Do Stock Market Returns Predict Changes to Output?*

Evidence from a Nonlinear Panel Data Model

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Abstract

Recent empirical work suggests a predictive relationship between stock returns and output growth. We employ quarterly data from a panel of 27 countries to test whether stock returns as useful in predicting growth. Unlike previous research, our approach allows for the possible non-linear effect of recessions on the growth-return relationship. There is strong evidence to suggest that a linear model would be misspecified and provide potentially misleading inference. Using a switching regression approach, we find evidence that returns are most useful in predicting growth when the economy is in recession.

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I. Introduction

The search for variables that have predictive power for aggregate output has a history in macroeconomics dating at least as far back as the NBER's pioneering efforts in the 1930s. Economic series associated with the early stages of the production process are often used in this context (Boehm and Moore 1984). However, there has been increasing interest in the use of financial variables to anticipate changes in aggregate output.

Three commonly used financial variables used for this purpose are the term structure of interest rates (Estrella and Hardouvelis 1991), the spread between the interest rates earned by commercial paper and Treasury Bills (Bernanke 1990, Friedman and Kutter 1991, Kashyap, Stein and Wilcox 1992) and stock market returns (Moore 1983). Both the term structure and the paper–bill spread are affected in a systematic way by monetary and fiscal policy initiatives and therefore provide a signal of changes in stance by policy makers. Blanchard and Fischer (1989 pages 532-536), for example, outline a modified IS-LM framework which incorporates financial assets having different maturities. They show that both anticipated and unanticipated policy measures impact on the spread between the short and long-term interest rates. The paper-bill spread is also affected by policy changes. In models featuring equilibrium credit rationing, for example, a tightening in monetary policy increases the proportion of firms denied credit (Stiglitz and Weiss 1981). To obtain finance, these firms must then issue commercial paper. This results in a widening of the spread between the returns on paper and Treasury bills.

Although clearly of importance for future macroeconomic activity, policy decisions are not the only factor that can affect aggregate output. Stock prices are systematically affected by any factor that bears on the expected future profitability of firms and may therefore have advantages over interest rate based predictive variables that respond primarily to fiscal and monetary policies. Lougani, Rush and Tave (1991), for example, argue that the inter-industry dispersion of stock prices, brought about by the existence of expanding and declining industries in a time of transition following taste or technology shocks, can predict changes in future economic activity.

More generally, there is considerable evidence of movements in stock prices leading the business cycle both in terms of predating peaks and troughs. Moore (1983, Chap 9) reviews and interprets evidence on the US stock market from 1873 through 1975 as a business cycle indicator. Writing in 1975, he noted that since 1873, stock prices had led the business cycle at eighteen of twenty-three peaks and at seventeen of twenty-three troughs. For the post World War II period, the only instances since 1948 of an economic slowdown where there was no substantial decline in stock prices were in 1951-1952 and 1980. A similar study conducted by Barro (1990), using US data between 1927 and 1988, found that the stock market predicted eight of the nine periods generally designated as recessions.

Regression analysis by Fama (1981) showed that US stock returns were positively related to the subsequent rate of growth of real GNP. Fischer and Merton (1984), using annual US data over the period 1950-1982, found that the stock market contributes substantially to the prediction of the growth rate of real GNP. Barro (1990) arrived at similar conclusions regarding US investment over several sample periods: 1891-1914, 1921-1940 & 1948-1987. Geske and Roll (1983), along with Fama (1990) and Schwert (1990), also found strong relations between stock returns and real activity. Similar relationships have been identified in Canada (Barro, 1990, Cozier and Rahman, 1988), Japan, Korea (Kwon and Shin, 1999), Germany, and the United Kingdom (Mullins and Wadhwani, 1989), the G-7 (Choi, 1999) and European countries (Wahlroos and Berglund, 1986, and Wasserfallen, 1989 and 1990 *inter alia*).

