ESSAYS ON ASSET PRICING AND GROWTH EFFECT

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ABSTRACT

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This dissertation comprises two essays on growth effects and opportunities experienced by companies and their implications for asset pricing models. In the first essay, I develop and test a model to explain the empirically observed value-growth stock return effect using real options theory. I simulate results from a real options model for two firm types. One type, the "value" firm, has a single growth opportunity. The other type, the "growth" firm, has infinitely repeated growth opportunities. Growth firms: (1) invest sooner, (2) pursue less lumpy investment paths, (3) have lower book-to-market ratios, and (4) generate lower rates of return than value firms. In the second essay, I examine relationships between sustainable growth and subsequent stock returns. Findings indicate that high sustainable growth firms have low default risk, low book-to-market ratio, and low subsequent returns. Cross-sectional tests indicate that sustainable growth subsumes the book-to-market equity ratio.

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CHAPTER 1

INTRODUCTION

1.1 Overview

The failure in explaining cross-section of return by the CAPM (so called anomaly) has been a main debate in literature for two decades. Two salient empirical explanations have appeared along the time. Rational expectation proponents posit that the CAPM fails to capture some kind of risk.(e.g. Fama and French (1992, 1993, 1995, 1996); Davis, Fama, and French (2000)). Behavioral finance proponents argue that the anomaly arises from systematic errors in growth forecasts of investors for value and growth stocks (e.g. Lakonishok, Shliefer and Vishny (1994), Daniel and Titman (1997, 2006); Daniel, Titman, and Wei (2001)).

Recently, real options models have been used to explain the systematic differences in returns between value and growth stocks. The literature focuses on a risk proposition in which expected returns depend on the evolution of assets-in-place and growth options. The literature relates value, size, and momentum anomalies with optimal firm-level investment decisions. The logic basically comes from irreversibility of investments (that creates "lumpy" capital) and cash flows or discount rate risk. Investing in growth opportunities creates more assets-in-place that are irreversible, that create distress risk when cash flows from operation turn out to be adverse.

Berk, Green, and Naik (1999) use dynamic turnover of firm's assets-in-place to explain regularities in cross-section of expected returns. Carlson, Fisher, and Giammarino (2004) explain the anomaly using uncertain product demand and operating leverage, which results from fixed operational costs that are proportional to level of capital. In their model, book-to-market relates to operating leverage in the sense that it reflects the states of product demand diffusion relative to established capital. Zhang (2005) point out that, in bad times, value firms suffer more from costly reversibility of investments and unproductive capital than growth firms. In good times, growth firms must invest more while value firms need not to do so because their previously unproductive capital now tends to be relatively productive. Consequently, value stock returns exceed those of growth firms during good times. Cooper (2006) measures distress risk as the deviation of uncertain product demand from fixed level of production of installed capital capacity. In his model, a high book-to-market results from idle capacity while a low book-to-market results from excess capacity that is beneficial when positive aggregate shocks arrive.

According to this line of research, firms face a dilemma when having excess capital, which creates risk for the firms, and which in turn gives rise to higher expected returns. In this dissertation, I rely on the real options theory suggesting that firm equity value is determined by the present value of equity cash flows attributable to assets-in-place and to assets underlying growth options available to the firm. Specifically, I examine relationships between rates of return and the growth rates of key economic variables. My intent is to demonstrate that value and growth stocks are affected differently by the growth rates in key economic variables. My dissertation addresses three important research questions.

1.2 Research Questions

Research question #1: Can a theoretical real options-based model produce the observed regularities between value and growth stocks documented in the studies of cross-section in returns?

In Chapter 2, I propose an alternative explanation for the value-growth anomaly, based on a contingent claims approach. The contingent claim approach (real option model) is a good candidate for this issue because it can endogenously determine amount of investment. With the amount of investment, book equity is from accumulated investment. The market equity is directly from the real option model. Therefore, I can come up with book-to-market ratio. The return is of course from the cum-dividend change in value of the firm. With book-to-market ratio, size (market equity), and return of individual firms, I have all what I want to perform tests just like what empirical studies do. Specifically, I create a simple real option model to see if simulations based on growth options produce results consistent with the value-growth anomaly observed in empirical studies. For the comparison, I assign a firm to the "value" category if it has only one growth option, and I assign a firm to the "growth" category if it has multiple growth options. I document several major findings. Relative to value firms, growth firms invest earlier and pursue less lumpy investment processes, have lower book-to-market equity ratios, and are expected to produce lower stock returns.[1] I also find that optimal investment trigger points depend on the state of the economy. Taken together, my findings indicate that the value-growth stock effect may be a natural consequence of differential growth options, investment irreversibility, and cash flow risk faced by value and growth firms.

Research question #2: What is the relationship between growth in key firm-specific economic variables and subsequent stock returns?

In Chapter 3, I argue that sustainable growth is a determinant of stock returns. While other studies examine the impact of past (ex post) growth (e.g. Titman, Wei and Xie (2004), Xing (2006), and Anderson and Garcia-Feijóo (2006)), this dissertation is the first to examine the effect of growth potential (ex ante) on stock returns. I argue that sustainable growth is a forward-looking factor that investors may implicitly consider when forming expectations. My tests provide a logical story relating the cross-section of expected returns to economic fundamentals in the real economy.

Using Fama and MacBeth (1973) regressions, sustainable growth plays vital roles in explaining the cross-section of stock returns. Sustainable growth subsumes the book-to-market when size, book-to-market, and sustainable growth are included in the regressions. The firm size effect also is weakened after including the sustainable growth in the regressions.

In this dissertation, I hope the make the following contributions:

[1] My results are consistent with those of Anderson and Garcia-Feijóo (2006) who empirically find that growth (value) firms accelerate (slow) investment prior to portfolio formation year.

1. To provide an alternative explanation for the value-growth stock return anomaly using a real options approach.

2. To provide tests of the relationship between investment growth variables and subsequent stock returns.

CHAPTER 2

INVESTMENT IRREVERSIBILITY, CASH FLOW RISK, AND VALUE-GROWTH STOCK RETURN EFFECTS

Rates of return for individual stocks are positively related to their book-to-market equity ratios.[2] Stocks with high book-to-market ratios are classified as value stocks, and those with low book-to-market ratios are classified as growth stocks. Two explanations have been offered for the dominance of value stock returns over growth stock returns. Rational expectations proponents hypothesize that value stocks have greater distress risk, exhibiting higher average returns as compensation (Fama and French (1992), (1993), (1995), 1996)). Behavioral finance proponents argue that the value anomaly is a manifestation of systematic mistakes by investors, i.e., over (under) extrapolation of growth (value) firm cash flows (Lakonishok, Shleifer and Vishny (1994), Haugen (1995)). Despite numerous papers on the subject, the value-growth stock anomaly remains unresolved.[3]

I propose an alternative explanation for the value-growth anomaly based on investment irreversibility and cash flow risk. My explanation differs from recent

[2] Other than book-to-market ratio (*BE*/*ME*) (Stattman (1980) and Rosenberg, Reid, and Lanstein (1985)), other documented anomalies include market equity (Banz (1981)), earnings-price ratio (Basu (1977)), and leverage (Bhandari (1988)).
[3] For instance, see Davis, Fama, and French (2000) who test their risk hypothesis against the characteristics hypothesis proposed by Daniel and Titman (1997).

research that focuses on product demand as the link to cash flows and stock returns.[4] In contrast to previous research in which product market shocks cause financial market shocks, I focus directly on cash flow shocks and their effects on financial markets.

I employ a real options model to determine whether option-based simulations produce results that are consistent with the value-growth anomaly. I assign a firm to the "value" category if it has only one growth option, and I assign a firm to the "growth" category if it has infinitely repeated growth options. My simulations indicate that growth firms: (1) invest sooner, (2) pursue less lumpy investment paths, (3) have lower book-to-market equity ratios, and (4) are expected to produce lower stock returns than value firms.[5] I also find that the optimal investment policy depends on economic conditions. My findings indicate that the value-growth stock effect may be a natural consequence of differential growth options, investment irreversibility, and cash flow risk faced by value and growth firms.

My work is consistent with research applying real option theory to the cross-section of expected stock returns. Berk, Green, and Naik (1999) investigate relationships between the dynamic turnover of firms' assets and stock return regularities. Firms that perform well find projects (growth options) with low systematic risk and positive net present values. This drives the systematic risk of the firms' cash flows down, leading to lower average returns for growth firms. Berk et al. use the book-to-market ratio to gauge the firm's risk. Carlson, Fisher, and Giammarino (2004)

[4] Among others, see Gomes, Kogan, and Zhang (2003), Carlson, Fisher, and Giammarino (2004), Zhang (2005), and Cooper (2006).

[5] My results are consistent with those of Anderson and Garcia-Feijóo (2006) who find that growth (value) firms accelerate (slow) investment prior to portfolio formation year.

explain the value-growth stock effect based on stochastic product demand and operating leverage. Fixed operating costs proportional to the capital employed drive their results. They show that the book-to-market equity ratio, operating leverage, systematic risk, and rates of return rise when demand for the firm's product decreases.

I assume the decision to exercise growth options depends on cash flows from assets-in-place and cash flows from assets underlying the growth options. Firms will not invest unless the present value of expected cash flows from assets underlying the growth options optimally exceed those from assets-in-place. This assumption differs from Berk, Green, and Naik (1999) and Gomes, Kogan, and Zhang (2003) who assume that investment decisions are unrelated to current levels of cash flows generated by assets-in-place. My model does not require adjustment cost attributes, unlike Zhang (2005) and Cooper (2006). Although my model derives in part from Malchow-Møller and Thorsen (2005), they pursue technology transfer issues and I explore the value anomaly.

This chapter is organized as follows. The next section sets forth the notation, assumptions, and structure of the model. I implement the model using a numerical illustration in Section 2.2. Section 2.3 presents the simulation results, and I offer conclusions in Section 2.4.

