Review of Economics & Finance
Submitted on 01/Apr./2012
Article ID: 1923-7529-2012-03-71-08 Samih Antoine Azar

Determinants of Cyclical Aggregate Dividend Behavior

Dr. Samih Antoine Azar

Faculty of Business Administration & Economics, Haigazian University
Mexique Street, Kantari, Beirut, LEBANON
Tel: + 961 1 349 230/1, Fax: + 961 1 350 926
E-mail: samih.azar@haigazian.edu.lb or azars@haigazian.edu.lb

Abstract: The purpose of this paper is to find the determinants of cyclical real aggregate dividends. In the literature, dividends are hypothesized to be proportional to real permanent earnings, with a smoothing factor that is between zero and +1. An additional postulate is that dividends adjust to a target dividend payout ratio. Managers will only change dividends if they can be sure that permanent earnings have increased. This allows for the payout ratio to be persistent and avoids reversing the payout decision if temporary earnings fall. The contribution of this paper is six-fold. The first is to generate cyclical changes of the variables by an appropriate filtering rule, a rule that is a common usage in macroeconomics. The second is to consider two proxies for real permanent earnings: real stock market prices, keeping real interest rates constant, and long term real interest rates, keeping market prices constant. The third is to adjust the estimation procedure for conditional heteroscedasticity. The fourth is to test whether transitory real earnings have an impact on dividends. The fifth is to find out if there are symmetrical effects of positive and negative earnings shocks. The last is to carry out stability tests over different time periods. One of the major findings is that, the three independent variables--stock market prices, interest rates, and transitory earnings, all have a significant effect on dividends, and that the smoothing factor is surprisingly the same for all three independent variables.

JEL Classifications: G12, G14, C22, E44
Keywords: Hodrick-Prescott de-trending method, Aggregate dividend behavior, Current and permanent aggregate earnings, Present value constraint, Real interest rates, Stationarity, Conditional heteroscedasticity

1. Introduction

The purpose of this paper is to find out the determinants of cyclical real aggregate dividends. A common filtering rule is applied on the target variables to induce them to become cyclical, a rule which is known as the Hodrick-Prescott de-trending filter (Hodrick and Prescott, 1997), and which is a common procedure utilized in macroeconomics.

In the literature the sole determinant of real aggregate dividends is permanent real aggregate earnings, although a partial adjustment mechanism is adopted. This practice goes back to Lintner (1956) and has been a working hypothesis for all subsequent research on the topic. If permanent earnings are higher, then corporations have the latitude to increase dividends. The persistence in dividend payouts necessitates that only a change in permanent earnings can help in financing these payouts. However current earnings could have an effect on dividends, an effect that is expected to be much less important than the effect of permanent earnings, although the literature assumes away any relevance of transitory earnings to dividends. The contribution of this paper is six-fold: to filter the variables in order to remove the common trend in them, to identify an additional determinant of

dividends besides market stock prices, which is the time-variable real interest rate, to adjust for conditional heteroscedasticity, to find whether there is a significant impact of current earnings on dividends, to test for symmetry in response, and finally to assess whether dividend behavior is stable over time. The first four contributions are novel to this paper. The last two contributions follow the literature on the subject. For example, Garret and Priestley (2000: 182), among others, find that only positive changes in permanent earnings impact dividends with no role for negative changes in permanent earnings. Although Garret and Priestley (2000) find no break in the data since the early 1870s, their estimated relation being robust over time, other authors, like Pan (2001), find that there is a post-WW2 break in aggregate dividend behavior.

Obviously, dividend policy is a gray area in corporate finance where dispute is more common than agreement. This paper makes an attempt to dissipate some of the confusion. It will set forth new applied evidence that is arguably reasonable, and is based on sound econometric diagnostics.

The literature on the behavior of dividends, earnings, and payout has taken two different routes: micro and macro. Micro studies involve the analysis of individual firms, while macro ones are concerned with aggregate variables. The two research agenda are interconnected as has been recognized since the 1950s (Lintner, 1956). This paper dwells upon the aggregate side, in the hope that it may give indications applicable to the corporate level by assuming a "representative or typical firm".

