Earnings Persistence and the Value Premium

Andres Reibel

September 30, 2014

Imperial College London, Business School

Ph.D. in Finance

The work undertaken for the completion of this thesis was done by Andres Reibel. Any work that was not undertaken by Andres Reibel is appropriately referenced throughout this dissertation.

Acknowledgement

It would not have been possible to write this doctoral thesis without the help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

Above all, I would like to dedicate this thesis to my mother, father and brother for their unequivocal personal support at all times.

I am deeply indebted to my first supervisor Dr David McCarthy and my second supervisor Professor James Sefton who have been unstinting in their encouragement and constructive criticism, well beyond the call of duty, not to mention their unsurpassed knowledge in the field of finance.

I would further like to thank Katharina Willmann for giving me the support throughout the years that enabled me to focus on this project continuously; her love provided my inspiration and was the force that allowed me to finish this journey.

For any errors or inadequacies that may remain in this work, of course, the responsibility is entirely my own.

Abstract

For many years, academics have argued that firms with high book-to-market ratios yield higher returns than firms with low book-to-market ratios (i.e. the value premium). While there is agreement that a book-to-market based value strategy produces superior returns, academics have neglected to research whether the value premium is a function of other firm characteristics. In this dissertation it is shown that the book-to-market ratio is a function of earnings persistence. Evidence is provided that the value premium in low earnings persistence portfolios is higher because investors misjudge earnings persistence and not because this value strategy is fundamentally riskier.

Table of Contents

List of Tables

List of Figures

Part I

Introduction

There is agreement amongst researchers that value strategies produce superior returns. These value strategies suggest buying stocks that have low prices relative to accounting quantities such as earnings, dividends, book value, cash-flows or other measures of fundamental value (e.g. Rosenberg et al. (1984), Fama and French (1992, 1993), Lakonishok et al. (2004)). However, as Lakonishok et al. (2004) point out, the interpretation of why value strategies yield higher returns is more controversial. Proponents of rational asset pricing argue that investors in value stocks, such as high book-to-market stocks, tend to bear higher fundamental risk and thus their average returns are simply compensation for that risk (Fama and French (1992)). An alternative explanation of why value stocks produce superior returns is that they are contrarian to “naive” strategies followed by other investors. Naive strategies range from extrapolation of past earnings growth too far into the future, to overreacting to good or bad news, to equating good firms with good investments. Regardless of the reason, overly optimistic investors tend to invest in these glamour stocks until they become overpriced. Similarly, they overreact to stocks that have done badly and oversell them until these stocks become underpriced; hence, they are called value stocks (Lakonishok et al. (2004)). The contrarian investor invests disproportionately in value stocks and underinvests in glamour stocks. In this dissertation, light is shed on the relationship between the value premium and earnings persistence, a firm characteristic. Sloan (1996) shows that investors misjudge the persistence of earnings - earnings consist of accounting cash-flows and accruals, the latter of which is more transitory. Since, as shown in Equation (1), the P/B ratio is a function of future earnings, the misjudgement of earnings results in a misjudgement of the P/B ratio. In the following this rationale is explained in more detail.

Using the Ohlson (1995) model, it can be shown that the P/B ratio, or the inverse book-to-market ratio, is a function of net income. Equation (1) documents this relationship:

$$\frac{P_t}{B_t} = 1 + \left[\sum_{i=1}^{\infty} \frac{X_{t+i} - r_e B_{t+i-1}}{(1+r_e)^i} \right] / B_t. \tag{1}$$

$\frac{P_t}{B_t}$, the P/B ratio, is a function of the sum of future residual income, $\sum_{i=1}^{\infty} \frac{X_{t+i} - r_e B_{t+i-1}}{(1+r_e)^i}$. Hence, the $\frac{P_t}{B_t}$ ratio is directly linked to future net income, X_{t+i}. One can observe that the P/B ratio is a positive function of future net income. Hence, properties of earnings, such as the time-series concept of earnings persistence, have direct implications for P/B ratios. In Equation (3), this relationship between earnings persistence and P/B ratios is expressed analytically.

Earnings persistence is a well-researched area in the accounting literature. A standard way to measure earnings persistence is an autoregressive process of order one (e.g. Sloan (1996)). The following equation expresses this AR(1) process:

$$X_t = \phi X_{t-1} + \varepsilon_t. \tag{2}$$

Substituting Equation (2) into Equation (1), one obtains an expression that shows that the P/B ratio is a positive function of earnings persistence (i.e. ϕ).[1] Equation (3) expresses this relationship:

$$\frac{P_t}{B_t} = 1 + \left[\sum_{i=1}^{\infty} \frac{\phi X_{t+i-1} + \varepsilon_t - r_e B_{t+i-1}}{(1+r_e)^i} \right] / B_t. \tag{3}$$

From Equation (3) it is observable that the P/B ratio is high if earnings persistence (ϕ) is high. Previous research has focused on the relationship between P/B ratios and average stock returns (Rosenberg et al. (1984), Fama and French (1992, 1993), Lakonishok et al. (1994)). However, these studies do not analyse how earnings persistence is related to P/B ratios and hence fail to recognise that the P/B ratio is a function of earnings persistence.[2]

In this dissertation, two explanations are examined that may explain why value strategies outperfom. The question of interest is whether value strategies have produced superior returns because market participants consistently underestimate future earnings of value stocks relative to glamour stocks, or whether the higher average returns of value strategies are compensation for taking on more fundamental risk. As explained by Lakonishok et al. (1994):

"...one natural version of the contrarian model argues that the overpriced glamour stocks are those which, first, have performed well in the past, and second, are expected by the

[1] In the accounting literature on earnings persistence, net income is usually standardised by assets or book value to ensure stationarity. However, for the sake of demonstrating the relationship between P/B ratio and earnings persistence, X_t is defined as the net income, ε is the error term and ϕ is the earnings persistence coefficient.

[2] The concept of earnings persistence is only one measure of earnings quality. There are various other measures of earnings quality. Other statistical properties of earnings are the smoothness of earnings, timeliness and benchmarking studies, which use small positive differences between reported earnings and any benchmark as a measure of earnings quality. A comprehensive overview is given by Dechow et al. (2010). The advocacy of value strategies goes back at least as far as Graham and Dodd (1934); interestingly, Graham et al. (1962) recommend a five-step process for adjusting current earnings to arrive at a measure of earnings power. Earnings power is defined as the level of earnings that a firm is expected to sustain over the next five to ten years. This suggests that Graham et al. (1962) believe that earnings persistence is relevant to the performance of value strategies.

market to perform well in the future. Similarly, the underpriced out-of-favor or value stocks are those that have performed poorly in the past and are expected to continue to perform poorly. Value strategies that bet against those investors who extrapolate past performance too far into the future produce superior returns." (p.1542)

In this dissertation, it is argued that the value premium that Lakonishok et al. (1994) attribute to the market's naive extrapolation of past information should be more pronounced in firms with low earnings persistence. This hypothesis is based on Sloan (1996) who argues that stock prices act as if investors "fixate" on earnings, failing to distinguish fully between the different properties of the accrual and cash-flow components of earnings. In other words, investors underestimate the degree of mean reversion of earnings with high accrual components, since they fail to understand that not all earnings are created equal - accruals are more transitory than cash-flows. Thus, growth/value firms will disappoint/surpass investors' high/low earnings growth expectations more strongly in low earnings persistence portfolios. Hence, it is hypothesised in the dissertation that a contrarian strategy that invests long in high book-to-market firms and short in low book-to-market stocks should work particularly well in low earnings persistence portfolios. Further, as explained below, it is argued that the higher value premium in low earnings persistence portfolios is most likely a result of investors' systematic misjudgement of earnings persistence and not a compensation for taking on higher systematic risk.

In a rational world, a stock's risk is summarised by its betas. After controlling for beta, no other characteristic of a stock should influence the return required by a rational investor. One way to control for beta in this study is to regress the value premia across deciles formed on the earnings persistence characteristic on the well-established Fama and French (1993) model's risk factors. The results of these time-series asset pricing regressions suggest that low earnings persistence portfolios have positive risk-adjusted returns of up to 11.5% annually. Further, the alphas in low earnings persistence deciles are positive and statistically significant, while the alphas in all other earnings persistence deciles are insignificant. These results prompt to ask an interesting question: is earnings persistence a priced risk?

To test whether a rational asset pricing argument can explain the superior returns of a book-to-market based value strategy in low earnings persistence portfolios, it is investigated whether or not earnings persistence is a priced risk factor using the following methodology: factor mimicking portfolios on earnings persistence are formed and a two-stage cross-sectional asset pricing test is performed (Cochrane (2005)). The results show that the risk premia in the second-stage regressions are positive but statistically insignificant, which suggests that earnings persistence is not a rationally priced risk.

In summary, earnings persistence is not a rationally priced risk factor in a two-stage cross-sectional asset pricing test. Additionally, a book-to-market based value strategy in low earnings persistence portfolios produces positive risk-adjusted returns. While one can never reject the "metaphysical" version of the risk story, in which securities that earn higher returns must by definition be fundamentally riskier, the weight of evidence in this dissertation supports a different model. In this model, value/glamour stocks with low earnings persistence have been underpriced/overpriced relative to their risk and return characteristics, and investing in them has indeed earned abnormal returns (Lakonishok (1994)).

In this dissertation, three different models are used to estimate earnings persistence in order to explain the relationship between the value premium and earnings persistence. First, a standard AR(1) model of return on equity (ROE) is used to analyse the economic link between earnings persistence and the value premium. This model assumes a constant cost of equity capital, which implies that all of the return news variance is driven by cash-flow news variance. Moreover, the AR(1) model assumes that future earnings are exclusively driven by past earnings. Since these assumptions are fairly unrealistic, the variance decomposition framework of Vuolteenaho (2000, 2002) and the variance decomposition framework of Callen and Segal (2004) are used to estimate earnings persistence. The use of three different models of earnings persistence allows a) the assumption of constant discount rates to be relaxed, b) the use of different state variables that drive the earnings persistence process, c) the results to be tested for robustness and d) analysing whether the separately generated value premia are captured by existing risk factors (Fama and French (1993)). The high correlation between the AR(1) model estimates of earnings persistence and the Vuolteenaho (2000, 2002) model estimates of earnings persistence provides evidence that these models capture a common component of earnings persistence. Further, the coefficient of a regression of the AR(1) earnings persistence estimates on the Vuolteenaho (2000, 2002) earnings persistence estimates is positive and statistically significant. The use of the Callen and Segal (2004) model allows earnings persistence to be estimated using a set of state variables that is different from Vuolteenaho (2000, 2002) - it focuses on the accrual component of earnings. Accruals involve subjective managerial estimations and are known to be used for managing earnings, while the cash-flow component of earnings is harder to manipulate. Thus, there seems to be an inherent link between earnings management and accruals, which forms an important factor in driving stock returns (e.g. Dechow et al. (1995)).

The analysis in this dissertation is structured as follows: the second part examines the relationship between earnings persistence and the value premium when estimating earnings persistence with an AR(1) process of ROE. The descriptive statistics show that firms with low earnings persistence tend to be of small size and in high financial distress. For this reason, it is necessary to analyse the results in this dissertation when controlling for size or financial distress. The relationship between earnings persistence and the value premium is statistically significant and negative before controlling for financial distress or size. However, after excluding distressed firms, the relationship becomes statistically insignificant. The disappearance of the statistical relationship between earnings persistence and the value premium when excluding distressed firms is attributable to a statistically significant relationship between financial distress and the value premium in portfolios of financially distressed firms. Three-way sorts on earnings persistence, size, financial distress and book-to-market ratios show a statistically significant relationship between earnings persistence and the value premium in portfolios of financially distressed firms and in portfolios of small firms.

In the third part of this dissertation, the relationship between earnings persistence and the value premium is examined estimating earnings persistence with the variance decomposition frameworks of Vuolteenaho (2000, 2002) and Callen and Segal (2004). The results for the Vuolteenaho (2000, 2002) model show that the relationship between earnings persistence and the value premium is statistically significant before controlling for financial distress. However, when removing financially distressed firms from the sample the relationship becomes insignificant. The disappearance of the statistical relationship between earnings persistence and the value premium when excluding distressed firms is attributable to a statistically significant relationship between financial distress and the value premium in portfolios of financially distressed firms. Three-way sorts on earnings persistence, size, financial distress and book-to-market ratios reveal a statistically significant relationship between earnings persistence and the value premium in portfolios of financially distressed firms and in the sample as a whole. When earnings persistence is estimated using the Callen and Segal (2004) model, there is a statistically significant relationship between earnings persistence and the value premium before excluding small or distressed firms. However, when removing small firms from the sample, the relationship becomes insignificant. It is revealed that there exists a statistically significant relationship between the value premium and size in portfolios of small firms. This causes the relationship between earnings persistence and the value premium to become statistically insignificant when removing small firms. Three-way sorts on earnings persistence, size, financial distress and book-to-market ratios reveal that a statistically significant relationship between earnings persistence and the value premium exists in portfolios of financially distressed firms, in portfolios of small firms and in the sample as a whole. Further, time-series regressions of value premia on the three Fama and French (1993) risk factors reveal that the value premia in low earnings persistence portfolios carry significant and positive alphas of 11.5% for the Callen and Segal (2004) model and between 5.2% and 6.9% for the Vuolteenaho (2000, 2002) model.

In the last part of this dissertation, it is tested whether earnings persistence is a priced risk factor by using the two-stage cross-sectional asset pricing approach as proposed by Cochrane (2005). The second-stage regressions reveal that the risk premium on the earnings persistence beta is positive, but statistically insignificant.

Part II

The Relationship between Earnings Persistence and the Value Premium - AR(1)

Graham and Dodd (1934) first note that firms with a high ratio of price to fundamentals (growth firms) have low expected returns relative to firms with a low ratio of price to fundamentals (value firms); this phenomenon is known as the value premium in the finance literature (e.g. Fama and French (1992), Lakonishok et al. (1994)). As financial analysts, Graham et al. (1962) estimate the intrinsic value of businesses and develop a ratio of intrinsic value to price in order to find undervalued securities. When establishing intrinsic value Graham et al. (1962) emphasise the importance of information in current earnings and its components for estimating the future earnings power of a firm.[3] The five-step process they recommend for adjusting current earnings to arrive at earnings power implies that Graham et al. (1962) believe that investors tend to make wrong predictions about future earnings and thus arrive at inaccurate intrinsic value estimates at times. Empirical results support the assumption Graham et al. (1962) make (Sloan (1996), Richardson et al. (2005)): investors make expectational errors about future earnings.

An AR(1) process of ROE is the simplest framework for analysing the economic link between earnings persistence and the value premium - it assumes, as discussed below, that all return variance is driven by cash-flow news variance, that the discount rate is held constant and that earnings persistence is purely driven by one state variable, i.e. ROE. While these assumptions are fairly unrealistic, this simple setting allows the relationship between earnings persistence and the value premium to be motivated and initially analysed. Later, two models specifications are considered that allow for variation in discount rates and for more information to be used for estimating earnings persistence (Vuolteenaho (2000, 2002) model and the Callen and Segal (2004) model). In this part of the dissertation using the AR(1) model, it is researched whether earnings persistence is systematically related to the returns from a book-to-market based value strategy. Sloan (1996) argues that stock prices act as if investors "fixate" on earnings, failing to distinguish fully between the different properties of the accrual and cash-flow components of earnings. In other words, investors underestimate the degree of mean reversion of earnings with high accrual components. Growth/value firms will thus disappoint/surpass investors' earnings growth expectations more strongly if earnings persistence is low. Hence, a contrarian strategy that invests long in high book-to-market

[3] Graham et al. (1962) define earnings power as the level of earnings a firm is expected to sustain over the next five to ten years.

firms and short in low book-to-market firms should work particularly well in low earnings persistence portfolios.

As explained above, it is argued that investors' expectational errors about future earnings results in a negative relationship between the value premium and earnings persistence. To examine the relationship between earnings persistence and the value premium it is tested whether the difference between the value premia of low and high earnings persistence portfolios is statistically different from zero. Further, second-stage regressions are performed by regressing value premia on portfolio values built on the earnings persistence estimates. Because firms with low earnings persistence estimates tend to be of small size and financially distressed it is possible that the relationship between earnings persistence and the value premium is driven by size or financial distress. For this reason the two-way sorts are repeated when excluding small and financially distressed firms. Moreover, three-way sorts on earnings persistence, distress, size and the value premium are performed for further robustness tests. This allows the relationship between size, distress, earnings persistence and the value premium to be examined within size, distress and earnings persistence portfolios.

The results show that the difference in the average annual value premium between low and high earnings persistence portfolios in the period from 1980 to 2004 lies between 5.32% (equally-weighted returns) and 16.37% (value-weighted returns) before excluding financially distressed or small firms. These return differences are statistically significant on the two and three-year investment horizon. Second-stage Fama and MacBeth (1973) regressions of value premia on earnings persistence decile values reveal significant and negative coefficients; these results appear to be robust to measurement error in the independent variable. These results suggest that the value premium is higher in low earnings persistence portfolios before excluding small or financially distressed firms. However, while controlling for size does not change these results, when excluding financially distressed firms the relationship between earnings persistence and the value premium disappears at least partially; for the equally-weighted returns the difference in value premia between low and high earnings persistence deciles become statistically insignificant. For the value-weighted returns these differences are statistically significant on the two and three-year investment horizon. Similarly, the second-stage regressions for the equally-weighted returns are statistically insignificant on all horizons and significant on the two and three-year horizon for the value-weighted returns. This partial disappearance of the relationship between earnings persistence and the value premium is not surprising since a significant relationship between distress and the value premium is found in portfolios of financially distressed firms. The three-way sorts reveal that the relationship between earnings persistence and the value premium prevails in small firms, financially distressed firms and the sample as a whole.

While the above evidence suggests that there is a statistically significant relationship between earnings persistence and the value premium, it is an open question whether the higher value premia in low earnings persistence portfolios are a compensation for taking on higher fundamental risk, or whether value stocks are underpriced relative to their risk return characteristics, and investing in them yields abnormal returns.

To examine this research idea two streams of literature are joined: the value premium has been widely discussed in the asset pricing literature. At the same time, the accounting literature on earnings persistence has advanced strongly. Yet, it has not been examined how investors' misjudgement of earnings persistence affects the performance of a book-to-market based value strategy. The literature in the field of asset pricing documents that firms with high book-to-market ratios (hereafter, BM) have been found to have higher average returns than firms with low BM ratios (e.g. Rosenberg et al. (1985)). Because the capital asset pricing model (hereafter, CAPM) of Sharpe (1964) and Lintner (1965) does not explain this pattern in average returns, it is often called an anomaly. There are various explanations for the BM anomaly. Black (1993) and MacKinlay (1995) write that the positive relation between BM and average return is a coincidental result unlikely to be observed out of sample. Out-of-sample evidence is, however, provided by Chan, Hamao, and Lakonishok (1991), Capaul, Rowley, and Sharpe (1993), and Fama and French (1998). They show that a strong relationship between average return and BM in markets outside the United States exists; Fama and French (1998) find for the period from 1975 to 1995 the value premium on global portfolios amounts to 7.68% (annualised). Value stocks outperform growth stocks in twelve out of thirteen global markets. Fama and French (2012) find value premia in average stock returns in North America, Europe, Asia Pacific and Japan. They analyse whether asset pricing models are integrated across regions and find that a global four-factor asset pricing model is passable for average returns on global size-BM and size-momentum portfolios. Evidence suggests that a global model is suitable for evaluating global portfolios as long as the portfolio does not overweight small stocks or specific regions. However, local three and four-factor models seem more suitable for the pricing of size-BM portfolios than the global models. Hou et al. (2011) find that momentum and cash-flow-to-price factor-mimicking portfolios (in combination with a global market portfolio), explain the average returns for regional and global industry portfolios. Further, these risk factors are capable of explaining the returns of various portfolios built on one-way and two-way characteristics-based sorts. Hou et al. (2011) argue that the two additional market factors have important implications for cross-sectional and time-series return variation in global markets. To understand the implications of this dissertation on an international level it is important to review the evidence of the earnings persistence literature and how it applies on an international level. If evidence for the accrual anomaly can be found on an international level then it seems sensible to conclude that the results in this dissertation are likely to apply in an international context. The discussion of the accrual anomaly literature in an international setting can be found below.

Using the time-series of stock returns and all NYSE industrial firms back to 1941, Davis et al. (2000) research the value premium. Their results show that the value premium in the period before 1963 is not significantly different from the value premium found in earlier studies. This finding provides evidence against the theory that the value premium is only observed in certain sample periods. Another theory attributes the higher returns earned on value stocks to the inherently higher riskiness of value stocks; value stocks outperform average stocks, because they are riskier and the excess return is a compensation for taking on this additional risk. These proponents propose multifactor versions of the traditional asset pricing models. Their models go beyond the well-known models such as the Intertemporal Capital Asset Pricing Model (Merton (1973)) or the Arbitrage Pricing Model of Ross (1973). The most prominent proponents of this theory are Fama and French (1993) who find BM is capable of explaining some of the covariation in stock returns after controlling the market excess return. Other studies find that the BM factor that drives stock returns, also drives fundamental values (Fama and French (1995)). The Fama and French (1993) factor model, arguably the most influential asset pricing model that emerged in the last three decades, is capable of capturing average returns of U.S. stocks very well. The three factor model captures returns of portfolio formed on variables that typically the CAPM is not capable of explaining. Another explanation is based on investors' behavioural overreaction. Investors systematically over- or underestimate future performance of firms. For example, high BM firms have demonstrated weak past performance and are hence expected to have weak future performance. These forecasts are incorporated into asset prices and when future performance surprises the high BM stock investor on the upside, the low BM stocks outperform (e.g. DeBondt and Thaler (1987), Lakonishok et al. (1994), and Haugen (1995)). Another explanation for the value premium is provided by Daniel and Titman (1997). Daniel and Titman relate stock returns to firm characteristics, which allows for a behavioural explanation that does not depend on irrational overreaction. Davies et al. (2000) extend the sample period of Daniel and Titman (1997) and they find that the risk explanation dominates the behavioural explanation. Other important contribution have been made by Zhang (2005), Zhang and Petkova (2005), and Fama and French (2006).

In the accounting literature accruals, as a component of earnings, are the most studied determinant of earnings persistence. Sloan (1996) shows that return on assets declines faster when earnings are composed of accruals than when earnings are composed of cash-flows.[4] Sloan (1996) explains that financial analysts argue that since investors tend to focus on reported earnings, securities can be mispriced. He examines the information contained in the accrual and cash-flow components of earnings and the extent to

[4] Note that earnings = cash-flows + accruals.

which this information is reflected in stock prices. Sloan's (1996) results indicate that earnings performance attributable to the accrual component of earnings exhibits lower persistence than earnings performance attributable to the cash-flow component of earnings. The results also indicate that stock prices act as if investors "fixate" on earnings, failing to distinguish fully between the different properties of the accrual and cash-flow components of earnings. Consequently, firms with relatively high (low) levels of accruals experience negative (positive) future abnormal stock returns that are concentrated around future earnings announcements. As explained above, the evidence on earnings persistence (accruals anomaly) in international markets can support the relevance of this dissertation on a global level. Pincus et al. (2007) analyse the accrual anomaly on an international scope. They find that this anomaly only exists in four out of the 19 countries they examine. Those four countries are: Australia, Canada, UK and the U.S. They find the anomaly is more likely to occur in countries with a common law legal tradition, more aggressive accrual accounting, weaker outside shareholder rights and lower concentration of share ownership. Muresan (2014) provides a summary of the empirical research on the accrual anomaly around the globe. She summarises all relevant studies and concludes that the accrual anomaly is pervasive around the globe. She states that this anomaly is particularly strong in developed countries with large companies and where accrual accounting is common practice. When combining the international evidence on the value premium with the international evidence on the accrual anomaly one can conclude that it is reasonably likely that the results in this dissertation apply on a global level. However, the confirmation that the results presented in this dissertation do apply on a global level is left for future research.

A rich body of models that estimate earnings persistence has emerged since the seminal work of Sloan (1996). Richardson et al. (2005) propose a more comprehensive measure of accruals and show that this measure of total accruals is more transitory than cash-flows. Further, studies decomposing accruals into its components, using similar methodologies to assess predictability for future earnings have been conducted. Lev and Thiagarajan (1993) and Abarbanell and Bushee (1997) focus on inventory and accounts receivable. Other research suggests that large negative accruals are more transitory than cash-flows because large negative accruals often stem from write-offs and impairment charges that correct the balance sheet (Fairfield et al. (1996), Dechow and Ge (2006)). An elaborate overview over the earnings persistence literature is given in Dechow et al. (2010). In this part of this dissertation earnings persistence is estimated with a standard AR(1) model. In part 2 and part 3 of this dissertation the variance decomposition frameworks of Vuolteenaho (2000, 2002) and Callen and Segal (2004) are used to decompose firm-based stock returns and estimate earnings persistence.

The remainder of part 2 of this dissertation is organized as follows. Section 1 describes the research methodology. Section 2 reports the sample. Section 3 discusses the main results.

1 Methodology

1.1 Decomposition of Stock Returns: Developing the Intuition

A simple model can be derived that decomposes returns into the proportion that is attributable to cash-flow news and the proportion that is attributable to discount rates. An algebraically equivalent model to the dividend discount model of Williams (1938) is the Ohlson (1995) model. Using clean surplus accounting, Ohlson (1995) demonstrates that share prices are equal to book value of equity plus the discounted sum of future residual income. The excess residual earnings are earnings in excess of the opportunity cost of equity capital. Equation (4) expresses the Ohlson (1995) model:

$$P_t = B_t + \sum_{i=1}^{\infty} \frac{X_{t+i} - r_e B_{t+i-1}}{(1+r_e)^i}. \tag{4}$$

P_t denotes the share price at t, B_t denotes the book value of equity at time t, X_t denotes the net income at time t and r_e denotes the equity cost of capital. The unexpected return component can be expressed in the following way:

$$\frac{P_t - E_{t-1}(P_t)}{P_{t-1}} = \frac{\Delta E_t(P_t)}{P_{t-1}}. \tag{5}$$

Where $\Delta E_t(P_t) = E_t(P_t) - E_{t-1}(P_t)$ (see Appendix). Equation (5) expresses that unexpected return is equal to today's stock price minus the expected value of today's stock price one period ago, divided by the stock price of one period ago.

To simplify the model it is assumed that the cost of equity capital is constant. In the more complex model this assumption is relaxed. Substituting out for prices using residual income, an expression for unexpected returns in terms of future changes in return on equity defined as net income over last period's book value of equity can be obtained:

$$r_t - \overline{r} = \frac{B_{t-1}}{P_{t-1}} \Delta E_t \sum_{i=0}^{\infty} \rho^i (ROE_{t+i} - r_e). \tag{6}$$

Where $\rho = (1+g)/(1+r_e)$, $\overline{r}$ is the expected return and g is the long-run average growth rate of book value of equity. Intuitively, Equation (6) states that, if cost of equity capital is constant, the unexpected return is a discounted sum of future changes in expected ROE (i.e. the cash-flow news). Note that it is important to take the horizon over which the cash-flow news is predictable into account for determining the magnitude of cash-flow news. An autoregressive model of order one is the simplest way to model this idea:

$$ROE_{i,t} = \xi ROE_{i,t-1} + \varepsilon_{i,t}. \quad (7)$$

$ROE_{i,t}$ denotes return on equity of asset i at time t, ξ is the earnings persistence estimate and $\varepsilon_{i,t}$ is the error term of asset i at time t. ξ measures the speed with which ROE reverts to the mean. The closer the persistence parameter is to one, the more persistent is ROE and the larger will be the impact of an increase/decrease in ROE on prices. Analogously, the closer the persistence parameter is to 0 the more transitory is the ROE, and the smaller is the impact of an increase/decrease in ROE on prices (or returns). Note that the simple AR(1) model of ROE is a standard model in the literature on earnings persistence (Freeman et al. (1982), Sloan (1996)).

By recursively substituting Equation (7) into Equation (6), an expression for the unexpected returns in terms of current ROE and future innovations ε is obtained. Taking the variance on both sides yields:

$$var(r_t - \overline{r}) = (\frac{B_{t-1}}{P_{t-1}})var(\Delta E_t \sum_{i=0}^{\infty} \rho^i (ROE_{t+i} - r_e)) = (\frac{B_{t-1}}{P_{t-1}})\frac{\sigma_{\varepsilon}^2(\rho\xi)^2}{1-(\rho\xi)^2}. \quad (8)$$

σ_{ε}^2 is the variance of ε. The term on the right hand side of Equation (8) represents the variance of cash-flow news. As long as discount rates are constant, as assumed in this simple representation, all the variance of returns must be explained by the cash-flow news variance. However, in reality the cash-flow news variance only explains a proportion of the total variance of returns and thus it seems intuitive to find a way to relax this fairly strong and unrealistic assumption. Moreover, when estimating earnings persistence with an AR(1) model one exclusively relies on the information contained in past earnings to forecast future earnings. While past earnings may be a good starting point to forecast future earnings it is reasonable to expect other variables to have additional predictive power of earnings. In reality, discount rates vary, cash-flow news variance only explains a proportion of the total variance of returns and other variables are expected to drive the earnings process. Hence, these fairly strong and unrealistic assumptions will be relaxed later on.

The proportion of cash-flow news is a measure of the importance of cash-flows as a driver of returns. The higher the proportion of cash-flow news, the higher the importance of cash-flow news for explaining returns. Therefore, returns of firms with relatively high persistence in ROE (high ξ) can be expected to be more strongly driven by cash-flow news rather than return news; i.e. earnings persistence (ξ) is positively related to cash-flow news variance (see Appendix for analytical proof).

1.2 Two-way Sorts on Earnings Persistence and BM

The relationship between earnings persistence and the value premium is investigated by firstly estimating earnings persistence on a firm-level with an AR(1) model which regresses ROE on its lagged values (see Equation (7)). Subsequently, in each year firms are sorted into deciles based on these earnings persistence estimates; these deciles are labelled AR(1) deciles. In each AR(1) decile firms are sorted into tertiles according to their BM ratio (i.e. a two-way sort on earnings persistence and BM). The returns from a long position in the top BM tertile and a short position in the bottom BM tertile proxy for the value premium.

1.3 Second-stage Regressions and Error in Variable Regressions

To provide further evidence on the relationship between earnings persistence and the value premium, second-stage regressions of value premia on AR(1) decile values are performed. Equation (9) expresses the second-stage regressions:

$$(x - year\,value\,premium)_{i,t} \quad = \quad \alpha + \beta\,(AR(1)\,dec\,value)_{i,t} + \varepsilon_{i,t}. \tag{9}$$

$(x - year\,value\,premium)_{i,t}$ is the x-year value premium of AR(1) decile i at time t, where x denotes the one-year, two-year and three-year value premium. $(AR(1)\,dec\,value)_{i,t}$ is the AR(1) decile value of decile i at time t. Further, the second-stage regressions are reversed in order to test for measurement error in the independent variable. The error in variable regressions are expressed in Equation (10):

$$(AR(1)\,dec\,value)_{i,t} = \quad \alpha + \beta\,(x - year\,value\,premium)_{i,t} + \varepsilon_{i,t}. \tag{10}$$

1.4 Three-way Sorts on Earnings Persistence, Size, Default Risk and BM

To examine the extent to which the relationship between earnings persistence and the value premium exists within size and default risk portfolios, three-way sorts are performed. Firstly, firms are sorted into quintiles based on size or financial distress. Subsequently, in each size or distress quintile firms are sorted into quintiles according to their earnings persistence (the first and second sort order is also reversed to examine the effect of size and distress on the value premium after controlling for earnings persistence). Lastly, BM tertiles in each of the 25 portfolios are formed and the value premia are calculated. This allows the difference between the value premia in low and high earnings persistence portfolios to be statistically tested. Further, it gives inside into the interrelation between earnings persistence, default risk and size.

1.5 Altman Z-score

Using Altman's model for the prediction of corporate bankruptcy, a Z-score is estimated to measure a corporation's degree of financial distress (Altman (1968)). Begley et al. (1996) reestimate Altman's model resulting in the following discriminant function:

$$Z = 0.104X_1 + 1.01X_2 + 0.106X_3 + 0.003X_4 + 0.169X_5. \quad (11)$$

Where $X_1 = (working\,capital/total\,assets)*100$, $X_2 = (retained\,earnings/total\,assets)*100$, $X_3 = (EBIT/total\,assets)*100$, $X_4 = (market\,value\,of\,equity/book\,value)*100$ and $X_5 = (sales/total\,assets)$. Scaling the reestimated model parameters by a constant yields a cutoff point at 2.675, Atlman's original cut-off point. Firms with a Z-score greater than 2.99 fall into the non-bankrupt group, while all firms with a Z-score less than 1.81 fall into the bankrupt group. The area between 1.81 and 2.99 is defined as the "zone of ignorance" because the susceptibility to error classification. In the robustness tests firms with a Z-score of less than 1.81 are excluded from the sample to prevent non-randomly choosing firms that are in financial distress.