2.1 The Model

Consider an all-equity firm with assets-in-place and growth option(s). The evolution of assets-in-place and assets underlying growth options is given by:[6]

[6] Childs, Mauer, and Ott (2005) use this setup to study agency conflicts.

$$dA = \alpha_A A dt + \sigma_A A dz_A \tag{2.1}$$

and

$$dG = \alpha_G G dt + \sigma_G G dz_G, \tag{2.2}$$

where A represents the present value of the expected cash flows generated by the firm's assets-in-place, α_A is the drift parameter for A, σ_A is the constant volatility rate of the assets-in-place, and z_A is a Wiener process. Parameters in Equation (2.2) are defined similarly. G represents the present value of expected cash flows from assets underlying the growth opportunities (and revised expected cash flows from assets-in-place). Both processes have increments of correlated Brownian motions, where $E(dz_A dz_G) = \rho dt$ with $-1 \leq \rho \leq 1$. To obtain a new cash flow generator, G, the firm must pay a fixed proportion, i, of G.[7] Consistent with Carlson, Fisher, and Giammarino (2004), I define cost iG to encompass all costs associated with pursuing the growth opportunities (e.g., adjustment costs as well as the cost of new capital).

Following Malchow-Møller and Thorsen (2005), I specify that optimal policies do not depend explicitly on time. This forces the time derivative to vanish, leaving the following value function:[8]

$$V(G, A) = \max\{(r - \alpha_A)Adt + (1 + rdt)^{-1} E[V(G + dG, A + dA \mid G, A],$$

[7] Adopting G does not necessarily mean that the firm totally changes its production process. For example, the firm can merely adopt new production technology to run alongside existing production processes, or may merely experience a management reorganization unrelated to production technology. The key points are that the firm has a new cash flow generator, and must pay a fixed proportion, i, of the value of the underlying assets of the growth option.

[8] The setup and derivation in this section closely follow those of Malchow-Møller and Thorsen (2005). Also, this specification of the value function follows from the infinite horizon models described in Dixit and Pindyck (1994).

$$(r-\alpha_G)Gdt - iG + (1+rdt)^{-1}E[V(G+dG, G+dA) \mid G, A=G]\}, \qquad (2.3)$$

where r is the discount rate. Invoking Ito's lemma, the continuation region of an unlevered firm is given by the partial differential equation:

$$\frac{1}{2}\sigma_A{}^2 A^2 V_{AA}^{"} + \frac{1}{2}\sigma_G{}^2 G^2 V_{GG}^{"} + \rho AG\sigma_A\sigma_G V_{AG}^{"} + \alpha_A A V_A^{'} + \alpha_G G V_G^{'} - rV + (r-\alpha_A)A = 0 \, .$$

(2.4)

Assuming $V(G, A)$ is homogeneous, the normalized value of the firm can be defined as

$$v(w) = A^{-1}V(G, A), \qquad (2.5)$$

where w = G/A. Following standard arguments (see Dixit and Pindyck (1994) and Malchow-Møller and Thorsen (2005)), Equation (4) reduces to the following ordinary differential equation:

$$v(r-\alpha_A) + w(\alpha_A - \alpha_G)v' + \frac{1}{2}w^2(2\sigma_A\sigma_G - \sigma_A^2 - \sigma_G^2)v" = r - \alpha_A, \qquad (2.6)$$

with the following general solution:

$$v = A_1 w^{a_1} + A_2 w^{a_2} + K, \qquad (2.7)$$

where a_1, a_2, A_1, A_2 and K are constants. Substituting Equation (7) into Equation (6) and appealing to standard arguments, firm value is given by:

$$v = A_1 w^{a_1} + 1, \qquad (2.8)$$

where:

$$a_1 = \frac{1}{2} - \frac{\alpha_G - \alpha_A}{\sigma_A^2 + \sigma_G^2 - 2\rho\sigma_A\sigma_G} + \sqrt{\left(\frac{1}{2} - \frac{\alpha_G - \alpha_A}{\sigma_A^2 + \sigma_G^2 - 2\rho\sigma_A\sigma_G}\right)^2 + \frac{2(r-\alpha_A)}{\sigma_A^2 + \sigma_G^2 - 2\rho\sigma_A\sigma_G}} > 1. \qquad (2.9)$$

2.1.1 Growth Firms

Growth firms expand into different channels whenever optimal (e.g., firms with high R&D). If the value of the assets underlying the growth option reaches λA, the firm invests by paying iG, where λ is the value of G/A at the exercise boundary. The firm invests again when G reaches the next exercise boundary, $\lambda^2 A$. By the Law of Motion (i.e., the "Clean Surplus" relation in accounting) for capital stock assuming no depreciation, investment cost iG will be accumulatively recorded as book equity BE (also see Cooper, 2006). The value matching condition for this repeated option is:

$$v(\lambda) = \lambda v(1) - i\lambda \,. \tag{2.10}$$

Equation (10) takes the explicit form: $V(G,A) = V(G,G) - iG$ at the optimal exercise boundary.

Growth firms have an infinitely repeating sequence of growth opportunities.[9] When the firm invests, A is replaced by G, and investment cost iG is deducted from firm value. Applying value matching and smooth pasting conditions to the general solution (Equation (8)), I obtain the following expression for the normalized value of the growth firm (see Appendix A for derivation):

$$V(G,A) = \frac{\lambda^{-a_1}}{a_1 - 1} G^{a_1} A^{1-a_1} + A \,, \tag{2.11}$$

and the following implicit trigger point function:

$$(1-i)(1-a_1) = \lambda^{-a_1} - a_1 \lambda^{-1} \,. \tag{2.12}$$

2.1.2 Value Firms

Value firms are by nature less inclined to invest. Utilities are a common example. The firm's optimal policy is to invest by paying *iG* when *G* reaches *λA* from below. Investment cost *iG* will be recorded only once as book equity *BE*. The value matching condition for the value firm is:

$$v(\lambda) = \lambda - i\lambda \,. \tag{2.13}$$

Equation (13) takes the explicit form: $V(G,A) = G - iG$ at the optimal exercise boundary.

Value firms have a single growth option. Applying value matching and smooth pasting conditions to the general solution (Equation (8)), I obtain the following expression for the normalized value of the value firm (see Appendix B for derivation):

$$V(G,A) = \left((1-i)/a_1\lambda^{a_1-1}\right)G^{a_1}A^{1-a_1} + A \,, \tag{2.14}$$

and the following implicit trigger point function:

$$\lambda = \frac{1}{(1-\frac{1}{a_1})(1-i)} \,. \tag{2.15}$$

2.1.3 Optimal Investment Policies

By substituting $\lambda = G/A$ into Equation (15), the value firm trigger point function may be re-expressed as

$$A + \frac{1}{a_1}G(1-i) = G(1-i) \,. \tag{2.16}$$

[9] The explicit form is derived by substituting v=V/A and λ =G/A and making use of the homogenous property for G/A and V.

The left-hand side of Equation (16) is the value of the live growth option, and the right-hand side is the cost of keeping it alive. If the firm retains the option, it expects to receive the cash flows from the assets-in-place, A, plus an "adjusted value" offered by the option, $[1/a_1]G(1\text{-}i)$. The term $1/a_1$ adjusts for uncertainty ($a_1 > 1$; Equation (9)) associated with option exercise. Therefore, $[1/a_1]G(1\text{-}i) < G(1\text{-}i)$. Also:

$$\left|\frac{\partial[A+(1/a_1)G(1-i)]}{\partial i}\right| \quad < \quad \left|\frac{\partial[G(1-i)]}{\partial i}\right|, \tag{2.17}$$

implying that a higher i reduces the benefit of option retention, albeit to a smaller degree than the corresponding cost reduction. The net effect is that firms delay investment because the benefit of retention becomes relatively greater than the corresponding cost. Similarly, since $\frac{\partial a_1}{\partial \alpha} < 0$, $\frac{\partial a_1}{\partial \sigma} < 0$, $\frac{\partial a_1}{\partial r} > 0$, and $\frac{\partial a_1}{\partial \rho} > 0$ an increase in α or σ and a decrease in r or ρ increases the benefit of holding the option, inducing the firm to wait longer.

The growth firm trigger function (Equation (12) may be expressed as:

$$A + \frac{1}{a_1}G(1-i) = G(1-i) + \frac{1}{a_1}G^{1-a_1}A^{a_1}, \tag{2.18}$$

where

$$\frac{1}{a_1}G^{1-a_1}A^{a_1} = \left(1-\frac{1}{a_1}\right)\left[V(G,G)-G\right], \tag{2.19}$$

and $[V(G,G) - G]$ is the difference in the trigger value for growth and value firms. For a given A, G in Equation (16) will be greater than G in Equation (18) because the second term on the right-hand side of Equation (18) is always positive. This implies that growth firms invest earlier than value firms. Changes in parameters i, α, σ, r, and ρ affect the value firm's trigger differently from growth firms. An increase in i has an additional effect by reducing the cost of option retention. A higher i has a larger effect on the growth firm trigger vis-à-vis the value firm.

2.1.4 Propositions

I formulate the following propositions from my model:

Proposition 1: Growth firms, with greater investment flexibility from repeated growth opportunities, invest faster and exhibit "less lumpy" investment processes.

Proposition 2: Growth firms have lower book-to-market ratios than value firms.

Proposition 3: The optimal investment policy depends on economic conditions.

Proposition 4: BE/ME ratios fall (rise) during business expansions (contractions).[10]

Proposition 5: Real option models that incorporate investment irreversibility and cash-flow risk are sufficient to generate the value stock return effect.

Proposition 1 is supported by my model (cf. Equations (2.16) and (2.18)), and likewise Proposition 3 (cf. Equations (2.12) and (2.15)).

2.2 Numerical Solutions

2.2.1 Firm Value and Present Value of Growth Opportunities

Base case parameter values are presented in Table C.1. Table C.2 applies the base case parameter values for Equations (2.11) and (2.14) to decompose firm value (*V*) into the present value of growth opportunities (*PVGO*) and the present value of expected cash flows generated by assets-in-place (*A*).[11] Since $a_1 > 1$, *PVGO* is increasing in *G*/*A*, and it is relatively more sensitive to changes in *G*.

Table C.2 shows how the values of both firm types change as *G* and *A* vary. Panel A shows that the growth firm appreciates more than the value firm as *G* increases (with *A* constant). Since growth and value firms differ solely on the number of growth options, I conclude that the differences in growth opportunities cause the observed effect.

