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Profit Persistence and Stock Returns

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Abstract

This paper attempts to assemble further empirical evidence on the relationship between the product and the financial market. Drawing back on work in industrial organization, we analyze the relationship between profit *persistence* and expected stock returns looking at more than 2000 US firms over the last 20 years. While the relationship between profit/earnings and returns has been extensively analyzed before, to our knowledge this is the first study to look at the relationship between stock returns and *profit persistence*. We show that long-run profit *persistence* together with other additional economic firm fundamentals have a significant impact on returns and on their volatility even after adjusting for risk and controlling for profits. At the same time we bring empirical evidence for a 'low volatility anomaly'.

Keywords: Profit Persistence; Competition; Stock Return; Heteroscedasticity; Low-Volatility Anomaly; Dividend Discount Model

JEL classification: L10, G11, L25

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1 Introduction

One of the basic ideas in mainstream economic theory is the 'Competitive Environment Hypothesis'. It states that the competitive process eliminates all economic profits and losses in the long-run. The intuition behind it is straight forward: if a firm has excess profits, competitors enter the market and offer similar products at lower prices, reducing the profit margin of the incumbent. This continues until profitability in that market equals the competitive rate. If firms have profits below average, investors move to markets with higher profits and therefore, unless corrective measures are introduced, restoring at least normal profits, firms with lower than average profitability are eliminated.

In the present study we investigate empirically if *persistent* profits have a significant impact on the stock returns and to what extent also other real economy variables contribute to their volatility. To our knowledge this is the first analysis that links stock returns to profitability *persistence*. While the Dividend Discount Model (DDM) - dating back to Gordon and Shapiro (1965) - relates the stock returns to discounted future cash flows which include profitability and dividends, to our knowledge there is no other study that relates them to profit *persistence*. The starting point was the use of profit persistence as a measure of competitiveness of the industry environment, as opposed (or additionally) to using the concentration ratio as most of the previous studies have done before. In their seminal paper Hou and Robinson (2006) show that measures of 'profitability surprises' are positively correlated to industry concentration (Table V) and that firms in less concentrated and so more competitive industries have a higher stock return and so receive a 'competition premium' (Table VI). However, we hold the view that *persistent* profit can be also an important indicator for potential investors and determines stock returns. Pattitoni et al. (2014) for example show that short-run profit persistence, together with other important financial determinants impacts significantly on profitability and therefore, using a dynamic specification to model profitability is crucial (see Table 4 on page 6). Especially in the light of the recent financial crisis the importance of fundamental industrial economic variables in determining the dynamics of financial variables seems to become important. We think that *long-run profit persistence* bears different information to the typical concentration measures and to simple profit earnings. Therefore, we consider that we bring a significant contribution to the better understanding of the determinants of the volatility of the stock returns and stock market fluctuations from an empirical point of view.[1]

Because of its basic importance as a building block of economic theory, much research has been undertaken in order to shed light on the empirical relevance of the competitive environment hypothesis. Starting with the seminal contributions by Mueller (1977, 1986), some examples of this branch of research are given by Geroski and Jacquemin (1988), Kambahampati (1995), Goddard and Wilson (1999), McGahan and Porter (1999), Cable and Jackson (2008), and Gschwandtner (2012) to mention just a few. The main conclusion of this fruitful and still growing literature is that deviations of profit rates from the norm are very persistent even in markets considered as very competitive. Using structural time series analysis, Cable and Jackson (2008) find "around 60% of the companies exhibiting non-eroding long-run persistence" in the UK. Fama and French (2000), looking at more than 2000 quoted US firms over 32 years find evidence that the mean reversion rate of profitability is about 38% per year which implies a 'persistence' rate of 62% per year and this is very much in accordance with the findings of Cable and Jackson (2008) and the profit persistence literature in general.

The 'Efficient Market Hypothesis' (EMH) constitutes another building block of economic theory. In his PhD thesis, Eugene Fama made the argument that in an active market that includes many well-informed and intelligent investors, securities will be appropriately priced and reflect all available information. If a market is efficient, no information or analysis can be expected to result in outperformance of an appropriate benchmark. The debate about efficient markets has resulted in a large number of empirical studies attempting to determine whether specific markets are in fact 'efficient', and if so to what degree. There is a tremendous amount of evidence in support of the efficient market hypothesis for financial markets. However, researchers have also uncovered stock

[1] We have to emphasize that similar to Hou and Robinson (2006) this is an empirical study and that we do not aim at developing a theory which could relate profit persistence to stock returns.

market ‘anomalies’ that seem to contradict the efficient market hypothesis. The search for anomalies is effectively the search for systems or patterns that can be used to outperform the market.

