Behavioral-related firm characteristics, risks and determinants of stock returns

Wikrom Prombutr and Chanwit Phengpis
Department of Finance, College of Business, California State University, Long Beach, Long Beach, California, USA

Received 29 March 2017
Revised 15 October 2017
22 December 2017
12 May 2018
Accepted 4 July 2018

Abstract

Purpose – This paper aims to investigate a relatively new anomaly of investment growth and revisits well-known anomalies of size and value. It aims to answer two main research questions. First, can covariance risks (i.e. factor loadings) be excluded from being determining variables that drive return premiums and explain stock returns? Second, from a behavioral finance standpoint, the authors examine whether using firm characteristics is a more practical and accessible approach and also meets the necessary and sufficient conditions to analyze stock returns.

Design/methodology/approach – The authors create the investment-growth-based factor (LMH) which is defined as the return difference between low and high investment growth portfolios. The authors then incorporate the LMH factor along with other characteristic-based factors and their loadings into characteristic-balanced portfolio and three-factor model tests.

Findings – The authors find that covariance risks on investment growth, size and value are not necessary as determining variables. Instead, they find that behavioral-related firm characteristics of investment growth, size and value are necessary and sufficient as determinants of return premiums and stock returns.

Practical implications – The results have practical and useful implications for investors in their stock portfolio analysis and selection because firm characteristics are relatively more available than covariance risks that need estimation and typically contain measurement errors.

Originality/value – The paper has practical value to investors in their stock portfolio analysis and selection. Methodologically, in contrast to prior studies that do not directly use the investment growth to control for portfolio characteristics, the use of the newly created LMH factor and its loadings allows us to directly and properly test if the investment growth anomaly is related to the investment growth characteristic that is hypothesized to drive return premiums and determine stock returns from behavioral finance perspectives.

Keywords Anomaly, Behavioural finance, Asset pricing, Investment growth

Paper type Research paper

1. Introduction

Previous studies in asset pricing have done considerable research on covariance risks that are priced in financial markets, especially in stock returns. If risks are priced, they drive return premiums and hence can explain stock returns. However, Fama and French (1992) show that the market factor loading of beta is not priced. Fama and French (1995) show that the value premium is associated with the firm's distress risk. Daniel and Titman (1997, 1998) argue that size and value factor loadings (i.e. covariance risks related to size and value) in the Fama and French (1993) three-factor model are not priced. Dichev (1998) examines the relationship between bankruptcy risk and systematic risk and finds that bankruptcy risk is not priced. Griffin and Lemmon (2002) reach a similar conclusion for the value effect. Vassalou and Xing (2004) use the Merton's (1974) option pricing model to compute the

Review of Accounting and Finance
Vol. 18 No. 1, 2019
pp. 95-112

1475-7702
DOI 10.1108/RAF-03-2017-0060

default probability risk and find that it subsumes the size effect while theoretically it is supposed to subsume the value effect.

The list of the risk-based asset pricing papers can go endlessly. We do not argue with these efforts. Nonetheless, rather than trying to estimate factor loadings and thus covariance risks, we are asking if there are any other practical approaches that can explain return premia and stock returns. Daniel and Titman (1997, 1998; hereafter DT) propose an alternative of using firm characteristics from behavioral finance perspectives to explain stock returns in asset pricing. We argue that even if behavioral-related firm characteristics might not be the *true* explanatory variables, the use of characteristics requires less effort and the data are more readily available and accessible, especially for average investors and practitioners. Daniel and Titman (1997, 1998) show that firm characteristics of size and book-to-market are necessary and sufficient in explaining stock returns. Relatively more sophisticated investors can enhance their investment returns by holding a portfolio that has a zero loading on each of the factors, but still has a long position in small stocks and value stocks and a short position in big stocks and growth stocks. Investors with mutual fund holdings can also evaluate the selection ability of fund managers by calculating the benchmark-adjusted returns in which the benchmarks are based on stocks with similar firm characteristics to the stocks in their mutual funds.

Further, it is natural to wonder if the conclusion that firm characteristics drive or explain returns is limited to only the case for size and value anomalies, as there are several new anomalies that have been found[1]. In this paper, we additionally investigate the relatively new anomaly of investment growth and revisit size and value anomalies using the Daniel and Titman (1997, 1998) methodology. Our main research questions are as follows: Can we exclude covariance risks (i.e. factor loadings) from being asset pricing variables? If so, can a more practical and accessible approach of using firm characteristics be necessary and sufficient in inducing return premiums and explaining returns[2]?

We find that the covariance risks for size, value and investment growth are not necessary while firm characteristics are proved to be necessary and sufficient as determinants of return premiums and stock returns from practical standpoints and from behavioral finance perspectives. Methodologically, we construct the *LMH* factor from investment growth (i.e. low growth in capital expenditures minus high growth in capital expenditures). The *LMH* factor is a characteristic-based factor like the *SMB* and *HML* factors. The *LMH* premium is positive and statistically significant, meaning the investment growth characteristic is sufficient as one of the determinants in asset pricing in explaining stock returns. In other words, the investment growth characteristic is "sufficient" in explaining stock returns without having to estimate the related factor loading or covariance risk as an explanatory variable. We revisit the *SMB* and *HML* factors and provide confirmation for Daniel and Titman (1997, 1998) that both size and book-to-market characteristics are sufficient as stock determinants as well. We then construct characteristic-balanced portfolios and find that their average returns are not statistically significant. When behavioral-related firm characteristics are controlled, varying factor loadings cannot induce return premiums, implying that firm characteristics are necessary determinants. In other words, the firm characteristics are "necessary" in explaining stock returns because they are true drivers that generate the investment growth, value or size premiums.

Section 1 provides literature review and hypothesis developments. Section 2I describes data and factor construction. Section 3 discusses how the investment growth, book-to-market ratio, size and their factors are related. Section 4 presents results from the tests of relationships between factor loadings and stock returns. Section 5 investigates whether factor loadings are related to stock returns when firm characteristics are controlled. Section 6 provides concluding remarks.

2. Literature review and hypothesis developments

Stock market anomalies and whether covariance risks or firm characteristics explain cross section of stock returns have been of considerable interest to researchers. Rational expectation theorists such as Fama and French (1992, 1993, 1995, 1996) and Davis *et al.* (2000) believe that the anomalies that are related to firm characteristics such as size, book-to-market ratio and investment growth are compensation for additional covariance or systematic risks in a multifactor version of the capital asset pricing model. Conversely, behavioral finance proponents such as Daniel and Titman (1997) and Daniel *et al.* (2001) hypothesize that the anomaly is driven by the investors' preference toward the underlying firm characteristic that is irrelevant to risk.

If factor loadings and their underlying characteristics are completely or sufficiently uncorrelated, the inference will be conclusive in that either covariance risks or firm characteristics, not a combination of the two, will stand out as the determinant of stock returns. Empirically, however, such inference can be inconclusive because covariance risks as measured by beta coefficients are normally correlated with the firm characteristics used to create priced factors. Daniel and Titman (1997) resolve the correlation problem by creating characteristic-balanced (CB) portfolios. The CB portfolios are zero-cost portfolios with a long position in high factor loading portfolios and a short position in low factor loading portfolios after controlling for firm characteristics such as size and book-to-market ratio. If the risk argument holds true, the CB portfolios should have significantly positive average returns because the real driver is the covariance risks or factor loadings, not the firm characteristics. In contrast, if the firm-characteristic argument holds true, the CB portfolios should not have significantly positive average returns because the real driver is the firm characteristics that are now controlled. Previous studies however do not provide consistent results of the above tests (Davis *et al.*, 2000; Daniel *et al.*, 2001). Therefore, the issue of the real determinants of the stock returns is still inconclusive.

