The relationship between Stock Market Returns and Inflation: An econometric investigation using Greek data

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Abstract. Since the theory establishes a relationship between stock market returns and inflation rate, this study examines whether this holds for Greece, over the period 1985 - 2000. Taking a step further, we re-examine the above relationship taking into account the existence of possible structural breaks over the considered time horizon. The empirical methodology uses ARDL cointegration technique in conjunction with Granger causality tests to detect possible long-run and short-run effects between the involved variables as well as the direction of these effects. The results provide evidence in favour of a negative long-run causal relationship between the considered series after 1992.

Keywords: Inflation, stock market returns, ARDL cointegration, causality.

1 Intoduction

The Greek economy suffered from high inflation rates since the late 70's. During the 80's the government followed a loose monetary policy which increased inflation even more. In 1992, a tight monetary policy was introduced, and Greece attempted to decrease the level of inflation in order to achieve the Maastricht criteria. On the other hand, the Greek stock market followed an upward trend from 1985 to 2000, with some fluctuations. According to the generalized Fisher hypothesis, equity stocks, which represent claims against the real assets of a business, may serve as a hedge against inflation. Consequently, investors would sell financial assets in exchange for real assets when expected inflation is pronounced. In such a case, stock prices in nominal terms should fully reflect expected inflation and the relationship between these two variables should be found positively correlated ex ante. According to [Bodie, 1976], equities are a hedge against the increase of the price level due to the fact that they represent a claim to real assets and, hence, the real change on the price of the equities should not be affected. If we consider that firms are in a position to predict their profit margins and since equities are claims on current and future earnings, it also follows that the stock market operates as a hedge against inflation, at least in the long run. The earnings should be consistent with the inflation rate, and hence the real value of the stock market should remain unaltered in the long run. The argument that stock market serves as a hedge against inflation, implies that investors are fully compensated for increases in the general price level through corresponding increases in nominal stock market returns and thus the real returns remain unaffected. In other words the argument is that the real value of the stock market is immune to inflation pressures. This has been tested in the literature numerous times. The hedge hypothesis has been examined extensively in the literature. Empirical evidence is rather mixed and could be classified into the following three categories: a) Research findings which provide support in favor of a positive relationship between inflation and stock market returns. [Firth, 1979], and [Gultekin, 1983], conclude that the relationship between nominal stock returns and inflation in the United Kingdom is relative positive, a finding consistent with the generalized Fisher hypothesis. [Boudhouch and Richarson, 1993], employed data sets covering the period from 1802 to 1990 for the U.S and from 1820 to 1988 for Britain. The results that they obtained suggest a positive relationship between inflation and nominal stock returns over long horizons. [Ioannidis *et al.*, 2004], found evidence of positive correlation between inflation and stock market returns in Greece between 1985 and 2003. [Kessel, 1956], suggests that unexpected inflation increases the firm's equity values if the firm is a net debtor. b) Studies which provide evidence of a negative relationship between the inflation rate and the stock market returns. [Fama, 1981], suggests that there is a negative correlation between stock returns and the level of inflation. The negative relationship exists due to the correlation between inflation and future output. In particular, since stock prices reflect firms' future earnings potential, an economic downturn predicted by a rise in inflation will depress stock prices. [Spyrou, 2001], suggests that there is a negative relationship between stock market returns and inflation in Greece for the period 1990 to 1995. c) Studies which provide mixed results. [Pearce and Roley, 1988], found mixed empirical evidence on the subject. [Anari and Kolari, 2001], report negative correlations between stock prices and inflation in the short run which are followed by positive correlations in the long run.

Our research focuses on the relationship between inflation and stock market returns. The question we attempt to answer through the investigation of the above relationship is whether the stock market has been a safe place for investors in Greece. The empirical analysis is carried out by means of an ARDL cointegration, which permits the detection of long run as well as short run [Granger, 1969] causal effects. The remainder of the paper is organized as follows. Section 2 presents the methodology followed, section 3 presents the data and reports the empirical findings. Finally, section 4 presents a brief summary with some concluding remarks.