In reality, markets are neither completely efficient nor inefficient. All markets are efficient to a certain extent, some more than others. The aim of this project is to compare empirically the efficiency of the stock market with the efficiency of the product market and investigate if it is possible to draw conclusions from the latter on the former using the merged CRSP and Compustat database of about 2000 US firms quoted at least 12 consecutive years during the period 1963-2006.[2] At the same time we aim to analyze the impact of profit persistence together with other factors on the stock returns in order to contribute to a better understanding of the stock prices fluctuations. Despite of its relevance the existing literature at the border line between product and financial markets is with few exceptions still sparse.

The present paper brings evidence of a significant impact of an important economic fundamental on stock return. This is an important additional information for investors at firm level. As the comprehensive summary by Harvey et al. (2014) shows, there are several studies looking at the impact of various economic fundamentals on stock return but there are only few looking at the impact of profitability and earnings. Moreover, to our knowledge there are none looking at the impact of profit *persistence* on stock returns even though this is considered to be an important economic fundamental according to the industrial organization literature. Additionally, while most of the studies look at the impact of various fundamentals in a cross section setting, we are looking at the history of profit and profit persistence. We analyze the impact over a period of more than 30 years and believe that it is the evolution of the variable over time that enters significantly in the decision making of the investor and show that profit persistence has, after correcting for other additional economic fundamentals, a significant positive impact on adjusted stock returns.

[2]We use a minimum of 10 years for the calculation of long-run profit persistence plus one year to calculate growth and one year for the predicted profitability.

2 Methodology

Since the seminal contribution by Mueller (1986), the dynamics of company profits tend to be specified as an autoregressive process, usually of first order. Geroski (1990) provides a theoretical justification for such an empirical specification, based on the assumption that profits depend on the threat of entry in the market, which in turn depends on past profits. Cable and Jackson (2008) add an innovation equation, so that the innovations of the firm counteract the resolution of entry barriers by competition. The reduced form of this system is an autoregression of order 1 (for simplicity) with respect to the firm i's profit rate at time t ($prof_{i,t}$), defined as income divided by total assets, and so justifying the approach of Mueller (1986).

$$prof_{i,t} = \alpha_i + \lambda_i \, prof_{i,t-1} + \zeta_{i,t}, \tag{1}$$

where $\lambda_i \in (-1, 1)$ and $\zeta_{i,t}$ is white noise with constant variance σ_i^2.
The unconditional expectation of $prof_{i,t}$ in (1) is given by $LrProf_i = \alpha_i/(1 - \lambda_i)$. The empirical literature on profit persistence usually compares the estimates of the unconditional expectations from (1) (or from stationary AR(p) generalizations) and tests the equality of unconditional expectations – long-run projections of the series – across companies.

The first measure for profit persistence used in the persistence studies is the so called 'long-run average profit rate' $LrProf_i$. This is a measure of permanent rents the firm is capable to generate, which are not eroded by competitive forces. The second measure of profit persistence, the short-run persistence, is the coefficient λ_i of the lagged variable in the autoregressive model. λ_i measures the strength of the firm specific surplus eroding process, with an average adjustment speed of $\lambda/(1 - \lambda)$. In Cable and Jackson λ_i decreases with the competitive pressure and increases with the innovation capacity of the firm.

The main scope of the present analysis is to try to explain stock returns by these two established persistence measures. For that we set up the following empirical model:

$$r_{i,t} = E(r_{i,t}|I_{m,t}, I_{i,t-1}) + \varepsilon_{i,t} \tag{2}$$

where $r_{i,t}$ is the stock return of firm i at time t depending on the market related information available at time t, namely $I_{m,t}$, as well as firm specific information available at time $t-1$, $I_{i,t-1}$. Market factor adjusted returns, $r_{i,t}^{adj}$, are obtained in a first step by

$$r_{i,t}^{adj} = r_{i,t} - E(r_{i,t}|I_{m,t}) \tag{3}$$

Thereby we correct for the market effects according to typical portfolios defined by Carhart (1997). Then we analyze the effect of the two industrial organization fundamentals, the firm specific short-run persistence and the firm specific long-run average, among others on the level and on the volatility of the stock return.

The asset pricing model predicts a positive relationship between risk and expected stock returns. Investors are willing to invest in high risk assets only if they expect a high return. The idiosyncratic risk is modeled also by our firm specific factors using a stochastic volatility specification.

$$\varepsilon_{i,t} = \sigma_{i,t}\,\eta_{i,t}, \quad \sigma_{i,t} = \exp(h_{i,t}/2) \tag{4}$$

So $\log(\varepsilon_{i,t}^2) = h_{i,t} + \log(\eta_{i,t}^2)$. $\eta_{i,t}$ is a serially uncorrelated noise with $E(\eta_{i,t}) = 0$, $V(\eta_{i,t}) = 1$. $\eta_{i,t}$ and $\sigma_{i,t}$ are uncorrelated. $h_{i,t}$ is a function of our persistence measures and the other firm specific characteristics as above. Therefore, we try to capture possible heteroscedasticity in the residuals of the return equation.

