Chapter 2

The Dynamic Relation Between Stock Returns and Key Financial Ratios: A Variance Decomposition Approach

1 Introduction

This paper investigates the dynamic relation between stock returns and key financial ratios, both analytically and empirically. Ratio analysis has been a traditional topic in financial statement analysis literature for academia and practitioners. Within these lines of research, there are many papers or publications that try to link stock returns or accounting earnings with underlying financial ratios, which is a fundamental objective of financial statement analysis. But there have been relatively few papers to propose an explicit analytical link between the stock returns and financial ratios. This paper tries to analytically establish a dynamic relation between unexpected stock returns and key financial ratios – asset turnover and financial leverage – then uses a methodology, which is called variance decomposition, proposed by Campbell (1991) to empirically implement the proposed model.

It has been widely described that the value of a firm is determined by its profitability and growth. Profitability and growth are influenced by its product market strategy and financial market strategy (for example, see Palepu, Bernard and Healy (1996) Chapter 4). One popular approach to understand how the product market strategy and financial market strategy are related with a firm's profitability is ratio analysis based on DuPont decomposition. It decomposes the return on equity (net income divided by shareholders' equity) into the multiplication of profit margin (net income divided by sales), asset turnover

(sales divided by total assets), and financial leverage (total assets divided by shareholders' equity). Profit margin and asset turnover ratios are about a firm's product market strategy and financial leverage ratio is about a firm's financial market strategy. Therefore, overall profitability (in terms of an accounting measure) of a firm represented as a return on equity can be analyzed and answers the question: what is the source of this overall profitability? This paper extends this analysis. This paper investigates how much variation of unexpected stock returns is explained by the variation of the product market strategy related ratios versus by the variation of the financial market strategy related ratios in a more systematic way. The results of the paper show which strategy is more closely related with stock price variation than the other and its relative magnitude.

Since financial statement analysis is a traditional topic in accounting, there have been several papers that link ratio analysis with stock returns, for example Ou and Penman (1989) and Lev and Thiagarajan (1993). Under my view, the relation between financial ratios and stock returns in those papers is rather indirect. They first use current financial ratios to forecast future accounting earnings, and then use the forecasted accounting earnings to forecast future stock returns. So the relation between financial ratios and stock returns is indirect. Also, the relation between financial ratios and future accounting earnings relies on purely statistical association, like in Ou and Penman (1989) or on expert judgment, like in Lev and Thiagarajan (1993). On the other hand, this paper directly links unexpected stock returns with financial ratios within the present value relation framework and empirically tests the relation under analytically consistent way.

The methodology adopted in this paper is called "variance decomposition" technique proposed by Campbell (1991) to explain how much stock price variation in aggregate market level is caused by news about cash flow (dividend) and news about expected return. He decomposes the variance of unexpected stock returns into the variance of news about cash flow (i.e. infinite sum of discounted changes in expectations of future dividends[1]), the variance of news about expected return (i.e. infinite sum of discounted changes in expectations of future expected return) and its covariance terms. Recently,

[1] In other words, the infinite sum of discounted forecast revision on dividends.

Vuolteenaho (1999) extends the Campbell (1991)'s model on firm-level data and replaces the dividend with accounting earnings using clean surplus relation. This paper uses this methodology and decomposes the variance of unexpected stock returns into the variance of news about product market strategy related ratio, news about financial market strategy related ratio, news about expected return and their covariance terms. Dealing with infinite sum of discounted changes in expectations can be simplified using vector autoregression (VAR) procedures, as in Campbell (1991). As a result of the analysis, we can gauge which strategy is more closely related with unexpected stock returns variation (or source of stock price movement) and how much each strategy take a portion in the total source of the movement.

Empirical implementation of the model uses two representative financial ratios: asset turnover for product market strategy and financial leverage for financial market strategy. Profit margin is not considered as a part of representative product market strategy related ratios, since (1) including the profit margin is not analytically consistent given the proposed setup, and (2) further analysis in the paper shows that the variance of news about profit margin has very small portion of the variance on unexpected stock returns.

The empirical results show that the variance of news about asset turnover, which is a representative measure for a firm's product market strategy, has relatively more portions in explaining the variation of unexpected stock returns than the variance of news about financial leverage, which is a measure for the financial market strategy. It turns out that the product market strategy is nearly twice more related with unexpected stock returns variation than the financial market strategy in the overall sample. On the other hand, industry analysis shows that the financial market strategy is more closely related with the unexpected stock returns variation than the product market strategy in manufacturing industry and others. If a firm becomes more capital intensive, the financial market strategy becomes more important relative to its product market strategy.

The first part of section 2 of the paper shows detailed derivation of the relation between unexpected stock returns and key financial ratios, and the second part of section 2 deals with empirical implementation issues. Section 3 shows empirical results of the model and section 4 concludes the paper.

2 Model

2.1 Model Derivation

Start from one period present value relation between stock price, dividend and expected return (or discount rate)[2]:

$$P_t = \frac{P_{t+1} + D_{t+1}}{1 + R_{t+1}}$$

or

$$1 + R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t} \tag{1}$$

where

P_t = Stock price at the beginning of period t

D_{t+1} = Dividend paid at the end of period t, but unknown at the beginning of t

R_{t+1} = Expected return or discount rate for t.

Assume clean surplus relation in accounting earnings, dividend and book value

$$BV_{t+1} = BV_t + NI_{t+1} - D_{t+1}$$

where

BV_t = Book value of equity at the beginning of period t.

NI_{t+1} = Net income for period t, but it is unknown at the beginning of t.

D_{t+1} = Dividend for period t, but it is unknown at the beginning of t.

The cleans surplus relation can be rewritten as

[2] In addition to the time subscript, I need to have an index for each individual firm since the relationship should hold on firm-level basis. But for more compact notation, I dropped the individual firm subscript except explicitly indicated in the paper.

$$1+\frac{NI_{t+1}}{BV_t}=\frac{BV_{t+1}+D_{t+1}}{BV_t}, \tag{2}$$

where NI_{t+1}/BV_t is interpreted as accounting return on equity, ROE_{t+1}. By taking log on both side of equation (1) and (2), I get

$$\begin{aligned} h_{t+1} &\equiv \log(1+R_{t+1}) \\ &= \log(P_{t+1}+D_{t+1})-\log(P_t) \\ e_{t+1} &\equiv \log(1+ROE_{t+1}) \\ &= \log(BV_{t+1}+D_{t+1})-\log(BV_t) \end{aligned}$$

Even after taking log, the above equation does not become a linear function. Campbell and Shiller (1988a, 1988b) and Vuolteenaho (1999a, 1999b) use a log-linear approximation to deal with this non-linearity. Here I apply their method to linearize these equations. With some algebraic manipulation, these equations can be written as: (See more details in Appendix A)

$$h_{t+1}=\log\left(\exp(\delta_t-\delta_{t+1})+\exp(\delta_t)\right)+\Delta d_{t+1} \tag{3}$$

$$e_{t+1}=\log\left(\exp(\gamma_t-\gamma_{t+1})+\exp(\gamma_t)\right)+\Delta d_{t+1} \tag{4}$$

where

$$\begin{aligned} d_t &= \log(D_t) \\ b_t &= \log(BV_t) \\ p_t &= \log(P_t) \\ \delta_t &= d_t-p_t \\ \gamma_t &= d_t-b_t \\ \Delta d_{t+1} &= d_{t+1}-d_t \end{aligned}$$

δ_t is interpreted as a log-transformed dividend-to-price ratio or dividend yield, γ_t as a log-transformed dividend-to-book value of equity ratio, and Δd_{t+1} as log-transformed dividend growth rate. Log-transformed stock returns and accounting return on book value of equity can be represented as a difference equation in terms of δ_t, γ_t and Δd_{t+1}.

Use first-order Taylor approximation with successive variables δ_t and δ_{t+1} for equation (3) and successive variables γ_t and γ_{t+1} for equation (4) around the same expansion point. Then subtract linearized equation (4) from the linearized equation (3). This procedure gives the following result[3]:

$$h_{t+1} - e_{t+1} \approx \xi_{t+1}$$

$$\xi_{t+1} = \theta_t - \rho\theta_{t+1} + k \tag{5}$$

with some constants ρ[4] and k. θ_t is defined as a log-transformed book-to-market ratio, $b_t - p_t$.