Given the inconclusive finding by prior studies, we use the firm's growth in capital expenditures (i.e. investment growth) to create a new factor in CB portfolio and three-factor model tests. This newly created investment-growth-based factor is denoted as *LMH* (i.e. low growth in capital expenditures minus high growth in capital expenditures) because low (high) growth in capital expenditures is typically associated with a high (low) return on the firm's stocks based on results in Titman *et al.* (2004), Anderson and Garcia-Feijóo (2006) and Xing (2008). The *LMH* factor has a unique and appealing feature in that its loading has very low correlation with the underlying firm characteristic (i.e. investment growth), thereby mitigating the correlation problem in the covariance-risk versus firm-characteristic test.

With respect to the growth in capital expenditures in particular, recent empirical studies investigate and detect the return premium between low and high investment growth stock portfolios, henceforth the investment growth anomaly. For instance, Anderson and Garcia-Feijóo (2006) and Xing (2008) find a negative relationship between the investment growth and stock returns. Without incorporating direct tests into their analyses, however, these two studies interpret that the investment growth anomaly is a compensation for the additional covariance risk.

Titman *et al.* (2004) use the methodology of Daniel *et al.* (1997) to examine the investment growth anomaly. They conclude that the investment growth anomaly may result from overinvestment in that investors underreact to the management's empire building behavior of increased capital expenditures. Nonetheless, whether the anomaly is risk-based (i.e.

covariance risk driven) or non-risk-based (i.e. characteristic driven) is not directly answered. This is because Titman *et al.* (2004) calculate the characteristic-adjusted return and control for firm characteristics by subtracting the average return on a portfolio that comprises stocks with the same size, the book-to-market ratio or momentum from the raw return. However, to directly and properly test if the anomaly results from the covariance risk, the underlying characteristic (i.e. the firm's investment growth) that is hypothesized to drive the return premium should have been used to control for portfolio characteristics. This issue is resolved by our estimation and direct use of the *LMH* factor and its loading in the CB portfolio and three-factor model tests based on Daniel and Titman (1997) methodology.

3. Data and factor construction

We use stock price, shares outstanding and return data from the monthly master files maintained by the Center for Research on Securities Prices (CRSP) and financial statement data from the Annual Industrial Compustat files. We exclude REITs, ADRs, non-US firms, closed-end funds, primes and scores and HOLDRs from our sample which covers the period from July 1975 to June 2006. To mitigate the selection/survival bias, firms are not included until they have been in COMPUSTAT for two years.

We follow Fama and French (1992) by matching returns for the period between July of year t to June of year $t+1$ to the accounting data of a firm for the fiscal year ending in calendar year $t-1$. This process is done to ensure that accounting information is known before being used to explain returns. For each firm, we define the investment growth (*IG*) as the percentage change in capital expenditures:

$$IG = \frac{CAPEX_{t-1}}{CAPEX_{t-2}} - 1 \tag{1}$$

where *CAPEX* is the firm's capital expenditures (COMPUSTAT item#128).

We obtain the market risk premium and the risk-free rate from Kenneth French's Data Library[3]. We create the Fama and French (1993) risk factors over our data sample using the Fama and French (1993) methodology. Specifically, we create the new *LMH* factor, the investment growth factor, so that we can directly examine the investment growth characteristic and its effects on returns. We create the SMB^* factor as a result of creating the *LMH* factor. The SMB^* factor is the return difference between small size portfolios and big size portfolios controlling for investment growth. In contrast, the original *SMB* factor in the Fama-French three-factor model is the return difference between small size portfolios and big size portfolios controlling for the book-to-market ratio or value effect. Additionally, to be consistent with the fact that we create the *LMH* and SMB^* factors ourselves, we also create the *SMB* and *HML* factors ourselves using the Fama and French (1993) methodology. Specific procedures in computing the *LMH* and SMB^* factors are as follows.

In July of year t from 1975 to 2005, the universe of NYSE, AMEX and NASDAQ stocks is sorted independently into three capital expenditure growth groups based on the breakpoints for the bottom 30 per cent, middle 40 per cent and top 30 per cent of the ranked values of growth in capital expenditures, and into two market capitalization groups based on median size (price times shares outstanding) breakpoints. NYSE breakpoints are used in deriving all breakpoints for the universe of stocks. Monthly value-weighted returns on the 6 intersection portfolios are then calculated from July of year t to June of year $t+1$.

The *LMH* factor is the difference, each month, between the simple average of the returns on the two low-*IG* portfolios and the average of the returns on the two corresponding high-*IG* portfolios.

$$LMH = \frac{(R_{IG1,SZ1} + R_{IG1,SZ2})}{2} - \frac{(R_{IG3,SZ1} + R_{IG3,SZ2})}{2} \quad (2)$$

where the first subscript (*IG*) of the value-weighted portfolio return *R* refers to *IG* groups (i.e. *IG*1 comprising stocks with the lowest *IG*), and the second subscript (*SZ*) refers to market capitalization groups (i.e. *SZ*1 comprising stocks with low market capitalization). Therefore, *LMH* is the return difference between low- and high-*IG* portfolios with about the same size. Similarly, we create SMB^*, which is the return difference between small size portfolios and big size portfolios controlling for the investment growth, as follows:

$$SMB^* = \frac{(R_{IG1,SZ1} + R_{IG2,SZ1} + R_{IG3,SZ1})}{3} - \frac{(R_{IG1,SZ2} + R_{IG2,SZ2} + R_{IG3,SZ2})}{3} \quad (3)$$

4. Investment growth, book-to-market ratio, size and their factors

Table I reports descriptive statistics and correlations for factors, factor loadings and other relevant variables. Panel A of Table I shows the descriptive statistics of the original Fama-French factors (*SMB* and *HML*) and two new factors (SMB^* and *LMH*). The *LMH* premium is significantly different from zero. The mean of the *LMH* premium of 0.302 is lower than the mean of the *HML* premium, but higher than the means of the *SMB* and SMB^* premiums. Therefore, the investment growth effect is significant and appears even stronger than the size effect. Similar to previous findings (Fama and French (1996)), the *SMB* and SMB^* premiums are not significantly different from zero.

Panel B of Table I shows that the correlation between SMB^* and *SMB* is 94.8 per cent (with the *p*-value of 0.000). This considerably high correlation implies that the size premium that controls for investment growth (SMB^*) is almost identical to the size premium that controls for the book-to-market ratio or value effect (*SMB*). Hence, there exists the size premium irrespective of how it is created. The existence of the size premium is found in many prior studies including Hou *et al.* (2015) and Fama and French (2015). Further, the correlation between *LMH* and *HML* is 43.4 per cent (with the *p*-value of 0.000). This correlation is considerably less than 100 per cent and implies that there is some information in *LMH* that is not in *HML*. Also, *LMH* and SMB^* are only −5.1 per cent correlated (with the *p*-value of 0.331), while *HML* and *SMB* are -28.9 per cent correlated (with the *p*-value of 0.000). The considerably low and statistically insignificant correlation between *LMH* and SMB^* implies that they will result in lower correlation than Fama-French *HML* and *SMB* factors.