Despite the significant body of literature that asserts the importance of stock returns as an important predictor of future economic activity, there has been some evidence to the contrary. Barro (1990) reports that the stock market erred in predicting three recessions that did not occur 1963, 1967 and 1978. Stock and Watson (1990) show that the relationship between stock returns and economic growth has not been stable over time, and that the systematic predictive information of stock returns for future activity is also contained in other financial variables – such as yield spreads between 10 year and 3 month government bonds or between T-bills and commercial paper (Estrella and Hardouvelis 1991). Hu (1993) argues that the yield spread between long-term and short-term government bonds is a better predictor of future economic activity than stock market returns in the G-7 countries. Binswanger (2000) presents evidence that there has been a breakdown in the relation between stock returns and future real activity in the US economy since the early 1980s.

Aylward and Glen (2000) conducted an analysis using annual average data on 23 markets: the G-7 countries, plus Australia and 15 emerging market countries over a sample period from 1951-1993. Estimation results were mixed, with only 6 countries having significant coefficients on lagged stock price variables when the OLS estimation technique was used. Using the SUR estimation technique, 12 of the 23 countries in the sample were found to have significant and positive coefficients on lagged stock price variables. Mauro (2000) conducted a similar analysis on a mix of 17 developed and 8 emerging countries. Results showed positive and significant relationships for 5 out of 8 emerging markets and 10 out of 17 advanced countries.

Panel estimation showed that lagged stock returns were significantly and positively associated with output growth in both advanced and emerging countries.

This paper revisits the issue of whether stock prices have predictive power for changes in aggregate output. Unlike previous papers that have investigated the link between the stock market and output, we do not assume that the dynamics of this relationship are linear. Rather, we employ a non-linear model that allows the dynamics underlying the quarterly change in output to be affected by whether or not the economy is in recession. As our specification nests the usual linear regressions, the empirical validity of allowing for non-linear recession effects can easily be determined. Our analysis is based on a panel of quarterly data for 27 countries comprising both OECD and non-OECD Asian economies.

The paper proceeds as follows. Section II describes the model. The third section presents the data and empirical results. Section IV examines the results for two sub-panels containing G7 and South East Asian economies. Section V discusses results based on a switching regression. A brief summary and some concluding comments form the basis of the final section.

II. The Empirical Model

Given data on the level of GDP, $Y_{i,t}$, and stock prices, $X_{i,t}$, at time *t* for country *i,* a natural starting point for an analysis of the relation between stock returns and output growth is the linear functional form,

$$y_{i,t} = \alpha_i + \sum_{j=1}^{p} \beta_j y_{i,t-j} + \sum_{k=1}^{q} \delta_k x_{i,t-k} + \varepsilon_{i,t} \tag{1}$$

where $y_{i,t} = \log(Y_{i,t} / Y_{i,t-1})$ represents real GDP growth between quarters *t* and *t*-1 for country *i*, α_i is a fixed effect and $x_{i,t} = \log(X_{i,t} / X_{i,t-1})$ represents stock returns.

Whilst the functional form (1) is intuitively appealing in estimating a causal or predictive relationship between two variables, it nevertheless imposes restrictions upon the empirical relationship. In particular, the linearity of the functional form imposes a symmetric relationship between positive and negative shocks to output. Symmetric response to shocks implies that only the size, and not the sign, of the output innovation is the important consideration in assessing the impact of a shock to growth. Thus positive and negative shocks to growth of equal absolute magnitude would have equal short and long run impacts on output growth. However, it is now widely recognised that the symmetry assumption may be tenuous, see Hamilton (1989), Bradley and Jansen (1997), Beaudry and Koop (1993), Jansen and Oh (1999) and Henry and Olekalns (2002) *inter alia*. Forecasts derived from (1) would be biased if the data were not fully consistent with the symmetry assumption (Beaudry & Koop, 1993). Moreover, asymptotic inference based on a mis-specified model is likely to be misleading.