2.2.2 Investment Trigger and Dollar Amount of Investments

Table C.2 also shows that growth firms invest earlier than value firms. The growth firm optimally invests when *G* reaches 1.5635 times greater than *A*. The value firm waits until *G* is 1.6821 times greater than *A*. The value of waiting falls when firms can distribute investments over time (cf. Equations (2.16) and (2.18)). These results support Proposition 1, i.e., growth firms invest faster than value firms. My predictions are supported by Anderson and Garcia-Feijóo (2006), who show that growth (value) firms accelerate (delay) investment prior to portfolio formation year.

The dollar investment per time decreases when the firm can invest over time. Given the same proportional investment cost of 20 percent, my growth firm spends 0.3127 (1.5635 x 0.20) while the value firm spends 0.3364.[12] This finding also supports

[10] See Zhang (2005) who contends that, in bad times, value firms' *ME* suffer more from costly reversibility of unproductive capital and countercyclical price of risk than growth firms.

[11] For my purposes, I define *PVGO* as the difference between firm value and present value of expected cash flows from assets-in-place.

[12] Lumpiness of investment is prevalent in literature when firms face adjustment costs (e.g. Carlson et. al. (2004) and Cooper (2006)). However, in my setting, the adjustment costs are not explicitly separated from investment costs.

Proposition 1 that growth firms pursue less lumpy investment processes than value firms.

The book-to-market ratio increases substantially once firms invest. In Panel A, *BE*/*ME* increases from 0.1545 to 0.3810 for growth firms at the optimal trigger point, and increases from 0.1587 to 0.3986 for value firms. When firms invest, *BE* rises abruptly, but *ME* grows less (cf. Equations (2.11) and (2.14)). For the growth firm, *BE* rises from 0.1545 to 0.3810 and *ME* rises only from 1.2941 to 1.3457.

In summary, Table C.2 shows that: (1) the optimal trigger point occurs sooner for growth firms than for value firms, (2) growth firms pursue less lumpy investment processes, and (3) *BE*/*ME* increases for investing firms.

2.2.3 Business Cycle Effects

I examine business cycle effects by incorporating a time-varying drift. Table C.3 reports findings for expansionary economies in Panel A and for contractionary economies in Panel B. The optimal trigger point occurs later during expansions than contractions (e.g., λ is larger during expansions than contractions). Firms postpone (hasten) investment and pursue more (less) lumpy investment when cash flow growth rises (falls).

The book-to-market ratio is lower during economic expansions than contractions (e.g., *BE*/*ME* is higher when α is negative). Zhang (2005) argues that in economic downturns, value firms are burdened with more unproductive capital and experience more difficulty reducing their capital stock, relative to growth firms (i.e., *BE* stays relatively flat while *ME* drops, causing *BE*/*ME* to rise). Zhang concludes that the net effect is a high dispersion of risk between value and growth strategies in bad times. The discount rate may increase more for value firms than for growth firms during economic contractions. This causes a larger rise in *BE*/*ME* for value firms than for growth firms (Panel D shows that *BE*/*ME* rises as *r* rises).

Consistent with Table C.2, my business cycle findings in Table C.3 indicate that value firms wait longer and pursue lumpier investment processes than growth firms regardless of drift (i.e., λ is higher for value versus growth firms in all economic states). The optimal trigger point for the growth firm is less sensitive to a change in the drift than that of the value firm (i.e., the change in λ between expansions and contractions is much larger for value firms). Value firm investment decisions are more sensitive to economic conditions. These results support Propositions 3 and 4.

2.2.4 Proportional Investment Cost Effects

Table C.3 Panel C demonstrates that optimal trigger points are positively related to proportional investment cost, *i*. Firms wait longer to invest as *i* rises. The optimal trigger point is more sensitive to changes in *i* for growth firms (increasing 118 percent versus a 67 percent increase for value firms). Results also indicate that the *BE*/*ME* ratio is highly sensitive to *i*, varying up to 0.3935 for growth firms and to 0.3941 for value firms over simulated values of *i*. And, as expected, increases in investment cost are associated with decreases in firm value.

Panel C also suggests that value firms incur a high degree of irreversibility. Controlling for *i*, the value firm has a higher trigger point versus growth firms. Given *A*, the value firm will invest with larger *G*, which, in turn, carries a larger investment cost *iG*. Therefore, the value firm faces a lumpier investment, which is associated with greater investment irreversibility.

2.2.5 Discount Rate Effect

Panel D of Table C.3 reports the sensitivity of results to changes in discount rates. An increase in the discount rate (r) causes a decrease in optimal trigger (λ). Both firms invest earlier and pursue less lumpy investment processes. The trigger for the growth firm is less sensitive to the change in discount rate (falling 16 percent versus 35 percent for value firms). This finding is consistent with the contractionary economy results in Panel B because firms are likely to face high hurdle rates during economic downturns (Zhang (2005)). Firms facing high hurdle rates have higher BE/ME ratios (e.g., ranging from 0.1569 to 0.1937 for growth firms and from 0.1741 to 0.1948 for value firms over the simulated values of r).

My model distinguishes growth and value firms solely on the number of growth options. All other parameters are identical. My work does not reveal large differences in BE/ME in direct comparisons of my growth and value firms (controlling for the model parameters). Two interpretations may apply. First, in a controlled environment, BE/ME is unlikely to differ between firms facing different numbers of growth options. Second, BE/ME differences in empirical studies are not caused by growth option differences, but rather to differences in other parameters. In particular, value firms are likely to experience greater irreversibility, implying higher proportional investment costs. Risk-adjusted discount rates are likely to be higher for value firms due to greater cash flow risk. Higher values for both investment cost (irreversibility) and discount rates (cash flow risk) lead to an increase in *BE*/*ME* (Table C.3). These findings support Proposition 2 that growth firms have lower *BE*/*ME* ratios than value firms.

2.3 The Value Stock Premium Simulation Evidence

I test the value stock premium proposition using returns simulated from my model. I derive the value of a_1 in Equation (2.9) using the base case parameters. I then derive the values of optimal triggers in Equations (2.12) and (2.15). Time series of the present value of expected cash-flows for assets-in-place (*A*) for each firm are obtained using the general solution of the diffusion process in Equation (2.1):

$$A_{t_{i+1}} = A_{t_i} \exp\left((\alpha_A - \frac{\sigma_A^2}{2})(t_{i+1} - t_i) + \sigma_A \sqrt{t_{i+1} - t_i} Z_A \right), \tag{2.20}$$

where *Z* is a standard normal random variable. The time series of the present value of expected cash-flows for assets underlying growth options (*G*) are derived using the Lévy representation of Geometric Brownian motion.

I calculate the value of both firm types using Equations (2.11) and (2.14). The book-to-market ratio is set initially to *A* times proportional investment cost *i*. At a trigger point, the new investment cost, *iG,* is accumulated into the previous book-to-market ratio. After calculating firm values, the value of *A* is replaced by its corresponding *G*. This happens once for value firms, but repeatedly for growth firms. The cum-dividend realized rate of return for a firm in month *t* is:

$$\frac{(V_t - \delta_A A_t) - (V_{t-1} - \delta_A A_{t-1}) + \delta_A A_t}{V_{t-1} - \delta_A A_{t-1}}. \tag{2.21}$$

I follow Cooper's (2006) procedure, simulating data for 2,000 firms over 600 months.[13] I derive premiums associated with beta and *BE*/*ME* following Fama and French (1992). Individual stock (pre-ranking) betas are estimated using the 60-month moving window beginning in month 141 (within the total 600 month period). Using data for the remaining 400 months, I sort firms into size deciles and then into beta deciles to obtain a total of 100 sorted (equally-weighted) portfolios. Each portfolio comprises 20 stocks. I run time-series regressions over the entire 400 month period to derive post-ranking beta estimates for the 100 portfolios. Stocks are assigned a beta equal to the post-ranking beta for the portfolio to which they are assigned. For each month in the 400 month performance period, cross-sectional regressions are run to obtain slopes associated with *beta* and *ln*(*BE/ME*):

$$R_{it} = \gamma_0 + \gamma_1 beta_i + \gamma_2 ln(BE/ME)_{i,\ t\text{-}1} + \varepsilon_{it}, \tag{2.22}$$

where $beta_i$ is the post-ranking beta assigned to stock i and $ln(BE/ME)_{i,t\text{-}1}$ is the natural logarithm for the lagged *BE*/*ME* ratio for firm *i*. [14] I average the monthly slopes derived from the 400 cross-sectional regressions. The t-statistics are the averaged slope estimates divided by the corresponding standard error. I run the simulation 100 times. [15]

I form portfolios comprising 50 percent growth stocks and 50 percent value stocks to ensure equal representation across firm types. Results indicate that both *beta*

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[13] I use a risk-free rate of 0.15 percent per month and I use the market-value weighted average return of all firms. to proxy the market portfolio return.

[14] Since the Brownian motion of the present value of expected cash flows of assets-in-place and growth options is, on average, exponentially increasing over time as shown in Equation (2.20), firm size will be positively correlated with firm's realized return in my model (as a consequence of the Brownian motion assumption). Therefore, I do not include *size* in my tests.

[15] I also perform robustness tests to confirm that the value stock return effect still exists even after varying the parameters from their base case settings. Primary results are unchanged.

and *BE/ME* premiums are positive and statistically significant: $\hat{\gamma}_1$ = 0.502 percent and $\hat{\gamma}_2$ = 0.106 percent; *t*-statistics equal 26.66 and 17.60, respectively.[16] My results support Proposition 5 that real options models that incorporate investment irreversibility and cash flow risk are sufficient to produce the value stock return effect.

2.4 Conclusions

I use a real options model to investigate the value stock return anomaly. Firm value evolves in response to optimal investment decisions. These investments generate new cash flows from assets underlying growth options. I focus on the extreme case by designating growth firms as those with infinitely repeated growth opportunities and value firms as those with single growth opportunities.

