Liquidity, volume and dividend yields in stock return data: Evidence from London Stock Exchange

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Liquidity, volume and dividend yields in stock return data:

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Abstract

This paper investigates monthly liquidity in FTSE 100 equity index in London Stock Exchange over the period 1986 to 2005. The relationship between excess returns, order flow, dividend yields and earning-price ratio was examined using GARCH(1,1). The variables found insignificant, but the unexpected shocks were significant. This research also examined financial crises in October 1987 and in August 1998 as dummy variables in excess returns. These dummies found to have great impact in excess returns and seemed to be very significant. The results of our analysis appear to be in contrast with the existing literature.

Keywords: GJR-GARCH models, liquidity, volume, dividend yields, earnings, excess returns

Jel Classification: F30, F15, F14

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1. Introduction

The turbulence in financial markets attracts the attention of traders, regulators, exchange officials and academics as liquidity is concerned. Adminhud and Mendelson (1986) investigated the implications of liquidity on expected stock returns. They argued that expected return was an increasing and concave function of the illiquidity level and found that assets with higher portfolio spreads have longer expected holding periods. Their empirical evidence about quoted bid-ask spreads on NYSE, was supportive of this opinion.

Following Aminhud and Mendelson(1986) and providing mixed support for the spread pricing hypothesis, Eleswarpu and Reinganum (1993) found that the specialist quoted spreads are priced on the NYSE, only in January. Eleswarapu (1997), examining NASDAQ securities, showed that there was evidence of seasonal differences in liquidity pricing and demonstrated that spreads are positively priced not only in January but also in other months. In the opposite side, Brennan and Subrahmanyam (1996) analyzed the negative relation between quoted spreads and expected returns on NYSE which disappeared when the inverse of price was included in regression.

The difficulty to obtain spread data more frequently than on an annual basis (for NYSE/AMEX stocks),was led Brennan, Chordia, and Subrahmanyam (1998) to propose the dollar volume trading as an alternative liquidity measure.[1]The basic data

[1] Brennan, Chordia and Subrahmanyam (1998) and Brennan and Subrahmanyam (1995) as providing evidence supporting trading volume as a determinant of Liquidity.

consisted of the monthly portfolios returns sorted by Kyle measure of depth "λ"[2](estimated using Glosten Harris method) and firm size for the period 1984-1991.They demonstrated that there was a negative and strongly significant relation between expected return and dollar volume on both the NYSE/AMEX and NASDAQ markets. Similar trading measures suggested by Datar, Naik and Radecliffe(1998) who examined the turnover rate (number of shares traded as a faction of the number of outstanding shares) and Easley, Hvidkjaer and O'Hara(2002) who investigated the number of daily trades.

The excess returns depend mainly by liquidity. The need of market-wide liquidity as a state variable for asset pricing was emphasized by the findings of Chordia, Roll, and Subrahmanyam (2000) and Pastor and Stambaugh (2003). In their models, the expected returns related to non-diversifiable factor risk and not to the level of illiquidity. Acharya and Pederson (2004), in a capital asset pricing model framework, suggested that both level and risk components were important. Examining the relationship between excess returns and traditional liquidity measures while controlling the systematic liquidity risk supported the proposition of Amidhud and Mendelson(1986) that excess returns was a positive function of illiquidity.

Becker, Blease and Donna (2003) investigated significant abnormal increases in capital expenditure associated with liquidity. They examined the hypothesis that an increase in stock liquidity would result in higher capital investment and found that the stock liquidity influenced investment decisions. They showed that the stock liquidity in most firms was raised after an increase in investor's interest. Their empirical tests demonstrated that the unobservable firm's characteristics determined a decision to enhance stock liquidity.

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[2] λ is the inverse measure of liquidity. Here, liquidity is the impact on price of a change in order flow. This is also knows as the depth.