Equation (5) can be thought of as a difference equation relating θ_t to θ_{t+1}, h_{t+1} and e_{t+1}. Solving the difference equation forward while imposing the terminal condition that $\lim_{i\to\infty} \rho^i \theta_{t+i} = 0$, we can obtain

$$\theta_t = \sum_{j=0}^{\infty} \rho^j (h_{t+j+1} - e_{t+j+1}) - \frac{k}{1-\rho}. \tag{6}$$

This equation says that the log book-to-market ratio, θ_t, can be written as the difference between future stock returns, h_{t+j+1}, and accounting return on equity, e_{t+j+1}, discounted at a constant rate ρ less a constant $k/(1-\rho)$. It is important to know that the equation (6) is measured *ex post*. However, equation (6) also holds *ex ante*. Take expectations of equation (6) conditional on the information set available at the beginning of period *t* and *t* + 1, respectively. Since $E_t\theta_t = \theta_t$ and $E_{t+1}\theta_{t+1} = \theta_{t+1}$, we have

$$\theta_t = E_t\left(\sum_{j=0}^{\infty} \rho^j (h_{t+j+1} - e_{t+j+1}) - \frac{k}{1-\rho}\right). \tag{7}$$

$$\theta_{t+1} = E_{t+1}\left(\sum_{j=0}^{\infty} \rho^j (h_{t+j+2} - e_{t+j+2}) - \frac{k}{1-\rho}\right). \tag{8}$$

Substituting equation (7) and (8) into equation (5) gives the following (see detailed derivation in appendix B):

$$h_{t+1} - E_t h_{t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j e_{t+j+1} - (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j h_{t+j+1} \tag{9}$$

[3] See more details in Vuolteenaho (1999a).

[4] In this paper, the value of ρ is set equal to 0.9448. But changing the value within reasonable ranges gives qualitatively similar results.

The equation (9) relates the unexpected stock returns at period *t* to changes in expectations of future accounting return on equity (or forecast revision of accounting return on equity) and changes in expectations of future expected return (or forecast revision of expected return). If the unexpected stock returns is lower, then either downward forecast revision of accounting return on equity, or upward forecast revision of expected return, or both case. The equation (9) is similar to the log-linear dividend-stock price model appearing in Campbell and Shiller (1988a).

I can further decompose the accounting return on equity on the right side of equation (9) into linear combination of three representative financial ratios:

$$\begin{aligned} e_{t+1} &\equiv \log\left(1+\frac{NI_{t+1}}{BV_t}\right) \\ &= \log\left(\frac{BV_t + NI_{t+1}}{SALES_{t+1}}\right) + \log\left(\frac{SALES_{t+1}}{TA_t}\right) + \log\left(\frac{TA_t}{BV_t}\right) \end{aligned}$$

NI_{t+1} is net income during period *t* and is not available in the information set available[5] as of time *t*. $SALES_{t+1}$ is net sales during period *t*, TA_t is total asset at the beginning of period *t*, and BV_t is book value of equity at the beginning of period *t*. Therefore, log one plus accounting return on equity can be decomposed into the inverse cum-dividend equity turnover ratio $\log((BV_t + NI_{t+1})/SALES_t)$, the total asset turnover ratio $\log(SALES_{t+1}/TA_t)$, and the financial leverage ratio $\log(TA_t/BV_t)$. Total asset turnover ratio indicates how much sales dollars the firm is able to generate for each dollar of its assets. The ratio of total assets to book value of equity is a measure of financial leverage and it represents how big the firm's asset base is relative to shareholders' investment. The inverse cum-dividend equity turnover ratio can be interpreted as a mixed measure of product market strategy and financial market strategy, since I can further decompose it into: $\log((BV_t + NI_{t+1})/PPE_t)$ and $\log(PPE_t/SALES_{t+1})$ where PPE_t is a beginning book value of property, plants and equipments. $\log((BV_t + NI_{t+1})/PPE_t)$ is related with financial market strategy, since it shows how much portion of a firm's long-term asset is

[5] The time index $t+1$ is used not for the actual time period, but for the information set index.

financed by equity capital. $\log(PPE_t / SALES_{t+1})$ is related with product market strategy, since it shows how efficiently a firm uses its long-term asset to generate sales.

The analysis in this paper focuses on the last two ratios – total asset turnover and financial leverage – to examine the source of stock price movement from the product market strategy and the financial market strategy. Two concerns might be raised: 1) profit margin (net income to sales ratio) is not included as a measure of product market strategy, and 2) how we interpret the mixed ratio – the inverse cum-dividend equity turnover ratio. The reason why profit margin is not part of the main analysis is that replacing inverse cum-dividend equity turnover with profit margin is inconsistent with the proposed analytical setup, since I use log-transformed gross accounting return on equity $\log(1+ROE_{t+1})$. Additionally, in the later part of this paper, I show that the variance of news about profit margin explains a very small portion of the variance of unexpected stock returns compared to the other ratios. This is why I only focus on the total asset turnover and the financial leverage without including profit margin to examine the source of stock price movement. In addition, In the later part, I also analyze the mixed ratio – the inverse cum-dividend equity turnover ratio. The result of further decomposition on the mixed ratio shows the same conclusion with that of using the two focused ratios. So it would be reasonable to focus on the two ratios – total asset turnover and financial leverage – to examine the source of stock price movement from the product market strategy and the financial market strategy.

Now, define new variables for each corresponding three log-transformed financial ratios: c_{t+1} is for inverse cum-dividend equity turnover, f_{t+1} for asset turnover, and l_{t+1} for financial leverage. Then accounting return on equity can be represented as:

$$e_{t+1} = c_{t+1} + f_{t+1} + l_{t+1} \tag{10}$$

Let's simplify the notation in equation (9). Define

$$\nu_{h,t+1} \equiv h_{t+1} - E_t h_{t+1}$$

$$\eta_{c,t+1} \equiv (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j c_{t+j+1}$$

$$\eta_{f,t+1} \equiv (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$$

$$\eta_{l,t+1} \equiv (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j l_{t+j+1}$$

$$\eta_{h,t+1} \equiv (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j h_{t+j+1}$$

$v_{h,t+1}$ is unexpected stock returns. $\eta_{c,t+1}$ is an infinite sum of discounted changes in expectations of future inverse cum-dividend equity turnover ratio. Hereafter, it will be called as "news about inverse cum-dividend equity turnover". Similarly, $\eta_{f,t+1}$ is called as "news about asset turnover", $\eta_{l,t+1}$ is called as "news about financial leverage", and $\eta_{h,t+1}$ is called as "news about expected return". By combining equation (9) and (10), I get

$$v_{h,t+1} = \eta_{c,t+1} + \eta_{f,t+1} + \eta_{l,t+1} - \eta_{h,t+1} \tag{11}$$

Now the variance of unexpected stock returns is decomposed into the variance of news about inverse cum-dividend equity turnover, news about asset turnover, news about financial leverage, news about expected return, and their covariance terms.

$$\begin{aligned} Var(v_{h,t+1}) = {} & Var(\eta_{c,t+1}) + Var(\eta_{f,t+1}) + Var(\eta_{l,t+1}) + Var(\eta_{h,t+1}) \\ & - 2Cov(\eta_{c,t+1}, \eta_{h,t+1}) - 2Cov(\eta_{f,t+1}, \eta_{h,t+1}) - 2Cov(\eta_{l,t+1}, \eta_{h,t+1}) \\ & + 2Cov(\eta_{c,t+1}, \eta_{l,t+1}) + 2Cov(\eta_{c,t+1}, \eta_{f,t+1}) + 2Cov(\eta_{f,t+1}, \eta_{l,t+1}) \end{aligned} \tag{12}$$

The equation (12) will be used to assess how important each component – news about inverse cum-dividend equity turnover, asset turnover, and financial leverage – is in explaining variation of unexpected stock returns in a present value relation framework.

2.2 Empirical Implementation – Variance Decomposition

Campbell (1991) uses vector autoregression (hereafter VAR) approach to solve the infinite sums with simple, closed form formulas. Then, he constructs a variance-covariance matrix, which is calculated from

the estimated VAR results, to decompose the unexpected stock returns variance into different components of news items – in his case, cash flow news and expected return news. In this part, I will describe how to construct a variance decomposition matrix using VAR approach to decompose the variance of unexpected stock returns into the variance of news about financial ratios and expected return.

Let's define a state vector for each firm as $\mathbf{z_{i,t+1}}$ whose first element is the stock returns, $h_{i,t+1}$, and news about financial ratios as remaining state variables. In this case, the components of the vector is

$$\mathbf{z_{i,t+1}} = \begin{bmatrix} h_{i,t+1} & c_{i,t+1} & f_{i,t+1} & l_{i,t+1} \end{bmatrix}'$$

Assume that the vector $\mathbf{z_{i,t+1}}$ follows a first-order VAR process[6]

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}} \tag{13}$$

The matrix Γ is the companion matrix of the VAR and assumed to be constant over time and across different firms. The error term $\mathbf{w_{i,t+1}}$ is assumed to have a covariance matrix[7] Σ.

Campbell (1991) and Campbell and Ammer (1993) use aggregate level market data to construct VAR and decompose the market unexpected stock returns into aggregate level dividend-to-price ratio, interest rate and other factors. In this paper, I use firm-level data to identify the sources of individual firm unexpected stock returns movement based on its product market strategy and financial market strategy. Therefore $\mathbf{z_{t+1}}$ is a pooled time-series cross-sectional vector. This have some advantages over time series VAR. As pointed out in Holtz-Eakin et al. (1988), the asymptotic distribution theory for a large number of cross-sectional units does not require the vector autoregression to satisfy the usual conditions that rule out unit and explosive roots.

