Unpublished Appendices to "Market Reactions to Tangible and Intangible Information."

This document contains the unpublished appendices for Daniel and Titman (2006), "Market Reactions to Tangible and Intangible Information."

Appendix A presents a model that links our empirical results to specific behavioral biases. Appendix C documents additional empirical analyses we carried out, mostly to assess the robustness of the results in the paper. Specifically, Subsection C.1 presents the results of analysis that relates measured changes in covariance risk and total return standard deviation to tangible and intangible returns. Subsection C.2 looks at the determinants firms future issuance activity. The analyses in Subsection C.3 examine whether our results are different for small or large firms. Finally, the analyses documented in Subsection C.4 examine the effects in January and outside of January.

A *Market Reactions to Different Types of Information*

This section develops a simple model that provides more explicit intuition for linking our empirical results to specific behavioral biases. The model describes three sources of stock price movements. These include accounting-based information about the firm's current profitability (*tangible* information); other information about the firm's future growth opportunities (*intangible* information); and pure noise. To keep it simple, there are three dates, 0, 1 and 2, a single risk-neutral investor, and a risk-free rate of zero.

Given these assumptions, price changes and returns would not be forecastable were all investors rational. However, in our model investors misinterpret new information and as a result make expectational errors. The model captures three kinds of errors:

1. *Over- or Underreaction to Tangible Information:* Investors may not correctly incorporate information contained in past accounting growth rates in forming their estimates of the future cash flows that will accrue to shareholders. In our empirical tests, we investigate whether investors over- or underreact to the information in earnings, cash flow, sales, or growth rates. Given the linear specification of our model Over- or Underreaction to past growth rates is equivalent to over- or underextrapolating these growth rates.

2. *Over- or Underreaction to Intangible Information:* Intangible information is news about future cash flows which is not reflected in current accounting-based growth numbers. Investors may over- or underreact to intangible information, perhaps because they over- or underestimate the precision of this information.

Table A.1: **A Summary of the Model Variables**

	$t=0$	$t=1$	$t=2$
Cash Flows (θ_t):	–	$\tilde{\theta}_1 = \bar{\theta} + \tilde{\epsilon}_1$	$\tilde{\theta}_2 = \bar{\theta} + \rho\tilde{\epsilon}_1 + \tilde{\epsilon}_2$
Intangible Signal:	–	$\tilde{s}\ \ (=\tilde{\epsilon}_2 - \tilde{u})$	–
Price "Noise":	–	$\tilde{e}$	–
B_t	B_0	$B_0 + \tilde{\theta}_1\ \ (= B_0 + \bar{\theta} + \tilde{\epsilon}_1)$	$B_1 + \tilde{\theta}_2$
$E_t^R[\tilde{B}_2])$	$B_0 + 2\bar{\theta}$	$B_1 + \rho\tilde{\epsilon}_1 + \tilde{s} + \tilde{e}$	B_2
$M_t\ (= E_t^C[\tilde{B}_2])$	$B_0 + 2\bar{\theta}$	$B_1 + \rho^E\tilde{\epsilon}_1 + (1+\omega)\tilde{s} + \tilde{e}$	B_2
$(B–M)_t$	$-2\bar{\theta}$	$-\left(\bar{\theta} + \rho^E\tilde{\epsilon}_1 + (1+\omega)\tilde{s} + \tilde{e}\right)$	0
$r_{t-1,t}^B$	–	$\tilde{\theta}_1\ \ (= \bar{\theta} + \tilde{\epsilon}_1)$	$\tilde{\theta}_2\ (= \bar{\theta} + \rho\tilde{\epsilon}_1 + \tilde{\epsilon}_2)$
$r_{t-1,t}$	–	$(1+\rho^E)\tilde{\epsilon}_1 + (1+\omega)\tilde{s} + \tilde{e}$	$-\left[(\rho^E - \rho)\tilde{\epsilon}_1 + \omega\tilde{s} + \tilde{e}\right] + \tilde{u}$

Also:

- $\tilde{\epsilon}_2 = \tilde{s} + \tilde{u}$, where $\tilde{u} \perp \{\tilde{s}, \tilde{\epsilon}_1\}$
- $\bar{\theta} \sim \mathcal{N}\left(\theta_0, \sigma^2(\bar{\theta})\right)$
- $\tilde{\epsilon}_1 \sim \mathcal{N}(0, \sigma_1^2)$, $\tilde{\epsilon}_2 \sim \mathcal{N}(0, \sigma_2^2)$, $\tilde{s} \sim \mathcal{N}(0, \sigma_s^2)$, $\tilde{e} \sim \mathcal{N}(0, \sigma_e^2)$

3. *Pure Noise:* Overreaction means that investors move prices too much in response to information about future cash flows. Alternatively, we classify stock movements as *pure noise* if they are uncorrelated with future cash flows. One interpretation of this comes from microstructure theory: if investors overestimate the extent to which their counterparts are informed, they will overreact to purely liquidity motivated trades. Alternatively, noise trades can represent an extreme form of overconfidence, in which investors believe that they have valuable signals about future cash flows, but in reality their signals are unrelated to future cash flows.

An alternative interpretation of what we call over- and underreaction to information and noise can arise in a model with rational risk averse investors who sometimes perceive changes in risk or experience changes in risk preferences. For example, holding expected cash flows constant, if an industrial sector becomes riskier, stock prices will initially decline (because of the increased required rate of return) and will then be expected to increase because of the increased risk premium. Moreover, changes in risk or risk preferences may also change in response to either tangible or intangible information in ways that generate return patterns that are indistinguishable from over or underreaction to these sources of information.