One issue of controversy in the micro field is whether corporate dividends are increased in response to past, present, future normal, or future abnormal earnings, if these earnings ought to be temporary, recurrent, or permanent, and if they should be taken in levels or in first-differences (Benartzi, Michaely, and Thaler, 1997; Nissim and Ziv, 2001). If the future is an extension of the past, then past earnings will signal current and future earnings which will in turn signal current dividend changes. However the empirical results are mixed. Benartzi et al. (1997) show that there is little evidence that dividend changes forecast future changes in earnings, while Garret and Priestley (2000) find evidence for a significant forecast signal.

In the following section, which is section 2, the theoretical model will be presented. In section 3 the source of the data is provided. In section 4, unit root tests are carried out on the real cyclical aggregate variables. In section 4 also, the model is estimated statistically and interpreted. In section 5, robustness tests are carried out on the model. Section 6 summarizes and concludes.

The main conclusions are that lagged permanent earnings are not the sole determinant of dividends paid by the typical firm. In addition, current permanent earnings, current and lagged transitory earnings, and the level of real interest rates are important determinants that typical managers take into consideration in their decision to pay dividends. It is also found that these three variables have the same magnitude of impact, and are hence equally likely to affect the amount of dividends paid.

2. The Model

The model that will be estimated has three determinants to cyclical real aggregate dividends. First, it is logical and reasonable to assume that dividends changes are due to profitability changes. In turn profitability can be assessed in two ways: current and permanent. Since the real market stock price is the present value of discounted earnings, changes in this real price reflect changes in permanent earnings. On the other hand current earnings are simply the aggregate profits that firms are gaining at the present time. It is expected that the impact of current earnings will be much lower than the impact of permanent earnings. Some researchers even give no importance to current or transitory earnings. For example Pan (2001), among others, believes that transitory earnings are unlikely to affect dividend payments, and he restricts his analysis to the effect of permanent

earnings. The literature on the subject has been consistent on this issue. See, for example, Marsh and Merton (1987), Kao and Wu (1994), Lee (1998) and Garret and Priestley (2000).

The final and third explanatory variable is the real long interest rate. If this rate is higher, keeping the present value of permanent earnings as is, or keeping stock market prices the same, permanent earnings must be higher to counterbalance the increase in rates. This can be seen by looking at the following equation which relates permanent earnings $E*$ to the market price of the stock S with α being an appropriate discount rate:

$$S_t = \frac{E*}{\alpha} \qquad (1)$$

If S is kept constant, an increase in α must necessarily coincide with an equal increase in $E*$. I will assume that α varies proportionately with real yields on long-term US Treasuries.

The contribution of this paper to the literature, besides the use of real cyclical variables, and the finding of a significant impact of current real earnings on dividends, is the identification and inclusion of the additional interest rate variable. Then both symmetry of the response to positive and negative shocks and stability of the dividend behavior over time are tested. In all econometric specifications allowance is made for conditional heteroscedasticity in the residuals (Engle, 1982).

Marsh and Merton (1986: 491) state that the non-stationarity of stock prices, dividends, and earnings is a standard working tool in financial economics. This assertion should be qualified. For example, if one takes firm level dividends and earnings, there may be grounds for non-stationarity (Murphy, 1997). But on the aggregate level, and because of averaging, of time-varying weights, and of deflation, the market stock index, aggregate dividends and earnings, are all likely to have different data generation processes than firm level variables, and be stationary in distribution. In such a case de-trending is enough to produce stationary processes as will be shown below.

3. The Data

The data are yearly, from 1871 to 2010. The total sample is made of 140 observations. All the observations are retrieved from the web site of Professor Robert Shiller of Yale University. The data is updated yearly by Professor Shiller. Part of the data appears at the end of Shiller's book *Market Volatility* (1989) on pages 439-446, where there are explanations about the sources of the data. This data was initially used by Shiller in his famous 1981 paper about excess stock market volatility.