Following the previous investigations, Chordia, Subrahmanyam and Anshuman (2001) tested the cross sectional relation between stock returns and the variability of liquidity. Liquidity was proxied by measures of trading activity such as volume and turnover. Thus, they reached an unexpected result. Stocks with more volatile liquidity have lower expected returns. On the contrary, Pastor and Stambaugh (2003) argued that stocks whose returns were influenced by the market liquidity fluctuations lead to higher expected returns.

Basu (1983) illustrated that earning-price ratio helped to explain the cross-section average returns on US stocks. He used tests that included size and market beta (β). Fama and French (1992) found evidence that companies' portfolios with low book-to-market ratio have earned sharply lower returns than those with high ratios. The book-to-market ratio (BE/ME) was defined as the accounting book value of the company's assets to the market value of its equity. The BE/MEratio can be thought as a measure of stock price value.

Furthermore, Campbell and Hamao (1992) explained that variables such as dividends and domestic short-term of interest rates were helpful in forecasting stock returns in the US and Japanese Markets. Aragon and Nieto (2005) considered the relation between the volume and the volatility and they concluded that the total trading volume was unable to eliminate the GARCH effects on the market returns. Clark (1973), Epps and Epps (1976) and Tauchen and Pitts (1983) reached in the same result using distribution models.

All previous evidence attracted to examine the relation of the excess returns with dividends yields, volume, and earnings price ratio together and separately, the relation between the volatility, volume and the dividend yields and if there was interaction between the mean and the variance.

The contribution of this paper is mainly the following, i) GARCH(1,1) model estimates variables such dividend yields, volume, order flow and the earning- price ratio ii) the conditional variance contains not only the volume as in Arago and Nieto (2005) but also the dividend yields and finally iii) the earning-price ratio relevance with the excess returns estimated not only with GARCH(1,1) but also with GJR-GARCH(1,1)in order to capture the asymmetries.

The paper is organized as follows: Section 2 describes the methodological issues, section 3 presents the data, section 4 discusses empirical results and section 5 concludes.

2. METHODOLOGY

This research investigates the relation between order flow, dividend yields and earning-price ratio with excess returns. This investigation is based on GARCH models, particular GARCH(1,1) model which was exhibited by Bollerslev. The model employed is the following:

$$s^2_t = w + a\varepsilon^2_{t-1} + bs^2_{t-1} \qquad (1)$$

Where s_t the conditional variance and w is the intercept.

Additionally, the sum of parameters a, b in the conditional variance equation measured the persistence in volatility and lied between 0 and 1.

All GARCH models used in this research included three dummies variables which are January effect, October 87 and August 98 financial crises effects. The reason which January effect was plugged in the model was to its significance according to Eleswarapu (1997). The other two dummies used to investigate financial crises and their impact in excess returns. The first model investigated is:

$$Er_t = c + aEr_{t-1} + bEr_{t-2} + gOct87 + dje + y\,Aug98 + f\,Vr_{t-1} + u \quad (2)$$

$$u \sim N\,(0,\ s_t^2) \text{ and } s_t^2 = w + au_{t-1}^2 + bs_{t-1}^2 \quad (3)$$

where Er_t is the excess return in the period t, Er_{t-1} is the excess return in the period t-1, Er_{t-2} is the excess return in the period t-2, Je denotes the January effect, while Oct87 denotes October 1987 financial crisis and Aug98 is August 1998 financial crisis and Vr_{t-1} is the order flow in the period t-1. The error u is a white process and the conditional and unconditional means of ε_t are equal to zero.

Restimating this model and modificating conditional variance (equation 3) with V_{t-1}: Volume (number of shares), and Dy_{t-1}: Dividend yield in period t-1,we construct model 2 :

$$Er_t = c + aEr_{t-1} + bEr_{t-2} + gOct87 + dje + y\,Aug98 + f\,Vr_{t-1} + u \quad (4)$$

$$u \sim N(\,0,\ s_t^2) \text{ and } s_t^2 = w + au_{t-1}^2 + bs_{t-1}^2 + mV_{t-1} + qDy_{t-1} \quad (5)$$

In this research, we used the same aspect of liquidity as Pastor and Stambaugh (2003) established. This aspect of liquidity associated with temporary price fluctuations created by order flow. The order flow formulated as the volume signed by a contemporaneous return on the stock (here volume and return of the last working month's day), it also accompanied by a return that we expect to be partially reversed in the future (here the first working month's day return). As Pastor and Stambaugh, we assume that the greater is that expected reversal for a given volume, the lower is the stock's liquid. The variable Vr_{t-1} = sign (Er_{t-1})* V_{t-1}.GARCH (1,1) was used to examine the relationship between volatility and trading volume and the dividend yields.