1. *The Model*

The following provides the timing of the various information and cash flow realizations along with a brief description of the structure of the model. A summary of the model variables are given in Table A.1.

Book Values and Cash Flows:

1. At date 0, the firm is endowed with assets with value B_0, which we denote as the initial book value of the firm's assets. We assume that the assets do not physically depreciate over time. At times 1 and 2, the firm's cash flows are $\tilde{\theta}_1$ and $\tilde{\theta}_2$. Each period, the book value grows by the amount of the cash flow.

2. At date 2 the firm is liquidated and all proceeds are paid to shareholders. Investors are risk-neutral and the risk-free rate is zero, so the price equals the expected book value at time 2.

Expectations of Future Cash Flows:

1. At $t = 0$ the expected cash flows at dates 1 and 2 are $E_0[\tilde{\theta}_1] = E_0[\tilde{\theta}_2] = \bar{\theta}$ respectively.[1]

2. The unexpected cash flow at time 1 is $\tilde{\epsilon}_1$, so the total realized time 1 cash flow is $\tilde{\theta}_1 = \bar{\theta}_1 + \tilde{\epsilon}_1$.

3. At $t = 1$, the conditional expected value of the time 2 cash flow reflects both accounting and non-accounting information. We assume a linear relation between the time 1 and time 2 accounting growth. Specifically $E^R[\tilde{\theta}_2|\tilde{\theta}_1] = \bar{\theta}_2 + \rho\tilde{\epsilon}_1$, where ρ is a measure of the accounting growth persistence.[2] The R superscript denotes *R*ational. Since investors are not necessarily rational in this setting, their perceived expectations may not be rational.

4. The investor also observes non-accounting based information. We summarize this information as the signal $\tilde{s} = E^R[\tilde{\theta}_2|\Omega_1] - E^R[\tilde{\theta}_2|\tilde{\theta}_1]$, where Ω_1 denotes the set of all information available to the investor at time 1. $\tilde{s}$ would represent the total effect of non-accounting based information on the price, were investors rational. Note that by definition s is orthogonal to accounting-based information – it can be thought of as summarizing the residual from the projection of Ω_1 onto θ_1.

Market Price Reactions to Information: Since investors are risk neutral and fully rational, conditional expected price changes equal zero, and the price at time 1 (P_1) is equal to $E^R[B_2|\Omega_1]$. However, as discussed earlier, in this model there are three possible biases in the way investors set prices:

1. We model over and underreaction to tangible information by allowing investors to believe that the persistence in cash flow growth is greater than it really is (*i.e.*, they think it is ρ^E when it is really $\rho < \rho^E$). Investors then set prices according to this belief.

[1] This assumption makes $(B-M)_0$ a perfect proxy for $E_0[r^B_{0,1}]$. If this were not the case, the model results would be qualitatively the same, but algebraically more complicated.

[2] In our empirical tests, the implicit specification will be different: there we assume a linear relation between the log-book return and future returns.

2. We model investor over and underreaction to intangible information by allowing the price response to the time 1 intangible information to be $(1+\omega)\tilde{s}$ rather than s. ω is thus the fractional overreaction to intangible information; if investors are rational, $\omega = 0$. Consistent with DHS, $\omega > 0$ could result from the investor overconfidence about their ability to interpret vague information, and $\omega < 0$ (underreaction to intangible information) could result from underconfidence.

3. In the model the time 1 price deviates from the expected payoff by $\tilde{e} \sim \mathcal{N}(0, \sigma_e^2)$, where $\tilde{e}$ is pure noise (*i.e.,* is orthogonal to θ_2, $\tilde{\epsilon}_1$ and $\tilde{s}$). One can interpret this "noise" term as an extreme form of overreaction where investors can receive a signal with zero precision, and act as though the signal is informative. However, as mentioned earlier, other interpretations are possible.[3]

As a result of these three biases, the time 1 price is not the expected payoff ($P_1 \neq E_t^R[\tilde{B}_2]$), so price changes (returns) are predictable using both past returns and tangible information. In the next subsection we consider the return patterns these three biases will generate, and ask how we can empirically separate these effects.

2. *Regression Estimates*

This subsection motivates the regressions we use to evaluate the importance of extrapolation bias, overreaction, and noise on stock returns. We consider both univariate and multivariate regressions of future price changes on past price changes, book value changes and book-to-market ratios. We carry out the related regressions in the empirical analyses documented in the paper. The derivations of the mathematical results in this Section are given in Appendix B.

Return Reversal:

Consider first a univariate regression of future price changes $r_{1,2}$ ($\equiv P_2 - P_1$) on past price changes $r_{0,1}$. This is equivalent to the long-horizon regression used by DeBondt and Thaler (1985). Based on our model assumptions, this coefficient is:

$$\beta = -\left(\frac{(\rho^E - \rho)(1+\rho^E)\sigma_1^2 + \omega(1+\omega)\sigma_s^2 + \sigma_e^2}{(1+\rho^E)^2\sigma_1^2 + (1+\omega)^2\sigma_s^2 + \sigma_e^2}\right) \quad (1)$$

If investors are fully rational ($\rho^E = \rho$, $\omega = 0$, and $\sigma_e^2 = 0$), β will be zero. However, a negative coefficient will result when investors over-extrapolate earnings ($\rho^E > \rho$), overreact to intangible information ($\omega > 0$), incorporate noise into the price ($\sigma_e^2 > 0$), or any combination of these three.