The relationship between long-run average $LrProf_{i,t}$ and stock returns is not unambiguous. At least three potential explanations exist: the competition premium, a productivity premium, and valuation theory.

A) Competition premium: Hou and Robinson (2006) find empirically a negative relation between concentration and (adjusted) returns (Table IV) and since a lower concentration is related to higher competition they find a positive relationship between competition and returns. This justifies the term 'competition premium'. Since higher competition is related to lower profits their relationship between profitability and return is negative, opposing the results in the present paper.

B) Productivity premium: Brown and Rowe (2007) find a positive relation between productivity, measured as return on invested capital (ROIC), and returns in large listed firms, which does not seem to be corrected for in the factor mimicking portfolios. They also find that high ROIC firms tend to be less risky than low ROIC firms. Interpreting the long-run profit level as a result of lasting high productivity not eroded by competition we should expect to find similar results. More recently, Novy-Marx (2013) using a sample of more than 4000 NYSE companies, shows that profitable firms generate significantly higher returns. The argument brought forward is that a profitability strategy finances the purchase of productive assets through the sale of unproductive assets.

C) Dividend discount model: On the other hand, Fama and French (2006) referring to valuation theory show that more profitable firms have higher expected returns, after controlling for book-to-market and expected rates of investment, and also exhibit higher risk.

The theory of financial markets is essentially forward looking, contrary to the concept of profit persistence as it is used in the literature of industrial organization. In order to link them we interpret the past average of profits rates as a projection of future or expected earnings.

The short-run persistence λ measures the difficulty to extract information about the mean out of the path of the profit rates. The larger λ in absolute value the larger is the variance of the profit process (given the underlying noise process and the mean), the larger the deviation from the long-run mean and the less successful is the extraction of information about the mean. This might lead to a reduction in the realized return.

The following equation states our basic model for idiosyncratic returns:

$$r_{i,t}^{adj} = c + \beta_1 prof_{i,t-1} + \beta_2 \lambda_{i,t-1} + \beta_3 LrProf_{i,t-1} + \varepsilon_{i,t} \qquad (5)$$

where $r_{i,t}^{adj}$ denotes the returns adjusted for common market characteristics, the signs of $\beta_1, \beta_2, \beta_3$ depend on the relationships of past profits, short-run profit persistence and long-run profit persistence. The lagged profit rate is to capture a possible short-run dynamics in decision making.

Finally, we extend our model in order to consider two other explanatory economic variables at firm level, namely firm's size and the firm's growth. They have been identified within the financial literature to be correlated to stock returns and therefore might provide useful additional information.

One of the strongest effects found in the literature is the so called 'Size Effect'. This effect describes the tendency for smaller firms to generate larger returns than those of large firms, due to higher risk. Keim (1983) shows that since 1926 small-firm stocks in the U.S. have produced rates of return over one percentage point larger than the returns from large-firm stocks. Fama and French (1992) show a clear tendency for the smaller firms to generate higher average monthly returns than larger firms. Current size (SMB, small-minus-big) is one of the four factors based on style portfolios used to adjust returns. However, we augment for lagged individual firm size in the spirit of the VAR approach of Vuolteenaho (2002).

Further we analyze the 'Growth Effect'. In the present study we measure growth - as is typically done in the persistence of profits literature - by the growth rate of deflated company sales. This is different from the concept typically used in the finance literature for the so called 'growth stocks', where growth refers to expected earnings relative to the market average, or asset growth (e.g. Fama and French, 2006). Several studies, e.g. Nicholson (1960), Basu (1977), Ball(1978), Fama and French (1992, 1997), Lakonishok, Shleifer and Vishny (1994), show that 'value stocks' tend to have higher returns than 'growth stocks'. However, to the extent that increasing sales of the companies also reflect sturdy quality, increasing earnings and a high probability of substantial capital gains.
Moreover, the 4-factor model for adjusting returns used below does not include any growth characteristics.[3]

[3]Growth dynamics measured by the lagged growth rate turns out to be insignificant in our estimated models.

Augmenting equation (5) by size and growth gives

$$r_{i,t}^{adj} = \beta_0 + \beta_1 prof_{i,t-1} + \beta_2 \lambda_{i,t-1} + \beta_3 LrProf_{i,t-1} + \beta_4 size_{i,t-1} + \beta_5 growth_{i,t} + \epsilon_{i,t} \quad (6)$$

All variables on the right hand side introduced are firm specific, contrary to the adjustment of stock return by factor-mimicking portfolios, as our scope is to explain returns by individual firm characteristics that seem relevant in the field of industrial organization.