A preliminary look at the raw data shows that the variables are highly correlated. The correlation coefficients between the dividend series and the series on earnings, market stock prices and the long interest rate are respectively 0.942172, 0.943872, and 0.328818. With a 5% two-sided marginal significance level the critical correlation coefficient is 0.166204. Therefore all correlation coefficients are statistically significantly different from zero, and indicate significant positive relations. Dividing the dividend, earnings and stock price series by the price level to obtain real, inflation-adjusted, variables, then the correlation coefficients with the real dividend series become respectively 0.905066 and 0.850607, both of which are statistically significantly different from zero, and denote significant positive relations. Finally, taking the logs of the inflation-adjusted variables, the correlation coefficients of the log real dividend series with the log real earnings and the log real stock prices become respectively 0.935605 and 0.930586, both of which are statistically significantly different from zero and reveal significant positive relations. These high correlation coefficients may be due to common stochastic trends. However, it is shown in the following section that they are due to common deterministic trends and not to common stochastic trends.

4. The Empirical Analysis

There are four relevant variables: real aggregate dividends, real aggregate earnings, the real aggregate stock market price, and the real interest rate. The latter is obtained as follows:

$$real \quad interest \quad rate = \left[\frac{1 + \left(\frac{i_t}{100} \right)}{1 + inflation_t} \right] - 1, \; where \;\; 1 + inflation_t = \frac{P_t}{P_{t-1}} \qquad (2)$$

where the symbol i is for the nominal interest rate in percent per annum, P is the price index, and t is the time period.

The natural logs of the first three variables, deflated by the price index P, and the real interest rate, are all de-trended by the Hodrick-Prescott filter, and are tested for stationarity (Table 1). Two unit root tests, which allow for the omission of the constant, are applied: the Augmented Dickey-Fuller test (Dickey and Fuller, 1979), and the Phillips and Perron (1988) test. Omitting the constant is necessary because all cyclical variables have a zero mean.

Table 1. Unit root tests without a constant and without a trend

Variable	Augmented Dickey-Fuller (optimal lag) [probability]	Phillips and Perron [probability]
CYCLED	-8.31303 (1) [0.0000]	-6.55020 [0.0000]
CYCLEE	-9.39090 (7) [0.0000]	-10.61860 [0.0000]
CYCLES	-7.98214 (3) [0.0000]	-7.31648 [0.0000]
CYCLEI	-8.31233 (7) [0.0000]	-41.08859 [0.0000]

It is clear that the cyclical components of the logs of real dividends, the logs of real earnings, the log of the real stock market price, and the real interest rate are stationary in distribution. These results show that simple de-trending makes all series stationary, implying that the trend in the original series is deterministic and not stochastic. A variable with a stochastic trend is by definition non-stationary. Since usually in the literature the nulls of non-stationarity of the original series fail to be rejected, the finding that the cyclical series are stationary is obviously due to the low power of the unit root tests. Proper de-trending produces stationary variables.

The de-trended cyclical series are named as follows: *CYCLED* for cyclical real dividends, *CYCLEE* for cyclical real earnings, *CYCLES* for the cyclical real stock market price, and *CYCLEI* for the cyclical real yield on long term US Treasuries.

Having identified all the variables that the theory suggests as important the regression in Table 2 (column 2) is carried out, where *CYCLED* is the dependent variable and the other three variables are the independent ones. The following adjustments are made: including not only the current value

but also the lagged values of the two independent variables *CYCLEE* and *CYCLES*, including a moving average term in the residuals in order to remove serial correlation of these residuals, and allowing for conditional heteroscedasticity in the residuals with an ARCH(1) model.