Campbell (1991) suggests a convenient notation for the variance decomposition approach. Define a column vector, $\mathbf{e1}$, whose first element is 1 and the other elements are all zero. Multiplying the transpose of $\mathbf{e1}$ by the state vector, $\mathbf{z_{i,t+1}}$, picks out stock returns, $h_{i,t+1}$, for example, $h_{i,t+1} = \mathbf{e1}'\mathbf{z_{i,t+1}}$ and

[6] This does not impose much restriction on the system, since higher-order VAR can be generalized into the first-order VAR by changing the state variable vector.

[7] Maximum likelihood estimates of disturbance covariance matrix can be estimated with average sums of squares or cross products of the least squares residuals, i.e. $\hat{\Sigma} = 1/T \sum_{t=1}^{T} \hat{\mathbf{w}}_{\mathbf{t+1}} \hat{\mathbf{w}}'_{\mathbf{t+1}}$. See Hamilton (1994) for details.

$\nu_{i,h,t+1} = \mathbf{e1}'\mathbf{w_{i,t+1}}$. Define another column vector, $\mathbf{e2}$, whose second element is 1 and the other elements are all zero. Multiplying the transpose of $\mathbf{e2}$ by the state vector, $\mathbf{z_{i,t+1}}$, picks out the second element of the state vector. Generally, define a column vector $\mathbf{ei}$ whose i^{th} element is 1 and the other elements are all zero. The first-order VAR gives simple multi-period ahead forecast as

$$E_t h_{i,t+j+1} = \mathbf{e1}'\Gamma^{j+1}\mathbf{z_t}$$

$$E_t c_{i,t+j+1} = \mathbf{e2}'\Gamma^{j+1}\mathbf{z_t}$$

$$E_t f_{i,t+j+1} = \mathbf{e3}'\Gamma^{j+1}\mathbf{z_t}$$

$$E_t l_{i,t+j+1} = \mathbf{e4}'\Gamma^{j+1}\mathbf{z_t}$$

Then the news about asset turnover, $\eta_{f,t+1}$, is[8]

$$\eta_{f,t+1} = \mathbf{e3}'(1-\rho\Gamma)^{-1}\mathbf{w_{t+1}}$$

$$= \lambda_3'\mathbf{w_{t+1}} \qquad (14)$$

where $\lambda_3' \equiv \mathbf{e3}'(1-\rho\Gamma)^{-1}$. See Appendix C for the derivation of equation (14). Similarly,

$$\eta_{l,t+1} = \mathbf{e4}'(1-\rho\Gamma)^{-1}\mathbf{w_{t+1}} = \lambda_4'\mathbf{w_{t+1}}$$

$$\eta_{c,t+1} = \mathbf{e2}'(1-\rho\Gamma)^{-1}\mathbf{w_{t+1}} = \lambda_2'\mathbf{w_{t+1}}$$

Since $\nu_{h,t+1} = \eta_{c,t+1} + \eta_{f,t+1} + \eta_{l,t+1} - \eta_{h,t+1}$, I get

$$\eta_{h,t+1} = \eta_{c,t+1} + \eta_{f,t+1} + \eta_{l,t+1} - \nu_{h,t+1}$$

$$= (\lambda_2' + \lambda_3' + \lambda_4' - \mathbf{e1}')\mathbf{w_{t+1}}$$

This expression can be easily used to decompose the variance of unexpected stock returns into the variance of news about inverse cum-dividend equity turnover, asset turnover, financial leverage, expected return, and its covariance terms. For the calculation of variance-covariance components for equation (12), so see the Appendix D.

[8] This procedure can be regarded as in the same line with Feltham and Ohlson (1995)'s linear information dynamics. As Feltham and Ohlson collapse future accounting figures into current one by assuming linear information dynamics, this paper assumes VAR(1) process among stock returns and financial ratios and uses the structure to represent infinite sum of discounted changes in expectations of future financial ratios.

3 Results

3.1 Data and Sample Description

The sample consists of firm-year observations between 1962 and 1998. I collect accounting variables to construct financial ratios from annual 1999 COMPUSTAT Industrial, Full Coverage, and Research files. 1999 CRSP monthly files are used to compound annual returns. To be included in the final sample, a firm-year observation should meet the following criteria. First, all firms must have a December fiscal year-end in order to align accounting variables across firms. Second, a firm must have *t*-1 data available for VAR(1) analysis both in COMPUSTAT and CRSP, where *t* denotes time in years. Third, the market value of equity should exceed $10 million. Fourth, firms in finance industry whose first two digit NAICS code is 52 are eliminated, because of different characteristics in financial ratios. Last, I exclude the following outliers from the sample: observations whose (1) net sales (item 12) is negative, (2) common equity (item 60) is negative, (3) income before extraordinary items[9] (item 18) is negative and its absolute value is greater than its lagged book value of equity or greater than its net sales, and (4) net income (item 172) is negative and its absolute value is greater than its lagged book value of equity or greater than its net sales. As a result, the minimum accounting returns and profit margin, which are both based on net income and income before extraordinary items, are truncated to negative 100%. Outliers regarding financial ratios and stock returns are truncated: below 1% percentile and above 99% percentile of the original observations are set equal to its 1% and 99% level. Using the original data produces the qualitatively same results with using truncated data, so the results are not reported here.

Annual returns are compounded from monthly CRSP returns, recorded from the beginning of June to the next year May. Combined with December year-end restriction, this ensures that the relevant accounting information is available at the time of return compounding. The final sample size is 24,109 firm-years.

[9] The results reported in the paper are based on the net income. But similar results have been obtained, but not reported, when using income before extraordinary items as a substitute for net income.

Table 2.1 shows the descriptive statistics of accounting return on equity, financial ratios, stock returns and market capitalization. The minimum and maximum value of the variables are subject to the treatment of extreme observation: lower than 1% and higher than 99% values are set equal to its 1% and 99% value, respectively. Accounting return on equity (NEBV) seems to have more variation than the annual stock return: the standard deviation of NEBV is 0.633 compared to the standard deviation of CUMRET is 0.366. But this occurs because the denominator, accounting book value of equity, is low and as a result magnifies the accounting return on equity figures. The coefficient of variations, which gives the standard deviation as a proportion of the mean, are 0.783, 1.132, 0.634, and 0.5030 for inverse cum-dividend equity turnover, profit margin, asset turnover, and financial leverage, respectively.

Table 2.2 shows the correlation matrix among the variables. It gives a contemporaneous correlation, i.e. correlation among current variables. Asset turnover has the highest correlation with stock returns (0.0423) among the financial ratios including accounting return on equity. Accounting return on equity has a correlation coefficient of 0.0097 with stock returns. Asset turnover has the lowest correlation with accounting return on equity (0.0435) among the DuPont decomposition-based ratios: profit margin, asset turnover, and financial leverage. Profit margin has a correlation coefficient of 0.1770 with accounting return on equity. Among the three ratios, profit margin is the most highly correlated with the return on equity, which is an accounting performance measure. But if we use stock return as another overall performance measure, then total asset turnover has the highest correlation with the measure among the three ratios.

3.2 Empirical Results

3.2.1 Stock Returns Based Model

Table 2.3 shows the unexpected stock return variance decomposition matrix based on the equation (12). Variance components include news about inverse cum-dividend equity turnover, asset turnover, financial leverage, and expected return. The state vector $\mathbf{z}_{i,t+1}$ is composed of the following four variables:

$$\mathbf{z_{i,t+1}} = [h_{i,t+1} \quad c_{i,t+1} \quad f_{i,t+1} \quad l_{i,t+1}]'$$

where

$h_{i,t+1}$ = Log-transformed one plus stock returns, i.e. $\log(1+R_{t+1})$

$c_{i,t}$ = Inverse cum-dividend equity turnover ratio defined as log-transformed beginning book value of equity plus net income to sales ratio, i.e. $\log((BV_t + NI_{t+1})/SALES_{t+1})$

$f_{i,t+1}$ = Asset turnover ratio defined as log-transformed sales to beginning total asset ratio, i.e. $\log(SALES_{t+1}/TA_t)$

$l_{i,t+1}$ = Financial leverage defined as log-transformed beginning total asset to beginning book value of equity ratio, i.e. $\log(TA_t/BV_t)$

The VAR companion matrix, Γ, is from the following VAR(1) system:

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}}$$

There are four sets of OLS regression in the VAR(1) system. The first regresses stock returns at time *t*+1 on stock returns, inverse cum-dividend equity turnover, asset turnover, and financial leverage at time *t*. The second set regresses profit margin at *t*+1 on all lagged variables and so on. Since the data used in the research is a cross-sectional and time series data, there might be some concerns about unknown cross-correlation and autocorrelation structure. As shown in Fitzenberger (1997), I use a moving block bootstrapping[10] to calculate standard errors which is robust to heteroskedasticity and autocorrelation of unknown forms.

