat{\delta}; \rho \equiv \frac{\exp(-\hat{\delta})}{\exp(-\hat{\delta}) + 1}$$

(A2) can be thought of as a difference equation relating δ_t to δ_{t+1}, Δd_t and r_t. We can solve this equation forward, and if we impose the terminal condition that $\lim_{i\to\infty} \rho^i \delta_{t+1} = 0$, we obtain

$$\delta_t \approx \sum_{j=0}^{\infty} \rho^i (r_{t+j} - \Delta d_{t+j}) - \frac{k}{1-\rho} \qquad \text{(A3)}$$

Using ex ante version (A3) to substitute δ_t and δ_{t+1} out of (A2), Campbell (1991) obtain:

$$r_{t+1} - E_t r_{t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta d_{t+j+1} - (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j r_{t+j+1}$$

$$= N_{CF,t+1} - N_{DR,t+1}$$

A2. The Vuolteenaho (2002) Model:

Denote p, b, d the log transformation of price P, book value P and dividend D, respectively. Following Vuolteenaho (2002) and (4), log stock return r_{t+1} and log accounting return on equity e_{t+1} is defined as:

$$r_{t+1} \equiv \log[(P_{t+1} + D_{t+1}) / P_t] \qquad \text{(A4)}$$
$$e_{t+1} \equiv \log[(B_t + X_{t+1}) / B_t] \equiv \log[(B_{t+1} + D_{t+1}) / B_t] \qquad \text{(A5)}$$

Assuming that d_{t+1} - p_{t+1} and d_{t+1} - b_{t+1} follows stationary processes, by construction, the unconditional mean of d_{t+1} - p_{t+1}, denoted $\overline{\text{d - p}}$ is equal to the average log dividend-price ratio. Loglinerize (A4) and (A5) around the expansion point $\overline{\text{d - p}}$ gives:

$$r_{t+1} \approx k + \rho p_{t+1} + (1-\rho) d_{t+1} - p_t$$
$$e_{t+1} \approx k + \rho b_{t+1} + (1-\rho) d_{t+1} - b_t$$

with $\rho = \left[1 + \exp(\overline{d-p})\right]^{-1}$ and Ignoring the approximation errors, we subtract the log-linearization for e_{t+1} from the log-linearization for r_{t+1} to get a difference equation for the log market-to-book ratio:

$$p_t - b_t = \rho(p_{t+1} - b_{t+1}) - r_{t+1} + e_{t+1} \qquad \text{(A6)}$$

Solving equation (A6) forward and imposing the condition $\lim_{j\to\infty} \rho^j (p_{t+j} - b_{t+j}) = 0$, we get:

$$\sum_{j=0}^{\infty} \rho^j \left[e_{t+1+j} - r_{t+1+j}\right] = p_t - b_t = \Delta \hat{E}_t \sum_{j=0}^{\infty} \rho^j \left[e_{t+1+j} - r_{t+1+j}\right] \qquad \text{(A7)}$$

The second equality follows from taking expectations with respect to operator $\hat{E}$ and noting $\hat{E}_t(p_t - b_t) = p_t - b_t$. Substituting the RHS of (A7) in (A6) leads to:

$$r_{t+1} - E_t[r_{t+1}] = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j e_{t+j+1} - (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j r_{t+j+1}$$