Product Market Competition and Equity Returns*

Evgeny Lyandres† Masahiro Watanabe‡

September 26, 2010

JEL Classification: G12

Keywords: product market competition, endogenous pricing kernel, expected returns.

*We thank Felipe Aguerrevere, Tomio Arai, Aditya Kaul, Lars-Alexander Kuehn, Vikas Mehrotra, seminar participants at the University of Alberta and Waseda University, and session participants at the Northern Finance Association Meetings and the Nippon (Japanese) Finance Association Meetings for helpful comments.

†Boston University School of Management, 595 Commonwealth Avenue, Boston, MA 02215. Phone: (617) 358-2279, Fax: (617) 353-6667, E-mail: lyandres@bu.edu, URL: http://people.bu.edu/lyandres/.

‡School of Business - FMS, University of Alberta, Edmonton, Alberta T6G 2R6, Canada. Phone: (780) 492-7343, Fax: (780) 492-3325, E-mail: masahiro.watanabe@ualberta.ca, URL: http://www.ualberta.ca/~masa/.

Product Market Competition and Equity Returns

ABSTRACT

We develop an analytically tractable equilibrium model to examine the link between firm competition and stock returns. Firms sell their products to consumers in an oligopolistic product market. Investors provide financing to firms and receive firm profits as investment returns. This implies that more profitable firms earn higher returns, and allows us to quantify a premium such firms earn relative to their less profitable industry peers. The model further suggests that the size, value, and investment effects may partly arise at the industry level. We provide empirical support for the model's predictions.

This paper develops a model that links the competitive structure of product markets to firms' expected equity returns. As noted by Hou and Robinson (2006), this link, while quite intuitive, has largely been unexplored both theoretically and empirically. On the empirical side, Hou and Robinson document a negative relation between equity returns and industry concentration. Hoberg and Phillips (2009) find that high industry-level stock market valuation, investment, and financing precede low stock returns in competitive industries.[1] In fact, there are reasons to believe that the nature and extent of product market competition can affect expected returns. Firms' operations consist of a series of activities. They perform initial market research, develop appealing products, secure financing from investors, engage in production, and finally sell the products to consumers. The nature of competition in product markets affects firms' behavior in almost every phase of this process. Firms' product market strategies influence their profits, free cash flows, and investors' valuation of these cash flows in financial markets. In short, product market competition can be value-relevant.

We explicitly model the interaction between investors, firms, and consumers in the presence of oligopolistic product market competition. Risk-averse consumers make optimal purchase decisions while facing uncertainty about the future performance of firms' products. Firms seek to maximize their expected profits net of production costs, conditional on their competitors' product market strategies. Competition affects firms' value because equilibrium prices of their products are affected by the output choices of their rivals. Investors optimally allocate funds to maximize their expected utility, thereby providing financing to firm production. At this financing stage the technological progress that firms will be able to make is uncertain, and so are the future selling prices of their products. This makes firm earnings and equity payoffs risky, for which investors command compensating expected returns. This way, firm competition in product markets connects to expected returns in equity markets.

Our model makes two primary theoretical contributions. First, it predicts that firms with higher profits per risk, as measured by the earnings-to-price ratio (EPR), should earn higher subsequent returns. In fact, this is a restatement of our model's premise that firms distribute profits as a stream of dividends, which is valued by investors at the firms' market capitalization.

[1] In addition, Gaspar and Massa (2006) show that firms that enjoy market power and those that operate in concentrated industries have lower idiosyncratic return volatility, while Irvine and Pontiff (2008) associate the positive temporal trend in average idiosyncratic volatility to more intense competition in product markets.

Our model allows us to analyze how the profits are determined in oligopolistically competitive product markets. Intuitively, firms that are more profitable than their industry peers can generate larger cash flows per risk. This is the source of the higher returns on their equity, which we call the competition premium. Since the competition is presumably stronger among firms of similar size within an industry, we expect that the competition premium is larger conditional on the firms' size.

The second contribution links within-industry variation in firm characteristics to expected returns. Specifically, we provide sufficient conditions under which firms with smaller size, higher book-to-market ratios, and lower investment relative to their product market rivals earn higher expected returns, and discuss when these conditions may be satisfied. This suggests the possibility that the existing size, value, and investment effects partly originate at the industry level, but the degree of industry origination will be time-varying.[2]

In the empirical part of the paper we provide evidence consistent with the model's predictions. We compute individual firms' EPR in excess of their industry averages, which are designed to gauge the firms' profitability relative to their industry peers'. Sorting firms on this measure, we find that firms with higher industry-excess EPRs earn higher subsequent returns. Specifically, the zero-cost portfolio that is long the highest and short the lowest excess EPR quintiles earns an average value-weighted return of 38bp per month ($t = 3.07$), which is an estimate of the competition premium. This effect is particularly strong when firms of like-size are compared, to which competition is supposed to be more relevant. In a double sort on size and excess EPR, the competition premium is statistically significant at 1% for all the size quintiles but the largest, ranging between 39bp and 72bp. These premia barely change upon risk-adjustment and deliver the four-factor alphas ranging from 24bp to 72bp, all of which are significant. This result is robust to additionally conditioning on the book-to-market ratio characteristic, to alternative industry classifications, and to alternative earnings measures. We further highlight the difference between our excess EPR portfolios and the raw EPR portfolios, whose return dispersion significantly shrinks after controlling for the value factor, a property known since Fama and French (1996).

[2]For these empirical regularities, see, among others, Fama and French (1993, 1996) and Daniel and Titman (1997) for the size and value effects, and Titman, Wei and Xie (2004), Anderson and Garcia-Feijóo (2006), and Xing (2008) for the investment effect.

Our paper adds to the growing literature that strives to explain stylized facts in equity markets by linking expected returns to firms' real activity. For example, in the real options models of Berk, Green and Naik (1999) and Carlson, Fisher, and Giammarino (2004), in the neoclassical model of Zhang (2005), and in the endogenous pricing-kernel model of Sagi, Spiegel, and Watanabe (2009), firms' physical investment plays a critical role in generating such empirical regularities as the size, value, and investment effects. The models by Gomes, Kogan, and Zhang (2003), Kogan (2004), and Cooper (2006) share similar features. In contrast, the current paper seeks the explanation in product market competition.

Aguerrevere (2009) analyzes how competition in a product market affects the relation between firms' real investment decisions and the dynamics of their asset returns. Using a real options model, he shows that firms in more competitive industries earn higher returns during times of weak demand, while firms in more concentrated industries earn higher returns during times of strong demand. In his model, multiple identical firms choose optimal output levels of a homogeneous product to maximize profits facing an exogenously given demand curve. The firms also make investment decisions to maximize their value, given as the risk-neutral value of future cash flows. In contrast, while firms in our model likewise maximize profits, they do not have an option to expand their productive capacity. This makes the model tractable despite the heterogeneity of firms, multiplicity of products, the additional inclusion of optimizing consumers and investors, and market clearing in both the product and equity markets. This implies that the pricing kernels for firm products and equities are endogenously determined in their respective markets. Regarding the models' implications, Aguerrevere (2009) studies the important link between beta and the book-to-market ratio, whereas we analyze the relation between expected returns and firm characteristics such as intra-industry profitability, size, the book-to-market ratio, and investment, for some of which we provide empirical evidence.

The remainder of the paper is organized as follows. The next section presents the model and analytically solves for its unique equilibrium. Section 2 examines the relation between firm characteristics and expected returns. Section 3 provides empirical evidence for the model's predictions. The last section concludes.

1. A Model of Product Market Competition

1.1 Overview

The model features three dates and three types of agents: firms, consumers, and investors. At date 0, investors make investment decisions to fund their retirement, while facing uncertainty about the technological progress that firms can make. This provides financing to firm production. Firms choose optimal output to maximize their expected profits, taking into account consumers' downward sloping demand curve that they will face in the product markets. At date 1, consumers purchase firms' products to maximize their expected utility under uncertainty about product performance. Firm profits are distributed to investors in the form of equity returns. At date 2, all uncertainty is resolved and consumers derive their utility. Below we provide the details about these agents, starting with the consumers.

1.2 Consumers

Throughout the paper, a lower case italic letter represents a scalar, a lower-case bold letter a vector, and an upper-case bold letter a matrix. There is a single consumption good that serves as the numeraire of the economy. At date 1, consumers make their purchase decisions by allocating their exogenous endowment w_{C_1} to the n products manufactured by firms and a risk-free bond. The bond is in infinitely elastic supply so that it pays a fixed gross interest rate of R_f for the price of unity. Let $\mathbf{q_D}$ be the n vector of consumer demand for the products. Then, the consumers' terminal wealth, w_{C_2}, is given by

$$w_{C_2} = \mathbf{s}'\mathbf{q_D} + R_f w_{C_1}, \tag{1}$$

$$\mathbf{s} \equiv \mathbf{d} - R_f \mathbf{p},$$

where $\mathbf{d}$ is the n vector of product performance measured in units of the single consumption good, $\mathbf{p}$ the n vector of product prices, and $\mathbf{s}$ the n vector of what we call "excess performance," or the vector of net delivery of the consumption good from a unit purchase of each product financed by a short position in the bond. $\mathbf{d}$ is a random vector distributed multivariate normally with mean α and variance $\mathbf{\Psi}$,

$$\mathbf{d} \sim N(\alpha, \mathbf{\Psi}),$$

where α is an n vector and $\mathbf{\Psi}$ is an n by n symmetric positive definite matrix. $\alpha_{\underline{i}}$, the $\underline{i}^{\text{th}}$ element of α, is the expected performance of product $\underline{i}$ measured in units of the consumption good. The under-bar indicates an index to a product here and throughout the paper. $\psi_{\underline{ii}}$, the $\underline{i}$'th diagonal element of $\mathbf{\Psi}$, represents the degree of uncertainty about product $\underline{i}$'s performance, and therefore is a measure of the product's reliability. $\psi_{\underline{ij}}$, the $(\underline{i}, \underline{j})$ off-diagonal element of $\mathbf{\Psi}$ with $\underline{i} \neq \underline{j}$, can be interpreted as the degree of substitutability between products $\underline{i}$ and $\underline{j}$. We will return to this point after deriving the price function for the products.