In table 2.3, the first diagonal term in the panel A shows the variance of news about expected stock return (or discount rate), $Var(\eta_{h,t+1})$, where $\eta_{h,t+1}$ is defined as $(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j h_{t+j+1}$. The third diagonal term shows the variance of news about asset turnover, $Var(\eta_{f,t+1})$ where $\eta_{f,t+1}$ is defined as $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$ and is empirically implemented as $\mathbf{e3}'(1-\rho\Gamma)^{-1}\mathbf{w_{t+1}}$. Similarly, the fourth

[10] This paper uses block size as 10 and the number of bootstrapping replication as 200. The changes in the block size and the number of replication do not change the results qualitatively.

diagonal term is a variance of news about financial leverage and the second is a variance of news about inverse cum-dividend equity turnover. The off-diagonal terms are the covariance among various news terms. As a result, the panel A in table 2.3 decomposes the variance of unexpected stock returns into 4 variance and 12 covariance components. The first line in each component is a variance-covariance estimate from the original sample, the second line is variance-covariance estimate from the moving block bootstrapped sample, and the third line is a standard error of variance-covariance estimate obtained from the moving block bootstrapped sample[11].

From the panel A of table 2.3, the variance estimates of news about expected return, inverse cum-dividend equity turnover, asset turnover and financial leverage are 0.1219, 4.6982, 3.5499 and 1.8131, with bootstrapped standard error estimate of 0.0061, 0.2330, 0.1154 and 0.0975, respectively. Estimates from the original sample and moving block bootstrapped sample are almost the same, so the original sample variance estimates are not biased. Larger portions of the variation of unexpected stock returns are explained by the variance components of news about inverse cum-dividend equity turnover and asset turnover. Table 2.3 uses inverse cum-dividend equity turnover ratio, $\log((BV_{t+1} + NI_t)/SALES_{t+1})$ instead of profit margin, $\log(1+NI_{t+1}/SALES_{t+1})$. Even though this replacement is not in the same line with DuPont decomposition, there are two reasons why I do this. First, using inverse cum-dividend equity turnover ratio is consistent with the analytical setup, since I decompose gross accounting return on equity, $\log(1+NI_{t+1}/BV_t)$, instead of $\log(NI_{t+1}/BV_t)$. Second, in the later part of this section, I show that the variance component of news about profit margin has very small portion compared to the variance of news about asset turnover and financial leverage ratios. Inverse cum-dividend equity ratio can be interpreted as the mixed measure of product and financial market strategy and will be covered in details in the next subsection. Therefore, the source of stock price movement from the product market strategy can be measured using asset turnover alone and the source of stock price movement from the financial market strategy can be measured using financial leverage.

[11] Since there is no analytical formula for the standard error estimate in variance decomposition matrix, I need to rely on a numerical method, in this case moving block bootstrapping. Vuolteenaho (199b) uses delete-group jackknife for the standard error calculation, as proposed in Shao and Rao (1993).

Panel C of table 2.3 shows the ratio between the variance of news about asset turnover (i.e. source of stock price movement from the product market strategy) and the variance of news about financial leverage (i.e. source of stock price movement from the financial market strategy). If the ratio is greater than one, then it means product market strategy has a more portion as a source of stock price movement (or more closely related with the variation of unexpected stock returns) than financial market strategy. In addition, it shows how much closely related with the stock price movement one strategy is compared to the other, i.e. the relative magnitude. As shown in the panel C, the ratio between the two variance component is 1.9575 (standard error 0.1264), which means the product market strategy is roughly 2 times more closely related with the variation of unexpected stock returns than the financial market strategy in the overall cross-sectional and time-series observations during the sample period[12].

Panel B of table 2.3 is the correlation matrix constructed from panel A variance decomposition matrix. News about financial leverage is negatively correlated (coefficient of -0.3054 with standard error 0.0365) with news about expected return[13]. Panel D of table 2.3 is about the variance of unexpected stock returns.

3.2.2 Further decomposition of inverse cum-dividend equity turnover

Table 2.4 shows the unexpected stock returns variance decomposition matrix based on the further decomposition of inverse cum-dividend equity turnover ratio, $\log((BV_t + NI_{t+1})/SALES_{t+1})$. This ratio can be decomposed into two different measures[14]: $\log((BV_t + NI_{t+1})/PPE_t)$ is related with financial market strategy and $\log(PPE_t / SALES_{t+1})$ is related with product market strategy. The first ratio is about how much portion of a firm's long-term assets, especially property, plant and equipment, are

[12] If accounting book value of equity as a denominator is small, then it magnifies the variation of the total asset to book value of equity (i.e. financial leverage) ratio. But it does not work against the result. If the financial leverage varies less, then the ratio between the variance of news about asset turnover and the variance of news about financial leverage becomes larger.

[13] Table 2.3 Panel B correlation matrix is different from the correlation matrix in table 2.2. Variables in the table2. 3 are news items (i.e. infinite sum of discounted changes in expectation of future financial ratios), while variables in the table 2 are realized values of financial ratios.

[14] I cannot decompose the inverse cum-dividend equity turnover ratio into the cum-dividend equity to total assets ratio and the total assets to sales ratio, since this decomposition produces an exact identification of the VAR system.

financed by long-term capital, especially common equity. The second ratio is about how efficiently a firm uses its long-term assets to generate sales. Now the state vector $\mathbf{z_{i,t+1}}$ is composed of the following five variables:

$$\mathbf{z_{i,t+1}} = \begin{bmatrix} h_{i,t+1} & u_{i,t+1} & s_{i,t+1} & f_{i,t+1} & l_{i,t+1} \end{bmatrix}'$$

where

$u_{i,t+1}$ = Cum-dividend equity to PPE ratio, i.e. $\log((BV_t + NI_{t+1})/PPE_t)$

$s_{i,t+1}$ = PPE to sales ratio, i.e. $\log(PPE_t / SALES_{t+1})$

and other variables' definitions are the same as previously.

In table 2.4, the second diagonal term shows the variance of news about cum-dividend equity to PPE, $Var(\eta_{u,t+1})$, where $\eta_{u,t+1}$ is defined as $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j u_{t+j+1}$ and empirically implemented as $\mathbf{e2}'(1-\rho\Gamma)^{-1}\mathbf{w_{t+1}}$. The third diagonal term is the variance of news about PPE turnover, and empirically implemented in a similar way. The purpose of the table 2.4 is to examine the nature of the mixed measure, inverse cum-dividend equity to sales ratio. Once I decompose the cum-dividend equity to sales ratio into cum-dividend equity to PPE and PPE turnover ratio, I can calculate the ratio between the variance of news about PPE turnover and the variance of news about cum-dividend equity to PPE, $Var(\eta_{s,t+1})/Var(\eta_{u,t+1})$. This shows how closely a firm's product market strategy is related with the stock price movement compared to its financial market strategy after further decomposing the mixed measure. If this ratio is greater than one[15] and the previous ratio, $Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$, is also greater than one, then I can generally conclude that product market strategy is more closely related with stock price movement than financial market strategy. As shown in the panel C of table 2.4, the ratio from two representative measures, $Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$, is 2.0201 (standard error 0.1168) and the ratio from the mixed measure, $Var(\eta_{s,t+1})/Var(\eta_{u,t+1})$, is 1.4820 (standard error 0.0612). The two ratios are both greater than one, and I can generally confirm the conclusion from table 2.3 that uses only the two representative

[15] $Var(\eta_{s,t+1})/Var(\eta_{u,t+1})$ is greater than one means that the product market strategy related ratio is more closely related with stock price movement than the financial market strategy related ratio, i.e. more portion of stock price movement is explained by its product market strategy.

measures. From now on, I will report the results using the two representative measures: asset turnover and financial leverage.

3.2.3 Including Profit Margin

DuPont decomposition is related to profit margin, asset turnover and financial leverage, while I need to use inverse cum-dividend equity turnover instead of profit margin. In table 2.5, I plug-in the profit margin, $\log(1+NI_{t+1}/SALES_{t+1})$[16], instead of inverse cum-dividend equity turnover. Even though this replacement does not follow the analytical setup in the section 2, it might be worthwhile to see how much news about profit margin is related with the variation of unexpected stock returns. In this setup, the state vector, $\mathbf{z_{i,t+1}}$, is composed of the following four variables:

$$\mathbf{z_{i,t+1}} = [h_{i,t+1} \quad g_{i,t+1} \quad f_{i,t+1} \quad l_{i,t+1}]'$$

where

$g_{i,t+1}$ = Profit margin, i.e. $\log(1+NI_{t+1}/SALES_{t+1})$

and other variables are defined as the same way before.