Panel C of Table I shows that the *LMH* factor loading (γ_{LMH}) has the highest standard deviation among all factor loadings. This relatively high variation makes the *LMH* factor loading appealing in an asset pricing test of how the variation in the factor loading affects the variation in stock returns. The SMB^* factor loading (γ_{SMB^*}) does not have any considerable differences in terms of means and standard deviations from the original *SMB* factor loading (γ_{SMB}).

Panel D of Table I presents pair-wise correlation between characteristics and the corresponding factor loadings. The size characteristic, *SZ*, is −13.2 per cent correlated with either of the size factor loadings, γ_{SMB} or γ_{SMB^*}. The correlation between the investment growth characteristic, *IG*, and the *LMH* factor loading, γ_{LMH}, is only −0.3 per cent and statistically insignificant (with the *p*-value of 0.421). The low correlation between the investment growth characteristic and the *LMH* factor loading is also similar to results in Prombutr *et al.* (2012). In contrast, the correlation between the book-to-market ratio or value

Table I. Summary statistics and correlations for factors, factor loadings and underlying variables: July 1975 to June 2006

	Mean	t-stat	Std. Dev.	Min	Max
Panel A: Descriptive statistics on factors					
SMB	0.225	1.475	2.946	−11.946	15.764
HML	0.427***	2.799	2.940	−11.412	14.554
*SMB**	0.242	1.539	3.034	−10.943	12.903
LMH	0.302***	3.764	1.549	−7.060	7.549

	SMB	*HML*	*SMB**	*LMH*
Panel B: Pair-wise correlation matrix between factors				
SMB	100.0%*** (0.000)			
HML	−28.9%*** (0.000)	100.0%*** (0.000)		
*SMB**	94.8%*** (0.000)	−8.7%* (0.095)	100.0%*** (0.000)	
LMH	−8.5% (0.101)	43.4%*** (0.000)	−5.1% (0.331)	100.0%*** (0.000)

Variable	Mean	Std. Dev.	Min	Max
Panel C: Descriptive statistics on factor loadings and characteristics				
γ_{SMB}	0.938***	1.237	−15.910	61.228
γ_{HML}	0.148***	1.324	−25.131	42.837
γ_{SMB^*}	0.900***	1.208	−14.456	64.591
γ_{LMH}	0.007	2.008	−44.107	51.838
SZ	1230.00***	8710.00	0.04	524000.00
BM	0.961***	1.084	0.000	53.132
IG	1.297***	91.609	−26.629	26173.000

(*continued*)

	γ_{SMB}	γ_{HML}	$\gamma_{SMB}{}^{*}$	γ_{LMH}	*SZ*	*BM*	*IG*
Panel D: Pair-wise correlation matrix between factor loadings and characteristics							
γ_{SMB}	100.0%*** (0.000)						
γ_{HML}	12.4%*** (0.000)	100.0%*** (0.000)					
$\gamma_{SMB}{}^{*}$	95.7%*** (0.000)	4.4%*** (0.000)	100.0%*** (0.000)				
γ_{LMH}	6.4%*** (0.000)	45.7%*** (0.000)	8.8%*** (0.000)	100.0%*** (0.000)			
SZ	−13.2%*** (0.000)	−1.7%*** (0.000)	−13.2%*** (0.000)	−1.0%*** (0.004)	100.0%*** (0.000)		
BM	−1.8%*** (0.000)	11.1%*** (0.000)	−2.1%*** (0.000)	4.0%*** (0.000)	−6.5%*** (0.000)	100.0%*** (0.000)	
IG	0.7%* (0.058)	−0.4% (0.255)	1.0%*** (0.004)	−0.3% (0.421)	−0.2% (0.597)	−0.2% (0.493)	100.0%*** (0.000)

Notes: In this table, *SMB* and *HML* are the Fama-French factors which are calculated from the data and sample period in this study. *SMB** is the difference between the average of returns on the three small-*SZ* portfolios and the average of returns on the three big-*SZ* portfolios, controlling for the *IG* characteristic. *LMH* is the difference between the average of returns on the two low-*IG* portfolios and the average of returns on the two high-*IG* portfolios, controlling for the *SZ* characteristic. All factor loadings (γ_{SMB}, γ_{HML}, $\gamma_{SMB}{}^{*}$, γ_{LMH}) are estimated based on the methodology in Davis, Fama, and French (2000), thereby spanning only from July 1981 to June 2006; *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively

Table I.

characteristic, *BM*, and the *HML* factor loading, γ_{HML}, is much higher at 11.1 per cent and strongly significant (with the *p*-value of 0.000). Therefore, using *LMH* as opposed to *HML* should allow a more definitive test if covariance risks (i.e. factor loadings) or firm characteristics explain the cross-section of stock returns.

5. Effects of characteristics and factor loadings on stock returns

In this section, returns are now brought into the analysis. Table II shows the mean excess returns for 45 triple-sorting portfolios. The triple-sorting process is as follows. All NYSE firms are ranked by their investment growth characteristics (*IG*) at the end of year t-1 and their size characteristics (*SZ*) at the end of June of year t. Based on these rankings, 33.3 and 66.7 per cent breakpoints for *IG* and *SZ* are formed so that all stocks are grouped into three *IG* portfolios and three *SZ* portfolios in July of year t. The firms remain in these portfolios from the beginning of July of year t to the end of June of year $t + 1$. Each firm in these nine portfolios is then further sorted into one of five portfolios according to its pre-formation *LMH, HML, SMB*, SMB* and *MKT* factor loadings. Following Davis *et al.* (2000), the pre-formation factor loadings are estimated with five years (three years minimum) of monthly returns ending in December of year t-1[4]. The value-weighted returns for each of these portfolios are then computed for each month between July 1981 and June 2006. The preceding process is then repeated by replacing the ranking by the firms' *IG* characteristics with the ranking by their book-to-market ratio or value characteristics (*BM*).

Panel A of Table II provides mean excess returns from the *LMH* factor loading portfolios sorted by *IG* and *SZ*, while Panel D provides mean excess returns from the *HML* factor loading portfolios sorted by *BM* and *SZ*. Panel B shows mean excess returns from the SMB^* factor loading portfolios sorted by *IG* and *SZ*, while Panel E shows mean excess returns from the *SMB* factor loading portfolios sorted by *BM* and *SZ*. Further, Panel C shows mean excess returns from the *MKT* factor loading portfolios sorted by *IG* and *SZ*, while Panel F shows mean excess returns from the *MKT* factor loading portfolios sorted by *BM* and *SZ*.

Panel A of Table II reveals no observable relationship or pattern between the *LMH* factor loading and returns. In other words, the variation in *LMH* factor loadings (from low to high) is not associated with the observable pattern of variation in excess returns. The relationship is not observable likely because the variation in *LMH* factor loadings does not pick up the variation in the investment growth characteristics as a result of insignificant correlation between the *LMH* factor loading and *IG*. Further, the *HML* factor loading in Panel D appears to have a weak positive relationship with excess returns. This relationship likely occurs because the variation in *HML* factor loadings picks up some variation in the book-to-market ratio or value characteristics (*BM*) within each relatively broad tercile.