[3]For example, prices can fall if investors receive liquidity shocks that force them to sell.

Isolating the Extrapolation Effect:

The extrapolation effect can be directly estimated with the following univariate regression of $r_{1,2}$ on the lagged book return ($r^B_{0,1} \equiv B_1 - B_0$).

$$r_{1,2} = \alpha + \beta_B \, r^B_{0,1} + \epsilon \tag{2}$$

The estimated coefficient from this regression will equal,

$$\beta_B = -(\rho^E - \rho) \left(\frac{\sigma_1^2}{\sigma^2(\bar{\theta}) + \sigma_1^2} \right). \tag{3}$$

This will be negative if $\rho^E > \rho$ (when the investor over-extrapolates past earnings growth) and will be zero if investors properly assess tangible information (if $\rho^E = \rho$). Neither overreaction to growth (ω) nor noise (σ_e^2) affects β_B, so β_B isolates the extrapolation effect.

Intuitively, this regression works because r^B is a proxy for the time 1 unexpected cash flow. However r^B is a noisy proxy because it is the sum of the expected and unexpected cash flows. We can better isolate the unexpected cash flows by controlling for the expected component of r^B. We can do this by including the lagged book-to-market ratio on the RHS of this regression:

$$r_{1,2} = \alpha + \beta_B r^B_{0,1} + \beta_{BM}(B-M)_0 + \epsilon$$

By controlling for the lagged book-to-market ratio, we control for the component of the book return that is expected and increase the absolute value of the coefficient of r^B. The coefficients from this multivariate regression are:

$$\begin{aligned} \beta_B &= -(\rho^E - \rho) \\ \beta_{BM} &= \beta_B/2 \end{aligned} \tag{4}$$

Thus, the regression on past book return isolates the extrapolation effect. We can isolate the overreaction and noise effects by using a multivariate regression of $r_{1,2}$ on past return, past book return and the lagged book-to-market ratio:

$$r_{1,2} = \alpha + \beta_{BM}(B - M)_0 + \beta_B r^B_{0,1} + \beta_R r_{0,1} + \tilde{\epsilon} \tag{5}$$

The coefficients in this regression are:

$$\begin{aligned}
\beta_R &= -\left(\frac{\sigma_e^2 + \omega(1+\omega)\sigma_s^2}{\sigma_e^2 + (1+\omega)^2\sigma_s^2}\right) && (6)\\
\beta_B &= -\beta_R(1+\rho^E) - (\rho^E - \rho) && (7)\\
\beta_{BM} &= \beta_B/2 && (8)
\end{aligned}$$

The "intangible reversal" coefficient in this regression, β_R, is indicative of the effect of past returns on future returns, after controlling for the tangible information in the book return ($r^B_{0,1}$). From equation (6), this will be negative when there is either noise or overreaction to intangible information. However, because of the presence of the controls, the magnitude of this coefficient is unaffected by under or overreaction to tangible information. Equation (6) shows that:

1. If $\sigma_e^2 \gg \sigma_s^2$, $\beta_R \to -1$.
   This coefficient captures the intangible return reversal. If all of the return between $t = 0$ and $t = 1$ that is not related to the book returns is due to pure noise, then this return must completely reverse on average.

2. If $\sigma_e^2 > 0$, but $\omega = 0$, the $\beta_R \to -\sigma_e^2/(\sigma_e^2 + \sigma_s^2)$ implying that $-1 < \beta_R < 0$.
   The past return will contain information about future growth, but will also contain noise. This will mean that there will be incomplete reversal.

3. If $\sigma_e^2 = 0$, but $\omega > 0$, then $\beta_R = -\omega/(1+\omega)$, again implying that $-1 < \beta_R < 0$.
   The intuition for this coefficient is straightforward: the time 1 price change is $(1 + \omega)\tilde{s}$, of which $-\omega s$ is reversed at time 2. This means that a fraction $\omega/(1+\omega)$ of this component of the price move is eventually reversed. Again with these parameters, there is incomplete reversal.

Interestingly, results 2 and 3 indicate that it is impossible to distinguish between the case of pure noise ($\sigma_e^2 > 0$, $\omega = 0$) and overreaction ($\omega > 0$, $\sigma_e^2 = 0$). This makes intuitive sense: the econometrician cannot directly observe s_g, but can only infer it through price movements. What this means is that, based on the analysis here, we will be unable to discriminate between overreaction and pure noise.[4] As we will discuss later, it is only possible to discriminate between these two alternatives by finding better proxies for the information about future cash flows, and analyzing whether the changes in mispricing are related to the arrival of this information.

It is important to note that, unlike in the univariate regression (2), the coefficient β_B in this multivariate regression will *not* necessarily be zero if there is no extrapolation

[4]Similarly, it is impossible to distinguish between overreaction and noise by looking at the relation between past return and book return and future book return.

bias (if $\rho^E = \rho$), because it is a control for the tangible component of the past returns. Similarly, the lagged book-to-market ratio $(B-M)_0$ in this regression serves as a control for the *ex-ante* forecastable component of the book return (the $\bar{\theta}_1$ term in r^B). Since, in the models, $(B-M)_0 = -2\bar{\theta}$, $\beta_{BM} = \beta_B/2$.