In table 2.5, the second diagonal term shows the variance of news about profit margin, $Var(\eta_{g,t+1})$, where $\eta_{g,t+1}$ is defined as $(E_{t+1}-E_t)\sum_{j=0}^{\infty}\rho^j g_{t+j+1}$ and empirically implemented as $\mathbf{e2}'(1-\rho\Gamma)^{-1}\mathbf{w_{t+1}}$. The other variables have the same definition before and use the similar empirical implementation procedure.

From the panel A of table 2.5, the variances of news about profit margin, asset turnover and financial leverage are 0.0274, 3.3844 and 1.6190 with standard error of 0.0015, 0.1039 and 0.0765, respectively. The variance of news about profit margin is relatively very small compared to the two representative ratios: asset turnover and financial leverage. It would be relatively safe to say that the impact of profit margin on the effectiveness of product market strategy is so low that we can measure the source of stock

[16] Based on the DuPont decomposition setting, the right expression should be $\log(NI_{t+1}/SALES_{t+1})$. But I need to add one to the profit margin so that the argument of the log function is not negative.

price movement by using only asset turnover. After considering news about profit margin, the table 2.5 still shows that the ratio between the variance of news about asset turnover and the variance of news about financial leverage is 2.0926 (standard error 0.1111) which suggests that the product market strategy is twice as closely related with stock price movement as that of financial market strategy in the overall cross-sectional and time-series observations during the sample period.

3.2.4 Industry Analysis

The results from table 2.3 to table 2.5 are based on the all observations in the sample. It is a rather general tendency that the source of the movement from the product market strategy is greater than that from the financial market strategy. In this subsection, I want to analyze whether the relative portion of the two strategies varies across different industries. The industry classification is based on the first two-digits of NAICS (North America Industry Classification System) code. From the previous subsection, it is clear that the variance of news about profit margin contributes only small portion of the variance of unexpected stock returns. Also, the analysis of the variance of news about inverse cum-dividend equity turnover shows that the product market strategy is relatively more effective than the financial market strategy. Therefore, the industry analysis is performed based on the basic model, equation (12), and does not include further decomposition of inverse cum-dividend equity turnover. The state vector of VAR(1) system includes the following four variables.

$$\mathbf{z_{i,t+1}} = [h_{i,t+1} \quad c_{i,t+1} \quad f_{i,t+1} \quad l_{i,t+1}]'$$

Table 2.6 only reports the ratio between the variance of news about asset turnover, $Var(\eta_{f,t+1})$, and the variance of news about financial leverage, $Var(\eta_{l,t+1})$. This ratio tells how the product market strategy is related with stock price movement, relative to the financial market strategy. If this ratio is greater than one, the product market strategy has relatively more portion than the financial market strategy and vice versa. Even though the product market strategy has more portion in general, there are some variations across industries. In mining (NAICS 21), manufacturing (NAICS 31 to 33), retail trade (NAICS 44 to 45), real estate and rental and leasing (NAICS 53), and art, entertainment and recreation

(NAICS 71) industries, the ratio between the variance of news about asset turnover and the variance of news about financial leverage, $Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$, is less than one which suggests that the financial market strategy is relatively more related than the product market strategy. In other industries than those, the product market strategy is relatively more related than the financial market strategy.

3.2.5 Capital Intensiveness

Table 2.7 examines whether the relative magnitude of the portion varies over how capital intensive a firm is. The capital intensiveness is measured in the ratio of property, plant and equipments to the total assets. I constructed quintile portfolio based on the measure of capital intensiveness, PPE to total assets ratio, and perform the variance decomposition analysis based on the equation (12). The state vector and VAR structure stay the same as table 2.3 and table 2.6, except the variance decomposition analysis are performed on each capital intensiveness ranked quintile portfolio. Table 2.7 reports only the ratio between the variance of news about asset turnover and the variance of news about financial leverage, $Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$, which measures how the product market strategy is closely related with the stock price movement relative to the financial market strategy. Overall the ratios is greater than one for all capital intensiveness ranked portfolios, but the relative portion of product market strategy decreases as the capital intensiveness of a firm increases. The ratio is 2.5521 in the lowest capital intensive quintile portfolio and 1.7971 in the highest capital intensive quintile portfolio. In general, the relative importance of a firm's financial market strategy compared to the product market strategy becomes larger as the firm becomes more capital intensive.

4 Conclusion

In this paper, I try to setup an analytical model that directly relates unexpected stock returns with financial ratios and expected returns: the unexpected stock return is expressed as the news about inverse cum-dividend equity turnover, news about asset turnover, news about financial leverage, and news about

expected return. The variance of news about asset turnover is treated as the representative measure of a firm's product market strategy and the variance of news about financial leverage is treated as the representative measure of its financial market strategy. After empirical implementation of the model, I show whether a firm's product market strategy is more closely related with the variation of unexpected stock returns than its financial market strategy. Based on the variance decomposition analysis combined with vector autoregression technique, the variance of news about asset turnover has larger portion in the variance of unexpected stock returns than the variance of news about financial leverage. The reason why the variance of news about profit margin is not a part of product market strategy measure is that: (1) including the profit margin in the model is not analytically consistent given the proposed setup, and (2) the variation of unexpected stock returns explained by this measure is very small. Analysis on the mixed measure, which is news about inverse cum-dividend equity turnover ratio, supports the general conclusion that product market strategy has relatively more portion. On the other hand, industry analysis reveals that the two strategies varies across industries. In mining, manufacturing, retail trade, real estate, and entertainment industries, the financial market strategy seems more closely related with the stock price movement than the product market strategy. In addition, if a firm becomes more capital intensive, the financial market strategy becomes more important relative to its product market strategy.

This paper contributes on the financial statement analysis research literature by providing an explicit link between stock returns and financial ratios within the present value relation framework. This paper does not rely on statistical association or expert judgment in selecting relevant financial ratios, like in Ou and Penman (1989), Lev and Thiagarajan (1993) and Abarbanell and Bushee (1997, 1998). Those past papers also do not link the financial ratios and stock returns directly. They first link relevant financial ratios with future accounting earnings and then link the future accounting earnings with subsequent stock returns. This indirect modeling is because the traditional ratio analysis is static analysis in nature. DuPont decomposition, which is a popular framework in ratio analysis, does not incorporate present value concept, which is dynamic in nature. Therefore the ratio analysis without incorporating present value framework is not able to directly link the financial ratios with subsequent stock returns. The framework

proposed by this paper incorporates the present value relation in ratio analysis so that we are able to evaluate the source of stock price movement from a firm's product market strategy and financial market strategy.

Appendix

A. Proof of Equation (4)

Consider the following algebraic manipulations:

$$
\begin{aligned}
e_{t+1} &\equiv \log\left(\frac{BV_{t+1}}{BV_t}+\frac{D_{t+1}}{BV_t}\right) \\
&= \log\left(\frac{D_t}{BV_t}\cdot\frac{BV_{t+1}}{D_{t+1}}\cdot\frac{D_{t+1}}{D_t}+\frac{D_t}{BV_t}\cdot\frac{D_{t+1}}{D_t}\right) \\
&= \log\left(\left\{\frac{\exp(d_t)}{\exp(b_t)}\cdot\frac{\exp(b_{t+1})}{\exp(d_{t+1})}+\frac{\exp(d_t)}{\exp(b_t)}\right\}\cdot\frac{D_{t+1}}{D_t}\right) \\
&= \log\left(\left\{\exp(d_t-b_t)\cdot\exp(-d_{t+1}+b_{t+1})+\exp(d_t-b_t)\right\}\cdot\frac{D_{t+1}}{D_t}\right) \\
&= \log\left(\exp(\gamma_t-\gamma_{t+1})+\exp(\gamma_t)\right)+\log(D_{t+1})-\log(D_t) \\
&= \log\left(\exp(\gamma_t-\gamma_{t+1})+\exp(\gamma_t)\right)+\Delta d_{t+1}
\end{aligned}
$$

where

$$
\begin{aligned}
d_t &= \log(D_t) \\
b_t &= \log(BV_t) \\
\gamma_t &= d_t-b_t \\
\Delta d_{t+1} &= d_{t+1}-d_t
\end{aligned}
$$

This gives the equation (4) and the equation (3) follows similarly.