To relax the symmetry constraint, our paper employs the idea, first found in Beaudry and Koop (1993), that the "current depth of recession" (hereafter CDR) produces an asymmetry in output growth. This asymmetry is reflected in what is sometimes known as a "bounce-back" effect; namely that output growth recovers strongly following a recent recession. The CDR approach treats the historical maximum level of output as an attractor that influences the dynamics of output growth when output falls below its previous peak. Beaudry and Koop (1993) hypothesise that there is a non-linearity in this "peak reversion"; the further output falls from its peak, the greater is the pressure that builds up for output to return to its historical maximum. As a result, the speed at which output recovers varies according to the severity of the recession.[1] Such effects have been neglected by the literature on the predictive ability of stock returns for output.

To represent this asymmetry, a CDR term is included in the estimated model. The CDR is defined as the gap between the current level of output and the economy's historical maximum level. It is expressed as:

$$CDR_{i,t} = \max\{Y_{i,t-s}\}_{s=0}^{t} - Y_{i,t} \tag{2}$$

The CDR term will take non zero values either when output drops below its historical maximum due to a negative shock or in the aftermath of a positive shock as the economy begins to expand.

We use the CDR term to identify a possible asymmetry in quarterly output growth and to correct for any possible misspecification that may arise from the estimation of such linear models in the presence of asymmetry. The model we estimate is given by:

$$y_{i,t} = \alpha_i + \sum_{j=1}^{p} \beta_j y_{i,t-j} + \sum_{k=1}^{q} \delta_k x_{i,t-k} + \sum_{l=1}^{r} \lambda_l CDR_{i,t-l} + \varepsilon_{i,t} \tag{3}$$

If the estimates of $\lambda_1, \dots \lambda_r$, are significantly different from zero, the symmetry restriction can be rejected.

An important advantage of (3) is that tests of the null hypothesis of linearity can be performed using an F-test of the null hypothesis $H_0 : \lambda_1 = ... = \lambda_r = 0$. This is in contrast to many other popular non-linear specifications. For example, Hansen (1999) and Kahn and Senhadji (2001) show that tests of the null of linearity in panel threshold models have non-standard distributions because the threshold is unidentified

[1] Henry and Olekalns (2002) find strong evidence of a bounce back effect in US GDP growth. They argue that output volatility itself is subject to asymmetry, with contractionary periods tending to be more volatile than expansions of similar magnitude. This asymmetry in output volatility serves to offset the bounce-back effect and acts to dampen growth.

under the null of linearity. Other commonly used non-linear time series models such as the Markov switching and STAR models present similar difficulties.

III. Estimation Results

The empirical results are based on the analysis of quarterly data from the DATASTREAM and INTERNATIONAL FINANCIAL STATISTICS databases between the second quarter of 1982 and the fourth quarter of 2001. The descriptive statistics of the growth series are shown in Table 1.

Table 1 suggests that that the South-east Asian economies of Hong Kong, Korea, Singapore and Taiwan experienced the fastest quarterly growth in the sample period, growing at an average of 1.45%, 1.74%, 1.69% and 1.77% per quarter respectively. The descriptive statistics also show that developing countries such as the Asian economies along with Mexico and Israel also tend to have higher variability in growth compared to developed economies such as Australia, Canada, or the United Kingdom.

Augmented Dickey Fuller and Phillips-Perron tests were carried out on all GDP and GDP growth series to test for the presence of unit roots. In all cases, the null hypothesis of a unit root could be not rejected at least at the 5% level for GDP. However, upon differencing the GDP data were found to be stationary.

Table 2 presents summary statistics for the stock returns series. The Asian economies provide the highest returns with Taiwan and Hong Kong offering 6% and 5% return per quarter, respectively. On the other hand, both of these countries have the highest volatility of return with standard deviations of 28% and 17.5% per quarter for Taiwan and Hong Kong. Again on the basis of unit root tests, the returns series appear stationary.