The consumers maximize expected negative exponential utility, defined over their terminal wealth, w_{C_2}, with constant absolute risk-aversion (CARA) coefficient θ_C:

$$\max_{\mathbf{q_D}} \mathbb{E}_1[u(w_{C_2})] = -\exp(-\theta_C CE_C), \tag{2}$$

$$CE_C \equiv \mathbb{E}_1(w_{C_2}) - \frac{\theta_C}{2}\mathbb{V}\text{ar}_1(w_{C_2}), \tag{3}$$

where CE_C is the certainty equivalent of the consumers' terminal wealth and the time subscripts on the expectation and variance operators indicate conditioning on their information set at date 1. Since w_{C_2} is distributed normally, maximizing the CARA utility in (2) is equivalent to maximizing the certainty equivalent in (3). This yields the first order conditions,

$$\mathbb{E}_1(\mathbf{d}) - R_f\mathbf{p} - \theta_C \mathbb{V}\text{ar}_1(\mathbf{d})\mathbf{q_D} = 0. \tag{4}$$

Solving (4) for the date-1 product prices results in the price function for the n firms' products,

$$\mathbf{p} = \frac{1}{R_f}(\alpha - \theta_C \mathbf{\Psi}\mathbf{q}), \tag{5}$$

where we have imposed the market clearing condition,

$$\mathbf{q_D} = \mathbf{q}, \tag{6}$$

and $\mathbf{q}$ is the vector representing the units of the n products supplied by the firms. $\mathbf{q}$ is determined through firms' profit maximization, which will be introduced below. As in a standard mean-variance problem, the consumers' expected excess "payoffs" are linear in supply:

$$\mathbb{E}(\mathbf{s}) = \theta_C \mathbf{\Psi} \mathbf{q}. \tag{7}$$

Note that the price function in (5) is equivalent to the reduced-form demand curve in a Cournot-type competition with heterogeneous products (e.g., Vives (1999)). To see this, write its $\underline{i}$'th element as

$$p_{\underline{i}} = \frac{1}{R_f} \left(\alpha_{\underline{i}} - \theta_C \sum_{\underline{j}=1}^{n} \psi_{\underline{i}\underline{j}} q_{\underline{j}} \right),$$

where $q_{\underline{j}}$ is the $\underline{j}$'th element of $\mathbf{q}$. Each diagonal element of $\mathbf{\Psi}$ represents the effect of an increase in a firm's output on its own product price. Each off-diagonal element of $\mathbf{\Psi}$, $\psi_{\underline{i}\underline{j}}$, represents the effect of a change in product $\underline{j}$'s output level on the equilibrium price of product $\underline{i}$. The larger $\psi_{\underline{i}\underline{j}}$, the stronger the effect of product $\underline{j}$'s demand on product $\underline{i}$'s equilibrium price. The closer $\psi_{\underline{i}\underline{j}}$ to $\psi_{\underline{i}\underline{i}}$, the closer substitutes products $\underline{i}$ and $\underline{j}$ are. When the two products are produced by different firms, $\psi_{\underline{i}\underline{j}}$ represents the effect of a firm's product market strategy ($q_{\underline{j}}$) on the other firm's equilibrium strategy ($q_{\underline{i}}$) and product value ($p_{\underline{i}}$), and hence the extent of "competitive interaction" among the two firms. When the two products are manufactured by the same firm, $\psi_{\underline{i}\underline{j}}$ measures cannibalization between them.

1.3 Firms

At date 0, k firms compete in the product market, recognizing that they will face the consumers' downward sloping demand curve in (5) when they sell their products in the next period. At this stage, the expected performance α is still uncertain to firms because it will depend on the technological progress that they will be able to make and its ultimate implementation during the manufacturing phase. We express this uncertainty by assuming that α is distributed multivariate normally with mean μ and variance $\mathbf{\Sigma}$,

$$\alpha \sim N(\mu, \mathbf{\Sigma}), \tag{8}$$

where μ is an n vector and $\mathbf{\Sigma}$ is an n by n symmetric positive definite matrix. The off-diagonal elements of $\mathbf{\Sigma}$ represent the correlations among shocks to the firms' technological innovations.

Firm i manufactures m_i products. Its date-1 profit can be written as

$$\pi_i = (\mathbf{p}_i - \mathbf{c}_i)'\mathbf{q}_i, \tag{9}$$

where $\mathbf{p}_i$, $\mathbf{c}_i$, and $\mathbf{q}_i$ are m_i vectors of firm i's portions of the product price vector $\mathbf{p}$, the production cost vector $\mathbf{c}$, and the output vector $\mathbf{q}$, respectively, all of which have length $n = \sum_{i=1}^{k} m_i$. The firm maximizes its expected profit over the output:

$$\max_{\mathbf{q}_i} \mathbb{E}_0(\pi_i) = [\mathbb{E}_0(\mathbf{p}_i) - \mathbf{c}_i]'\mathbf{q}_i. \tag{10}$$

The first order condition is

$$\mathbb{E}_0(\mathbf{p}_i) - \mathbf{c}_i + \frac{\partial \mathbb{E}_0(\mathbf{p}_i')}{\partial \mathbf{q}_i}\mathbf{q}_i = 0. \tag{11}$$

Here, differentiating firm i's portion of Equation (5) by $\mathbf{q}_i$, we have

$$\frac{\partial \mathbb{E}_0(\mathbf{p}_i')}{\partial \mathbf{q}_i} = -\frac{\theta_C}{R_f}\mathbf{\Psi}_{ii}, \tag{12}$$

where $\mathbf{\Psi}_{ii}$ is the m_i by m_i diagonal block of $\mathbf{\Psi}$ in the rows and columns corresponding to firm i. Stacking the first order condition (11) across all firms using (12), (5), and (8) yields

$$\theta_C(\mathbf{\Psi} + \mathbf{G_\Psi})\mathbf{q} = \mu - R_f\mathbf{c}, \tag{13}$$

where $\mathbf{G_\Psi}$ is the block diagonal matrix containing $\mathbf{\Psi}_{ii}$'s in the main diagonal:

$$\mathbf{G_\Psi} \equiv \begin{pmatrix} \mathbf{\Psi}_{11} & \mathbf{0} & \cdots & \mathbf{0} \\ \mathbf{0} & \mathbf{\Psi}_{22} & \ddots & \vdots \\ \vdots & \ddots & \ddots & \mathbf{0} \\ \mathbf{0} & \cdots & \mathbf{0} & \mathbf{\Psi}_{kk} \end{pmatrix}.$$

Solving for $\mathbf{q}$ gives the unique vector of the n firms' equilibrium outputs,

$$\mathbf{q} = \frac{1}{\theta_C}(\mathbf{\Psi} + \mathbf{D_\Psi})^{-1}(\mu - R_f\mathbf{c}). \tag{14}$$

The firms distribute the maximized profits to their shareholders. When there are h_i shares of firm i's equity outstanding, each share receives

$$\pi_i/h_i \equiv v_{1_i} \tag{15}$$

as the dividend.

1.4 Investors

At date 0, investors are born with endowment, w_{I_0}. They live for two periods and derive utility from consumption, or equivalently, wealth at date 1. At date 0 they can invest in the equities of the k firms operating in the industry and the risk-free bond. Let $\mathbf{x}$ be the k vector of investors' demand for the firms' equities. The date-1 wealth of investors, w_{I_1}, is given by

$$w_{I_1} = \mathbf{\Delta v}'\mathbf{x} + R_f w_{I_0}, \tag{16}$$

$$\mathbf{\Delta v} \equiv \mathbf{v}_1 - R_f\mathbf{v}_0, \tag{17}$$

where $\mathbf{v}_0$ is the k vector of date-0 share prices, $\mathbf{v}_1$ the k vector of dividends in (15), and $\mathbf{\Delta v}$ the k vector of excess payoffs, i.e., the net payoffs from a zero-cost portfolio long one share of each equity financed by a short position in the bond.

Investors maximize expected negative exponential utility defined over their date-1 wealth with CARA coefficient θ_I:

$$\max_{\mathbf{x}} \mathbb{E}_0[u(w_{I_1})] = -\exp(-\theta_I CE_I), \tag{18}$$

$$CE_I = \mathbb{E}_0(w_{I_1}) - \frac{\theta_I}{2}\mathbb{V}\text{ar}_0(w_{I_1}).$$

We assume that there is no information asymmetry between firms and investors, and therefore use the same time subscript for the conditional expectation and variance above. In particular, this implies that the investors can solve the firms' problems and know the optimal $\mathbf{q}$ in (14). Thus, the maximized profit in (9) is linear in $\mathbf{p}$ and hence in α, and therefore is normally distributed. Maximizing the certainty equivalent, CE_I, the first-order conditions of the investors' optimization problem in (18) are:

$$\mathbb{E}_0(\mathbf{\Delta v}) - \theta_I \mathbb{V}\mathrm{ar}_0(\mathbf{v}_1)\mathbf{h} = 0, \tag{19}$$

where we have substituted the market clearing condition

$$\mathbf{x} = \mathbf{h},$$

which is the k vector of h_i's. We will see that the choice of $\mathbf{h}$ does not affect expected returns because it does not affect real production.

1.5 Equilibrium Returns

From Equation (19) we can compute expected returns once we calculate $\mathbb{V}\mathrm{ar}_0(\mathbf{v}_1)$ and $\mathbb{E}_0(\Delta\mathbf{v})$, or more precisely $\mathbb{E}_0(\mathbf{v}_1)$ embedded in the latter. First, using the expressions for the equity payoff in (15), the firm profits in (9), and the consumers' pricing in (5), the (i,j)'th element of $\mathbb{V}\mathrm{ar}_0(\mathbf{v}_1)$ is

$$\mathbb{C}\mathrm{ov}_0(v_{1_i}, v_{1_j}) = \frac{\mathbb{C}\mathrm{ov}_0(\pi_i, \pi_j)}{h_i h_j} = \frac{\mathbf{q}_i' \mathbb{C}\mathrm{ov}_0(\mathbf{p}_i, \mathbf{p}_j')\mathbf{q}_j}{h_i h_j} = \frac{\mathbf{q}_i' \mathbf{\Sigma}_{ij} \mathbf{q}_j}{R_f^2 h_i h_j}, \tag{20}$$

where $\mathbf{\Sigma}_{ij}$ is the m_i by m_j block of Σ in the rows and columns corresponding to firms i and j, respectively:

$$\mathbf{\Sigma} \equiv \begin{pmatrix} \mathbf{\Sigma}_{11} & \cdots & \mathbf{\Sigma}_{1k} \\ \vdots & \ddots & \vdots \\ \mathbf{\Sigma}_{k1} & \cdots & \mathbf{\Sigma}_{kk} \end{pmatrix}.$$

Note that the firm output vector $\mathbf{q}$ is not a random vector here, because the investors share the same information set as the firms. Thus, from the i'th element of Equation (19), firm i's expected excess payoff is

$$\mathbb{E}_0(\Delta v_i) = \theta_I \frac{\mathbf{q}_i'(\boldsymbol{\Sigma}_{i1}\mathbf{q}_1 + \cdots + \boldsymbol{\Sigma}_{ik}\mathbf{q}_k)}{R_f^2 h_i} = \frac{\theta_I}{R_f^2 h_i}\mathbf{q}_i'\boldsymbol{\Sigma}_{i\cdot}\mathbf{q}, \tag{21}$$

where $\boldsymbol{\Sigma}_{i\cdot}$ is the rows of $\boldsymbol{\Sigma}$ corresponding to firm i. For $i \neq j$, Equation (21) indicates that the covariance matrix of technological shocks, $\boldsymbol{\Sigma}_{ij}$, also measures how firm j's output choice affects firm i's expected equity payoffs. For this reason, the elements of $\boldsymbol{\Sigma}_{ij}$, $i \neq j$, can also be considered measures of equity substitutability.