B. Proof of Equation (9)

Substituting equation (7) and (8) into equation (5) with further algebraic manipulation will give the result.

$$
\begin{aligned}
h_{t+1} &= k + \theta_t - \rho \cdot \theta_{t+1} + e_{t+1} \\
&= k + E_t\left(\sum_{j=0}^{\infty} \rho^j (h_{t+j+1} - e_{t+j+1}) - \frac{k}{1-\rho} \right) \\
&\quad - \rho E_{t+1}\left(\sum_{j=0}^{\infty} \rho^j (h_{t+j+2} - e_{t+j+2}) - \frac{k}{1-\rho} \right) + \Delta d_{t+1} \\
&= E_t \sum_{j=0}^{\infty} \rho^j h_{t+j+1} - E_t \sum_{j=0}^{\infty} \rho^j e_{t+j+1} \\
&\quad - E_{t+1} \sum_{j=0}^{\infty} \rho^{j+1} h_{t+j+2} + E_{t+1} \sum_{j=0}^{\infty} \rho^{j+1} e_{t+j+2} + e_{t+1} \\
&= E_t \sum_{j=0}^{\infty} \rho^j h_{t+j+1} - E_{t+1} \sum_{j=1}^{\infty} \rho^j h_{t+j+1} \\
&\quad - E_t \sum_{j=0}^{\infty} \rho^j e_{t+j+1} + E_{t+1} \sum_{j=1}^{\infty} \rho^j e_{t+j+1} + e_{t+1} \\
&= E_t h_{t+1} + E_t \sum_{j=1}^{\infty} \rho^j h_{t+j+1} - E_{t+1} \sum_{j=1}^{\infty} \rho^j h_{t+j+1} \\
&\quad - E_t \sum_{j=0}^{\infty} \rho^j e_{t+j+1} + E_{t+1} \sum_{j=0}^{\infty} \rho^j e_{t+j+1} \\
&= E_t h_{t+1} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j h_{t+j+1} \\
&\quad + (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j e_{t+j+1}
\end{aligned}
$$

Therefore, I get

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

C. Proof of Equation (14)

Algebraic manipulation of the definition of $\eta_{f,t+1}$ gives the result.

$$
\eta_{f,t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j f_{t+j+1}
$$

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

$$= \sum_{j=0}^{\infty} \rho^j (\mathbf{e3}' \Gamma^j \mathbf{z_{t+1}} - \mathbf{e3}' \Gamma^{j+1} \mathbf{z_t})$$

$$= \sum_{j=0}^{\infty} \rho^j (\mathbf{e3}' \Gamma^j (\Gamma \mathbf{z_t} + \mathbf{w_{t+1}}) - \mathbf{e3} \Gamma^{j+1} \mathbf{z_t})$$

$$= \sum_{j=0}^{\infty} \rho^j \mathbf{e3}' \Gamma^j \mathbf{w_{t+1}}$$

$$= \mathbf{e3}' (1 - \rho \Gamma)^{-1} \mathbf{w_{t+1}}$$

$$= \lambda_2' \mathbf{w_{t+1}}$$

D. Variance-Covariance Matrix Calculation

Variance decomposition for the unexpected stock returns appeared in the equation (10) is:

$$Var(\eta_{c,t+1}) = \lambda_2' \Sigma \lambda_2$$

$$Var(\eta_{f,t+1}) = \lambda_3' \Sigma \lambda_3$$

$$Var(\eta_{l,t+1}) = \lambda_4' \Sigma \lambda_4$$

$$Var(\eta_{h,t+1}) = (\lambda_2' + \lambda_3' + \lambda_4' - \mathbf{e1}') \Sigma (\lambda_2 + \lambda_3 + \lambda_4 - \mathbf{e1})$$

$$Cov(\eta_{c,t+1}, \eta_{f,t+1}) = \lambda_2' \Sigma \lambda_3$$

$$Cov(\eta_{c,t+1}, \eta_{l,t+1}) = \lambda_2' \Sigma \lambda_4$$

$$Cov(\eta_{c,t+1}, \eta_{h,t+1}) = \lambda_2' \Sigma (\lambda_2 + \lambda_3 + \lambda_4 - \mathbf{e1})$$

$$Cov(\eta_{f,t+1}, \eta_{l,t+1}) = \lambda_3' \Sigma \lambda_4$$

$$Cov(\eta_{f,t+1}, \eta_{h,t+1}) = \lambda_3' \Sigma (\lambda_2 + \lambda_3 + \lambda_4 - \mathbf{e1})$$

$$Cov(\eta_{l,t+1}, \eta_{h,t+1}) = \lambda_4' \Sigma (\lambda_2 + \lambda_3 + \lambda_4 - \mathbf{e1})$$

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Table 2.1: Descriptive Statistics

Variable	Mean	Standard Deviation	Min	25%	Median	75%	Max
NEBV	0.133	0.633	-0.989	0.078	0.136	0.188	92.285
BNSALE	0.612	0.479	0.069	0.316	0.477	0.751	3.020
NESALE	0.061	0.080	-0.260	0.026	0.055	0.097	0.363
SALETA	1.236	0.784	0.191	0.627	1.150	1.613	4.435
TABV	2.515	1.265	1.127	1.662	2.193	3.034	8.862
CUMRET	0.154	0.366	-0.596	-0.073	0.108	0.326	1.518
MKTCAP ($M)	1601.4	5502.3	10.0	71.1	253.1	967.0	162604.1

The table describes a summary statistics for selected variables. The statistics is before cross-sectionally demeaned and before log-transformation. When implementing the model, all variables are cross-sectionally demeaned and log-transformed. The definitions of variables are as follows:

NEBV:	Net income to beginning book value of equity ratio, i.e. accounting return on equity
BNSALE:	Cum-dividend book value of equity (i.e. beginning book value of equity plus net income) to sales ratio, i.e. inverse cum-dividend equity turnover
NESALE:	Net income to sales ratio, i.e. profit margin
SALETA:	Sales to beginning value of total asset, i.e. total asset turnover
TABV:	Beginning value of total asset to beginning value of equity ratio, i.e. financial leverage
CUMRET:	Cumulated monthly stock returns from current year June to next year May, i.e. stock returns
MKTCAP:	Market capitalization in millions

Among the above variables, NEBV, NESALE, and CUMRET are treated as a gross value, i.e. add one to the original value, in empirical implementation. This table shows the result before adding the one.

Table 2.2: Correlation Analysis

	CUMRET	NEBV	BNSALE	NESALE	SALETA	TABV
CUMRET	1.0000	0.0097	-0.0408	0.0175	0.0423	0.0156
NEBV		1.0000	-0.0039	0.1770	0.0435	0.0525
BNSALE			1.0000	0.4968	-0.5977	-0.2205
NESALE				1.0000	-0.2399	-0.1180
SALETA					1.0000	-0.1863
TABV						1.0000

The table describes a summary statistics for selected variables. The statistics is before cross-sectionally demeaned and before log-transformation. When implementing the model, all variables are cross-sectionally demeaned and log-transformed. The definitions of variables are as follows:

CUMRET: Cumulated monthly stock returns from current year June to next year May, i.e. annual stock returns

NEBV: Net income to beginning book value of equity ratio, i.e. accounting return on equity

BNSALE: Cum-dividend book value of equity (i.e. beginning book value of equity plus net income) to sales ratio, i.e. inverse cum-dividend equity turnover

NESALE: Net income to sales ratio, i.e. profit margin

SALETA: Sales to beginning value of total asset, i.e. total asset turnover

TABV: Beginning value of total asset to beginning value of equity ratio, i.e. financial leverage

Table 2.3: Variance Decomposition for Stock Returns: Basic Case

Panel A. Variance Decomposition Matrix

		$\eta_{h,t+1}$	$\eta_{c,t+1}$	$\eta_{f,t+1}$	$\eta_{l,t+1}$
$\eta_{h,t+1}$	Original Estimate	0.1219	0.2177	-0.0113	-0.1436
	Bootstrapped Estimate	(0.1214)	(0.2156)	(-0.0111)	(-0.1424)
	Bootstrapped SE	[0.0061]	[0.0327]	[0.0151]	[0.0226]
$\eta_{c,t+1}$	Original Estimate	0.2177	4.6982	-2.9737	-1.4826
	Bootstrapped Estimate	(0.2156)	(4.7002)	(-2.9717)	(-1.4887)
	Bootstrapped SE	[0.0327]	[0.2330]	[0.1397]	[0.1347]
$\eta_{f,t+1}$	Original Estimate	-0.0113	-2.9737	3.5499	-0.5313
	Bootstrapped Estimate	(-0.0111)	(-2.9717)	(3.5414)	(-0.5254)
	Bootstrapped SE	[0.0151]	[0.1397]	[0.1154]	[0.0679]
$\eta_{l,t+1}$	Original Estimate	-0.1436	-1.4826	-0.5313	1.8131
	Bootstrapped Estimate	(-0.1424)	(-1.4887)	(-0.5254)	(1.8150)
	Bootstrapped SE	[0.0226]	[0.1347]	[0.0679]	[0.0975]