Table 3 presents the results of the estimation of (3) for the entire sample. All coefficients that were insignificant at 10% or greater levels of confidence were eliminated from the regression. The estimated model was

$$y_{i,t} = \alpha_i + \sum_{j=1}^{4} \beta_j y_{i,t-j} + \sum_{k=1}^{2} \delta_k x_{i,t-k} + \sum_{l=1}^{2} \lambda_l CDR_{i,t-l} + \varepsilon_{i,t} \qquad (4)$$

The CDR and stock returns are jointly and marginally significant at all possible levels of significance and the regression appears reasonably well specified. The relationship between growth and returns is small and positive. A Wald test of the hypothesis $H_0 : \delta_1 = \delta_2 = 0$ was overwhelmingly rejected (Wald=15.87292, marginal significance level =0.0004). An F-test of the hypothesis $H_0 : \lambda_1 = \lambda_2 = 0$ was not satisfied for the data (Wald = 16.20385, marginal significance level = 0.0003). This implies that the lagged CDR terms cannot be excluded from the model; the linear model (1) would be misspecified.

The effect of the CDR term is ambiguous, with a significant and negative coefficient being associated with the first lag of the CDR variable, while the second lag coefficient is significant and positive. A Wald test of the restriction $H_0 : \lambda_1 + \lambda_2 = 0$ was satisfied for the data (Wald = 2.6580, marginal significance level = 0.1030). At face value the evidence suggests that positive and negative shocks to growth have asymmetric effects. All else equal, a negative estimate of λ_1 would imply that negative innovations to growth would have a more persistent effect on output than a positive innovation of equal magnitude. The model does not imply that positive and negative innovations have only temporary effects since the model allows for non-zero drift. The results are consistent with a sharp decline into recession λ_1<0 followed by a rapid bounce-back effect λ_2 >0.[2]

IV. Sub-panel estimates

IV.a. OECD Nations

Table 4 presents estimates of (3) for the OECD states. Again there is a positive relationship between returns and growth, which is of small magnitude. A Wald test (Wald test = 0.5996, marginal significance level = 0.7410) suggests that the CDR terms are not statistically significant. (F-statistic 1.1354, marginal significance level = 0.3388). After excluding the CDR terms a positive and significant relationship between lagged returns and growth is observed. A test for the joint insignificance of lagged returns was not satisfied at the 5% level (Wald test = 6.3278, marginal significance level = 0.0423).

IV.b South East Asian Nations

Table 5 presents estimates of (3) for the five South East Asian nations in our sample, namely Hong Kong, Korea, Philippines, Singapore and Taiwan. Again the relationship between returns and growth is positive and significant. A Wald test for the joint insignificance of $x_{i,t}$ was satisfied at the 5% level but rejected at the 10% level. The first lagged return term is individually significant at the 5% level while the second lag could be eliminated as the t-ratio is insignificant at all usual levels of confindence (marginal significance level = 0.4397). On the other hand the CDR terms are jointly significant (Wald = 10.3388, marginal significance level = 0.0057). Again

[2] Actual quantification of the asymmetries would require simulation techniques that are beyond the scope of the current study.

the first lagged CDR term is significantly negative while the second lagged CDR term is significantly positive.

V. A Switching Regression

We now allow for the possibility that the parameters on lagged output and stock returns are affected by whether or not the economy is in recession. This can be done by estimating the switching regression:

$$y_{i,t} = \begin{cases} \alpha_i + \sum_{j=1}^{4} \beta_{0,j} y_{t-j} + \sum_{k=1}^{4} \delta_{0,j} x_{i,t-k} + \varepsilon_{i,t} & \text{if } CDR_{i,t-1} = 0 \\ (\alpha_i + \phi) + \sum_{j=1}^{4} \beta_{1,j} y_{t-j} + \sum_{k=1}^{4} \delta_{1,j} x_{i,t-k} + \varepsilon_{i,t} & \text{if } CDR_{i,t-1} > 0 \end{cases} \tag{5}$$