To compute date-0 share prices, first use Equations (11) and (12) to evaluate firm i's maximized profit in (10):

$$\max_{\mathbf{q}_i} \mathbb{E}_0(\pi_i) = -\mathbf{q}_i' \frac{\partial \mathbb{E}_0(\mathbf{p}_i')}{\partial \mathbf{q}_i}\mathbf{q}_i = \frac{\theta_C}{R_f}\mathbf{q}_i'\boldsymbol{\Psi}_{ii}\mathbf{q}_i. \tag{22}$$

Then from Equation (15), firm i's expected equity payoff is

$$\mathbb{E}_0(v_{1_i}) = \frac{\mathbb{E}_0(\pi_i)}{h_i} = \frac{\theta_C}{R_f h_i}\mathbf{q}_i'\boldsymbol{\Psi}_{ii}\mathbf{q}_i. \tag{23}$$

By the definition of the expected excess payoffs in (17), firm i's date-0 share price is

$$v_{0_i} = [\mathbb{E}_0(v_{1_i}) - \mathbb{E}_0(\Delta v_i)]/R_f. \tag{24}$$

Then, its expected excess return is

$$\mathbb{E}_0(R_i) = \frac{\mathbb{E}_0(\Delta v_i)}{v_{0_i}} = \frac{\mathbb{E}_0(\Delta v_i)}{[\mathbb{E}_0(v_{1_i}) - \mathbb{E}_0(\Delta v_i)]/R_f} = \frac{1}{[\mathbb{E}_0(v_{1_i})/\mathbb{E}_0(\Delta v_i) - 1]/R_f} \equiv \frac{1}{1/f(m_i, q_i) - 1/R_f}, \tag{25}$$

where

$$f(m_i, q_i) \equiv \frac{1}{\frac{1}{\mathbb{E}_0(R_i)} + \frac{1}{R_f}} = \frac{R_f \mathbb{E}_0(\Delta v_i)}{\mathbb{E}_0(v_{1_i})} = \frac{\theta_I}{\theta_C}\frac{\mathbf{q}_i'\boldsymbol{\Sigma}_{i\cdot}\mathbf{q}}{\mathbf{q}_i'\boldsymbol{\Psi}_{ii}\mathbf{q}_i}, \tag{26}$$

which is the harmonic mean of firm i's expected excess return, $\mathbb{E}_0(R_i)$, and the gross risk-free rate, R_f. This can be readily calculated from the solution for $\mathbf{q}$ in (14), and so can the expected excess return. As noted earlier, the number of shares outstanding does not affect the expected return because it does not influence real production.

2. Firm Competition and Expected Returns

The general model presented in the previous section allows us to analyze the link between product market competition and expected return. In this section, we examine the properties of the equilibrium under tractable assumptions. We first derive the fundamental relation between the earnings-to-price ratio and expected return. We will also demonstrate that empirical regularities such as the size, value, and investment effects can arise at the industry level.

2.1 An Analytical Example

For analytical tractability, assume the following parametrization:

Assumption 1 *(Product homogeneity within a firm and common substitutability)*

$$\mu_i = \mu_i \mathbf{1}_{m_i}, \quad \mathbf{c}_i = c_i \mathbf{1}_{m_i}, \quad \mu_i - R_f c_i > 0 \ \forall i,$$

$$\mathbf{\Psi}_{ij} = \begin{cases} \varsigma_i^2 \begin{pmatrix} 1 & \gamma & \cdots & \gamma \\ \gamma & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \gamma \\ \gamma & \cdots & \gamma & 1 \end{pmatrix} & \text{if } i = j, \\ \gamma \varsigma_i \varsigma_j \mathbf{1}_{m_i} \mathbf{1}'_{m_j} & \text{if } i \neq j, \end{cases} \qquad \mathbf{\Sigma}_{ij} = \begin{cases} \sigma_i^2 \begin{pmatrix} 1 & \rho & \cdots & \rho \\ \rho & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \rho \\ \rho & \cdots & \rho & 1 \end{pmatrix} & \text{if } i = j, \\ \rho \sigma_i \sigma_j \mathbf{1}_{m_i} \mathbf{1}'_{m_j} & \text{if } i \neq j, \end{cases}$$

where $\mathbf{\Psi}_{ij}$ and $\mathbf{\Sigma}_{ij}$ are the m_i by m_j block of $\mathbf{\Psi}$ and $\mathbf{\Sigma}$, respectively, corresponding to the rows and columns for firms i and j.

The inequality restriction requires that a project's net risk-neutral payoff be positive. This ensures that consumers indeed demand the products suppled by the firms, i.e., the product market clears (see Equation (14) and more explicitly Theorem 1 below). The rest of the conditions imply that products are homogeneous within a firm and that both product substitutability parameter, γ, and equity substitutability parameter, ρ, are common across the firms.[3] We argue that these assumptions are not implausible if, for example, a technological shock commonly affects firms in the economy and each firm applies its own implementation of that technology to

[3] We require that $\gamma < 1$ to ensure that the effect of a change in a firm's output on the price of its own product is larger than the effect of a corresponding change in the firm's rivals' outputs (see Vives (1999)). This ensures that $\mathbf{\Psi}$ is positive definite as has been assumed. Similarly, we require that $\rho < 1$.

its products. Note that product reliability, ς_i, and the volatility of the technological shock, σ_i, can still differ across firms. This is where firm heterogeneity can arise, and will be the source of competition premium when firm size is controlled in asset pricing tests. Above, $\mathbf{1}_{m_i}\mathbf{1}'_{m_j}$ is simply an m_i by m_j matrix of ones.

Given product homogeneity within a firm, we look for an equilibrium in which a firm produces the same quantity of each of its products, denoted q_i for firm i. If we indeed find a solution, it is unique since so is q_i in Equation (14). The following theorem summarizes the result:

Theorem 1. *Under Assumption 1, there is a unique equilibrium in which firm i produces the following quantity, q_i, for each of its products:*

$$q_i = \frac{\delta + SR_i/\theta_C}{[2(1-\gamma)+\gamma m_i]\varsigma_i}, \quad SR_i \equiv \frac{\mu_i - R_f c_i}{\varsigma_i}, \quad \delta \equiv \frac{-\gamma \sum_{j=1}^{k} \frac{m_j SR_j}{2(1-\gamma)+\gamma m_j}}{\theta_C \left[1 + \gamma \sum_{j=1}^{k} \frac{m_j}{2(1-\gamma)+\gamma m_j}\right]}.$$

Note that δ is common across firms. Thus, when γ is positive, i.e., products are substitutes, other things being equal firms with larger scopes (m_i) will produce fewer units per product. This can be understood as product cannibalization; the larger a firm's product line-up is, the more it is concerned about the reduced residual demand for its products as it manufactures a larger quantity of a particular product. This way, a firm with a relatively broad scope internalizes the cannibalization effect of increasing output more than a firm with a relatively narrow scope does. In other words, the more dominant a firm is (the higher the m_i), the more similar its optimization problem is to the problem of a monopolist. In contrast, when γ is negative, i.e., products are complements, firms with larger scopes will produce more units per product. This is because the production of complements encourages one another's production. When γ is zero, q_i does not depend on the firms' scopes because a product can be manufactured independently of others. Since $2(1-\gamma)+\gamma m_i > 0$ regardless of the sign of γ due to the positive definiteness of $\mathbf{\Psi}$,[4] ceteris paribus firms with less reliable products (larger ς_i) and lower product Sharpe ratios (SR_i) will produce fewer units of each product.

[4]Specifically, pre- and post-multiplying a vector of ones to $\mathbf{\Psi}_{ii}$ must yield a positive scalar, $\varsigma_i^2[m_i + (m_i^2 - m_i)\gamma] > 0$, which is a sufficient condition for the relation in question.

Equipped with the explicit analytical solution, we are ready to analyze the relation between firm characteristics and expected return in the next section.

2.2 Firm Characteristics and Expected Return

2.2.1 Intra-industry Earnings-to-Price Ratio

A firm's size is measured by the market capitalization of its equity,

$$MV_i \equiv v_{0_i} h_i. \tag{27}$$

From this and the definition of profit in (15), the excess return is given by

$$R_i \equiv \frac{v_{1_i}}{v_{0_i}} - R_f = \frac{\pi_i}{MV_i} - R_f, \tag{28}$$

which immediately yields the following proposition:

Proposition 1. *(Expected return) A firm's expected excess return is given by the ratio of the expected profit to the market capitalization less the gross risk-free rate:*

$$\mathbb{E}_0(R_i) = \frac{\mathbb{E}_0(\pi_i)}{MV_i} - R_f. \tag{29}$$

The ratio in the right hand side of Equation (29) is nothing else than the earnings-to-price ratio. This is due to the assumption that the whole profit is distributed as dividend. To the extent that firms retain earnings and engage in dividend smoothing, the relation in Equation (29) will be violated in the real world. However, the equation underscores Berk's (1995) point that relative firm size measures predict returns because the market value is theoretically inversely related to the risk of the firm. Likewise, the earnings-to-price ratio above is a readily available proxy for risk, potentially measured more accurately than beta. As Berk argues, this provides "a sound theoretical justification for using market value related measures to increase the power of an empirical test." (p.285) Our model's content is then the determination of the profits in Equation (29) through competitive interaction of firms. Intuitively, firms with better products in higher consumer demand should have higher profits (cash flows) per risk which lead to higher expected returns. This is guaranteed when the firms have the same size and the same number of products, as stated in the next proposition:

Proposition 2. *(Expected return and size) If two firms have the same size and the same number of products under Assumption 1, the firm with a better product as measured by a higher SR_i has a higher expected return.*

Another advantage of comparing firms of similar size is that competition is likely fiercest among them if they are within the same industry. This leads to the following hypothesis which we will test in our empirical analysis:

Hypothesis 1 *The positive association between the earnings-to-price ratio and subsequent returns is stronger among firms of similar size within an industry.*