3 Data

The dataset for profitability comes from Standard and Poor's Compustat. The corresponding share prices are taken from the CRSP database. It contains information about around 2000 surviving US companies from 1963-2006 quoted at NASDAQ, AMEX or NYSE. Not all companies have such a long time series but we assure that we have at least 10 consecutive years per company.[4] Observation units are firm-years. There is of course a survivorship bias in our sample which is inherent to the whole profit persistence literature. We need a minimum number of years to allow profits to converge to the norm and for the estimates to be statistically sound. However, Gschwandtner (2005) shows that with respect to profit persistence the results for non-surviving companies do not differ substantially from the ones of surviving companies.

Another question is the issue of the 'delisting bias'. Beaver, McNichols and Price (2007) show that the tests of market efficiency are sensitive to the inclusion of delisting firm-years. We have corrected for the delisting bias as usually done in the literature.

[4] Actually, only firms with at least 12 years of consecutive observations are included, as one observation is required for our long run profit forecasts and one is lost by the inclusion of one lag in the model.

Variables description

We use two different measures for profitability: net income after taxes divided by total assets, and operating profits divided by total assets. For both measures the results are very similar, so we present only the results for *Net Income/Total Assets* the measure most commonly used in the profit-persistence literature in order to save space.

Yearly stock returns include dividend yields and are calculated as geometric mean of monthly stock returns. The adjusted returns are obatined according to and calculated by Kent, Grinblatt, Titman and Wermers (1997) (KGTW).[5] They refer to a 4-factor model proposed by Carhart(1997) which tries to explain returns in excess of the one-month T-bill rate. The factors are an excess return measure of an aggregate market proxy, and returns on value-weighted, zero-investment, factor-mimicking portfolios for size, book-to-market equity, and one-year momentum in stock returns. No growth factor is included.

$$R_{i,t} - R_{F,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i PR1YR_t + e_{i,t} \quad (7)$$

where:
$R_{i,t}$ ... observed fund return
$R_{F,t}$ ... observed risk free return, the 1-month T-bill rate
$RMRF_t$ ... CRSP value-weighted index less T-bills
SMB_t ... Small minus big size
HML_t ... High book-to-market minus low book-to-market
$PR1YR_t$ ... High prior-year return less low prior return (momentum)

According to this model the return for a fund i, $R_{i,t}$ is the sum of the risk free return $R_{F,t}$ and four other market and firm type factors. The adjusted returns, r^{adj}, are then $r^{adj}_{i,t} = \alpha_i + e_{i,t}$.

Model (6) corrects for systematic effects in the stock market. The firm specific variable size is measured as the logarithm of firm's total assets. Firm's growth is calculated as the growth rate of the company's sales. Size and growth are

[5] Data can be downloaded from:
http://www.rhsmith.umd.edu/Faculty/rwermers/ftpsite/Dgtw/coverpage.htm

both adjusted for inflation using the CPI on 1982-84 basis from the Bureau of Labor Statistics of the U.S. Department of Labor.

The two profit persistence measures, $\lambda_{i,t}$ and $LrProf_{i,t}$, are calculated using a moving window with the length of 10 years, $t-9,\ldots,t$. The last 10 years are viewed as covering the information potential investors base their decisions on. We have discarded observations (firm-years) according to their untypical behavior with respect to the relevant variables in the following way: 5 observations with respect to adjusted returns, 200 observations with respect to growth at the tails of the distribution, and 100 firms with respect to the profit variable mostly because of irregularly reported data. This results in 37965 firm-years as observation units and 1860 firms in the sample.

Table 1: *Descriptive Statistics*

	Mean	**Median**	**StDev**
Adj. Stock Return ($r_{i,t}^{adj}$)	0.00126	0.00007	0.03067
Profit Rate ($\pi_{i,t}$)	0.04221	0.04547	0.07332
Short-Run Persistence ($\lambda_{i,t}$)	0.35442	0.39127	0.34822
Long-Run Profit ($LrProf_{i,t}$)	0.04639	0.04466	0.04139
Firm Size *($size_{i,t}$)*	1.2628	1.15951	2.06055
Firm Growth *($growth_{i,t}$)*	0.05105	0.03447	0.22798

Remark: The number of observations are 37965 firm-years of 1860 firms.