Panels E, C and F provide similar results to those in Panels A and D in that there seems to be no or weak relationship between factor loadings and excess returns. In fact, Panel B shows the SMB^* factor loading tends to have an inverse relationship with excess returns. In sum, the findings in Table II provide preliminary evidence that is inconsistent with the covariance-risk explanation of stock returns because factor loadings do not appear to have a strong positive relationship with excess returns.

6. Results from characteristic-balanced portfolios

In this section, we test zero-cost characteristic-balanced (CB) portfolios against the three-factor model. First, we control for firm characteristics by constructing nine CB portfolios based on *IG-SZ* combinations. Within each of the nine portfolios or combinations, we sort stocks based on the *LMH*, SMB^* or *MKT* factor loading. We then form a CB portfolio that has a long position in the highest tercile factor loading portfolio and a short position in the

Panel A

Portfolio		LMH factor loading portfolios: excess return				
IG	*SZ*	Low	2	3	4	High
3	3	0.538	0.331	0.449	0.515	0.576
3	2	0.449	0.587	0.779	0.511	0.412
3	1	0.406	0.643	0.48	0.542	0.274
2	3	0.809	0.728	0.565	0.715	0.738
2	2	1.119	0.736	0.912	0.84	0.777
2	1	0.83	0.975	0.771	0.89	0.482
1	3	1.03	0.971	0.73	0.603	0.849
1	2	0.812	0.906	0.896	0.869	0.791
1	1	0.799	0.933	0.916	0.827	0.711

Panel B

Portfolio		SMB* factor loading portfolios: excess return				
IG	*SZ*	Low	2	3	4	High
3	3	0.606	0.464	0.645	0.403	0.362
3	2	0.696	0.811	0.726	0.266	0.207
3	1	0.638	0.515	0.617	0.592	0.055
2	3	0.706	0.783	0.583	0.607	0.846
2	2	0.877	1.014	0.913	0.819	0.734
2	1	0.988	0.873	0.892	0.828	0.327
1	3	0.942	0.803	0.866	0.746	0.921
1	2	0.775	1.01	0.979	0.821	0.674
1	1	0.733	0.923	0.895	1.023	0.629

Panlel C

Portfolio		MKT factor loading portfolios: excess return				
IG	*SZ*	Low	2	3	4	High
3	3	0.644	0.844	0.298	0.674	0.041
3	2	0.701	0.871	0.692	0.435	0.049
3	1	0.49	0.589	0.719	0.559	0.109
2	3	0.8	0.8	0.769	0.746	0.51
2	2	0.887	0.855	0.942	0.912	0.789
2	1	0.78	0.915	0.964	0.827	0.554
1	3	0.622	1.063	0.995	0.793	0.738
1	2	0.906	0.921	0.901	0.761	0.773
1	1	0.844	0.816	0.926	0.803	0.824

Panel D

Portfolio		HML factor loading portfolios: excess return				
BM	*SZ*	Low	2	3	4	High
3	3	0.578	0.694	0.766	0.849	1.24
3	2	0.918	0.878	1.08	0.993	1.268
3	1	1.08	1.007	1.102	1.193	1.025
2	3	0.405	0.859	0.949	0.74	0.87
2	2	0.657	0.756	0.927	0.949	1.025
2	1	0.862	0.866	0.873	0.928	1.099
1	3	0.446	0.556	0.668	0.772	0.847
1	2	0.39	0.684	0.724	0.716	0.651
1	1	0.113	0.326	0.507	0.342	0.218

(*continued*)

Table II. Mean excess monthly returns of 45 portfolios formed on the basis of firm characteristics and factor loadings: July 1981 to June 2006

Panel E						
Portfolio		*SMB* factor loading portfolios: excess return				
BM	*SZ*	Low	2	3	4	High
3	3	0.68	0.735	0.666	1.005	1.041
3	2	0.898	0.998	1.04	1.158	1.087
3	1	1.148	1.107	1.166	0.964	1.065
2	3	0.725	0.697	0.825	0.798	0.899
2	2	0.765	0.939	0.853	0.947	0.825
2	1	0.943	0.957	0.939	0.985	0.913
1	3	0.663	0.65	0.633	0.516	0.667
1	2	0.703	0.704	0.68	0.729	0.332
1	1	0.279	0.411	0.535	0.276	0.007
Panel F						
Portfolio		*MKT* factor loading portfolios: excess return				
BM	*SZ*	Low	2	3	4	High
3	3	0.722	0.759	0.887	0.87	0.865
3	2	1.024	0.983	1.134	0.959	1.061
3	1	1.23	1.021	1.136	1.185	0.938
2	3	0.588	0.845	0.81	0.784	0.827
2	2	0.845	0.826	0.843	0.859	0.948
2	1	0.748	0.9	0.943	1.038	1.02
1	3	0.615	0.817	0.534	0.687	0.364
1	2	0.583	0.86	0.705	0.448	0.553
1	1	0.098	0.388	0.384	0.401	0.224

Note: This table reports mean excess returns (in percentage) of 45 portfolios which are formed on the basis of firm characteristics and the estimated factor loadings for the period from July 1981 through June 2006

Table II.

lowest tercile factor loading portfolio based on the procedure by Davis *et al.* (2000)[5]. Finally, we compute the average return on each CB portfolio and regress the time-series return on each CB portfolio on the new three-factor model of *MKT*, *SMB** and *LMH* portfolio returns as follows:[6]

$$R_{CB} = \alpha + \gamma MKT(MKT) + \gamma SMB*(SMB*) + \gamma LMH(LMH) + \varepsilon \tag{4}$$

where γ_{MKT}, γ_{SMB}* and γ_{LMH} are coefficients of the factors[7].

Based on Daniel and Titman (1997, 1998), if the covariance-risk argument is correct, the real driver of returns is the covariance risk as captured by the factor loading. Average returns on CB portfolios should be significantly positive because the portfolios are created such that they have high loading on one of the risk factors (despite having approximately the same characteristics). The coefficient of the factor for which the loading is used to sort stocks into CB portfolios should be significantly positive. In other words, the factor should be able to explain the CB portfolio returns such that the higher the factor loading, the higher the stock returns when stocks are sorted each year based on that factor loading.

In contrast, also based on Daniel and Titman (1997, 1998), if the firm-characteristic argument is correct, the real driver of returns must be the underlying firm characteristic, not the factor loading. Average returns on CB portfolios will be very small or flat (i.e. does not differ significantly from zero) because individual CB portfolios have approximately the same controlled characteristics. The coefficient of the factor that is used to sort stocks into CB portfolios should not be significantly positive, implying that the factor loading does not induce any return premium[8]. We can also infer that the investment growth anomaly is non-risk-based if average returns on CB portfolios sorted by the *LMH* factor loading and the coefficient of the *LMH* factor are not significantly positive. The CB portfolios sorted by the *LMH* factor loading have the investment growth as the underlying firm characteristic. The zero average return on CB portfolios and the zero *LMH* coefficient directly indicate that the covariance risk based on the investment growth does not induce returns and thus the investment growth anomaly must be non-risk-based.