1.6 Discussion of Measures of Distress

Two types of models of distress exist. One type of model are accounting-based models such as the Altman (1968) model and the Ohlson (1980) model. The second type of model is market-based such as the Merton (1974) model. In general, market-based models have the advantage of not relying on accounting information that may be inaccurate or biased. However, market-based models rely on market efficiency. As Bharath and Shumway (2005) point out, accounting information is useful for the prediction of default probabilities if markets are not perfectly efficient. In the following the two most prominent accounting-based models, the KMV-Merton model, Credit Default Swaps and Credit Ratings are discussed:

The Altman (1968) Multivariate Discriminate Analysis (hereafter, MDA) has been the most popular technique for the prediction of bankruptcy. Altman states that one of the main advantages of the technique is that it considers the entire profile of firm characteristics (financial ratios) and that it takes the interaction of these characteristics into account. In this way MDA allows all characteristics to be analysed simultaneously rather than sequentially. Further, MDA greatly simplifies the analyst's task by reducing the space dimensionality (number of different firm characteristics) into one dimension: i.e. the discriminant score (Z-score) that groups firms into bankrupt and non-bankrupt firms. If predictive variables are carefully chosen multicollinearity is avoided; in such cases MDA usually yields a highly parsimonious model that conveys a large degree of relevant information with a relatively low number of carefully chosen variables.

Altman (1968) states that the weaknesses of MDA are the following: MDA imposes requirements on the distributional properties of the predictive variables; e.g. the variance-covariance matrix of the predictive variables has to be the same for bankrupt and non-bankrupt firms. Further, predictive variables are required to be normally distributed; therefore, the use of dummy variables is problematic. The produced score lacks intuitive interpretation since it is an ordinal ranking. Eisenbeis (1977) states that misclassification is not a suitable description of the payoff partition. Further, the matching procedure of bankrupt and non-bankrupt firms can be problematic; matching firms according to characteristics such as size and industry tends to be arbitrary. It is questionable what the benefits of matching are, or whether one would be better advised to avoid matching entirely. It seems to make more sense to use matching variables as independent variables.

A type of model that is fundamentally different from MDA is the logit model. A wide variety of logit models has been used to predict bankruptcy. The most well-known (conditional) logit study was conducted by Ohlson (1995). He states that the model avoids virtually all of the issues of MDA as discussed above. Given a subsample, this model estimates the probability of a firm failing within a prespecified time period. As a result the model makes no assumptions regarding prior probabilities of bankruptcy and the distribution of predictive variables. Further, the maximum likelihood estimation procedure allows elements of zero to be asymptotically efficient and normally distributed. This makes the model applicable for small sample settings. MDA assumes several distinct subsamples, each of which produces a different score given a set of independent variables. Hence, MDA splits the population into subsamples and then estimates a discriminant function that classifies firms into groups in the most efficient way. It does not take the relationship between differences in characteristics and importance of characteristics into account. In conditional logit models the difference in characteristics and the importance of these differences can be taken into account for the prediction of bankruptcy. Traditional MDA assumes a linear relationship between bankruptcy and financial ratios. Logit models allow for non-linearity in general. The logistic curve recognises that for certain parts of the curve a small change in a financial ratio might lead to only small changes in bankruptcy probabilities, whereas for other positions on the curve small changes in financial ratios lead to large changes in bankruptcy probabilities.

A different perspective on financial distress is provided by the literature on credit risk. Most prominently, Merton (1974) derives a structural model that models a firm's default as a function of its assets. Merton (1974) assumes that a firm will default when the value of its liabilities exceeds the market value of the firm. At maturity debt holders are paid the minimum between face value of debt and the market value of the firm's assets. Merton develops a model to estimate the probability of default and the difference between the corporate bond yield and a risk-free bond. The Merton (1974) model has various disadvantages: for example, most defaults occur at maturity (not at coupon payment dates as assumed in the Merton model). Further, it assumes a flat term-structure, which is obviously not true. The KMV Corporation reformulated the Merton (1974) model to calculate a firm's default probability at any given point in time (see Bharath and Shumway (2005) for details of the methodology). Most problematic is the fact that firm value is a function of the market value of debt, which is not readily observable. To solve this issue KMV applied Merton's (1974) model and as such the KMV model is subject to the assumptions of Merton's model.

Another perspective on financial distress is provided by the literature on credit derivatives. Credit derivatives are contingent claims with payoffs that are linked to the creditworthiness of a firm. These derivatives allow market participants to trade the risk associated with so called credit events. As Longstaff et al. (2005) describe, the most common credit derivatives used are total-return swaps, spread options and credit default swaps (hereafter, CDS). In this dissertation the focus is on CDSs of corporations; those contracts are the most widely-used credit derivative trading in the market. CDSs function in the following way: they are contracts between two parties; one party of the contract, the protection buyer, is seeking insurance against the possibility of default on a corporate bond of a firm. The protection seller is the second party to the contract; the seller is bearing the risk associated with default by the reference firm. In the event of a default, the CDS seller agrees to buy the defaulted bond at its face value from the CDS buyer. The CDS seller receives periodic payments from the CDS buyer in return. This payment (fee) is called the default swap premium. In practice it is assumed that the CDS premium equals the default component of the firm's bond. If no default occurs the contract terminates at its expiry date. If default occurs the contract when the CDS buyer receives the payment of face value of the bond and the periodic fee payments discontinue. As opposed to using accounting quantities (or financial ratios) to measure financial distress, CDSs are traded market instruments (OTC) and as such are not subject to measurement differences in accounting variables that may be due to varying accounting rules or subjective judgment by managements.

Credit Rating Agencies such as Standard & Poor's, Moody's and Fitch have the objective to provide ordinal rakings of credit risk at each point in time without referring to a specific time horizon. These agencies seek stability in their ratings and therefore adopt a long-term horizon on the probability of a firm defaulting (rating stability). Further, rating agencies follow a prudent migration policy and hence rating changes only occur after substantial shifts in the credit quality of a firm; rating changes occur gradually over time. The details of the rating methodology employed by rating agencies is proprietary; as such, it is unclear whether agencies place more importance on the timeliness of rating changes or the rating stability. Credit ratings as default risk measure have various disadvantages: first, credit ratings are discrete measures and it is unclear how timeliness and stability of credit ratings are determined. Second, during the global financial crisis rating agencies came under increased pressure due to incentive problems (rating receiver is also the client of the rating agency) and lack of timeliness of their credit rating adjustments. Moody's rating on the failed bond insurer MBIA fell from AAA (investment grade) in February, 2008 to Ba1 (speculative grade) in June, 2009. In the aftermath to the global financial crisis the SEC introduced various measures to increases the oversight of credit rating agencies.

1.7 Equally-weighted and Value-weighted Returns

Two-way sorts, three-way sorts and second stage regressions are performed for equally and value-weighted returns. This procedure is followed in order to test the results for robustness. In particular, value-weighted returns overweight firms with relatively large market capitalisation, while equally-weighted returns assign equal weights to all firms. When the relationship between earnings persistence and value-weighted returns is insignificant, but the relationship between earnings persistence and equally-weighted returns is significant one can conclude that this finding is related to size; i.e. adding weight back to the small firms in the equally-weighted returns yields a statistically significant relationship, which implies that the relationship between earnings persistence and returns is particularly strong for small firms.

2 Data

2.1 Basic Data and Requirements

This study uses monthly data from the Center for Research in Security Prices (CRSP) and annual data from Compustat. The CRSP monthly stock file contains monthly prices, shares outstanding, dividends, and returns for NYSE, AMEX, and NASDAQ stocks. The Compustat industrial annual research file contains the relevant accounting information for most publicly traded U.S. stocks. In addition, the one-month Treasury-bill returns the risk-free rate, the small-minus-big portfolio returns (SMB), high-minus-low portfolio returns (HML) and market excess returns (MKT) are provided by Kenneth French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/). All accounting variables are defined in annual frequency and the return data is defined in monthly frequency.

Following Vuolteenaho (2002) page 237, all firms are required to have a December fiscal year end in order to align accounting variables across firms. Further, firms are required to have sufficient long-term debt and net income data. Firms with BM ratios of smaller than 1/100 and bigger than 100 are excluded. Further, firms with ROE of more than 100 percent and less than 100 percent are excluded and clear data errors and mismatches are screened out by excluding firms with market equity of less than $10 million.

2.2 Variable Definitions

Annual returns are compounded from monthly returns recorded from the beginning of June to the end of May.[5] Market equity is calculated from Compustat data and is defined as common shares outstanding (DATA 25) times the price at fiscal year-end (DATA 199). If the year t market equity is missing, the t-1 market equity is compounded with the return data. For book value of equity the total assets (DATA 6), minus total liabilities (DATA 181), minus the liquidating value of preferred stocks (DATA 10), plus deferred tax and investment tax credit (DATA 35), plus convertible debt (DATA 79) is used. If book value is unavailable, the clean surplus identity is applied to proxy for book value by last period's book value plus earnings, less dividends. Negative or zero book values are treated as missing. The BM ratio equals book value divided by market equity.

ROE is defined as earnings over the last period's book value, measured according to the U.S. Generally Accepted Accounting Principles. Net income (DATA 172) from Compustat is used and divided by book value to calculate ROE. When earnings are missing, the clean surplus identity is used to compute a proxy for earnings; that is, earnings equals the change in book value plus dividends. Firms are not allowed to lose more than their book value. That is, net income is defined as a maximum of the reported net income, or clean surplus net income, if earnings are not reported and negative at the beginning of the period book value. Hence, the minimum ROE is truncated to -100 percent. As stated above, observations with an ROE of no more than +100 percent are also excluded.[6]

Following Altman (1968), for the estimation of the Z-score the following five independent variables are defined: X_1 equals (working capital divided by total assets) multiplied by 100. X_2 equals (retained earnings divided by total assets) multiplied by 100. X_3 equals (earnings before interest and taxes divided by total assets) multiplied by 100. X_4

[5] This procedure is followed to avoid introducing a look-ahead bias and ex-post selection bias into this study (Banz and Breen (1986)).

[6] The independent variables in the vector autoregression are market-adjusted by subtracting the cross-sectional average each year.

equals (market value of equity divided by book value) multiplied by 100. X_5 equals (sales divided by total assets) multiplied by 100.

2.3 Sample

Table (1) shows the firm years by year and how data requirements affect sample size (the data requirements are shown on the horizontal axis). Also not shown in Table (1), the merge success of the CRSP database and the Compustat Industrial tape amounted to 77.5% overall.

Table 1: Sample

In table below the columns show the number of firm years in the raw data set by year. From left to right, additional data restrictions on the raw sample are imposed and the number of firm years is shown at each step. The restriction fyr<12 excludes firms that don't have a December fiscal year end, book==. excludes firm that don't have sufficient book value data, data172==. excludes firms that don't have sufficient GAAP earnings data, data9==. excludes firms that don't have sufficient long-term debt data, market<10 excludes firm that have a market capitalisation of less than $ 10 Million, bm<1/100 excludes firms with a BM ratio of less than 1/100, bm>100 excludes firms that have a BM ratio of over 100 and AR(1) restrictions excludes firms that have less than three years worth of accounting data that is required for robust AR(1) estimations. The CRSP-Compustat intersection from 1971 to 2004 is used.

Year	firm years	fyr<12	book==.	data172==.	data9==.	market<10	bm<1/100	bm>100	roe<=-1	roe>=1	AR1 restriction
1971	2153	1182	1027	1027	1027	912	912	912	911	898	
1972	2292	1233	1088	1088	1088	957	957	954	953	854	
1973	4395	1951	1616	1616	1616	1180	1180	1169	1169	1024	
1974	4349	2139	1854	1851	1851	1213	1213	1062	1062	1184	
1975	4305	2119	1885	1884	1884	1374	1374	1220	1220	1299	
1976	4324	2127	1884	1882	1882	1473	1472	1329	1328	1314	
1977	4292	2111	1868	1865	1864	1489	1489	1338	1338	1300	
1978	4177	2056	1803	1801	1800	1439	1439	1320	1320	1328	
1979	4122	2045	1777	1774	1772	1411	1407	1372	1371	1357	
1980	4132	2043	1769	1767	1764	1457	1454	1424	1422	1332	982
1981	4440	2170	1866	1865	1862	1469	1468	1458	1452	1402	1002
1982	4486	2298	1877	1875	1871	1502	1499	1486	1480	1477	1036
1983	4730	2403	1960	1958	1953	1659	1656	1644	1628	1461	1049
1984	5107	2572	2068	2066	2059	1675	1675	1664	1660	1547	1072
1985	5076	2615	2085	2081	2076	1726	1724	1710	1698	1550	1038
1986	5237	2767	2160	2151	2150	1803	1803	1787	1761	1597	1058
1987	5742	3075	2305	2302	2301	1878	1875	1865	1843	1672	1096
1988	5727	3088	2246	2245	2242	1859	1857	1850	1833	1681	1092
1989	5688	3122	2263	2262	2261	1888	1887	1877	1857	1615	1151
1990	5711	3208	2294	2288	2287	1804	1803	1789	1772	1730	1212
1991	5720	3253	2344	2340	2339	1962	1957	1945	1920	1880	1281
1992	6072	3483	2554	2553	2551	2266	2259	2249	2210	2157	1310
1993	6567	3784	2846	2843	2841	2606	2600	2584	2547	2320	1375
1994	7181	4239	3344	3339	3336	3043	3041	3022	2980	2730	1408
1995	7314	4357	3451	3449	3446	3179	3176	3171	3111	2848	1537
1996	7731	4719	3832	3830	3823	3576	3569	3562	3465	3103	1627
1997	7847	4903	4000	3996	3989	3739	3730	3724	3643	3093	1827
1998	7718	4957	4002	3993	3985	3689	3681	3674	3599	3108	1782
1999	7357	4758	3852	3850	3846	3622	3609	3602	3479	2822	1839
2000	7187	4750	3838	3837	3834	3480	3477	3468	3325	2940	1859
2001	6841	4534	3608	3607	3603	3336	3329	3327	3247	2866	1917
2002	6486	4291	3399	3398	3395	3129	3124	3122	3059	2887	1919
2003	6253	4109	3274	3274	3271	3183	3177	3172	3085	2835	2024
2004	6194	4095	3254	3254	3249	3208	3201	3198	3116	2832	2023
Average firm years per year	5499	3134	2509	2506	2503	2182	2179	2149	2114	1942	1421
Summation of firm years	186953	106556	85293	85211	85118	74186	74074	73050	71864	66043	35516

Note that a relatively large loss of observations occurs when enforcing the market capitalisation and BM restrictions (see description of Table (1)). First, if the year t market equity is missing, the t-1 market equity is compounded with the return data. During relatively volatile market conditions market capitalisations vary more strongly; as a result relatively many observations exceed the market capitalisation restrictions and are hence excluded. Second, if book value is unavailable, the clean surplus identity is applied to proxy for book value by last period's book value plus earnings, less dividends.

Hence, during periods of strong changes in earnings (e.g. write-offs during phases of market corrections) book values frequently exceed the imposed restrictions, which cause the sample to shrink in size. Third, the BM restrictions are a function of book value and market capitalisation; as a consequence the compounding of market equity and the application of the clean surplus relationship cause the BM restrictions to exclude relatively many observations.

2.4 Descriptive Statistics

Table (2) shows that there is wide dispersion in the level of earnings persistence (ξ) across persistence deciles (AR(1) deciles). The portfolio with the highest earnings persistence (portfolio 10) has an average ξ of 1.25, while the decile with the lowest earnings persistence (portfolio 1) has an has an average ξ of -0.21. The sorting on the earnings persistence estimate seems to non-randomly allocate small stocks as well as value stocks to low earnings persistence deciles; firms in portfolio 1 have relatively high BM values and the smallest market capitalisations on average. Thus, it is possible that the relationship between earnings persistence and the value premium is driven by size or financial distress. Elaborate robustness tests are conducted to obtain a good understanding of the relationship between earnings persistence and the value premium when controlling for size or financial distress.

Table 2: Descriptive Statistics - AR(1) Model

The table shows descriptive statistics across the persistence deciles formed on the AR(1) model's earnings persistence estimates. The averages of size (in Million \$), BM, and the earnings persistence estimate (ξ) from the AR(1) model are shown. The CRSP-Compustat intersection from 1980 to 2004 is used as the sample, in total 35,516 firm years. Earnings persistence is estimated using the following AR(1) model:

$$ROE_{i,t} \quad = \quad \xi ROE_{i,t-1} + \varepsilon_{i,t}.$$

AR(1) Decile	ξ	BM	Size
1	-0.21	0.93	1064
2	0.29	0.98	1380
3	0.49	0.95	1700
4	0.63	0.93	1900
5	0.73	0.88	1875
6	0.81	0.85	2614
7	0.88	0.79	3407
8	0.94	0.72	3998
9	0.98	0.66	5516
10	1.25	0.58	4640

2.5 Alternative Measures of Earnings Persistence

The literature on inflation in macroeconomics has a long history of analysing the persistence of inflation data. An economic variable is persistent if it does not change much over time in the absence of other economic influences. If inflation does not change much over time price levels remain constant and hence inflation is said to be persistent. The literature on inflation has various definitions of persistence, some of which this dissertation scrutinises in the context of the time-series properties of corporate profits. For example, to estimate the relationship between unemployment and inflation (Phillips curve), researches argue that inflation has an autoregressive feature that goes beyond just one lag (Gordon et al. (1982)); the speed with which autocorrelative effects die out over time is determined by the autocorrelation coefficient(s). Said differently, the more past shocks affect current observations, the more will the distant past be reflected in current observations. This specific feature is often shown analytically in the moving average representation (through backward induction).

A concept often mentioned in the context of persistence is the concept of stationarity. Many papers in macroeconomics research the stationarity of inflation and the results often show that inflation contains a unit root before the 1990s (Barsky (1987), Ball et al. (1990)). If a variable is stationary any past shock will persist infinitely into the future. Ex-ante this is not expected to be the case for ROE as it would be unreasonable to expect profitability to grow infinitly. Various tests for stationarity exist (e.g. Dickey-Fuller (1979)) test and Phillips and Perron (1988) test).

The famous Cox-Ingersoll-Ross model (hereafter, CIR) in the literature on interest rate models describes the rate of interest rate movements by only one source of market risk (Cox et al. (1985)). This model, which is based on the Vasicek (1977) term-structure model, describes interest rate as a process that fluctuates around a long-run mean. This model can be discretised and estimated using OLS. The main difference between an AR(1) and the discretised CIR is that when expressing the dependent variable as a first-difference (instead of the undifferenced variable in the AR(1) case - this can be analytically shown), the constant in the CIR regression can be interpreted as the long-run mean.

As mentioned above, the exact definition and modelling of persistence is a well-researched theme that spans many academic disciplines. The results in this dissertation focus on the estimation of earnings persistence in AR(1) and VAR settings; in particular, the full sample rank correlation between the simple AR(1) measure without constant, the AR(1) measure with constant, the AR(1) measure with constant and deterministic time trend, the AR(1) measure of first-differences with constant and the discretised CIR model (a model for crossing the means) are researched. Subsequently, these rank correlations are interpreted in particular with respect to the sensitivity of the results in this dissertation. In the following equations the earnings persistence models are expressed mathematically:

The AR(1) model without constant (main model):

$$ROE_{i,t} = \xi ROE_{i,t-1} + \varepsilon_{i,t}. \tag{12}$$

The AR(1) model with constant:

$$ROE_{i,t} = \alpha + \xi ROE_{i,t-1} + \varepsilon_{i,t}. \tag{13}$$

The AR(1) model with constant and deterministic time drift, where t indicates the age of the firm expressed in years.

$$ROE_{i,t} = \alpha + \xi ROE_{i,t-1} + \gamma t + \varepsilon_{i,t}. \tag{14}$$

The AR(1) model of first-differences with constant

$$\Delta ROE_{i,t} = \alpha + \xi \Delta ROE_{i,t-1} + \varepsilon_{i,t}. \tag{15}$$

The discretised CIR model:

$$\Delta ROE_{i,t} = \alpha + \xi ROE_{i,t-1} + \varepsilon_{i,t}. \tag{16}$$

Table 3: Full Sample Spearman Rank Correlations between Persistence Measures

The table depicts the Spearman rank correlation between the alternative models of earnings persistence as discussed above. No constant indicates the AR(1) model without constant (main model), constant indicates the AR(1) model with a constant, constant + trend indicates the AR(1) model with a constant and a deterministic time trend for the age of the firm expressed in years, first diff + constant indicates the AR(1) model of the differences with a constant, discretised CIR indicates the discretised Cox, Ingersoll, Ross (1985) model. The correlations are estimated on the full sample of firms - the CRSP-Compustat 1980 to 2004 intersection is used as the sample, in total 35,516 firm years. T-statistics and p-values are omitted as all correlations are significant at the 1% confidence level.

Spearman rank correlation	No constant	Constant	Constant + trend	First diff + constant	Discretised CIR
No constant	1				
Constant	0.61	1			
Constant + trend	0.43	0.70	1		
First diff + constant	0.16	0.38	0.55	1	
Discretised CIR	0.61	0.99	0.70	0.38	1

Table (3) shows that the AR(1) persistence measure of the "no constant" model, i.e. the model on which the results of this dissertation are based, is substantially and significantly correlated with all but the persistence measure of the "first differences + constant" model. Arguably, the first differences are least comparable to the level regressions, as one would expect the persistence of the change in profitability to be different than the persistence in the level of profitability. The relatively high magnitude and strong statistical significance of the correlation between the measure of persistence of the main model ("no constant" model) and three of the four alternative measures of persistence is signal that the results of this dissertation are likely to be robust to the choice of persistence measure. Further, the correlation between the VAR estimates from the Vuolteenaho (2002) model and the AR(1) model amounts to approximately 43% across all years (see below). The conclusions drawn from the Vuolteenaho (2002) model are in line with the conclusion of the AR(1) model; hence, this provides further evidence that it is reasonable to expect the results of this dissertation to be robust with respect to the above alternative measures of earnings persistence. Together with the fact that the AR(1) model without constant is a common way of estimating earnings persistence in the accounting literature, the results of this thesis are based on the earnings persistence estimates form the AR(1) process of ROE with no constant.

3 Main Results

3.1 Two-way Sorts and Second-stage Regressions: Earnings Persistence and the Value Premium

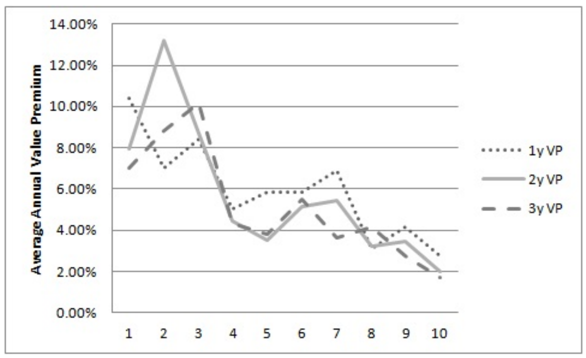
The simplest way to measure earnings persistence is an autoregressive model of order one on ROE (see Equation (7)). The persistence coefficient on a firm level is estimated with a rolling window (unbalanced panel) regression from 1980 to 2004 on an annual basis. A firm is required to have at least three years of past accounting information available to be included in the sample. After the estimation procedure, firms are sorted into deciles according to their persistence parameters (i.e. AR(1) deciles are formed) in each year. Subsequently, the value premium in each AR(1) decile is measured. That is, for each AR(1) decile, the average returns of a zero-investment strategy that goes long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is calculated. Over the entire sample period in each AR(1) decile, the average one-year-ahead, two-year-ahead and three-year-ahead value premium is reported on the vertical axis in Figure (1).

Figure 1: Average Value Premium across AR(1) Deciles - AR(1) Model

The figure depicts how the average value premium varies across deciles formed on earnings persistence estimates from an AR(1) model. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. Firstly, earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into deciles according to their earnings persistence estimate (AR(1) deciles). In each AR(1) decile firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year *t* and matched with the return data in June of year *t+1* to avoid a look-ahead bias. Then, for each persistence decile, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile to proxy for the value premia. The figure below then shows the average value premium (vertical axis) of each AR(1) decile (horizontal axis) from 1980 to 2004 . On the horizontal axis the AR(1) decile values are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead value premia are reported. That is, the average value premium for each persistence decile over the 25 year period is calculated. ROE is defined as the ratio of net income over last year's book equity. The CRSP-Compustat 1980 to 2004 intersection is used as the sample, in total 35,516 firm years. The following equation expresses the model that is used to estimate earnings persistence:

$$ROE_{i,t} \quad = \quad \xi ROE_{i,t-1} + \varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

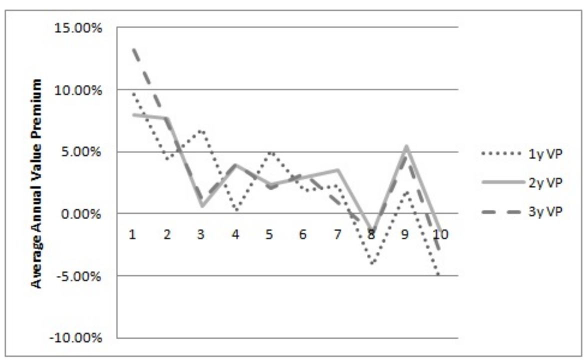


Figure (1) shows that a negative relationship between the average value premium and earnings persistence exists. For equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 7.65% (t-statistic: 1.87) on the one-year horizon, 5.99% (t-statistic: 2.32) on the two-year horizon and 5.32% (t-statistic: 2.61) on the three-year investment horizon. For value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 14.91% (t-statistic: 1.78) on the one-year horizon, 9.28% (t-statistic: 2.08) on the two-year horizon and 16.37% (t-statistic: 2.68) on the three-year investment horizon. The returns are annualised for all investment horizons.[7]

Figure (1) provides first evidence on the relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the average annual value premia of each persistence decile on the AR(1) decile values. Panel A in Table (4) provides the results for the equally-weighted returns. Second-stage regressions of one-year, two-year, and three-year value premia on AR(1) decile values are reported. Then the second-stage regressions are reversed to test for measurement error in the independent variable. Similarly, in Panel B of Table (4) the results for the value-weighted returns are provided. Second-stage regressions of one-year, two-year and three-year value premia on AR(1) decile values are reported. Then the second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (4) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. This procedure yields standard errors that are corrected for cross-sectional correlation.

[7] The difference between the annual returns across investment horizons in the same persistence decile is a result of differences in the amount of used return data in each investment period. The one-year investment horizon includes one return data point more than the two-year investment horizon. The two-year investment horizon includes one return data point more than the three-year horizon, while the one-year investment horizon includes two return data points more than the three-year investment horizon.

Table 4: Second-stage Regressions: Value Premium and Earnings Persistence - AR(1) Model

The table reports the parameter estimates of a panel regression in which value premia are regressed on AR(1) decile values. Subsequently, the regressions are reversed to test for robustness to measurement error in the independent variable. Panel A of Table (4) reports the results for the equally-weighted returns, while Panel B of Table (4) reports the results for the value-weighted returns. Firstly, the earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE); to estimate the AR(1) model a firm is required to have at least three years of past accounting information available. Then, in each year, firms are sorted into deciles according to their earnings persistence estimates; these portfolios are labelled AR(1) deciles. In each AR(1) decile firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year *t* and matched with the return data in June of year *t+1* to avoid a look-ahead bias. Then, for each AR(1) decile, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. The returns from this value strategy proxy for the value premia. The coefficients and t-statistics for the second-stage regressions are obtained by regressing value premia (x-year value premium) on the AR(1) decile values (AR(1) dec value) for all three time horizons from 1980 to 2004. Reversing these second-stage regressions allows the independent variable to be tested for measurement error. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure in order to obtain standard errors that are corrected for cross-sectional correlation. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1980 to 2004, in total 35,516 firm years.

Second-stage Regressions:

$$(x - year\,value\,premium)_{i,t} = \alpha + \beta\,(AR(1)\,dec\,value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(AR(1)\,dec\,value)_{i,t} = \alpha + \beta\,(x - year\,value\,premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-Weighted Returns

Variables	1y	2y	3y
Second-stage Regressions			
β	-0.007**	-0.007***	-0.008***
	(-2.47)	(-3.65)	(-3.03)
Intercept	0.096***	0.105***	0.092***
	(2.79)	(4.30)	(4.14)
Error in Variable Regressions			
β	-5.906**	-9.566***	-14.495***
	(-2.08)	(-4.53)	(-6.86)
Intercept	6.492***	6.392***	6.844***
	(21.97)	(30.56)	(17.01)

Panel B. Value-Weighted Returns

Variables	1y	2y	3y
Second-stage Regressions			
β	-0.012**	-0.006*	-0.011***
	(-2.00)	(-1.94)	(-3.28)
Intercept	0.090**	0.067**	0.091***
	(2.47)	(2.49)	(2.68)
Error in Variable Regressions			
β	-2.210	-4.335**	-4.060**
	(-1.44)	(-2.14)	(-2.00)
Intercept	5.71***	5.574***	5.710***
	(32.79)	(31.92)	(34.29)

For the equally-weighted returns, the second-stage regression results in Panel A of Table (4) show that the relationship between earnings persistence (AR(1) deciles) and the returns from the value premia is statistically significant and negative on all investment horizons. On the one-year horizon a factor loading of -0.007 (t-statistic: -2.47) is obtained, on the two-year horizon a factor loading of -0.007 (t-statistic: -3.65) is obtained and on the three-year horizon a factor loading of -0.008 (t-statistic: -3.03) is obtained. The one, two and three-year horizon results are robust to measurement error in the independent variable; the coefficients in the error in variable regressions are significant on all horizons.

For the value-weighted returns, the second-stage regression results in Panel B of Table (4) show that the relationship between earnings persistence (AR(1) deciles) and the value premia is statistically significant and negative on all investment horizon. On the one-year horizon a factor loading of -0.012 (t-statistic: -2.00) is obtained, on the two-year horizon a factor loading of -0.006 (t-statistic: -1.94) is obtained and on the three-year horizon a factor loading of -0.011 (t-statistic: -3.28) is obtained. The two and three-year horizon results are robust to measurement error in the independent variable; the coefficients in the error in variable regressions are significant on the two and three-year investment horizons.

The above results suggest that earnings persistence is negatively related to the value premium across all investment horizons for equally-weighted returns. For the value-weighted returns the relationship between earnings persistence and the value premium is statistically significant. These results are robust to measurement error in the independent variable on the two and three-year investment horizon.

3.2 Two-way Sorts and Second-stage Regressions: Financial Distress, Earnings Persistence and the Value Premium

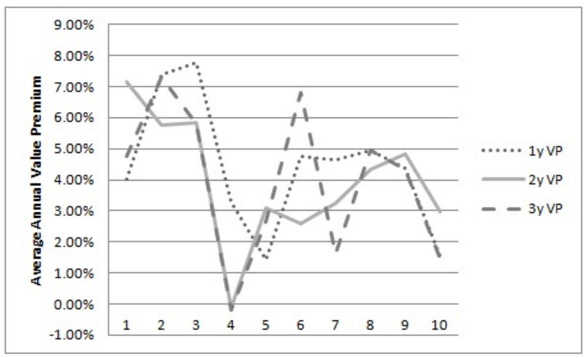
As shown in Table (2), firms in portfolios with low earnings persistence tend to have higher BM ratios and tend to be of smaller size. For this reason it is necessary to examine whether the negative relationship between earnings persistence and the value premium persists after excluding small or financially distressed firms. In the following this issue is analysed. To control for financial distress firms with a Z-score below 1.81 are excluded from the sample. Similarly, to control for size, firms are sorted into deciles according to their market value of equity and the firms in the smallest two deciles are excluded.

Figure 2: Average Value Premium across AR(1) Deciles Excluding Distressed Firms - AR(1) Model

The figure depicts how the value premium varies across deciles formed on earnings persistence estimates from an AR(1) model after excluding financially distressed firms. To control for financial distress firms with a Z-score of less than 1.81 are excluded from the sample. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. Firstly, earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into deciles according to their earnings persistence estimate (AR(1) decile). In each AR(1) decile firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, for each AR(1) decile, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. The figure below then shows the average value premium (vertical axis) of each AR(1) decile (horizontal axis) from 1980 to 2004. On the horizontal axis the AR(1) persistence deciles are reported, where 1 is the decile with the lowest persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. That is, the average value premium for each AR(1) decile over the 25 year period is calculated. ROE is defined as the ratio of net income over book equity. The CRSP-Compustat 1980 to 2004 intersection is used as the sample, in total 35,516 firm years. The following equation expresses the model that is used to estimate earnings persistence:

$$ROE_{i,t} = \xi ROE_{i,t-1} + \epsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

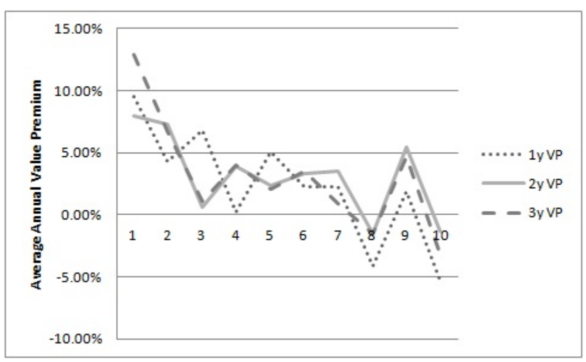


Figure (2) shows that the relationship between the average value premium and earnings persistence. For the equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 2.47% (t-statistic: 0.60) on the one-year horizon, 4.17% (t-statistic: 1.69) on the two-year horizon and 3.29% (t-statistic: 0.88) on the three-year investment horizon. For the value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 14.86% (t-statistic: 1.78) on the one-year horizon, 9.21% (t-statistic: 2.08) on the two-year horizon and

16.00% (t-statistic: 2.68) on the three-year investment horizon. The difference between the annual returns across investment horizons in the same persistence decile is a result of differences in the amount of used return data in each investment period. The one-year investment horizon includes one return data point more than the two-year investment horizon and the two-year investment horizon includes one return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year investment horizon.

Figure (2) provides first evidence on the relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the yearly value premia of each AR(1) persistence decile on the AR(1) persistence decile values. Panel A in Table (5) provides the results of the second-stage regression of one-year, two-year, and three-year value premia on AR(1) persistence decile values. In Panel B of Table (5) these second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (5) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. This procedure yields standard errors that are corrected for cross-sectional correlation.