Two more models 3 and 4 were run and their specification including new regressors are as follows: the order flow Vr_{t-1} the dividend yields Dy_{t-1}:

$$Er_t = c + \alpha Er_{t-1} + \beta Er_{t-2} + \gamma Oct87 + \delta je + \psi Aug98 + \phi Dy_{t-1} + u_t \quad (6)$$

u~N(0, σ_t^2) and $\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2$ (7)

and $Er_t = c + \alpha Er_{t-1} + \beta Er_{t-2} + \gamma Oct87 + \delta je + \psi Aug98 + \phi Dy_{t-1} + u_t$ (8)

u~N(0, σ_t^2) and $\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2 + \mu V_{t-1} + \theta Dy_{t-1}$ (9)

These modifications made to compare these models to Campell and Hamao (1992) evidence which showed that dividend yields had positive effect in the excess returns. Arago and Nieto (2005) used GARCH (1,1) model with volume the conditional variance Based on that we added the dividend yields and the volume there. Moreover, in the position of dividend yields we plugged in the earning-price ratio t-1 Ear_{t-1} in the equation (6) so the model 5 was taken the following form:

$$Er_t = c + \alpha Er_{t-1} + \beta Er_{t-2} + \gamma Oct87 + \delta je + \psi Aug98 + \phi Ear_{t-1} + u_t \quad (10)$$

u~N(0, σ_t^2) and $\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2$ (11)

The results of this model were compared with the evidence of Basu (1983), who argued that the earning- price ratio explained the excess returns. We also tried to compare these results with another model, the GJR-GARCH(1,1) that captures the asymmetries (Glosten, Jagannathan, Runcle (1993) which was:

$$\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2 + \phi u_{t-1} I_{t-1} \qquad (12)$$

Where $I_{t-1} = 1$ if $u_{t-1} < 0$ $u_{t-1} \geq 0$ and $I_{t-1} = 0$ if $u_{t-1} < 0$

So model 6 was transformed into:

$$Er_t = c + \alpha Er_{t-1} + \beta Er_{t-2} + \gamma Oct87 + \delta je + \psi Aug98 + \phi Ear_{t-1} + u_t \qquad (13)$$

u~N(0, σ_t^2) and $\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2 + \phi u_{t-1} I_{t-1}$ (14)

Where I_{t-1} : the factor which capture the asymmetries.

Finally, last two models (7,8) were estimated in this paper as a combination of all previous variables:

$$Er_t = c + \alpha Er_{t-1} + \beta Er_{t-2} + \xi Dy_{t-1} + \phi Je + \varepsilon oct87 + \zeta Aug98 + \theta ear_{t-1} + \eta yr_{t-1} + \qquad (15)$$

u~N(0, σ_t^2) and $\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2$ (16)

and

$$Er_t = c + \alpha Er_{t-1} + \beta Er_{t-2} + \xi Dy_{t-1} + \phi Je + \varepsilon oct87 + \zeta Aug98 + \theta ear_{t-1} + \eta yr_{t-1} + \qquad (17)$$

u ~N(0, σ_t^2)

$$\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2 + \gamma V_{t-1} + \delta Dy_{t-1} \qquad (18)$$

In these models, dividend yields, earning-price ratio, order flow and dummy variables January effect, August98, October 87 were plugged in. In conditional variance volume and dividend yields were added like in Aragon and Nieto (2005). ARCH effects in the UK index returns were also tested for each model mentioned above.