Table 1 presents the descriptive statistics of the relevant variables. We observe that, while the average stock return, the profit rate and the long run profit are close to zero as they should be, the adjusted stock return is much closer to it than the other two. The average profit rate and long-run average parameter $LrProf_{it}$ are around 0.04 which is plausible. The average short-run persistence parameter λ_{it} is around 0.4 which in line with the literature (see for example Gschwandtner (2012) for a comparison). The average firms size is 1.26 which doesn't say much since it is the logarithm of total assets but the variation of this measure is very large which means that the firms are very heterogenous. Most of the firms are medium sized but we seem to have few very large firms that skew the distribution to the right. Therefore, even though we have only surviving companies in our sample we do not have only large firms. In fact, the number of very large firms seems to be very small. The average firm growth is 0.051 which indicates that the sales of the company rise on average by 5.1%.

4 Results

First, we provide some empirical indicators for the persistence in profits and for comparison also in adjusted and non-adjusted stock returns. For this we estimate the short and long-run persistence using the ten year data windows as described in equation (1) by Maximum Likelihood, which guarantees that the estimates of λ are smaller one, $\hat{\lambda} < 1$. Table 2 summarizes the values for the short- and long-run persistence measures.

Table 2: *Persistence measures for profitability, adjusted returns and returns using model (1)*

	long-run			**short-run persistence**, λ		
	profit	**adj returns**	**returns**	**profit**	**adj returns**	**returns**
$\% \neq 0^{a)}$	80.2	8.9	29.3	36.5	11.6	8.3
pos : *neg*	91.6 : 8.4	55.2 : 44.8	94.7 : 5.3	83.1 : 16.9	36.5 : 63.5	38.8 : 61.2
Mean	0.0464	0.0016	0.1994	0.3544	-0.1072	-0.0792
Median	0.0447	0.0008	0.1702	0.3913	-0.1169	-0.0814
StDev	0.0414	0.0087	0.5427	0.3482	0.3185	0.2962

Remark: moving data window of 10 years, $^{a)}$ empirical rejection rate based on a nominal significance level of 10%

A first observation is that for profitability the percentage of long-run persistence values significantly different from zero is 80.2% at a nominal level of 10%. For returns measured as stock growth plus dividend payments the percentage is 29.3%, while for adjusted returns, measured as firm stock growth corrected for market factors it is close to the nominal level, 8.9%.

An observation worth commenting is that among all observed long-run projected profit rates the positive values clearly dominate with 91%. However still 8.4% of the companies exhibit a negative 10 year average.[6]

The percentage of λ_i's significantly different from zero is 36.5% for profits while the values for adjusted an non-adjusted returns are close to the 10% level, 11.6% and 8.3%. Also the mean short-run persistence parameter is much higher for profitability, 0.3544, than for stock returns, -0.0792. The latter (small in modulus) negative value is in line with Baur et al. (2012) where positive/negative autocorrelation is found within firms belonging to low/high return quantiles. Our data exclude companies with valid observations less than 10 years in sequence, so some low return companies are likely to be excluded. However, negative short-run projected profit rates are not an exception within the profit persistence literature (see e.g. Gschwandtner 2012). In general the results in Table 2 bring evidence for less competition in the product market as expected.

Table 3 presents the regression results for equation (6) for factor adjusted returns. Panel A refers to the whole sample. In Panel B equation (6) is reestimated for different sets of firms: all firms belonging either to the first, ..., or fifth quintile of the explanatory variables size, growth, and long-run profit, respectively.

First we observe that also firm specific information contributes to the explanation of the structured portfolio adjusted returns. The impact of lagged profits, $prof_{-1}$, on the stock return is negative ceteris paribus and indicates some correction with respect to the long-run profits.

The short-run persistence coefficient of (mostly positive) λ_{-1} is negative as suggested. The increase of the variance in the profit process makes the signal extraction more difficult.

The effect of the level of the long-run profit rate $LrProf_{-1}$ is significant and positive indicating that either the productivity premium or the dividend discount model of Fama and French (2006) holds. However, the relationship found by Hou and Robinson (2006) cannot be confirmed. Hou and Robinson

[6]Reasons for this might be high sunk costs, big assets or protection by the government.

(2006) find a negative relationship between profitability as a measure of low competition and return.

The coefficient of the lagged firm size ($size_{-1}$) is negative and highly significant in accordance with the discussion about the 'Size Effect'. Smaller firms seem to have higher stock returns, if they survive.