6.1 Characteristic-balanced portfolios sorted by LMH factor loadings

Panel A of Table III presents results for the CB portfolios sorted by the *LMH* factor loading which has insignificant correlation with the underlying *IG* characteristic. The average returns do not differ significantly from zero for all nine CB portfolios. Essentially, sorting stocks based on the *LMH* factor loading does not pick up any variation in the underlying firm characteristic. No variation in the underlying firm characteristic implies that CB portfolio returns will be essentially flat and hence average returns on the CB portfolios will not differ statistically from zero. Further, the *LMH* coefficient is not significantly positive for eight out of nine CB portfolios[9]. These results strongly support not only the firm-characteristic determinant of stock returns but also the non-risk-based explanation for the investment growth anomaly. In other words, the variation in stock returns as a result of the investment growth anomaly (i.e. the higher return on low *IG* stocks over high *IG* stocks) must be driven the investment growth characteristic itself (i.e. non-risk-based explanation), not by the factor loading or covariance risk (i.e. risk-based explanation).

Additionally, the bottom row of the Panel A provides the result for the combined portfolio that consists of an equally weighted combination of all nine CB portfolios. The average return on the combined CB portfolio is −0.105. It is statistically insignificant and hence is indistinguishable from zero. The coefficient on the LMH premium is −0.088 and insignificant. This result occurs because the IG characteristic and the LMH factor loading have very low correlation. Thus, the variation in factor loadings does not pick up the variation in the IG characteristic that could otherwise induce a significant LMH coefficient. Finally, the intercept (alpha) is 0.072. It is positive, but insignificant. In this case, it acts as a neutral "adjuster". In other words, there is no need for the intercept to be negative and significant because both the LMH premium on the right-hand side and the return on the CB portfolio on the left-hand side are already zero statistically. Therefore, similar to those for individual CB portfolios, the results for the combined portfolio support the firm-characteristic determinant and the non-risk-based explanation.

Panel B of Table III presents results for the CB portfolios sorted by the *HML* factor loading which has significant correlation with the underlying book-to-market characteristic. Due to the significant correlation (explained in Footnote 8), the coefficient of the *HML* factor is significantly positive for each of the nine CB portfolios as well as for the combined CB portfolio. Most importantly, the average return on the combined CB portfolio of 0.225 and the average returns on other CB portfolios, in general, do not differ significantly from zero. Hence, the difference in factor loadings cannot induce return premiums, thereby supporting the firm-characteristic determinant of stock returns.

6.2 Characteristic-balanced portfolios sorted by other factor loadings

This subsection discusses results from testing if the *SMB** or *MKT* factor loadings (that are used in sorting stocks for CB portfolio construction) can explain the cross-section of stock returns, after controlling for firm characteristics.

Table III.
Regression results for the characteristic-balanced portfolios sorted by pre-formation *LMH* or *HML* factor loadings

Portfolio		Characteristic-balanced portfolios by *LMH* factor loading					
IG	*SZ*	Avg Ret	α	*MKT*	*SMB**	*LMH*	Adj R^2
Panel A							
3	3	0.116 (0.43)	0.373 (1.43)	−0.407*** (−6.59)	0.002 (0.03)	−0.029 (−0.18)	0.1355
3	2	−0.072 (−0.42)	0.050 (0.30)	−0.189*** (−4.78)	−0.208*** (−3.83)	−0.001 (−0.01)	0.1314
3	1	−0.092 (−0.67)	−0.002 (−0.02)	−0.080** (−2.48)	−0.196*** (−4.41)	−0.106 (−1.26)	0.0820
2	3	−0.030 (−0.13)	0.063 (0.28)	−0.281*** (−5.41)	−0.199*** (−2.80)	0.254* (1.87)	0.1607
2	2	−0.198 (−1.18)	−0.048 (−0.30)	−0.214*** (−5.75)	−0.245*** (−4.79)	−0.037 (−0.37)	0.1833
2	1	−0.255 (−1.51)	−0.054 (−0.33)	−0.221*** (−5.79)	−0.194*** (−3.70)	−0.181* (−1.81)	0.1489
1	3	−0.306 (−1.27)	−0.075 (−0.31)	−0.245*** (−4.37)	−0.279*** (−3.61)	−0.223 (−1.52)	0.1047
1	2	0.021 (0.11)	0.247 (1.34)	−0.264*** (−6.08)	−0.273*** (−4.58)	−0.175 (−1.54)	0.1808
1	1	−0.131 (−0.84)	0.095 (0.62)	−0.209*** (−5.79)	−0.102** (−2.06)	−0.290*** (−3.06)	0.1192
Combined		−0.105 (−0.78)	0.072 (0.60)	−0.234*** (−8.25)	−0.188*** (−4.82)	−0.088 (−1.18)	0.2645
Panel B							
Portfolio		Characteristic-balanced portfolios by *HML* factor loading					
BM	*SZ*	Avg Ret	α	*MKT*	*SMB*	*HML*	Adj R^2
3	3	0.528** (2.45)	0.538** (2.49)	−0.163*** (−2.96)	0.138* (1.85)	0.190** (2.27)	0.0736
3	2	0.253 (1.52)	0.223 (1.37)	−0.055 (−1.33)	−0.183*** (−3.25)	0.173*** (2.73)	0.1147
3	1	0.050 (0.29)	−0.074 (−0.47)	−0.021 (−0.52)	−0.229*** (−4.18)	0.348*** (5.66)	0.2391
2	3	0.258 (1.36)	0.234 (1.26)	−0.083* (−1.77)	−0.211*** (−3.30)	0.202*** (2.82)	0.1306
2	2	0.323* (1.95)	0.271* (1.78)	−0.080** (−2.07)	−0.208*** (−3.97)	0.261*** (4.44)	0.2210
2	1	0.135 (0.66)	0.151 (0.93)	−0.226*** (−5.48)	−0.334*** (−5.96)	0.326*** (5.18)	0.4073
1	3	0.304 (1.26)	−0.112 (−0.58)	0.040 (0.81)	−0.001 (−0.01)	0.914*** (12.13)	0.4071
1	2	0.125 (0.45)	−0.153 (−0.76)	−0.140*** (−2.75)	−0.295*** (−4.25)	0.886*** (11.36)	0.5170
1	1	0.049 (0.21)	−0.105 (−0.55)	−0.199*** (−4.10)	−0.057 (−0.87)	0.648*** (8.73)	0.3967
Combined		0.225 (1.49)	0.108 (0.95)	−0.103*** (−3.58)	−0.153*** (−3.91)	0.439*** (9.96)	0.4816

Notes: This table reports the average return and factor coefficients and t-statistics (in parentheses) on the zero-cost characteristic-balanced (CB) portfolio within each *IG* and *SZ* combination or within each *BM* and *SZ* combination over period July 1981 to June 2006. In Panel A, stocks are controlled for their characteristics by forming CB portfolios based on $3 \times 3 = 9$ *IG-SZ* combinations. Within each combination, stocks are sorted by their *LMH* factor loadings and the CB portfolio is formed such that it has a long position in the highest tercile *LMH* factor loading portfolio and a short position in the lowest tercile *LMH* factor loading portfolio. Similarly, in Panel B, stocks are controlled for their characteristics by forming CB portfolios based on 9 *BM-SZ* combinations. Within each combination, stocks are sorted by their *HML* factor loadings and the CB portfolio is formed such that it has a long position in the highest tercile *HML* factor loading portfolio and a short position in the lowest tercile *HML* factor loading portfolio. The bottom row in each panel provides the results from a combined portfolio that consists of an equally weighted combination of the 9 CB portfolios; *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively

Panel A of Table IV shows time-series regression results of CB portfolios sorted by the SMB^* factor loading. Given significant correlation between the factor loading and the underlying characteristic, the overall findings based on the combined CB portfolio support the characteristic-based determinant argument. The average return on the combined CB portfolio is −0.217 which is statistically indistinguishable from zero. The intercept (alpha) is −0.329. It is negative and significant. It acts as an "adjuster" to offset the positive SMB^* premium (resulting from the positive and significant SMB^* coefficient of 0.405) so that the average return on the combined CB portfolio is statistically indistinguishable from zero. Further, Panel B of Table IV presents results from time-series regressions of CB portfolios sorted by the *SMB* factor loading. The results are similar to those in Panel A. The average return on the combined CB portfolio is −0.022. It is statistically insignificant. The negative (albeit insignificant) intercept of −0.106 helps compensate the *SMB* premium as a result of a positive and significant *SMB* coefficient of 0.397. Therefore, the results support the characteristic determinant of returns irrespective of how the size-based factor (i.e. SMB^* versus *SMB*) is created.

Panels A and B of Table V show the time-series regression results of CB portfolio sorted by the *MKT* factor loading. Both panels reveal results that are consistent with the characteristic-based determinant of stock returns. Specifically, the average returns on the combined CB portfolios are −0.226 (in Panel A) and −0.006 (in Panel B). They are not significant at any conventional level, suggesting that differences in loadings do not generate return premiums. The negative intercepts of −0.432 (in Panel A) and −0.300 (in Panel B) are an "adjuster" to offset the *MKT* premiums as a result of the positive and significant *MKT* coefficients of 0.527 (in Panel A) and 0.401 (in Panel B) so that the average returns on the combined CB portfolios in both panels are statistically indistinguishable from zero. In sum, sorting stocks based on other factor loadings (in addition to the *LMH* factor loading) leads to the results that reiterate the firm-characteristic determinant of stock returns[10].

7. Conclusions

This paper analyzes determinants of stock returns and a recently discovered and less documented anomaly related to the firm's growth in capital expenditures (i.e. the investment growth). It also revisits more well-known size and value anomalies. Specifically, the paper investigates if covariance risks (i.e. factor loadings) can be excluded from being asset pricing variables that drive return premiums and determine stock returns. Importantly, from a behavioral finance standpoint, it examines if a more practical and accessible approach of using firm characteristics as determining variables is necessary and sufficient.

We create the investment-growth-based factor (*LMH*) which is defined as the return difference between low and high investment growth portfolios. We then incorporate the *LMH* factor along with other characteristic-based factors and their loadings into characteristic-balanced portfolio and three-factor model tests.

Main results strongly suggest that behavioral-related firm characteristics (as opposed to covariance risks) are necessary and sufficient as explanatory variables for return premiums and stock returns. The *LMH* factor loading does not induce any return premium in the CB portfolios and the covariance risk reflected by this loading does not play the determining role in the cross-section of stock returns. Related results show that constructing CB portfolios based on other factor loadings leads to the inference that is also in favor of the firm-characteristic determinant of stock returns.

The finding that firm characteristics can explain stock returns have practical and useful implications for investors in simplifying their stock portfolio analysis and selection. Investors can select stocks and expect to obtain return premiums based on the low or high

Table IV.
Regression results for the characteristic-balanced portfolios sorted by pre-formation *SMB** or *SMB* factor loadings

Portfolio		Characteristic-balanced portfolios by *SMB** factor loading					
IG	*SZ*	Avg Ret	α	*MKT*	*SMB**	*LMH*	Adj R^2
Panel A							
3	3	−0.200 (−0.72)	−0.152 (−0.66)	0.349*** (6.41)	0.440*** (5.89)	−0.825*** (−5.80)	0.3564
3	2	−0.464** (−2.09)	−0.398** (−2.18)	0.302*** (7.02)	0.259*** (4.39)	−0.780*** (−6.93)	0.3789
3	1	−0.358* (−1.73)	−0.448*** (−2.77)	0.323*** (8.48)	0.473*** (9.03)	−0.364*** (−3.64)	0.4397
2	3	−0.093 (−0.46)	−0.273 (−1.46)	0.289*** (6.54)	0.289*** (4.76)	−0.013 (−0.11)	0.2150
2	2	−0.135 (−0.61)	−0.339* (−1.89)	0.438*** (10.34)	0.327*** (5.63)	−0.216* (−1.95)	0.3965
2	1	−0.439** (−1.95)	−0.642*** (−3.46)	0.378*** (8.66)	0.464*** (7.72)	−0.122 (−1.07)	0.3740
1	3	−0.064 (−0.29)	−0.115 (−0.58)	0.278*** (5.96)	0.364*** (5.67)	−0.389*** (−3.19)	0.2726
1	2	−0.132 (−0.56)	−0.355* (−1.83)	0.394*** (8.62)	0.503*** (8.00)	−0.096 (−0.80)	0.3765
1	1	−0.066 (−0.29)	−0.236 (−1.32)	0.383*** (9.07)	0.527*** (9.08)	−0.238** (−2.15)	0.4342
Combined		−0.217 (−1.23)	−0.329*** (−2.76)	0.348*** (12.41)	0.405*** (10.51)	−0.338*** (−4.60)	0.5790

Panel B

Portfolio		Characteristic-balanced portfolios by *SMB* factor loading					
BM	*SZ*	Avg Ret	α	*MKT*	*SMB*	*HML*	Adj R^2
3	3	0.202 (0.89)	0.087 (0.41)	0.222*** (4.07)	0.316*** (4.25)	−0.088 (−1.06)	0.1688
3	2	0.124 (0.59)	−0.110 (−0.64)	0.348*** (7.97)	0.457*** (7.70)	−0.008 (−0.13)	0.3793
3	1	−0.065 (−0.45)	−0.148 (−1.29)	0.161*** (5.53)	0.403*** (10.16)	−0.088** (−1.98)	0.4298
2	3	0.130 (0.71)	0.032 (0.20)	0.196*** (4.76)	0.381*** (6.82)	−0.098 (−1.56)	0.2887
2	2	0.006 (0.04)	−0.157 (−1.26)	0.224*** (7.08)	0.326*** (7.57)	0.018 (0.38)	0.3337
2	1	0.008 (0.04)	−0.100 (−0.80)	0.297*** (9.42)	0.478*** (11.13)	−0.233*** (−4.84)	0.6077
1	3	−0.103 (−0.49)	−0.203 (−1.18)	0.262*** (5.99)	0.445*** (7.47)	−0.196*** (−2.93)	0.3896
1	2	−0.196 (−0.93)	−0.093 (−0.60)	0.189*** (4.78)	0.272*** (5.04)	−0.544*** (−8.99)	0.4982
1	1	−0.303 (−1.41)	−0.263* (−1.73)	0.186*** (4.82)	0.497*** (9.48)	−0.422*** (−7.15)	0.5368
Combined		−0.022 (−0.15)	−0.106 (−1.27)	0.232*** (10.96)	0.397*** (13.81)	−0.184*** (−5.71)	0.6906