Panel B. Correlation Matrix

		$\eta_{h,t+1}$	$\eta_{c,t+1}$	$\eta_{f,t+1}$	$\eta_{l,t+1}$
$\eta_{h,t+1}$	Original Estimate	1.0000	0.2877	-0.0172	-0.3054
	Bootstrapped Estimate	(1.0000)	(0.2846)	(-0.0168)	(-0.3023)
	Bootstrapped SE	[0.0000]	[0.0341]	[0.0230]	[0.0365]
$\eta_{c,t+1}$	Original Estimate	0.2877	1.0000	-0.7282	-0.5080
	Bootstrapped Estimate	(0.2846)	(1.0000)	(-0.7284)	(-0.5089)
	Bootstrapped SE	[0.0341]	[0.0000]	[0.0157]	[0.0253]
$\eta_{f,t+1}$	Original Estimate	-0.0172	-0.7282	1.0000	-0.2094
	Bootstrapped Estimate	(-0.0168)	(-0.7284)	(1.0000)	(-0.2075)
	Bootstrapped SE	[0.0230]	[0.0157]	[0.0000]	[0.0276]
$\eta_{l,t+1}$	Original Estimate	-0.3054	-0.5080	-0.2094	1.0000
	Bootstrapped Estimate	(-0.3023)	(-0.5089)	(-0.2075)	(1.0000)
	Bootstrapped SE	[0.0365]	[0.0253]	[0.0276]	[0.0000]

Panel C. Variance of news about asset turnover to variance of news about financial leverage ratio

	Original Estimate	Bootstrapped Estimate	Bootstrapped SE
$Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$	1.9579	1.9570	0.1264

Panel D. Total Variance of Unexpected Stock Returns

	Original Estimate	Bootstrapped Estimate	Bootstrapped SE
Variance of Unexpected Returns	0.0822	0.0821	0.0013

Panel A reports the variance decomposition matrix. It decomposes the variance of the unexpected stock returns into the variance of the news about expected return, cum-dividend equity turnover, asset turnover, financial leverage, and their covariance terms. The state variable of the VAR(1) system and the definition of variables are:

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}}$$

where

$\mathbf{z_{i,t}}$ = $\begin{bmatrix} h_{i,t} & c_{i,t} & f_{i,t} & l_{i,t} \end{bmatrix}$

$h_{i,t}$ = log-transformed stock returns

$c_{i,t}$ = log-transformed cum-dividend equity to sales ratio

$f_{i,t}$ = log-transformed sales to beginning total asset ratio

$l_{i,t}$ = log-transformed beginning total asset to beginning book value of equity ratio

The first element of Panel A is an estimate from the original sample, the second element is an estimate from the moving block bootstrapped sample, and the third element is moving block bootstrapping standard error estimate.

Panel B reports the correlation matrix which is constructed from the variance decomposition matrix. The first element of Panel B is an estimate of the correlation coefficient from the original sample, the second element is an estimate from the moving block bootstrapped sample, and the third element is a moving block bootstrapping standard error estimate.

Panel C reports the variance of news about asset turnover to the variance of news about financial leverage ratio. If this ratio is greater than one, I can say the news about asset turnover is relatively more related with unexpected stock return variations than the news about financial leverage is. It also reports the mean statistic from moving block bootstrapped sample and its standard error estimate.

Panel D reports the total variance of unexpected stock returns with original sample, moving block bootstrapped sample and its standard error estimate.

Each variable represents news items and the definitions are:

$\eta_{h,t+1}$ = $(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j h_{t+j+1}$: news about expected return

$\eta_{c,t+1}$ = $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j c_{t+j+1}$: news about inverse cum-dividend equity turnover

$\eta_{f,t+1}$ = $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$: news about asset turnover

$\eta_{l,t+1}$ = $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j l_{t+j+1}$: news about financial leverage

Table 2.4: Variance Decomposition for Stock Returns: Decomposing equity turnover

Panel A. Variance Decomposition Matrix

		$\eta_{h,t+1}$	$\eta_{u,t+1}$	$\eta_{s,t+1}$	$\eta_{f,t+1}$	$\eta_{l,t+1}$
$\eta_{h,t+1}$	Original Estimate	0.1697	0.0047	0.2459	-0.0109	-0.1298
	Bootstrapped Estimate	(0.1718)	(0.0007)	(0.2518)	(-0.0102)	(-0.1303)
	Bootstrapped SE	[0.0188]	[0.0457]	[0.0524]	[0.0273]	[0.0218]
$\eta_{u,t+1}$	Original Estimate	0.0047	6.1725	-5.3640	1.3680	-2.0695
	Bootstrapped Estimate	(0.0007)	(6.2060)	(-5.4004)	(1.3762)	(-2.0781)
	Bootstrapped SE	[0.0457]	[0.2763]	[0.2979]	[0.1384]	[0.1100]
$\eta_{s,t+1}$	Original Estimate	0.2459	-5.3640	9.1475	-4.2574	0.6195
	Bootstrapped Estimate	(0.2518)	(-5.4004)	(9.1827)	(-4.2590)	(0.6286)
	Bootstrapped SE	[0.0524]	[0.2979]	[0.3651]	[0.1791]	[0.1175]
$\eta_{f,t+1}$	Original Estimate	-0.0109	1.3680	-4.2574	3.3140	-0.3679
	Bootstrapped Estimate	(-0.0102)	(1.3762)	(-4.2590)	(3.3104)	(-0.3705)
	Bootstrapped SE	[0.0273]	[0.1384]	[0.1791]	[0.1172]	[0.0758]
$\eta_{l,t+1}$	Original Estimate	-0.1298	-2.0695	0.6195	-0.3679	1.6405
	Bootstrapped Estimate	(-0.1303)	(-2.0781)	(0.6286)	(-0.3705)	(1.6420)
	Bootstrapped SE	[0.0218]	[0.1100]	[0.1175]	[0.0758]	[0.0922]

Panel B. Correlation Matrix

		$\eta_{h,t+1}$	$\eta_{u,t+1}$	$\eta_{s,t+1}$	$\eta_{f,t+1}$	$\eta_{l,t+1}$
$\eta_{h,t+1}$	Original Estimate	1.0000	0.0046	0.1974	-0.0145	-0.2460
	Bootstrapped Estimate	(1.0000)	(0.0020)	(0.1996)	(-0.0144)	(-0.2452)
	Bootstrapped SE	[0.0000]	[0.0435]	[0.0330]	[0.0358]	[0.0342]
$\eta_{u,t+1}$	Original Estimate	0.0046	1.0000	-0.7138	0.3025	-0.6503
	Bootstrapped Estimate	(0.0020)	(1.0000)	(-0.7152)	(0.3040)	(-0.6512)
	Bootstrapped SE	[0.0435]	[0.0000]	[0.0206]	[0.0314]	[0.0204]
$\eta_{s,t+1}$	Original Estimate	0.1974	-0.7138	1.0000	-0.7732	0.1599
	Bootstrapped Estimate	(0.1996)	(-0.7152)	(1.0000)	(-0.7726)	(0.1625)
	Bootstrapped SE	[0.0330]	[0.0206]	[0.0000]	[0.0194]	[0.0322]
$\eta_{f,t+1}$	Original Estimate	-0.0145	0.3025	-0.7732	1.0000	-0.1578
	Bootstrapped Estimate	(-0.0144)	(0.3040)	(-0.7726)	(1.0000)	(-0.1595)
	Bootstrapped SE	[0.0358]	[0.0314]	[0.0194]	[0.0000]	[0.0338]
$\eta_{l,t+1}$	Original Estimate	-0.2460	-0.6503	0.1599	-0.1578	1.0000
	Bootstrapped Estimate	(-0.2452)	(-0.6512)	(0.1625)	(-0.1595)	(1.0000)
	Bootstrapped SE	[0.0342]	[0.0204]	[0.0322]	[0.0338]	[0.0000]

Panel C. Variance of news about asset turnover to variance of news about financial leverage ratio

	Original Estimate	Bootstrapped Estimate	Bootstrapped SE
$Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$	2.0201	2.0213	0.1168
$Var(\eta_{s,t+1})/Var(\eta_{u,t+1})$	1.4820	1.4812	0.0612

Panel A reports the variance decomposition matrix. It decomposes the variance of the unexpected stock returns into the variance of the news about expected return, cum-dividend equity turnover, asset turnover, financial leverage, and their covariance terms. The state variable of the VAR(1) system and the definition of variables are:

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}}$$

where

$\mathbf{z_{i,t}} = \begin{bmatrix} h_{i,t} & u_{i,t} & s_{i,t} & f_{i,t} & l_{i,t} \end{bmatrix}$

$h_{i,t}$ = log-transformed stock returns

$u_{i,t}$ = log-transformed cum-dividend equity to property, plant, and equipment (PPE) ratio

$s_{i,t}$ = log-transformed PPE to sales ratio

$f_{i,t}$ = log-transformed sales to beginning total asset ratio

$l_{i,t}$ = log-transformed beginning total asset to beginning book value of equity ratio

The first element of Panel A is an estimate from the original sample, the second element is an estimate from the moving block bootstrapped sample, and the third element is moving block bootstrapping standard error estimate.

Panel B reports the correlation matrix which is constructed from the variance decomposition matrix. The first element of Panel B is an estimate of the correlation coefficient from the original sample, the second element is an estimate from the moving block bootstrapped sample, and the third element is a moving block bootstrapping standard error estimate.