Table 2. Regressions with *CYCLED* as the dependent variable and with an ARCH(1) model of the conditional variance

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
Constant	0.003205 (0.38226)	0.00008 (0.00700)	0.00545 (0.70953
$CYCLEE_t$	0.182058 (9.46682)	0.177275 (7.49834)	0.130618 (3.61928)
$CYCLEE_{t-1}$	0.125939 (5.05556)	0.125067 (5.09240)	0.128065 (5.88079)
$CYCLES_t$	0.235345 (5.22663)	0.220069 (3.53386)	0.128065 (1.74548)
$CYCLES_{t-1}$	0.181793 (4.56641)	0.171772 (4.16835)	0.110862 (3.09774)
$CYCLEI$	0.457846 (4.34714)	0.439479 (4.08539)	0.149763 (0.42411)
$CYCLEE * D1$		0.011615 (0.19481)	
$CYCLES * D2$		0.034657 (0.47323)	
$CYCLEE * D3$			0.051563 (1.07385)
$CYCLES * D3$			0.256733 (2.84650)
$CYCLEI * D3$			0.333916 (0.91004)
MA(1)	0.597755 (13.43104)	0.593378 (11.5009)	0.577073 (8.86317)
Constant in variance equation	0.002179 (5.27923)	0.002214 (5.39694)	0.001908 (5.16370)
ARCH(1)	0.664753 (3.01495)	0.641266 (2.80959)	0.639095 (2.61055)
Adjusted R-Square	0.67453	0.67045	0.71565
Q(k)	Q(2): 0.936 Q(3): 0.386 Q(4): 0.280	Q(2): 0.951 Q(3): 0.361 Q(4): 0.258	Q(2): 0.748 Q(3): 0.212 Q(4): 0.237
$Q^2(k)$	Q(2): 0.224 Q(3): 0.313 Q(4): 0.418	Q(2): 0.267 Q(3): 0.330 Q(4): 0.422	Q(2): 0.589 Q(3): 0.412 Q(4): 0.481
Jarque-Bera normality test	0.004007	0.014662	0.024269

Notes: *CYCLED* is the cyclical real dividend, *CYCLEE* is the cyclical real earnings, *CYCLES* is the cyclical real stock market price, and *CYCLEI* is the cyclical real yield on US Treasuries. All cyclical variables, except the interest rate series, are logged before filtering. $D1$ is a dummy variable that takes the value 1 if $CYCLEE > 0$ and zero otherwise. $D2$ is a dummy variable that takes the value 1 if $CYCLES > 0$, and zero otherwise. $D3$ is a dummy variable that takes the value 1 for the period 1871 to 1943, and zero otherwise. Q(k) is the Ljung-Box Q-statistic on the standardized residuals with lag length k. $Q^2(k)$ is the Ljung-Box Q-statistic on the squares of the standardized residuals with lag length k. Actual p-values are reported for the Ljung-Box Q-statistics and for the Jarque-Bera normality test.

All the estimated coefficients have the expected positive signs and are statistically significant, except for the constant, which is as expected insignificant. The minimum t-statistic is 4.3471, and the maximum is 9.4668. All the marginal significance levels are reported by the statistical package to be 0.0000, except for the constant. The expectation that the coefficients on the current value and lagged value of $CYCLEE$, the current cyclical earning variable, are statistically insignificant is not confirmed. To the opposite both coefficients are highly significant statistically with t-statistics of 9.4668 and 5.0556 respectively. The coefficients on the current value and lagged value of $CYCLES$, the permanent cyclical earning variable, as proxied by the real stock market price, are highly significant statistically with t-statistics of 5.2266 and 4.5664 respectively. This means that permanent earnings are meaningful in explaining dividend behavior as predicted by the theory. These results show that the current value of the real stock market price is also useful in predicting dividends. This is more reasonable than the results in Marsh and Merton (1987) and Garrett and Priestley (2000) who both find that only the lagged value of this variable has statistical significance. There is no reason that current permanent earnings, as proxied by the current real stock market price, should not explain or signal current dividends. The coefficient on the cyclical real yield on US Treasuries is also statistically highly significant with a t-statistic of 4.3471. Nevertheless the expectation that the sum of the coefficients on permanent earnings $CYCLES$ is higher than the sum of the coefficients on current earnings $CYCLEE$ is not materialized. In fact the hypothesis that these sums are equal to each other and equal both to the coefficient on the real US Treasuries variable is not rejected, the actual F-value being 1.91458, with an actual p-value of 0.1515. The latter coefficient and the former two sums of coefficients measure the smoothing factor. There are thus three estimates for this smoothing factor, all three being insignificantly different from each other: 0.307997, 0.417138, and 0.457846.