Notes: This table reports the average return and factor coefficients and t-statistics (in parentheses) on the zero-cost characteristic-balanced (CB) portfolio within each *IG* and *SZ* combination or within each *BM* and *SZ* combination over period July 1981 to June 2006. In Panel A, stocks are controlled for their characteristics by forming CB portfolios based on $3 \times 3 = 9$ *IG-SZ* combinations. Within each combination, stocks are sorted by their *SMB** factor loadings and the CB portfolio is formed such that it has a long position in the highest tercile *SMB** factor loading portfolio and a short position in the lowest tercile *SMB** factor loading portfolio. Similarly, in Panel B, stocks are controlled for their characteristics by forming CB portfolios based on 9 *BM-SZ* combinations. Within each combination, stocks are sorted by their *SMB* factor loadings and the CB portfolio is formed such that it has a long position in the highest tercile *SMB* factor loading portfolio and a short position in the lowest tercile *SMB* factor loading portfolio. The bottom row in each panel provides the results from a combined portfolio that consists of an equally weighted combination of the 9 CB portfolios; *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively

Table V. Regression results for the characteristic-balanced portfolios sorted by pre-formation MKT factor loading

Portfolio		Characteristic-balanced portfolios by *MKT* factor loading					
IG	*SZ*	Avg Ret	α	*MKT*	*SMB**	*LMH*	Adj R^2
Panel A							
3	3	−0.445 (−1.38)	−0.465* (−1.83)	0.569*** (9.49)	0.286*** (3.48)	−1.013*** (−6.46)	0.4303
3	2	−0.580** (−2.02)	−0.616*** (−2.72)	0.489*** (9.14)	0.375*** (5.11)	−0.824*** (−5.89)	0.4283
3	1	−0.280 (−1.15)	−0.445** (−2.50)	0.507*** (12.10)	0.386*** (6.70)	−0.470*** (−4.28)	0.5077
2	3	−0.230 (−0.98)	−0.394** (−2.04)	0.456*** (10.02)	0.251*** (4.01)	−0.366*** (−3.07)	0.3782
2	2	−0.023 (−0.10)	−0.320* (−1.80)	0.536*** (12.84)	0.478*** (8.33)	−0.133 (−1.22)	0.5120
2	1	−0.181 (−0.77)	−0.428** (−2.45)	0.469*** (11.40)	0.510*** (9.01)	−0.161 (−1.49)	0.4886
1	3	−0.061 (−0.22)	−0.295 (−1.31)	0.537*** (10.14)	0.341*** (4.69)	−0.312** (−2.25)	0.3782
1	2	−0.191 (−0.66)	−0.557** (−2.56)	0.612*** (11.94)	0.613*** (8.70)	−0.074 (−0.55)	0.4870
1	1	−0.046 (−0.17)	−0.365* (−1.84)	0.570*** (12.22)	0.527*** (8.23)	−0.131 (−1.08)	0.4915
Combined		−0.226 (−0.99)	−0.432*** (−2.88)	0.527*** (14.93)	0.419*** (8.63)	−0.387*** (−4.19)	0.6025

Panel B

Portfolio		Characteristic-balanced portfolios by *MKT* factor loading					
BM	*SZ*	Avg Ret	α	*MKT*	*SMB*	*HML*	Adj R^2
3	3	0.114 (0.43)	−0.228 (−0.96)	0.482*** (8.01)	0.358*** (4.37)	0.065 (0.70)	0.2723
3	2	−0.071 (−0.31)	−0.478*** (−2.59)	0.506*** (10.82)	0.463*** (7.27)	0.169** (2.36)	0.4103
3	1	−0.110 (−0.66)	−0.531*** (−4.80)	0.462*** (16.44)	0.443*** (11.59)	0.268*** (6.24)	0.5992
2	3	0.118 (0.53)	−0.244 (−1.18)	0.442*** (8.45)	0.134* (1.89)	0.199** (2.49)	0.2099
2	2	0.081 (0.47)	−0.240* (−1.83)	0.414*** (12.42)	0.313*** (6.92)	0.119** (2.33)	0.4572
2	1	0.190 (1.17)	−0.099 (−0.88)	0.392*** (13.79)	0.369*** (9.55)	0.068 (1.57)	0.5592
1	3	−0.227 (−1.11)	−0.473*** (−2.65)	0.386*** (8.51)	0.233*** (3.79)	−0.005 (−0.07)	0.2995
1	2	−0.214 (−1.16)	−0.351** (−2.42)	0.313*** (8.52)	0.300*** (6.01)	−0.164*** (−2.93)	0.4318
1	1	0.064 (0.37)	−0.056 (−0.37)	0.211*** (5.49)	0.379*** (7.26)	−0.068 (−1.16)	0.4318
Combined		−0.006 (−0.04)	−0.300*** (−3.07)	0.401*** (16.18)	0.333*** (9.87)	0.072* (1.91)	0.6167

Notes: This table reports the average return and factor coefficients and t-statistics (in parentheses) on the zero-cost characteristic-balanced (CB) portfolio within each *IG* and *SZ* combination or within each *BM* and *SZ* combination over period July 1981 to June 2006. In Panel A, stocks are controlled for their characteristics by forming CB portfolios based on $3 \times 3 = 9$ *IG-SZ* combinations. Within each combination, stocks are sorted by their *MKT* factor loadings and the CB portfolio is formed such that it has a long position in the highest tercile *MKT* factor loading portfolio and a short position in the lowest tercile *MKT* factor loading portfolio. Similarly, in Panel B, stocks are controlled for their characteristics by forming CB portfolios based on 9 *BM-SZ* combinations. Within each combination, stocks are sorted by their *MKT* factor loadings and the CB portfolio is formed such that it has a long position in the highest tercile *MKT* factor loading portfolio and a short position in the lowest tercile *MKT* factor loading portfolio. The bottom row in each panel provides the results from a combined portfolio that consists of an equally weighted combination of the 9 CB portfolios; *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively level of investment growth, size and book-to-market characteristics of the firms. The information on these firm characteristics is typically available and readily accessible for investors and practitioners. In contrast, obtaining covariance risks (i.e. factor loadings) requires considerably greater effort because they must be estimated through complex statistical procedures. Further, relatively more sophisticated investors can potentially increase their returns by holding a portfolio that has a zero loading on each of the factors, but still has a long position in low investment growth stocks, small stocks and value stocks and a short position in high investment growth stocks, big stocks and growth stocks. Mutual fund investors can also evaluate the selection ability of fund managers by computing the benchmark-adjusted returns in which the benchmarks are portfolios of stocks with similar investment growth, size and book-to-market characteristics to the stocks in their mutual funds.