3. *Direct Intangible Return Estimation*

An alternative way to generate the results described in the last subsection is to first isolate the intangible return by regressing $\tilde{r}_{0,1}$ on $r^B_{0,1}$ and $(B-M)_0$:

$$r_{0,1} = \gamma_0 + \gamma_{BM}(B-M)_0 + \gamma_B r^B_{0,1} + \tilde{v}$$

The residual from this regression, the component of the past return that is orthogonal to the unexpected book return, is defined as the *intangible return* (though it captures both the return associated with intangibles and the noise term):

$$r_I^{(B)}(0,1) \equiv \tilde{v} \equiv \left(r_{1,2} - \gamma_0 - \gamma_{BM}(B-M)_0 - \gamma_B r^B_{0,1}\right) = (1+\omega)\tilde{s} + \tilde{e} \qquad (9)$$

The *(B)* superscript denotes that this return is orthogonalized with respect to the unexpected book return. Then, a modified version of the regression in equation (5) (the only change being the substitution of $r^I_{0,1}$ for $r_{0,1}$:)

$$r_{1,2} = \alpha + \beta'_{BM}(B-M)_0 + \beta'_B r^B_{0,1} + \beta'_I r_I^{(B)}(0,1) + \tilde{\epsilon}$$

yields the regression coefficients:

$$\begin{aligned} \beta'_I &= -\left(\frac{\sigma_e^2 + \omega(1+\omega)\sigma_s^2}{\sigma_e^2 + (1+\omega)^2\sigma_s^2}\right) \\ \beta'_B &= -(\rho^E - \rho) \\ \beta'_{BM} &= \beta'_B/2 \end{aligned}$$

Notice that the coefficient β'_I is identical to that in equation (6), and β'_B and β'_{BM} are identical to those in equation (4). Thus, the coefficients in this regression tell us directly about the magnitude of the noise/intangible effect (β'_I) and the extrapolation effect (β'_B).

One final item of note here: in this model, if there is only overreaction to intangible information or noise, but no overreaction to tangible information, and if $\rho \approx 1$, then the two coefficients γ_{BM} and γ_B in the regression in equation (5) will be $-\beta_R/2$, $-\beta_R$, and β_R, respectively. In this case, some straightforward algebra shows that the best estimate of $r_{1,2}$ is (a constant times) $\left((B-M)_1 - \frac{(B-M)_0}{2}\right)$, in other words close to the book-to-market ratio at time 1. What this illustrates is that, depending on some of the persistence parameters, the current book-to-market ratio may end up being a good proxy for the intangible information, and specifically a much better proxy than the past return itself, which incorporates the effects of both tangible and intangible information.

B *Derivation of Model Equations*

Derivation of Equation (1):

The univariate regression coefficient in equation (1) is equal to:

$$\beta = \frac{cov(r_{1,2}, r_{0,1})}{var(r_{0,1})}.$$

¿From the equations for $r_{0,1}$ and $r_{1,2}$ in Table A.1, and given that that ϵ_1, $\tilde{s}$, $\tilde{e}$, and $\tilde{u}$ are mutually uncorrelated, and that $\epsilon_1 \sim \mathcal{N}(0, \sigma^1)$, $s \sim \mathcal{N}(0, \sigma_s^2)$, $e \sim \mathcal{N}(0, \sigma_e^2)$ this is equal to:

$$\beta = \frac{cov(r_{1,2}, r_{0,1})}{var(r_{0,1})} = \frac{-(\rho^E - \rho)(1+\rho^E)\sigma_1^2 - \omega(1+\omega)\sigma_s^2 - \sigma_e^2}{(1+\rho^E)^2\sigma_1^2 + (1+\omega)^2\sigma_s^2 + \sigma_e^2}$$

Derivation of Equation (3):

From the equations for $r_{1,2}$ and $r_{1,2}^B$ given in Table A.1, and given the assumption that $\tilde{\epsilon}_1$ and $\bar{\theta}_1$ are uncorrelated, the regression coefficient is equal to:

$$\beta_B = \frac{cov(r_{1,2}, r_{0,1}^B)}{var(r_{0,1}^B)} = \frac{-(\rho^E - \rho)\sigma_1^2}{\sigma^2(\bar{\theta}) + \sigma_1^2} = -(\rho^E - \rho)\left(\frac{\sigma_1^2}{\sigma^2(\bar{\theta}) + \sigma_1^2}\right).$$

Derivation of Equation (4):

Define: $X = \begin{bmatrix} r_{0,1}^B \\ (B-M)_0 \end{bmatrix}$, then using the equations for $r_{0,1}^B$ and $(B-M)_0$ in Table A.1, we have that:

$$var(X) = \begin{bmatrix} \sigma^2(\bar{\theta}) + \sigma_1^2 & -2\sigma^2(\bar{\theta}) \\ -2\sigma^2(\bar{\theta}) & 4\sigma^2(\bar{\theta}) \end{bmatrix}$$

and

$$var(X)^{-1} = \frac{1}{\sigma_1^2}\begin{bmatrix} 1 & 1/2 \\ 1/2 & \left(1 + \sigma_1^2/\sigma^2(\bar{\theta})\right)/4 \end{bmatrix}$$