Garrett and Priestley (2000: 179) find a smoothing coefficient of around 0.4399 on their market stock price variable, a value which is close to my estimates. However their dependent variable is the actual change in log dividends and the log of the stock price series is first-differenced. Pan (2001) uses only a measure of permanent income to explain dividend changes and he finds a coefficient on permanent earnings that is higher than one (1.136). Most probably his single independent variable has cumulated the effect of the other omitted variables that I have included in the regression above. It is noteworthy that the sum of the coefficients in the above regression is 1.182981, which is close to Pan's single estimate of 1.136. Hence this paper has demonstrated empirically that Pan's conclusion of over-adjustment is not warranted.

It is worthwhile to test whether increases in the variables have a different impact than decreases in these variables. For this purpose 2 dummy variables are defined that take each a value of 1 if the respective variable is positive, and zero otherwise. These 2 dummies are entered in interaction with their respective variable, and the regression is run again with all 8 variables, including the MA term. For example the first dummy, say $D1$, takes the value 1 if $CYCLEE > 0$, and 0 otherwise. The new interactive variable for $CYCLEE$ becomes $CYCLEE * D1$, where * is the multiplication operator. The second dummy, say $D2$, takes the value 1 if $CYCLES > 0$, and 0 otherwise. The new interactive variable for $CYCLES$ becomes $CYCLES * D2$. The variables $CYCLEE * D1$ and, $CYCLES * D2$ should pick up the differential impact of positive shocks to the underlying variables. The whole regression with the 8 variables, 6 of them as before, and the additional 2 interactive variables, produced insignificant t-statistics on the slopes of the two interactive variables (Table 2, column 3). The Wald test that the slopes on these 2 interactive variables are jointly zero produces an F-statistic of 0.1495, with a probability of 0.8613, failing to reject the hypothesis that both slopes are zero. These results confirm the earlier results and lead to the additional conclusion that all effects are symmetric: positive changes have the same impact as negative changes. This is surprising and contrary to the evidence in the literature like in Garrett and Priestley (2000).

5. Robustness Tests

According to the econometric diagnostics obtained by the statistical package, the first estimated multiple regression equation in the previous section for cyclical log real dividends, without the interactive variables, is robust except for normality of the residuals, which is rejected by the Jarque-Bera normality test (Jarque and Bera, 1980). However ordinary least squares (OLS) is usually robust to departures from normality, and if the sample size is sufficiently large one can invoke asymptotic normality. The adjusted R-Square is high at 0.6745, higher than in the models of Marsh and Merton (1987) and in Garrett and Priestley (2000). The standardized residuals, i.e. the residuals adjusted for conditional heteroscedasticity, exhibit no serial correlation or further heteroscedasticity.

There is evidence in the literature that the post-WWII period is different from its preceding period (Pan, 2001). To check such a claim a new dummy variable $D3$ is defined as follows: it takes the value 1 between 1871 and 1943, and zero otherwise. This dummy variable is included interactively with the same three independent variables $CYCLEE$, $CYCLES$ and $CYCLEI$. The null hypothesis that these three interactive variables have zero coefficients is rejected with a likelihood ratio test that has a p-value of 0.0002, implying that the two periods are indeed different. Nonetheless the nulls that the smoothing factors are equal to each other for each one of the two periods fail to be rejected. The respective p-values for the Wald F-tests are 0.9236, and 0.1305. For the pre-WWII period, the three estimates of the smoothing coefficient are 0.310246, 0.489116, and 0.483679. For the post-WWII period the three estimates of this smoothing coefficient are 0.258683, 0.232383, and 0.149763.

6. Conclusions

The paper has successfully estimated a multiple regression that explains cyclical aggregate real dividends. It is important to stress that all variables are in real or inflation-adjusted terms. One explanatory variable was selected based on the literature on the subject. This is permanent earnings. As in part of the literature, permanent earnings are measured by the real stock market price. Two additional variables, not considered in the literature, are included in the analysis: transitory earnings and a real long interest rate.

