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Stock returns and Inflation:
Evidence from Quantile Regressions

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Abstract

The relationship between stock returns and inflation is examined for the G7 countries and some positive coefficients in the distribution for Italy and the UK were revealed. A positive one-for-one relationship is found once a GARCH filter is employed in all cases except Canada.

Keywords: Stock Returns, Inflation, Hedging, quantile regression
JEL: G10, G15, C32

1. INTRODUCTION

The relationship between stock returns and inflation has remained an important topic in economics, yielding several empirical regularities for different countries. There is much evidence that common stock returns and inflation has been negatively related, especially during the post-war period for the US and other developed economies (see Bodie, 1976; Nelson, 1976; Fama and Schwert, 1977; Jaffe and Mandelker, 1976). These studies document negative relations between stock returns and both expected and unexpected components of inflation. International evidence by Gultekin (1983) covering 26 countries during the post-war period, consistently confirmed that common stocks are a poor hedge against inflation (the only exception is UK). These results are puzzling and are at variance with the general proposition that all things equal, in a competitive market, equity stocks, which represent claims against the real assets of a business may serve as a hedge against inflation, and hence, return on common equity should keep pace with inflation.

Empirical research has been devoted to explain this anomaly. Fama (1981) posits a proxy hypothesis: the negative relationship between stock returns and inflation are proxying for positive relationship between stock returns and real variables which are more fundamental determinants of equity values. The negative relations are induced by negative relations between inflation and real activity which in turn are explained by a combination of money demand and the quantity theory of money. Feldstein (1980) argue that for the US, the failure of share prices to rise during periods of inflation is the result of the basic features of US tax laws.

Departing from previous studies, we employ quantile regression to investigate how the different quantiles of stock returns are affected by the inflation rate. We show that by minimizing the asymmetrically weighted absolute residuals, and by estimating conditional median functions, the lower quantiles of the relationship between stock returns and inflation is negative for Canada and Italy. For the US, there is a negative and significant relationship between stock returns and inflation throughout the distribution. Using a GARCH filter, we find evidence to suggest that nominal stock returns are positively related to inflation. Indeed our estimates indicate that stock returns tend to move one-for-one with the inflation rate in G7 countries.

The rest of the paper is organised as follows: the next section outlines the methodology and the intuition for resorting to quantile regressions and the GARCH filter. We briefly describe the data in section 3. Results are discussed in section 4.

2. Methodology

Most of the empirical literature to date has focused on the conditional mean of the dependent variable, stock returns. Koenker and Bassett (1978) proposed quantile regression that provides estimates of the linear relationship between the regressors and a specified quantile of the dependent variable. OLS regressions that have dominated the literature have identified only the conditional mean response of stock returns. In this study, we model the quantiles of stock returns for a given inflation rate. For a more detailed analysis of quantile regression see Koenker and Hallock (2001).

The conditional quantile function of y at quantile τ given regressor x can be defined as:

$$Q_y(\tau / x) = \beta_0 + \beta_1 x + F_u^{-1}(\tau)$$

where F_u denotes the common distribution function of the errors and β_0 and β_1 the parameters to be estimated. In a stock return-inflation nexus which we investigate, y are stock returns and x inflation.

For the τth conditional quantile function, $0 < \tau < 1$, $\hat{\beta}_\tau$ is defined as a solution to the problem:

$$\min_{\beta \in \mathbb{R}^p} \sum_{i=1}^{n} \rho_\tau (y_i - x_i^T \beta)$$

where ρ_τ is the check function defined as $\rho_\tau(u) = \theta_u$ if $u \geq 0$ or $\rho_\tau(u) = (\tau - 1)_u$ if $u < 0$. This problem does not have an explicit form but can be solved by linear programming methods. Standard errors are obtainable by bootstrap methods. The least absolute deviation (LAD) estimator of β is a particular case within this framework. This is obtained by setting $\tau = 0.5$ (median regression). The first quantile is obtained by setting $\tau = 0.1$ and so on. As one increases τ from 0 to 1, one traces the entire distribution of the regressor conditional on the regressand.

Thus quantile regressions provide snapshots of different points of a conditional distribution. This flexibility has so far been precluded in the stock returns-inflation debate, to the best of our knowledge.