2 Methodological Issues

The autoregressive distributed lag approach to cointegration (ARDL) following the methodology outlined in [Pesaran and Shin, 1995] is employed in this paper. The main advantage of this procedure is that it can be applied regardless of the stationary properties of the variables in the sample and allows for inferences on long-run estimates, which is not possible under alternative cointegration procedures. In other words this strategy may applied irrespective of whether the series are $I(0)$ or $I(1)$, and this avoids the pre-testing in the model may be large. It is worth mentioning that the VAR models are not in position to allow for large number variables. The ARDL model in the [Pesaran and Shin, 1995] context is defined as:

$$\Phi(L)yt = \alpha_0 + \alpha_1 w + \beta'(L)xI + ut \tag{1}$$

where $\Phi(L) = 1 - \sum_{i=1}^{\infty} \Phi_i L^i$,
$\beta(L) = \sum_{j=1}^{\infty} \beta_j L^j$
and $L$is the lag operator and wt is a vector of deterministic variables such as the intercept term, seasonal dummies, time trends or exogenous variables with fixed lags. Most of the standard model specifications can be easily derived by imposing restrictions on the parameters. The standard static model can be obtained by imposing the restriction $\beta_1 = \phi_1 = 0$. The restrictions $\beta_1 = 0$and $\phi_1 \neq 1$, on the other hand, implies the partial adjustment mechanism. The corresponding long run solution to equation (1) adjustment mechanism. The corresponding long run solution to equation (1)

$$\delta = \alpha_1/\varphi(1), \theta = \beta/\varphi(1) \tag{2}$$

is invalid but they provide an alternative method, which yields consistent estimates of the parameters and their standard errors. There are three steps that must be followed for the ARDL approach to cointegration. In particular in the first step the existence of a long run relationship between the variables is established by testing for the significance of lagged variables in an error correction mechanism regression. In this paper the regression estimated in this step is defined as:

$$DLSN = \alpha_0 + \sum_{i=0}^{p} cDLSN_{t-1} + \sum_{i=0}^{p} cDLSN_{t-1} + e_i \tag{3}$$

Where DLSN is the first log difference of the stock market index and DLP is the first log difference of the consumer price index (inflation)

In this step, the first lag of the levels of each variable are added to the equation to create the error correction mechanism equation and a variable addition test is performed by computing an f-test on the significance of all the added lagged variables.

$$DLSN = \alpha_0 + \sum_{i=0}^{p} cDLSN_{t-i} + \sum_{i=0}^{p} cDLSN_{t-i} + \delta_1 LSN_{t-1} + \delta_2 LP_{t-1} + e_i \quad (4)$$

The null hypothesis of non-existence of a long-run relationship is defined by

$H_0 : \delta_1 = \delta_2 = 0$ while $H_1 : \delta_1 \neq 0, \delta_2 neq 0$

The relevant statistic is the F-statistic for the joint significance of 1 and 2. The tests are distributed according to a non-standard F-statistic irrespective of whether the explanatory variables are stationary or non-stationary. The critical value bounds for these tests were computed by [Pesaran *et al.*, 1996]. In the case where the F-statistic lies below the lower bound, the long run relationship may be rejected. On the other hand if the F-statistic is higher than the upper bound of the critical value band the null of no long run relationship between the variables can be rejected irrespective of their order integration. In the case that the F-statistic is between the two bounds then a unit root test should be applied. The second step of this approach involves estimating the ARDL form of 1 where the optimal lag length is chosen according to one of the standard criteria such as the Akaike Information Criterion (AIC) or the Schwartz Bayesian Criterion (SBC). Then the restricted version of the equation is solved for the long run solution. The third step involves the estimation of the error correction equation using the differences of the variables and the lagged long run solution and determines the speed of adjustment of employment equilibrium.

3 Data and Empirical Results

Data

For the empirical analysis we use monthly data collected from the OECD data bank and covering the period between 1/1985 and 1/2000. In particular, we use the General Index of the Greek stock market (S) and the Consumer Price Index (P). The inflation rate (DLP) and the stock market returns (DLSN) were calculated as the first differences of the logarithmic price levels of the respective series. We do not expand the data sample beyond 1/2000 since after that date Greece joined the EMU.

Empirical Results

Since the ARDL methodology does not require pre-testing for the integration properties of the individual series used in the empirical analysis, we proceed by applying the bounds testing-ARDL procedure to equation (4). The joint significance of the lagged levels of the variables in (4) was next tested by computing an F-test and comparing it with the appropriate critical value tabulated by [Pesaran *et al.*, 1996]. The findings of the empirical analysis are reported in tables 1,2 and 3 in the appendix. Initially the analysis covered the period 1/985 to 1/2000. The results suggested cointegration with long run causality running from inflation to stock market returns. Nevertheless, the application of CUSUM and CUSUMSQ test, indicated lack of stability of the coefficients for the sample period. Based on the respective graphs, presented in the appendix, as well as the LS ([Lee and Strazicich, 1999a] and [Lee and Strazicich, 1999b]) stationarity test which accounts for possible structural breaks, we split the sample period into two sub-periods (1/1985-5/1992 and 6/1992-1/2000). The date of the break suggested by the above tests coincides with the 1992 Athens Stock Market Crisis. The results of the bounds test are reported in Table 1. For the shake of robustness, we report the f-tests for $p = q = 6$ and 12. The evidence is in favor of the existence of cointegration between the stock market returns and inflation only over the second sub-period. With regard to the whole period, as was mentioned earlier, the evidence is unreliable. The empirical findings from the application of the ARDL cointegration methodology is presented in Table 2 in the appendix. Considering only the results obtained from the examination of the two sub-periods the evidence is as follows. Over the first sub-period there is evidence of a long run relationship running from LP towards LSN. In the second sub-period the results indicate bidirectional long-run causality. Finally, the paper addresses the issue of possible short-run causal relationships by means of Granger causality tests. The results reported in table 3 in the appendix indicate that over the first sub-period there is a causal effect running from returns to inflation while over the second sub-period we found evidence of a causal effect running from inflation to returns. The results regarding the whole period are ignored as it was explained earlier.