2.2.2 Size, the Book-to-Market Ratio, and Investment

As noted earlier, the model helps us analyze how firm characteristics may relate to expected returns in equilibrium. We define a firm's real investment as the acquisition cost of capital required to produce its output:

$$I_i \equiv \mathbf{c}_i'\mathbf{q}_i = c_i m_i q_i. \tag{30}$$

This coincides with the firm's book value in our model in which firms operate for a single period with no debt. The market value of a firm's output is its size. The book-to-market ratio is then the ratio of these two quantities,

$$BM_i \equiv \frac{I_i}{MV_i} = \frac{c_i m_i q_i}{v_{0_i} h_i}. \tag{31}$$

Finally, compute the harmonic mean of the expected excess return and the gross risk-free rate in (26):

$$f(m_i, q_i) = \frac{\theta_I \sigma_i}{\theta_C \varsigma_i^2} \frac{\rho \sum_{j=1}^{k} m_j q_j \sigma_j + (1-\rho) q_i \sigma_i}{\gamma m_i q_i + (1-\gamma) q_i}. \tag{32}$$

In general, the effect of firm scope on expected return is ambiguous. The next proposition provides sufficient conditions to clear this ambiguity:

Proposition 3. *(Competition in substitutes and intra-industry characteristics) Suppose firm i has a larger scope than firm j, $m_i > m_j$. Under Assumption 1, if products are substitutes ($\gamma \geq 0$), there is a region of the parameter space with the following properties: relative to firm j, (i) firm i's expected excess return is lower, $\mathbb{E}_0(R_i) < \mathbb{E}_0(R_j)$; (ii) firm i's size is larger, $MV_i > MV_j$; (iii) firm i's book-to-market ratio is lower, $BM_i < BM_j$; and (iv) firm i's investment is larger, $I_i > I_j$. A sufficient condition for all these to hold is that*

$$\frac{\sigma_i}{\sigma_j} \leq \frac{\varsigma_i}{\varsigma_j} = \frac{c_i}{c_j} \leq \frac{\mu_i}{\mu_j}. \tag{33}$$

It should be intuitive that firms with larger scopes can have larger market capitalization and larger investment. This, however, makes the behavior of the book-to-market ratio ambiguous because it raises both the numerator and the denominator of Equation (31). Roughly, the equality condition in the middle of Equation (33) suppresses the tendency of high investment firms to be value firms with large assets on their books. The inequality condition for the σ's implies that firm i has a lower risk in the equity market, while that for the μ's, along with the equality constraint, indicates that the same firm has a lower risk per reward in the product market, i.e., a higher product Shape ratio. This guarantees that firm i has a lower expected return in the equity market. The proposition restricts that $\gamma \geq 0$ because positive γ corresponds to competition in strategic substitutes, in which firms' output reaction functions are downward-sloping, i.e., an increase in a firm's output reduces its rivals' profits and optimal output levels. Competition in substitutes has a more intuitive appeal than competition in complements in which an increase in a firm's output positively contributes to its rivals' profits.

Proposition 3 raises the possibility that the size, value, and investment effects may partly originate in product markets, and this industry origination will be time-varying as firms change, presumably improve, the characteristics of their products. Specifically, Equation (33) implies that firms with high-performance, reliable products as indicated by their high product Sharpe ratios *can* be large, growth, high investment firms that earn lower subsequent returns. We emphasize the word "can," because we have only translated the restrictions for the product-market parameters (ς, c, μ) in Equation (33). It is also important to understand that the equation is a sufficient condition. A profitable firm with an innovative technology can earn high subsequent returns per Proposition 1 without being a small, value, or low investment firm. In particular, by no means does Proposition 3 contradict Proposition 2, which says that given an equal amount of risk the firm with a higher cash flow should earn a higher expected return.

3. Empirical Result

This section examines the model's empirical implications. We will construct a version of the earnings-to-price ratio that measures individual firms' profitability relative to their industry peers. Sorting stocks on this measure produces a return premium that is separate from existing anomalies, which we confirm by a battery of robustness tests.

3.1 Data and Methodology

We use ordinary common shares (CRSP share code 10 and 11) on NYSE, AMEX, and NASDAQ (CRSP exchange code 1, 2, and 3) that are commonly included in CRSP and Compustat. We exclude firms in financial industries (the four-digit SIC code in 6000's) because financial products and firms are unlikely to fit the framework developed here. We compute an individual firm's size ($SIZE$) as the product of its share price and the number of shares outstanding from CRSP. The book-to-market ratio (BM) is constructed following Fama and French (1993).

According to Proposition 1, firms with higher earnings-to-price ratios (EPRs) should have higher expected returns. To measure how much of such return dispersion is due to product market competition, we employ a variant of EPR that is designed to gauge individual firms' profitability relative to their industry peers. We use as earnings operating profits, a construct of the price-cost margin that is widely used in the Industrial Organization literature. Following Peress (2008), we compute operating profits by subtracting from sales (Compustat annual Xpressfeed data item $SALE$, FTP data item 12) the cost of goods sold ($COGS$, item 41) and selling general and administrative expenses ($XSGA$, item 189). If any of these three variables is missing, operating income after depreciation ($OIADP$, item 178) is substituted for operating profits. The earnings-to-price ratio, EPR, is then the ratio of operating profits to $SIZE$ in December of the Compustat fiscal year. Our final measure, the excess earnings-to-price ratio ($EEPR$), is the firm's EPR less the average EPR of its industry. We initially define an industry by the four-digit SIC code, but we will examine the robustness to alternative definitions of industry as well as earnings measures. The portfolio that is long highest $EEPR$ firms and short lowest $EEPR$ firms mimics the difference in earnings per risk due to competition within the same industry. We call the return on the long-short portfolio the "competition premium."

To investigate the investment characteristics of firms, we follow Lyandres, Sun, and Zhang (2008) and first calculate investment as the change in gross property, plant and equipment ($PPEGT$, item 7) plus the change in total inventories ($INVT$, item 3). Then, the investment-to-asset ratio (IA) is investment divided by lagged total assets (AT, item 6).

In June of each year we form portfolios and measure value-weighted monthly returns from July through next June. We use size at the end of June and other characteristics at the end of the previous fiscal year for portfolio sorting. Only NYSE firms are used to compute the breakpoints for ranking $SIZE$ and BM, but all firms are included in portfolio formation as well as calculating breakpoints for other characteristics. The final sample is monthly from July 1963 through December 2008.

3.2 The Excess Earnings-to-Price Ratio and Expected Return

Table 1 shows the characteristics of portfolios sorted by the excess earnings-to-price ratios ($EEPR$) and, for comparison purposes, the raw measure (EPR) as well.[5] The top row of Panel A tells us that firms in the lowest quintile make operating losses on average, resulting in a negative EPR. The corresponding row in Panel B indicates that taking the difference from the industry average and resorting on that makes the distribution of $EEPR$ roughly symmetric around zero. The next three rows report the characteristics known to be associated with returns. While the distribution of the investment-to-asset ratio (IA) is similar between the two panels (and interestingly the second quintile has the highest IA), $SIZE$ and BM are more evenly distributed across the quintiles in Panel B. Thus, $EEPR$ is less correlated with these characteristics than raw EPR. The average number of firms (N) implies that each portfolio is well populated on average. The remaining rows show the excess return ($EXRET$)

[5]We form quintile portfolios as one of the decile $EEPR$ portfolios (specifically the sixth decile) turns out to be missing for some periods. This is because there is a non-trivial number of single-firm industries as defined by the four-digit SIC code at some points in time. By construction all these firms have zero $EEPR$ (mainly falling in the fifth decile) and make two consecutive decile ranking breakpoints identical at zero.

as well as the four-factor alpha (α) and betas (β), computed from the regression of each excess portfolio return on the excess market return ($MKTRF$) and the size (SMB), value (HML), and momentum (MOM) factors.[6] First, observe that the excess return strongly increases in EPR in Panel A, resulting in an impressive return spread of 84bp per month ($t = 3.22$) between the two extreme quintiles. However, this spread does not survive the four-factor regression nor does any of the excess quintile portfolio returns; the alphas are all insignificant along the row. The Gibbons-Ross-Shanken (GRS) test fails to reject the hypothesis that the five alphas jointly equal zero ($F = 0.84$, $p = 0.52$). The reason is the strong association between the valueness and EPR, as indicated by β_{HML}, which monotonically increases from -0.79 for the lowest EPR quintile to 0.67 for the highest quintile. This is consistent with Fama and French's (1996, Tables II and III) finding that their three-factor model deprives the earnings-to-price ratio of its cross-sectional explanatory power.

The picture is different for the excess earnings-to-price ratio. Although the return spread between the two extreme $EEPR$ quintiles in Panel B is a modest 38bp, it is significant at 1%. Likewise while the four-factor alpha is smaller at 21bp, it remains significant at 10%. Importantly, the three highest $EEPR$ quintile portfolios have statistically significant alphas. This leads to the strong rejection of the hypothesis that the five alphas jointly equal zero (GRS $F = 3.03$, $p = 0.01$). Another striking difference is the independence of $EEPR$ on the value factor; β_{HML} is generally close to zero along the row, with the largest deviation being only -0.13.

This provides the first glance at the competition premium. We will now examine it among the firms of similar size within an industry for which competition is supposed to be fiercest.

3.3 Competition and Firm Size

To examine the relevance of competition between like-size firms within an industry, we double sort firms on size and the excess earnings-to-price ratio independently into quintiles and form portfolios as their intersections. Table 2 reports the characteristics of the resulting 25 portfolios. Panel A shows that the distribution of $EEPR$ is roughly symmetric around zero within each size quintile. According to Panel B, only smallest firms with lowest EPR within

[6] The four factors are downloaded from Kenneth French's website.

their industries (i.e., lowest $EEPR$) make losses on average. Panel C confirms that the size sorting produces little variation in size along the columns, the important premise for examining the effect of firm competition. However, Panel D indicates that the average book-to-market ratio continues to be highest for highest $EPCM$ firms. Thus, it is important to control for the value factor in the analysis to follow. There is no discernible pattern in the investment-to-asset ratio in Panel E, except for the curious spikes on the smallest two portfolios in the second $EEPR$ rank. The disproportionately large number of firms in the smallest size quintile in Panel F implies that most NASDAQ firms fall in that quintile.

Panel G shows the excess returns. Consistent with Hypothesis 1, the excess return roughly increases with $EEPR$ within each size quintile, producing return spreads between the two extreme $EEPR$ quintiles that are significant for all size quintiles but the largest; the return spreads for the four quintiles range between 39bp and 72bp, all of which are statistically significant at 1%. As we have seen above, $EEPR$ is correlated with BM, which raises a concern that part of the $EEPR$ spread may be the value premium in disguise. The estimated four-factor alphas in Panel H address this concern. Observe that the return spread barely changes upon risk adjustment; the alpha of the zero-cost portfolios ranges between 24bp and 72bp across the four smallest quintiles, all of which are significant at 5% or lower. The Gibbons-Ross-Shanken test strongly rejects the hypothesis that all the 25 alphas are jointly zero ($F = 4.22$, $p < 0.001$). Therefore, the $EEPR$ return spread is unexplained by the most prominent existing factors.