The coefficient of current growth is positive and highly significant. The growth of firm sales turns out to be reflected quickly in the stock price as information about the business volume is available on a regular basis through quarterly reports, advertising and other media. This could be an indicator that a mimicking-growth portfolio should be incorporated in the Carhart measure. In the comprehensive summary of Harvey et al. (2014) at least five studies are cited that find a significant impact of firm growth on stock returns. However, most of them refer to growth in assets as opposed to the present study that looks at growth in sales. We have chosen growth in sales because we consider that it better reflects the growth of the firm and its expected positive impact on stock returns. The message of assets can be ambiguous. If the company has grown through a merger and/or acquisition, the impact can be positive or negative depending if the firm is the acquiring firm or the acquired one. Typically, after a merger the share price of the acquiring firm (and hence its return) falls while the share price of the acquired firm (and hence is return) increases (e.g Gugler, Mueller and Yurtoglu 2006). Fairfeld, Whisenant and Yohn (2003) find for example that growth in net operating assets has a negative impact on one-year-ahead return on assets and they speak about a 'growth anomaly'. Fama and French (2006) find a positive impact of assets growth on monthly stock returns but the impact is mostly insignificant. The authors conclude that it is due to the possible collinearity with profitability that they also use in their analysis. However, the impact of lagged assets growth on stock returns is clearly negative. Mohanram (2005) on the other hand construct a composite index of growth consisting of several growth parameters such as growth stability and intensity among others and find that a strategy based on this index earns significant excess returns. Soliman (2008), using DuPont analysis, finds that the change in sales over net operating assets has on average a positive impact on assets return. We think, that the message of sales growth is more accurate than the message of assets growth and use them therefore in our analysis.

Turning to Panel B we can analyze these effects in more depth by looking at the regressions results for the quintile subsets with respect to the explanatory variables size, growth and long-run profits. The distinction between low/high lagged profits and low/high short-run persistence are not included as they do not provide additional insights.

Similar to Fama and French (1996) and Cochrane (2001 p.437) we distinguish according to different size, growth and profit quintiles, but we run regressions for each of these quintiles. I.e. we investigate whether the relations found in the overall sample also hold in the single quintiles.

Table 3: *Regressions Explaining Adjusted Stock Returns.*

	const.	$prof_{-1}$	λ_{-1}	$LrProf_{-1}$	$size_{-1}$	*growth*	N	$Mean(r_{it}^{adj})$	R^2
Panel A: Whole Sample									
r_{it}^{adj}	0.00087	−0.02439	−0.00190	0.02989	−0.00048	0.02294	31562	0.00126	0.033
Panel B: Quintile Regressions									
size1	–	−0.03305	(−0.00364)$^{(\nabla)}$	0.02991	−0.00369$^{\nabla}$	0.02721$^{\Delta}$	6313	0.00312$^{\Delta}$	0.054
size2	–	–	(−0.00271)	0.03552	(−0.00268)	0.02913	6312	–	0.042
size3	(−0.00400)	(−0.01758)	–	0.03129	(0.00209)	0.01789	6312	–	0.019
size4	–	(−0.01610)	−0.00247	0.05800	–	0.01500	6312	–	0.019
size5	(−0.00317)	−0.04799	–$^{(\nabla)}$	0.05210	(0.00060)$^{\nabla}$	0.01402$^{\Delta}$	6313	–$^{\Delta}$	0.019
growth1	−0.00787$^{\nabla}$	−0.03438$^{\nabla}$	−0.00453	0.05615$^{\Delta}$	0.00128$^{\Delta}$	–	6313	−0.00737$^{\nabla}$	0.013
growth2	−0.00393	−0.04614	−0.00264	0.05901	0.00048	–	6312	−0.00300	0.011
growth3	–	−0.03502	–	–	−0.00054	0.06542	6312	0.00084	0.007
growth4	–	−0.03143	–	–	−0.00101	0.05600	6312	0.00362	0.012
growth5	0.01245$^{\nabla}$	–$^{\nabla}$	–	–$^{\Delta}$	−0.00272$^{\Delta}$	0.00543	6313	0.01007$^{\nabla}$	0.033
LrProf1	–	−0.03923$^{\nabla}$	−0.00438$^{(\nabla)}$	0.05114$^{\Delta}$	−0.00063	0.02742$^{(\nabla)}$	6313	–	0.037
LrProf2	–	(−0.02171)	–	–	−0.00060	0.02168	6312	–	0.033
LrProf3	–	–	–	–	−0.00057	0.02278	6312	0.00069	0.031
LrProf4	–	–	–	–	–	0.01461	6312	0.00147	0.022
LrProf5	–	(0.01718)$^{\nabla}$	–$^{(\nabla)}$	–$^{\Delta}$	–	0.03252$^{(\nabla)}$	6313	0.00125	0.059

Remark: size1,. . ., size5 are the quintile sets of $size_{-1}$, LrProf1,. . ., LrProf5 of $LrProf_{-1}$
estimated coefficient significantly different from zero at 1% level (t-test)
'(...)' significant between 1 and 5%, '–' estimated but not significantly different from zero at the 5% level
$^{\nabla}$, $^{\Delta}$ indicate the significance of the test of equality of the coefficient of 1st and 5th quintile

The estimated coefficients for the whole sample are approximately the average of the 5 quintile coefficients, if the correlations of the explanatory variables within quintiles do not differ between the quintiles. We test for the equality of the coefficients of the first and 5th quintile to find out whether variables have different effects and, whether some effects tend to cancel out and vanish after aggregation. The significant results at the 1% level are indicated by $^{\Delta}$ or $^{\nabla}$ pointing to the direction of increase, and by $^{(\Delta)}$ and $^{(\nabla)}$ for the 5% level. However, the latter are not discussed further in order to save space.