OLS estimates of the model are presented in table 6. After eliminating the third and fourth lags of equity returns the model predicts that in the expansionary regime ($CDR_{i,t} = 0$), $y_{i,t}$ follows an AR(4) process estimated as

$$\underset{}{y_{i,t} = \hat{\alpha}_i -} \underset{(-0.0671)}{0.0240 y_{i,t-1}} \underset{(-2.3699)}{- 0.1119 y_{i,t-2}} \underset{(0.1999)}{+ 0.0068 y_{i,t-3}} \underset{(4.9351)}{+ 0.2178 y_{i,t-4}} \underset{(0.9721)}{+ 0.0022 x_{i,t-1}} \underset{(1.2901)}{+ 0.0018 x_{i,t-1}} + \varepsilon_{i,t}$$

A Wald test for the exclusion of $X_{i,t-1}$ and $X_{i,t-2}$ was satisfied for the data (Wald = 2.2445, marginal significance level = 0.3255). This implies that there is no evidence to support the theory that returns predict growth when the economy is expanding. In the contractionary regime, when the CDR variable takes on non-zero values, the estimated model for growth is:

$$y_{i,t} = (\hat{\alpha}_i - \phi) - \underset{(-1.3001)}{0.0953 y_{i,t-1}} \underset{(-3.5178)}{- 0.2360 y_{i,t-2}} \underset{(0.9834)}{+ 0.0607 y_{i,t-3}} \underset{(0.7784)}{+ 0.0570 y_{i,t-4}} \underset{(3.4284)}{+ 0.0141 x_{i,t-1}} \underset{(2.0589)}{+ 0.0092 x_{i,t-1}} + \varepsilon_{i,t}$$

The estimate of ϕ, $\hat{\phi}_i = -0.1252$ and is significant at all usual levels (t-ratio = -3.19). This implies that the implied growth rates differ across regimes since the estimated intercept terms differ in a significant fashion.

In the contractionary regime there is evidence that equity returns contain information that is useful in predicting growth. A Wald test for the exclusion of lagged stock returns from the contractionary regime was strongly rejected by the data (Wald = 15.4805, marginal significance level = 0.0004).

The autoregressive dynamics for growth appear to differ across regimes. In the low growth regime only the second AR lag of growth is significant, while in the high growth regime both the second and fourth AR coefficient are significant. A Wald test of the null hypothesis $H_0 : \beta_{0,i} = \beta_{1,i}$ for $i = 1,...,4$ was satisfied for the data (Wald = 5.4704, marginal significance level = 0.2423). Thus while the point estimates of the AR coefficients on growth appear to differ, the difference is not statistically significant.

Table 7 presents estimates of the switching regression for the sub panel of South East Asian nations. Here, the apparent change in the autoregressive dynamics is not statistically significant. A Wald test of the null hypothesis $H_0 : \beta_{0,i} = \beta_{1,i}$ for $i = 1,...,4$ was satisfied for the data (Wald = 3.1927, marginal significance level 0.5261). It is not possible to exclude the lagged returns from the low growth regime, (Wald = 7.6209, marginal significance level 0.0221). The null of no switching is overwhelmingly rejected for the Asian data. The estimate of ϕ is negative and highly significant (marginal significance level = 0.0000). Since the intercept terms differ in a significant fashion the implied growth rates differ across regimes. Overall the evidence is consistent with the view that the stock market leads growth when these economies are in recession.

VI. Conclusions

This paper examines the nature of the relationship between stock returns and the quarterly growth rate of output. Our results suggest that the relationship is positive and significant but the magnitude of the effect is small. The implication of this finding is that stock returns contain information useful in forecasting output.

However our results also suggest that there is a significant non-linearity in growth rates. This asymmetry is reflected in what is sometimes known as a "bounce-back" effect; namely that output growth recovers strongly following a recent recession. Failure to allow for this asymmetry in growth would lead to a misspecification of the relationship between growth and stock returns.

Re-estimation of the model for two sub-panels, consisting of the OCED nations and five South East Asian countries reveals a significant relationship between stock returns and growth. However, the depth of recession measure was strongly significant as a determinant of growth only for the former Asian tiger economies.