Another way to control for the value characteristics is to further sort firms on the book-to-market ratio. Table 3 summarizes the characteristics of the 27 portfolios formed as the independent intersections of $SIZE$, BM, and $EEPR$ terciles. For simplicity, we focus on the extreme $EEPR$ portfolios. From Panels A and B we see that the triple sorting controls for size and BM fairly well, except possibly for the largest size and highest BM terciles. Panel C reveals that the spikes in the investment-to-asset ratio occur in the uncharacteristic mid BM tercile. Panel D shows that five of the nine spread portfolio returns are significant, ranging from 17bp to 55bp. Again, the spreads barely change upon risk adjustment in Panel E; the six alphas in the smallest and mid size terciles are all statistically significant, varying between 25bp and 60bp. Thus, the returns of $EEPR$ zero-cost portfolios, or the competition premium, cannot be fully explained by existing characteristics for factors.

3.4 Robustness

3.4.1 Alternative Industry Classifications

This section presents robustness of the results presented above. For simplicity, we focus on double sorting on size and the excess earnings-to-price ratio. We first examine the robustness to alternative industry classifications. While the above analysis uses the four-digit SIC code to define industries, here we use the two- and three-digit SIC codes to recalculate the excess earnings-to-price ratio and repeat portfolio formation. Panels A and B of Table 4 present the result. Regardless of industry classification, we observe patterns very similar to the previous one; the spreads of excess returns between the two extreme $EEPR$ quintiles are statistically significant within all size quintiles but the largest, ranging between 42bp and 87bp. The same is true for the four factor alphas, which range from 22bp to 79bp. The Gibbons-Ross-Shanken test continues to reject the hypothesis that all the 25 alphas are jointly zero.

A legitimate question is whether taking the difference from the industry average makes our excess measures any different from the raw earnings-to-price ratio. The answer is yes. For comparison, we perform double sorting on size and the raw earnings-to-price ratio and report the results in Panel C. While the excess return spreads may seem stronger than those based on any of the excess earnings-to-price ratios, this is largely because of the association between raw earnings-to-price ratio and other known characteristics. To see this, notice that, although the spread alphas for the two smallest size quintiles are significant, they are smaller in magnitude at 59bp and 30bp. The largest quintile even has a negative and significant spread in alpha. This implies that the stronger excess return patterns in Panel C are due to the close association between the raw earnings-to-price ratio and the book-to-market ratio (recall the difference in HML loadings between the two panels of Table 1). This suggests that our industry-excess earnings-to-price ratios capture something that the raw measure does not, arguably the difference in individual firm profitability due to competition within an industry.

3.4.2 Alternative Earnings Measures

We further examine the robustness of our results against alternative measures of earnings. Researchers employ different earnings measures in various context. Below we describe several of these with our implementation in parentheses. Fama and French (1992) define earnings as income before extraordinary items (Compustat annual Xpressfeed item IB, FTP data item 18), plus income-statement deferred taxes ($TXDI$, item 50), minus preferred dividends (DVP, item 19) to compute the earnings-to-price ratio. Kenneth French's website posts portfolios sorted on the earnings-to-price ratio based on earnings before extraordinary items (IB, item 18). Vuolteenaho (2002) uses "earnings available for common" (NI, item 172), and if it is missing the clean-surplus formula (the change in book equity defined as the sum of common equity (CEQ, item 60) and preferred stock ($PSTK$, item 130)), to calculate return on equity[7]. Two more readily available measures are worth examining. Operating income before depreciation ($OIBDP$, item 13) is closer to financial cash flows than any type of income after non-cash expenses like depreciation. This measure is used by Sagi, Spiegel and Watanabe (2009). Finally, net income (NI, item 172) is one of the most closely followed earnings figures. This can be viewed as Vuolteenaho's (2002) earnings without the clean-surplus correction. Dividing each of these measures by fiscal-December market equity ($SIZE$) and subtracting the industry average yields five additional measures of excess earnings-to-price ratios.

We first sort firms independently on size and the excess earnings-to-price ratio using the four-digit SIC code. If this produces a missing portfolio in any period, we perform dependent sort on size. If this still leaves missing portfolios, we use the three-digit SIC code to recalculate the excess earnings-to-price ratio and revert to independent sort. Table 5 shows the results with the final choices of sorting and industry definition in its caption. All the five panels repeat the same message: the spreads of both excess returns and the four-factor alphas between the two extreme $EEPR$ portfolios, or the competition premia, are significantly positive within all size quintiles but the largest. In all cases, the Gibbons-Ross-Shanken test strongly rejects the joint hypothesis of zero alphas.

3.5 Discussions–An Industrial Organization Perspective

According to a typical Industrial Organization story, firms under the competitive threat of their industry rivals tend to make lower profits on average. The evidence presented here challenges the view that such firms are riskier and therefore should earn higher expected returns.

[7]Strictly speaking, the clean surplus formula should include dividends as Vuolteenaho does.

Our model helps reconcile this apparent paradox. According to Equation (29), holding the risk priced in the market capitalization constant, firms with higher profits earn higher expected returns. The profits here are the measure of equity payoffs, rather than an inverse measure of risk. And the higher the average profits, the higher the risk investors must bear. This line of reasoning is consistent with Fama and French (2006) who argue that, controlling for the book-to-market ratio and investment, firms with higher profits earn higher returns in a dividend discount framework. In our notation, rewrite Equation (29) using (31):

$$\mathbb{E}_0(R_i) = BM_i \frac{\mathbb{E}_0(\pi_i)}{I_i} - R_f.$$

This expression relates the expected profits, the book-to-market ratio, and investment in a way Fama and French (2006) do. Their argument using the dividend discount framework is valid here because our model can be considered a single-period dividend-discount model. The model extends the idea put forth by Fama and French (2006) by allowing us to analyze how product market competition affects firm profits.

To summarize, we find that firms with higher price-to-earnings ratios relative to their industry peers earn higher subsequent returns. This is consistent with the existence of the competition premium. This effect is particularly strong when firms of like-size are compared, to which competition is supposed to be more relevant. Statistically and economically significant, these effects are not explained by existing characteristics or factors, and are robust to alternative industry classifications and earnings measures.

4. Conclusion

This paper analyzes the mechanism through which product market competition can affect firms' expected returns. We propose an equilibrium model featuring investors, consumers, and firms that compete in an oligopolistic product market.

The model builds on the premise that firms distribute profits as dividends, which are valued by investors at the firms' market capitalization. This justifies the use of the earnings-to-price ratio as a measure of risk and hence as a predictor of future returns. Sorting firms on the earnings-to-price ratio within industries, we find that firms that are more profitable than their industry peers earn higher average returns. The competition premium is significant and robust controlling for factors and characteristics known to be correlated with stock returns. The result suggests that competition among industry rivals is an economically significant determinant of cross-sectional variation in equity returns.

In addition, the model generates numerous empirical predictions relating within-industry firm characteristics to expected returns. Specifically, it provides an industrial-organization-based motivation for the well-known empirical regularities in equity markets, such as the size, value, and investment effects. Our result points to the possibility that these effects partially originate at the industry level through competitive interaction among firms.

Our analysis leaves some interesting agenda for future research. A potential extension of our model includes the analysis of the real options in product markets. In our model, a firm's scope can affect its industry rival's market value and other characteristics through competition. Thus, such an option to expand or contract can have a strategic value and be modeled as an option to alter the scope. Another interesting topic is the risk analysis, for example, through modeling of beta. Although we have focused on the analysis of characteristics in this paper, the model is fully rational and the pricing is purely risk-based. Characteristics really are proxies for, and reflections of, risk. The flexibility of our model may help predict beta using empirically consistent parameter values through calibration.

References

Aguerrevere, Felipe, 2009, "Real Options, Product Market Competition, and Asset Returns," *Journal of Finance* 64 (2), 957-983.

Anderson, Christopher W. and Luis Garcia-Feijóo, 2006, "Empirical Evidence on Capital Investment, Growth Options and Security Returns," *Journal of Finance*, 61, 171-194.

Berk, Jonathan, 1995, "A Critique of Size-Related Anomalies," *Review of Financial Studies* 8 (2), 275-286.

Berk, Jonathan, Richard Green, and Vasant Naik, 1999, "Optimal Investment, Growth Options, and Security Returns," *Journal of Finance*, 54, 1553-1607.

Carlson, Murray, Adlai Fisher, and Ron Giammarino, 2004, "Corporate Investment and Asset Price Dynamics: Implications for the Cross-section of Returns," *Journal of Finance*, 59, 2577-2603.

Cooper, Ilan, 2006, "Asset Pricing Implications of Non-convex Adjustment Costs and Irreversibility of Investment," *Journal of Finance* 61, 139–170.

Daniel, Kent and Sheridan Titman, 1997, "Evidence on the Characteristics of Cross Sectional Variation in Stock Returns," *Journal of Finance*, 52, 1-33.

Fama, Eugene F. and Kenneth R. French, 1993, "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics*, 33, 3-56.

Fama, Eugene F. and Kenneth R. French, 1996, "Multifactor Explanations of Asset Pricing Anomalies," *Journal of Finance*, 51, 55-84.

Fama, Eugene F. and Kenneth R. French, 2006, Profitability, investment and average returns, *Journal of Financial Economics* 82, 491–518.

Fama, E. F. and J. D. MacBeth, 1973, "Risk, Return, and Equilibrium: Empirical Tests," *Journal of Political Economy*, 81, 607-636.

Gaspar, Jose-Miguel and Massimo Massa, 2006, "Idiosyncratic Volatility and Product Market Competition," *Journal of Business*, 79, 3125-3152.

Gomes, Joao, Leonid Kogan, and Lu Zhang, 2003, "Equilibrium cross section of returns," *Journal of Political Economy* 111, 693–732.

Hoberg, Gerard, and Gordon Phillips, 2009, "Real and Financial Industry Booms and Busts," *Journal of Finance*, forthcoming.

Hou, Kewei, and David T. Robinson, 2006, "Industry Concentration and Average Stock Returns," *Journal of Finance*, 61 (4), 1927-1956.

Irvine, Paul J. and Jeffrey Pontiff, 2008, "Idiosyncratic Return Volatility, Cash Flows, and Product Market Competition", *Review of Financial Studies*, forthcoming.

Kogan, Leonid, 2004, "Asset Prices and Real Investment," *Journal of Financial Economics* 73, 411–431.

Lyandres, Evgeny, Le Sun, and Lu Zhang, 2008, "The New Issues Puzzle: Testing the Investment-Based Explanation," *Review of Financial Studies*, forthcoming.