Table 5: Second-stage Regressions: Value Premium and Earnings Persistence Excluding Distressed Firms - AR(1) Model

The table reports the parameter estimates of a panel regression in which value premia are regressed on AR(1) persistence decile values after excluding financially distressed firms. To control for financial distress firms with a Z-score of less than 1.81 are therefore excluded from the sample. Then the earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE); to estimate the AR(1) model a firm is required to have at least three years of past accounting information available. Then, in each year, firms are sorted into deciles according to their earnings persistence estimates; these portfolios are labelled AR(1) persistence deciles. In each AR(1) persistence decile firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, for each AR(1) persistence decile, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. The returns from this value strategy proxy for the value premia. Panel A presents the coefficients and t-statistics regressing value premia on the AR(1) persistence decile values (AR(1) dec value) for all three time horizons from 1980 to 2004 (second-stage regressions). In Panel B, the results from reversing these second-stage regressions are presented. In this way, the robustness of the results is tested for measurement error in the independent variable. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1980 to 2004, in total 35,516 firm years.

Second-stage Regressions:

$$(x - year\, value\, premium)_{i,t} \quad = \quad \alpha + \beta\,(AR(1)\, dec\, value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(AR(1)\, dec\, value)_{i,t} = \quad \alpha + \beta\,(x - year\, value\, premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-Weighted Returns

Variables	1y	2y	3y
	Second-stage Regressions		
β	-0.001	-0.003	-0.002
	(-0.30)	(-0.88)	(-0.69)
Intercept	0.054	0.054*	0.052*
	(1.47)	(1.80)	(1.68)
	Error in Variable Regressions		
β	0.011	-1.102	-4.393
	(0.01)	(-0.37)	(-1.45)
Intercept	6.105**	6.021**	6.493**
	(11.93)	(27.82)	(25.21)

Panel B. Value-Weighted Returns

Variables	1y	2y	3y
	Second-stage Regressions		
β	-0.012**	-0.006**	-0.011***
	(-2.00)	(-1.96)	(-3.34)
Intercept	0.09**	0.067***	0.092**
	(2.47)	(2.69)	(2.52)
	Error in Variable Regressions		
β	-2.212	-4.346**	-4.234**
	(-1.46)	(-2.17)	(-2.11)
Intercept	5.414***	5.564***	5.722***
	(32.88)	(33.05)	(34.08)

For the equally-weighted returns, the second-stage regression results in Panel A of Table (5) show that the relationship between earnings persistence (AR(1) deciles) and the returns from the value premia is negative but statistically insignificant and on all investment horizons when excluding financially distressed firms. On the one-year horizon a factor loading of -0.001 (t-statistic: -0.30) is obtained, on the two-year horizon a factor loading of -0.003 (t-statistic: -0.88) is obtained and on the three-year horizon a factor loading of -0.002 (t-statistic: -0.69) is obtained.

For the value-weighted returns, the second-stage regression results in Panel B of Table (5) show that the relationship between earnings persistence (AR(1) deciles) and the value premium is statistically significant and negative on all investment horizons when controlling for financial distress. On the one-year horizon a factor loading of -0.012 (t-statistic: -2.00) is obtained, on the two-year horizon a factor loading of -0.006 (t-statistic: -1.96) is obtained and on the three-year horizon a factor loading of -0.011 (t-statistic: -3.28) is obtained. The two and three-year horizon results are robust to measurement error in the independent variable; the coefficients in the error in variable regressions are significant on the two and three-year investment horizon.

From Table (5) and Figure (2) the following conclusion can be drawn: for equally-weighted returns in Graph A of Figure (2) the relationship between earnings persistence and the value premium seems to become statistically insignificant when financially distressed firms are removed from the sample. The difference in average value premia between low and high earnings persistence portfolios is positive on all investment horizons; however, these positive returns are statistically insignificant. Further, the second-stage regressions in Panel A of Table (5) show negative slope coefficients on all investment horizons, but these coefficients are statistically insignificant.

For value-weighted returns in Graph B of Figure (2) it can be observed that the difference in the average value premium between low and high earnings persistence portfolios is statistically significant on the two and three-year investment horizons. Moreover, the second-stage regressions in Panel B of Table (5) show negative and statistically significant slope coefficients on all investment horizons. Only the two and three-year investment horizon results seem to be robust to measurement error in the independent variable.

In summary, for equally-weighted returns the earnings persistence effect on the value premium seems to become statistically insignificant after excluding financially distressed firms. For value-weighted returns the earnings persistence effect on the value premium prevails after excluding financially distressed firms. This leads to the conclusion that the relationship between earnings persistence and the value premium may be particularly pronounced in small firms because the value-weighted returns overweight big firms.

3.3 Two-way Sorts and Second-stage Regressions: Size, Earnings Persistence and the Value Premium

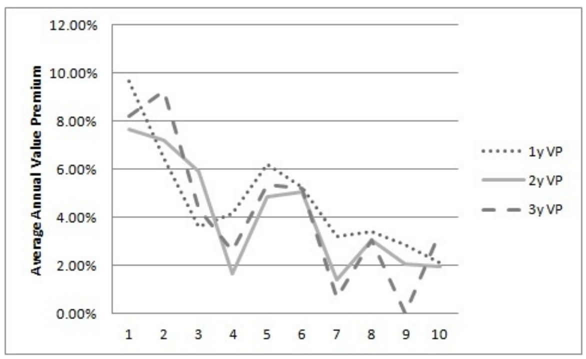
As shown in Table (2), firms in portfolios with low earnings persistence also tend to be of smaller size. For this reason it is necessary to examine whether the negative relationship between earnings persistence and the value premium persists after excluding small firms. In the following this issue is analysed. To control for size firms are sorted into deciles according to their market capitalisation and the two smallest deciles are excluded from the sample.

Figure 3: Average Value Premium across AR(1) Deciles Excluding Small Firms - AR(1) Model

The figure depicts how the value premium varies across deciles formed on earnings persistence estimates from an AR(1) model after excluding small firms. To control for size firms are sorted into deciles according to their market capitalisation and the smallest two deciles are excluded from the sample. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. Firstly, earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into deciles according to their earnings persistence estimate (AR(1) deciles). In each AR(1) persistence decile firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year *t* and matched with the return data in June of year *t+1* to avoid a look-ahead bias. Then, for each AR(1) decile, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. The figure below then shows the average value premium (vertical axis) of each persistence decile (horizontal axis) from 1980 to 2004. On the horizontal axis the AR(1) deciles are reported, where 1 is the decile with the lowest persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year, and three-year ahead returns (value premia) from the trading strategy are reported. That is, the average value premium for each persistence decile over the 25 year period is calculated. ROE is defined as the ratio of net income over book equity. The CRSP-Compustat 1980 to 2004 intersection is used as the sample, in total 35,516 firm years. The following equation expresses the model that is used to estimate earnings persistence:

$$ROE_{i,t} \quad = \quad \xi ROE_{i,t-1} + \epsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

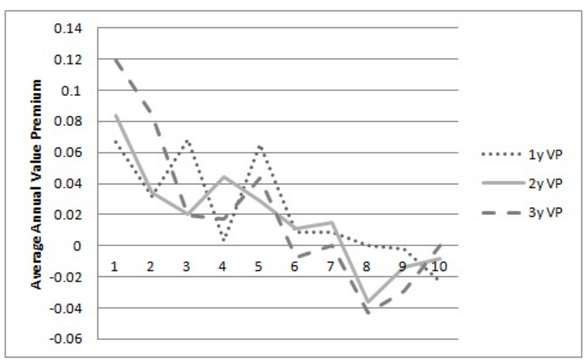


Figure (3) shows the relationship between the average value premium and earnings persistence after excluding small firms. For equally-weighted returns, the difference in average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 7.55% (t-statistic: 1.84) on the one-year horizon, 5.69% (t-statistic: 2.54) on the two-year horizon, and 4.81% (t-statistic: 2.15) on the three-year investment horizon. For value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 9.00% (t-statistic: 1.53) on the one-year horizon, 9.27% (t-statistic: 2.25) on the two-year horizon, and 11.92% (t-statistic: 1.96) on the three-year investment horizon. The returns are annualised for all investment horizons.[8]

Figure (3) provides first evidence on the negative relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the yearly value premia of each AR(1) decile on the AR(1) decile values. Panel A in Table (6) provides the results of the second-stage regression of one-year returns, two-year returns, and three-year value premia on AR(1) decile values. In Panel B of Table (6) these second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (6) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. This procedure yields standard errors that are corrected for cross-sectional correlation.

[8] The difference between the annual returns across investment horizons in the same persistence decile is a result of differences in the amount of used return data in each investment period. The one-year investment horizon includes one return data point more than the two-year investment horizon and two-year investment horizon includes one return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year investment horizon.

Table 6: Second-stage Regressions: Value Premium and Earnings Persistence Excluding Small Firms - AR(1) Model

The table reports the parameter estimates of a panel regression in which value premia are regressed on AR(1) persistence decile values after controlling for size. To control for size firms are sorted into deciles according to their market capitalisation and the smallest two deciles are excluded from the sample. Then the earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE); to estimate the AR(1) model a firm is required to have at least three years of past accounting information available. Then, in each year, firms are sorted into deciles according to their earnings persistence estimates; these portfolios are labelled AR(1) persistence decile. In each AR(1) persistence decile firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, for each AR(1) persistence decile, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. The returns from this value strategy proxy for the value premia. Panel A presents the coefficients and t-statistics regressing value premia on the AR(1) persistence decile values (AR(1) dec value) for all three time horizons from 1980 to 2004 (second-stage regressions). In Panel B, the results from reversing these second-stage regressions are presented. In this way, the robustness of the results to measurement error in the independent variables is tested. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1980 to 2004, in total 35,516 firm years.

Second-stage Regressions:

$$(x - year\,value\,premium)_{i,t} \quad = \quad \alpha + \beta\,(AR(1)\,dec\,value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(AR(1)\,dec\,value)_{i,t} = \quad \alpha + \beta\,(x - year\,value\,premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-Weighted Returns

Variables	1y	2y	3y
Second-stage Regressions			
β	-0.006*	-0.006***	-0.007***
	(-1.79)	(-2.69)	(-3.18)
Intercept	0.080**	0.075***	0.082***
	(2.23)	(3.35)	(4.12)
Error in Variable Regressions			
β	-1.761	-6.961**	-12.148***
	(-0.56)	(-2.08)	(-3.62)
Intercept	6.183***	6.064***	6.437***
	(28.91)	(25.91)	(26.18)

Panel B. Value-Weighted Returns

Variables	1y	2y	3y
Second-stage Regressions			
β	-0.009*	-0.009***	-0.014***
	(-1.74)	(-3.05)	(-4.46)
Intercept	0.070**	0.069***	0.010***
	(2.00)	(3.80)	(4.76)
Error in Variable Regressions			
β	-3.174*	-5.758**	-4.786**
	(-1.83)	(-2.14)	(-1.96)
Intercept	6.183***	6.064***	6.437***
	(29.51)	(20.51)	(16.24)

For equally-weighted returns, the second-stage regression results in Panel A of Table (6) show that the relationship between earnings persistence (AR(1) deciles) and the value premium is negative and statistically significant on all investment horizons after excluding small firms. On the one-year horizon a factor loading of -0.006 (t-statistic: -1.79) is obtained, on the two-year horizon a factor loading of -0.006 (t-statistic: -2.69) is obtained, and on the three-year horizon a factor loading of -0.007 (t-statistic: -3.18) is obtained. The results also show that, on the two and three-year investment horizon a measurement error in the independent variable can be excluded; the slope coefficients in the error in variable regressions are significant.

For value-weighted returns, the second-stage regression results in Panel B of Table (6) show that the relationship between earnings persistence (AR(1) deciles) and the value premium is statistically significant and negative on all investment horizons. On the one-year horizon a factor loading of -0.009 (t-statistic: -1.74) is obtained, on the two-year horizon a factor loading of -0.009 (t-statistic: -3.05) is obtained and on the three-year horizon a factor loading of -0.014 (t-statistic: -4.46) is obtained.

From Table (6) and Figure (3) the following conclusion can be drawn: for equally-weighted returns in Graph A of Figure (3) the relationship between earnings persistence and the value premium prevails when small firms are removed from the sample. The difference in the average value premium between low and high earnings persistence portfolios is positive on the two and three-year investment horizons and these positive returns are statistically significant. Further, the second-stage regressions in Panel A of Table (6) show negative slope coefficients on all investment horizons, and these coefficients are statistically significant. Moreover, the results appear to be robust to measurement error in the independent variable on the two and three-year investment horizon.

Graph B of Figure (3) presents the results for value-weighted returns. It can be observed that the difference in the average value premium between low and high earnings persistence portfolios is statistically significant on the two and three-year investment horizon. Moreover, the second-stage regressions in Panel B of Table (6) show negative and statistically significant slope coefficients on all investment horizons. These slope coefficients appear to be robust to measurement error in the independent variable.

In summary, these results paint a clear picture. The difference between the value premium in low and high earnings persistence portfolios is positive and statistically significant after controlling for size; similarly, the second-stage regressions yield negative and statistically significant slope coefficients. Thus, for equally and value-weighted returns the earnings persistence effect on the value premium seems to prevail after excluding small firms.

3.4 Understanding the Two-way Sorts

From the above analysis the following observation can be made. The relationship between earnings persistence and the value premium is negative and statistically significant (see Table (4)); when excluding financially distressed firms the relationship between earnings persistence and the value premium becomes statistically insignificant in parts (see Table (5)). At first this seems confusing, because the relationship between financial distress and the value premium is statistically insignificant (see Table (8)). To understand why the relationship between earnings persistence and the value premium becomes statistically insignificant after excluding firms in financial distress it is important to note that distressed firms are removed from the sample. Further analysis shows that when restricting the sample to distressed firms (i.e. firms with a Z-score < 1.81) a negative and statistically significant relationship between financial distress and the value premium exists.[9] This explains why excluding financially distressed firms from the sample weakens the relationship between earnings persistence and the value premium to a degree that renders it statistically insignificant.

3.5 Three-way Sorts: Size, Financial Distress, Earnings Persistence and the Value Premium

In the following the extent to which the relationship between earnings persistence and the value premium exists within size and distress portfolios is examined. Firms are sorted into quintiles according to their earnings persistence. Subsequently, in each quintile firms are sorted into quintiles according to their size or financial distress (the first and second sort order is also reversed to control for size and financial distress; i.e. first sort on size or distress and second sort on earnings persistence). Thirdly, BM tertiles in each of these 25 portfolios are formed and the value premia are calculated. This allows the difference in value premia between low and high earnings persistence portfolios to be statistically tested. Further, it gives inside into the interrelation between earnings persistence, default risk, size and the value premium.

3.5.1 The Size Effect

In the following the relationship between size and the value premium is examined within earnings persistence quintiles. Table (7) presents results from three-way sorts on earnings persistence, size, and BM. Stocks are firstly sorted into five quintiles based on their earnings persistence. Subsequently, the stocks within each earnings persistence quintile are sorted into five quintiles based on their size. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium.

Panel A of Table (7) shows that there is no statistically significant relationship between the value premium and size in any of the earnings persistence quintiles. Moreover, there

[9] The relationship between financial distress and the value premium is tested by regressing yearly Z-scores on a constant and value premia across the entire sample from 1980 to 2004. The following regression model was used: $Z-score_{i,t} = \alpha + \beta HML_t + \varepsilon_{i,t}$, where i indicates a firm and t indicates a year. HML is the value premium as proxied for by the return differential of high book-to-market and low book-to-market firms. The data is taken from Kenneth French's homepage.

is no statistically significant size effect in the whole sample.

Panel B reveals that there is little variation in earnings persistence with size within all earnings persistence portfolios and the whole sample, which indicates that size and earnings persistence have little relation. Not surprisingly, Panel C reveals that there is variation in size across size quintiles when controlling for earnings persistence. The variation in size increases monotonically with the degree of earnings persistence. Panel D of Table (7) reports the average Z-score of the earnings persistence and size-sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk are interrelated. Panel D shows that default risk decreases monotonically with size within all earnings persistence quintiles. This is coherent with other empirical studies (e.g. Vassalou and Xing (2004)) and indicates that size and financial distress are closely related.

The conclusion that emerges from Table (7) is that the relationship between size and the value premium is statistically insignificant. Size does not seem to drive the value premium. Moreover, size, default risk and earnings persistence seem to be related.

Table 7: Three-way Sorts: Size Effect Controlled by Earnings Persistence - AR(1) Model

The table below depicts how the value premium varies with size when controlling for earnings persistence. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their earnings persistence. Subsequently, within each quintile firms are again sorted into size quintiles according to their market capitalisation. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Small-Big" is the return difference in the value premia between the smallest and biggest size portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-statistics are calculated from Newey-West standard errors.

	Small 1	2	3	4	Big 5	Small-Big	*t-stat*
	Panel A: Average Annual Value Premium						
Low EP	0.06	0.04	0.10	0.07	0.06	0.01	0.4566
2	0.04	0.01	0.07	0.06	0.06	-0.03	-0.1085
3	-0.02	0.03	0.02	0.03	0.04	-0.06	-0.3841
4	0.14	-0.05	0.03	0.03	0.04	0.10	1.2397
High EP	-0.08	0.04	0.03	0.05	0.02	-0.10	-1.7961
Whole sample	0.03	0.01	0.05	0.05	0.04	-0.02	-0.9654
	Panel B: Average Earnings Persistence						
Low EP	0.011	0.002	0.021	0.057	0.098		
2	0.552	0.555	0.557	0.559	0.563		
3	0.771	0.773	0.775	0.777	0.777		
4	0.901	0.909	0.909	0.912	0.913		
High EP	1.291	1.139	1.077	1.048	1.037		
Whole sample	0.705	0.675	0.668	0.671	0.677		
	Panel C: Average Size						
Low EP	27	71	174	491	5390		
2	32	97	259	832	7837		
3	41	137	366	1094	9664		
4	66	250	662	1905	15745		
High EP	61	263	793	2354	22074		
Whole sample	45	164	451	1335	12142		
	Panel D: Average Z-score						
Low EP	0.82	0.96	1.95	2.12	3.37		
2	0.00	2.22	3.18	3.79	4.86		
3	0.04	4.04	5.38	5.82	6.74		
4	1.07	6.29	7.51	7.81	7.46		
High EP	-6.95	2.90	7.70	8.02	8.27		
Whole sample	-1.01	3.28	5.14	5.51	6.14		

3.5.2 The Distress Effect

Table (8) presents results from portfolio sortings in the same spirit as those of Table (7). Stocks are first sorted into five earnings persistence quintiles, and then each of the five earnings persistence quintiles is sorted into five default risk quintiles. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following, it is examined how default risk affects the value premium within each earnings persistence quintile, as well as for the market as a whole.

Panel A of Table (8) shows that there is no statistically significant relationship between the value premium and financial distress in any of the earnings persistence quintiles. Moreover, there is no statistically significant relationship between the value premium and financial distress in the whole sample.

Panel B reveals that earnings persistence has little variation with distress risk. To further examine the relationship between earnings persistence and default risk Panel D is analysed. As expected, across the entire sample, there is a monotonic increase in default risk observable. Coherent with previous research it can be seen that default risk decreases with size (Panel C). Small stocks bear the highest default risk (Vassalou and Xing (2004)).

Table 8: Three-way Sorts: Default Risk Effect Controlled by Earnings Persistence - AR(1) Model

The table below depicts how the value premium varies with financial distress when controlling for earnings persistence. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their earnings persistence. Subsequently, within each quintile firms are again sorted into distress quintiles according to their Z-score. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year *t* and matched with the return data in June of year *t+1* to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Low-High" is the return difference between the value premia of the low Z-score and the high Z-score portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in our sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Low Z-score			High Z-score			
	1	2	3	4	5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Low EP	0.15	0.04	0.10	0.08	0.05	0.10	1.3791
2	0.06	0.01	0.09	0.05	0.06	0.00	-0.6513
3	0.05	0.04	0.08	0.09	0.01	0.04	0.9431
4	0.04	0.08	0.09	0.03	0.02	0.02	0.6494
High EP	0.01	0.02	0.02	0.06	0.07	-0.06	-1.4600
Whole sample	0.06	0.04	0.07	0.06	0.04	0.02	0.6471
	Panel B: Average Earnings Persistence						
Low EP	-0.071	-0.038	0.054	0.105	0.140		
2	0.544	0.551	0.553	0.568	0.570		
3	0.768	0.770	0.774	0.779	0.782		
4	0.908	0.909	0.907	0.909	0.912		
High EP	1.323	1.100	1.084	1.056	1.028		
Whole sample	0.694	0.658	0.674	0.683	0.686		
	Panel C: Average Size						
Low EP	568	1203	1646	1616	1081		
2	831	2322	2231	1952	1674		
3	1280	2521	3386	3037	995		
4	2015	3241	5184	4919	3167		
High EP	1307	3149	4231	6761	10009		
Whole sample	1200	2487	3336	3657	3385		
	Panel D: Average Z-score						
Low EP	-9.09	-0.01	2.32	4.72	9.77		
2	-10.95	2.00	4.46	6.82	11.84		
3	-10.83	3.42	6.15	8.80	14.62		
4	-7.30	3.89	7.23	10.51	15.96		
High EP	-15.50	3.37	6.43	10.05	15.71		
Whole sample	-10.73	2.53	5.32	8.18	13.58		

3.5.3 The Earnings Persistence Effect

Table (9) presents results from three-way sorts on size, earnings persistence and BM. Stocks are first sorted into five quintiles based on their size. Subsequently, the stocks within each size quintile are sorted into five quintiles based on their earnings persistence. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles. The difference in returns between the high BM tertiles and the low BM tertiles proxies for the value premium. In the following it is examined whether the earnings persistence effect exists in size quintiles.

Panel A of Table (9) shows that there is a statistically significant relationship between the value premium and earnings persistence in the smallest size quintile and in the entire sample.

Panel C reveals that size does not vary much with earnings persistence in the first size quintile. However, the average market capitalisation in the smallest size quintile is below $ 50 Mio, which shows that the earnings persistence is particularly affecting the value premia in portfolios of very small firms. Panel D of Table (9) reports the average Z-score of the earnings persistence and size-sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk earnings persistence. Panel D shows that default risk increases monotonically with earnings persistence.

The conclusion that emerges from Table (9) is that the relationship between earnings and the value premium is statistically significant after controlling for size; in the entire sample as well as in the small size quintile the difference between the value premia in low and high earnings persistence quintiles is positive and statistically significant. Earnings persistence seems to drive the value premium in general and particularly in the small size quintile. The question of interest that emerges is whether the relationship between the value premium and earnings persistence prevails after controlling for financial distress.

Table 9: Three-way Sorts: Earnings Persistence Effect Controlled by Size - AR(1) Model

The table below depicts how the value premium varies with earnings persistence when controlling for size. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their market capitalisation. Subsequently, within each quintile firms are again sorted into earnings persistence quintiles according to their earnings persistence estimates from the AR(1) model. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Low-High" is the return difference in the value premia between the low earnings persistence and high earnings persistence portfolios within each size quintile. The rows labelled "Whole sample" report results using all stocks in our sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Low EP 1	2	3	4	High EP 5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Small	0.12	-0.02	-0.02	0.07	0.02	0.10	2.4900
2	0.06	0.02	0.04	0.04	0.00	0.06	1.3125
3	0.11	0.01	0.04	-0.03	0.04	0.07	1.0288
4	0.03	0.03	0.07	0.03	0.03	0.00	-0.0233
Big	0.07	0.04	0.02	0.00	0.03	0.04	1.5089
Whole sample	0.08	0.02	0.03	0.02	0.03	0.05	2.2139
	Panel B: Average Earnings Persistence						
Small	-0.18	0.36	0.60	0.80	1.20		
2	-0.07	0.47	0.70	0.86	1.11		
3	0.11	0.60	0.79	0.91	1.11		
4	0.19	0.65	0.83	0.94	1.07		
Big	0.35	0.73	0.88	0.96	1.07		
Whole sample	0.08	0.56	0.76	0.89	1.11		
	Panel C: Average Size						
Small	36	37	37	38	40		
2	125	130	130	131	132		
3	371	369	377	386	393		
4	1169	1179	1197	1211	1243		
Big	9677	9918	11653	13382	17012		
Whole sample	2276	2327	2679	3029	3764		
	Panel D: Average Z-score						
Small	-0.63	0.34	-1.06	-0.35	-5.63		
2	1.17	2.55	3.00	4.39	0.90		
3	2.24	3.76	6.15	7.17	5.35		
4	3.30	4.02	6.82	7.97	7.78		
Big	4.44	5.72	8.15	7.64	8.34		
Whole sample	2.10	3.28	4.61	5.36	3.35		

Table (10) presents results from three-way sorts on distress risk, earnings persistence and BM. Stocks are first sorted into five quintiles based on their Z-score. Subsequently, the stocks within each distress quintile are sorted into five quintiles based on their earnings persistence. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles. The difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following it is examined whether the earnings persistence effect exists in distress quintiles.

Panel A of Table (10) shows that there is a statistically significant relationship between the value premium and earnings persistence within distress quintiles one and the sample as a whole. The average annual difference in the value premium between the low and high earnings persistence quintile amounts to 0.9% (t-statistic: 2.41) in distress quintile one and to 2% (t-statistics: 2.34) in the sample as a whole. Considering that only firms with a Z-score of less than 1.81 are classified as bankrupt firms, special attention needs to be paid to the first distress quintile. The first quintile is the only distress quintile with an average Z-score of less than 1.81 within all earnings persistence quintiles. The question of interest is whether earnings persistence varies within the distress quintiles. If there is variation of earnings persistence within distress quintiles then this could be an explanation for the relationship between earnings persistence and the value premium after controlling for distress.

Panel B reveals that there is substantial variation in earnings persistence within all distress quintiles and the sample as a whole. This variation in earnings persistence should lead to a statistically significant return difference between low and high earnings persistence quintiles if there is a relationship between earnings persistence and the value premium after controlling for financial distress. Panel C reveals that size varies with earnings persistence within all distress quintiles and the sample as a whole. However, the variation in size within the earnings persistence quintiles increases with the degree of financial distress. Panel D of Table (10) reports the average Z-score of the earnings persistence and distress-sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk are interrelated. Panel D shows that default risk is stable across earnings persistence quintiles. The conclusion that emerges from Table (10) is that the relationship between earnings and the value premium is statistically significant in financially distressed firms.

Table 10: Three-way Sorts: Earnings Persistence Effect Controlled by Distress - AR(1) Model

The table below depicts how the value premium varies with earnings persistence when controlling for financial distress. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their Z-score. Subsequently, within each distress quintile firms are again sorted into earnings persistence quintiles according to their earnings persistence estimates from the AR(1) model. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Low-High" is the return difference in the value premia between the low earnings persistence and high earnings persistence portfolios within each distress quintile. The rows labelled "Whole sample" report results using all stocks in our sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Low EP				High EP		
	1	2	3	4	5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Low Z-score	0.02	0.12	0.08	0.08	0.02	0.00	2.4137
2	0.17	0.03	0.07	0.06	0.07	0.10	1.5467
3	0.04	0.07	0.07	0.04	0.03	0.01	0.9987
4	0.08	0.08	0.12	0.04	0.07	0.01	0.6687
High Z-score	0.01	0.02	0.04	0.03	0.06	-0.05	-1.1354
Whole sample	0.07	0.06	0.08	0.05	0.05	0.02	2.2364
	Panel B: Average Earnings Persistence						
Low Z-score	-0.30	0.30	0.57	0.79	1.28		
2	-0.04	0.45	0.69	0.85	1.06		
3	0.13	0.56	0.75	0.89	1.08		
4	0.29	0.67	0.82	0.92	1.08		
High Z-score	0.46	0.80	0.90	0.96	1.05		
Whole sample	0.11	0.56	0.74	0.88	1.11		
	Panel C: Average Size						
Low Z-score	1134	780	786	846	932		
2	1242	2317	2296	2792	3178		
3	1570	2151	3109	3479	3328		
4	1434	1963	4401	4947	5381		
High Z-score	1412	1281	3219	6203	10176		
Whole sample	1358	1698	2762	3654	4599		
	Panel D: Average Z-score						
Low Z-score	-5.47	-6.17	-11.66	-14.06	-19.05		
2	2.22	2.30	2.41	2.35	2.49		
3	5.11	5.19	5.17	5.17	5.11		
4	8.08	8.16	8.28	8.35	8.38		
High Z-score	13.86	14.38	14.27	14.51	14.08		
Whole sample	4.76	4.77	3.69	3.26	2.20		

Several studies exist that explore the survivorship bias in the Compustat tape and its effect on HML returns. On page 204 Kothari et al. (1995) compare the Compustat, CRSP and the CRSP – Compustat tapes and argue that this comparison shows that Compustat includes a large amount of failing firms. Therefore, they argue, returns in high BM portfolios suffer from an upward bias. Further, they argue that this bias is specific to time periods. First, prior to 1978 Compustat included historical financial statement information back to 1946 for firms that were added ex-post. In 1978 Compustat expanded its database, adding 5 years of data back to 1973 for most firms. Hence, high BM firms that performed badly since 1973 and failed (or didn't meet Compustat minimum asset or market capitalisation thresholds) before 1978 were possibly excluded from the sample. However, high BM firms that performed well after 1973 and emerged from (survived) financial distress may well be included in the 1978 dataset. This causes a spurious relationship between high BM portfolios formed in 1973 and the subsequent 5 year of returns. Banz and Breen (1986) find similar arguments. Alford et al. (1994) argue that firms may delay the filing of financial statements due to unfavourable economic conditions. Some of these firms may be delisted. However, some firms that delay the reporting of financial statements file these statements after they have survived economic hardship. Hence, Compustat may suffer from a survivorship bias and a related upward bias in average returns, especially in high BM portfolios. Breen and Korajcyk (1995) construct a Compustat dataset that is free of the selection bias due to backfilling of data (see page 6 Breen and Korajcyk (1995) for details). Their results show that unconditional betas and size are in line with Fama and French (1992). However, the estimated BM effect is less than half of that reported by Fama and French (1992). The cross-sectional regressions reveal that the BM effect in the survivorship corrected dataset is significantly below the estimated BM effect of the original Compustat tape. Davis (1994) finds similar results as Breen and Korajczyk (1993); however, his results are statistically significant. Chen et al. (1995) provide direct evidence that refutes the findings of Kothari et al. (1995). They argue that the proportion of domestic firms on the CRSP tape that is missing from Compustat is not large and the average returns are similar in magnitude. However, they find that outperformance of high BM firms can be found in the top quintile of NYSE-Amex firms (after using a sample that is corrected for survivorship bias). Further, they recommend to pay particular attention to studies that focus on emerging markets; these data sets are still in expansion and hence may be subject to backfilling biases (e.g. Worldscope).

This dissertation does not explicitly correct for survivorship bias. It would be interesting to investigate whether low earnings persistence is related to the survival (turn-around) of high BM firms. If so, then this could have meaningful implications for the relationship between earnings persistence and the BM ratio. However, such study goes beyond the scope of this dissertation and is left for future research.

Part III

The Relationship between Earnings Persistence and the Value Premium - Variance Decomposition Frameworks

In the previous part a framework was used to analyse the economic link between earnings persistence and the value premium. This part extends this framework by allowing for time variation in discount rates and by acknowledging the existence of different state variables that drive earnings persistence. The two model specifications considered both allow for variation in discount rates and for more information to be used for estimating earnings persistence (Vuolteenaho (2000, 2002) model and the Callen and Segal (2004) model). This allows the relationship between earnings persistence and the value premium to be examined from two different perspectives; while the Vuolteenaho (2000, 2002) model focuses on return on equity as a state variable that drives cash-flow news, Callen and Segal (2004) directly model accounting accruals as a state variable that drives accrual news, the analogue to cash-flow news in the Vuolteenaho (2000, 2002) model. Firstly, ex-ante it is interesting to understand whether two different specifications that allow earnings persistence to be estimated reveal the same relationship between earnings persistence and the value premium. Secondly, having estimated earnings persistence with two different specifications and analysed the relationship between earnings persistence and the value premium separately, it is interesting to understand whether the generated value premia are captured by existing risk factors; to answer this question value premia of both models are regressed on the three Fama and French (1993) risk factors. Thirdly, testing whether the relationship between earnings persistence and the value premium is statistically significant across three model specifications (AR(1), Vuolteenaho (2000, 2002) and Callen and Segal (2004)) allows the robustness of these results to be examined.

The accounting literature has reached a consensus that the cash-flow as well as the accrual component of earnings have value relevance. An accounting amount is defined as value relevant if it has predictive association with equity market values. Callen and Segal (2004) find that all three factors - cash-flows, accruals and expected future discount rates - are value relevant and they find that accrual earnings news dominates cash-flow earnings news in driving stock returns. The information incorporated in the accrual component of earnings seems to have higher value relevance. Previous research has shown that the cash-flow component of earnings is harder to manipulate; accruals involve subjective estimations and are known to be used for managing earnings: expense manipulation such as delayed recognition of expenses, revenue or margin manipulation such as the premature recognition of revenue are discussed in the accounting literature on earnings management. The inherent link between earnings management and accruals as an important factor in driving stock returns is discussed in the literature (e.g. Dechow et al. (1995)).