3. Data

Monthly stock price and consumer price data from 1970:01 to 2008:04 are employed for Canada, France, Germany, Italy, Japan, UK and the US. The stock price data are: CAC 40 for France, DAX 40 for Germany, Nikkei 225 for Japan, S&P 500 for US, and FTSE 100 for UK, TSX for Canada and MIBTEL for Italy and were obtained from DataStream. Monthly stock returns are calculated as $\Delta S_t = 100(\ln S_t - \ln S_{t-12})$. Inflation was measured as $\Delta P_t = 100(\ln P_t - \ln P_{t-12})$ and was obtained from IFS of the IMF.

4. Results

We examine the contemporaneous relationship between stock returns and inflation by estimating the following regression:

$$\Delta S_t = \alpha + \beta \Delta P_t$$

where ΔS_t are stock returns and ΔP_t inflation. The results appear in Table 1 (OLS). A negative and significant coefficient appears only for the US. Insignificant coefficients appear for all the other cases. We then proceed and employ quantile regression (10 quantiles, see Table 1). In the first quantile a significant and positive relation is revealed for Germany compared to an insignificant OLS coefficient. Negative and significant coefficients were found for Canada, Italy and the US for the same quantile. The median estimators were all insignificant with the exception of the US (similar to the OLS results). On the right tail of the distribution (higher returns), though we observe positive coefficients that are statistically significant in some cases (Italy and the UK). In the US the coefficient is negative throughout the distribution but with an upward slope (see Figure 1).

Both the BDS and the Engle LM test confirm that residuals from the OLS are not *iid* (results available upon request). Hamilton (2008) demonstrates the importance of neglected ARCH in macroeconomics and in particular in the conditional mean which will be influenced by outliers and high variance episodes. A univariate GARCH (1, 1) with *t*-distribution filter is thus employed in all cases and the results of the filtered data are presented in Table 2. All the OLS (and GARCH) coefficients are highly significant and very close to unity with the exception of Canada where the latter is still positive and significant. These results are confirmed with the quantile regression where we get unity significant coefficients in all countries but Canada. This is also true across the conditional distribution (see Table 2).

5. Conclusions

This study revisits the relationship between stock returns and inflation for the G7 countries. We focus on the short-term relationship between the two and employ a quantile regression framework. A positive relationship was found for most cases: as we move to higher quantiles for the dependent variable the response increases. Positive coefficients in the right tail of the distribution were found for Italy and the UK. A significantly upward slope is found for the US. Once a GARCH filter is employed unity coefficients were obtained from the OLS, GARCH and quantile estimation with the exception of Canada. Thus, stocks after all do act as a hedge against inflation for the G7 countries.

Table 1: Quantile and OLS Regression

	Quantile	Canada	France	Germany	Italy	Japan	UK	US
ΔP_t	0.1	-1.462*	-3.863	3.5262**	-1.549*	0.5652	-0.5970	-5.091***
		(-1.831)	(-1.538)	(2.284)	(-1.828)	(0.978)	(-0.774)	(-5.85)
	0.2	-0.623	0.3804	1.6914	-1.2864*	-0.172	-0.5854	-3.097***
		(-0.863)	(0.119)	(0.897)	(-1.695)	(-0.316)	(-1.135)	(-2.70)
	0.3	-0.354	-0.4881	-0.2124	-0.776	0.0532	-0.667	-2.429***
		(-0.542)	(-0.179)	(-0.1213)	(-0.964)	(0.078)	(-1.140)	(-3.71)
	0.4	-0.569	-0.963	0.0163	-0.5726	0.4458	0.1693	-2.539***
		(-0.905)	(-0.478)	(0.011)	(-0.751)	(1.106)	(0.269)	(-4.24)
	0.5	-0.5530	-0.5765	0.1827	0.2277	0.3780	-0.0392	-1.888***
		(-0.909)	(-0.3168)	(0.1473)	(0.297)	(1.0787)	(-0.068)	(-3.14)
	0.6	-0.4176	-1.0201	0.0302	0.56782	0.3997	0.1034	-1.892***
		(-0.73)	(-0.573)	(0.0255)	(0.859)	(1.222)	(0.205)	(--2.88)
	0.7	-0.574	-1.6979	-0.2088	0.8337	0.1467	0.268	-2.218***
		(-1.019)	(-0.980)	(-0.186)	(1.1764)	(0.4424)	(0.472)	(-2.85)
	0.8	0.3675	0.5517	0.3949	2.3812***	-0.1274	0.90902	-1.506
		(0.556)	(0.298)	(0.2809)	(3.3057)	(-0.359)	(1.3602)	(-1.60)
	0.9	1.0061	-1.1730	-0.4364	2.5462**	-0.5942	1.3156*	-1.277
		(1.4141)	(-0.296)	(-0.2707)	(2.0014)	(-1.609)	(1.687)	(-1.70)*
OLS								
ΔP_t		-0.498 (-0.92)	-1.07 (-0.63)	0.861 (0.643)	0.0036 (0.73))	0.004 (0.001)	0.143 (0.320)	-2.126*** (-3.624)
Pseudo R-squared		0.001638	0.000124	0.00003	0.000154	0.002263	0.00007	0.01917
Adjusted R-squared		-0.00055	-0.00392	-0.00485	-0.001019	0.000075	-0.0027	0.01702