Peress, Joel, 2008, "Product Market Competition, Insider Trading and Stock Market Efficiency," *Journal of Finance*, forthcoming.

Sagi, Jacob, Matthew Spiegel, and Masahiro Watanabe, 2009,"Dynamic Corporate Capital Stocks: Cross-sectional and Inter-temporal Stock Return Patterns," working paper.

Titman, Sheridan, K.C. John Wei, and Feixuo Xie, 2004, "Capital Investments and Stock returns," *Journal of Financial and Quantitative Analysis*, 39, 677-700.

Vives, Xavier, 1999, *Oligopoly Pricing: Old Ideas and New Tools*; MIT Press.

Vuolteenaho, Tuomo, 2002, "What Drives Firm-Level Stock Returns?" *Journal of Finance* 57 (1), 233-264.

Xing, Yuhang, 2008, "Interpreting the Value Effect Through the Q-theory: An Empirical Investigation," *Review of Financial Studies*, forthcoming.

A. Appendix

A.1 Proofs

Proof of Theorem 1

Under Assumption 1, the element for firm i's any product in Equation (13) can be written as

$$[2(1-\gamma)+\gamma m_i]\varsigma_i q_i + \gamma \sum_{j=1}^{k} m_j \varsigma_j q_j = \frac{SR_i}{\theta_C}, \quad i = 1, \cdots, k. \tag{34}$$

Since the summation term is constant across firms, the first term must be a function of SR_i. Guess that it is linear in SR_i,

$$[2(1-\gamma)+\gamma m_i]\varsigma_i q_i = \delta_0 + \delta_1 SR_i, \tag{35}$$

where δ_0 and δ_1 are common across firms. Substitute this into Equation (34) and take the difference between firms i and j. Eliminating the common summation term immediately requires that $\delta_1 = 1/\theta_C$. Substitute this back into (35) and then into (34), sum it across firms, and rearrange to obtain

$$k\delta_0 + k\gamma \sum_{j=1}^{k} m_j \frac{\delta_0 + \frac{1}{\theta_C} SR_j}{2(1-\gamma)+\gamma m_j} = 0.$$

Dropping k and solving for δ_0 produces the expression for δ in the theorem. It is straightforward to confirm the sufficiency. This is the solution for q in Equation (13) because it is unique as in (14). ■

Proof of Proposition 2

Under Assumption 1, a firm's maximized profit in (22) is given by

$$\begin{aligned}\mathbb{E}_0(\pi_i) &= \frac{\theta_C}{R_f}\mathbf{q}_i' \mathbf{\Psi}_{ii} \mathbf{q}_i = \frac{\theta_C}{R_f}\varsigma_i^2 q_i^2 m_i [1-\gamma+\gamma m_i] \\ &= \frac{\theta_C}{R_f} m_i [1-\gamma+\gamma m_i] \frac{(\delta + SR_i/\theta_C)^2}{[2(1-\gamma)+\gamma m_i]^2},\end{aligned}$$

where we have used Theorem 1 in the last equality. Then, if two firms have the same MV_i and m_i, the one with a higher SR_i has a higher expected return by Equation (29). ■

Proof of Proposition 3

Define

$$\xi_i \equiv \frac{\varsigma_i}{\sigma_i}. \tag{36}$$

Using Theorem 1, rewrite Equation (32) explicitly as

$$f(m_i, q_i) = \frac{\theta_I}{\theta_C \xi_i} \frac{\frac{\rho}{\delta + SR_i/\theta_C} \sum_{j=1}^{k} m_j q_j \sigma_j + \frac{1-\rho}{[2(1-\gamma)+\gamma m_i]\xi_i}}{\frac{1-\gamma+\gamma m_i}{2(1-\gamma)+\gamma m_i}}. \tag{37}$$

Note that the summation term is common across firms. Since the following term in the denominator:

$$\frac{1-\gamma+\gamma m_i}{2(1-\gamma)+\gamma m_i} = 1 - \frac{1-\gamma}{2(1-\gamma)+\gamma m_i} \tag{38}$$

increases in m_i when $\gamma > 0$, a sufficient condition for $f(m_i, q_i) < f(m_j, q_j)$ or equivalently $\mathbb{E}_0(R_i) < \mathbb{E}_0(R_j)$ is that

$$SR_i \geq SR_j \;\text{ and } \xi_i \geq \xi_j \Longleftrightarrow \frac{\sigma_i}{\sigma_j} \leq \frac{\varsigma_i}{\varsigma_j}. \tag{39}$$

Next, rewrite Equation (29) as

$$\mathbb{E}_0(R_i) = BM_i \frac{\mathbb{E}_0(\pi_i)}{I_i} - R_f.$$

Since $\mathbb{E}_0(R_i) < \mathbb{E}_0(R_j)$ under condition (39), a sufficient condition for $BM_i < BM_j$ is that $\frac{\mathbb{E}_0(\pi_i)}{I_i} > \frac{\mathbb{E}_0(\pi_j)}{I_j}$. Here, substituting for the optimal $\mathbb{E}_0(\pi_i)$ from Equation (22),

$$\frac{\mathbb{E}_0(\pi_i)}{I_i} = \frac{\frac{\theta_C \varsigma_i^2}{R_f} m_i q_i^2 [1-\gamma+\gamma m_i]}{c_i m_i q_i} = \frac{\theta_C}{R_f} \frac{\varsigma_i}{c_i} \varsigma_i q_i (1-\gamma+\gamma m_i) = \frac{\theta_C}{R_f} \frac{\varsigma_i}{c_i} \left(\delta + \frac{SR_i}{\theta_C}\right) \frac{1-\gamma+\gamma m_i}{2(1-\gamma)+\gamma m_i}, \tag{40}$$

where we have used Theorem 1 in the last equality. Again, since the last term increases in m_i (see (38)), under condition (39) an additional sufficient condition for $\frac{\mathbb{E}_0(\pi_i)}{I_i} > \frac{\mathbb{E}_0(\pi_j)}{I_j}$ is

$$\frac{\varsigma_i}{c_i} \geq \frac{\varsigma_j}{c_j}. \tag{41}$$

Further, from Theorem 1, firm i's investment is

$$I_i = c_i m_i q_i = \frac{c_i m_i (\delta + SR_i/\theta_C)}{[2(1-\gamma)+\gamma m_i]\varsigma_i} = \frac{(\delta + SR_i/\theta_C) c_i}{\gamma \varsigma_i} \left[1 - \frac{2(1-\gamma)}{2(1-\gamma)+\gamma m_i}\right] \text{ if } \gamma > 0. \tag{42}$$

Since the square bracket increases in m_i, we have $I_i > I_j$ if, in addition to condition (39),

$$\frac{c_i}{\varsigma_i} \geq \frac{c_j}{\varsigma_j}.$$

Together with (41), this implies that $\frac{\varsigma_i}{\varsigma_j} = \frac{c_i}{c_j}$.

Finally, under these conditions it is guaranteed that the sizes of the two firms satisfy

$$MV_i = \frac{I_i}{BM_i} > \frac{I_j}{BM_j} = MV_j.$$

A sufficient condition for having all these can be summarized as in Equation (33) of the proposition. ■

Table 1: **Portfolios sorted on raw and excess earnings-to-price ratio**

Panel A: Raw EPR Portfolios

EPR rank	1	2	3	4	5	5-1
EPR	-0.12	0.10	0.18	0.26	0.54	
$SIZE$	261.44	1361.25	1549.25	1175.37	620.91	
BM	0.72	0.58	0.74	0.97	1.55	
IA	0.21	1.29	0.28	0.12	0.12	
N	632.02	658.12	659.09	656.93	650.04	
$EXRET$(%)	-0.02	0.26	0.45	0.58	0.82	0.84
	(-0.07)	(1.16)	(2.44)	(3.22)	(3.81)	(3.22)
	[0.94]	[0.25]	[0.01]	[0.00]	[0.00]	[0.00]
α(%)	-0.14	0.11	0.05	0.03	0.06	0.20
	(-0.90)	(1.63)	(0.88)	(0.49)	(0.77)	(1.08)
	[0.37]	[0.10]	[0.38]	[0.62]	[0.44]	[0.28]
β_{MKTRF}	1.07	1.03	0.96	0.96	1.10	0.03
	(29.10)	(63.23)	(69.89)	(64.66)	(57.86)	(0.75)
β_{SMB}	0.56	-0.04	-0.04	0.02	0.20	-0.36
	(11.42)	(-1.77)	(-2.28)	(1.24)	(7.91)	(-6.08)
β_{HML}	-0.79	-0.38	0.09	0.42	0.67	1.47
	(-14.07)	(-15.22)	(4.44)	(18.55)	(23.11)	(21.62)
β_{MOM}	-0.10	-0.08	0.01	0.00	0.01	0.11
	(-2.63)	(-4.61)	(0.90)	(0.23)	(0.46)	(2.39)
GRS-F(5, 537): 0.84 [p = 0.521]						

Panel B: Excess EPR Portfolios

$EEPR$ rank	1	2	3	4	5	5-1
$EEPR$	-0.28	-0.06	0.00	0.06	0.31	
$SIZE$	836.34	1173.17	1065.51	1128.37	811.19	
BM	0.84	0.70	0.82	0.86	1.33	
IA	0.20	1.20	0.37	0.13	0.12	
N	636.04	655.64	643.37	671.18	649.98	
$EXRET$(%)	0.37	0.33	0.40	0.43	0.75	0.38
	(1.86)	(1.78)	(2.11)	(2.10)	(3.25)	(3.07)
	[0.06]	[0.08]	[0.04]	[0.04]	[0.00]	[0.00]
α(%)	0.00	-0.01	0.08	0.13	0.21	0.21
	(0.05)	(-0.14)	(1.62)	(1.98)	(2.23)	(1.73)
	[0.96]	[0.89]	[0.10]	[0.05]	[0.03]	[0.08]
β_{MKTRF}	1.01	0.95	0.95	0.99	1.06	0.05
	(64.80)	(84.11)	(84.84)	(62.97)	(46.58)	(1.88)
β_{SMB}	-0.02	-0.07	-0.04	-0.01	0.29	0.31
	(-0.98)	(-4.67)	(-2.56)	(-0.43)	(9.55)	(8.03)
β_{HML}	0.00	-0.05	-0.08	-0.13	0.09	0.09
	(-0.07)	(-2.63)	(-4.61)	(-5.25)	(2.62)	(2.10)
β_{MOM}	0.00	0.02	0.01	-0.02	0.03	0.04
	(-0.18)	(1.54)	(0.71)	(-1.24)	(1.49)	(1.26)
GRS-F(5, 537): 3.03 [p = 0.010]						

This table shows the characteristics of quintile portfolios sorted on the raw (EPR, Panel A) and excess ($EEPR$, Panel B) earnings-to-price ratios. $EEPR$ is a firm's earnings-to-price ratio (EPR) in excess of its industry average using the four-digit SIC code as the industry definition. $SIZE$ is the average market capitalization of member firms in millions of dollars. BM is the average book-to-market ratio, constructed as in Fama and French (1993). IA is the investment-to-asset ratio in Lyandres, Sun, and Zhang (2008). N is the average number of stocks. $EXRET$ is the monthly excess value-weighted return. α and the four β's are the intercept and the slope coefficients from the time-series regression of the excess portfolio return on the excess market return ($MKTRF$) and the size (SMB), value (HML), and momentum (MOM) factors. "GRS-F(n, d)" is the Gibbons-Ross-Shanken F-statistic (with the numerator and denominator degrees of freedom n and d, respectively) for the hypothesis that all the five portfolio alphas jointly equal zero. The t-statistics and the p-values are in round and square parentheses, respectively. The sample contains ordinary common shares of firms in non-financial industries traded on NYSE, AMEX, and NASDAQ. The monthly sample runs from July 1963 through December 2008.