In the following the results for the Vuolteenaho (2000, 2002) model are summarised. The results show that the difference in the average annual value premium between low and high earnings persistence portfolios in the period from 1980 to 2004 lies between 12.04% (equally-weighted returns) and 6.69% (value-weighted returns) before excluding financially distressed or small firms. These return differences are statistically significant. Second-stage Fama and MacBeth (1973) regressions of value premia on earnings persistence decile values reveal significant and negative coefficients; these results appear to be robust to measurement error in the independent variable. These results suggest that the difference between the value premia in low and high earnings persistence portfolios is significantly different from zero before excluding distressed or small firms. However, when excluding financially distressed firms the relationship between earnings persistence and the value premium disappears at least partially; for the equally-weighted returns the difference in value premia between low and high earnings persistence deciles become statistically insignificant on all investment horizons. For the value-weighted returns these differences are statistically significant on the two and three-year investment horizon. Similarly, the second-stage regressions for the equally-weighted returns are statistically insignificant on all horizons and only significant on the two-year investment horizon for the value-weighted returns. The disappearance of the relationship between earnings persistence and the value premium after excluding distressed firms is not surprising because a statistically significant relationship between distress and the value premium is found in portfolios of financially distressed firms. The three-way sorts reveal that the relationship between earnings persistence and the value premium prevails in portfolios of financially distressed firms and the sample as a whole. In summary, these results suggest that the earnings persistence characteristic is systematically associated with the average returns from a book-to-market based value strategy.

In the following the results for the Callen and Segal (2004) model are summarised. The results show that the difference in the average annual value premium between low and high earnings persistence portfolios in the period from 1980 to 2004 lies between 11.03% (equally-weighted returns) and 1.65% (value-weighted returns) before excluding financially distressed or small firms. However, only the equally-weighted returns obtain statistical significance. Second-stage Fama and MacBeth (1973) regressions of value premia on earnings persistence decile values reveal significant and negative coefficients for all investment horizons for the equally weighted returns; these results appear to be robust to measurement error in the independent variable. These results suggest that the difference between the value premia in low and high earnings persistence portfolios is significantly different from zero before excluding distressed or small firms. However, when excluding small firms the relationship between earnings persistence and the value premium disappears at least partially; for the equally-weighted and value-weighted returns the difference in value premia between low and high earnings persistence deciles become statistically insignificant on all investment horizons. Similarly, the second-stage regressions for the equally-weighted and value-weighted returns are statistically insignificant on all investment horizons. The disappearance of the relationship between earnings persistence and the value premium after excluding small firms is not surprising because a statistically significant relationship between distress and the value premium is found in portfolios of small firms. The three-way sorts reveal that the relationship between earnings persistence and the value premium prevails in portfolios of small firms, distressed firms and the sample as a whole. In summary, these results suggest that the earnings persistence characteristic is systematically associated with the average returns from a book-to-market based value strategy.

The Fama and French (1993) regressions reveal that the value premia in low earnings persistence portfolios produce statistically significant positive risk-adjusted returns regardless of the model specification chosen for the estimation of earnings persistence. The results for the Vuolteenaho (2000, 2002) model show that portfolios of low earnings persistence yield positive and statistically significant risk-adjusted returns (alphas) between 5.2% and 6.9% annually. The alphas of portfolios with high earnings persistence are considerably lower and statistically insignificant. Similarly, the results for the Callen and Segal (2004) model show that portfolios of low earnings persistence yield positive and statistically significant risk-adjusted returns (alphas) of 11.5% annually. The alphas of portfolios with high earnings persistence are considerably lower and statistically insignificant. A stock's risk is summarised by its beta. After controlling for beta, the earnings persistence characteristic should not influence the return required by a rational investor. These results are interesting because, although each model specification allows earnings persistence to be estimated using different state variables, the relationship between earnings persistence and the value premium remains consistent. It can be concluded that both model specification capture a common earnings persistence component and allow the relationship between earnings persistence and the value premium to be exposed. Moreover, the consistency across model specifications supports the robustness of results. The Fama and French (1993) regression results prompt to ask the question of whether earnings persistence is a priced risk. Consequently, the next part of this dissertation answers this questions.

The remainder of part 3 of this dissertation is organized as follows. Section 1 describes the research methodology. Section 2 reports the sample. Sections 3 and 4 discuss the main results.

1 Methodology

As in part 1 of this dissertation, the relationship between earnings persistence and the value premium is investigated by performing two-way sorts on earnings persistence and

BM. Subsequently, further evidence on the relationship between earnings persistence and the value premium is provided by performing second-stage regressions of value premia on portfolios formed on the earnings persistence estimates from the VAR models. Further, the second-stage regressions are reversed in order to test for measurement error in the independent variable. Three-way sorts are performed in order to examine the extent to which the relationship between earnings persistence and the value premium prevails after controlling for size or default risk. The Altman Z-Score is estimated as in section 1.5 of part 1 of this dissertation.

1.1 The Vuolteenaho (2000, 2002) Model

Using the clean surplus accounting identity, on page 235pp Vuolteenaho (2002) shows how the Campbell (1991) model can be transformed into an accounting-based present value formula that uses ROE (return on equity) as cash-flow variable. The clean surplus relationship (hereafter, CSR) is defined as follows:

$$B_t = B_{t-1} + X_t - D_t. \tag{17}$$

The above accounting identity states that current book value (B_t) equals last period's book value plus net income (X_t) minus dividends (D_t). Based on Vuolteenaho (2000), Vuolteenaho (2002) derives a model that expresses unexpected stock returns as expected return news less expected cash-flow news. The key equation that is taken from Vuolteenaho (2002) is depicted on page 236 of Vuolteenaho (2002) and derived on page 235pp of the same paper. To be consistent with the aforementioned literature, the variable definitions and nomenclature is adpoted. Vuolteenaho (2002) shows that unexpected stock returns ($r_t - E_{t-1}(r_t)$) can be decomposed into cash-flow news ($N_{cf,t}$) and expected return news ($N_{r,t}$), where the approximation error is defined as$\kappa_t \equiv E_t\kappa_{t-1}$; the details of the derivation are given in Vuolteenaho (2002). Vuolteenaho (2002) shows that the expectation operator ΔE_t expresses the change in expectations from $t-1$ to t:

$$r_t - E_{t-1}(r_t) = \Delta E_t \sum_{j=0}^{\infty} \rho^j \left(e_{t+j} - f_{t+j}\right) - \Delta E_t \sum_{j=1}^{\infty} \rho^j r_{t+j} + \kappa_t. \tag{18}$$

$$N_{cf,t} \equiv \Delta E_t \sum_{j=0}^{\infty} \rho^j \left(e_{t+j} - f_{t+j}\right) + \kappa_t, \quad N_{r,t} \equiv E_t \sum_{j=1}^{\infty} \rho^j r_{t+j}. \tag{19}$$

As shown in Vuolteenaho (2002) page 236, a variance decomposition of unexpected return news can be derived using Equation (18):

$$var(r_t - E_{t-1}(r_t)) \quad = var(N_{cf,t}) + var(N_{r,t}) - 2cov(N_{r,t}, N_{cf,t}). \tag{20}$$

The decomposition in Equation (20) allows the importance of cash-flow news and expected return news as stock return drivers to be measured. The cash-flow news term in Equation (18) is analogous to the one on the right-hand side of the residual income model in the first part of this dissertation, with the log-approximation substituting for the level of ROE. The contribution of expected return news is represented by the second term on the right-hand side, which can be viewed as the discounted sum of changes in the forecasts of future returns. The intuition behind this formulation is straightforward. Suppose that expected future returns are revised upwards, while the level of expected cash-flows (both current and future) is unchanged. This may happen, for example, because risk aversion increases and investors discount future streams of cash more heavily. Equation (18) implies that the effect on the current surprise return is negative because, given that expected cash-flows are unchanged, the price must fall in the current period in order for demand to match supply.

It can be analytically shown that cash-flow news variance is positively related to earnings persistence (see Appendix). Equation (21) shows this relationship; on the left hand side the variance of cash-flow news is found. The ξ estimate represents the persistence coefficient in a standard AR(1) model of ROE:

$$var_t \left[\Delta E_t(\sum_{j=1}^{\infty} \rho^j e_{t+j}) \right] \quad = \quad \left[\frac{1}{1 - \rho\xi} \right]^2 \sigma^2. \tag{21}$$

That is, the more persistent ROE is (the higher ξ), the higher is the cash-flow news variance; intuitively, a positive shock to cash-flows for a firm with high earnings persistence will revert less quickly to the mean and therefore result in a relatively high cash-flow news variance. Equation (21) is the analogue of total variance for an AR(1) process applied to the variance of expectation shocks (Dichev and Tang (2009)).

1.2 The Callen and Segal (2004) Model

Callen and Segal (2004) show on page 533pp how the Campell (1991) dividend-growth model can be rewriten as an accounting-based valuation model using the Feltham and Ohlson clean surplus relationship. In Equation (22) and Equation (23) the Feltham-Ohlson clean surplus relations are documented:

$$FA_t \quad = \quad FA_{t-1} + i_t - (D_t + C_t), \tag{22}$$

$$OA_t = OA_{t-1} + OX_t - C_t. \tag{23}$$

Following Callen and Segal (2004), FA_t denotes net financial assets at time t, i_t denotes net interest income received from net financial assets at time t, D_t denotes net cash dividends at time t, C_t denotes free cash-flows (cash from operations less investment in operating assets) at time t, OA_t denotes net operating assets at time t and OX_t denotes net operating earnings at time t.[10]

The dynamics of the relationship between financial and operating assets are explained in more detail on page 534 of Callen and Segal (2004) and are not repeated at this junction. The key equation that is taken from Callen and Segal (2004) is depicted on page 534 of Callen and Segal (2004) and formally derived on page 553pp of the same paper. Furher, this study adopts the definitions, notations and nomenclature of variables as in Callen and Segal (2004). The unexpected change in the ex-dividend stock return can be decomposed into an expected return news component and an accruals news component. Proposition 2 in the Appendix of Callen and Segal (2004) demonstrates this decomposition:

$$r_t - E_{t-1}(r_t) = \Delta E_t \sum_{j=0}^{\infty} (acc_{t+j} - f_{t+j}) - \Delta E_t \sum_{j=1}^{\infty} r_{t+j}. \tag{24}$$

Where, $r_t = log(1 + R_t + F_t) - f_t$ is the ex-dividend log stock return at time t, R_t is the simple excess stock return at time t, and acc_t is the log accrual growth at time t. Unexpected return news can be mathematically expressed as the expected return news, which is dentoed by (N_r), and accrual news, which is denoted by (N_{acc}). Hence, Equation (24) can be expressed as:

$$r_t - E_{t-1}(r_t) = N_{acc,t} - N_{r,t}. \tag{25}$$

Where,

$$N_{r,t} = \Delta E_t \sum_{j=1}^{\infty} r_{t+j}, \tag{26}$$

and

[10] Following Callen and Segal (2004), net financial assets equal financial assets minus financial liabilities, net operating assets equal operating assets minus operating liabilities. Net interest received equals interest revenue minus interest expenses. Net dividends equal cash dividends paid out minus equity capital issued.

$$N_{acc,t} = \Delta E_t \sum_{j=0}^{\infty} (acc_{t+j} - f_{t+j}). \tag{27}$$

The Callen and Segal (2004) model in Equation (25) provides a mathematical formulation of the unexpected change in contemporaneous stock returns: it shows an increase in accruals causes unexpected contemporaneous stock returns to increase, while an increase in expected return news causes a decrease in unexpected contemporaneous stock returns. A positive shock to expected return news implies higher discounting, which implies negative stock returns (e.g. an increase in risk aversion). On the other hand, a positive shock to the accrual news component implies higher future cash-flows and hence should be accompanied by positive stock returns. As shown in Callen and Segal (2004) on page 535, a variance decomposition of unexpected return news can be derived using Equation (25):

$$var(r_t - E_t - 1(r_t)) = var(N_{r,t}) + var(N_{acc,t}) - 2cov(N_{r,t}, N_{acc,t}). \tag{28}$$

Equation (28) is used to analyse the relationship between expected return news, accrual news and equity returns; specifically, a proxy for earnings persistence is derived (see Appendix) and it is analysed how earnings persistence relates to the value premium. It can be analytically shown that accrual news variance is positively related to earnings persistence. That is, the more persistent accruals are, the higher is the accrual news variance; intuitively, a positive shock to accruals for a firm with high earnings persistence will revert less quickly to the mean and therefore result in a relatively high accrual news variance.[11]

1.3 State Variable Choice in VAR models

Standard issues in the context of VAR modelling are the choice of state variables and the number of lags to be included. In the same way as in a univariate autoregressive model, the Akaike Information Criterion or the Bayesian Information Criterion can be used to choose the number of lags in the VAR. In both cases, the model that minimises the criterion given a number of lags is optimal. Another standard test applied to determine the optimal number of lags is the likelihood ratio test. These tests are standard in

[11] As Callen and Segal (2004) discuss on page 535, the Feltham and Ohlson clean surplus equality that their model is based on has a distinct advantage over the Campbell (1991), Campbell and Ammer (1993), and Vuolteenaho (2002) model set ups. The main advantage is that the Callen and Segal (2004) does not depend on a Taylor series approximation for its validity and the model holds even if the firm does not pay dividends.

the econometric literature. This dissertation closely followed the suggestions given by Vuolteenaho (2002) and Callen and Segal (2004). This procedure was followed in order to ensure that the results obtained in this dissertation are comparable to the existing results in the literature. Hence, the number of lags was determined to be one for all state variables in both VAR models and the same state variables as in Vuolteenaho (2002) and Callen and Segal (2004) were used.

It may be of interest to investigate how an exogenous shock to one variable affets one (or all) other variable(s). Most importantly, we would like to measure the effect of the exogenous shock to the system assuming that the errors are uncorrelated. If the errors are not uncorrelated, it is impossbile to determine cause and effect between variables and exogenous shocks. Using the Choleski decomposition, orthogonalised impulse response functions can be produced (the ordering of the state variables is of importance). However, since VARs are usually specified in the most parsimonious way, assuming that the effects of other variables are captured by the innovations, omitted (important) variables may lead to major distortions in the impulse responses.

Callen and Segal (2004) test their results for robustness with respect to the VAR specification in the following way. They limit the parsimonious short-VAR specification to one lag for each state variable. In a long-VAR specification they use a richer lag structure and further control variables (leverage and firm size). Then long-VAR uses four lags for r(t), one lag of oa(t), two lags for acc(t), two lags for leverage and one lag for size. Leverage is defined as book value as a fraction of the sum of book value and financial liabilities. Size is the market-adjusted market capitalisation scaled by the standard deviation of market capitalisation. In the short-VAR accruals is significant and explains 60% of the total variance of the unexpected changes in returns. Variance of expected return news is able to explain 10% of the total variance of unexpected changes in returns and is insignificant. These results are more pronounced for the long-VAR, where accrual news explains more than 100% of the total variance of changes in returns. Callen and Segal (2004) use further decomposition of accruals to test their results for robustness.

On page 255 Vuolteenaho (2002) examines the approximation errors of the VAR with an additional VAR specification. He adds the market-adjusted clean surplus ROE as a fourth state variable, which enables him to calculate the cumulative approximation error. He then compares the covariance matrix of expected return news to cashflow news using the indirect and direct method and to the approximation error. The results show that the approximation error is negatively correlated with cashflow news (for both, the direct and indirect method) and positively correlated with expected return news. He concludes that the direct method produces a higher cashflow news variance than the indirect method and that therefore the indirect method is the more conservative approach given that cashflow news dominates. Lastly, he concludes that the choice of method (direct or indirect) is inconsequential since the approximation error is very small. Further robustness can be tested by considering the magnitude of rho (discount coefficient) and the return data frequency. Most studies find that changing rho does not change results (Vuolteenaho 2002, Callen and Segal (2004) and Chen and Zhao (2009)).

Chen and Zhao (2009) use annual and quarterly data and find that conclusions do not depend on the data frequency. Chen and Zhao (2009) further argue that backing out the cashflow news as the residuals of the directly modelled discount rate news has important implications for validity and robustness. If the "true model" for discount rate news is known, the approach works very well. However, empirical results show that discount rate news has small predictive power and cannot be estimated accurately – as result, cashflow news, as the residual, captures the large misspecification error of the discount rate news. An omitted state variable in the forecasting equation for the discount rate news will be incorporated in the cashflow news and is likely to change the relative importance of both news components. In return decompositions inference is made based on the comparison between specific factors and residuals – hence, an omitted factor could be of great importance. Chen and Zhao (2009) show that changes in state variables can meaningfully change the impact of cashflow news and discount rate news on time-series and cross-sectional return variation. They propose to model discount rate news and cash flow news directly. Further, they argue that a Bayesian model averaging approach and a principal component analysis can offer possible solutions.

1.4 Estimation of Earnings Persistence using the Vuolteenaho (2000, 2002) and the Callen and Segal (2004) Model

Note that in Part II of this thesis earnings persistence is estimated using an AR(1) process on ROE for the entire sample. That is, for each firm in the sample earnings persistence is estimated separately using the described AR(1).

Throughout Part III of this thesis earnings persistence for the VAR models is estimated in two steps: first firms are sorted into twenty portfolios according to the AR(1) earnings persistence estimates of ROE for the Vuolteenaho (2000, 2002) model. For the Callen and Segal (2004) model firms are sorted into twenty portfolios according to the absolute value of the accrual component of earnings. After firms have been sorted into these twenty portfolios, earnings persistence for each of the twenty portfolios is estimated using the unbalanced panel VAR models of Vuolteenaho (2000, 2002) and Callen and Segal (2004). The twenty portfolios are then sorted into deciles according to the earnings persistence estimates from the VAR models (VAR deciles). The earnings persistence estimate from the VAR is the ratio of cash-flow news variance to total return news variance for the Vuolteenaho (2000, 2002) model (and the ratio of the accrual news variance to total return news variance for the Callen and Segal (2004) model). This procedure is followed since the number of independent variables in the VAR models together with the relatively small number of observations per firm would result in too few degrees of freedom and result in distorted coefficient estimates and t-statistics.

1.5 Risk-adjusted Returns

The monthly value premia of each VAR decile are regressed on a constant (α) and the three Fama-French risk factors (Fama and French (1993)). In this way, it is tested whether the value premium in portfolios with low earnings persistence yields positive risk-adjusted returns. The following equation expresses the Fama and French (1993) time-series regression:

$$R_{i,t} = \alpha_i + \beta_i MKT_t + h_i HML_t + s_i SMB_t + \varepsilon_{i,t}. \tag{29}$$

Where $R_{i,t}$ represents the value premium of VAR decile i at time t, MKT_t represents market excess return at time t, HML_t represents the high minus low BM portfolio return at time t, and SMB_t represents the small minus big portfolio return at time t. β_i, h_i and s_i are the respective regression coefficients of VAR decile i and α_i is the constant of VAR decile i.

1.6 Equally-weighted and Value-weighted Returns

Two-way sorts, three-way sorts and second stage regressions are performed for equally and value-weighted returns. This procedure is followed in order to test the results for robustness. In particular, value-weighted returns overweight firms with relatively large market capitalisation, while equally-weighted returns assign equal weights to all firms. When the relationship between earnings persistence and value-weighted returns is insignificant, but the relationship between earnings persistence and equally-weighted returns is significant one can conlcude that this finding is related to size; i.e. adding weight back to the small firms in the equally-weighted returns yields a statistically significant relationship, which implies that the relationship between earnings persistence and returns is particularly strong for small firms.

2 Data

The basic data and requirements are equal to those found in section 2.1 of part 2 of this dissertation. In accordance with Callen and Segal (2004), all firms are required to have non-missing observations from each of the data items used to compute the following variables. The same sample is used as described in section 2.3 of part 2 of this dissertation.

2.1 Variable Definitions

The basic variable definitions can be found in section 2.2 of part 2 of this dissertation. Additionally, the Compustat items used to construct the accounting variables in this section are taken from Callen and Segal (2004) on page 537: DATA1 for cash and cash equivalents, DATA4 for current assets, DATA5 for current liabilities, DATA9 for long-term debt, DATA14 for depreciation and amortisation, DATA15 for interest expense, DATA16 for income tax expense, DATA17 for special items, DATA19 for preferred dividends, DATA32 for investments and advancements, DATA34 for debt in current liabilities, DATA55 for equity earnings, DATA62 for interest income, DATA130 for preferred shares, DATA170 for pretax income, DATA193 for short-term investments, DATA181 for total liabilities, and DATA206 for notes payable. As in Callen and Segal (2004), this study follows Penman (2000) to compute financial assets, financial liabilities, operating assets, and operating liabilities. Further, net interest income and operating income are calculated following Begley and Feltham (2002).

Follwoing Callen and Segal (2004), the following variables are calculated: accural earnings equal DATA4 minus lagged DATA3 minus DATA1 plus lagged DATA1 minus DATA5 plus lagged DATA5 minus DATA34 plus lagged DATA34 minus DATA14. Cash earnings equal DATA18 minus accrual earnings. Net interest income equals (DATA62 minus DATA15) multiplied by (1 minus TAX) minus DATA19 plus DATA55. Net operating earnings equal (DATA18 minus DATA17) multiplied by (1 minus TAX) minus DATA19 minus net interest earned. Financial assets equal DATA32 plus DATA193 minus DATA1. Financial liabilities equal DATA9 plus DATA34 plus DATA130 plus DATA206. Opeating assets equal DATA6 minus financial assets. Operating liabilities are DATA181 plus DATA130 minus financial liabilities. Net operating assets equal financial assets minus financial liabilities. Book value equals net operating assets plus net financial assets. Free cash flow equals net operating earnings minus change in net operating assets. The effective tax rate equals DATA16 divided by DATA170. Return on equity equals (net operating earnings plus net interest earned) divided by lagged book value.

3 Main Results: The Vuolteenaho (2000, 2002) Model

3.1 Vector Autoregression and Firm-level Variance Decomposition

In part 2 of this dissertation, the residual income model is derived that decomposes returns into the proportion that is attributable to cash-flow news and the proportion that is attributable to discount rates. The implicit assumption of this model is that the cost of equity capital is constant; this implies that all of the return news variance is determined by cash-flow news variance. The unexpected return is the discounted sum of future changes in expected ROE (i.e. cash-flow news) and the simplest way to model this idea is an AR(1) process of ROE. However, in reality the cash-flow news variance only explains a proportion of the total variance of return news. In the methodology section a model is introduced that relaxes this fairly strong and unrealistic assumption. Another drawback of estimating earnings persistence with an AR(1) model of ROE is that one exclusively relies on information contained in past earnings to forecast earnings. The model used by Vuolteenaho (2000, 2002) is an extension of the Campbell and Shiller (1988), Campbell (1991) and the Campbell and Ammer (1993) model; Vuolteenaho's model allows the assumption of a constant discount rate to be relaxed and stock returns, ROE and BM to be used as predictive variables for the earnings persistence estimation procedure. Moreover, the model allows for more general dynamic feedback between the independent variables.

In the following the vector autoregressive estimation procedure is explained that allows the Vuolteenaho (2002) model to be implemented. This section follows closely the description of the implementation procedure as detailed on page 240 of Vuolteenaho (2002). Following Campbell (1991), Campbell and Ammer (1993), and Vuolteenaho (2002), the return variance decomposition is implemented using a log-linear vector autoregressive model. As in the aforementioned literature, $z_{i,t}$ is defined as a vector of firm-specific state variables describing a firm i at time t. The firm's state vector is assumed to follow the multivariate log-linear dynamic:

$$z_{i,t} = \Gamma z_{i,t-1} + \varepsilon_{i,t}. \tag{30}$$

As explained on page 239pp of Vuolteenaho (2002), the state variables included in vector $z_{i,t}$ are the market-adjusted log stock return, $\tilde{r}$ (the first element of the state vector z); the market-adjusted log BM ratio, $\tilde{\theta}$ (the second element) and the market-adjusted log return on equity, $\tilde{e}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average in each year. An individual firm's state vector is assumed to follow the linear law expressed in equation (30). The error terms $\varepsilon_{i,t}$ is assumed to have a variance-covariance matrix (Σ). Further, the errors terms are independent of information known at $t - 1$. Firms with the same values of the state variable are assumed to behave similarly. Nevertheless, because the error terms are not necessarily correlated across firms, firms that are similar today need not be similar tomorrow.

The VAR implies a return decomposition. Define $e1' \equiv (1\,0\ldots0)$ and

$$\lambda' \equiv e1'\rho\Gamma(I-\rho\Gamma)^{-1}. \tag{31}$$

The definition in Equation (31), introduced by Campbell (1991), simplifies the expressions considerably: Expected return news can then be conveniently expressed as $\lambda'\varepsilon_{i,t}$ and cash-flow news as $(e1'+\lambda')\varepsilon_{i,t}$. If returns are unpredictable (i.e., the first row of Γ is zeros) expected return news is identically zero and the entire return is due to cash-flow news.

For the variance decomposition of unexpected returns, the innovation covariance matrix Σ is required, in addition to the Γ matrix. Equation (32), Equation (33), and Equation (34) show the formulae for the elements of the news covariance matrix:

$$var(N_r) = \lambda'\Sigma\lambda, \tag{32}$$

$$var(N_{cf}) = (e1'+\lambda')\Sigma(e1+\lambda), \tag{33}$$

$$cov(N_r, N_{cf}) = \lambda'\Sigma(e1+\lambda). \tag{34}$$

The matrix Γ plays the role of the earnings persistence estimate (ε) in the AR(1) model introduced in part 2 of this dissertation. In fact, in the special case where Γ is diagonal, each component of the vector $z_{i,t}$ follows a process of the AR(1) model introduced in part 2 of this dissertation. As explained above, the cash-flow news variance to total return news variance ratio provides a proxy for earnings persistence in the Vuolteenaho (2000, 2002) model (see Appendix for the analytical proof).

The deciles formed on the earnings persistence estimates from the VAR approach are defined as VAR deciles. Table (11) shows descriptive statistics across these VAR deciles. The averages of size (in million $), BM, the average earnings persistence estimate (VAR estimate) from the VAR model, and the average earnings persistence estimate from the AR(1) model (AR(1) estimate) are shown.

Table 11: Descriptive Statistics - Vuolteenaho (2000, 2002) Model

The table shows descriptive statistics across the deciles formed on the VAR model's earnings persistence estimate, the variance of cash-flow news over the variance of total return news. The averages of size (in Million $), average BM, the average earnings persistence proxy (VAR estimate) from the VAR model, and the average earnings persistence estimate from the AR(1) model (AR(1) estimate) are shown. The CRSP-Compustat intersection from 1980 to 2004 is used as the sample, in total 35,516 firm years.

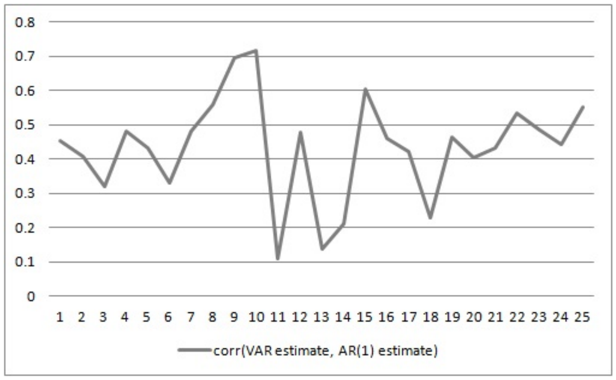
VAR Decile	VAR estimate	AR(1) estimate	Size	BM
1	0.59	-0.05	1282	0.96
2	0.69	0.23	1488	0.96
3	0.83	0.54	1699	0.94
4	1.01	0.64	2102	0.94
5	1.35	0.79	2548	0.85
6	1.87	0.86	2478	0.84
7	3.37	0.91	3098	0.81
8	5.94	0.97	4013	0.75
9	12.98	0.98	5309	0.68
10	398.60	1.02	6670	0.60

Table (11) shows that there is wide dispersion in the level of cash-flow news variance to total return news variance (VAR estimate) across the VAR deciles. Further, wide dispersion in the level of the earnings persistence estimate from the AR(1) model (AR(1) estimate) is observable. The portfolio with the highest earnings persistence (portfolio 10) has an average cash-flow news variance to total return news variance ratio of 398.60, while the decile with the lowest earnings persistence (portfolio 1) has an average cash-flow news variance to total return news variance ratio of 0.59 (similarly, variation is observable for the AR(1) earnings persistence estimate). The high value of the average VAR earnings persistence estimate in VAR decile 10 is caused by outliers. The sorting on the VAR earnings persistence estimate seems to pick up on small stocks as well as value stocks. It is possible that the relationship between earnings persistence and the value premium is driven by size and/or distress. Elaborate robustness tests are conducted to obtain a good understanding of the relationship between earnings persistence and the value premium when controlling for size or financial distress.

Firstly, to analyse whether the earnings persistence estimate from the AR(1) model and the earnings persistence estimate from the VAR model are measuring a similar economic phenomenon, the correlation between the two estimates is calculated. Figure (4) shows the correlation between the earnings persistence estimate from the VAR model (VAR estimate) and the earnings persistence estimate from the AR(1) model (AR(1) estimate) in each year from 1980 to 2004. The average correlation between the two estimates across all 25 years amounts to 43.4%. Further, regressions of AR(1) earnings persistence estimates on VAR earnings persistence estimates yield positive and statistically significant coefficients. This provides evidence that both estimates are measuring a similar economic phenomenon.

Figure 4: Correlation between Earnings Persistence Estimate from Vuolteenaho (2000, 2002) and AR(1) Model

The figure shows the annual correlation between the earnings persistence estimate from the VAR model (VAR estimate), which is defined as the ratio of cash-flow news variance to total return variance, and the earnings persistence estimate from the AR model (AR(1) estimate), which is defined as the persistence coefficient in an autoregressive process of order one of ROE. The horizontal axis depicts the years, where 1 is set to 1980 and 25 is set to 2004, 25 years. On the vertical axis the correlation value can be found. The CRSP-Compustat intersection from 1980 to 2004 is used as the sample, in total 35,516 firm years.



Panel A of Table (12) shows the average annual return, standard deviation and the minimum and the maximum value (in decimals) for each VAR decile from 1980 to 2004. Panel B of Table (12) shows the average annual return across top and bottom BM tertile (in decimals) across VAR deciles. As expected, the bottom BM tertile has on average lower annual returns than the top BM tertile. Further, the average annual return across all stocks in the different VAR deciles (Panel A) lies between the top and bottom BM tertile returns.

Table 12: Descriptive Statistics of Returns - Vuolteenaho (2000, 2002) Model

Panel A shows the annual return (1y ret), the standard deviation and the minimum and maximum value (in decimals) across all firms in each year for each VAR persistence decile. The VAR persistence deciles are formed on the earnings persistence estimate from the VAR model, which is defined as the ratio of cash-flow news variance to total return news variance. Panel B of the table shows the annual return for the top and bottom BM tertile across all firms in each year for each VAR persistence decile. The CRSP-Compustat intersection from 1980 to 2004 is used as the sample, in total 35,516 firm years.

Panel A				
VAR Decile	**1y ret**	**Std. Dev.**	**Min**	**Max**
1	0.1768	0.6683	-0.9255	8.7446
2	0.1674	0.7424	-0.9405	17.7433
3	0.1565	0.5743	-0.9589	7.7222
4	0.156	0.5353	-0.962	6.3513
5	0.1636	0.5256	-0.9327	10.925
6	0.1763	0.565	-0.9655	8.8695
7	0.165	0.5438	-0.9367	14.3542
8	0.1609	0.4417	-0.9027	10.0303
9	0.1423	0.3486	-0.8997	3.1265
10	0.1519	0.3642	-0.9304	3.9736
Panel B				
VAR Decile	**Bottom BM Tertile**	**Top BM Tertiel**		
1	0.1327	0.2051		
2	0.1082	0.2086		
3	0.1068	0.1831		
4	0.1214	0.1911		
5	0.1298	0.2227		
6	0.152	0.1931		
7	0.138	0.2054		
8	0.1401	0.1943		
9	0.1195	0.1595		
10	0.1354	0.1887		

3.2 Two-way Sorts and Second-stage Regressions: Earnings Persistence and the Value Premium

In the following analysis earnings persistence is estimated implementing the variance decomposition of returns as explained above. As opposed to the AR(1) earnings persistence procedure, the VARs use three state variables. Estimating earnings persistence on a firm-level using three state variables imposes further data restrictions. Further, the lack of complete time-series would not allow for robust estimation of the VAR models on a firm-level in some instances. Lastly, estimation on a firm-level is noisy due to idiosyncrasy. Hence, to circumvent these estimation issues, firms a first sorted into portfolios; in a second step the earnings persistence of each portfolio is estimated using the VARs. In particular, earnings persistence for each firm in each year is estimated using an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into twenty portfolios according to these earnings persistence estimates. Subsequently, the earnings persistence of each of these twenty portfolios is estimated with a vector autoregressive process and deciles according to these VAR estimates (VAR deciles) are built. Then, the value premium in each VAR decile is measured. That's is, for each VAR decile, the returns on a zero-investment strategy that goes long in the top tertile of BM stocks and short in the bottom tertile of BM stocks are calculated. Over the entire sample period, the average one-year-ahead, two-year-ahead and three-year-ahead value premia are reported on the vertical axis in Figure (5). Note that the choice of variable on which firms are sorted into portfolios is a matter of choice; however, sorting on earnings persistence in the first instance seems like a sensible choice.