3. Data

The data used in this paper are from the London Stock Exchange FTSE 100. They consisted of monthly (the last day of each month) values of volume (number of shares), dividend yields, earning/price ratio for a period from January 31 1986 to May 31 2005. All data used are selected from Data Stream International and are converted in logs.

Excess returns estimated as the difference between the return index and the monthly risk free rate. r_m is the difference between the logarithm of return index and the logarithm of return index of previous month ($r_m = [\log(RI)_t - \log(RI)_{t-1}]$. The monthly risk free rate is calculated as $r_f = R_f/12$, where R_f is the annual risk free rate.

4. Empirical Results

The econometric techniques applied to investigate the key aspect of this paper which is to examine how the variables volume and dividend yields in the conditional variance influence the excess returns. Table 1 presents the results of the models 1, 3 and 7 while table 2 records the estimation of the models 2, 4 and 8 where volume and dividend yields contained in conditional variance. Table 3 presents the results model 5 and 6 because of using a different GARCH model (GJR-GARCH(1,1)). Tables 1 to 3 presents dummy variables, especially Oct87 to have high impact in the excess returns.

Insert table 1

Insert table 2

Insert table 3

In contrast to Eleswarapu (1997), this research proved that there is no evidence that equities have seasonal differences specially due to January effect because in each model which was tested, it was noticed that the January effect was insignificant at any significance level. Also, January effect found to have positive impact to excess returns.

On the other hand, while Campbell and Hamao (1992) found that dividend yields have positive impact to returns, this paper showed that the dividend yields have negative effect(see coefficients of dividend yields in tables 1 and 2), especially in model 7, which presented the greatest impact in excess returns.

Furthermore, in tables 1 and 2, it was noticed that the order flow was insignificant and it has small impact in excess returns against the evidence of Pastor and Stambourgh (2003). Therefore, as it is mentioned in the existing evidence, Basu (1983) stated that the earning-price ratio helped to explain returns but in this analysis it is demonstrated that the earning-price ratio was insignificant in all models tested. But, when the model changed (from GARCH(1,1) to GJR-GARCH(1,1),(see table 3) the earning-price ratio was very significant.

From this analysis, it could be concluded that there was GARCH effects in the index of returns in UK market because in all models studied, the ARCH and the

GARCH[3] were significant. Also, the shocks of the conditional variances would be highly persistent because this sum was closed to unity in each model. In the existing evidence as it was mentioned in Arago and Nieto(2005) when they used GARCH[4] model to examine all the markets they conclude that the volume in the conditional variance is significant in UK market. In contrast to above, it was noticed that the volume was insignificant in UK market (see the volume t-statistic in tables 1and 2) and demonstrated that the dividend yields are insignificant in the conditional variance and mean when we examine all the variables but in table 1 the dividend yields were significant only at 1% significance level. This indicates that when added the volume and the dividend yields in the conditional variance the order flow, the dividend yields, the earning-price ratio and the Oct87 had greater effect in excess returns than without them in the conditional variance in the model 8(table 2). When we follow the same in models 2 and 4 (see table 2) the opposite result appeared[5].

5. Conclusions

The purpose of this paper was to examine the relationship between the excess returns, the volume, the dividend yields and the earning-price ratio using a GARCH (1, 1) model. This research examined the FTSE 100 equity index from London Stock Exchange and these data were consisted of the last day of each month values of volume, dividend yields, earning-price ratio from January 31 1980 to May 31 2005.

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[3] GARCH (1, 1) was stationary because the sum of the coefficients of ARCH and GARCH were less than one.

[4] The Akaike info criterion and the Schwarz criterion were lower in models (model 2 and 4) with volume and dividend yields in conditional variance than in models 1 and 3. Consequently, the models 2 and 4 were better than the models 1 and 3.

[5] The Akaike the Schwarz info criterion were lower in models 2 and 4 than in models 1 and 3 with volume and dividend yields in conditional variance.