Table 2: **25 portfolios sorted on size and excess earnings-to-price ratio**

Panel A: Excess earnings-to-price ratio

				SIZE		
		1	2	3	4	5
	1	-0.31	-0.23	-0.24	-0.22	-0.22
	2	-0.06	-0.06	-0.06	-0.06	-0.06
EEPR	3	0.00	0.00	0.00	0.00	0.00
	4	0.06	0.06	0.06	0.06	0.06
	5	0.33	0.26	0.26	0.24	0.25

Panel B: Earnings-to-price ratio

				SIZE		
		1	2	3	4	5
	1	-0.10	0.11	0.14	0.14	0.15
	2	0.11	0.15	0.16	0.16	0.16
EEPR	3	0.19	0.19	0.19	0.19	0.17
	4	0.22	0.22	0.21	0.21	0.21
	5	0.49	0.39	0.36	0.34	0.33

Panel C: Size ($ million)

				SIZE		
		1	2	3	4	5
	1	35	244	549	1361	10657
	2	52	245	555	1356	8836
EEPR	3	52	244	560	1341	8390
	4	54	241	551	1328	11157
	5	47	240	557	1309	10530

Panel D: Book-to-market ratio

				SIZE		
		1	2	3	4	5
	1	1.00	0.69	0.62	0.57	0.51
	2	0.82	0.65	0.62	0.64	0.59
EEPR	3	0.99	0.71	0.69	0.68	0.61
	4	0.96	0.78	0.75	0.74	0.67
	5	1.47	1.11	1.03	0.95	0.87

Panel E: Investment-to-asset ratio

				SIZE		
		1	2	3	4	5
	1	0.21	0.18	0.19	0.13	0.13
	2	1.95	1.48	0.19	0.13	0.11
EEPR	3	0.51	0.25	0.13	0.12	0.10
	4	0.13	0.14	0.13	0.11	0.10
	5	0.12	0.12	0.11	0.11	0.11

Panel F: Number of stocks

				SIZE		
		1	2	3	4	5
	1	426	67	52	48	43
	2	332	97	79	75	72
EEPR	3	335	109	77	64	59
	4	372	112	76	59	52
	5	454	83	51	33	29

Table 2: **25 portfolios sorted on size and excess earnings-to-price ratio–continued**

Panel G: Excess return (%)

		SIZE 1	2	3	4	5	1-5
	1	0.33	0.47*	0.50**	0.34	0.40**	-0.07
	2	0.47	0.53**	0.44*	0.45**	0.31*	0.16
EEPR	3	0.73**	0.53**	0.50**	0.55**	0.38**	0.35
	4	0.80***	0.77***	0.60**	0.60**	0.37*	0.43**
	5	1.05***	0.88***	0.89***	0.97***	0.59**	0.46**
	5-1	0.72***	0.41***	0.39***	0.63***	0.19	

Panel H: Four-factor alpha (%)

		SIZE 1	2	3	4	5	1-5
	1	-0.43***	-0.26***	-0.07	-0.16*	0.10	-0.53***
	2	-0.20**	-0.06	-0.05	-0.04	0.03	-0.22**
EEPR	3	0.04	-0.12	-0.03	0.06	0.14**	-0.10
	4	0.12*	0.15**	0.09	0.17*	0.14*	-0.01
	5	0.29***	0.17**	0.17	0.37***	0.15	0.14
	5-1	0.72***	0.43***	0.24**	0.53***	0.05	
GRS-F(25, 517): 4.22 [p = 0.000]							

This table shows the characteristics of 25 portfolios formed as the intersection of independently sorted size ($SIZE$) and excess earnings-to-price ($EEPR$) quintiles. $EEPR$ is a firm's earnings-to-price ratio (EPR) in excess of its industry average using the four-digit SIC code as the industry definition. Panels A and B show $EEPR$ and EPR, respectively. Panel C: Size is the average market capitalization of member firms in millions of dollars. Panel D: The book-to-market ratio is constructed following Fama and French (1993). Panel E: The investment-to-asset ratio is computed following Lyandres, Sun, and Zhang (2008). Panel F: N is the average number of stocks. Panel G: The excess return is the excess monthly value-weighted return. Panel H: The four-factor alpha is the intercept from the time-series regression of the excess portfolio return on the excess market return ($MKTRF$) and the size (SMB), value (HML), and momentum (MOM) factors. *, **, and *** represent significance at 10, 5, and 1%, respectively. "GRS-F(n, d)" is the Gibbons-Ross-Shanken F-statistic (with the numerator and denominator degrees of freedom n and d, respectively) for the hypothesis that all the 25 portfolio alphas jointly equal zero, with the p-value in square parentheses. The sample contains ordinary common shares of firms in non-financial industries traded on NYSE, AMEX, and NASDAQ. The monthly sample runs from July 1963 through December 2008.

Table 3: **27 portfolios sorted on size, B/M, and excess earnings-to-price ratio**

Panel A: Size ($ million)

(i) Low $EEPR$ portfolios

		$SIZE$ 1	2	3
BM	1	67	572	7,365
	2	69	556	5,426
	3	47	558	3,698

(ii) High $EEPR$ portfolios

		$SIZE$ 1	2	3
BM	1	91	563	8,251
	2	83	549	5,128
	3	58	554	5,103

Panel B: Book-to-market ratio

(i) Low $EEPR$ portfolios

		$SIZE$ 1	2	3
BM	1	0.31	0.34	0.33
	2	0.77	0.76	0.75
	3	1.76	1.35	1.34

(ii) High $EEPR$ portfolios

		$SIZE$ 1	2	3
BM	1	0.39	0.39	0.39
	2	0.78	0.77	0.77
	3	1.85	1.55	1.49

Panel C: Investment-to-asset ratio

(i) Low $EEPR$ portfolios

		$SIZE$ 1	2	3
BM	1	0.29	0.23	0.15
	2	0.66	0.88	0.10
	3	0.09	0.07	0.07

(ii) High $EEPR$ portfolios

		$SIZE$ 1	2	3
BM	1	0.18	0.17	0.13
	2	0.12	0.11	0.09
	3	0.10	0.09	0.09

Panel D: Return (high - low $EEPR$)

		$SIZE$ 1	2	3
BM	1	0.55***	0.21	0.09
	2	0.36***	0.24**	0.13
	3	0.17**	0.33***	0.22
GRS-F(27, 515): 3.13 [p = 0.000]				

Panel E: Alpha (high - low $EEPR$)

		$SIZE$ 1	2	3
BM	1	0.60***	0.25*	0.16
	2	0.36***	0.25**	0.21
	3	0.25***	0.26**	0.24

This table shows the characteristics of 27 portfolios formed as the intersection of independently sorted size ($SIZE$), book-to-market ratio (BM), and excess earnings-to-price ($EEPR$) terciles. $EEPR$ is a firm's earnings-to-price ratio in excess of its industry average using the four-digit SIC code as the industry definition. Panel A: Size is the average market capitalization of member firms in millions of dollars. Panel B: The book-to-market ratio is constructed following Fama and French (1993). Panel C: The investment-to-asset ratio is computed following Lyandres, Sun, and Zhang (2008). Panel D: The zero-cost portfolio return is the spread of excess monthly value-weighted returns between the high and low $EEPR$ portfolios. Panel E: The four-factor alpha is the intercept from the time-series regression of the zero-cost portfolio return on the excess market return ($MKTRF$) and the size (SMB), value (HML), and momentum (MOM) factors. *, **, and *** represent significance at 10, 5, and 1%, respectively. "GRS-F(n, d)" is the Gibbons-Ross-Shanken F-statistic (with the numerator and denominator degrees of freedom n and d, respectively) for the hypothesis that all the 27 portfolio alphas jointly equal zero, with the p-value in square parentheses. The sample contains ordinary common shares of firms in non-financial industries traded on NYSE, AMEX, and NASDAQ. The monthly sample runs from July 1963 through December 2008.

Table 4: **Robustness to alternative industry classifications**

Panel A: SIC2

(i) Excess return (%)

		SIZE					
		1	2	3	4	5	1-5
	1	0.25	0.26	0.49*	0.33	0.47**	-0.22
	2	0.40	0.45	0.32	0.42*	0.33*	0.08
EEPR	3	0.73***	0.65**	0.52**	0.52**	0.39*	0.34*
	4	0.80***	0.78***	0.64***	0.72***	0.36*	0.44**
	5	1.12***	0.92***	0.93***	0.78***	0.45**	0.66***
	5-1	0.87***	0.66***	0.44***	0.46***	-0.02	

(ii) Four-factor alpha (%)

		SIZE					
		1	2	3	4	5	1-5
	1	-0.47***	-0.44***	-0.06	-0.16	0.20*	-0.66***
	2	-0.23**	-0.16**	-0.17**	-0.05	0.06	-0.28**
EEPR	3	0.13*	0.06	0.04	0.11	0.16*	-0.03
	4	0.13*	0.15**	0.09	0.14*	0.04	0.09
	5	0.28***	0.14*	0.16	0.15	-0.02	0.29**
	5-1	0.74***	0.59***	0.22*	0.31**	-0.21	
GRS-F(25, 517): 4.07 [p = 0.000]							

Panel B: SIC3

(i) Excess return (%)

		SIZE					
		1	2	3	4	5	1-5
	1	0.26	0.40	0.46*	0.35	0.49**	-0.22
	2	0.47	0.46*	0.42*	0.44**	0.27	0.20
EEPR	3	0.63**	0.64**	0.50**	0.55**	0.27	0.36*
	4	0.88***	0.78***	0.64***	0.67***	0.45**	0.44**
	5	1.10***	0.82***	0.89***	0.81***	0.48**	0.61***
	5-1	0.83***	0.42***	0.43***	0.45***	-0.01	