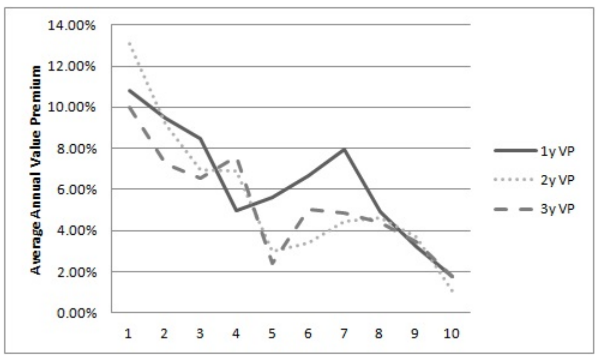
The choice of forming portfolio on firm characteristics prior to the earnings persistence estimation procedure is subject to the criticism that the patterns might be driven by those firm characteristics (Daniel and Titman (1997)). Further, patterns could also be driven by mechanical portfolio formation procedures (Lewellen et al. (2006)). However, these criticisms are independent of the choice of firm characteristic. The more standard approach of sorting on size and BM ratios suffers from the same disadvantages.

Figure 5: Average Value Premium across VAR Deciles - Vuolteenaho (2000, 2002) Model

The figure depicts the average one-year, two-year and three-year value premia across earnings persistence deciles built on the earnings persistence estimates from the Vuolteenaho (2000, 2002) model. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. Firstly, the earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into twenty percentiles according to these AR(1) earnings persistence estimates. Subsequently, the earnings persistence for each of these twenty portfolios is estimated using a vector autoregressive process. Then, ten deciles (VAR deciles) according to the earnings persistence estimate from the VAR model are built. For each VAR decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns from this trading strategy proxy for the value premia for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. The figure below then shows the average value premium across VAR decile in each year from 1980 to 2004. On the horizontal axis the VAR deciles are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. The model variables used in the VAR are stored in vector $z_{i,t}$. $z_{i,t}$ is defined as a vector of firm-specific variables describing a firm i at time t. The variables include the market-adjusted log stock return, $\tilde{r}$ (the first element of the state vector z); the market-adjusted log BM ratio, $\tilde{\theta}$ (the second element) and the market-adjusted log ROE, $\tilde{e}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average each year. The CRSP-Compustat intersection from 1971 to 2004 is used as the sample, in total 66,043 firm years. The following equation expresses the VAR model that is used to estimate earnings persistence:

$$z_{i,t} = \Gamma z_{i,t-1} + \varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

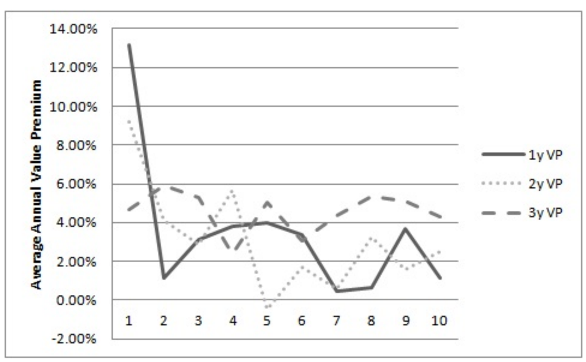


Figure (5) shows that, a negative relationship between the value premia and the earnings persistence estimates exists. For equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 9.04% (t-statistic: 2.59) for the one-year horizon, 12.04% (t-statistic: 2.39) for the two-year horizon and 8.25% (t-statistic: 2.91) for the three-year horizon. For value weighted-returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 12.01% (t-statistic: 3.11) on the one-year horizon, 6.69% (t-statistic: 2.34) on the two-year horizon and 0.4% (t-statistic: 0.19) on the three-year investment horizon (returns are annualised for all horizons).[12]

Figure (5) provides first evidence on the negative relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the average annual value premia of each persistence decile on the VAR decile values. Panel A in Table (13) provides the results for equally-weighted returns. Second-stage regressions of one-year, two-year and three-year value premia on VAR decile values are reported. Then the second-stage regressions are reversed to test for the measurement error in the independent variable. Similarly, in Panel B of Table (13) the results for value-weighted returns are provided. Second-stage regressions of one-year, two-year and three-year value premia on VAR decile values are reported. Then the second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (13) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. This procedure yields standard errors that are corrected for cross-sectional correlation.

[12] The difference between the annual returns across investment horizons in the same persistence decile are a result of differences in the amount of return data in each investment period. The one-year investment horizon includes one return data point more than the two-year investment horizon and two-year investment horizon includes on return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year horizon.

Table 13: Second-stage Regressions: Value Premium and Earnings Persistence - Vuolteenaho (2000, 2002) Model

The table reports the parameter estimates from regressions of alue premia on decile values built on VAR earnings persistence estimates. For this purpose, earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into twenty percentiles according to these AR(1) earnings persistence estimates. Subsequently, the earnings persistence for each AR(1) persistence percentile is estimated using the Vuolteenaho (2000, 2002) model. Ten deciles (VAR deciles) according to these earnings persistence estimates from the VAR model are formed. For each VAR persistence decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns of this trading strategy proxy for the value premium for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year *t* and matched with the return data in June of year *t+1* to avoid a look-ahead bias. Panel A presents the coefficients and t-statistics of regressions of the equally-weighted value premia on the VAR decile values for all three time horizons. The regressions are then reversed to test for measurement error in the independent variable. In Panel B the value-weighted returns are presented. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Second-stage Regressions:

$$(x - year\,value\,premium)_{i,t} \quad = \quad \alpha + \beta\,(VAR\,dec\,value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(VAR\,dec\,value)_{i,t} = \quad \alpha + \beta\,(x - year\,value\,premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-weighted Returns

Variables	1y	2y	3y
	Second-stage Regressions		
β	-0.010***	-0.007***	-0.007***
	(-2.66)	(-2.87)	(-2.76)
Intercept	0.010***	0.076***	0.075***
	(2.69)	(3.20)	(3.85)
	Error in Variable Regressions		
β	-6.325**	-8.270***	-12.251**
	(-2.22)	(-2.70)	(-4.00)
Intercept	6.129***	5.931***	6.264***
	(19.97)	(26.16)	(24.74)

Panel B. Value-weighted Returns

Variables	1y	2y	3y
	Second-stage Regressions		
β	-0.007***	-0.049**	0.000
	(-2.61)	(-2.41)	(-0.08)
Intercept	0.080***	0.008***	0.069***
	(3.18)	(3.57)	(5.01)
	Error in Variable Regressions		
β	-2.990**	-5.604**	4.391*
	(-1.98)	(-2.30)	(-1.81)
Intercept	5.34***	5.37***	5.83***
	(30.04)	(28.51)	(11.15)

For equally-weighted returns, the second-stage regression results in Panel A of Table (13) show that the relationship between earnings persistence (VAR deciles) and the returns from the value premia is statistically significant and negative on all investment horizons. On the one-year horizon a factor loading of -0.009 (t-statistic: -2.96) is obtained, on the two-year horizon a factor loading of -0.010 (t-statistic: -2.94) is obtained and on the three-year horizon a factor loading of -0.007 (t-statistic: -2.08) is obtained. All coefficients are robust to measurement error in the independent variable; the coefficients in the error in variable regressions are significant on all horizons.

For value-weighted returns, the second-stage regression results in Panel B of Table (13) show that the relationship between earnings persistence (VAR deciles) and the value premia is statistically significant and negative on the one-year and two-year investment horizon. On the one-year horizon a factor loading of -0.007 (t-statistic: -2.61) is obtained, on the two-year horizon a factor loading of -0.049 (t-statistic: -2.41) is obtained and on the three-year horizon a factor loading of -0.000 (t-statistic: -0.08) is obtained. All results are robust to measurement error in the independent variable.

In summary, the above results suggest that earnings persistence is negatively related to the value premium across all investment horizons for equally-weighted returns. These results are robust to measurement error in the independent variable for all investment horizons. For value-weighted returns the relationship between earnings persistence and the value premium is statistically significant. These results are robust to measurement error in the independent variable for the one and two-year investment horizon. Further, results of additional robustness tests are reported in the Appendix.

4 Main Results: The Callen and Segal (2004) Model

4.1 Vector Autoregression and Firm-level Variance Decomposition

The vector autoregressive estimation procedure for the Callen and Segal (2004) model is analogous to the estimation procedure of the Vuolteenaho (2000, 2002) model as explained in section 3.1 of part 3 of this dissertation. However, following Callen and Segal (2004) the state variables included in vector $z_{i,t}$ are the market-adjusted log stock return, $r_{i,t}$ (the first element of the state vector z); the market-adjusted log accrual measure, $acc_{i,t}$ (the second element) and the market-adjusted log operating assets, $oa_{i,t}$ (the third element). An individual firm's state vector is assumed to follow the linear law expressed in Equation (30).

In the Callen and Segal (2004) model the expected return news and the accrual news in matrix form can be expressed in the following equations.

$$N_{r,t} = \Delta E_t \sum_{j=0}^{\infty} (r_{t+j}) = \lambda_1' \varepsilon_{i,t} = e_i' \Gamma (I - \Gamma)^{-1} \varepsilon_{i,t}. \quad (35)$$

$$N_{acc,t} = \Delta E_t \sum_{j=0}^{\infty} (acc_{t+j} - f_{t+j}) = (e_1' + \lambda_1') \varepsilon_{i,t} = e_1' (I - \Gamma)^{-1} \varepsilon_{i,t}. \quad (36)$$

ΔE_t describes the change in expectations from $t - 1$ to t. The unexpected return news component as expressed in Equation (37), $r_t - E_{t-1}(r_t)$, is defined as accrual news ($N_{acc,t}$) less expected-return news ($N_{r,t}$).

$$r_t - E_{t-1}(r_t) \quad = \quad N_{acc,t} - N_{r,t}. \tag{37}$$

The variance decomposition of the Callen and Segal model is then expressed in matrix form analogously to Equation (32), Equation (33), and Equation (34). As explained above, the accrual news variance to total return news variance ratio provides a proxy for earnings persistence (see Appendix for the analytical proof).

Table (11) shows descriptive statistics across deciles formed on the VAR earnings persistence estimates (VAR deciles) implementing the Callen and Segal (2004) model. The averages of size (in million $), BM, the average earnings persistence proxy from the VAR model, and the average earnings persistence estimate from the VAR model (VAR Estimate) are shown.

Table 14: Descriptive Statistics - Callen and Segal (2004) Model

The table below shows descriptive statistics across deciles (VAR decile) formed on the (earnings persistence) estimate from the VAR model. The earnings persistence estimate from the VAR model is defined as the variance of accrual news over the variance of total return news. Across VAR deciles the mean values of size (in Million $), BM and the earnings persistence estimate are shown. The CRSP-Compustat intersection from 1980 to 2004 is used as the sample, in total 35,516 firm years.

VAR Decile	VAR Estimate	Size	BM
1	0.815	1447	0.78
2	0.933	1785	0.75
3	1.015	2077	0.76
4	1.113	1901	0.75
5	1.198	2056	0.75
6	1.270	2153	0.75
7	1.389	2138	0.75
8	1.551	2275	0.73
9	2.534	2104	0.74
10	53.198	1745	0.73

Table (14) shows that a wide dispersion in the level of the earnings persistence estimate from Callen and Segal (2004) model (VAR Estimate) is observable. The portfolio with the highest earnings persistence, portfolio 10, has an average accrual news variance to total return news variance ratio of 53.198, while the decile with the lowest earnings persistence, portfolio 1, has an average accrual news variance to total return news variance ratio of 0.815. The high VAR estimate value in decile 10 is caused by outliers. The sorting on the earnings persistence estimate seems to pick up on small cap stocks since portfolio 1 has a relatively low average size value.

Panel A of Table (15) shows the average annual return, standard deviation and the minimum and the maximum value (in decimals) for each VAR decile from 1980 to 2004. Panel B of Table (15) shows the average annual return across top and bottom BM tertile (in decimals) across VAR deciles. As expected, the bottom BM tertile has on average lower annual returns than the top BM tertile. Further, in each VAR decile, the average annual return across all stocks in the sample (Panel A) lies between the top and bottom BM tertile returns (Panel B).

Table 15: Descriptive Statistics of Returns - Callen and Segal (2004) Model

Panel A shows the annual return (1y ret), the standard deviation and the minimum and maximum value (in decimals) across all firms in each year for each VAR decile. The VAR deciles are formed on the earnings persistence estimate from the VAR model, which is defined as the ratio of accrual news variance to total return news variance. Panel B of the table shows the annual return for the top and bottom BM tertile across all firms in each year for each VAR decile. The CRSP-Compustat intersection from 1980 to 2004 is used as the sample, in total 35,516 firm years.

Panel A				
VAR Decile	1y ret	Std. Dev.	Min	Max
1	0.1325	0.6204	-0.9426	10.2964
2	0.1549	0.6762	-0.9817	14.0380
3	0.1310	0.4871	-0.9588	5.1279
4	0.1415	0.5458	-0.9394	7.3571
5	0.1471	0.6041	-0.9656	17.7434
6	0.1518	0.5529	-0.9328	7.9804
7	0.1557	0.5855	-0.9789	7.3407
8	0.1379	0.6165	-0.9986	14.3542
9	0.1363	0.6784	-0.9774	11.9730
10	0.1486	0.8340	-0.9792	16.4061

Panel B		
VAR Decile	Bottom BM Tertile	Top BM Tertile
1	0.0813	0.1516
2	0.0950	0.1946
3	0.0871	0.1613
4	0.1048	0.1645
5	0.0980	0.1557
6	0.1111	0.1738
7	0.0952	0.1836
8	0.0575	0.1886
9	0.0773	0.1876
10	0.0347	0.2133

4.2 Two-way Sorts and Second-stage Regressions: Earnings Persistence and the Value Premium

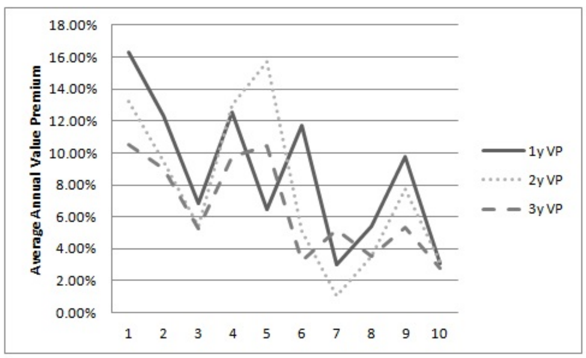
In the following analysis earnings persistence is estimated implementing the variance decomposition framework of Callen and Segal (2004). In order to obtain robust estimates from the VAR model the following procedure is implemented. In each year, firms are sorted into twenty portfolios according to the absolute value of the accrual component of earnings. Subsequently, the earnings persistence of each of these twenty portfolios is estimated with a vector autoregressive process and deciles according to these VAR estimates (VAR deciles) are built. Then, the value premium in each VAR decile is measured. That's is, for each VAR decile, the returns of a zero-investment strategy that goes long in the top tertile of BM stocks and short in the bottom tertile of BM stocks are calculated. Over the entire sample period, the average one-year-ahead, two-year-ahead and three-year-ahead value premia are reported on the vertical axis in Figure (6).

Figure 6: Average Value Premium across VAR Deciles - Callen and Segal (2004) Model

The figure depicts the average one-year, two-year and three-year value premia across earnings persistence deciles built on the earnings persistence estimates from the Callen and Segal (2004) model. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. In each year, firms are sorted into twenty percentiles according to the absolute value of the accrual component of earnings. The absolute accrual component of earnings is defined as the absolute value of $((\Delta CA-\Delta Cash)$-$(\Delta CL$-ΔSTD-$\Delta ITP)$-Depreciation$)$. Subsequently, the earnings persistence for each of these twenty portfolios is estimated using a vector autoregressive process. Then, ten deciles (VAR deciles) according to the earnings persistence estimates from the VAR model are built. For each VAR decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns from this trading strategy proxy for the value premia for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. The figure below then shows the average value premium across VAR deciles in each year from 1980 to 2004. On the horizontal axis the VAR deciles are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. The model variables used in the VAR are stored in vector $z_{i,t}$. $z_{i,t}$ is defined as a vector of firm-specific variables describing a firm i at time t. The variables include the market-adjusted log stock return, $r_{i,t}$ (the first element of the state vector z); the market-adjusted log accrual measure, $acc_{i,t}$ (the second element) and the market-adjusted log operating assets, $oa_{i,t}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average in each year. The CRSP-Compustat intersection from 1971 to 2004 is used as the sample, in total 66,043 firm years. The following equation expresses the VAR model that is used to estimate earnings persistence:

$$z_{i,t} \quad = \quad \Gamma z_{i,t-1}+\varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

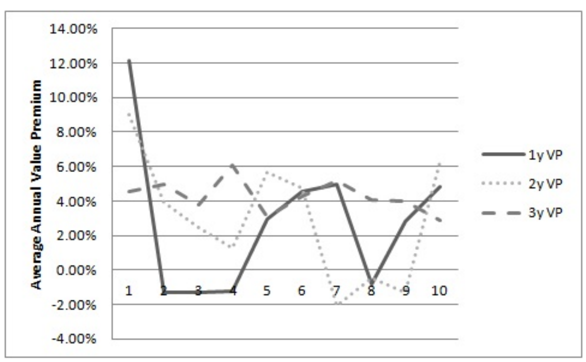


Figure (6) shows that a negative relationship between the value premia and the earnings persistence exists. For equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 8.47% (t-statistic: 2.63) for the one-year horizon, 9.75% (t-statistic: 3.16) for the two-year horizon, and 11.03% (t-statistic: 2.34) for the three-year horizon. For value weighted-returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 7.32% (t-statistic: 1.33) on the one-year horizon, 2.69% (t-statistic: 0.70) on the two-year horizon, and 1.65% (t-statistic: 1.18) on the three-year investment horizon. Returns are annualised for all horizons.[13]

Figure (6) provides first evidence on the negative relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the average annual value premia of each persistence decile on the VAR decile values. Panel A in Table (16) provides the results for equally-weighted returns. Second-stage regressions of one-year, two-year and three-year ahead value premia on VAR decile values are reported. Then the second-stage regressions are reversed to test for measurement error in the independent variable. Similarly, in Panel B of Table (16) the results for value-weighted returns are provided. Second-stage regressions of one-year, two-year and three-year ahead value premia on VAR decile values are reported. Then the second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (16) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. This procedure yields standard errors that are corrected for cross-sectional correlation.

[13] The difference between the annual value premia in the same decile is a result of differences in the amount of return data used in each investment period. The one-year value premium includes one return data point more than the two-year investment horizon and two-year investment horizon includes on return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year horizon.

Table 16: Second-stage Regressions: Value Premium and Earnings Persistence - Callen and Segal (2004) Model

The table reports the parameter estimates of a regression in which value premia are regressed on VAR earnings persistence decile values. The regression is then reversed to test for measurement error in the independent variable. In each year, firms are sorted into twenty percentiles according to the absolute value of the accrual component of earnings. The absolute accrual component of earnings is defined as the absolute value of (($\Delta CA-\Delta Cash$)-(ΔCL-ΔSTD-ΔITP)-Depreciation). Subsequently, the earnings persistence of these twenty portfolios is estimated using a vector autoregressive process following Callen and Segal (2004). Ten deciles (VAR deciles) according to these earnings persistence estimates from the VAR model are formed. For each decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns of this trading strategy proxy for the value premium for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Panel A reports the coefficients and t-statistics for equally-weighted returns. Panel B presents the value-weighted returns. Panel A presents the coefficients and t-statistics regressing value premia on the VAR earnings persistence decile values (VAR dec value) for all three time horizons from 1980 to 2004 (second-stage regressions). In Panel B the results from reversing the second-stage regressions are presented. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Second-stage Regressions:

$$(x - year\, value\, premium)_{i,t} \quad = \quad \alpha + \beta\, (VAR\, dec\, value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(VAR\, dec\, value)_{i,t} = \quad \alpha + \beta\, (x - year\, value\, premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-weighted Returns

Variables	1y	2y	3y
	Second-stage Regressions		
β	-0.010***	-0.010***	-0.008**
	(-2.68)	(-3.16)	(-2.51)
Intercept	0.143***	0.130***	0.107***
	(3.25)	(4.31)	(3.25)
	Error in Variable Regressions		
β	-3.171***	-4.796***	-6.189***
	(-2.69)	(-2.98)	(-3.84)
Intercept	5.940***	5.785***	6.188***
	(22.30)	(19.78)	(21.11)

Panel B. Value-weighted Returns

Variables	1y	2y	3y
	Second-stage Regressions		
β	-0.001	-0.005*	-0.001
	(-0.14)	(-1.71)	(-0.46)
Intercept	0.080	0.008**	0.069***
	(0.63)	(2.14)	(5.08)
	Error in Variable Regressions		
β	-2.425**	-2.104	-8.899***
	(-2.12)	(-1.29)	(-5.48)
Intercept	5.621***	5.799***	5.971***
	(64.71)	(43.00)	(17.15)

For equally-weighted returns, the second-stage regression results in Panel A of Table (16) show that the relationship between earnings persistence (VAR deciles) and the value premia is statistically significant and negative on all investment horizons. On the one-year horizon a factor loading of -0.010 (t-statistic: -2.68) is obtained, on the two-year horizon a factor loading of -0.010 (t-statistic: -3.16) is obtained, and on the three-year horizon a factor loading of -0.008 (t-statistic: -2.51) is obtained. All coefficients are robust to measurement error in the independent variable; the coefficients in the error in variable regressions are significant on all horizons.

For value-weighted returns, the second-stage regression results in Panel B of Table (16) show that the relationship between earnings persistence (VAR deciles) and the value premia is statistically significant on the two-year investment horizon. However, this statistical significance may suffer from a measurement error in the independent variable. One possible explanation for the insignificance on the one and three-year investment horizon results is the overweighting of large stocks for value-weighted returns. It could be the case that the relationship between earnings persistence and the value premium is particularly pronounced in small firms. This matter is subject to further investigation in the three-way sorts as shown in the appendix. It is found that the relationship between earnings persistence and the value premium is particularly pronounced for small stocks.

In summary, the above results suggest that earnings persistence is negatively related to the value premium across all investment horizons for equally-weighted returns. For value-weighted returns the relationship between earnings persistence and the value premium seems to disappear. However, robustness tests in the appendix show that the relationship prevails for small stocks.

5 Risk-adjusted Returns

To formally test whether the book-to-market based value strategy in low earnings persistence portfolios earns positive risk-adjusted returns time-series regressions of portfolio returns on the returns of different risk factors are performed. In particular, the three risk factors as proposed by Fama and French (1993) are used; the market excess return (MKT), the value-related risk factor (HML) and the size-related risk factor (SMB). MKT is the difference between the monthly returns on the market and the risk-free rate (one-month T-Bill rate), HML (high minus low) is difference in monthly return between a portfolio of high BM stocks and low BM stocks and SMB (small minus big) is the difference in monthly returns between a portfolio of small and big firms. A priori, a difference in returns among the portfolios could be explained by different factor loadings.

Table (18) and Table (17) report alphas, factor loadings, and R^2 of the time-series regressions as found in Equation (29) for the Callen and Segal (2004) and the Vuolteenaho (2000, 2002) approach, respectively.

Table 17: Fama and French (1993) Regressions - Vuolteenaho (2000, 2002) Model

The table depicts the coefficients and t-statistics obtained from regressions of monthly value premia on the three Fama and French (1993) risk factors (MKT, HML, SMB) and a constant (α) across earnings persistence deciles. Panel A presents the results for the equally-weighted returns and Panel B presents the results for the value-weighted returns. Firstly, earnings persistence for each firm in each year is estimated using an AR(1) model of ROE. Then, in each year, firms are sorted into twenty percentiles according to these AR(1) earnings persistence estimates. Subsequently, earnings persistence for each of these twenty portfolios is estimated using the Vuolteenaho (2000, 2002) model. Then deciles are formed according to the earnings persistence estimates from the VAR. For each decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The monthly returns of this trading strategy proxy for the value premia. Specifically, firms are allocated to BM tertiles in year t and matched with the monthly return data in June of year $t+1$ to avoid a look-ahead bias. The tables below then show the regression results of the monthly value premia on the three Fama and French (1993) risk factors, and a constant (α) across all deciles. The market excess return (MKT), the return on the HML portfolio and the return on the SMB portfolio are taken from Kenneth French. For each risk factor, the first row shows the coefficient estimates and the second row shows the t-statistics. In the last row the adjusted $R^2$is reported. The columns show the deciles, where column 1 (Low EP) is the decile with the lowest earnings persistence and column 10 (High EP) is the decile with the highest earnings persistence. Each decile has 300 monthly return observations, from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Panel A: Equally-weighted Returns:

Panel A	Low EP	2	3	4	5	6	7	8	9	High EP
MKT	-0.0455	-0.0156	-0.0406	-0.0422	-0.0634	-0.0271	-0.1146**	-0.1998***	-0.1920***	-0.1870***
t-stat	(-0.78)	(-0.28)	(-0.67)	(-0.68)	(-1.40)	(-0.49)	(-2.39)	(-4.34)	(-4.47)	(-4.48)
SMB	0.0840	0.0180	0.1566**	-0.0483	0.1909***	-0.0334	-0.1125*	0.0244	-0.1298**	-0.1268**
t-stat	(1.14)	(0.26)	(2.05)	(-0.62)	(3.36)	(-0.48)	(-1.87)	(0.42)	(-2.40)	(-2.41)
HML	0.7261***	0.6538***	0.7112***	0.7102***	0.5909***	0.7083***	0.4732***	0.5916***	0.5166***	0.6966***
t-stat	(8.25)	(7.84)	(7.78)	(7.62)	(8.68)	(8.45)	(6.56)	(8.52)	(7.99)	(11.07)
α	0.0042*	0.0056**	0.0044*	0.0003	0.0035	0.0001	0.0031	0.0011	0.0020	0.0029
t-stat	(1.82)	(2.54)	(1.85)	(0.15)	(1.34)	(0.44)	(1.62)	(0.60)	(1.16)	(1.44)
Adj R^2	0.26	0.24	0.23	0.26	0.28	0.29	0.28	0.39	0.42	0.53

Panel B: Value-weighted Returns:

Panel B	Low EP	2	3	4	5	6	7	8	9	High EP
MKT	0.0120	0.1305**	-0.0104	0.0324	0.0616	-0.0763	-0.2223***	-0.0118	-0.1530**	-0.0481
t-stat	(0.18)	(2.03)	(-0.17)	(0.56)	(0.92)	(-1.05)	(-3.12)	(-0.17)	(-2.25)	(-0.62)
SMB	-0.1581*	-0.1162	0.1378*	0.1925***	-0.1275	0.1469	0.3255***	0.2789***	0.0492	0.4521***
t-stat	(-1.92)	(-1.43)	(1.81)	(2.64)	(-1.51)	(1.61)	(3.63)	(3.19)	(0.57)	(4.61)
HML	0.7564***	0.7232***	0.9937***	0.7670***	0.8528***	0.6322***	0.8186***	0.47328***	0.4504***	0.4579***
t-stat	(7.68)	(7.46)	(10.87)	(8.80)	(8.45)	(5.78)	(7.63)	(4.52)	(4.39)	(3.90)
α	0.0041	-0.0006	-0.0019	0.0014	-0.0019	0.0003	0.0019	-0.0003	-0.0017	0.0011
t-stat	(1.57)	(-0.23)	(-0.81)	(0.61)	(-0.71)	(0.12)	(0.69)	(-0.11)	(-0.63)	(0.35)
Adj R^2	0.27	0.22	0.36	0.24	0.28	0.15	0.28	0.08	0.14	0.09

From Panel A of Table (17) it can be inferred that risk-adjusted returns (α) of portfolios with low earnings persistence (portfolio 1, portfolio 2, portfolio 3) are positive and statistically significant. Portfolio 1 has a positive and significant α of 0.42% monthly (i.e. 5.2% annualised), portfolio 2 has a positive and significant α of 0.56% monthly (i.e. 6.93% annualised) and portfolio 3 a positive and significant α of 0.44% monthly (i.e. 5.4% annualised). All other deciles report insignificant α and the αs are considerably smaller in magnitude than in deciles one, two and three. The significant positive risk-adjusted returns of deciles 1, 2, and 3 demonstrate that the variation in value premia across earnings persistence deciles cannot be entirely explained by the Fama and French (1993) risk factors.

From Panel B of Table (17) it can be inferred that risk-adjusted returns (α) across all earnings persistence deciles are not statistically significant. This result demonstrates that the variation in value premia can be explained by the Fama and French (1993) risk factors. However, the α in the lowest earnings persistence decile is the largest across all earnings persistence deciles.

Table 18: Fama and French (1993) Regressions - Callen and Segal (2004) Model

The table depicts the coefficients and t-statistics obtained from regressions of monthly value premia on the three Fama and French (1993) risk factors (MKT, HML, SMB) and a constant (α) across earnings persistence deciles. Panel A presents the results for the equally-weighted returns and Panel B presents the results for the value-weighted returns. Firstly, earnings persistence for each firm in each year is estimated using an AR(1) model of ROE. Then, in each year, firms are sorted into twenty percentiles according to these AR(1) earnings persistence estimates. Subsequently, earnings persistence for each of these twenty portfolios is estimated using the Callen and Segal (2004) model. Then deciles are formed according to the earnings persistence estimates from the VAR. For each decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The monthly returns of this trading strategy proxy for the value premia. Specifically, firms are allocated to BM tertiles in year t and matched with the monthly return data in June of year $t+1$ to avoid a look-ahead bias. The tables below then show the regression results of the monthly value premia on the three Fama and French (1993) risk factors, and a constant (α) across all deciles. The market excess return (MKT), the return on the HML portfolio and the return on the SMB portfolio are taken from Kenneth French. For each risk factor, the first row shows the coefficient estimates and the second row shows the t-statistics. In the last row the adjusted $R^2$is reported. The columns show the deciles, where column 1 (Low EP) is the decile with the lowest earnings persistence and column 10 (High EP) is the decile with the highest earnings persistence. Each decile has 300 monthly return observations, from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years. The following time-series regressions are used to estimate risk-adjusted returns:

$$R_{i,t} \quad = \quad \alpha_i + \beta_i MKT_t + h_i HML_t + s_i SMB_t + \varepsilon_{i,t}.$$

Panel A: Equally-weighted Returns

Panel A	Low EP	2	3	4	5	6	7	8	9	High EP
MKT	0.1203	-0.1480**	-0.1448*	-0.0231	-0.0589	-0.0504	-0.0492	-0.0520	-0.1034	-0.2094***
t-stat	(1.41)	(-1.99)	(-1.90)	(-0.29)	(-0.82)	(-0.61)	(-0.68)	(-0.68)	(-1.33)	(-3.05)
SMB	-0.1094	-0.1647*	-0.0171	-0.1966**	-0.0227	-0.2152**	-0.2106**	0.1418	-0.2738***	-0.1303
t-stat	(-1.02)	(-1.76)	(-0.18)	(-1.97)	(-0.25)	(-2.09)	(-2.30)	(1.46)	(-2.80)	(-1.51)
HML	0.5865***	1.0286***	0.6620***	0.6534***	0.6638***	0.6333***	0.7446***	0.8057***	0.8151***	0.4520***
t-stat	(4.55)	(9.18)	(5.78)	(5.48)	(6.11)	(5.13)	(6.56)	(6.94)	(6.95)	(4.38)
α	0.0091***	0.0028	0.0020	0.0056*	0.0007	0.0078	0.0046	-0.0004	0.0021	0.0010
t-stat	(2.68)	(0.95)	(0.67)	(1.78)	(0.25)	(1.41)	(1.62)	(-0.13)	(0.68)	(0.38)
Adj R^2	0.09	0.39	0.20	0.18	0.18	0.17	0.26	0.19	0.29	0.20

Panel B: Value-weighted Returns

Panel B	Low EP	2	3	4	5	6	7	8	9	High EP
MKT	-0.1231	0.1591	-0.3170**	0.0789	-0.0594	0.2483**	-0.1158	0.0573	-0.1954	0.0948
t-stat	(-0.94)	(1.31)	(-2.53)	(0.71)	(-0.64)	(2.33)	(-0.96)	(0.56)	(-1.55)	(1.07)
SMB	0.1297	-0.0171	0.3371**	-0.1510	0.2573**	0.0981	-0.0491	0.1294	0.4564***	-0.3118***
t-stat	(0.78)	(-0.11)	(2.13)	(-1.08)	(2.22)	(0.73)	(-0.32)	(1.01)	(2.88)	(-2.81)
HML	0.4023**	1.4002***	0.6067***	0.9155***	0.6485***	1.0090***	0.5909***	0.7416***	0.6463***	0.6316***
t-stat	(2.04)	(7.62)	(3.21)	(5.46)	(4.67)	(6.30)	(3.26)	(4.82)	(3.40)	(4.75)
α	0.0108**	-0.0062	-0.0017	-0.0022	-0.0012	-0.0007	0.0003	-0.0068	-0.0039	-0.0003
t-stat	(2.08)	(-1.29)	(-0.34)	(-0.51)	(-0.33)	(-0.17)	(0.06)	(-1.63)	(-0.79)	(-0.10)
Adj R^2	0.09	0.21	0.09	0.14	0.09	0.12	0.07	0.08	0.07	0.14

From Panel A of Table (18) it can be inferred that risk-adjusted returns (α) of portfolios with low earnings persistence are positive and statistically significant. Portfolio 1 has a positive and significant α of 0.91% monthly (i.e. 11.48% annualised). It is further observable that all other deciles report insignificant α and the αs are considerably smaller in magnitude than in decile one. Similarly, from Panel B of Table (18) it can be inferred that the risk-adjusted returns (α) in decile one are statistically significant. It is further observable that all other deciles report insignificant α and the αs are considerably smaller than in decile one. These result demonstrate that the variation in value premia cannot be explained by the Fama and French (1993) risk factors.