Using a switching panel regression there is evidence that stock returns contain information that is useful for predicting growth when the economy is contracting. However, in non-recession periods there is no evidence that equity returns can be usefully employed to predict growth.

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Table 1: Summary Statistics - Growth

	Mean	Standard Deviation	ADF Test Statistic		**PP** Test Statistic	
Australia	0.007965	0.009383	-4.97548	**	-9.41915	**
Austria	0.005919	0.011206	-4.87499	**	-13.6617	**
Belgium	0.004835	0.007638	-4.78173	**	-7.97879	**
Canada	0.007338	0.008054	-4.04119	**	-5.74367	**
Denmark	0.004697	0.011413	-5.93307	**	-10.1822	**
Finland	0.006109	0.012841	-2.73367		-8.93083	**
France	0.005867	0.006249	-3.1885	*	-8.99976	**
Germany	0.006586	0.014541	-3.63622	**	-10.3721	**
Greece	0.005205	0.026262	-4.19894	**	-13.6108	**
Hong Kong	0.014509	0.071542	-3.69908	**	-12.927	**
Israel	0.009848	0.019947	-5.45437	**	-11.6126	**
Italy	0.005847	0.006961	-4.67043	**	-7.82235	**
Japan	0.00755	0.009237	-1.69654		-10.3978	**
Korea	0.017415	0.019306	-4.39986	**	-9.01368	**
Mexico	0.006255	0.022634	-6.01732	**	-11.5931	**
Netherlands	0.006239	0.009514	-3.44224	*	-11.7696	**
Norway	0.007212	0.011172	-6.13215	**	-11.0927	**
New Zealand	0.004339	0.012345	-5.63863	**	-7.60186	**
Philippines	0.005343	0.035364	-7.02982	**	-9.60861	**
Singapore	0.016875	0.023883	-3.2964	*	-10.6776	**
South Africa	0.005288	0.018021	-3.65201	**	-9.89122	**
Spain	0.006343	0.006426	-2.59291		-8.0902	**
Sweden	0.004389	0.010812	-4.34683	**	-11.2665	**
Switzerland	0.003627	0.005878	-3.9346	**	-4.5587	**
Taiwan	0.01767	0.026814	-2.12277		-11.4591	**
United Kingdom	0.005667	0.008415	-3.13702	*	-9.88558	**
United States	0.00797	0.008091	-3.89368	**	-7.50678	**

Table 2: Summary statistics: Stock returns series

	Mean	Standard Deviation	ADF Test Statistic		PP Test Statistic	
Australia	0.030928	0.093149	-5.18695	**	-11.25792	**
Austria	0.024161	0.135963	-4.34607	**	-9.381589	**
Belgium	0.026083	0.098512	-3.61443	**	-11.8696	**
Canada	0.023937	0.0861	-6.10284	**	-9.486433	**
Denmark	0.036268	0.102018	-5.45303	**	-8.295507	**
Finland	0.041644	0.129195	-4.43957	**	-7.452767	**
France	0.029667	0.090162	-3.92955	**	-7.569427	**
Germany	0.026778	0.106524	-4.84484	**	-10.84016	**
Hong Kong	0.054615	0.175857	-4.96753	**	-12.70933	**
Italy	0.0359	0.146232	-4.4058	**	-9.853244	**
Japan	0.015247	0.105161	-4.11741	**	-10.97461	**
Korea	0.034945	0.169432	-4.74361	**	-10.59384	**
Netherlands	0.035232	0.096529	-4.28623	**	-11.74148	**
Norway	0.041683	0.161459	-4.68443	**	-9.909408	**
New Zealand	0.032232	0.126706	-4.50507	**	-11.28297	**
Philippines	0.0362	0.251977	-4.2421	**	-9.256863	**
Singapore	0.030291	0.157618	-5.13638	**	-12.92862	**
South Africa	0.022158	0.110271	-6.25408	**	-8.946662	**
Spain	0.027521	0.139871	-3.66053	**	-10.86399	**
Sweden	0.052	0.134583	-4.78743	**	-9.314546	**
Switzerland	0.03476	0.104439	-4.52086	**	-10.6775	**
Taiwan	0.062445	0.280223	-4.02918	**	-11.56862	**
United Kingdom	0.029628	0.0852	-6.5444	**	-11.39193	**
United States	0.029492	0.081891	-4.93114	**	-10.98914	**