Notes

1. See, for example, Sloan (1996), Titman *et al.* (2004), Hirshleifer *et al.* (2004), Richardson *et al.* (2005), Anderson and Garcia-Feijóo (2006), Daniel and Titman (2006), Pontiff and Woodgate (2008), Cooper *et al.* (2008), Xing (2008) and Polk and Sapienza (2009).
2. It is worth noting that while the market factor loading of beta is available for free, for example, on finance.yahoo.com. Other factor loadings (i.e. loadings for size, value and investment growth) are not publicly available for investors.
3. The data can be obtained from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
4. We also estimate the pre-formation factor loadings using five (or the minimum of three) years of monthly returns ending in June of year t. The factor loadings from this estimation do not make any significant change in the characteristic-balanced portfolio test results.
5. To test for the robustness of results, we also follow the Daniel and Titman's (1997) procedure that uses a long position in the fourth and fifth quintile factor loading portfolios and a short position in the first and second quintile factor loading portfolios. However, this differing choice of procedures does not significantly alter the test outcome.
6. We follow the new three-factor model specification used in Xing (2008). Other specification is by nature possible and more rigorous tests are warranted.
7. For comparative purposes, we also construct nine CB portfolios of *BM-SZ* combination. Within each of the nine portfolios or combinations, we sort stocks based on the *HML*, *SMB* or *MKT* factor loading. The corresponding regression is $R_{CB} = \alpha + \gamma MKT(MKT) + \gamma SMB(SMB) + \gamma HML(HML) + \varepsilon$.
8. This is true if the factor loading is uncorrelated with the underlying firm characteristic. However, if the factor loading is significantly correlated with the underlying firm characteristic, it is possible that the coefficient of the factor is positive. In other words, the factor is still able to explain some (albeit small) variation in the CB portfolio returns as a result of the variation in the underlying firm characteristic that is correlated with the loading.
9. In one CB portfolio, the *LMH* coefficient is positive, but statistically significant at only the 10% level (t-statistic of 1.87). In two CB portfolios, the *LMH* coefficients are significantly negative (t-statistics of −1.81 and −3.06), thereby supporting the firm-characteristic determinant argument even more strongly than if the coefficients were simply not significantly positive.
10. To ensure that our main result (that characteristics explain stock returns) is not time-dependent or time-varying, we perform a sub-period analysis to examine if the result is the same for each of first-half and second-half sub-periods. The results for the two sub-periods are consistent with

each other in that average returns for the CB portfolios are very small and not statistically significant at any conventional level. This is true irrespective of the factor loading used in creating CB portfolios. Therefore, factor loadings do not induce returns. In other words, characteristics explain the characteristic-based return premiums and the cross-section of stock returns. The sub-period results are not tabulated, but are available upon request.

References

Anderson, C.W. and Garcia-Feijóo, L. (2006), "Empirical evidence on capital investment, growth options, and security returns", *The Journal of Finance*, Vol. 61 No. 1, pp. 171-194.

Cooper, M.J., Gulen, H. and Schill, M.J. (2008), "Asset growth and the cross-section of stock returns", *The Journal of Finance*, Vol. 63 No. 4, pp. 1609-1651.

Daniel, K. and Titman, S. (1997), "Evidence on the characteristics of cross sectional variation in stock returns", *Journal of Finance*, Vol. 52 No. 1, pp. 1-33.

Daniel, K. and Titman, S. (1998), "Characteristics or covariances?", *The Journal of Portfolio Management*, Vol. 24 No. 4, pp. 24-33.

Daniel, K. and Titman, S. (2006), "Market reactions to tangible and intangible information", *The Journal of Finance*, Vol. 61 No. 4, pp. 1605-1643.

Daniel, K., Grinblatt, M., Titman, S. and Wermers, R. (1997), "Measuring mutual fund performance with characteristic-based benchmarks", *Journal of Finance*, Vol. 52 No. 3, pp. 1035-1058.

Daniel, K., Titman, S. and Wei, K.C. (2001), "Explaining the cross-section of stock returns in Japan: factors or characteristics?", *Journal of Finance*, Vol. 56 No. 2, pp. 743-766.

Davis, J.L., Fama, E.F. and French, K.R. (2000), "Characteristics, covariances, and average returns: 1929 to 1997", *Journal of Finance*, Vol. 55 No. 1, pp. 389-406.

Dichev, I.D. (1998), "Is the risk of bankruptcy a systematic risk?", *Journal of Finance*, Vol. 53 No. 3, pp. 1131-1147.

Fama, E.F. and French, K.R. (1992), "The cross-section of expected stock returns", *Journal of Finance*, Vol. 47 No. 2, pp. 427-465.

Fama, E.F. and French, K.R. (1993), "Common risk factors in the returns on stocks and bonds", *Journal of Financial Economics*, Vol. 33 No. 1, pp. 3-56.

Fama, E.F. and French, K.R. (1995), "Size and book-to-market factors in earnings and returns", *Journal of Finance*, Vol. 50 No. 1, pp. 131-155.

Fama, E.F. and French, K.R. (1996), "Multifactor explanations of asset pricing anomalies", *Journal of Finance*, Vol. 51 No. 1, pp. 55-84.

Fama, E.F. and French, K.R. (2015), "A five-factor asset pricing model", *Journal of Financial Economics*, Vol. 116 No. 1, pp. 1-22.

Griffin, J.M. and Lemmon, M.L. (2002), "Book–to–market equity, distress risk, and stock returns", *Journal of Finance*, Vol. 57 No. 5, pp. 2317-2336.

Hirshleifer, D., Hou, K., Teoh, S.H. and Zhang, Y. (2004), "Do investors overvalue firms with bloated balance sheets?", *Journal of Accounting and Economics*, Vol. 38, pp. 297-331.

Hou, K., Xue, C. and Zhang, L. (2015), "Digesting anomalies: an investment approach", *Review of Financial Studies*, Vol. 28 No. 3, pp. 650-705.

Merton, R.C. (1974), "On the pricing of corporate debt: the risk structure of interest rates", *Journal of Finance*, Vol. 29 No. 2, pp. 449-470.

Polk, C. and Sapienza, P. (2009), "The stock market and corporate investment: a test of catering theory", *Review of Financial Studies*, Vol. 22 No. 1, pp. 187-217.

Pontiff, J. and Woodgate, A. (2008), "Share issuance and cross-sectional returns", *The Journal of Finance*, Vol. 63 No. 2, pp. 921-945.

Prombutr, W., Phengpis, C. and Zhang, Y. (2012), "What explains the investment growth anomaly?", *Journal of Banking and Finance*, Vol. 36 No. 9, pp. 2532-2542.

Richardson, S.A., Sloan, R.G., Soliman, M.T. and Tuna, I. (2005), "Accrual reliability, earnings persistence and stock prices", *Journal of Accounting and Economics*, Vol. 39 No. 3, pp. 437-485.

Sloan, R. (1996), "Do stock prices fully reflect information in accruals and cash flows about future earnings", *Accounting Review*, Vol. 71 No. 3, pp. 289-315.

Titman, S., Wei, K.J. and Xie, F. (2004), "Capital investments and stock returns", *Journal of Financial and Quantitative Analysis*, Vol. 39 No. 4, pp. 677-700.

Vassalou, M. and Xing, Y. (2004), "Default risk in equity returns", *The Journal of Finance*, Vol. 59 No. 2, pp. 831-868.

Xing, Y. (2008), "Interpreting the value effect through the Q-theory: an empirical investigation", *Review of Financial Studies*, Vol. 21 No. 4, pp. 1767-1795.

Corresponding author
Wikrom Prombutr can be contacted at: wikrom.prombutr@csulb.edu