Panel B can be interpreted as a robustness check of model (6). All coefficients in the different sets of quintile regressions show either the same sign as in the overall regression or are not significantly different from zero supporting the results in Panel A. However there is one notable exception: The overall negative lagged size effects seems to be generated by high growth firms, as the sign of the coefficient is positive for low growth firms and changes to negative for high growth firms. For low growth firms the size effect of smaller firms tending to have higher returns does not seem to hold.

In Table 4 we summarize the estimation results for modelling heteroscedasticity in the residuals of the adjusted returns regressions, both for the whole sample and for each quintile of the variables size, growth and long-run profit. We regress the log of the squared residuals of Equation (4) on the same explanatory variables as in the level regression.

$$h_{i,t} = d_0 + d_1 prof_{i,t-1} + d_2 \lambda_{i,t-1} + d_3 LrProf_{i,t-1} + d_4 size_{i,t-1} + d_5 growth_{i,t} \quad (8)$$

Panel A presents the results for the log-volatility of the residuals for all companies. All the coefficients except of the short-run persistence, λ_{-1}, are significant.

Here in the volatility equation also lagged profits seem to correct for some effect of the long-run profit variable. The coefficient of $LrProf$ is clearly negative, indicating a reduction in volatility with increasing long-run profits. The pattern of a positive effect of long-run profits on the returns (cp. Table 3) and a negative effect on risk corresponds with the productivity premium of Brown and Rowe (2007). On the other hand, Fama and French (2006) is not supported as positive signs of the long-run profit variable in both equations would be required. However, we cannot reject Fama and French (2006), since we have not corrected for expected rates of investment as would be required.

The sign of the coefficient of size conforms with standard theory despite the use of lagged firm specific data. An increase in growth of sales induces consistently both an increase in the return, as well in the risk.

Table 4: *Regressions Explaining the Volatility of Adjusted Stock Returns.*

	const.	$prof_{-1}$	λ_{-1}	$LrProf_{-1}$	$size_{-1}$	*growth*	N	$Mean(\log(\hat{\epsilon}^2))$	R^2
Panel A: Whole Sample									
$\log(\hat{\epsilon}^2)$	−8.1586	−1.2515	−	−6.4934	−0.2351	0.3875	31562	−8.841	0.063
Panel B: Quintile Regressions									
size1	−8.1037	$-^{\Delta}$	−	−7.5384	−0.1616	$0.5207^{(\Delta)}$	6313	-8.138^{Δ}	0.039
size2	−8.0990	−2.2611	−	−6.1915	−0.2149	0.5202	6312	−8.528	0.032
size3	−8.0328	−1.8106	−	−6.4187	−0.2650	(0.2908)	6312	−8.795	0.022
size4	−8.6800	−3.6213	−	(−3.0079)	−	−	6312	−9.250	0.012
size5	−8.2230	-2.9879^{Δ}	−	−5.7185	−0.2096	$-^{(\Delta)}$	6313	-9.484^{Δ}	0.018
growth1	−8.1297	−	−	-7.7352^{∇}	-0.1720^{Δ}	-0.5964^{∇}	6313	−8.511	0.057
growth2	−8.4136	−1.8324	−	−6.6440	−0.2035	−	6312	−9.041	0.050
growth3	−8.3273	(−1.7169)	−	−6.3817	−0.2448	−	6312	−9.114	0.059
growth4	−8.4506	−	−	−7.0906	−0.2521	−	6312	−8.999	0.058
growth5	−8.2309	(−1.1114)	(−0.1732)	-2.9501^{∇}	-0.2493^{Δ}	0.7810^{∇}	6313	−8.540	0.072
LrProf1	-8.0005^{Δ}	−1.2156	−	$-6.1829^{(\nabla)}$	−0.2164	$-^{\nabla}$	6313	-8.175^{Δ}	0.076
LrProf2	−7.8898	(−1.7685)	−	−17.2938	−0.2071	0.4278	6312	−8.721	0.038
LrProf3	−9.4848	(−1.8203)	−	(17.9045)	−0.2539	0.7014	6312	−9.151	0.045
LrProf4	−8.6259	−	−	−	−0.2428	0.5905	6312	−9.018	0.042
LrProf5	-8.6160^{Δ}	−	−	$-^{(\nabla)}$	−0.2160	0.6594^{∇}	6313	-9.140^{Δ}	0.030