From the equations for $r^B_{0,1}$, $r_{1,2}$ and $(B-M)_0$ in Table A.1, we have that

$$cov(X, r_{1,2}) = \begin{bmatrix} -(\rho^E - \rho)\sigma_1^2 \\ 0 \end{bmatrix},$$

giving the vector of regression coefficients as:

$$\begin{bmatrix} \beta_B \\ \beta_{BM} \end{bmatrix} = var(X)^{-1} \cdot cov(X, r_{1,2}) = \begin{bmatrix} -(\rho^E - \rho) \\ -(\rho^E - \rho)/2 \end{bmatrix}$$

Derivation of Equations (6)-(8):

First, note that $cov(B–M_0, r^B_{0,1}) = -2\sigma^2(\bar{\theta})$, and $cov(B–M_0, r_{0,1}) = cov(B–M_0, r_{1,2}) = 0$. Therefore, in this regression, as in the regression discussed immediately above, $B - M_0$ will serve as a perfect control for the component of $r^B_{0,1}$ that is uncorrelated with $r_{1,2}$ and $r_{0,1}$ (*i.e.*, for $\bar{\theta}$).

This means that $\beta_{BM} = \beta_B/2$. It also means that the coefficients β_{IR} and β_B are identical to what they would be in the regression:

$$r_{1,2} = \alpha + \beta_B \underbrace{\left(r^B_{0,1} + (1/2)(B-M)_0\right)}_{=\tilde{\epsilon}_1} + \beta_{IR} r_{0,1} + \epsilon$$

Now, define:

$$X = \begin{bmatrix} r^B_{0,1} - (1/2)(B-M)_0 \\ r_{1,2} \end{bmatrix}.$$

Then:

$$var(X) = \begin{bmatrix} \sigma_1^2 & (1+\rho^E)\sigma_1^2 \\ (1+\rho^E)\sigma_1^2 & (1+\rho^E)^2\sigma_1^2 + (1+\omega)^2\sigma_s^2 + \sigma_e^2 \end{bmatrix}$$

$$cov(X, r_{1,2}) = \begin{bmatrix} -(\rho^E - \rho)\sigma_1^2 \\ -(1+\rho^E)(\rho^E - \rho)\sigma_1^2 - (1+\omega)\omega\sigma_s^2 - \sigma_e^2 \end{bmatrix}$$

The inverse of the covariance matrix is:

$$var(X)^{-1} = \frac{1}{\sigma_1^2((1+\omega)^2\sigma_s^2 + \sigma_e^2)} \begin{bmatrix} (1+\rho^E)^2\sigma_1^2 + (1+\omega)^2\sigma_s^2 + \sigma_e^2 & -(1+\rho^E)\sigma_1^2 \\ -(1+\rho^E)\sigma_1^2 & \sigma_1^2 \end{bmatrix}.$$

giving the regression coefficients:

$$\begin{bmatrix} \beta_B \\ \beta_{IR} \end{bmatrix} = var(X)^{-1} \cdot cov(X, r_{1,2})$$

$$= \frac{1}{(1+\omega)^2\sigma_s^2+\sigma_e^2} \begin{bmatrix} (1+\rho^E)\left(\omega(1+\omega)\sigma_s^2+\sigma_e^2\right) - (\rho^E - \rho)((1+\omega)^2\sigma_s^2+\sigma_e^2) \\ -\omega(1+\omega)\sigma_s^2 - \sigma_e^2 \end{bmatrix},$$

or, simplifying,

$$\beta_{IR} = -\left(\frac{\sigma_e^2 + \omega(1+\omega)\sigma_s^2}{\sigma_e^2 + (1+\omega)^2\sigma_s^2}\right)$$

$$\beta_B = -\beta_{IR}(1+\rho^E) - (\rho^E - \rho).$$

C Tables Documenting Additional Empirical Analyses

This section documents the results of additional empirical analyses.

1. Analyses of the Effect of Tangible and Intangible Returns on Asset Risk.

Table A.2 examines how the market betas of firms' common stock change as a function of past tangible and intangible returns, and Table A.3 examines how the volatility (return standard deviation) of the returns change as a function of past tangible and intangible returns.

2. The Determinants of Issuance

Table A.4 examines the relation between future changes in the composite issuance measure and past issuance, and past tangible and intangible return measures.

3. Size Robustness Tests

The analyses documented here examine the relation between past tangible and intangible returns and past issuance and future returns among small and large firms.

In Panels A and B of Table A.5, zero-investment intangible information and orthogonalized issuance portfolios that consist of small firms have mean returns that are significantly different from zero. Consistent with the results for the full sample, the small capitalization intangible portfolio returns cannot be explained by the CAPM, but can be largely explained by the Fama and French (1993) three factor model. The issuance returns cannot be explained by either of the models. Panels C and D show that the past intangible return effect is not present in this period for the largest capitalization firms, but the issuance portfolio remains robust even for the largest firms.

Finally, Table A.6 examines whether the return differences between small and large quintile firms reported in Table A.5 are statistically different from zero. Regressions 1-3 show that the difference of slightly more than 0.3%/month between the small and large intangible return portfolio is just statistically significant, while the difference of −0.218%/month between the large and small quintile issuance portfolios is not, even after adjusting for market, size and book-to-market effects with the Fama and French three-factor model.

4. Seasonality Analyses

This subsection presents the results of Fama MacBeth regressions of firm's common stock returns on past tangible and intangible returns for January months only (Table A.7), and for non-January months only (Table A.8).

References

Daniel, Kent D., and Sheridan Titman, 2006, Market reactions to tangible and intangible information, *Journal of Finance* 61, 1605–1643.

DeBondt, Werner F. M., and Richard H. Thaler, 1985, Does the stock market overreact?, *Journal of Finance* 40, 793–808.