This paper makes at least seven contributions to the literature. It uses filtered or de-trended variables. De-trending is found to be sufficient to render all variables stationary. It identifies and includes two additional explanatory variables. It finds a significant impact of current earnings on dividends. It finds that the contemporaneous values of both current and permanent earnings are relevant. It tests for symmetry in effects. It checks for time stability. And finally it models the residuals as an ARCH process in order for the empirical relation to be well-specified.

The model is found to be econometrically appropriate. Real current and lagged transitory earnings, real current and lagged permanent earnings, and a proxy for the discount rate have statistically the same impact, i.e. the same smoothing factor. The model explains around 70% of the variation in the dependent variable, an R-Square that is a higher than in the literature. Another conclusion is that positive and negative values of the two independent variables, that measure profitability, have the same impact, making these impacts symmetric. Finally the post-WWII period is found to be different from the pre-WWII period.

The results show that, besides current and lagged permanent earnings, current and lagged transitory earnings and a proxy for real interest rates have an impact on the aggregate dividends paid by a typical firm. This impact is of the same magnitude for all three variables. Therefore firms choose the amount of dividends to pay out by looking, not only on permanent earnings, but also on transitory income. In addition the level of real interest rates is important for firms, with higher real

interest rates leading to more dividends paid. These results are more substantive than in the literature.

References

[1] Benartzi, S., R. Michaely and R. Thaler, R. (1997), "Do changes in dividends signal the future or the past?", *Journal of Finance*, 52(3): 1007-1034.

[2] Dickey, D. A. and W. A. Fuller (1979), "Distribution of the estimators for autoregressive time series with a unit root", *Journal of the American Statistical Association*, 74(366): 427-431.

[3] Engle, R. F. (1982), "Autoregressive conditional heteroskedasticity with estimates of the variance of UK inflation", *Econometrica*, 50(4): 987-1008.

[4] Garrett, I., and R. Priestley (2000), "Dividend behavior and dividend signaling", *Journal of Financial and Quantitative Analysis*, 35(2): 173-189.

[5] Hodrick, R. J. and E. C. Prescott (1997), "Postwar U.S. business cycles: an empirical investigation", *Journal of Money, Credit and Banking*, 29(1): 1-16.

[6] Jarque, C. M., and A. K. Bera (1980), "Efficient tests for normality, homoscedasticity and serial independence of regression residuals", *Economics Letters*, 6(3): 255–259.

[7] Kao, C., and C. Wu (1994), "Tests of dividend signaling using the Marsh-Merton model: a generalized friction approach", *Journal of Business*, 67(1): 45-68.

[8] Lee, B.-S. (1998), "Permanent, temporary, and non-fundamental components of stock prices", *Journal of Financial and Quantitative Analysis*, 33(1): 1-32.

[9] Lintner, J. (1956), "Distribution of incomes of corporations among dividends, retained earnings, and taxes", *The American Economic Review*, 46(2): 97-113.

[10] Marsh, T. A. and R. C. Merton (1987), "Dividend behavior for the aggregate stock market", *Journal of Business*, 60(1): 1-40.

[11] Murphy, J. E. (editor) (1997), *The random character of corporate earnings*, Minneapolis, Minnesota: Crossgar Press.

[12] Nissim, D., and A. Ziv (2001), "Dividends changes and future profitability", *Journal of Finance*, 56(6): 2111-2133.

[13] Pan, M-S. (2001), "Aggregate dividend behavior and permanent earnings hypothesis", *The Financial Review*, 36(1): 23-38.

[14] Phillips, P.C.B and P. Perron (1988), "Testing for a unit root in time series regression", *Biometrika*, 75(2): 335–346.

[15] Shiller, R. J. (1981), "Do stock prices move too much to be justified by subsequent changes in dividends?", *The American Economic Review*, 71(3): 421-436.

[16] Shiller, R. J. (1989), *Market Volatility*, Cambridge, MA: MIT Press.