Table 3: Stock Returns and Growth: Non-linear regression – Full Sample

$$y_{i,t} = \alpha_i + \sum_{j=1}^{4} \beta_j y_{i,t-j} + \sum_{k=1}^{2} \delta_k x_{i,t-k} + \sum_{l=1}^{2} \lambda_l CDR_{i,t-l} + \varepsilon_{i,t}$$

Parameter	Estimate	Std. Error	t-Statistic	Prob.
β_1	-0.071005	0.045001	-1.577841	0.1148
β_2	-0.148437	0.040171	-3.695175	0.0002
β_3	0.086652	0.035649	2.430734	0.0152
β_4	0.390159	0.039735	9.819083	0.0000
δ_1	0.008838	0.002452	3.603856	0.0003
δ_2	0.004757	0.002171	2.191105	0.0286
λ_1	-0.225775	0.070864	-3.186053	0.0015
λ_2	0.268094	0.069419	3.861987	0.0001
α_i				
AUS--C	0.005543			
AUT--C	0.003636			
BEL--C	0.003489			
CAN--C	0.005137			
DEN--C	0.003265			
ESP--C	0.004850			
FIN--C	0.002740			
FRA--C	0.002985			
GER--C	0.004780			
HK--C	0.009283			
ITA--C	0.003320			
JAP--C	0.004811			
KOR--C	0.014735			
NZ--C	0.003149			
NED--C	0.004439			
NOR--C	0.004819			
PHI--C	0.000958			
RSA--C	0.001293			
SIN--C	0.013590			
SWE--C	0.002474			
SWT--C	0.001929			
TAW--C	0.012506			
UK--C	0.004215			
US--C	0.006150			
R-squared	0.334273	Mean dependent var		0.008041
Adjusted R-squared	0.321751	S.D. dependent var		0.015289
S.E. of regression	0.012591	Sum squared resid		0.261264
Log likelihood	4981.954	F-statistic		26.69324
Durbin-Watson stat	2.018727	Prob(F-statistic)		0.000000

Table 4: Stock Returns and Growth: Non-linear regression – OECD Nations

$$y_{i,t} = \alpha_i + \sum_{j=1}^{4} \beta_j y_{i,t-j} + \sum_{k=1}^{2} \delta_k x_{i,t-k} + \sum_{l=1}^{2} \lambda_l CDR_{i,t-l} + \varepsilon_{i,t}$$

Parameter	Estimate	Std. Error	t-Statistic	Prob.
β_1	0.053475	0.059913	0.892544	0.3725
β_2	0.088077	0.069948	1.259187	0.2085
β_3	0.141426	0.066968	2.111847	0.0351
β_4	0.105852	0.057429	1.843180	0.0658
δ_1	0.004203	0.005548	0.757565	0.4490
δ_2	0.007806	0.003149	2.479165	0.0134
λ_1	-0.056722	0.105317	-0.538585	0.5904
λ_2	0.082073	0.108643	0.755441	0.4503
α_i				
CAN--C	0.003664			
FRA--C	0.002580			
GER--C	0.003252			
ITA--C	0.002469			
JAP--C	0.003849			
UK--C	0.002800			
US--C	0.003891			
R-squared	0.074535	Mean dependent var		0.006203
Adjusted R-squared	0.052977	S.D. dependent var		0.009090
S.E. of regression	0.008846	Sum squared resid		0.047032
Log likelihood	2045.825	F-statistic		3.457374
Durbin-Watson stat	2.012542	Prob(F-statistic)		0.000019