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 James MacBeth, 1973, Risk, return and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.

Table A.2: **Fama-MacBeth Regressions of Market Betas on Tangible and Intangible Return Measures**

Annual, 1968-1999, Newey-West t-statistics in parentheses

This table reports the results the coefficients and t-statistics
from of a set of Fama and MacBeth (1973) regressions. The dependent variable in each cross-sectional regression is $\hat{\beta}(t,t+2)$, the estimated slope coefficient from a regression of the excess return of the individual stock's excess return on the CRSP value-weighted portfolio excess return from July of year t through June of year t+2. The independent variables in these regressions are the lagged estimated market beta, $\hat{\beta}_{t-5}$, estimated using returns from July:$(t-6)$ through June:$(t-4)$; bm_t, the book-to-market ratio as of the end of December:$(t-1)$; bm_{t-5}, the book-to-market ratio as of the end of December:$(t-6)$; and $r^{BV}(t-5,t)$, $r^{T(B)}(t-5,t)$, $r^{I(B)}(t-5,t)$, the book-return, and the tangible and intangible returns using book, calculated as described in the text. Measures using Sales, Cash Flow, and Earnings are calculated similarly. We perform annual cross-sectional regressions from t = 1968 through 1999. Standard errors are calculated using a Newey-West procedure with 11 lags.

	Const	$\hat{\beta}_{t-5}$	bm_t	bm_{t-5}	$r^{BV}(t-5,t)$	$r^{T(B)}(t-5,t)$	$r^{I(B)}(t-5,t)$
1	0.828	0.281	-0.081				
	(32.01)	(11.92)	(-2.62)				
2	0.866	0.276		-0.071	-0.056		
	(22.03)	(12.22)		(-2.48)	(-2.78)		
3	0.907	0.266				-0.084	0.061
	(22.23)	(12.16)				(-2.69)	(1.90)
	Const	$\hat{\beta}_{t-5}$	sp_t	sp_{t-5}	$r^{SLS}(t-5,t)$	$r^{T(S)}(t-5,t)$	$r^{I(S)}(t-5,t)$
4	0.858	0.280	0.031				
	(32.37)	(13.51)	(1.31)				
5	0.852	0.280		0.032	0.022		
	(17.55)	(13.28)		(1.28)	(0.72)		
6	0.824	0.263				0.092	-0.015
	(26.00)	(12.71)				(3.20)	(-0.63)
	Const	$\hat{\beta}_{t-5}$	cp_t	cp_{t-5}	$r^{CF}(t-5,t)$	$r^{T(C)}(t-5,t)$	$r^{I(C)}(t-5,t)$
7	0.593	0.298	-0.101				
	(28.05)	(12.95)	(-9.25)				
8	0.680	0.290		-0.060	-0.018		
	(10.91)	(13.52)		(-2.68)	(-0.81)		
9	0.826	0.279				-0.042	0.102
	(23.75)	(11.81)				(-1.40)	(4.25)
	Const	$\hat{\beta}_{t-5}$	ep_t	ep_{t-5}	$r^{ERN}(t-5,t)$	$r^{T(E)}(t-5,t)$	$r^{I(E)}(t-5,t)$
10	0.553	0.302	-0.102				
	(13.80)	(13.10)	(-3.83)				
11	0.638	0.296		-0.065	-0.014		
	(18.04)	(14.04)		(-4.84)	(-0.62)		
12	0.819	0.281				-0.044	0.112
	(24.04)	(11.67)				(-1.23)	(3.83)
	Const	$\hat{\beta}_{t-5}$				$r_T^{(Tot)}(t-5,t)$	$r^{I(Tot)}(t-5,t)$
13	0.772	0.285				0.010	0.095
	(31.24)	(12.08)				(0.40)	(3.09)
14	1.112					0.018	0.110
	(22.68)					(0.92)	(3.14)

Table A.3: **Fama-MacBeth Regressions of Return Standard Deviation on Tangible and Intangible Return Measures**

Annual, 1968-1999, Coefficients ×1000, Newey-West t-statistics in parentheses

This table reports the results the coefficients (×1000) and t-statistics from of a set of Fama and MacBeth (1973) regressions. The dependent variable in each cross-sectional regression is $\hat{\sigma}(t, t+2)$, the estimated standard deviation the excess return of the individual stock's excess return from July of year t through June of year $t+2$. The independent variables in these regressions are the lagged estimated excess return standard-deviation, $\hat{\sigma}_{t-5}$, estimated using returns from July:$(t-6)$ through June:$(t-4)$; bm_t, the book-to-market ratio as of the end of December:$(t-1)$; bm_{t-5}, the book-to-market ratio as of the end of December:$(t-6)$; and $r^{BV}(t-5, t)$, $r^{T(B)}(t-5, t)$, $r^{I(B)}(t-5, t)$, the book-return, and the tangible and intangible returns using book, calculated as described in the text. Measures using Sales, Cash Flow, and Earnings are calculated similarly. We perform annual cross-sectional regressions from $t = 1968$ through 1999. Standard errors are calculated using a Newey-West procedure with 11 lags.