The above findings provide evidence that the earnings persistence characteristic is associated with the value premium after controlling for risk; i.e. after controlling for beta, earnings persistence drives the return from a book-to-market based value strategy beyond the return required by a rational investor. This finding is of particular interest as two different model specifcations are used to estimate earnings persistence - the identification of the realtionship between earnings persistence and the value premium after controlling for systematic risk is robust to model specification. This prompts one to ask the question of whether earnings persistence is a priced risk. In the next part of this dissertation this question will be answered.

Part IV

Is Earnings Persistence a Priced Risk Factor?

Previously, it was analysed and documented that the value premium is negatively related to earnings persistence. To obtain an answer for the question of whether the higher value premia in low earnings persistence portfolios are a result of bearing more fundamental risk or whether this observation is a result of investors' misjudgement, it needs to be tested whether earnings persistence is a priced risk. Ex-ante, if asset pricing test finds that earnings persistence is not a priced risk, then this provides evidence against a rational asset pricing argument. Hence, the superior returns of the book-to-market based value strategy in portfolios with low earnings persistence are unlikely to be a reward for bearing risk. A more likely explanation in this scenario would be that value stocks in low earnings persistence portfolios are underpriced relative to their risk-return characteristics as a result of investors' misjudgement, and investing in them yields abnormal returns.

Francis et al. (2004) investigate the association between attributes of accounting earnings and investors' resource allocation decisions, using the cost of equity capital as a summary indicator of those decisions. They use seven well-established earnings characteristics - accruals quality, persistence, predictability, smoothness, value relevance, timeliness, and conservatism - that are associated with benefits in the form of a lower cost of equity capital. In particular, Francis et al. (2004) find that accruals quality (hereafter, AQ), earnings persistence, and smoothness have strong effects on the cost of equity. Francis et al. (2005) investigate whether investors price accruals quality by running times-series regressions of contemporaneous stock returns on contemporaneous factor returns. Core et al. (2008) argue that the time-series regressions in Francis et al. (2005) do not test the hypothesis that AQ is a priced risk factor. Core et al. (2008) conduct appropriate tests for determining whether a risk factor is priced, and they find no evidence that AQ is a priced risk factor. However, accruals quality is only one proxy for information risk; Francis et al. (2008) point out that other proxies for information risk may well exhibit risk factor characteristics. In this part of this dissertation is investigated whether earnings persistence may be such a priced risk. Earnings persistence is estimated using an autoregressive model of order one, a standard approach in the accounting literature and the variance decomposition framework of Vuolteenaho (2000, 2002). To test if a candidate variable is a priced risk factor, two-stage cross-sectional regressions as proposed by Cochrane (2005) are run.

The question of whether information risk is diversifiable is an open one in the literature. Fama (1991) argues that information risk can be diversified away and thus returns should not be related to information risk. Easley and O'Hara (2004) argue that firms with less public information and more private information have higher information risk and higher expected returns. Their argumentation is based on the idea that informed investors are better able to adjust their portfolio weights than less informed investors. Hence, information risk cannot be diversified away. Lambert et al. (2007) find that information risk can be diversified away when the number of traders becomes large enough. Lambert et al. (2007) develop a model in which the accounting information filters into the investors' assessment of the covariance of firm cash-flows with those of the market; their model is consistent with the CAPM and therefore information risk should affect beta. However, if beta is measured with error, a proxy for information risk could appear to be priced if it proxies for measurement error in beta.

To test whether earnings persistence is a priced risk factor earnings persistence is estimated using an AR(1) model and the Vuolteenaho (2000, 2002) model; factor mimicking portfolios are built based on these estimates. Following Cochrane (2005) a two-stage cross-sectional regression technique is used to estimate factor betas in the first stage and the factor risk premia in the second stage. In this way the proposed hypothesis that a risk factor explains cross-sectional variation in expected returns is tested. Positive and significant factor risk premia are taken as evidence that a risk factor is priced. This method has been widely used in the literature. For example, the method is used to test the CAPM (Fama and MacBeth (1973)), the conditional CAPM (Jagannathan and Wang (1996)), the intertemporal CAPM (Brennan et al. (2004), Petkova (2006)), and the two-beta model (Campbell and Vuolteenaho (2004)).

The asset pricing tests in this dissertation are conducted on a firm level in order to maximise the statistical power of the test and to avoid rejecting a null hypothesis when it is true (Type I error). Moreover, examining firm level returns circumvents the issue of non-randomly choosing characteristics (i.e. size and bm) that could induce a data-snooping bias (Lo and MacKinlay (1990)). The results show that earnings persistence is not a priced risk. The second-stage regression coefficients (i.e. the risk premia) are positive but statistically insignificant.

The remainder of part 4 of this dissertation is organized as follows. Section 1 describes the research methodology. Section 2 reports the sample. Section 3 discusses the main results.

1 Methodology

1.1 Building the Earnings Persistence Factor Mimicking Portfolios

Factor mimicking portfolios are built using a) the AR(1) earnings persistence estimates and b) the Vuolteenaho (2000, 2002) VAR earnings persistence estimates. For the factor mimicking portfolios built on the AR(1) earnings persistence estimate the estimation procedure in Part II of this thesis is used: earnings persistence is estimated using an

AR(1) on ROE for the entire sample. That is, for each firm in the sample earnings persistence is estimated separately using the described AR(1) process (see details in Part II of this thesis). To construct the factor mimicking portfolio returns for the earnings persistence risk factor firms are sorted by their AR(1) earnings persistence estimate and the average monthly equally-weighted returns in each decile are calculated. Subsequently, the top three deciles are bought and bottom three deciles are shorted. In this way monthly mimicking portfolio returns are created in the time period from 1980 to 2004. This new factor is named persistence factor (hereafter, PERS). For details regarding the estimation procedure see the methodology part 2 and part 3 of this dissertation.

For the factor mimicking portfolios built on the Vuolteenaho (2000, 2002) VAR model earnings persistence estimates the estimation procedure in Part III of this thesis is used: that is, earnings persistence for the Vuolteenaho (2000, 2002) VAR model is estimated in two steps: first firms are sorted into twenty portfolios according to the AR(1) earnings persistence estimates of ROE for the Vuolteenaho (2000, 2002) model. After firms have been sorted into these twenty portfolios, earnings persistence for each of the twenty portfolios is estimated using the unbalanced panel VAR model of Vuolteenaho (2000, 2002). The twenty portfolios are then sorted into deciles according to the earnings persistence estimates from the VAR model (see Part III for details of the estimation procedure). Analogously to above, the earnings persistence factor mimicking portfolio returns are constructed as follows: the average monthly equally-weighted returns in each earnings persistence decile are calculated, the top three deciles are bought and the bottom three deciles are shorted. In this way monthly mimicking portfolio returns are created in the time period from 1980 to 2004.

1.2 Two-stage Cross-Sectional Regressions

To test whether earnings persistence is a priced risk factor a two-stage cross-sectional regression approach is used. Betas are estimated by regressing stock excess returns on the three Fama and French (1993) risk factors, the momentum factor (Jegadeesh and Titman (1993)) and the earnings persistence factor in time-series regressions. Secondly, cross-sectional risk factor premia are estimated by performing Fama and MacBeth (1973) regressions of stock returns on the time-series betas from first-stage regressions. This approach is a well-established methodology in the literature to test whether a candidate variable is a priced risk factor (Cochrane (2005)).

2 Data

The basic data and requirements, the variable definition as well as the descriptive statistics are equal to those in part 2 of this dissertation. Additionally, the momentum factor returns (UMD) and the 25 size and book-to-market adjusted portfolio returns are provided by Kenneth French.[14]

3 Main Results

3.1 Time-series Regressions of Contemporaneous Excess Returns on Factor Returns

In the first stage, time-series regressions of stock returns on contemporaneous factor returns are performed. The 25 size and book-to-market portfolio returns are regressed on the specified risk factors and the average estimated coefficients of portfolio level regressions are reported in Table (19). The analysis examines the contemporaneous relationship between firm returns, the earnings persistence factor (PERS), the momentum factor (UMD), and the three Fama and French (1993) factors, market risk premium (MKT), size (SMB) and book-to-market (HML). For example, when the earnings persistence factor (PERS) and the momentum factor (UMD) are added to the Fama and French (1993) model, the multivariate betas are estimated using the following time-series regression:

$$R_{q,t} - R_{F,t} = b_0 + b_{q,MKT}MKT_t + b_{q,HML}HML_t + b_{q,SMB}SMB_t + b_{q,UMD}UMD_t + b_{q,PERS}PERS + \varepsilon_{q,t}. \quad (38)$$

Where $R_{q,t} - R_{F,t}$ represents the excess return of firm q at time t. The constant, the risk premia, and the factor loadings are represented on the right hand side of Equation (38). For example, the factor loading $b_{q,MKT}$ represents the factor loading on the market risk premium of asset q at time t and MKT_t is the return on the market risk premium at time t.

[14] (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/)

Table 19: Time-Series Regressions of Contemporaneous Excess Returns on Factor Returns

The table reports the average coefficient estimates and average adjusted R^2 of time-series regressions of monthly contemporaneous portfolio excess stock returns (stock returns minus the risk-free rate) on factor risk premia. The 25 size and book-to-market adjusted portfolio returns of Kenneth French are used as the dependent variable in Equation (38). In column (1) the standard Fama and French (1993) three factor model is estimated. In column (2) the momentum factor is added to the three factor model. In column (3) the momentum factor and the earnings persistence factor are added to the three factor model. MKT is the excess return on the market portfolio. SMB is the return on the size factor-mimicking portfolio. HML is the return on the book-to-market factor mimicking portfolio. PERS is the return on the earnings persistence factor-mimicking portfolio. The earnings persistence factor mimicking portfolio returns are calculated based on the AR(1) earnings persistence estimates. The t-statistics are computed based on the standard error of the portfolio-specific estimates (i.e. 25 coefficients on each variable for the 25 size and book-to-market portfolios). The CRSP-Compustat 1980 to 2004 intersection is used as the sample, in total 35,516 firm years.

	1	2	3
b_0	-0.000	0.000	-0.000
t-stat	(-0.191)	(0.103)	(-0.051)
$b_{q,MKT}$	1.040***	1.035***	1.047***
t-stat	(41.87)	(41.34)	(39.99)
$b_{q,SMB}$	0.487***	0.490***	0.526***
t-stat	(15.42)	(15.57)	(12.72)
$b_{q,HML}$	0.324***	0.317***	0.317***
t-stat	(8.44)	(8.26)	(8.56)
$b_{q,UMD}$		-0.034	-0.419*
t-stat		(-1.37)	(-1.74)
$b_{q,PERS}$			0.069
t-stat			(1.39)
Adj. R^2	0.89	0.89	0.90
N	25	25	25

Table (19) reports summary results of the first-stage time-series regressions of Equation (38) at the portfolio level. The first column shows that, similar to Core et al. (2008) and Fama and French (1993), all three Fama and French (1993) risk factors obtain positive average factor loadings; the model is able to explain 89% of the variation in portfolio returns for the average of the 25 size and book-to-market portfolios. The average coefficients for the Fama and French (1993) model ($b_{q,MKT} = 1.040$, $b_{q,SMB} = 0.487$, $b_{q,HML} = 0.324$) are almost identical to those reported by Core et al. (2008), all statistically significant. These time-series regressions where conducted on a portfolio level in order to test whether similar results to Core et al. (2008) can be obtained. In the second-stage regressions below the firm level time-series betas are used. In the second column the momentum factor (UMD) is added to the three factor Fama and French (1993) model. The inclusion of the momentum factor does not result in a considerable increase in the explanatory power of the model. The estimated average coefficient on the momentum factor is -0.034 and statistically insignificant. In the third column the momentum factor (UMD) and the earnings persistence factor (PERS) are added to the Fama and French (1993) model. The average adjusted R^2 slightly increases to 90%. The estimated average coefficient on the persistence factor is 0.069 and statistically insignificant.

At this point it is important to note that the average positive coefficient on the persistence factor in the time-series regressions does not provide an answer of whether earnings persistence is a priced risk factor or not. It merely means that, on average, firms have a positive exposure to the earnings persistence factor returns. To explain in further detail, a significant coefficient on a potential risk factor in the model does not suggest that this risk factor is priced, but rather confirms that the average coefficient in the sample of firms is positive and that a mechanical relationship between stock returns and the factor mimicking portfolio returns exists. The time-series regressions may seem no different from the Fama and French (1993) time-series regressions, which show that book-to-market and size are priced risk factors. However, the Fama and French (1993) results are based on cross-sectional tests of Fama and French (1992) and thus show that size and book-to-market are capable of explaining the cross-sectional variation in expected returns.

3.2 Cross-sectional Regressions of Mean Excess Returns on Factor Betas

In the second stage, cross-sectional Fama and MacBeth (1973) regressions of mean excess returns on the factor betas are performed on a firm level. To test whether the earnings persistence factor is a priced risk, the following model is estimated:

$$\overline{R}_{q,t} - \overline{R}_{F,t} = \lambda_1 + \lambda_2 b_{q,MKT} + \lambda_3 b_{q,HML} + \lambda_4 b_{q,SMB} + \lambda_5 UMD_{q,UMD} + \lambda_6 PERS_{q,PERS} + \varepsilon_q. \quad (39)$$

Where $\overline{R}_{q,t} - \overline{R}_{F,t}$ is the mean excess return of asset q and $\lambda_2$through λ_6 represent the risk premia that are estimated for each risk factor.

Ex-ante, if the estimated factor loading (λ_6) on the earnings persistence factor (PERS) is positive and statistically significant then earnings persistence is a priced risk. To mitigate concerns about cross-sectional dependence in the data, standard errors from monthly cross-sectional regressions using the Fama and MacBeth (1973) approach are computed. Moreover, the firm level regressions have higher statistical power and avoid the potential concern of non-randomly selecting characteristics (i.e. size and bm) that could induce a data-snooping bias (Lo and MacKinlay (1990)).

Table 20: Cross-sectional Regressions of Contemporaneous Excess Returns on Factor Returns

The table reports the average coefficient estimates and average adjusted R^2 of cross-sectional regressions of monthly excess returns (stock returns minus the risk-free rate) on full-period factor betas on a firm level. Full-period betas are estimated in a multivariate time-series regression of stock returns on the respective factor during the period from 1980 to 2004. $b_{q,MKT}$ is the portfolio beta related to the MKT factor, $b_{q,HML}$is the portfolio beta related to the HML factor, $b_{q,SMB}$ is the portfolio beta related to the SMB factor, $b_{q,UMD}$ is the portfolio beta related to the UMD factor and $b_{q,PERS}$ is the portfolio beta related to the PERS factor. λ_2 through λ_6 are second-stage regression coefficients that represent the risk premia. The standard errors of these coefficients are calculated using the Fama and MacBeth (1973) procedure. Column 1 represents the results for the three factor Fama and French (1993) model. In column 2 the momentum factor is added to the three factor model. In column 3 the momentum and the persistence factor are added to the three factor model; in columns 1 through 3 earnings persistence is estimated using the Vuolteenaho (2000, 2002) model and earnings persistence factor mimicking returns are built from these estimates. In column 4 the results for the five risk factor model are shown when estimating earnings persistence using the AR(1) approach. The CRSP-Compustat 1980 to 2004 intersection is used as the sample, in total 35,516 firm years.

Panel B	1	2	3(VAR)	4(AR1)
CONST - λ_1	0.419**	0.412**	0.431***	0.425***
t-stat	(2.35)	(2.55)	(4.40)	(4.40)
MKT - λ_2	0.410*	0.484**	0.474*	0.492*
t-stat	(1.77)	(2.04)	(1.84)	(1.91)
HML - λ_3	0.059	0.132	(0.110)	0.083
t-stat	(0.45)	(0.86)	(0.55)	(0.75)
SMB - λ_4	-0.114	-0.179	-0.151	-0.138
t-stat	(-0.78)	(-1.09)	(-0.82)	(-0.41)
UMD - λ_5		0.591**	0.655**	0.646**
t-stat		(2.52)	(2.46)	(2.44)
PERS - λ_6			0.155	0.197
t-stat			(1.02)	(1.31)
Adj. R^2	0.07	0.09	0.13	0.14

In Table (20) the betas from first-stage firm level time-series regressions are used as independent variables in the second-stage regressions to test whether the earnings persistence factor (PERS) has a positive and significant risk premium.

In columns 1 through 3 earnings persistence is estimated using the Vuolteenaho (2000, 2002) model and earnings persistence factor mimicking portfolios are built based on these VAR estimates. In column 4 earnings persistence is estimated using the AR(1) approach and earnings persistence factor mimicking portfolios are built on these AR(1) estimates. In column 1 assets are priced using first-stage betas on the Fama and French (1993) risk factors and the results show that the coefficient estimates, the obtained t-statistics and the adjusted R^2 are similar in magnitude to those of prior research (Petkova (2006), Core et al. (2008)). The market risk premium ($\lambda_2 = 0.410$, $t-statistic = 1.77$) is positive and significant, the value risk premium ($\lambda_3 = 0.059$, $t-statistic = 0.45$) is positive and insignificant and the size risk premium ($\lambda_4 = -0.114$, $t-statistic = -0.78$) is negative and insignificant. In column 2 the momentum factor is added to the Fama and French (1993) model. For the second-stage regressions, the momentum risk premium ($\lambda_5 = 0.591$, $t-statistic = 2.52$) and the market risk premium ($\lambda_2 = 0.484$, $t-statistic = 2.04$) are positive and significant. The size and value risk premia are insignificant. In column 3 the second-stage regressions are shown when testing all five risk factors at the same time. The market risk premium ($\lambda_2 = 0.474$, $t-statistic = 1.84$) and the momentum risk premium ($\lambda_5 = 0.656$, $t-statistic = 2.46$) are positive and significant, while the value risk premium ($\lambda_3 = 0.110$, $t-statistic = 0.55$) and the earnings persistence risk premium

($\lambda_6 = 0.155$, $t - statistic = 1.02$) are positive and insignificant. The size risk premium ($\lambda_4 = -0.151$, $t - statistic = -0.82$) is negative and insignificant. In column 4 earnings persistence is estimated using the AR(1) approach. Then earnings persistence factor mimicking portfolios are built based on these AR(1) estimates, first-stage regressions are performed, and firm-level second-stage regression are performed as in column 3. The results show that the market risk premium ($\lambda_2 = 0.492$, $t - statistic = 1.91$) and the momentum risk premium ($\lambda_5 = 0.646$, $t - statistic = 2.44$) are significant and positive. The value risk premium ($\lambda_3 = 0.083$, $t - statistic = 0.75$) and the earnings persistence risk premium ($\lambda_6 = 0.197$, $t - statistic = 1.31$) are positive and insignificant.

To summarise, Table (20), shows positive but insignificant earnings persistence risk premia in columns 3 and 4. This provides evidence that earnings persistence is not a priced risk. If a candidate variable is a priced risk factor then there are two possible explanations why this candidate variable is able to explain cross-sectional variation in returns. It could either be because the candidate variable represents a rationally priced risk or because investors are incapable of rationally processing the information contained in the candidate variable leading to a mispricing of securities. However, if a candidate variable (i.e. earnings persistence in this case) is not priced risk factor, then this provides evidence against a rational pricing argument.

Part V

Conclusion

As argued by Lakonishok et al. (1994), a likely reason why value strategies work in general is the fact that the actual future growth rates of earnings of glamour stocks relative to value stocks turn out to be much lower than expected by investors. The results in this dissertation establish the following propositions: a value investment strategy that involves buying high book-to-market stocks (value stocks) and shorting low book-to-market stocks (glamour stocks) works particularly well in portfolios of low earnings persistence. The reason why a book-to-market based value strategy works particularly well in low earnings persistence portfolios is the fact that investors underestimate the mean reversion process of earnings of firms with low earnings persistence. Future earnings of value stocks revert upwards more strongly than expected by investors and future earnings of growth firms revert downwards more strongly than expected, if earnings persistence is low. This argument of mean-reversion in earnings is established by Sloan (1996). This book-to-market based value strategy does not appear to yield superior returns as a compensation for risk - the evidence in this dissertation rather supports the argument that this outperformance is attributable to investors' misjudgement of the mean-reversion properties of earnings.

As Lakonishok et al. (1994) point out, while one can never reject the "metaphysical" version of the risk story, in which firms that earn higher returns must by definition be fundamentally riskier, the evidence in this dissertation suggests a more straightforward model. This model argues that value stocks are underpriced relative to their risk return characteristics, and investing in them yields abnormal returns. In a well-established two-stage cross-sectional asset pricing test, earnings persistence is found not to be a priced risk (Cochrane (2005)). This result provides evidence against a rational pricing argument. Further, Fama and French (1993) regressions reveal that a book-to-market based value strategy in low earnings persistence portfolios yields annual risk-adjusted returns of 11.5% over the period from 1980 to 2004.

A possible explanation is that this dissertation documents more than just a cross-sectional pattern of returns. The evidence points to a systematic pattern of expectational errors on the part of investors that is capable of explaining the differential of stock returns across value and glamour stocks in low earnings persistence portfolios. Investors appear to excessively tie future expectations on past earnings growth despite the fact that future earnings growth is highly mean reverting. In particular, investors expect growth stocks to continue growing faster than value stocks, but they are systematically disappointed (Lakonishok et al. (1994)). Further, investors fail to distinguish fully between the mean reversion properties of the accrual and cash-flow component of earnings (Sloan (1996)). Investors' future earnings expectations of value/growth firms with low earnings persistence (high accruals) are systematically too low/high compared to value/growth stocks with higher earnings persistence (low accruals). This is one possible explanation why the return differential between high and low book-to-market firms is particularly high in low earnings persistence portfolios.

An interesting avenue for future research is the question of whether the higher returns of the book-to-market based value strategy in low earnings persistence portfolios is priced in the two-beta model that is based on an intertemporal asset pricing theory. Campbell and Vuolteenaho (2004) break the beta of the stock with the market portfolio into two components; one reflecting news about the market's future cash-flows and the other one reflecting news about the market's discount rate. Intertemporal asset pricing theory suggests that the cash-flow beta should have a higher price of risk and their empirical findings confirm this theory. Their model explains why firms with high cash-flow betas may reward investors with higher returns. Campbell and Vuolteenaho (2004) find that value stocks have higher cash-flow betas than growth stocks. If the returns of value stocks with low earnings persistence have a higher covariance with the bad news (cash-flow news) about the stock market than the returns of value stocks in high earnings persistence portfolios, then this may provide evidence in favour of a rational asset pricing argument; i.e. the higher returns of the value strategy in low earnings persistence portfolios may indeed be a compensation for taking on more fundamental risk.

Lastly, the results reported in this dissertation have policy and investment implications for asset managers. Large parts of the assets of global pension funds, sovereign wealth funds, insurance companies, family offices and other financial institutions are invested with traditional long-only public equity funds and alternative asset managers. Traditional asset managers provide exposure to certain investments styles (i.e. value, growth, large cap, small cap funds). Alternative asset managers often try to directly exploit the academic findings documented in the finance literature by building long-short portfolios; in this way exposure to risk factors is maximised (e.g. Applied Quantitative Research specialises in offering clients exposure to momentum, size, value, betting against beta, and carry trades). The findings in this dissertation may help asset managers to build a quantitative framework that examines the time-series properties of earnings. Such a framework may have relevance in particular for investment strategies that exploit the value premium. Further, if the extrapolation story of Lakonishok et al. (1994) applies, then managers may alter their investment behaviour in order to account for the psychology of human misjudgment.

Part VI

Appendix

1 Analytical Proof of the Relationship between Variance of Cash-Flow News and Earnings Persistence

In the following it is analytically proven that the variance of cash-flow news is positively related to earnings persistence. The variance of cash-flow news is defined as:

$$I = var_t \left[\Delta E_t \sum_{j=1}^{\infty} \rho^j e_{t+j} \right],$$

where,

$$\Delta E_t(\cdot) \quad = \quad E_t(\cdot) - E_{t-1}(\cdot).$$

$\rho$is the period time discount rate of preference and e_{t+j} is earnings, which are modelled as a persistent autoregressive process:

$$e_{t+j} \quad = \quad \xi e_{t+j-1} + \varepsilon_{t+j.}$$

Defining $d_t = \sum_{j=1}^{\infty} \rho^j e_{t+j}$, one can write:

$$I_t \quad = \quad var_t \left[\Delta E_t(d_t) \right].$$

An expression for expectation shocks is obtained as follows:

$$E_t(e_{t+j}) \quad = \quad \xi E_t(e_{t+j-1}) + E_t(\varepsilon_{t+j}),$$

$$E_t(e_{t+j}) \quad = \quad \xi E_t(\xi e_{t+j-2}) + E_t(\varepsilon_{t+j-1}),$$

$$E_t(e_{t+j}) \quad = \quad \xi^2 E_t(\xi e_{t+j-3}) + E_t(\varepsilon_{t+j-2}),$$

$$...$$

$$E_t(e_{t+j}) \quad = \quad \xi^j E_t(\xi e_{t+j-j}) = \xi^j e_t.$$

Using an expression for unexpected future earnings one can show that:

$$(E_t - E_{t-1})(e_{t+j}) \quad = \quad \xi^j e_t - \xi^j E_{t-1}(e_t) = \xi^j E_t(e_t) - \xi^j E_{t-1}(e_t),$$

$$(E_t - E_{t-1})(e_{t+j}) = \xi^j (E_t - E_{t-1})(e_t)$$

$$(E_t - E_{t-1})(e_{t+j}) = \xi^j \varepsilon_t.$$

Therefore,

$$\Delta E_t(d_t) = \sum_{j=1}^{\infty} \rho^j \xi^j e_t = \frac{1}{1-\rho\xi}\varepsilon_t,$$

$$var(\Delta E_t(d_t)) = (\frac{1}{1-\rho\xi})^2 \sigma^2.$$

This is the analogue of total return variance of an AR(1) process applied to the variance of expectation shocks (Dichev and Tang (2009)).

2 Robustness Tests for the Vuolteenaho (2000, 2002) Model Results

2.1 Two-way Sorts and Second-stage Regressions: Size, Earnings Persistence and the Value Premium

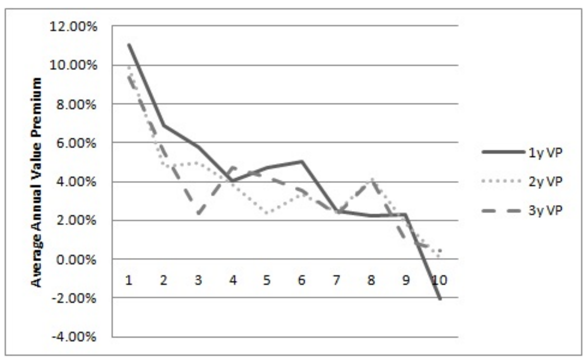
Firms in VAR deciles with low earnings persistence tend to have higher BM ratios and tend to be of smaller size. For this reason it is necessary to examine whether the negative relationship between earnings persistence and the value premium persists after controlling for size or financial distress. To control for financial distress firms with a Z-score below 1.81 are excluded from the sample. Similarly, firms are sorted into deciles according to their market value of equity and the firms in the two smallest deciles are excluded.

Figure 7: Average Value Premium across VAR Deciles Excluding Small Firms - Vuolteenaho (2000, 2002) Model

The figure depicts the average one-year, two-year and three-year value premia across earnings persistence deciles built on earnings persistence estimates from a VAR model when excluding small firms. Firstly, firms are sorted into deciles according to their market capitalisation and subsequently the firms in the two smallest deciles are removed from the sample. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. Earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into twenty portfolios according to their earnings persistence estimate. Subsequently, the earnings persistence for each of these twenty portfolios is estimated using the Vuolteenaho (2000, 2002) model. Then, ten deciles (VAR deciles) according to the earnings persistence estimate from the VAR model are built. For each VAR decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns from this trading strategy proxy for the value premia for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t{+}1$ to avoid a look-ahead bias. The figure below then shows the average value premium across VAR decile in each year from 1980 to 2004. On the horizontal axis the VAR deciles are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. The model variables used in the VAR are stored in vector $z_{i,t}$. $z_{i,t}$ is defined as a vector of firm-specific variables describing a firm i at time t. The variables include the market-adjusted log stock return, $\tilde{r}$ (the first element of the state vector z); the market-adjusted log BM ratio, $\tilde{\theta}$ (the second element) and the market-adjusted log ROE, $\tilde{e}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average each year. The CRSP-Compustat intersection from 1971 to 2004 is used as the sample, in total 66,043 firm years. The following equation expresses the VAR model that is used to estimate earnings persistence:

$$z_{i,t} = \Gamma z_{i,t-1} + \varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

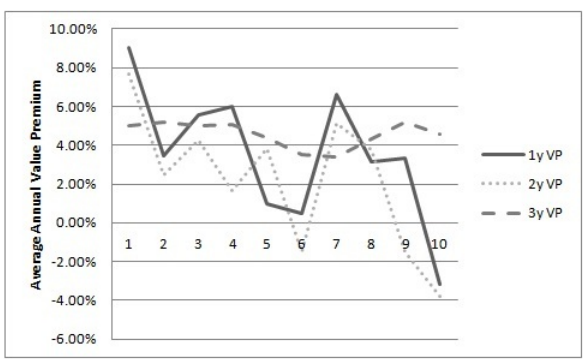


Figure (7) shows that a negative relationship between the average value premium and earnings persistence is observable. For equally-weighted returns, the difference in the average annual value premium between the VAR decile with the lowest earnings persistence (1) and the VAR decile with the highest earnings persistence (10) amounts to 13.06% (t-statistic: 3.08) on the one-year horizon, 9.76% (t-statistic: 3.67) on the two-year horizon and 8.96% (t-statistic: 4.15) on the three-year investment horizon.

For value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 13.06% (t-statistic: 2.21) on the one-year horizon, 9.76% (t-statistic: 2.83) on the two-year horizon and 8.96% (t-statistic: 2.39) on the three-year investment horizon (returns are annualised for all horizons).[15]

Figure (7) provides first evidence on the relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the yearly value premia of each VAR decile on the VAR decile values. Panel A in Table (21) provides the results of the second-stage regression of one-year value premia, two-year value premia and three-year value premia on VAR decile values. In Panel B of Table (21) these second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (21) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure.

[15] The difference between the annual returns across investment horizons in the same persistence decile are a result of differences in the amount of return data in each investment period. The one-year investment horizon includes one return data point more than the two-year investment horizon and two-year investment horizon includes on return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year horizon.

Table 21: Second-stage Regressions: Value Premium and Earnings Persistence Excluding Small Firms - Vuolteenaho (2000, 2002) Model

The table reports the parameter estimates from regression in which value premia are regressed on persistence decile values built on VAR earnings persistence estimates. Firstly, firms are sorted into deciles according to their market capitalisation and subsequently the firms in the two smallest deciles are removed from the sample. The earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into twenty percentiles according to these AR(1) earnings persistence estimates. Subsequently, the earnings persistence for each AR(1) persistence percentile is estimated using the Vuolteenaho (2000, 2002) model. Ten deciles (VAR deciles) according to these earnings persistence estimates from the VAR model are formed. For each VAR persistence decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns of this trading strategy proxy for the value premium for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Panel A presents the coefficients and t-statistics of regressions of the equally-weighted value premia on the VAR decile values (VAR dec value) for all three time horizons. The regressions are then reversed to test for measurement error in the independent variable. In Panel B the value-weighted returns are presented. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Second-stage Regressions:

$$(x - year\, value\, premium)_{i,t} = \alpha + \beta\,(VAR\, dec\, value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(VAR\, dec\, value)_{i,t} = \alpha + \beta\,(x - year\, value\, premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-weighted Returns

Variables	Second-stage Regressions 1y	2y	3y
β	-0.010***	-0.007***	-0.007***
	(-2.66)	(-2.87)	(-2.76)
Intercept	0.010***	0.076***	0.075***
	(2.69)	(3.20)	(3.85)
	Error in Variable Regressions		
β	-6.325**	-8.270***	-12.251***
	(-2.22)	(-2.70)	(-4.00)
Intercept	6.129***	-5.931***	6.264***
	(19.97)	(26.16)	(24.74)

Panel B. Value-weighted Returns

Variables	Second-stage Regressions 1y	2y	3y
β	-0.007*	-0.008**	-0.001
	(-1.67)	(-2.46)	(-0.23)
Intercept	0.076**	0.066***	0.050***
	(2.27)	(3.91)	(5.29)
	Error in Variable Regressions		
β	-2.950	-5.159**	5.305**
	(-1.62)	(-2.01)	(2.07)
Intercept	5.397***	5.141***	5.916***
	(26.10)	(30.93)	(10.33)

For equally-weighted returns, the second-stage regression results in Panel A of Table (21) show that the relationship between earnings persistence (VAR deciles) and the returns from the value premia is negative and statistically significant and on all investment horizons after excluding small firms. On the one-year horizon a factor loading of -0.010 (t-statistic: -2.66) is obtained, on the two-year horizon a factor loading of -0.007 (t-statistic: -2.87) is obtained and on the three-year horizon a factor loading of -0.007

(t-statistic: -2.76) is obtained. The results also show there is no measurement error in the independent variable; the coefficients in the error in variable regressions are significant on all horizons.

For value-weighted returns, the second-stage regression results in Panel B of Table (21) show that the relationship between earnings persistence (VAR deciles) and the value premia is statistically significant and negative on the one and two-year investment horizons after excluding small firms. On the one-year horizon a factor loading of -0.007 (t-statistic: -1.67) is obtained, on the two-year horizon a factor loading of -0.008 (t-statistic: -2.46) is obtained and on the three-year horizon a factor loading of -0.001 (t-statistic: -0.23) is obtained. The two-year horizon results are robust to measurement error in the independent variable; the slope coefficient in the error in variable regression is significant on the two-year investment horizon.