4 Concluding Remarks

In this paper we have examined the relationship between inflation and stock market returns in Greece. The causal effects among the considered variables were explored by means of ARDL cointegration and Granger causality tests. The evidence is in favor of a bidirectional negative long-run causal relationship which is consistent with [Fama, 1981] and [Spyrou, 2001]. Besides, we report short run causal effects running from returns to inflation for the period between 1/1985 and 5/1992, while for the period 6/1992 to 1/2000 the direction is from inflation towards returns.

5 Appendix

In this section we present our numerical results.

Period: 1/1985 - 1/2000		
Dependent Variable	lag length (p=q)	F-values
DLSN	6	6.78
	12	7.45
DLP	6	3.28
	12	4.76
Period: 1/1985 - 5/1992		
Dependent Variable	lag length (p=q)	F-values
DLSN	6	2.45
	12	3.26
DLP	6	2.25
	12	2.87
Period: 6/1992 - 1/2000		
Dependent Variable	lag length (p=q)	F-values
DLSN	6	6.65
	12	6.93
DLP	6	7.15
	12	7.85

Table 1. Table 1. Critical values bounds testing-ARDL, for 0.05 significance levels (4.94 - 5.73)

Period: 1/1985 - 1/2000		
LSN	LP	P-value
1	1.8677	0.06
Period: 6/1992 - 1/2000		
LSN	LP	P-value
1	-6.2965	0.00
-0.1	1	0.005

Table 2. Table 2. Long-Run Causality based on ARDL selected model

References

[Anari and Kolari, 2001]A. Anari and J. Kolari. Stock prices and inflation. *Journal of Financial Research*, pages 587–602, 2001.

[Bodie, 1976]Z. Bodie. Common stocks as a hedge against inflation. *Journal of Finance*, pages 459–470, 1976.

[Boudhouch and Richarson, 1993]J. Boudhouch and M. Richarson. Stock returns and inflation: a long-horizon perspective. *American Economic Review*, pages 1346–1355, 1993.

[Fama, 1981]E.F. Fama. Stock returns, real activity, inflation and money. *American Economic Review*, pages 545–565, 1981.

[Firth, 1979]M. Firth. The relationship between stock market returns and rates of inflation. *Journal of Finance*, pages 743–749, 1979.

[Granger, 1969]C.W.I. Granger. Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, pages 423–438, 1969.

[Gultekin, 1983]N.B. Gultekin. Stock market returns and inflation: evidence from other countries. *Journal of Finance*, pages 49–65, 1983.

[Ioannidis *et al.*, 2004]D. Ioannidis, K. Katrakilidis, and A.E. Lake. Inflation, uncertainty and stock market returns evidence using greek data. *Under Publication*, 2004.

[Kessel, 1956]R.A. Kessel. Inflation caused wealth redistribution: a test of hypothesis. *American Economics Review*, pages 128–141, 1956.

[Lee and Strazicich, 1999a]J. Lee and M. Strazicich. Minimum lm unit root test. 1999a.

[Lee and Strazicich, 1999b]J. Lee and M. Strazicich. Minimum lm unit root test with two structural breaks. 1999b.

[Pearce and Roley, 1988]D.K. Pearce and V.V. Roley. Firm characteristics, unanticipated inflation, and stock returns. pages 965–981, 1988.

[Pesaran and Shin, 1995]M.H. Pesaran and Y. Shin. An autoregressive distributed lag modelling approach to cointegration analysis. *DAE Working Paper, No. 9514*, 1995.

[Pesaran *et al.*, 1996]M.H. Pesaran, Y. Shin, and R.J. Smith. Testing for the existence of a long-run relationship. *DAE Working Paper, No. 9622*, 1996.

[Spyrou, 2001]S. Spyrou. Stock returns and inflation: Evidence from an emerging market. *Applied Economics Letter*, pages 447–450, 2001.