	Const	$\hat{\sigma}_{t-5}$	bm_t	bm_{t-5}	$r^{BV}(t-5,t)$	$r^{T(B)}(t-5,t)$	$r^{I(B)}(t-5,t)$
1	13.461	121.819	-0.712				
	(46.69)	(6.33)	(-1.62)				
2	14.218	116.513		-0.987	-1.271		
	(44.66)	(6.22)		(-1.74)	(-5.41)		
3	14.548	111.443				-1.527	0.402
	(20.58)	(5.34)				(-2.23)	(1.68)
	Const	$\hat{\sigma}_{t-5}$	sp_t	sp_{t-5}	$r^{SLS}(t-5,t)$	$r^{T(S)}(t-5,t)$	$r^{I(S)}(t-5,t)$
4	13.670	122.315	0.375				
	(33.51)	(6.14)	(1.53)				
5	13.848	119.078		0.197	0.043		
	(31.39)	(6.16)		(0.58)	(0.30)		
6	13.628	112.555				0.303	-0.512
	(28.24)	(5.09)				(1.05)	(-2.28)
	Const	$\hat{\sigma}_{t-5}$	cp_t	cp_{t-5}	$r^{CF}(t-5,t)$	$r^{T(C)}(t-5,t)$	$r^{I(C)}(t-5,t)$
7	10.389	118.805	-1.304				
	(16.69)	(5.80)	(-7.67)				
8	10.971	116.389		-1.178	-0.537		
	(13.21)	(5.52)		(-4.01)	(-5.37)		
9	13.897	109.685				-1.167	1.004
	(66.30)	(4.59)				(-4.66)	(6.30)
	Const	$\hat{\sigma}_{t-5}$	ep_t	ep_{t-5}	$r^{ERN}(t-5,t)$	$r^{T(E)}(t-5,t)$	$r^{I(E)}(t-5,t)$
10	9.435	116.821	-1.454				
	(18.02)	(5.60)	(-12.04)				
11	9.784	115.106		-1.435	-0.430		
	(11.07)	(5.53)		(-5.37)	(-6.66)		
12	13.901	108.374				-1.270	1.266
	(66.52)	(4.49)				(-6.45)	(5.73)
	Const	$\hat{\sigma}_{t-5}$				$r^{T(Tot)}(t-5,t)$	$r^{I(Tot)}(t-5,t)$
13	13.031	112.655				-0.344	0.768
	(115.96)	(4.48)				(-1.27)	(4.32)
14	14.584					-0.268	0.927
	(31.89)					(-0.87)	(4.14)

Table A.4: **Annual Fama-MacBeth Regressions of $\boldsymbol{\iota}(t, t+1)$ on Tangible and Intangible Return Measures**

1968-2001 Fama-MacBeth t-statistics in parentheses

This table presents the results of a set of Fama-MacBeth regressions of our composite-issuance measure over the period 1968-2001. The dependent variable in each regression is the is the composite issuance measure $\boldsymbol{\iota}(t, t+1)$. The independent variables are the fundamental-to-price ratios, measures of fundamental performance, the intangible return from $t-5$ to t, and composite issuance from $t-5$ to t. All coefficient are $\times 100$.

Const	bm_t	bm_{t-5}	$r^B(t-5,t)$	$r^{I(B)}$	$r(t-5,t)$	$\boldsymbol{\iota}(t-5,t)$
-1.276	-1.904					
(-5.64)	(-12.74)					
-0.281		-0.922	-1.159			
(-0.80)		(-7.23)	(-6.76)			
-1.073					0.781	
(-3.58)					(3.52)	
-0.904		-1.843	-2.892		2.106	
(-3.46)		(-17.29)	(-14.01)		(8.28)	
-0.281		-0.922	-1.159	2.106		
(-0.80)		(-7.23)	(-6.76)	(8.28)		
-0.433						7.276
(-1.64)						(18.94)
-0.261		-0.427	-0.756	1.613		6.591
(-0.81)		(-3.58)	(-4.45)	(7.99)		(21.61)

Table A.5: **Big and Small Quinitle Firms – Time-Series Regression Results**

1968:07-2001:12, All Months, t-statistics in parentheses

The results here are the same as reported in the paper, except that two separate set of tests were done for "big" and "small" firms (higher and lower than the 20th percentile of NYSE market capitalization).

Panel A: Small – Intangible Portfolio Return					
	$\hat{\alpha}$	$\hat{\beta}_{Mkt}$	$\hat{\beta}_{SMB}$	$\hat{\beta}_{HML}$	$R^2(\%)$
1	-0.551 (-3.56)				
2	-0.631 (-4.21)	0.183 (5.70)			7.51
3	-0.199 (-1.84)	-0.046 (-1.78)	-0.020 (-0.60)	-0.763 (-19.80)	54.28
Panel B: Small Firms – Issuance Portfolio Return - *Orthogonalized*					
	$\hat{\alpha}$	$\hat{\beta}_{Mkt}$	$\hat{\beta}_{SMB}$	$\hat{\beta}_{HML}$	$R^2(\%)$
4	-0.560 (-4.31)				
5	-0.682 (-6.04)	0.282 (11.64)			25.32
6	-0.644 (-6.30)	0.196 (8.03)	0.309 (9.66)	-0.069 (-1.89)	41.55
Panel C: Big – Intangible Portfolio Return					
	$\hat{\alpha}$	$\hat{\beta}_{Mkt}$	$\hat{\beta}_{SMB}$	$\hat{\beta}_{HML}$	$R^2(\%)$
7	-0.228 (-1.35)				
8	-0.322 (-1.97)	0.214 (6.13)			8.59
9	0.144 (1.19)	0.011 (0.38)	-0.226 (-6.00)	-0.821 (-19.04)	52.38
Panel D: Big Firms – Issuance Portfolio Return - *Orthogonalized*					
	$\hat{\alpha}$	$\hat{\beta}_{Mkt}$	$\hat{\beta}_{SMB}$	$\hat{\beta}_{HML}$	$R^2(\%)$
10	-0.341 (-2.75)				
11	-0.446 (-4.01)	0.241 (10.09)			20.28
12	-0.410 (-3.62)	0.213 (7.87)	0.039 (1.10)	-0.064 (-1.58)	21.22