The main model used had as dependent variable the excess returns and independent variables two lags of returns, dividend yields, earning-price ratio, January effect and August 1998 and October 1987 financial crises as dummy variables. Volume and dividend yields were in conditional variance as in Arago and Nieto (2004). We estimated a number of models and we found that there is an interrelation between the variables of the mean and the conditional variance because the coefficients in the mean had higher effects to the excess returns. Moreover, it was clear that the order flow had no significant effect on the excess returns. The dividend yields and earning-price ratio it was found that if they had an effect or not on excess returns depends on the significant level and the GARCH model. Finally, the dummy variable Oct87 had high effect in excess returns.

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Table 1
GARCH(1,1) models for monthly returns without Volume and Dividend yields in conditional variance.

Coefficients of Variables (SE)	**Model 1**	**Model 3**	**Model 7**
C (SE)	-0.0007(0.00112)	0,004(0,003)	0,007(0,0056)
	-0.6568	*1,45*	*1,34*
Er_{t-1} **(SE)**	-0.098(0.07421)	-0,042(0,059)	-0,10(0,072)
	-1.3289	*-0,71*	*-1,38*
Er_{t-2} **(SE)**	-0.0083(0.07198)	-0,006(0,068)	-0,005(0,070)
	-0.1148	*-0,09*	*0,07*
JE (SE)	0.0025(0.00371)	0,002(0,003)	0,002(0,003)
	0.6802	*0,51*	*0,76*
OCT87(SE)	-0.124(0.02584)	-0,113(0,029)	-0,12(0,0277)
	-4.7823	*-3,78*	*-4,31*
AUG98(SE)	-0.0603(0.00556)	-0,049(0,006)	-0,058(0,003)
	-10.843	*-8,15*	*-15,83*
Vr_{t-1} **(SE)**	$2.21*10^{-13}(1.96*10^{-13})$	-	$2,04*10^{-13}$ $(1,89*10^{-13})$
	1.1265		*1,07*
Dy_{t-1} **(SE)**	-	$-9,12*10^{-12}$ $(5,96*10^{-12})$	$-1,08*10^{-11}$ $(5,98*10^{-12})$
		-1,54	*-1,81*
Ear_{t-1} **(SE)**	-	-	$-2,27*10^{-12}(4,07*10^{-12})$
			-0,56
		Variance equation	
W (SE)	$1.84*10^{-5}(1.20*10^{-5})$	$1,02*10^{-5}$ $(8,44*10^{-6})$	$1,14*10^{-5}$ $(9,30*10^{-6})$
	1.533004	*1,21*	*1,22*
ARCH(1)(SE)	0.155971(0.052217)	0,19(0,05)	0,177(0,053)
	2.986946	*3,54*	*3,31*
GARCH(1)(SE)	0.794000(0.070801)	0,79(0,057)	0,799(0,062)
	11.21454	*13,8*	*12,91*
ARCH Test	-0,0018(0,057)	-0,013(0,06)	-0,017(0,05)
	-0,032	*-0,22*	*-0,31*

t-statistics are in italics.
The square errors are referred in brackets and all the models in this table has the form: $s^2_t = w + a\varepsilon^2_{t-1} + bs^2_{t-1}$

Table 2
GARCH(1,1) Models for monthly returns with Volume and Dividend yields in conditional variance.