I document five findings. First, relative to value firms, growth firms invest more quickly and pursue less lumpy investment processes. Second, the optimal investment trigger point depends on economic conditions. Firms postpone (hasten) investment and pursue more (less) lumpy investment if the cash flow growth rate rises (falls). Third, *BE*/*ME* ratios fall (rise) during business cycle expansions (contractions). The change in *BE*/*ME* may be more pronounced for value firms because they likely experience larger discount rate increases during contractions. My business cycle findings are consistent with Zhang (2005), who contends that value firms encounter greater difficulty reducing their capital stock during business contractions. Fourth, value firms experience greater

[16] My beta premium results are similar to those documented in empirical research using *ex-ante* expectational data by Brav, Lehavy, and Michaely (2005). And, my *BE/ME* premium results agree those documented in Cooper's (2006) real options model. Cooper's source of uncertainty is measured by the ratio of the firm's stock of capital to its productivity. This ratio, by construction, is positively correlated to the book-to-market ratio. Therefore, the source of uncertainty also is reflected in the book-to-market

investment irreversibility and cash flow risk, implying higher proportional investment costs and risk-adjusted discount rates. *BE*/*ME* ratios are higher for firms with higher investment irreversibility and cash flow risk, implying higher *BE*/*ME* ratios for value firms. Fifth, my simulated cross-sectional returns test reveals significantly positive *BE*/*ME* premiums controlling for market risk.

My simulation results are consistent with the value stock return effect. Firms facing higher degrees of investment irreversibility and cash flow risk (i.e., value firms) are likely to provide higher rates of return as compensation for risk.

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ratio itself, which would induce a significant *BE/ME* premium. My model, however, is constructed using expected cash flows as the source of uncertainty, yet still produces a significant *BE/ME* premium.

CHAPTER 3

SUSTAINABLE GROWTH AND STOCK RETURNS

In the quest to identify the key determinants of asset pricing, researchers have scrutinized numerous company growth factors and their relationships with stock returns. For example, stock returns have been found to have negative relationships with prior growth rates in sales by Lakonishok, Vishny, and Shleifer (1994), total assets by Cooper, Gulen, and Schill (2006), capital expenditures by Titman, Wei and Xie (2004), Xing (2006), and Anderson and Garcia-Feijóo (2006), market share by Hou and Robinson (2006), and operating efficiencies by Nguyen and Swanson (2007). Berk, Green, and Naik (1999) link dynamic turnover of assets-in-place with low systematic risk and expected returns. And, Fama and French (2006) use classical valuation equations to show that growth in book equity is negatively correlated with returns.

In contrast to most prior studies that examine effects of past growth rates, I focus instead on future growth potential as reflected in the firm's sustainable growth. As defined by Higgins (2007, p. 117), sustainable growth is the "maximum rate at which a company sales can increase without depleting financial resources."[17] Therefore, I contend that sustainable growth, defined as the earnings retention rate times the return on equity, is a more forward-looking factor that investors might use to form

[17] References to sustainable growth date at least as far back as Babcock (1970).

expectations. Sustainable growth does not contain a market value component, and, therefore, does not suffer from investor sentiment or mispricing. The same cannot be said for market capitalization and book-to-market equity factors that are often employed in asset pricing tests (e.g., Berk (1995, 2000)).

Sustainable growth is a multifaceted metric that can be split into separate components or drivers that reflect the company's retention policy, cost containment ability, asset utilization efficiency, and financial leverage strategy, all of which are key determinants of firm performance. In fact, Hou and Robinson's (2006) tests of monopolistic power are closely related to my net profit margin tests. Hou and Robinson find that firms with high monopolistic power have low risk and low expected returns. High monopolistic power usually translates to high profit margins. I should find that firms with high profit margins, are low risk firms, and, therefore, are associated with low required returns.

Combinations of the sustainable growth components also provide important insights. For example, net margin times asset turnover equals return on assets; return on assets times financial leverage equals return on equity; and retention rate times financial leverage is the compound financing factor (reflecting the company's compound strategies to finance operations with retained earnings and debt).

Finally, under certain conditions, namely that the company is reluctant to issue new equity, sustainable growth equals the percent change in book equity. Increases in book equity are used to finance growth in assets, sales, and earnings, all of which have been shown to be significantly related to subsequent stock returns. Therefore, sustainable growth appears to be a key variable that underlies much of the value-growth stock return literature.

I find that sustainable growth is indeed related to risk, using the Vassalou and Xing (2004) default risk classifications. This makes perfect sense because sustainable growth is growth that investors can reasonably expect to persist. Thus, solid sustainable growth implies a solid company and a low-risk stock, and hence, low required returns. My framework is consistent with the notion that growth firms will experience low future returns.

Consistent with my expectations, I find that high sustainable growth firms have low risk, low book equity to market equity (*BE/ME*), and low returns. During the five years prior to portfolio formation based on *BE/ME* ratios, sustainable growth rises for low *BE/ME* firms and falls for high *BE/ME* firms, indicating that the sorting of stocks into *BE/ME* groups also is conditional on changes in sustainable growth. In tests of stock return effects, I find that returns are negatively related to prior sustainable growth, regardless of firm size, or *BE/ME.* Retention rate alone has no discriminatory power, but *ROE* is negatively related to subsequent returns. This finding is consistent with Fama and French's (1995) rational pricing story, in which low equity income to book equity firms have both high *BE/ME* ratios and high required returns. Fama and French contend that low profitability reflects high distress, which, in turn, should be associated with high required returns.

The return on the spread portfolio, long the low sustainable growth stocks and short the high sustainable growth stocks, remains significant after controlling for exposures to the broad market, firm size, and value-growth factors (using the Fama-French 3 factor model specification). The result is unchanged after winsorizing on firm size, *BE/ME*, or sustainable growth. If the three factors properly encompass priced risk, then these findings also suggest that behavioral factors may be at play in which investors drive prices too high for high sustainable growth firms and/or too low for low sustainable growth firms. Alternatively, my findings suggest that premiums based on *BE/ME* classifications should be replaced by premiums based on sustainable growth classifications. Finally, I show that the sustainable growth effect is different from the capital expenditures growth effect of Anderson and Garcia-Feijóo (2006). The correlation between sustainable growth and capital expenditure growth is low, and returns are negatively related to sustainable growth after controlling for capital expenditure growth. Cross-sectional Fama-MacBeth (1973) regressions show that both sustainable growth and capital expenditure growth are significantly (and negatively) related to returns. The *BE/ME* variable is no longer significant after the inclusion of the sustainable growth variable.

3.1 Data Construction

I use monthly 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 such as book value of equity, balance-sheet deferred taxes, and capital expenditures from the Annual Industrial Compustat files. My sample period spans 1975 to 2005. Only firms with ordinary common equity (security type 10 or 11 in CRSP) are included (i.e., ADRs, REITs, and unit of beneficial interest are excluded). To avoid selection/survival bias, firms are not included until they have been in COMPUSTAT for three years. I also exclude financial firms (SIC 6000s). To be comparable to Anderson and Garcia-Feijóo (2006), I also make proper adjustments for delisted firms using Shumway's (1997) methods.

To ensure that accounting information is known before I use it to explain the returns, I 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. Book equity (*BE*) is defined as the book value of common equity (COMPUSTAT item#60) plus balance-sheet deferred taxes (COMPUSTAT item#74). Firms with negative book value of common equity are deleted each year in which negative book equity is recorded. The book-to-market equity ratio (*BE/ME*) is the ratio of book value of equity at the end of fiscal year $t-1$ divided by the market value of equity (stock price times shares outstanding) at the end of December of calendar year $t-1$. Sustainable growth in the formation year *t* is calculated as:

$$SUSG = \frac{BE_{t-1}}{BE_{t-2}} - 1, \tag{3.1}$$

also equal to the product of the retention rate (retained earnings divided by net income), net profit margin (net income divided by sales), asset turnover (sales divided by assets) and financial leverage (assets divided by equity). Conclusions from this paper do not change when redefining *SUSG* equal to the average percentage change in *BE* over the past three years.

3.2 Patterns in Sustainable Growth for Value and Growth Stocks

3.2.1 Characteristics of Sustainable Growth Portfolios

Table C.4 reports characteristics of *SUSG* decile portfolios, winsorized at the 1st and 99th percentiles. I also report results for split halves of deciles 1 (Low *SUSG*) and 10 (High *SUSG*). The data indicate that lower *SUSG* firms tend to have lower levels of sales growth and return on assets, and higher levels of *BE/ME* and default risk.[18,19] Sales growth exceeds sustainable growth for low *SUSG* firms, indicating a potential problem, if unresolved, in which these firms may run short on ways to finance operations.

Findings also show that low *SUSG* firms allocate higher percentages of sales for research and development (*RDSALES*) measured by R&D (COMPUSTAT item#128) divided by sales (COMPUSTAT item#12). This finding is consistent with Hou and

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[18] I use default probabilities provided by Maria Vassalou at her website http://www.maria-vassalou.com/. The default probabilities are available only through 1999, so the default probabilities reported in Table 1 do not span the entire length of my sample period. Means and Medians for the remaining variables in the Table are derived from the entire sample period. I also replicated the calculations for all variables through 1999, with no material change in the patterns.

[19] I ran tests of equality of the mean default probability, *ROA*, and *BE/ME* across the sustainable growth portfolios. The Wilk's Lambda *F* statistic is significant in all cases at the 0.01 level, leading to a rejection of the hypothesis (for each variable) that the means are equal across the portfolios. Similarly, I ran tests on the medians. The non-parametric Kruskal-Wallis chi-square test statistic was significant at the 0.01 level for each variable, also indicating that the hypothesis of equality of medians across the portfolios is rejected.

Robinson (2006) who show that that firms with low market share (and low profit margins) invest a larger percentage of sales on R&D.

Table C.5 reports sustainable growth rates for portfolios sorted on *SIZE* and *BE/ME*. At the end of June of each year *t* (1977 to 2005), I divide the universe of NYSE, AMEX, and NASDAQ stocks into quintiles based on market capitalization and into quintiles based on ranked values of *BE/ME* (*BE* at the end of fiscal year *t*-1 divided by market capitalization at the end of December of calendar year *t*-1). I use NYSE stocks to determine the *SIZE* and *BE/ME* breakpoints, and form 25 portfolios by combining the sorts by *SIZE* and by *BE/ME*. The growth rates are winsorized at their 1^{st} and 99^{th} percentiles. The Table presents both mean and median *SUSG* for each portfolio.