(ii) Four-factor alpha (%)

		SIZE					
		1	2	3	4	5	1-5
	1	-0.51***	-0.36***	-0.10	-0.14	0.17**	-0.68***
	2	-0.19**	-0.18**	-0.11	-0.06	0.02	-0.21*
EEPR	3	-0.01	0.08	0.04	0.10	0.05	-0.06
	4	0.23***	0.12*	0.09	0.16**	0.18**	0.05
	5	0.29***	0.12	0.15	0.20*	0.02	0.27**
	5-1	0.79***	0.47***	0.24*	0.33**	-0.16	
GRS-F(25, 517): 4.59 [p = 0.000]							

Panel C: Raw earnings-to-price ratio

(i) Excess return (%)

		SIZE					
		1	2	3	4	5	1-5
	1	0.26	0.16	0.06	0.34	0.21	0.05
	2	0.28	0.46	0.36	0.28	0.23	0.05
EPR	3	0.66**	0.76***	0.67***	0.47**	0.36**	0.30
	4	0.93***	0.76***	0.70***	0.65***	0.37**	0.56***
	5	1.10***	0.92***	0.95***	0.81***	0.58***	0.52***
	5-1	0.84***	0.77***	0.89***	0.47**	0.37*	

(ii) Four-factor alpha (%)

		SIZE					
		1	2	3	4	5	1-5
	1	-0.37**	-0.25**	-0.08	0.21*	0.26***	-0.62***
	2	-0.25**	0.04	-0.03	0.04	0.10	-0.35***
EPR	3	0.04	0.12	0.16**	-0.03	0.03	0.01
	4	0.17**	0.04	0.03	0.06	0.00	0.16
	5	0.22***	0.05	0.09	0.04	-0.01	0.23**
	5-1	0.59***	0.30*	0.17	-0.16	-0.26*	
GRS-F(25, 517): 2.11 [p = 0.001]							

This table shows the characteristics of 25 portfolios formed as the intersection of independently sorted size ($SIZE$) quintiles and either the raw or the excess ($EEPR$) earnings-to-price quintiles. $EEPR$ is a firm's earnings-to-price ratio in excess of its industry average. Panels A and B sort stocks on $EEPR$ using the two- and three-digit SIC codes, respectively, as the industry definition, while Panel C sorts stocks on the raw earnings-to-price ratio. The excess return is the excess monthly value-weighted return. The four-factor alpha is the intercept from the time-series regression of the excess portfolio return on the excess market return ($MKTRF$) and the size (SMB), value (HML), and momentum (MOM) factors. *, **, and *** represent significance at 10, 5, and 1%, respectively. "GRS-F(n, d)" is the Gibbons-Ross-Shanken F-statistic (with the numerator and denominator degrees of freedom n and d, respectively) for the hypothesis that all the 25 portfolio alphas jointly equal zero, with the p-value in square parentheses. The sample contains ordinary common shares of firms in non-financial industries traded on NYSE, AMEX, and NASDAQ. The monthly sample runs from July 1963 through December 2008.

Table 5: **Robustness to alternative earnings measures**

Panel A: Fama and French (1992)

(i) Excess return (%)

		SIZE					
		1	2	3	4	5	1-5
	1	0.49	0.38	0.37	0.36	0.27	0.22
	2	0.61**	0.58**	0.47*	0.51**	0.45**	0.16
EEPR	3	0.60**	0.63**	0.46*	0.49**	0.23	0.37*
	4	0.79***	0.85***	0.77***	0.74***	0.63***	0.16
	5	0.94***	0.73***	0.82***	0.68**	0.14	0.80***
	5-1	0.45***	0.34**	0.45***	0.31**	-0.13	

(ii) Four-factor alpha (%)

		SIZE					
		1	2	3	4	5	1-5
	1	-0.32***	-0.39***	-0.30***	-0.24**	-0.16	-0.16
	2	-0.06	-0.05	-0.06	0.00	0.15**	-0.21*
EEPR	3	-0.06	0.02	-0.05	0.04	0.06	-0.12
	4	0.07	0.18**	0.15**	0.19**	0.29***	-0.22**
	5	0.20**	0.11	0.20**	0.11	-0.23*	0.42***
	5-1	0.52***	0.50***	0.50***	0.35***	-0.07	
GRS-F(25, 517): 3.07 [p = 0.000]							

Panel B: French

(i) Excess return (%)

		SIZE					
		1	2	3	4	5	1-5
	1	0.46	0.43	0.40	0.35	0.43**	0.04
	2	0.55*	0.55**	0.47**	0.48**	0.40**	0.16
EEPR	3	0.65**	0.51*	0.39	0.43**	0.32*	0.33
	4	0.74***	0.83***	0.62**	0.72***	0.44**	0.30
	5	0.92***	0.71**	0.79***	0.69**	0.30	0.62***
	5-1	0.46***	0.28**	0.39***	0.34**	-0.13	

(ii) Four-factor alpha (%)

		SIZE					
		1	2	3	4	5	1-5
	1	-0.34***	-0.28***	-0.20**	-0.16*	0.10	-0.44***
	2	-0.17**	-0.07	-0.07	-0.05	0.10	-0.27***
EEPR	3	-0.01	-0.14**	-0.11	0.02	0.07	-0.08
	4	0.08	0.20**	0.08	0.23**	0.11	-0.03
	5	0.20***	0.11	0.16	0.15	0.08	0.13
	5-1	0.54***	0.39***	0.36***	0.31**	-0.02	
GRS-F(25, 517): 2.92 [p = 0.000]							

Panel C: Vuolteenaho (2002)

(i) Excess return (%)

		SIZE					
		1	2	3	4	5	1-5
	1	0.61*	0.53*	0.55**	0.48**	0.38*	0.23
	2	0.45	0.60**	0.50**	0.48**	0.34*	0.11
EPR	3	0.67**	0.54**	0.33	0.38*	0.22	0.45**
	4	0.77***	0.72**	0.65**	0.62***	0.38**	0.39*
	5	0.88***	0.77***	0.79***	0.69**	0.37*	0.51**
	5-1	0.28**	0.24**	0.24**	0.21*	-0.01	

(ii) Four-factor alpha (%)

		SIZE					
		1	2	3	4	5	1-5
	1	-0.21	-0.15*	-0.04	-0.03	0.01	-0.22
	2	-0.22***	-0.01	-0.03	0.00	0.09	-0.32***
EPR	3	-0.01	-0.12*	-0.14*	-0.03	0.03	-0.04
	4	0.06	0.11	0.12	0.15	0.11	-0.04
	5	0.16**	0.14*	0.18**	0.20**	0.16*	0.00
	5-1	0.36***	0.29***	0.22*	0.23**	0.15	
GRS-F(25, 517): 2.10 [p = 0.002]							

Table 5: **Robustness to alternative earnings measures–continued**

Panel D: Operating income before depreciation

(i) Excess return (%)

		SIZE 1	2	3	4	5	1-5
EEPR	1	0.24	0.38	0.46*	0.31	0.45**	-0.21
	2	0.47	0.43	0.41*	0.48**	0.26	0.21
	3	0.62**	0.62**	0.49**	0.50**	0.29	0.33
	4	0.88***	0.80***	0.66***	0.67***	0.46**	0.42**
	5	1.10***	0.83***	0.89***	0.85***	0.48**	0.61***
	5-1	0.86***	0.45***	0.43***	0.54***	0.04	

(ii) Four-factor alpha (%)

		SIZE 1	2	3	4	5	1-5
EEPR	1	-0.52***	-0.34***	-0.08	-0.17*	0.15*	-0.67***
	2	-0.19**	-0.21***	-0.14*	-0.03	0.01	-0.20*
	3	-0.02	0.08	0.03	0.06	0.09	-0.10
	4	0.20***	0.15**	0.13*	0.19**	0.15*	0.05
	5	0.29***	0.11	0.15	0.23**	0.00	0.29**
	5-1	0.81***	0.45***	0.23*	0.40***	-0.15	

GRS-F(25, 517): 4.86 [p = 0.000]

Panel E: Net income

(i) Excess return (%)

		SIZE 1	2	3	4	5	1-5
EEPR	1	0.58*	0.51*	0.53**	0.47**	0.37*	0.21
	2	0.47	0.59**	0.46**	0.51**	0.36**	0.11
	3	0.67**	0.58**	0.39*	0.36*	0.26	0.41*
	4	0.78***	0.73**	0.65**	0.60**	0.36*	0.42**
	5	0.88***	0.76***	0.76***	0.69**	0.37*	0.51**
	5-1	0.30**	0.25**	0.23**	0.22*	-0.01	

(ii) Four-factor alpha (%)

		SIZE 1	2	3	4	5	1-5
EEPR	1	-0.22	-0.15*	-0.05	-0.04	0.00	-0.22
	2	-0.23***	-0.04	-0.06	0.01	0.11	-0.34***
	3	-0.02	-0.09	-0.08	-0.03	0.05	-0.07
	4	0.09	0.11	0.14	0.13	0.16**	-0.06
	5	0.15**	0.14*	0.14	0.21**	0.10	0.05
	5-1	0.37***	0.30**	0.19*	0.25**	0.10	

GRS-F(25, 517): 2.08 [p = 0.002]

This table shows the characteristics of 25 portfolios formed as the intersection of independently sorted size ($SIZE$) quintiles and either the raw or the excess ($EEPR$) earnings-to-price quintiles. $EEPR$ is a firm's earnings-to-price ratio in excess of its industry average. The following earnings measures are implemented: Panel A, Fama and French (1992); Panel B, Compustat earnings before extraordinary items as in Kenneth French's website; Panel C, Vuolteenaho (2002); Panel D, Compustat operating income before depreciation; and Panel E, Compustat net income. We first sort firms independently on size and the excess earnings-to-price ratio using the four-digit SIC code (Panel B). If this produces a missing portfolio in any period, we perform dependent sort on size (Panels C and E). If this still leaves missing portfolios, we use the three-digit SIC code to recalculate the excess earnings-to-price ratio and revert to independent sort (Panels A and D). The excess return is the excess monthly value-weighted return. The four-factor alpha is the intercept from the time-series regression of the excess portfolio return on the excess market return ($MKTRF$) and the size (SMB), value (HML), and momentum (MOM) factors. *, **, and *** represent significance at 10, 5, and 1%, respectively. "GRS-F(n, d)" is the Gibbons-Ross-Shanken F-statistic (with the numerator and denominator degrees of freedom n and d, respectively) for the hypothesis that all the 25 portfolio alphas jointly equal zero, with the p-value in square parentheses. The sample contains ordinary common shares of firms in non-financial industries traded on NYSE, AMEX, and NASDAQ. The monthly sample runs from July 1963 through December 2008.