From the above results it can be concluded that after removing small firms from the sample the negative relationship between earnings persistence and the value premium persists on all investment horizons for equally-weighted returns, and on the two-year horizon for value-weighted returns.

2.2 Two-way Sorts and Second-stage Regressions: Financial Distress, Earnings Persistence and the Value Premium

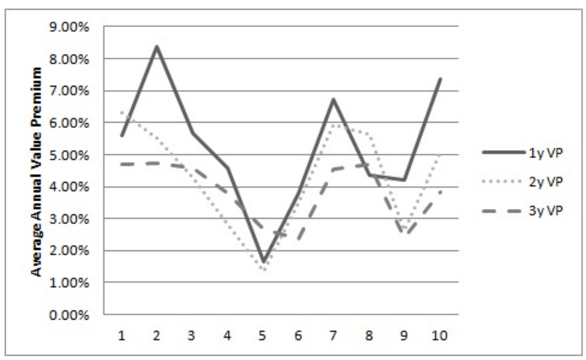
In part 2 of this dissertation it is shown that after the exclusion of financially distressed firms the relationship between earnings persistence and the value premium becomes statistically insignificant when estimating earnings persistence with an AR(1) model. In the following the relationship between earnings persistence and the value premium is examined when estimating earnings persistence with a vector autoregressive model. Distressed firms are excluded from the sample to control for financial distress.

Figure 8: Average Value Premium across VAR Deciles Excluding Distressed Firms - Vuolteenaho (2000, 2002) Model

The figure depicts the average one-year, two-year and three-year value premia across earnings persistence deciles built on earnings persistence estimates from a VAR model when excluding financially distressed firms. Therefore, firms with a Z-score of less than 1.81 are excluded from the sample. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. Earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into deciles according to their earnings persistence estimate. Subsequently, the earnings persistence for each of these twenty portfolios is estimated using the Vuolteenaho (2000, 2002) model. Then, ten deciles (VAR deciles) according to the earnings persistence estimate from the VAR model are built. For each VAR decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns from this trading strategy proxy for the value premia for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year *t+1* to avoid a look-ahead bias. The figure below then shows the average value premium across VAR decile in each year from 1980 to 2004. On the horizontal axis the VAR deciles are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. The model variables used in the VAR are stored in vector $z_{i,t}$. $z_{i,t}$ is defined as a vector of firm-specific variables describing a firm i at time t. The variables include the market-adjusted log stock return, $\tilde{r}$ (the first element of the state vector z); the market-adjusted log BM ratio, $\tilde{\theta}$ (the second element) and the market-adjusted log ROE, $\tilde{e}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average each year. The CRSP-Compustat intersection from 1971 to 2004 is used as the sample, in total 66,043 firm years. The following equation expresses the VAR model that is used to estimate earnings persistence:

$$z_{i,t} = \Gamma z_{i,t-1} + \varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

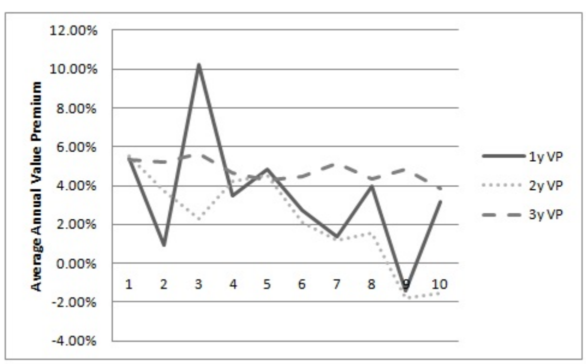


Figure (8) shows that a negative relationship between the average value premium and earnings persistence is observable. For equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to -1.74% (t-statistic: -0.42) on the one-year horizon, 1.23% (t-statistic: 0.52) on the two-year horizon and

0.87% (t-statistic: 0.38) on the three-year investment horizon.

For value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 2.25% (t-statistic: 0.45) on the one-year horizon, 7.10% (t-statistic: 2.97) on the two-year horizon and 1.52% (t-statistic: 2.89) on the three-year investment horizon (returns are annualised for all horizons). [16]

Figure (8) provides first evidence on the relationship between the value premium and earnings persistence. More formal evidence is provided by regressing the yearly value premia of each VAR persistence decile on the VAR persistence decile values. Panel A in Table (22) provides the results of the second-stage regression of one-year value premia, two-year value premia and three-year value premia on VAR persistence decile values. In Panel B of Table (22) these second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (22) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure.

[16] The difference between the annual returns across investment horizons in the same persistence decile are a result of differences in the amount of return data in each investment period. The one-year value premium includes one return data point more than the two-year investment horizon and two-year investment horizon includes on return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year horizon.

Table 22: Second-stage Regressions: Value Premium and Earnings Persistence Excluding Distressed Firms - Vuolteenaho (2000, 2002) Model

The table reports the parameter estimates of a panel VAR regression in which value premia are regressed on VAR earnings persistence decile values. First, firms with a Z-score of less than or equal to 1.81 are excluded from the sample. The earnings persistence for each firm in each year is estimated with an AR(1) model of return on equity (ROE). Then, in each year, firms are sorted into twenty percentiles according to these AR(1) earnings persistence estimates. Subsequently, the earnings persistence for each AR(1) persistence percentile is estimated using the Vuolteenaho (2000, 2002) model. Ten deciles (VAR deciles) according to these earnings persistence estimates from the VAR model are formed. For each VAR persistence decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns of this trading strategy proxy for the value premium for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Panel A presents the coefficients and t-statistics of regressions of the equally-weighted value premia on the VAR decile values (VAR dec value) for all three time horizons. The regressions are then reversed to test for measurement error in the independent variable. In Panel B the value-weighted returns are presented. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Second-stage Regressions:

$$(x - year\, value\, premium)_{i,t} = \alpha + \beta\,(VAR\, dec\, value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(VAR\, dec\, value)_{i,t} = \alpha + \beta\,(x - year\, value\, premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-weighted Returns

	Second-stage Regressions		
Variables	1y	2y	3y
β	-0.001	-0.001	-0.001
	(-0.26)	(-0.35)	(-0.58)
Intercept	0.060*	0.047*	0.045*
	(1.71)	(1.90)	(1.88)
	Error in Variable Regressions		
β	0.752	0.060	-1.345
	(0.28)	(0.17)	(-0.38)
Intercept	5.958***	5.944***	6.139***
	(19.82)	(20.70)	(18.26)

Panel B. Value-weighted Returns

	Second-stage Regressions		
Variables	1y	2y	3y
β	-0.005	-0.007**	-0.001
	(-1.13)	(-2.27)	(-0.43)
Intercept	0.060*	0.062***	0.055***
	(1.86)	(3.21)	(5.55)
	Error in Variable Regressions		
β	-2.41	-6.78***	-14.31***
	(-1.19)	(-2.67)	(-5.63)
Intercept	5.34***	5.19***	6.48***
	(21.64)	(23.88)	(14.67)

For equally-weighted returns, the second-stage regression results in Panel A of Table (22) show that the relationship between earnings persistence (VAR deciles) and the value premia is negative and statistically insignificant on all investment horizons. On the one-year horizon a factor loading of -0.001 (t-statistic: -0.26) is obtained, on the two-year horizon a factor loading of -0.001 (t-statistic: -0.35) is obtained and on the three-year horizon a factor loading of -0.001 (t-statistic: -0.58) is obtained.

For the value-weighted returns, the second-stage regression results in Panel B of Table

(22) show that the relationship between earnings persistence (VAR deciles) and the value premia is statistically significant and negative on the two-year investment horizon. On the one-year horizon a factor loading of -0.005 (t-statistic: -1.13) is obtained, on the two-year horizon a factor loading of -0.007 (t-statistic: -2.27) is obtained and on the three-year horizon a factor loading of -0.001 (t-statistic: -0.43) is obtained. The two-year investment horizon results are robust to measurement error in the independent variable; the slope coefficient in the error in variable regression is statistically significant.

In summary, these results show that the relationship between earnings persistence and the value premium disappears when financially distressed firms are excluded. For equally-weighted returns the earnings persistence effect on the value premium seems to disappear entirely after excluding financially distressed firms and for value-weighted returns only on the two-year investment a statistically significance relationship is observable.

2.3 Understanding the Two-way Sorts for the Vuolteenaho (2000, 2002) Model

Similar to the results in section 3.4 in the second part of this dissertation the disappearance of the statistical relationship between earnings persistence and the value premium is a result of the exclusion of financially distressed firms (see Table (22)). The relationship between financial distress and the value premium is statistically insignificant when analysing the entire sample. However, when examining portfolios of firms in financial distress (i.e. a Z-score < 1.81) it is observable that there is a negative and statistically significant relationship between earnings persistence and financial distress. Thus, excluding financially distressed firms from the sample renders the relationship between earnings persistence and the value premium statistically insignificant.

2.4 Three-way Sorts: Size, Financial Distress, Earnings Persistence and the Value Premium

In the following the extent to which the relationship between earnings persistence and the value premium persists after controlling for size or financial distress is researched more thoroughly. Firms are sorted into quintiles according to their earnings persistence. Subsequently, in each quintile firms are sorted into quintiles according to their size or financial distress (the first and second sort order is also reversed to control for size and financial distress; i.e. first sort on size or distress and second sort on earnings persistence). Thirdly, BM tertiles in each of these 25 portfolios are formed and the value premia are calculated. This allows the difference in the value premia between low earnings persistence and high earnings persistence portfolios to be statistically tested. Further, this gives insights into the interrelation between earnings persistence, default risk, size and the value premium.

2.4.1 The Size Effect

In the following the relationship between size and the value premium is examined within earnings persistence quintiles. As opposed to part 2 of this dissertation, the earnings persistence is estimated with the Vuolteenaho (2000, 2002) model. Table (23) presents results from three-way sorts on earnings persistence, size and BM. Stocks are firstly sorted into five quintiles based on their earnings persistence. Subsequently, the stocks within each earnings persistence quintile are sorted into five quintiles based on their size. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium.

Panel A of Table (23) shows that there is no statistically significant relationship between the value premium and size within any of the earnings persistence quintiles. Moreover, there is no statistically significant size effect in the whole sample.

Panel B reveals that there is little variation in earnings persistence with size within all earnings persistence quintiles and the whole sample, which indicates that size and earnings persistence may have little relation. As expected, Panel C reveals that there is variation in size across size quintiles when controlling for earnings persistence. The variation in size increases almost monotonically with the degree of earnings persistence. Panel D of Table (23) reports the average Z-score of the earnings persistence and size-sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk are interrelated. Panel D shows that default risk decreases monotonically with size within all earnings persistence quintiles. This is coherent with other empirical studies (e.g. Vassalou and Xing (2004)) and indicates that size and financial distress are closely related. Panel E shows that BM decreases with size within all earnings persistence quintiles and in the whole sample. The conclusion that emerges from Table (23) is that the relationship between size and the value premium is statistically insignificant. Size does not seem to drive the value premium.

Table 23: Three-way Sorts: Size Effect Controlled by Earnings Persistence - Vuolteenaho (2000, 2002) Model

The figure depicts how the value premium varies with size when controlling for earnings persistence. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to the earnings persistence estimates from the Vuolteenaho (2000, 2002) model. Subsequently, within each quintile firms are again sorted into size quintiles according to their market capitalisation. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invest long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Small-Big" is the return difference in the value premia between the smallest and biggest size portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors.

	Small				Big		
	1	2	3	4	5	Small-Big	*t-stat*
	Panel A: Average Annual Value Premium						
Low EP	0.16	0.05	0.07	0.04	0.05	0.12	1.4257
2	-0.05	0.10	0.10	0.09	0.04	-0.09	-0.9733
3	-0.08	0.02	0.14	0.05	0.05	-0.13	-1.3349
4	-0.02	0.01	-0.03	0.02	0.07	-0.09	-1.6446
High EP	-0.03	0.06	-0.01	0.01	0.07	-0.11	-0.6972
Whole sample	0.07	0.05	0.04	0.01	0.02	0.05	0.5556
	Panel B: Average Earnings Persistence						
Low EP	0.736	0.739	0.737	0.738	0.741		
2	0.831	0.829	0.833	0.831	0.832		
3	0.926	0.924	0.925	0.924	0.927		
4	1.060	1.058	1.064	1.072	1.069		
High EP	1.282	1.282	1.281	1.284	1.281		
Whole sample	0.967	0.966	0.968	0.970	0.970		
	Panel C: Average Size						
Low EP	30	83	189	543	6381		
2	30	88	225	711	7055		
3	32	92	240	743	6893		
4	33	97	248	776	7665		
High EP	38	126	326	1016	8794		
Whole sample	32	97	246	758	7358		
	Panel D: Average Z-score						
Low EP	-1.20	1.47	1.97	2.69	3.86		
2	-0.90	0.56	1.96	3.47	4.55		
3	-1.51	1.24	2.03	2.61	4.83		
4	0.45	1.56	2.91	4.05	5.27		
High EP	-0.18	2.25	4.91	5.54	7.31		
Whole sample	-0.67	1.41	2.76	3.67	5.17		

2.4.2 The Distress Effect

Table (24) presents results from portfolio sortings in the same spirit as those of Table (23). Stocks are first sorted into five earnings persistence quintiles, and then each of these five earnings persistence quintiles is sorted into five default risk quintiles. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following, it is examined how default risk affects the value premium within each earnings persistence quintile, as well as for the market as a whole.

Panel A of Table (24) shows that there is no statistically significant relationship between the value premium and financial distress in any of the earnings persistence quintiles. Moreover, there is no statistically significant financial distress effect in the whole sample. These results support the findings in part 2 of this dissertation; the relationship between the value premium and financial distress is statistically insignificant. Note that in the second part of this dissertation a statistically significant relationship between the value premium and financial distress is found in portfolios of distressed firms.

Panel B shows that earnings persistence varies only very little with distress risk. As expected, Panel D shows that financial distress decreases monotonically in all earnings persistence quintiles and the market as a whole. It can also be seen that the lowest Z-score quintiles tend to hold the smallest size firms; as found in previous research, small stocks seem to bear the highest default risk (Vassalou and Xing (2004)). The relevant conclusion from Table (24) is that default risk does not drive the value premium when controlling for earnings persistence. Moreover, default risk varies independently of earnings persistence.

Table 24: Three-way Sorts: Distress Effect Controlled by Earnings Persistence - Vuolteenaho (2000, 2002) Model

The figure depicts how the value premium varies with financial distress when controlling for earnings persistence. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to the earnings persistence estimates from the Vuolteenaho (2000, 2002) model. Subsequently, within each quintile firms are again sorted into distress quintiles according to their Z-score. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Low-High" is the return difference between the value premia of the low Z-score and the high Z-score portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors.

	Low Z-score			High Z-score			
	1	2	3	4	5	Low-High	*t-stat*
Panel A: Average Annual Value Premium							
Low EP	0.13	0.16	0.07	0.04	0.15	-0.02	-0.3146
2	0.22	0.01	0.07	0.10	0.07	0.15	1.7956
3	0.10	-0.03	0.17	0.04	-0.01	0.10	0.8632
4	0.07	0.03	-0.06	0.07	0.08	-0.01	-0.6644
High EP	0.08	0.05	0.09	0.05	0.06	0.02	0.1486
Whole sample	0.12	0.04	0.07	0.06	0.07	0.05	0.6946
Panel B: Average Earnings Persistence							
Low EP	0.737	0.736	0.739	0.742	0.738		
2	0.830	0.830	0.832	0.833	0.829		
3	0.925	0.924	0.925	0.925	0.927		
4	1.059	1.064	1.068	1.065	1.067		
High EP	1.284	1.272	1.278	1.284	1.294		
Whole sample	0.967	0.965	0.968	0.969	0.971		
Panel C: Average Size							
Low EP	478	1532	2240	1333	1558		
2	572	1569	1999	2303	1557		
3	731	1455	1788	2450	1450		
4	970	1941	2277	2166	1347		
High EP	982	2171	3040	3006	968		
Whole sample	747	1733	2269	2252	1376		
Panel D: Average Z-score							
Low EP	-9.94	0.41	2.85	5.32	10.39		
2	-11.08	0.92	3.51	5.91	10.63		
3	-12.57	0.86	3.62	6.18	11.41		
4	-11.07	1.86	4.48	7.03	12.22		
High EP	-11.36	2.74	5.51	8.12	15.14		
Whole sample	-11.21	1.36	3.99	6.51	11.96		

2.4.3 The Earnings Persistence Effect

Table (25) presents results from three-way sorts on size, earnings persistence and BM. Stocks are first sorted into five quintiles based on their size. Subsequently, the stocks within each size quintile are sorted into five quintiles based on their earnings persistence. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following it is examined whether the earnings persistence effect exists within size quintiles.

Panel A of Table (25) shows that there is no statistically significant relationship between the value premium and earnings persistence after controlling for size; neither within size quintiles nor in the market as a whole. Panel C reveals that size does not vary much with earnings persistence. Panel D of Table (25) reports the average Z-score of the size and earnings persistence sorted quintiles. Panel D shows that default risk increases monotonically with earnings persistence. The conclusion that emerges from Table (25) is that the relationship between earnings and the value premium is statistically insignificant after controlling for size; this is true for the entire sample as well as within all size quintiles.

Table 25: Three-way Sorts: Earnings Persistence Effect Controlled by Size - Vuolteenaho (2000, 2002) Model

The figure depicts how the value premium varies with earnings persistence when controlling for size. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their market capitalisation. Subsequently, within each quintile firms are again sorted into earnings persistence quintiles according to the earnings persistence estimates from the Vuolteenaho (2000, 2002) model. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Low-High" is the return difference in the value premia between the low earnings persistence and high earnings persistence portfolios within each size quintile. The rows labelled "Whole sample" report results using all stocks in our sample. T-values are calculated from Newey-West standard errors.

	Low EP 1	2	3	4	High EP 5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Small	0.09	-0.06	0.01	0.02	0.12	-0.02	-0.3546
2	0.05	0.06	0.06	-0.02	0.15	-0.11	-1.5713
3	0.08	0.05	0.02	-0.03	0.08	0.00	0.1456
4	0.06	0.04	0.04	0.03	-0.01	0.06	1.1444
Big	0.08	0.05	0.02	0.00	0.03	0.05	0.6997
Whole sample	0.07	0.03	0.03	0.00	0.08	0.00	0.2397
	Panel B: Average Earnings Persistence						
Small	0.77	0.89	1.07	1.48	21.18		
2	0.78	0.94	1.22	2.05	46.59		
3	0.81	1.08	1.62	3.97	64.94		
4	0.84	1.26	2.36	7.16	87.10		
Big	0.92	1.53	4.80	10.15	72.77		
Whole sample	0.82	1.15	2.25	4.97	58.09		
	Panel C: Average Size						
Small	37	38	37	38	41		
2	125	129	130	133	130		
3	373	369	379	382	396		
4	1189	1185	1167	1202	1264		
Big	9730	9950	11490	14019	17647		
Whole sample	2225	2387	2773	3064	3809		
	Panel D: Average Z-score						
Small	-0.55	-0.63	-1.54	-2.21	-2.69		
2	1.49	1.67	2.64	2.85	3.60		
3	2.61	3.34	5.89	6.60	6.78		
4	3.51	4.88	5.85	7.82	8.34		
Big	5.00	6.44	7.31	7.51	8.48		
Whole sample	2.35	3.21	4.08	4.56	4.83		

Table (26) presents results from three-way sorts on distress risk, earnings persistence and BM. Stocks are first sorted into five quintiles based on their Z-score. Subsequently, the stocks within each distress quintile are sorted into five quintiles based on their earnings persistence. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following it is examined whether the earnings persistence effect exists within distress quintiles.

Panel A of Table (26) shows that there is a statistically significant relationship between the value premium and earnings persistence in the sample as a whole. In distress quintile one a statistically significant relationship between earnings persistence and the value premium is found. In distress quintile one, the average annual difference in the value premium between the low and high earnings persistence quintile amounts to 1% (t-statistic: 2.01). Considering that only firms with a Z-score of less than 1.81 are classified as bankrupt firms, special attention needs to be paid to the first distress quintile. The first distress quintile is the only distress quintile with an average Z-score of less than 1.81. For this reason, to draw a conclusion of whether earnings persistence is related to the value premium after controlling for financial distress, the first distress quintile needs to be examined. The question of interest is whether earnings persistence varies within distress quintile one. If there is variation of earnings persistence within distress quintile one then this would provide further evidence for the significant relationship between earnings persistence and the value premium.

As expected, Panel B reveals that there is substantial variation in earnings persistence within all distress quintiles and the sample as a whole. Thus, the strong variation in earnings persistence should lead to a statistically significant return difference between low and high earnings persistence quintiles if there is a relationship between earnings persistence and the value premium after controlling for financial distress. Panel C reveals that size does not vary considerably with earnings persistence within all distress quintiles and the sample as a whole. Panel D of Table (26) reports the average Z-score of the distress and earnings persistence sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk are interrelated. Panel D shows that default risk is stable across earnings persistence quintiles. The conclusion that emerges from Table (26) is that the relationship between earnings and the value premium is statistically significant in portfolios of financially distressed firms and the sample as a whole. These results are consistent with the results in part 2 of this of this dissertation.

Table 26: Three-way Sorts: Earnings Persistence Effect Controlled by Distress - Vuolteenaho (2000, 2002) Model

The figure depicts how the value premium varies with earnings persistence when controlling for financial distress. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their Z-score. Subsequently, within each distress quintile firms are again sorted into earnings persistence quintiles according to the earnings persistence estimates from the Vuolteenaho (2000, 2002) model. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invest long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Low-High" is the return difference in the value premia between the low earnings persistence and high earnings persistence portfolios within each size quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors.

	Low EP 1	2	3	4	High EP 5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Low Z-score	0.07	0.20	0.04	0.11	0.06	0.01	2.0123
2	0.11	0.11	0.06	0.05	0.07	0.04	1.6311
3	0.05	0.09	0.06	0.02	0.08	-0.02	0.2456
4	0.07	0.09	0.13	0.05	0.04	0.03	1.5498
High Z-score	0.03	-0.02	0.06	0.03	0.00	0.03	0.9867
Whole sample	0.07	0.09	0.07	0.05	0.05	0.01	1.9620
	Panel B: Average Earnings Persistence						
Low Z-score	0.76	0.91	1.11	2.73	46.16		
2	0.78	1.03	2.00	5.71	55.54		
3	0.80	0.99	1.36	2.50	48.85		
4	0.84	1.17	1.65	4.06	60.04		
High Z-score	0.94	1.46	2.99	8.23	93.91		
Whole sample	0.82	1.11	1.86	4.58	60.52		
	Panel C: Average Size						
Low Z-score	908	782	846	834	1145		
2	1941	1901	2023	2810	3337		
3	1745	2287	2533	3589	3760		
4	1991	2398	3623	4987	5612		
High Z-score	1419	1829	3863	6550	10341		
Whole sample	1595	1842	2616	3738	4766		
	Panel D: Average Z-score						
Low Z-score	-6.95	-8.39	-12.23	-13.82	-16.69		
2	2.22	2.36	2.41	2.39	2.43		
3	5.17	5.11	5.22	5.14	5.11		
4	8.09	8.18	8.26	8.35	8.42		
High Z-score	13.84	14.86	13.87	14.29	14.26		
Whole sample	4.25	4.53	3.86	3.20	2.54		

3 Robustness Tests for the Callen and Segal (2004) Model Results

3.1 Two-way Sorts and Second-stage Regressions: Size, Earnings Persistence and the Value Premium

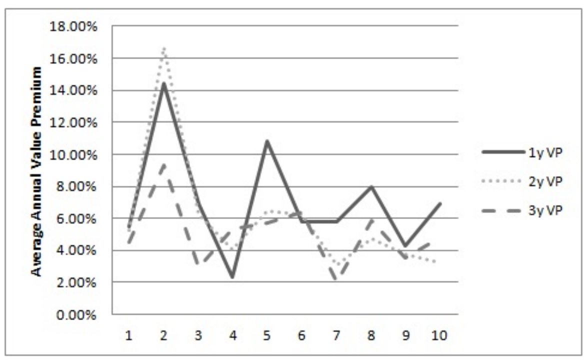
Firms in deciles of low earnings persistence tend to be of smaller size. For this reason it is necessary to examine whether the negative relationship between earnings persistence and the value premium persists after excluding small firms. Firms are sorted into deciles according to their market value of equity and the firms in the two smallest deciles are excluded.

Figure 9: Average Value Premium across VAR Deciles Excluding Small Firms - Callen and Segal (2004) Model

The figure depicts the average one-year, two-year and three-year value premia across earnings persistence deciles built on the earnings persistence estimates from the Callen and Segal (2004) model when excluding small firms. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. In each year, firms are sorted into twenty percentiles according to the absolute value of the accrual component of earnings. The absolute accrual component of earnings is defined as the absolute value of $((\Delta CA - \Delta Cash)$-$(\Delta CL$-$\Delta STD$-$\Delta ITP)$-Depreciation$)$. Subsequently, the earnings persistence for each of these twenty portfolios is estimated using a vector autoregressive process. Then, ten deciles (VAR deciles) according to the earnings persistence estimates from the VAR model are built. For each VAR decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns from this trading strategy proxy for the value premia for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. The figure below then shows the average value premium across VAR deciles in each year from 1980 to 2004. On the horizontal axis the VAR deciles are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. The model variables used in the VAR are stored in vector $z_{i,t}$. $z_{i,t}$ is defined as a vector of firm-specific variables describing a firm i at time t. The variables include the market-adjusted log stock return, $r_{i,t}$ (the first element of the state vector z); the market-adjusted log accrual measure, $acc_{i,t}$ (the second element) and the market-adjusted log operating assets, $oa_{i,t}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average in each year. The CRSP-Compustat intersection from 1971 to 2004 is used as the sample, in total 66,043 firm years. The following equation expresses the VAR model that is used to estimate earnings persistence:

$$z_{i,t} = \Gamma z_{i,t-1} + \varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

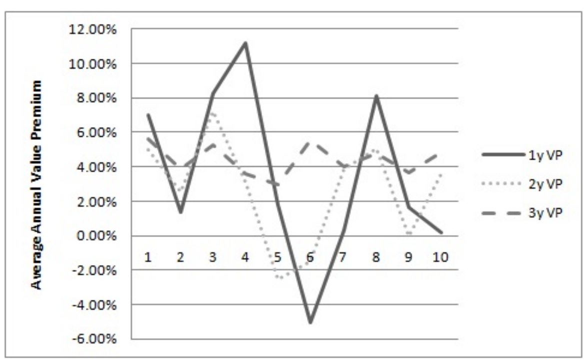


Figure (9) examines the relationship between the value premium and earnings persistence when excluding small firms. For equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to -1.47% (t-statistic: -0.31) on the one-year horizon, 1.99% (t-statistic: 0.69) on the two-year horizon, and 1.34% (t-statistic: 1.07) on the three-year investment horizon. For value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 6.85% (t-statistic: 1.39) on the one-year horizon, 2.13% (t-statistic: 0.41) on the two-year horizon, and 0.77% (t-statistic: 0.56) on the three-year investment horizon. Returns are annualised for all horizons.[17]

Figure (9) provides first evidence on the relationship between the value premium and earnings persistence when excluding small firms. More formal evidence is provided by regressing the yearly value premia of each decile on the decile values. Panel A in Table (27) provides the results of the second-stage regression of one-year, two-year and three-year ahead value premia on VAR decile values. In Panel B of Table (27) these second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (27) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure.

[17] The difference between the annual value premia in the same decile is a result of differences in the amount of return data used in each investment period. The one-year value premium includes one return data point more than the two-year investment horizon and two-year investment horizon includes on return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year horizon.

Table 27: Second-stage Regressions: Value Premium and Earnings Persistence Excluding Small Firms - Callen and Segal (2004) Model

The table reports the parameter estimates of a regression in which value premia are regressed on VAR earnings persistence decile values when controlling for size. Firms are sorted into deciles according to their market capitalisation and the firms in the smallest two size deciles are excluded. The regression is then reversed to test for measurement error in the independent variable. Firms are sorted into twenty percentiles according to the absolute value of the accrual component of earnings. The absolute accrual component of earnings is defined as the absolute value of $((\Delta CA - \Delta Cash)$-$(\Delta CL$-$\Delta STD$-$\Delta ITP)$-Depreciation). Subsequently, the earnings persistence of these twenty portfolios is estimated using a vector autoregressive process following Callen and Segal (2004). Ten deciles (VAR deciles) according to these earnings persistence estimates from the VAR model are formed. For each decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns of this trading strategy proxy for the value premium for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Panel A presents the coefficients and t-statistics of regressions of the equally-weighted value premia on the VAR decile values (VAR dec value) for all three time horizons. The regressions are then reversed to test for measurement error in the independent variable. In Panel B the value-weighted returns are presented. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. * indicates the 90% confidence level, ** indicates the 95% confidence level and *** indicates the 99% confidence level. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Second-stage Regressions:

$$(x - year\, value\, premium)_{i,t} \quad = \quad \alpha + \beta\,(VAR\, dec\, value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(VAR\, dec\, value)_{i,t} = \quad \alpha + \beta\,(x - year\, value\, premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-weighted Returns

	Second-stage Regressions		
Variables	1y	2y	3y
β	-0.003	-0.007**	-0.004
	(-0.86)	(-2.20)	(-1.19)
Intercept	0.086**	0.099***	0.068**
	(2.17)	(2.94)	(2.34)
	Error in Variable Regressions		
β	-3.171***	-4.796***	-6.189***
	(-2.69)	(-2.98)	(-3.84)
Intercept	5.938***	5.785***	6.188***
	(22.30)	(19.78)	(21.11)

Panel B. Value-weighted Returns

	Second-stage Regressions		
Variables	1y	2y	3y
β	-0.006	-0.003	-0.000
	(-1.21)	(-0.92)	(-0.14)
Intercept	0.068	0.045	0.047***
	(1.35)	(1.35)	(4.68)
	Error in Variable Regressions		
β	-1.022	-1.284	-7.211***
	(-1.14)	(-1.00)	(-5.61)
Intercept	5.744***	5.828***	5.981***
	(38.87)	(49.75)	(14.52)

For equally-weighted returns, the second-stage regression results in Panel A of Table (27) show that the relationship between earnings persistence (VAR deciles) and the value premium is negative and statistically significant on the two-year investment horizon. On the one-year horizon a factor loading of -0.003 (t-statistic: -0.86) is obtained, on the two-year horizon a factor loading of -0.007 (t-statistic: -2.20) is obtained, and on the three-year horizon a factor loading of -0.004 (t-statistic: -1.19) is obtained. These are robust to measurement error in the independent variable; the coefficients in the error in variable regressions are significant on all horizons.

For value-weighted returns, the second-stage regression results in Panel B of Table (27) show that the relationship between earnings persistence (VAR deciles) and the value premium is statistically insignificant and negative on all investment horizons. On the one-year horizon a factor loading of -0.006 (t-statistic: -1.21) is obtained, on the two-year horizon a factor loading of -0.003 (t-statistic: -0.92) is obtained, and on the three-year horizon a factor loading of -0.000 (t-statistic: -0.14) is obtained.

It can be concluded from the above results that the negative relationship between earnings persistence and the value premium does not persist after removing the smallest two deciles, as measured by market capitalisation, from the sample. Only for equally-weighted returns on the two-year investment horizon a statistically significant relationship can be observed.

3.2 Two-way Sorts and Second-stage Regressions: Financial Distress, Earnings Persistence and the Value Premium

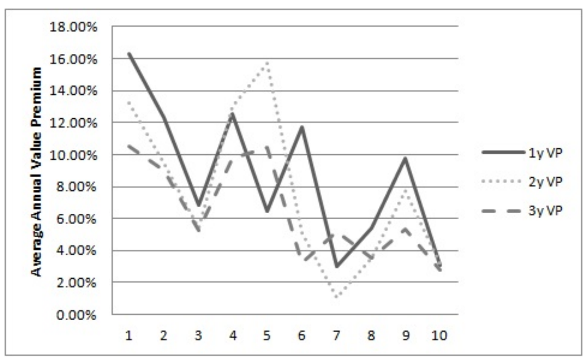
In part 2 of this dissertation it is shown that after the exclusion of financially distressed firms the relationship between earnings persistence and the value premium becomes statistically insignificant when estimating earnings persistence with an AR(1) model. The results in Section 4.4 in part 3 of this dissertation confirm that the relationship between earnings persistence and the value premium becomes statistically insignificant when removing financially distressed firms from the sample (Vuolteenaho (2000, 2002) model). In the following it is tested whether the relationship between earnings persistence and the value premium also disappears when estimating earnings persistence with the Callen and Segal (2004) model.