The data reveal negative relationships between average *BE/ME* and *SUSG* within each *SIZE* sort. I note that sorting based on *SIZE* does not produce similarly strong relationships with *SUSG*. Therefore, sustainable growth is related to *BE/ME* characteristic, but not to *SIZE.* Later, I will examine the performance of the *SUSG* portfolios after controlling for *BE/ME* effects. If *SUSG* is subsumed by the *BE/ME* effect, then I should find no abnormal performance for the low and high *SUSG* portfolios after controlling for *BE/ME* effects.

3.2.2 Buy-and-Hold Strategy

Table C.6 presents an analysis of *SUSG* rates for portfolios formed based on *BE/ME* for years surrounding the portfolio formation year. At the end of June of each year *t* (from 1977 to 2005), I divide the universe of NYSE, AMEX, and NASDAQ stocks into three groups (low, medium, or high; L, M, or H) based on the NYSE breakpoints for the bottom 30 percent, middle 40 percent, and top 30 percent of ranked *BE/ME* ratios (book equity at the end of fiscal year $t-1$ divided by market equity at the end of December of calendar year $t-1$). For each of the 11 years surrounding the portfolio formation year (year 0), I derive mean and median *SUSG* across all stocks in the portfolio. Then, the yearly means and medians are averaged over the sample period. Means and medians are reported in Panels A and B, respectively.

Findings indicate that *SUSG* increases for growth firms (low *BE/ME*) and decreases for value firms (high *BE/ME*) in the years leading up to portfolio formation. Therefore, these results show that sorting of stocks into value and growth categories is also conditioned on previous *changes* in *SUSG*. My results show that not only is *SUSG* much higher for growth firms versus value firms, but that the spread in *SUSG* between the two groups widens in the years prior to portfolio formation. For example, the spread widens from 0.081 to 0.346 using the mean *SUSG* or from 0.034 to 0.131 using the median *SUSG*. Also, note that the spread narrows considerably during the post formation period from 0.346 to 0.123 using the mean *SUSG* or from 0.131 to 0.036 using the median *SUSG*.

Figure D.1 illustrates these patterns for median values of *SUSG*. Presumably, as the post-formation *SUSG* gap narrows, investors will adjust required returns upward for growth stocks and downward for value stocks to reflect changing views of risk, resulting in immediate valuation improvements for value stocks relative to growth stocks. This rational pricing story is consistent with the observed value-growth performance dichotomy.

3.3 Effects of Sustainable Growth on Stock Returns

3.3.1 Returns for Portfolios Formed Based on Sustainable Growth

I examine the performance of portfolios formed based on *SUSG*, *BE/ME,* and *SIZE*, after sorting stocks independently on each variable. In June of each year *t* (1977 to 2005), I form 5 portfolios based on ranked *SIZE* and ranked *BE/ME* using NYSE quintile breakpoints. I also sort stocks independently into quintiles based on sorted *SUSG*.

Results for the single-sort and double-sort portfolios are presented in Table C.7. Panels A and B report equal-weighted and value-weighted averages, respectively, for *BE/ME* and *SIZE* sorted groups. Panels C and D report results for the *SUSG* and *SIZE* sorted groups. I follow Shumway's (1997) methods to mitigate survivorship bias for delisted stocks. Panels A and B confirm that mean returns are higher for high *BE/ME* and small stocks in both single and double sort portfolios.

Panels C and D report results for the *SUSG-SIZE* sorted portfolios. Returns are higher for the low versus high *SUSG* portfolios with or without considering *SIZE*. For example, for small firms, the mean monthly value-weighted returns drop from 1.90 percent for low-*SUSG* stocks to 1.11 percent for high-*SUSG* stocks, and, for large firms, the mean monthly value-weighted returns drop from 1.35 percent for low-*SUSG* stocks to 1.10 percent for high-*SUSG* stocks. The annualized difference in value-weighted returns between single-sort low and high *SUSG* stocks equals 4.78 percent. Coupled with Table C.4, Table C.7 shows that lower *SUSG* firms, on average, have higher default probability, lower profitability, higher *BE/ME*, and higher subsequent stock returns.[20]

3.3.2 Times-Series Portfolio Regression Tests

None of the results presented thus far control for differences in risk between low and high *SUSG* firms. In Table C.4, I showed that, on average, lower *SUSG* firms are associated with higher default probabilities. I now perform tests based on the Fama-French 3-factor model, controlling for exposures of the *SUSG* portfolios to broad market (stock market risk premium), firm size (small minus big stock return premium), and distress risk (high minus low *BE/ME* stock premium).

Table C.8 presents results derived from the Fama-French 3-factor model:

$$R_P - R_F = a_p + b_p(R_M - R_F) + s_P(SML) + h_P(HML) + e_P \,, \qquad (3.2)$$

where R_P is the value-weighted return on portfolio *P* formed based on *SUSG* stock sorts (decile 1 consists of lowest *SUSG* stocks and decile 10 consists of highest *SUSG* stocks), R_M is the CRSP (Center for Research in Security Prices) return on the value-weighted market index of all NYSE, AMEX, and NASDAQ stocks, R_F is the return on the 30-day treasury bill, *SML* is the small minus large stock return premium, and *HML*

[20] This paper shows that the mean *BE/ME* is higher for low *SUSG* firms, but I also find that the average rank correlation between *BE/ME* and *SUSG* is only -0.32, indicating that sorts of stocks into *SUSG* portfolios are not identical to sorts of stocks into BE/ME portfolios. Therefore, my *SUSG* portfolios are not merely *BE/ME* portfolios in disguise.

is the high minus low *BE/ME* stock return premium.[21] Slope coefficients *b*, *s*, and *h* measure the sensitivity or exposure of the portfolio to changes in each of the three factors. According to the Fama-French model, firms with high factor loadings have high systematic risks. The intercept measures the average abnormal performance of the portfolios. Decile portfolios 1 and 10 are split into halves 1A (lowest *SUSG*), Low 1B, and High 10A, and High 10B (highest *SUSG*), respectively. The final rows of the table present results for the spread portfolios (low *SUSG* portfolio returns minus high *SUSG* portfolio returns). Regression are run using monthly returns over 1977-2005. *t*-statistics are reported below the parameter estimates.

Findings indicate that the low *SUSG* portfolio returns match the 3-factor benchmark return. As expected, these portfolios exhibit higher risk; e.g., high beta, small value stock compositions. After controlling for exposures to the three factors, the portfolio return appears to have matched the higher required return (alpha is small). In contrast, the highest *SUSG* portfolios underperformed the 3-factor benchmark returns (monthly alpha for Decile 10 equals -0.38 percent and for Decile 10B equals -0.92 percent). The factor sensitivities indicate that the *SUSG* portfolios are high beta, small growth stocks. The spread portfolio alphas are large and significant (monthly alphas equals 0.55 percent for the decile 1-10 spread and 1.15 percent for the 1A-10B spread). These findings indicate that my earlier priors that high *SUSG* firms are low risk firms may not hold for the highest *SUSG* firms, at least when considering exposures to the

[21] Factor data and risk-free rates are derived from Professor Kenneth French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

broad market and small firm premiums. My results indicate that the high *SUSG* portfolio did not deliver the returns commensurate with its factor exposures. Finally, note that the 1A minus 10B spread portfolio was neutral to the broad market and firm size effects on average over 1977-2005. But, even after controlling for the differential exposures to the *HML* factor, the spread alphas remain large, mostly attributable to the negative positions in the high *SUSG* stocks. In other words, a long-only strategy would not have delivered abnormal performance, based on segmentation of stocks by *SUSG*.

3.3.3 Cross-Sectional Firm-Level Regression Tests

Table C.9 reports the results of tests patterned after Fama and MacBeth (1973) and Fama and French (1992). Each month from July 1977-July 2005, cross-sectional regressions are run in which individual stock returns are regressed against various combinations of *SIZE*, *BE/ME*, and *SUSG*:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\ln(SIZE_{it-1}) + \gamma_{2t}\ln(BE/ME_{it-1}) + \gamma_{3t}\ln(1 + SUSG_{it-1}) + \varepsilon_{it}\ , \qquad (3.3)$$

where for month t, R_{it} is the return on stock i, and the definitions previously provided apply to *SIZE, BE/ME*, and *SUSG.* γ_{1t} is the slope associated with firm size, γ_{2t} is the slope associated with book-to-market, γ_{3t} is the slope associated with sustainable growth, The time subscripts on *SIZE*, *BE/ME*, and *SUSG* correspond to the lagged observations for these variables. For each version of the model, a total of 348 regressions are performed (one regression for each month, July 1977 – July 2005). The monthly gamma estimates are averaged over the 348 months, and *t*-statistics are used to test for significance. The *t*-statistics are calculated from the means and standard deviations across the 348 gamma values for a given factor. Explanatory variables in each regression are winsorized at their 1st and 99th percentiles. Initially, I run tests to confirm previous findings of *SIZE* and *BE/ME* for my data during 1977-2005. Then, I present results of tests including *SUSG*.

My initial tests confirm that *SIZE* and *BE/ME* have significant explanatory power for the cross-section of average stock returns. As shown in columns 1-3 of Table C.9, slopes for both ln(*SIZE*) and ln(*BE/ME*) are significant at the 0.05 level. Slope estimates are negative and significant for ln(*SIZE*) in cross-sectional regressions including size alone (column 1), or along with ln(*BE/ME*) (column 3). Similarly, slope estimates are positive and significant for ln(*BE/ME*) in both regressions (columns 2 and 3, respectively). Therefore, as shown in previous research, large firms and low *BE/ME* firms are associated with smaller average returns.

Column 4 reports results of cross-sectional regressions using sustainable growth as the sole explanatory variable. As expected, the *SUSG* slope coefficient is negative and significant. Therefore, the regression confirms my earlier findings that lower stock returns accrue for firms with higher sustainable growth. Also, data reported in column 5 indicate that the sustainable growth contributes significantly to the cross-section of average returns even after controlling for *SIZE* and *BE/ME* effects. The *BE/ME* effect is no longer significant at the 0.05 level, after controlling for differences in *SUSG* across stocks. Therefore, when purged of *SUSG* effects, *BE/ME* loses its ability to explain the cross-section of stock returns. My findings are consistent with the Cooper, Gulen, and Schill (2006) argument that growth variables are the best cross-sectional determinants of returns.