Remark: size1,…, size5 are the quintile sets of $size_{-1}$, LrProf1, …, LrProf5 of $LrProf_{-1}$
estimated coefficient significantly different from zero at 1% level (t-test)
'(...)' significant between 1 and 5%, '−' estimated but not significantly different from zero at the 5% level
$^{\nabla}$, $^{\Delta}$ indicate the significance of the test of equality of the coefficient of 1st and 5th quintile

As above we interpret Panel B as a robustness check of model (8). All coefficients in the different sets of quintile regressions show either the same sign as in the overall regression or are not significantly different from zero supporting the results in Panel A similar to Table 3. But again there is one exception: The sign of the growth coefficient changes from minus for low growth firms to plus for high growth firms. This indicates that an increase in the growth of sales of firms with negative or zero growth induces an increase in returns but decreases risk.

5 Robustness of the results

Our findings might depend on the choice of firms, the effects of the survivorship bias, delisting, and on the choice of the profit variable, the window size when calculating the persistence measures, and the observation period.

All firms which are available in the merged Compustat and CRSP database from 1963 to 2006 are used, where at least 10 consecutive years of "outlier free" data are reported, resulting in 1860 firms. For details, as well for the discussion of a potential survivorship bias and our solution to the delisting problem see Section 3. The choice between the two available income variables, net income after taxes or operating profits divided by total assets, is also discussed in Section 3.

Apart from the window size 10, we have calculated persistence measures for window size 5 and 15, and reestimated Table 3 and 4. A window size of 5 would lead to an increased number of observations, a choice of widow size 15 to a reduction to 24802. We find only minor changes in the estimated parameters, no change of significance in both the return and the volatility equation for the whole sample. For the window size 5 some tests for the differences of some quintiles allow less clear statements. So we choose a window size of 10 in order to capture some long-run aspects, keep the uncertainty in the persistence estimates low, and obtain a sample as large as possible.

Further, we split the observation period in approximatively two halves, 1963 (1970 effectively) to 1990 and 1991 to 2006 and reestimated the models using the window size of 10. In the first period the lagged profit and the short-run persistence variables obtain somewhat smaller and insignificant coefficients in the return equation. I.e., the observed correction with respect to the long-run profit and the difficulty of extracting the correct long-run profits is not in effect in period 1963 to 1990. The other effects remain the same. On the other hand, the volatility equation does not at all change in a relevant way. For the second subsample the results for both equations are hardly to distinguish from Table 3 and 4. So, the presented main conclusions are stable over time.

6 Conclusion

The present paper analyzes the empirical relationship between profit persistence and expected stock returns using data about 2000 surviving US companies from 1963-2006. We present evidence for significant impacts of economic fundamentals at the firm level like firm's profit and profit persistence, firm's size and firm's growth on the level and volatility of the stock return.

Despite the fact that the Carhart 4-factor model (Carhart 1997) manages to eliminate contemporary size effects, lagged effects seem to be still prevalent. In general lagged firm size impacts negatively on both the level and the volatility of stock return. Introducing the company's growth rate with respect to sales, which is not taken into account in the Carhart 4-factor adjustment, we find that current growth has in general a positive and highly significant impact on both the level and the volatility of the stock return.
The most interesting findings of our paper are the positive relationship between the long-run profitability and stock returns, and the negative relationship between long-run profitability and the volatility of the stock returns. This evidence does not support the findings of Hou and Robinson, (2006) as the relation between returns and average profits should be negative, according to their results. On the other hand the discount dividend model of Fama and French (2006) would suggest that more profitable firms would be more risky, which is also not supported by the results in Table 4.

Table 5: *Summary: Q5 : Q1 of Regressions for Adjusted Stock Returns.*

Panel B: Quintile Regressions							
	$const$	$prof_{-1}$	λ_{-1}	$LrProf_{-1}$	$size_{-1}$	$growth$	$Mean(r)$
size1	·	·	−	·	−	++	+
size5	·	·	(0)	·	0	+	0
growth1	−	−	·	+	+	·	−
growth5	0	0	·	0	−	·	+
LrProf1	·	−	−	+	·	+	·
LrProf5	·	0	(0)	0	·	++	·

Table 6: *Summary: Q5 : Q1 of Regressions for the Volatility of the Adjusted Stock Returns.*

Panel B: Quintile Regressions							
	$const$	$prof_{-1}$	λ_{-1}	$LrProf_{-1}$	$size_{-1}$	$growth$	$Mean(\log(\epsilon^2))$
size1	·	0	·	·	·	+	−
size5	·	−	·	·	·	(0)	−−
growth1	·	·	·	−−	−	−	·
growth5	·	·	·	−	−−	+	·
LrProf1	−	·	·	−	·	0	−
LrProf5	−−	·	·	(0)	·	+	−−