Panel C reports the variance of news about asset turnover to the variance of news about financial leverage ratio, and the variance of news about PPE turnover to the variance of news about cum-dividend equity turnover ratio. It also reports the mean statistic from moving block bootstrapped sample and its standard error estimate.

Each variable represents news items and the definitions are:

$\eta_{h,t+1} = (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j h_{t+j+1}$: news about expected return

$\eta_{u,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j u_{t+j+1}$: news about cum-dividend equity to PPE

$\eta_{s,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j s_{t+j+1}$: news about PPE turnover

$\eta_{f,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$: news about asset turnover

$\eta_{l,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j l_{t+j+1}$: news about financial leverage

Table 2.5: Variance Decomposition for Stock Returns: Including Profit Margin

Panel A. Variance Decomposition Matrix

		$\eta_{h,t+1}$	$\eta_{g,t+1}$	$\eta_{f,t+1}$	$\eta_{l,t+1}$
$\eta_{h,t+1}$	Original Estimate	3.3238	-0.1981	2.5398	0.9124
	Bootstrapped Estimate	(3.3247)	(-0.1980)	(2.5393)	(0.9136)
	Bootstrapped SE	[0.1408]	[0.0105]	[0.1035]	[0.0818]
$\eta_{g,t+1}$	Original Estimate	-0.1981	0.0274	-0.1297	-0.0858
	Bootstrapped Estimate	(-0.1980)	(0.0273)	(-0.1296)	(-0.0858)
	Bootstrapped SE	[0.0105]	[0.0015]	[0.0087]	[0.0075]
$\eta_{f,t+1}$	Original Estimate	2.5398	-0.1297	3.3844	-0.6667
	Bootstrapped Estimate	(2.5393)	(-0.1296)	(3.3835)	(-0.6665)
	Bootstrapped SE	[0.1035]	[0.0087]	[0.1039]	[0.0659]
$\eta_{l,t+1}$	Original Estimate	0.9124	-0.0858	-0.6667	1.6190
	Bootstrapped Estimate	(0.9136)	(-0.0858)	(-0.6665)	(1.6202)
	Bootstrapped SE	[0.0818]	[0.0075]	[0.0659]	[0.0765]

Panel B. Correlation Matrix

		$\eta_{h,t+1}$	$\eta_{g,t+1}$	$\eta_{f,t+1}$	$\eta_{l,t+1}$
$\eta_{h,t+1}$	Original Estimate	1.0000	-0.6563	0.7572	0.3933
	Bootstrapped Estimate	(1.0000)	(-0.6569)	(0.7571)	(0.3932)
	Bootstrapped SE	[0.0000]	[0.0176]	[0.0115]	[0.0239]
$\eta_{g,t+1}$	Original Estimate	-0.6563	1.0000	-0.4258	-0.4072
	Bootstrapped Estimate	(-0.6569)	(1.0000)	(-0.4263)	(-0.4072)
	Bootstrapped SE	[0.0176]	[0.0000]	[0.0243]	[0.0239]
$\eta_{f,t+1}$	Original Estimate	0.7572	-0.4258	1.0000	-0.2848
	Bootstrapped Estimate	(0.7571)	(-0.4263)	(1.0000)	(-0.2847)
	Bootstrapped SE	[0.0115]	[0.0243]	[0.0000]	[0.0264]
$\eta_{l,t+1}$	Original Estimate	0.3933	-0.4072	-0.2848	1.0000
	Bootstrapped Estimate	(0.3932)	(-0.4072)	(-0.2847)	(1.0000)
	Bootstrapped SE	[0.0239]	[0.0239]	[0.0264]	[0.0000]

Panel C. Variance of news about asset turnover to variance of news about financial leverage ratio

	Original Estimate	Bootstrapped Estimate	Bootstrapped SE
$Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$	2.0904	2.0926	0.1111

Panel A reports the variance decomposition matrix. It decomposes the variance of the unexpected stock returns into the variance of the news about expected return, cum-dividend equity turnover, asset turnover, financial leverage, and their covariance terms. The state variable of the VAR(1) system and the definition of variables are:

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}}$$

where

$\mathbf{z_{i,t}} = \begin{bmatrix} h_{i,t} & g_{i,t} & f_{i,t} & l_{i,t} \end{bmatrix}$

$h_{i,t}$ = log-transformed stock returns

$g_{i,t}$ = log-transformed net income to sales ratio

$f_{i,t}$ = log-transformed sales to beginning total asset ratio

$l_{i,t}$ = log-transformed beginning total asset to beginning book value of equity ratio

The first element of Panel A is an estimate from the original sample, the second element is an estimate from the moving block bootstrapped sample, and the third element is moving block bootstrapping standard error estimate.

Panel B reports the correlation matrix which is constructed from the variance decomposition matrix. The first element of Panel B is an estimate of the correlation coefficient from the original sample, the second element is an estimate from the moving block bootstrapped sample, and the third element is a moving block bootstrapping standard error estimate.

Panel C reports the variance of news about asset turnover to the variance of news about financial leverage ratio. If this ratio is greater than one, I can say the news about asset turnover is relatively more related with unexpected stock return variations than the news about financial leverage is. It also reports the mean statistic from moving block bootstrapped sample and its standard error estimate.

Each variable represents news items and the definitions are:

$\eta_{h,t+1} = (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j h_{t+j+1}$: news about expected return

$\eta_{g,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j g_{t+j+1}$: news about profit margin

$\eta_{f,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$: news about asset turnover

$\eta_{l,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j l_{t+j+1}$: news about financial leverage

Table 2.6: Variance Decomposition for Stock Returns: Industry Analysis

NAICS	Industry Description	Obs	$Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$
11	Agriculture, Forestry, Fishing and Hunting	78	3.0443
21	Mining	1640	0.9667
22	Utilities	3326	4.0263
23	Construction	389	3.0673
31-33	Manufacturing	12944	0.7540
42	Wholesale Trade	1047	1.7263
44-45	Retail Trade	467	0.7939
48	Transportation and Warehousing	1028	1.8421
51	Information	1299	1.3889
53	Real estate and Rental and Leasing	327	0.6246
54	Professional, Scientific and Technical Service	531	1.1607
56	Administrative and Support	445	5.0238
61	Educational Service	57	3.3889
62	Health Care and Social Assistant	132	8.0734
71	Arts, Entertainment and Recreation	53	0.5611
72	Accommodation and Food Services	304	1.2343
81	Other services	42	2.6451

Based on the first two-digits of NAICS code, the table reports the ratio of the two variances: news about asset turnover and news about financial leverage. It is based on the variance decomposition of the unexpected stock returns into the variance of the news about expected return, cum-dividend equity turnover, asset turnover, financial leverage, and their covariance terms. Obs is the number of firm-years within the industry classification. The state variable of the VAR(1) system and the definition of variables are:

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}}$$

where

$\mathbf{z_{i,t}}$ = $\begin{bmatrix} h_{i,t} & c_{i,t} & f_{i,t} & l_{i,t} \end{bmatrix}$

$h_{i,t}$ = log-transformed stock returns

$c_{i,t}$ = log-transformed cum-dividend equity to sales ratio

$f_{i,t}$ = log-transformed sales to beginning total asset ratio

$l_{i,t}$ = log-transformed beginning total asset to beginning book value of equity ratio

Each variable represents news items and the definitions are:

$\eta_{f,t+1}$ = $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$: news about asset turnover

$\eta_{l,t+1}$ = $(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j l_{t+j+1}$: news about financial leverage

Table 2.7: Variance Decomposition for Stock Returns: Capital Intensiveness

Capital intensiveness ranked portfolio	$Var(\eta_{f,t+1})/Var(\eta_{l,t+1})$
Low	2.5521
2	2.1161
3	1.9055
4	1.5407
High	1.7971

Being ranked based on the capital intensiveness, the table reports the ratio of the two variances: news about asset turnover and news about financial leverage. The level of capital intensiveness is measured as property, plant and equipment to total asset ratio. The table is based on the variance decomposition of the unexpected stock returns into the variance of the news about expected return, cum-dividend equity turnover, asset turnover, financial leverage, and their covariance terms. The state variable of the VAR(1) system and the definition of variables are:

$$\mathbf{z_{i,t+1}} = \Gamma \mathbf{z_{i,t}} + \mathbf{w_{i,t+1}}$$

where

$\mathbf{z_{i,t}} = \begin{bmatrix} h_{i,t} & c_{i,t} & f_{i,t} & l_{i,t} \end{bmatrix}$

$h_{i,t}$ = log-transformed stock returns

$c_{i,t}$ = log-transformed cum-dividend equity to sales ratio

$f_{i,t}$ = log-transformed sales to beginning total asset ratio

$l_{i,t}$ = log-transformed beginning total asset to beginning book value of equity ratio

Each variable represents news items and the definitions are:

$\eta_{f,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j f_{t+j+1}$: news about asset turnover

$\eta_{l,t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j l_{t+j+1}$: news about financial leverage