3.3.4 Sustainable Growth Decomposition

Sustainable growth can be decomposed as follows:

$$SUSG = RR \text{ x } NPM \text{ x } ATO \text{ x } FL, \tag{3.4}$$

where *RR* is retained earnings (year *t*-1) divided by net income (year *t*-1), *NPM* is net income (year *t*-1) divided by sales (year *t*-1), *ATO* is sales (year *t*-1) divided by total assets (year *t*-2), and *FL* is total assets (year *t*-2) divided by book equity (year *t*-2).

Table C.10 reports results of Fama-MacBeth (1973) regressions using various combinations of the *SUSG* components:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\ln(1 + SUSG^{*}_{it-1}) + \varepsilon_{it}, \tag{3.5}$$

where $SUSG^*$ is the result of equation (4) after removing components. Panel A reports results for tests in which the time-series average slope estimate was significant at the 0.10 level. Panel B reports all insignificant results. Nearly all tests that included the net profit margin were statistically significant. These results are consistent with Hou and Robinson (2006) who argue that barriers to entry drive up net profit margins, leading to lower risk and required returns.[22]

I also augment the tests to include a capital expenditure growth variable. Anderson and Garcia-Feijóo (2006) find that growth in capital expenditures is negatively correlated with subsequent returns, and argue that growth rates in capital expenditures can be used to proxy the exercise of growth options (Berk, Green, and

Naik's (1999)). To determine if my *SUSG* effects are independent of *CAPEX* effects, I examine the effects of both variables together. For each firm, I define capital expenditure growth as the percent change in capital expenditures:

$$CEGTH = \frac{CAPEX_{t-1}}{CAPEX_{t-2}} - 1, \qquad (3.6)$$

where *CAPEX* is the firm's capital expenditures (COMPUSTAT item#128). Findings reported in column 6 of Table C.9 indicate that capital expenditure growth and *SUSG* exert independent effects on stock return differences across firms, even after controlling for more traditional factors encompassing firm size and *BE/ME*. This is an important result indicating that expansionary capital expenditure and book equity programs often precede sub-par stock performance, after controlling for firm size and value/growth (*BE/ME*) differences. Also, note that *BE/ME* is no longer significant in regressions that include both growth variables.[23] Therefore, the *BE/ME* effect is subsumed by the growth effects reflected in capital expenditure and book equity growth.

3.4 Conclusions

I examine the relationships between stock returns and sustainable growth defined as the percent change in book equity. Sustainable growth affects potential asset

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[22] I ran tests of relationships between net profit margins and Vassalou and Xing's (2004) default probabilities. Default probabilities increase monotonically when moving from high to low NPM portfolios.

[23] Consistent with Anderson and Garcia-Feijóo (2006), I also find that *BE/ME* also is no longer significant in regressions with *SIZE*, *BE/ME*, and *CEGTH*.

growth which, in turn, underlies the sales and earnings growth potential of the firm. I contend that sustainable growth is a forward-looking factor that investors may implicitly consider when forming expectations. Solid sustainable growth implies a solid company and a low-risk stock, and hence, low required returns. My framework is consistent with the notion that growth firms will experience low future returns, and compliments much of the existing literature examining relationships between stock returns and past growth realizations.

I document five major findings. First, the sorting of stocks into value (high book-to-market equity) and growth (low book-to-market equity) categories is conditioned on prior sustainable growth. High sustainable growth firms, on average, tend to be low book-to-market equity firms, and tend to have experienced recent increases in sustainable growth. The reverse is true for value stocks. Second, sustainable growth is related to default risk. Risk is higher for low sustainable growth firms. Third, returns are negatively related to past sustainable growth. This result is consistent with a risk proposition, in which lower sustainable growth firms are higher risk firms. I also show that the gap in sustainable growth between high and low book-to-market equity firms narrows during the portfolio post-formation years. The narrowing gap may also explain the higher post-formation returns for the previously classified low sustainable growth stocks. Fourth, the return on the spread portfolio, long the low sustainable growth stocks and short the high sustainable growth stocks, remains significant after controlling for exposures to broad market, firm size, and value-growth factors (using the Fama-French 3 factor model specification). These findings suggest that behavioral factors may be at play in which investors drive prices too high for high sustainable growth firms and/or too low for low sustainable growth firms. Or, they may merely imply that a stock return premium conditioned on *SUSG* extremes is a more appropriate risk premium versus the traditional *HML* premium conditioned on *BE/ME* extremes. Fifth, I show that sustainable growth is a key determinant of the cross-section of returns. The sustainable growth effect subsumes the book-to-market equity effect, and persists after controlling for capital expenditure growth.

APPENDIX A

DERIVATION OF EQUATIONS (11) AND (12)

The first derivative of Equation (10) is the smooth pasting condition:

$$v'(\lambda) = v(1) - i\,. \tag{A.1}$$

Equating the first derivative of Equation (8) at the trigger point to Equation (A.1) yields

$$v(1) = A_1 a_1 \lambda^{a_1 - 1} + i\,. \tag{A.2}$$

By substituting Equation (A.2) into the value matching condition, Equation (10), I obtain

$$v(\lambda) = A_1 a_1 \lambda^{a_1}\,. \tag{A.3}$$

The constant A_1 can be obtained by substituting Equation (A.3) into the general solution, Equation (8), at the trigger point:

$$A_1 = \frac{\lambda^{-a_1}}{a_1 - 1}\,. \tag{A.4}$$

Therefore, the de-normalized value of the growth firm can be derived as follows:

$$v(w) = \left(\frac{\lambda^{-a_1}}{a_1 - 1}\right) w^{a_1} + 1\,, \tag{A.5}$$

$$\frac{V(G, A)}{A} = \frac{\lambda^{-a_1}}{a_1 - 1}\left(\frac{G}{A}\right)^{a_1} + 1\,, \tag{A.6}$$

$$V(G, A) = \frac{\lambda^{-a_1}}{a_1 - 1} G^{a_1} A^{1-a_1} + A\,. \tag{A.7}$$

Equation (A.5) also implies that:

$$v(1) = \frac{\lambda^{-a_1}}{a_1 - 1} + 1\,, \tag{A.8}$$

and

$$v(\lambda) = \frac{\lambda^{-a_1}}{a_1 - 1}\lambda^{a} + 1 = \frac{a_1}{a_1 - 1}. \tag{A.9}$$

Substituting Equations (A.8) and (A.9) into the value matching condition, Equation (10), yields Equation (12):

$$(1 - i)(1 - a_1) = \lambda^{-a_1} - a_1\lambda^{-1}. \tag{A.10}$$

APPENDIX B

DERIVATION OF EQUATIONS (14) AND (15)

The value matching condition for the value firm is:

$$v(\lambda) = \lambda - i\lambda \,. \tag{B.1}$$

Equation (B.1) takes the explicit form: $V(G,A) = G - iG$ at the optimal exercise boundary. That is, value firms in my model face a single growth option. The corresponding smooth pasting condition is:

$$v'(\lambda) = 1 - i \,. \tag{B.2}$$

Equating the first derivative of Equation (8), at the trigger point, to the smooth pasting condition, Equation (B.2) yields

$$A_1 = (1-i)/a_1\lambda^{a_1-1} \,. \tag{B.3}$$

The de-normalized value of the value firm is derived as follows:

$$v(w) = \left((1-i)/a_1\lambda^{a_1-1}\right)w^{a_1} + 1 \,, \tag{B.4}$$

$$\frac{V(G,A)}{A} = \left((1-i)/a_1\lambda^{a_1-1}\right)\left(\frac{G}{A}\right)^{a_1} + 1 \,, \tag{B.5}$$

$$V(G,A) = \left((1-i)/a_1\lambda^{a_1-1}\right)G^{a_1}A^{1-a_1} + A \,. \tag{B.6}$$

The trigger point for the value firm is obtained by substituting the optimal normalized value function into Equation (B.1):

$$\lambda = \frac{1}{(1-1/a_1)(1-i)} \,. \tag{B.7}$$

APPENDIX C

TABLES

Table C.1 Base Case Parameter Values

The base-case parameter values are as follows. The initial value of assets-in-place (A), the volatility of assets-in-place (σ_A), the drift of assets-in-place (α_A), the initial value of asset underlying the growth option (G), the volatility of the asset underlying the growth option (σ_G), the drift of the assets underlying the growth option (α_G), the correlation between assets-in-place and the assets underlying the growth option (ρ), the proportional investment cost of exercising the growth option (i), and the discount rate (r). The values for the drift rates and standard deviations are chosen from Dixit and Pindyck (1994) page 72. Initial book equity is proportional to the initial investment cost of assets-in-place, iA.

Variable	Value
A	1
σ_A	5.77% per month
α_A	0.75% per month
G	1
σ_G	5.77% per month
α_G	0.75% per month
ρ	0.8
i	20%
r	1.5% per month