Table A.6: **Small minus Big Difference Portfolio – Time-Series Regression Results**

1968:07-2001:12, All Months, t-statistics in parentheses

The results here are based on those reported in Table A.5, except that here use the difference between the returns on small-quintile and big-quintile Fama MacBeth coefficient portfolios. Thus, the series analyzed in Panel A is the VW-intangible portfolio returns, for small firms only, minus the equivalent monthly returns for big firms.

Panel A: Small minus Big – Intangible Port Rets					
	$\hat{\alpha}$	$\hat{\beta}_{Mkt}$	$\hat{\beta}_{SMB}$	$\hat{\beta}_{HML}$	$R^2(\%)$
1	-0.323				
	(-2.05)				
2	-0.309	-0.031			0.21
	(-1.95)	(-0.93)			
3	-0.342	-0.057	0.206	0.058	4.36
	(-2.16)	(-1.50)	(4.15)	(1.02)	
Panel B: Small minus Big – Issuance Portfolio Return - *Orthogonalized*					
	$\hat{\alpha}$	$\hat{\beta}_{Mkt}$	$\hat{\beta}_{SMB}$	$\hat{\beta}_{HML}$	$R^2(\%)$
4	-0.218				
	(-1.46)				
5	-0.236	0.041			0.40
	(-1.57)	(1.27)			
6	-0.234	-0.017	0.270	-0.005	8.74
	(-1.59)	(-0.48)	(5.86)	(-0.09)	

Table A.7: **Fama-MacBeth Regressions of Returns on Fundamental-Price Ratios, Lagged Returns and Lagged Growth Measures**

1968:07-2001:12, **January Only**,
Coefficients ×100, *t-statistics in parentheses*

	Const		$r(t-5,t)$			$\iota(t-5,t)$
1	4.641		-1.784			
	(4.47)		(-4.16)			
2	4.214					0.886
	(3.48)					(1.21)
	Const	bm_t		$r^{T(BV)}$	$r^{I(BV)}$	$\iota(t-5,t)$
3	4.314	1.628				
	(3.84)	(3.61)				
4	4.638			-0.867	-2.259	
	(4.02)			(-2.60)	(-4.09)	
	Const	sp_t		$r^{T(SLS)}$	$r^{I(SLS)}$	$\iota(t-5,t)$
5	3.410	1.155				
	(3.18)	(3.75)				
6	4.586			-0.635	-2.156	
	(3.92)			(-1.15)	(-4.51)	
	Const	cp_t		$r^{T(CF)}$	$r^{I(CF)}$	$\iota(t-5,t)$
7	5.162	0.752				
	(3.35)	(1.96)				
8	4.496			-1.667	-1.950	
	(4.18)			(-4.62)	(-3.34)	
	Const	ep_t		$r^{T(ERN)}$	$r^{I(ERN)}$	$\iota(t-5,t)$
9	5.117	0.641				
	(3.35)	(1.86)				
10	4.224			-1.422	-1.934	
	(3.87)			(-3.92)	(-3.34)	
	Const			$r^{T(Tot)}$	$r^{I(Tot)}$	
11	3.697			-1.289	-2.619	
	(3.49)			(-3.41)	(-4.52)	

Table A.8: **Fama-MacBeth Regressions of Returns on Fundamental-Price Ratios, Lagged Returns and Lagged Growth Measures**

1968:07-2001:12, **February-December Only**, *Coefficients* ×100, *t-statistics in parentheses*

	Const		$r(t-5,t)$			$\iota(t-5,t)$
1	0.962		-0.073			
	(3.66)		(-1.03)			
2	0.882					-0.778
	(3.17)					(-5.14)
	Const	bm_t		$r^{T(BV)}$	$r^{I(BV)}$	$\iota(t-5,t)$
3	0.955	0.155				
	(3.59)	(1.96)				
4	0.845			0.049	-0.142	
	(3.08)			(0.60)	(-1.54)	
	Const	sp_t		$r^{T(SLS)}$	$r^{I(SLS)}$	$\iota(t-5,t)$
5	0.817	0.096				
	(2.96)	(1.93)				
6	0.709			0.211	-0.147	
	(2.66)			(1.96)	(-1.85)	
	Const	cp_t		$r^{T(CF)}$	$r^{I(CF)}$	$\iota(t-5,t)$
7	1.538	0.262				
	(6.21)	(3.45)				
8	0.876			0.090	-0.319	
	(3.28)			(1.38)	(-2.98)	
	Const	ep_t		$r^{T(ERN)}$	$r^{I(ERN)}$	$\iota(t-5,t)$
9	1.553	0.224				
	(6.26)	(3.10)				
10	0.874			0.127	-0.298	
	(3.27)			(1.87)	(-2.75)	
	Const			$r^{T(Tot)}$	$r^{I(Tot)}$	
11	1.045			-0.0175	-0.309	
	(4.07)			(-0.26)	(-2.73)	