Coefficients of Variables (SE)	Model 2	Model 4	Model 8
C (SE)	-0,0018(0,0011)	0,004(0,003)	0,003(0,0064)
	-1,639	*1,36*	*0,617*
Er_{t-1} **(SE)**	-0,0078(0,0764)	-0,042(0,061)	-0,082(0,1111)
	-1,024	*-0,68*	*-0,744*
Er_{t-2} **(SE)**	-0,0174(0,0695)	-0,006(0,066)	-0,011(0,1059)
	0,251	*-0,097*	*-0,106*
JE (SE)	0,0021(0,0037)	0,0018(0,0033)	0,002(0,0002)
	0,583	*0,542*	*0,750*
OCT87(SE)	-0,1381(0,0049)	-0,113(0,029)	-0,136(0,0072)
	-27,905	*-3,94*	*-18,82*
AUG98(SE)	-0,0538(0,0027)	-0,049(0,006)	-0,054(0,0039)
	-19,648	*-8,053*	*-13,69*
Vr_{t-1} **(SE)**	$2{,}11*10^{-12}(2{,}01*10^{-13})$	-	2,16E-13(5,00E-13)
	1,053		*0,43*
Dy_{t-1} **(SE)**	-	$-9{,}06*10^{-12}$ $(6{,}23*10^{-12})$	$-8{,}10*10^{-12}(6{,}52*10^{-12})$
		-1,456	*-1,24*
Ear_{t-1} **(SE)**	-	-	$-7{,}40*10^{-13}$ $(4{,}11*10^{-12})$
			-0,18
	Variance Equation		
W (SE)	$3{,}11*10^{-5}$ $(5{,}20*10^{-5})$	$1{,}02*10^{-5}$ $(3{,}67*10^{-5})$	0,00033(0,0001)
	0,59	*0,27*	*2,69*
ARCH(1)(SE)	0,15(0,05)	0,19(0,056)	0,17(0,113)
	2,61	*3,38*	*1,49*
GARCH(1)(SE)	0,79(0,07)	0,79(0,052)	0,8(0,112)
	10,27	*15,32*	*7,11*
V_{t-1}	$-5{,}20*10^{-15}$ $(1{,}18*10^{-14})$	$5{,}45*10^{-14}$ $(9{,}55*10^{-14})$	$-4{,}18*10^{-14}$ $(2{,}86*10^{-14})$
	-0,44	*0,57*	*-1,46*
Dy_{t-1}	$4{,}66*10^{-14}$ $(1{,}40*10^{-13})$	$-4{,}34*10^{-15}$ $(9{,}06*10^{-15})$	$-5{,}86*10^{-14}$ $(1{,}52*10^{-13})$
	0,33	*-0,47*	*-0,38*
ARCH Test	-0,007(0,064)	0,02(0,05)	0,27(0,24)
	-0,114	*0,35*	*1,1*

t-statistics are in italics.
The square errors are referred in brackets and all the models in this table has the form:

$$s_t^2 = w + a\varepsilon_{t-1}^2 + bs_{t-1}^2 + \gamma V_{t-1} + cDy_{t-1}.$$

Table 3
Changing model's 5 GARCH (1,1) into GJR-GARCH(1,1).

Coefficients of Variables (SE)	Model 5	Model 6
C (SE)	0,0015(0,005)	-0,0007(0,0011)
	0,31	*-0,67*
Er_{t-1} (SE)	-0,0317(0,063)	-0,035(0,063)
	-0,5	*-0,55*
Er_{t-2} (SE)	-0,012(0,068)	-0,0049(0,066)
	-0,17	*-0,07*
JE (SE)	0,002(0,004)	0,0012(0,004)
	0,63	*0,31*
OCT87(SE)	-0,112(0,033)	-0,11(0,032)
	-3,40	*-3,46*
AUG98(SE)	-0,053(0,003)	-0,056(0,0032)
	-16,1	*-17,32*
Ear_{t-1} (SE)	$-1{,}30*10^{-12}$ ($4{,}08*10^{-12}$)	$2{,}59*10^{-13}$ ($2{,}15*10^{-15}$)
	-0,32	*120,65*
	Variance Equation	
W (SE)	$2{,}36*10^{-5}$ ($1{,}15*10^{-5}$)	$4{,}73*10^{-5}$ ($9{,}04*10^{-5}$)
	2,04	*0,523*
ARCH(1)(SE)	0,22(0,068)	0,126(0,10)
	3,23	*1,2*
GARCH(1)(SE)	0,72(0,075)	0,65(0,10)
	9,71	*6,45*
(RESID<0)*ARCH(1)	-	0,157(0,13)
		1,25

t-statistics are in italics. The square errors are referred in brackets.