Table C.2 Effects of Assets-in-Place and Growth Options on Firm Decision, Firm Value, Book Equity, and Book-to-Market Ratio

he normalized value of assets underlying the growth option (w) is the ratio of the present value of expected cash flows of asset underlying the growth ption (G) to the present value of expected cash flows of assets-in-place (A). The investment decision is characterized by the normalized underlying of rowth option at which the firm exercises the growth option given the following parameter values: the value of assets-in-place (A) is fixed at 1.0, the olatility of assets-in-place (σ_A) is 5.77 percent per month, the drift of assets-in-place (α_A) is 0.75 percent per month, the initial value of asset underlying the rowth option (G) is 1.0, the volatility of the asset underlying the growth option (σ_G) is 5.77 percent per month, the drift of the assets underlying the growth ption (α_G) is 0.75 percent per month, the correlation between assets-in-place and the assets underlying the growth option (ρ) is 0.8, the proportional nvestment cost of exercising the growth option (i) is 20 percent, and the discount rate (r) is 1.5 percent per month. The table reports the firm value (V) of oth growth and value types. The cost of investment (iG) is accumulatively recorded as book equity (BE) for growth firms but is recorded just once for value irms. The initial value of the book equity is the proportional investment cost (i) of the initial value of assets-in-place (A). Panel A illustrates the results of ncreasing G, with A constant. Panel B illustrates the results of decreasing A, with G constant. The bold numbers indicate values at trigger points

ormalized Underlying of rowth Option ($w = G/A$)	Growth			Value			Book Equity		*BE/ME*	
	Firm Value	*PVGO*	*A*	Firm Value	*PVGO*	*A*	Growth	Value	Growth	Value
anel A (Increasing G)										
.0000	1.0607	0.0607	1.0000	1.0456	0.0456	1.0000	0.2000	0.2000	0.1886	0.1913
.1000	1.0879	0.0879	1.0000	1.0662	0.0662	1.0000	0.2000	0.2000	0.1838	0.1876
.2000	1.1234	0.1234	1.0000	1.0928	0.0928	1.0000	0.2000	0.2000	0.1780	0.1830
.3000	1.1685	0.1685	1.0000	1.1268	0.1268	1.0000	0.2000	0.2000	0.1712	0.1775
.4000	1.2249	0.2249	1.0000	1.1692	0.1692	1.0000	0.2000	0.2000	0.1633	0.1711
.5000	1.2941	0.2941	1.0000	1.2213	0.2213	1.0000	0.2000	0.2000	0.1545	0.1638
.5635	**1.3457**	**0.3457**	**1.0000**	1.2600	0.2600	1.0000	**0.5127**	0.2000	**0.3810**	0.1587
.6821	NA	NA	NA	**1.3457**	**0.3457**	**1.0000**	NA	**0.5364**	NA	**0.3986**
anel B (Decreasing A)										
.1000	0.989	0.0799	0.9091	0.9692	0.0601	0.9091	0.2000	0.2000	0.2022	0.2064
.2000	0.9362	0.1029	0.8333	0.9107	0.0774	0.8333	0.2000	0.2000	0.2136	0.2196
.3000	0.8988	0.1296	0.7692	0.8667	0.0975	0.7692	0.2000	0.2000	0.2225	0.2308
.4000	0.8749	0.1606	0.7143	0.8351	0.1208	0.7143	0.2000	0.2000	0.2286	0.2395
.5000	0.8628	0.1961	0.6667	0.8142	0.1475	0.6667	0.2000	0.2000	0.2318	0.2456
.5635	**0.8607**	**0.2211**	**0.6396**	0.8059	0.1663	0.6396	**0.4000**	0.2000	**0.4647**	0.2482
.6821	NA	NA	NA	**0.8**	**0.2055**	**0.5945**	NA	**0.4000**	NA	**0.5000**

Table C.3 Sensitivity Analysis of Optimal Trigger, Firm Value, and Book-to-Market Ratio

The optimal trigger (λ) is the ratio ($w = G/A$) of the present value of cash flows of asset underlying the growth option to the present value of cash flows of assets-in-place associated with the optimal investment point for the firm to invest. I use the following parameter values: value of assets-in-place (A) is 1.0, the volatility of assets-in-place (σ_A) is 5.77 percent per month, the drift of assets-in-place (α_A) is 0.75 percent per month, the value of asset underlying the growth option (G) is 1.0, the volatility of the asset underlying the growth option (σ_G) is 5.77 percent per month, the drift of the assets underlying the growth option (α_G) is 0.75 percent per month, the correlation between assets-in-place and the assets underlying the growth option (ρ) is 0.8, the proportional investment cost of exercising the growth option (i) is 20 percent, and the discount rate is 1.5 percent per month. With optimal trigger, the corresponding firm value (V) can be determined. The cost of investment iG is accumulatively recorded as book equity BE for the growth firm but will be recorded just a single time for value firm.

	Optimal Trigger (λ)		Firm Value		*BE/ME*	
	Growth	Value	Growth	Value	Growth	Value
Base Case	1.5635	1.6821	1.0607	1.0456	0.1886	0.1913
Panel A. Sensitivity Analysis for α in a business expansion cycle						
α = 0.0065	1.5490	1.6522	1.0533	1.0409	0.1899	0.1921
α = 0.0070	1.5559	1.6664	1.0568	1.0432	0.1892	0.1917
α = 0.0080	1.5717	1.6995	1.0651	1.0484	0.1878	0.1908
α = 0.0085	1.5806	1.7192	1.0701	1.0515	0.1869	0.1902
Panel B. Sensitivity Analysis for α in a business contraction cycle						
α = -0.0065	1.4562	1.4902	1.0187	1.0162	0.1963	0.1968
α = -0.0070	1.4542	1.4872	1.0181	1.0158	0.1964	0.1969
α = -0.0080	1.4504	1.4815	1.0172	1.0150	0.1966	0.1970
α = -0.0085	1.4486	1.4789	1.0167	1.0146	0.1967	0.1971
Panel C. Sensitivity Analysis for i						
i = 0	1.0000	1.3456	1.3456	1.1088	0.0000	0.0000
i = 0.1	1.3250	1.4952	1.1156	1.0722	0.0896	0.0933
i = 0.3	1.8374	1.9223	1.0324	1.0271	0.2906	0.2921
i = 0.4	2.1825	2.2427	1.0166	1.0149	0.3935	0.3941
Panel D. Sensitivity Analysis for r						
r =0.009	1.7899	2.4053	1.2750	1.1487	0.1569	0.1741
r =0.012	1.6276	1.8321	1.1005	1.0693	0.1817	0.1870
r =0.018	1.5256	1.6069	1.0426	1.0337	0.1918	0.1935
r =0.021	1.4996	1.5601	1.0323	1.0265	0.1937	0.1948

Table C.4 Characteristics of Sustainable Growth Portfolios

This table reports means for selected characteristics for the sustainable growth decile portfolios. Deciles 1 and 10 are split into halves Low-A and Low-B for decile 1 and High-A and High-B for decile 10. Panel A presents means. For each portfolio and year, each variable is averaged across stocks. Means equal the time-series averages computed over all years. *SUSG* is sustainable growth (percentage change in book value of equity at the end of fiscal year $t-1$ relative to book value of equity at the end of fiscal year $t-2$). *SG* is sales growth (percentage change in sales at the end of fiscal year $t-1$ relative to sales at the end of fiscal year $t-2$). *DIFF* is the *SG-SUSG* difference. *DEFPROB* is the default probability at the end of June of each year *t*. *ROA* equals net income at the end of fiscal year $t-1$ divided by total assets at the end of fiscal year $t-2$. *RDSALES* is R&D divided by sales ratio (R&D at the end of fiscal year $t-1$ divided by sales at the end of fiscal year $t-1$). *BE/ME* is book-to-market ratio (the ratio of book value equity at the end of fiscal year $t-1$ divided by the market value of equity at the end of December of calendar year $t-1$). The variables are winsorized at their 1st and 99th percentiles.

SUSG Portfolio	*SUSG*	*SG*	*DIFF*	*DEFPROB*	*PROF*	*RDSALES*	*BE/ME*
Low-A	-0.49	0.04	0.52	0.12	-0.28	0.55	0.74
Low-B	-0.25	0.06	0.30	0.07	-0.16	0.45	1.00
2	-0.11	0.06	0.17	0.05	-0.07	0.30	1.06
3	-0.02	0.07	0.08	0.04	0.00	0.17	1.08
4	0.03	0.08	0.04	0.02	0.03	0.12	1.03
5	0.07	0.11	0.03	0.02	0.05	0.08	0.95
6	0.11	0.14	0.02	0.02	0.06	0.08	0.83
7	0.15	0.17	0.02	0.01	0.07	0.09	0.72
8	0.22	0.22	0.00	0.01	0.09	0.10	0.62
9	0.36	0.30	-0.07	0.02	0.09	0.18	0.55
High-A	0.67	0.42	-0.26	0.02	0.07	0.26	0.51
High-B	1.64	0.58	-0.94	0.03	0.02	0.42	0.45

Table C.5 Sustainable Growth Sorted by Size and Book-to-Market

At the end of June of each year *t*, *t* = 1977 to 2005, I divide the universe of NYSE, AMEX, and NASDAQ stocks into five groups based on their *SIZE* (price times shares outstanding, at the end of June of year *t*), and into five groups based on ranked values of book-to-market ratio (*BE/ME*, the ratio of book value of equity at the end of fiscal year $t-1$ divided by market value of equity at the end of December of calendar year $t-1$). Firms with negative book value of common equity are excluded in the year in which the negative book equity is recorded. I use NYSE stocks to determine the *SIZE* and *BE/ME* breakpoints. I form 25 portfolios by combining the sorts by *SIZE* and by *BE/ME*. *SUSG* is sustainable growth (percentage change in book value of equity at the end of fiscal year $t-1$ relative to book value of equity at the end of fiscal year $t-2$). For each portfolio, the table reports mean and median sustainable growth rates. The growth rates are winsorized at their 1st and 99th percentiles.

SUSG	Small Firm		2		3		4		Large Firm	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Low *BE/ME*	0.26	0.14	0.37	0.23	0.39	0.24	0.30	0.21	0.23	0.16
2	0.19	0.13	0.26	0.15	0.20	0.14	0.17	0.13	0.13	0.10
3	0.13	0.09	0.15	0.10	0.14	0.10	0.13	0.09	0.14	0.08
4	0.08	0.06	0.11	0.08	0.12	0.08	0.11	0.07	0.10	0.07
High *BE/ME*	0.00	0.01	0.07	0.04	0.06	0.03	0.09	0.05	0.09	0.07

Table C.6 Sustainable Growth in the 11 Years around Portfolio Formation

he end of June of each year *t*, *t* = 1977 to 2005, I divide the universe of NYSE, AMEX, and NASDAQ stocks into three groups (low, medium, or high; L, M, I) based on breakpoints for the bottom 30 percent, middle 40 percent, and top 30 percent of the ranked values of the book-to-market ratio (*BE/ME*, the ratio of k value of equity at the end of fiscal year $t-1$ divided by market value of equity at the end of December of calendar year $t-1$). Firms are deleted in any year which their *BE* is negative. I use NYSE stocks to determine the *BE/ME* breakpoints. For each portfolio and each of the 11 years surrounding the portfolio nation year (year 0), mean and median *SUSG* are derived across stocks in the portfolio. Yearly means and medians are then averaged over the sample period. *G* is percentage change in book value of equity at the end of fiscal year $t-1$ relative to book value of equity at the end of fiscal year $t-2$.