t-stats in parenthesis. Pseudo R-squared from Koenker and Machado (1999). ***, ** and * denote 1%, 5% and 10% significance level.

Table 2: Quantile, OLS and GARCH from the filtered data

	Quantile	Canada	France	Germany	Italy	Japan	UK	US
ΔP_t	0.1	0.0467	0.9995	0.9968	0.9999	0.9985	0.9835	0.9849
		(51.386)	(333.15)	(478.06)	(1666.2)	(436.57)	(154.08)	(107.53)
	0.2	0.0448	0.9999	1.0013	1.0000	0.9988	0.9817	1.0014
		(92.435)	(906.52)	(447.56)	(1251.2)	(1164.5)	(174.52)	(114.71)
	0.3	0.0441	1.0005	1.0013	1.0005	0.9989	0.9806	0.9972
		(107.79)	(967.57)	(571.808)	(1505.27)	(1485.61)	(166.18)	(127.57)
	0.4	0.0435	1.000	0.999	1.000	0.999	0.9818	0.997
		(109.534)	(1029.5)	(639.74)	(3464.27)	(1910.44)	(173.79)	(124.22)
	0.5	0.0435	1.0000	1.0000	1.0002	0.9997	0.9810	0.9957
		(107.08)	(950.23)	(689.694)	(3966.85)	(2152.04)	(168.90)	(103.49)
	0.6	0.0434	0.9995	1.0015	1.0001	1.0003	0.9840	0.9899
		(107.90)	(839.69)	(623.70)	(4213.3)	(2340.4)	(167.56)	(89.738)
	0.7	0.0435	1.0005	1.0008	1.0002	1.0004	0.9852	0.9884
		(90.622)	(788.41)	(671.30)	(4174.2)	(2384.6)	(159.49)	(85.148)
	0.8	0.0446	1.0006	1.0021	0.9999	1.0007	0.9855	0.9889
		(92.605)	(651.38)	(702.20)	(3612.99)	(2197.25)	(174.56)	(76.125)
	0.9	0.0448	1.0009	1.0008	0.9999	1.0007	0.9868	0.9881
		(93.46)	(79.86)	(59.384)	(417.49)	(767.91)	(215.7)	(48.23)
Pseudo R-squared		0.8835	0.9848	0.9816	0.9947	0.9892	0.9364	0.8314
Adjusted R-squared		(0.883)	(0.984)	(0.981)	(0.994)	(0.989)	(0.936)	(0.831)
OLS								
C		0.00032	0.0005	0.0010	-0.0007	0.0009	0.0850	0.0164
		(0.981)	(0.525)	(0.785)	(-3.113)	(1.479)	(23.84)	(1.991)
ΔP_t		0.0461	0.999	1.0000	1.0000	0.999	0.981	0.986
		(144.41)	(1020.9)	(718.86)	(3892.9)	(1722.5)	(280.43)	(120.72)
GARCH								
C		0.00045	0.00135	0.0014	0.00167	0.0035	0.0846	-0.015
		(3.794)	(1.421)	(1.0002)	(11.29)	(8.818)	(27.26)	(-2.452)
ΔP_t		0.0417	0.999	1.000	1.000	0.999	0.976	0.998
		(506.19)	(1272.8)	(751.43)	(7719.2)	(2528.4)	(435.36)	(173.24)

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