Figure 10: Average Value Premium across VAR Deciles Excluding Distressed Firms - Callen and Segal (2004) Model

The figure depicts the average one-year, two-year and three-year value premia across earnings persistence deciles built on the earnings persistence estimates from the Callen and Segal (2004) model when excluding financially distressed firms. For this purpose, firms with a Z-score of less than 1.81 are removed from the sample. Graph A shows the equally-weighted returns, while Graph B shows the value-weighted returns. In each year, firms are sorted into twenty percentiles according to the absolute value of the accrual component of earnings. The absolute accrual component of earnings is defined as the absolute value of $((\Delta CA - \Delta Cash)$-$(\Delta CL$-$\Delta STD$-$\Delta ITP)$-Depreciation). Subsequently, the earnings persistence for each of these twenty portfolios is estimated using a vector autoregressive process. Then, ten deciles (VAR deciles) according to the earnings persistence estimates from the VAR model are built. For each VAR decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns from this trading strategy proxy for the value premia for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. The figure below then shows the average value premium across VAR deciles in each year from 1980 to 2004. On the horizontal axis the VAR deciles are reported, where 1 is the decile with the lowest earnings persistence and 10 is the decile with the highest earnings persistence. On the vertical axis the average one-year, two-year and three-year ahead returns (value premia) from the trading strategy are reported. The model variables used in the VAR are stored in vector $z_{i,t}$. $z_{i,t}$ is defined as a vector of firm-specific variables describing a firm i at time t. The variables include the market-adjusted log stock return, $r_{i,t}$ (the first element of the state vector z); the market-adjusted log accrual measure, $acc_{i,t}$ (the second element) and the market-adjusted log operating assets, $oa_{i,t}$ (the third element). The variables are market-adjusted by subtracting the cross-sectional average in each year. The CRSP-Compustat intersection from 1971 to 2004 is used as the sample, in total 66,043 firm years. The following equation expresses the VAR model that is used to estimate earnings persistence:

$$z_{i,t} = \Gamma z_{i,t-1} + \varepsilon_{i,t}.$$

Graph A. Equally-weighted Returns



Graph B. Value-weighted Returns

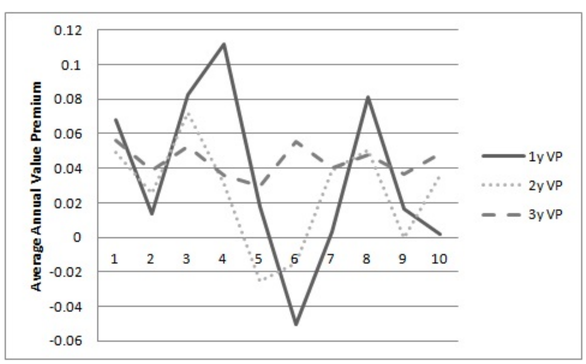


Figure (10) shows that a negative relationship between the average value premium and earnings persistence is observable. For equally-weighted returns, the difference in the average annual value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 13.19% (t-statistic: 2.63) on the one-year horizon, 10.08% (t-statistic: 3.16) on the two-year horizon, and

7.78% (t-statistic: 2.34) on the three-year investment horizon. The results for the equally-weighted returns show that the relationship between earnings persistence and the value premium persists after excluding financially distressed firms on all investment horizons.

For value-weighted returns, the difference in the average value premium between the decile with the lowest earnings persistence (1) and the decile with the highest earnings persistence (10) amounts to 6.64% (t-statistic: 1.34) on the one-year horizon, 1.36% (t-statistic: 0.38) on the two-year horizon, and 0.77% (t-statistic: 0.57) on the three-year investment horizon. Returns are annualised for all horizons. For value-weighted returns the relationship between earnings persistence and the value premium becomes statistically insignificant after removing financially distressed firms. Since the equally-weighted results are statistically significant and the value-weighted results are insignificant the question arises of whether the relationship between earnings persistence and the value premium is particular to small stocks. This phenomenon is subject to further investigation.[18]

Figure (10) provides first evidence on the relationship between the value premium and earnings persistence after excluding financially distressed firms. More formal evidence is provided by regressing the yearly value premia of each VAR decile on the VAR decile values. Panel A in Table (28) provides the results for the second-stage regression of one-year, two-year and three-year ahead value premia on VAR decile values. In Panel B of Table (28) these second-stage regressions are reversed to test for measurement error in the independent variable. The second-stage coefficients and t-statistics reported in Table (28) are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure.

[18] The difference between the annual value premia in the same decile is a result of differences in the amount of return data used in each investment period. The one-year value premium includes one return data point more than the two-year investment horizon and two-year investment horizon includes on return data point more than the three-year horizon. The one-year investment horizon includes two return data points more than the three-year horizon.

Table 28: Second-stage Regressions: Value Premium and Earnings Persistence Excluding Distressed Firms - Callen and Segal (2004) Model

The table reports the parameter estimates of a regression in which value premia are regressed on VAR earnings persistence decile values when controlling for financial distress. For this purpose, firms with a Z-score of less than 1.81 are removed from the sample. The regression is then reversed to test for measurement error in the independent variable. Firms are sorted into twenty percentiles according to the absolute value of the accrual component of earnings. The absolute accrual component of earnings is defined as the absolute value of (($\Delta CA - \Delta Cash$)-(ΔCL-ΔSTD-ΔITP)-Depreciation). Subsequently, the earnings persistence of these twenty portfolios is estimated using a vector autoregressive process following Callen and Segal (2004). Ten deciles (VAR deciles) according to these earnings persistence estimates from the VAR model are formed. For each decile, a zero-investment trading strategy that invests long in the top tertile of BM stocks and short in the bottom tertile of BM stocks is implemented. The returns of this trading strategy proxy for the value premium for the one-year, two-year and three-year investment horizon. Specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Panel A reports the coefficients and t-statistics for equally-weighted returns. Panel B presents the value-weighted returns. The coefficient estimates and the t-statistics are derived from cross-sectional regressions using the Fama and MacBeth (1973) procedure. The regression data consists of 250 observations (10 deciles over 25 years) from 1980 to 2004. The underlying sample is the CRSP-Compustat intersection from 1971 to 2004, in total 66,043 firm years.

Second-stage Regressions:

$$(x - year\, value\, premium)_{i,t} \quad = \quad \alpha + \beta\,(VAR\, dec\, value)_{i,t} + \varepsilon_{i,t}.$$

Error in Variable Regressions:

$$(VAR\, dec\, value)_{i,t} = \quad \alpha + \beta\,(x - year\, value\, premium)_{i,t} + \varepsilon_{i,t}.$$

Panel A. Equally-weighted Returns

	Second-stage Regressions		
Variables	1y	2y	3y
β	-0.010***	-0.010***	-0.008**
	(-2.68)	(-3.17)	(-2.51)
Intercept	0.143***	0.130***	0.107***
	(3.61)	(4.31)	(3.25)
	Error in Variable Regressions		
β	-3.171***	-4.796***	-6.189***
	(-2.69)	(-2.98)	(-3.84)
Intercept	5.938***	5.785***	6.188***
	(22.30)	(19.78)	(21.11)

Panel B. Value-weighted Returns

	Second-stage Regressions		
Variables	1y	2y	3y
β	-0.006	-0.003	-0.000
	(-1.18)	(-0.78)	(-0.13)
Intercept	0.067	0.042	0.046***
	(1.33)	(1.22)	(4.67)
	Error in Variable Regressions		
β	-1.011	-1.136	-7.188***
	(-1.12)	(-0.88)	(-5.59)
Intercept	5.743***	5.840***	5.983***
	(38.84)	(50.01)	(14.55)

For equally-weighted returns, the second-stage regression results in Panel A of Table (28) show that the relationship between earnings persistence (VAR deciles) and the value premium is negative and statistically significant on all investment horizons. On the one-year horizon a factor loading of -0.010 (t-statistic: -2.68) is obtained, on the two-year horizon a factor loading of -0.010 (t-statistic: -3.17) is obtained, and on the three-year horizon a factor loading of -0.008 (t-statistic: -2.51) is obtained. These results are robust to measurement error in the independent variable.

For value-weighted returns, the second-stage regression results in Panel B of Table (28) show that the relationship between earnings persistence (VAR deciles) and the value premium is statistically insignificant on all investment horizons. On the one-year horizon a factor loading of -0.006 (t-statistic: -1.18) is obtained, on the two-year horizon a factor loading of -0.003 (t-statistic: -0.78) is obtained, and on the three-year horizon a factor loading of -0.000 (t-statistic: -0.13) is obtained. Only the three-year horizon results are robust to measurement error in the independent variable.

3.3 Understanding the Two-way Sorts for the Callen and Segal (2004) Model

When estimating earnings persistence with the Callen and Segal (2004) model it is observable that the relationship between earnings persistence and the value premium becomes statistically insignificant after excluding small firms (see Table (27)). When examining small firms only, it is observable that there is a negative and statistically significant relationship between earnings persistence and size. Thus, excluding small firms from the sample renders the relationship between earnings persistence and the value premium statistically insignificant.

3.4 Three-way Sorts: Size, Financial Distress, Earnings Persistence and the Value Premium

In the following the extent to which the relationship between earnings persistence and the value premium persists after controlling for size or financial distress is researched more thoroughly. Firms are sorted into quintiles according to their earnings persistence. Subsequently, in each quintile firms are sorted into quintiles according to their size or financial distress (the first and second sort order is also reversed to control for size and financial distress; i.e. first sort on size or distress and second sort on earnings persistence). Thirdly, BM tertiles in each of these 25 portfolios are formed and the value premia are calculated. This allows the difference in the value premia between low earnings persistence and high earnings persistence portfolios to be statistically tested. Further, it gives insight into the interrelation between earnings persistence, default risk, size and the value premium.

3.4.1 The Size Effect

In the following the relationship between size and the value premium is examined within earnings persistence quintiles. Earnings persistence is estimated with a vector autoregressive model as proposed by Callen and Segal (2004). Table (29) presents results from three-way sorts on earnings persistence, size and BM. Stocks are firstly sorted into five quintiles based on their earnings persistence. Subsequently, the stocks within each earnings persistence quintile are sorted into five quintiles based on their size. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium.

Panel A of Table (29) shows that there is no statistically significant relationship between the value premium and size in any of the earnings persistence quintiles. Moreover, there is no statistically significant size effect in the whole sample. These results support the findings in part 2 of this dissertation; the relationship between the value premium and size is statistically insignificant. Note that, as stated in the second part of this dissertation, there is a statistically significant relationship between size and the value premium in portfolios of small firms.

Panel B shows that there is little variation in earnings persistence with size within all earnings persistence quintiles and the whole sample, which indicates that size and earnings persistence may have little relation. As expected, Panel C reveals that there is variation in size across size quintiles when controlling for earnings persistence. The variation in size increases almost monotonically with the degree of earnings persistence. Panel D of Table (29) reports the average Z-score of the earnings persistence and size-sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk are interrelated. Panel D shows that default risk decreases monotonically with size within all earnings persistence quintiles; this is coherent with other empirical studies (e.g. Vassalou and Xing (2004)) and indicates that size and financial distress are closely related.

The conclusion that emerges from Table (29) is that the relationship between size and the value premium is statistically insignificant; size does not seem to drive the value premium. Moreover, size, default risk and earnings persistence seem to be related.

Table 29: Three-way Sorts: Size Controlled by Earnings Persistence - Callen and Segal (2004) Model

The table depicts how the value premium varies with size when controlling for earnings persistence. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their earnings persistence as estimated with the Callen and Segal (2004) model. Subsequently, within each quintile firms are again sorted into size quintiles according to their market capitalisation. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Small-Big" is the return difference in the value premia between the smallest and biggest size portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Small 1	2	3	4	Big 5	Small-Big	*t-stat*
	Panel A: Average Annual Value Premium						
Low EP	0.24	0.21	0.16	0.06	0.11	0.13	1.1133
2	0.09	0.07	0.17	-0.01	0.02	0.07	0.5619
3	0.16	-0.05	0.07	-0.04	-0.02	0.18	1.1001
4	0.18	0.15	0.01	0.09	0.01	0.17	1.1163
High EP	-0.12	0.14	0.02	0.08	0.08	-0.20	-0.8080
Whole sample	0.11	0.10	0.09	0.04	0.04	0.07	0.7231
	Panel B: Average Earnings Persistence						
Low EP	0.84	0.79	0.82	0.82	0.82		
2	0.93	0.94	0.94	0.94	0.95		
3	1.03	1.04	1.04	1.03	1.03		
4	1.15	1.14	1.15	1.15	1.14		
High EP	1.25	1.25	1.24	1.23	1.25		
Whole sample	1.04	1.03	1.04	1.04	1.04		
	Panel C: Average Size						
Low EP	19	62	149	562	3482		
2	24	73	219	560	10974		
3	22	66	208	691	6667		
4	28	86	215	627	5532		
High EP	21	78	186	461	6123		
Whole sample	23	73	195	580	6556		
	Panel D: Average Z-score						
Low EP	-20.13	-15.12	-2.42	-1.93	8.40		
2	-14.08	-12.49	-5.48	4.01	8.41		
3	-9.78	-5.72	3.97	6.63	7.52		
4	-18.95	-14.91	-2.78	2.63	7.84		
High EP	-13.10	-9.25	-7.58	6.15	9.22		
Whole sample	-15.21	-11.47	-2.80	3.45	8.28		

3.4.2 The Distress Effect

Table (30) presents results from portfolio sortings in the same spirit as those of Table (29). Stocks are first sorted into five earnings persistence quintiles, and then each of these five earnings persistence quintiles is sorted into five default risk quintiles. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following, it is examined how default risk affects the value premium within each earnings persistence quintile, as well as for the market as a whole.

Panel A of Table (30) shows that there is no statistically significant relationship between the value premium and financial distress within all earnings persistence quintiles and the market as a whole. These results support the findings in part 2 of this dissertation; the relationship between the value premium and financial distress is statistically insignificant. However, in part two of this dissertation it was found that in portfolios of high distressed firms the relationship between earnings persistence and the value premium is statistically significant.

Panel B reveals that earnings persistence varies only little with financial distress. As expected, Panel D shows that financial distress decreases monotonically from the Low Z-score to High Z-score quintiles within all earnings persistence quintiles and the market as a whole. It can also be seen that the low Z-score quintiles tend to hold the small size firms; as found in previous research, small stocks seem to bear the highest default risk (Vassalou and Xing (2004)). The relevant conclusion from Table (30) is that default risk does not drive the value premium within earnings persistence quintiles and the market as a whole.

Table 30: Three-way Sorts: Distress Controlled by Earnings Persistence - Callen and Segal (2004) Model

The figure depicts how the value premium varies with financial distress when controlling for earnings persistence. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their earnings persistence as estimated with the Callen and Segal (2004) model. Subsequently, within each quintile firms are again sorted into size quintiles according to their market capitalisation. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Small-Big" is the return difference in the value premia between the smallest and biggest size portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Low Z-score			High Z-score			
	1	2	3	4	5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Low EP	0.39	0.11	0.04	0.13	0.03	0.37	0.6360
2	0.20	0.11	0.14	0.14	0.00	0.19	0.4973
3	0.14	0.11	0.04	-0.05	0.06	0.08	1.0167
4	0.13	0.09	0.11	0.06	0.09	0.04	1.3003
High EP	0.04	0.06	0.16	-0.01	-0.01	0.04	1.6325
Whole sample	0.18	0.10	0.10	0.06	0.03	0.15	1.1979
	Panel B: Average Earnings Persistence						
Low EP	0.809	0.824	0.836	0.781	0.824		
2	0.941	0.938	0.940	0.949	0.942		
3	1.029	1.034	1.036	1.032	1.151		
4	1.149	1.137	1.155	1.141	1.253		
High EP	1.253	1.237	1.241	1.242	1.235		
Whole sample	1.037	1.036	1.038	1.031	1.035		
	Panel C: Average Size						
Low EP	340	333	973	697	7960		
2	331	881	3476	1335	4564		
3	124	516	2928	12568	1993		
4	890	375	2697	7999	6055		
High EP	328	821	5092	3835	6897		
Whole sample	403	585	3033	5287	5494		
	Panel D: Average Z-score						
Low EP	-31.52	-0.25	4.04	6.72	14.34		
2	-22.41	0.85	4.26	7.89	14.14		
3	-16.83	1.53	4.78	7.97	13.10		
4	-27.10	0.47	1.14	7.58	14.71		
High EP	-38.09	0.11	4.46	8.34	13.44		
Whole sample	-27.19	0.54	4.37	7.70	13.95		

3.4.3 The Earnings Persistence Effect

Table (31) presents results from three-way sorts on size, earnings persistence and BM. Stocks are first sorted into five quintiles based on their size. Subsequently, the stocks within each size quintile are sorted into five quintiles based on their earnings persistence. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following it is examined whether the earnings persistence effect on the value premium exists within size quintiles.

Panel A of Table (31) shows that there is a statistically significant relationship between the value premium and earnings persistence within the market as a whole and in size quintiles one. The return difference between firms with low earnings persistence and firms with high earnings persistence in size quintile one amounts to 12% (t-statistics: 2.45).

Panel C shows that size does not vary considerably with earnings persistence within all size quintiles. Panel D of Table (31) reports the average Z-score of the size and earnings persistence sorted quintiles. Panel D shows that default risk tends to decrease with size; this is coherent with previous research (Vassalou and Xing (2004)). The conclusion that emerges from Table (31) is that the relationship between earnings and the value premium is statistically significant in portfolios of small firms and the market as a whole.

Table 31: Three-way Sorts: Earnings Persistence Controlled by Size - Callen and Segal (2004) Model

The figure depicts how the value premium varies with earnings persistence when controlling for size. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their earnings persistence as estimated with the Callen and Segal (2004) model. Subsequently, within each quintile firms are again sorted into size quintiles according to their market capitalisation. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t+1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Small-Big" is the return difference in the value premia between the smallest and biggest size portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Low EP 1	2	3	4	High EP 5	Low-High	*t-stat*
			Panel A: Average Annual Value Premium				
Small	0.18	0.19	-0.01	0.08	0.06	0.12	2.4529
2	0.13	0.00	-0.04	0.04	-0.05	0.17	1.3984
3	0.19	0.03	0.07	0.11	0.01	0.19	1.0330
4	0.03	0.07	0.06	-0.05	0.13	-0.09	-0.4900
Big	0.07	-0.01	0.04	0.05	0.00	0.07	1.3340
Whole sample	0.18	0.19	-0.01	0.08	0.06	0.12	2.0791
			Panel B: Average Earnings Persistence				
Small	0.90	1.11	1.37	1.78	134.95		
2	0.86	1.12	1.29	1.65	88.59		
3	0.84	1.11	1.32	1.53	7.11		
4	0.92	1.13	1.32	1.62	8.40		
Big	0.89	1.14	1.35	1.76	9.16		
Whole sample	0.88	1.12	1.33	1.67	49.64		
			Panel C: Average Size				
Small	24	26	20	24	22		
2	64	69	61	67	72		
3	166	192	175	209	150		
4	586	609	493	483	591		
Big	9111	11237	16532	6114	9625		
Whole sample	1990	2427	3456	1380	2092		
			Panel D: Average Z-score				
Small	-14.26	-23.46	-15.19	-17.47	-8.97		
2	-9.42	-13.97	-1.23	-16.81	-10.26		
3	-14.14	4.03	-1.61	-0.92	-5.23		
4	6.98	8.18	4.95	-15.11	-1.21		
Big	7.83	7.61	10.43	9.08	9.42		
Whole sample	-4.56	-3.60	-0.41	-8.10	-3.28		

Table (32) presents results from three-way sorts on distress risk, earnings persistence and BM. Stocks are first sorted into five quintiles based on their Z-score. Subsequently, the stocks within each distress quintile are sorted into five quintiles based on their earnings persistence. Following this procedure 25 portfolios are obtained. In each of these 25 portfolios firms are sorted into BM tertiles; the difference in returns between the high BM tertiles and the low BM tertiles proxy for the value premium. In the following it is examined whether the earnings persistence effect on the value premium exists within distress quintiles.

Panel A of Table (32) shows that there is a statistically significant relationship between the value premium and earnings persistence in distress quintile one. The difference between the low and high earnings persistence quintile amounts to 18% annually (t-statistics: 2.22). The other distress quintile that has an average Z-score of less than 1.81 is distress quintile two, but within distress quintile two there is no statistically significant relationship between earnings persistence and the value premium. The question of interest is whether earnings persistence varies within distress quintile one. If there is variation of earnings persistence within distress quintiles then this is a possible explanation for the relationship between earnings persistence and the value premium within portfolios of financially distressed firms. I.e. the earnings persistence characteristic drives the value premium.

As expected, Panel B reveals that there is substantial variation in earnings persistence within all distress quintiles and the sample as a whole. The strong variation in earnings persistence should lead to a statistically significant return difference between low and high earnings persistence quintiles if there is a relationship between earnings persistence and the value premium after controlling for size. In other words, controlling for distress does not eliminate the statistical relationship between earnings persistence and the value premium. Panel C reveals that size does not vary considerably with earnings persistence within all distress quintiles and the sample as a whole, apart from distress quintile one. Panel D of Table (32) reports the average Z-score of the distress and earnings persistence sorted portfolios. These results are helpful to understand to which extent earnings persistence, size, and default risk are interrelated. Panel D shows that default risk is stable across earnings persistence quintiles.

The conclusion that emerges from Table (32) is that the relationship between earnings and the value premium is statistically significant within financially distressed firms and the sample as a whole.

Table 32: Three-way Sorts: Earnings Persistence Controlled by Distress - Callen and Segal (2004) Model

The figure depicts how the value premium varies with earnings persistence when controlling for financial distress. In each year from 1980 to 2004 firms are firstly sorted into quintiles according to their earnings persistence as estimated with the Callen and Segal (2004) model. Subsequently, within each quintile firms are again sorted into size quintiles according to their market capitalisation. In each of the resulting 25 portfolios firms are sorted into tertiles according to their BM ratios; specifically, firms are allocated to BM tertiles in year t and matched with the return data in June of year $t{+}1$ to avoid a look-ahead bias. Then, in each of the 25 portfolios, a zero-investment trading strategy is implemented that invests long in the top BM tertile and short in the bottom BM tertile. Panel A then depicts the equally-weighted one-year ahead value premia in decimals for each of the 25 portfolios. "Small-Big" is the return difference in the value premia between the smallest and biggest size portfolios within each earnings persistence quintile. The rows labelled "Whole sample" report results using all stocks in the sample. T-values are calculated from Newey-West standard errors at the 5 percent significance level.

	Low EP				High EP		
	1	2	3	4	5	Low-High	*t-stat*
	Panel A: Average Annual Value Premium						
Low Z-score	0.23	0.11	0.13	0.16	0.05	0.18	2.2230
2	0.14	0.09	0.06	0.15	-0.08	0.22	0.4461
3	0.12	0.10	0.13	0.03	0.08	0.04	0.8721
4	0.08	-0.01	0.10	0.14	0.03	0.05	1.6098
High Z-score	0.06	0.06	-0.02	0.02	0.04	0.02	0.9100
Whole sample	0.13	0.07	0.08	0.10	0.02	0.10	2.0101
	Panel B: Average Earnings Persistence						
Low Z-score	0.85	1.09	1.31	2.63	3.73		
2	0.93	1.13	1.32	1.65	128.13		
3	0.84	1.14	1.32	1.61	6.25		
4	0.89	1.10	1.29	1.55	84.84		
High Z-score	0.94	1.17	1.35	1.69	129.51		
Whole sample	0.89	1.13	1.32	1.83	70.49		
	Panel C: Average Size						
Low Z-score	105	172	161	140	2701		
2	958	499	216	1967	469		
3	3299	1042	2604	1779	2480		
4	2139	1777	2584	1678	2157		
High Z-score	5430	2993	6177	1860	6256		
Whole sample	2386	1297	2348	1485	2812		
	Panel D: Average Z-score						
Low Z-score	-28.18	-23.13	-20.48	-21.29	-24.51		
2	1.48	0.53	1.53	1.09	0.25		
3	4.24	4.23	4.51	4.49	4.37		
4	7.58	7.75	7.52	7.78	7.81		
High Z-score	15.49	13.86	14.97	13.16	13.83		
Whole sample	2.63	1.86	1.61	2.31	2.36		

References

[1] J. Abarbanell, B. Bushee, Fundamental analysis, future earnings, and stock prices, Journal of Accounting Research 35 (1) (1997) 1–24.

[2] A. W. Alford, J. J. Jones, M. E. Zmijewski, Extensions and violations of the statutory sec form 10-k filing requirements, Journal of Accounting and Economics 17 (1) (1994) 229–254.

[3] E. Altman, Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, Journal of Finance 23 (4) (1968) 589–609.

[4] R. W. Banz, W. J. Breen, Sample-dependent results using accounting and market data: some evidence, The Journal of Finance 41 (4) (1986) 779–793.

[5] J. Begley, J. Ming, S. Watts, Bankruptcy classification errors in the 1980s: An empirical analysis of altman's and ohlson's models, Review of Accounting Studies 1 (4) (1996) 267–284.

[6] S. T. Bharath, T. Shumway, Forecasting default with the merton distance to default model, Review of Financial Studies 21 (3) (2008) 1339–1369.

[7] F. Black, Beta and return, Journal of Portfolio Management 20 (1993) 8–28.

[8] W. J. Breen, R. A. Korajczyk, On selection biases in book-to-market based tests of asset pricing models, Northwestern Universi& Workingpaper 167.

[9] M. Brennan, A. Wang, Y. Xia, Estimation and test of a simple model of intertemporal capital asset pricing, Journal of Finance 59 (4) (2004) 1743–1776.

[10] J. Callen, D. Segal, Do accruals drive firm-level stock returns? a variance decomposition analysis, Journal of Accounting Research 42 (3) (2004) 527–560.

[11] J. Campbell, R. Shiller, The dividend-price ratio and expectations of future dividends and discount factors, Review of Financial Studies 1 (3) (1988) 195–228.

[12] J. Campbell, A variance decomposition for stock returns, Economic Journal 101 (405) (1991) 157–179.

[13] J. Campbell, J. Ammer, What moves the stock and bond markets? a variance decomposition for long-term asset returns, Journal of Finance 48 (1) (1993) 3–37.

[14] J. Campbell, T. Vuolteenaho, Bad beta, good beta, American Economic Review 94 (5) (2004) 1249–1275.

[15] C. Capaul, I. Rowley, W. Sharpe, International value and growth stock returns, Financial Analysts Journal 49 (1) (1993) 27–36.

[16] L. Chan, Y. Hamao, J. Lakonishok, Fundamentals and stock returns in japan, Journal of Finance 46 (5) (1991) 1739–1764.

[17] L. K. Chan, N. Jegadeesh, J. Lakonishok, Evaluating the performance of value versus glamour stocks the impact of selection bias, Journal of Financial Economics 38 (3) (1995) 269–296.

[18] L. Chen, Z. Da, X. Zhao, What drives stock price movements?, Review of Financial Studies 26 (4) (2013) 841–876.

[19] J. Cochrane, Asset pricing, Vol. 30, Princeton university press, 2005.

[20] J. Core, W. Guay, R. Verdi, Is accruals quality a priced risk factor?, Journal of Accounting and Economics 46 (1) (2008) 2–22.

[21] K. Daniel, S. Titman, Evidence on the characteristics of cross sectional variation in stock returns, Journal of Finance 52 (1) (1997) 1–33.

[22] J. Davis, The cross-section of realized stock returns: The pre-compustat evidence, Journal of Finance 49 (5) (1994) 1579–1593.

[23] J. Davis, E. Fama, K. French, Characteristics, covariances, and average returns: 1929 to 1997, Journal of Finance 55 (1) (2000) 389–406.

[24] W. De Bondt, R. Thaler, Further evidence on investor overreaction and stock market seasonality, Journal of Finance 42 (3) (1987) 557–581.

[25] P. Dechow, R. Sloan, A. Sweeney, Detecting earnings management, Accounting Review 70 (2) (1995) 193–225.

[26] P. Dechow, W. Ge, The persistence of earnings and cash flows and the role of special items: Implications for the accrual anomaly, Review of Accounting Studies 11 (2) (2006) 253–296.

[27] P. Dechow, W. Ge, C. Schrand, Understanding earnings quality: A review of the proxies, their determinants and their consequences, Journal of Accounting and Economics 50 (2) (2010) 344–401.

[28] I. Dichev, V. Tang, Earnings volatility and earnings predictability, Journal of Accounting and Economics 47 (2009) 160–181.

[29] D. Dodd, B. Graham, Security analysis (1934).

[30] D. Easley, M. O'hara, Information and the cost of capital, Journal of Finance 59 (4) (2004) 1553–1583.

[31] R. A. Eisenbeis, Problems in applying discriminant analysis in credit scoring models, Journal of Banking & Finance 2 (3) (1978) 205–219.

[32] P. Fairfield, R. Sweeney, T. Yohn, Accounting classification and the predictive content of earnings, Accounting Review 71 (3) (1996) 337–355.

[33] E. Fama, J. MacBeth, Risk, return, and equilibrium: Empirical tests, Journal of Political Economy 81 (3) (1973) 607–636.

[34] E. Fama, Efficient capital markets: 2, Journal of Finance 46 (5) (1991) 1575–1617.

[35] E. F. Fama, K. R. French, The cross-section of expected stock returns, Journal of Finance 47 (2) (1992) 427–465.

[36] E. Fama, K. French, Common risk factors in the returns on stocks and bonds, Journal of Financial Economics 33 (1) (1993) 3–56.

[37] E. Fama, K. French, Value versus growth: The international evidence, Journal of Finance 53 (6) (1998) 1975–1999.

[38] E. Fama, K. French, The value premium and the capm, Journal of Finance 61 (5) (2006) 2163–2185.

[39] E. F. Fama, K. R. French, Size, value, and momentum in international stock returns, Journal of Financial Economics 105 (3) (2012) 457–472.

[40] E. Fama, K. French, Size and book-to-market factors in earnings and returns, Journal of Finance 50 (1) (1995) 131–155.

[41] G. Feltham, J. Ohlson, Uncertainty resolution and the theory of depreciation measurement, Journal of Accounting Research 34 (2) (1996) 209–234.

[42] J. Francis, R. LaFond, P. Olsson, K. Schipper, Costs of equity and earnings attributes, Accounting Review 79 (4) (2004) 967–1010.

[43] J. Francis, M. Smith, A reexamination of the persistence of accruals and cash flows, Journal of Accounting Research 43 (3) (2005) 413–451.

[44] J. Francis, R. LaFond, P. Olsson, K. Schipper, The market pricing of accruals quality, Journal of Accounting and Economics 39 (2) (2005) 295–327.

[45] R. Freeman, J. Ohlson, S. Penman, Book rate-of-return and prediction of earnings changes: An empirical investigation, Journal of accounting research 20 (2) (1982) 639–653.

[46] B. Graham, D. Dodd, S. Cottle, Security analysis, principles and technique (new york (1962).

[47] R. Haugen, The New Finance: The Case Against Efficient Markets, Prentice Hall, 1995.

[48] K. Hou, G. A. Karolyi, B.-C. Kho, What factors drive global stock returns?, Review of Financial Studies 24 (8) (2011) 2527–2574.

[49] R. Jagannathan, Z. Wang, The conditional capm and the cross-section of expected returns, Journal of Finance 50 (1) (1996) 3–53.

[50] N. Jegadeesh, S. Titman, Returns to buying winners and selling losers: Implications for stock market efficiency, Journal of Finance 48 (1) (1993) 65–91.

[51] S. P. Kothari, J. Shanken, R. G. Sloan, Another look at the cross-section of expected stock returns, The Journal of Finance 50 (1) (1995) 185–224.

[52] J. Lakonishok, A. Shleifer, R. Vishny, Contrarian investment, extrapolation, and risk, Journal of Finance 49 (5) (1994) 1541–1578.

[53] R. Lambert, C. Leuz, R. Verrecchia, Accounting information, disclosure, and the cost of capital, Journal of Accounting Research 45 (2) (2007) 385–420.

[54] B. Lev, S. Thiagarajan, Fundamental information analysis, Journal of Accounting Research 31 (2) (1993) 190–215.

[55] J. Lintner, Security prices, risk, and maximal gains from diversification, Journal of Finance 20 (4) (1965) 587–615.

[56] A. Lo, A. MacKinlay, Data-snooping biases in tests of financial asset pricing models, Review of Financial studies 3 (3) (1990) 431–467.

[57] R. Merton, An intertemporal capital asset pricing model, Econometrica 41 (5) (1973) 867–887.

[58] R. C. Merton, On the pricing of corporate debt: The risk structure of interest rates*, The Journal of Finance 29 (2) (1974) 449–470.

[59] J. A. Ohlson, Financial ratios and the probabilistic prediction of bankruptcy, Journal of accounting research (1980) 109–131.

[60] J. Ohlson, Earnings, book values, and dividends in equity valuation, Contemporary Accounting Research 11 (2) (1995) 661–687.

[61] R. Petkova, Do the fama–french factors proxy for innovations in predictive variables?, Journal of Finance 61 (2) (2006) 581–612.

[62] M. Pincus, S. Rajgopal, M. Venkatachalam, The accrual anomaly: International evidence, The Accounting Review 82 (1) (2007) 169–203.

[63] S. Richardson, R. Sloan, M. Soliman, I. Tuna, Accrual reliability, earnings persistence and stock prices, Journal of Accounting and Economics 39 (3) (2005) 437–485.

[64] B. Rosenberg, K. Reid, R. Lanstein, Persuasive evidence of market inefficiency, Streetwise: the Best of the Journal of Portfolio Management 11 (1998) 48.

[65] S. Ross, The arbitrage theory of capital asset pricing, Journal of Economic Theory 13 (3) (1976) 341–360.

[66] W. Sharpe, Capital asset prices: A theory of market equilibrium under conditions of risk, Journal of Finance 19 (3) (1964) 425–442.

[67] R. Sloan, Do stock prices fully reflect information in accruals and cash flows about future earnings?, Accounting Review 71 (3) (1996) 289–315.

[68] M. Vassalou, Y. Xing, Default risk in equity returns, Journal of Finance 59 (2) (2004) 831–868.

[69] T. Vuolteenaho, Understanding the aggregate book-to-market ratio and its implications to current equity-premium expectations, working paper - (2000) –.

[70] T. Vuolteenaho, What drives firm-level stock returns?, Journal of Finance 57 (1) (2002) 233–264.

[71] J. Williams, The theory of investment value, Harvard university press, 1938.

[72] L. Zhang, The value premium, Journal of Finance 60 (1) (2005) 67–103.

[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72]