	Year *i* Relative to Portfolio Formation										
	-5	-4	-3	-2	-1	0	1	2	3	4	5
	Panel A. Mean of Sustainable Growth for *t+i*										
Low *BE/ME*	0.302	0.300	0.352	0.413	0.428	0.494	0.651	0.478	0.407	0.305	0.295
High *BE/ME*	0.221	0.192	0.189	0.174	0.136	0.148	0.006	0.069	0.106	0.171	0.172
	Panel B. Median of Sustainable Growth for *t+i*										
Low *BE/ME*	0.121	0.125	0.130	0.136	0.147	0.165	0.168	0.127	0.102	0.094	0.089
High *BE/ME*	0.087	0.083	0.079	0.070	0.055	0.034	0.028	0.041	0.044	0.049	0.053

Table C.7 Average Monthly Returns for Single- and Double-Sort Portfolios

In June of each year *t*, *t*=1977 to 2005, stocks are classified independently into five *SIZE* portfolios and five *BE/ME* portfolios using NYSE quintile breakpoints. Stocks also are classified independently into quintile portfolios based on *SUSG*. The equal-weighted monthly portfolio returns are calculated for July of year *t* to June of year *t* + 1. The value-weighted monthly portfolio returns are calculated for July of year *t* to June of year *t* + 1 using *SIZE* of June in year *t*. Returns for stocks delisted for performance reasons are adjusted according to Shumway (1997). Panels A and B report average returns for the intersections of the *BE/ME* and *SIZE* groups. Panels C and D report average returns for the intersections of *SUSG* and *SIZE* groups.

Panel A: Average Equally Weighted Monthly Percent Returns by *SIZE* and *BE/BE*

	All	Small SIZE	2	3	4	Large SIZE
All	1.76	2.06	1.42	1.46	1.41	1.31
Low *BE/ME*	1.38	1.62	1.20	1.35	1.46	1.33
2	1.61	1.88	1.41	1.53	1.46	1.33
3	1.81	2.16	1.63	1.56	1.38	1.31
4	1.77	2.03	1.54	1.40	1.43	1.23
High *BE/ME*	2.38	2.55	1.60	1.94	1.41	1.48

Panel B: Average Value Weighted Monthly Percent Returns by *SIZE* and *BE/ME*

	All	Small SIZE	2	3	4	Large SIZE
All	1.25	1.65	1.41	1.46	1.40	1.22
Low *BE/ME*	1.23	1.30	1.21	1.34	1.45	1.24
2	1.27	1.58	1.40	1.55	1.43	1.25
3	1.30	1.71	1.62	1.52	1.37	1.22
4	1.33	1.84	1.53	1.41	1.42	1.22
High *BE/ME*	1.52	2.06	1.59	1.97	1.44	1.35

Panel C: Average Equally Weighted Monthly Percent Returns by *SIZE* and *SUSG*

	All	Small SIZE	2	3	4	Large SIZE
All	1.76	2.06	1.42	1.46	1.41	1.31
Low *SUSG*	2.23	2.44	1.46	1.73	1.41	1.58
2	1.89	2.24	1.52	1.49	1.41	1.48
3	1.72	2.00	1.59	1.62	1.41	1.29
4	1.68	1.91	1.62	1.55	1.58	1.32
High *SUSG*	1.27	1.47	1.08	1.04	1.28	1.15

Panel D: Average Value Weighted Monthly Percent Returns by *SIZE* and *SUSG*

	All	Small SIZE	2	3	4	Large SIZE
All	1.25	1.65	1.41	1.46	1.40	1.22
Low *SUSG*	1.45	1.90	1.39	1.75	1.35	1.35
2	1.41	1.81	1.50	1.49	1.39	1.43
3	1.21	1.78	1.57	1.60	1.41	1.16
4	1.34	1.65	1.61	1.54	1.59	1.26
High *SUSG*	1.06	1.11	1.11	1.04	1.25	1.10

Table C.8 Time Series Regressions

This table presents alphas (a) and factor loading estimates from the Fama-French 3-factor model. b is the loading of market risk premium. s is the loading of size premium. h is the loading of value premium. The decile portfolios are formed using sustainable growth (*SUSG*). Decile 1 consists of the lowest *SUSG* stocks, and Decile 10 consists of the highest *SUSG* stocks. Spread is the hedge portfolio that takes a long position in the lowest *SUSG* (Low) and short position in the highest *SUSG* (High). Deciles 1 and 10 are split in half into 1A and 1B and into 10-A and 10-B, respectively. Regression are run using monthly returns over 1977-2005. t-statistics are reported below the parameter estimates.

SUSG Portfolio	*a*	*b*	*s*	*h*
1A (lowest)	0.0023	1.292	0.422	0.300
	0.76	17.53	4.43	2.67
1B	0.0004	1.036	0.216	0.3310
	0.18	20.33	3.28	4.27
1	0.0016	1.100	0.231	0.272
	0.83	22.41	3.65	3.64
2	-0.0011	1.075	0.114	0.392
	-0.74	30.42	2.49	7.30
3	0.0020	0.971	-0.022	0.227
	1.83	35.24	-0.61	5.41
4	0.0010	0.916	-0.163	0.247
	0.79	30.28	-4.18	5.37
5	0.0013	0.887	-0.240	0.154
	1.32	35.36	-7.40	4.02
6	-0.0003	0.947	-0.199	0.074
	-0.27	37.68	-6.12	1.92
7	0.0005	0.904	-0.203	0.094
	0.44	35.07	-6.10	2.40
8	0.0023	1.026	-0.079	-0.108
	1.96	34.60	-2.06	-2.39
9	-0.0001	1.097	0.053	-0.397
	-0.10	36.85	1.38	-8.77
10	-0.0038	1.292	0.293	-0.436
	-2.13	29.03	5.11	-6.44
10A	-0.0006	1.222	0.297	-0.355
	-0.30	23.50	4.43	-4.48
10B (highest)	-0.0092	1.396	0.334	-0.560
	-4.27	26.02	4.83	-6.87
1 minus 10	0.0055	-0.192	-0.062	0.707
	2.02	-2.86	-0.72	6.93
1A minus 10B	0.0115	-0.103	0.087	0.860
	3.05	-1.10	0.72	6.03

Table C.9 Average Slopes from Cross-Sectional Regressions of Monthly Returns on Firm Size, Book-to-Market Ratio, and Sustainable Growth

Each month during July 1977-July 2005, monthly returns for individual stocks are regressed against the natural logarithms of *SIZE, BE/ME,* and 1+*SUSG.* Returns for stocks delisted for performance reasons are adjusted according to Shumway (1997). *SIZE* is measured as the market value of equity (price times shares outstanding) measured in June of year *t*., *t* = 1977 to 2005. *BE/ME* is the ratio of book value of equity at the end of fiscal year $t - 1$ divided by the market value of equity at the end of December of calendar year $t - 1$. *SUSG* is percentage change in book value of equity at the end of fiscal year $t - 1$ relative to book value of equity at the end of fiscal year $t - 2$. *CEGTH* is the analogous percent change in capital expenditure. In the regressions, the explanatory variables for individual stocks are matched with CRSP returns for the months from July of year *t* to June of year $t + 1$. Explanatory variables in each regression specification are winsorized at their 1st and 99th percentiles. The table presents the time-series average slopes and *t*-statistics computed over the 348 month period.

	(1)	(2)	(3)	(4)	(5)	(6)
ln(*SIZE*)	-0.0020		-0.0017		-0.0015	-0.0014
	-3.41		-2.55		-2.35	-2.25
ln(*BE/ME*)		0.0042	0.0025		0.0019	0.0016
		4.48	2.13		1.67	1.36
ln(1+*SUSG*)				-0.0097	-0.0066	-0.0058
				-4.89	-4.26	-3.74
ln(1+*CEGTH*)						-0.0017
						-3.94

Table C.10 Average Slopes from Cross-Sectional Regressions of Monthly Returns on SUSG Components

Each month, the natural logarithms of individual stock returns are regressed on the natural logarithm of 1 plus various combination products of the sustainable growth components: *RR, NPM, ATO,* and *FL,* where *RR* is retained earnings (year *t*-1) divided by net income (year *t*-1), *NPM* is net income (year *t*-1) divided by sales (year *t*-1), *ATO* is sales (year *t*-1) divided by total assets (year *t*-2), and *FL* is total assets (year *t*-2) divided by book equity (year *t*-2). Returns for stocks delisted for performance reasons are adjusted according to Shumway (1997). In the regressions, the explanatory variables for individual stocks are matched with CRSP returns for the months from July, year *t* to June, year *t* + 1. The time-series average slope and associated t-statistic are presented each set of regressions. Explanatory variables in each regression specification are winsorized at their 1st and 99th percentiles. Panel A report results of all tests that were significant at the 0.10 level. Panel B reports results that were not significant at the 0.10 level.

Panel A: Statistically Significant		
Specification	Average slope	*t*-statistic
NPM x ATO x FL	-0.0060	-1.78
RR x NPM x FL	-0.0089	-5.58
RR x NPM x ATO	-0.0185	-4.68
NPM x FL	-0.0098	-2.59
RR x NPM	-0.0048	-6.26
NPM	-0.0133	-2.08
Panel B. Not Statistically Significant		
RR x ATO x FL	-0.0005	-0.75
ATO x FL	0.0004	0.29
NPM x ATO	-0.0095	-1.42
RR x FL	-0.0003	-0.51
RR x ATO	-0.0004	-0.77
RR	-0.0002	-0.46
ATO	0.0004	0.22
FL	-0.0016	-0.93

APPENDIX D

FIGURES

Figure D.1. Median Sustainable Growth for Low and High BE/ME Stocks. Stocks are classified into high and low *BE/ME* groups as of the end of June of each year (t) from 1977 through 2005. I use NYSE breakpoints to classify stocks into low *BE/ME* (bottom 30 percent) and high *BE/ME* (top 30 percent) groups. *BE/ME* is the ratio of book equity at the end of fiscal year $t - 1$ divided by market equity at the end of December of calendar year $t - 1$. Firms are deleted in any year in which their *BE* is negative. For each portfolio and each of the 11 years surrounding the portfolio formation year (year 0), the median *SUSG* is derived, and then averaged throughout the sample period. Sustainable growth is the percentage change in book value of equity at the end of fiscal year $t - 1$ divided by book value of equity at the end of fiscal year $t - 2$.

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