Table 5: Stock Returns and Growth: Non-linear regression – Asian Countries

$$y_{i,t} = \alpha_i + \sum_{j=1}^{4} \beta_j y_{i,t-j} + \sum_{k=1}^{2} \delta_k x_{i,t-k} + \sum_{l=1}^{2} \lambda_l CDR_{i,t-l} + \varepsilon_{i,t}$$

Parameter	Estimate	Std. Error	t-Statistic	Prob.
β_1	-0.085152	0.078425	-1.085776	0.2783
β_2	-0.242096	0.064954	-3.727211	0.0002
β_3	0.104068	0.058919	1.766278	0.0782
β_4	0.475900	0.055153	8.628664	0.0000
δ_1	0.009558	0.004301	2.222396	0.0269
δ_2	0.002886	0.003731	0.773507	0.4397
λ_1	-0.301475	0.104008	-2.898590	0.0040
λ_2	0.342687	0.106714	3.211256	0.0014
α_i				
HK--C	0.007520			
KOR--C	0.012531			
PHI--C	0.000821			
SIN--C	0.012177			
TAW--C	0.011803			
R-squared	0.497239	Mean dependent var		0.013579
Adjusted R-squared	0.480800	S.D. dependent var		0.026981
S.E. of regression	0.019442	Sum squared resid		0.138718
Log likelihood	964.7455	F-statistic		30.24746
Durbin-Watson stat	1.876112	Prob(F-statistic)		0.000000

Table 6: Stock Returns and Growth: Switching regression – Full Sample

$$y_{i,t} = \begin{cases} \alpha_i + \sum_{j=1}^{4} \beta_{0,j} y_{t-j} + \sum_{k=1}^{4} \delta_{0,j} x_{i,t-k} + \varepsilon_{i,t} & \text{if } CDR_{i,t-1} = 0 \\ (\alpha_i + \phi) + \sum_{j=1}^{4} \beta_{1,j} y_{t-j} + \sum_{k=1}^{4} \delta_{1,j} x_{i,t-k} + \varepsilon_{i,t} & \text{if } CDR_{i,t-1} > 0 \end{cases}$$

Parameter	Estimate	Std. Error	t-Statistic	Prob.
$\beta_{0,1}$	-0.029952	0.036340	-0.824231	0.4099
$\beta_{0,2}$	-0.122339	0.048292	-2.533320	0.0114
$\beta_{0,3}$	0.000234	0.034194	0.006837	0.9945
$\beta_{0,4}$	0.208771	0.043641	4.783801	0.0000
$\delta_{0,1}$	0.002283	0.002365	0.965521	0.3344
$\delta_{0,2}$	0.002887	0.001843	1.565955	0.1176
$\delta_{0,3}$	0.003680	0.001842	1.997483	0.0459
$\delta_{0,4}$	-0.001695	0.002003	-0.846179	0.3976
ϕ	-0.012511	0.000971	-12.89097	0.0000
$\beta_{1,1}$	-0.091256	0.075514	-1.208465	0.2270
$\beta_{1,2}$	-0.249346	0.069356	-3.595141	0.0003
$\beta_{1,3}$	-0.059653	0.065101	-0.916303	0.3596
$\beta_{1,4}$	0.063404	0.073085	0.867537	0.3858
$\delta_{1,1}$	0.015061	0.004317	3.488820	0.0005
$\delta_{1,2}$	0.007399	0.004608	1.605656	0.1085
$\delta_{1,3}$	-0.000622	0.007005	-0.088841	0.9292
$\delta_{1,4}$	0.004360	0.004788	0.910741	0.3626
α_i				
AUS--C	0.009994			
AUT--C	0.009429			
BEL--C	0.009122			
CAN--C	0.010295			
DEN--C	0.010490			
ESP--C	0.009198			
FIN--C	0.011452			
FRA--C	0.007551			
GER--C	0.012568			
HK--C	0.021798			
ITA--C	0.008555			
JAP--C	0.011033			
KOR--C	0.020973			
NZ--C	0.011156			
NED--C	0.008231			
NOR--C	0.012061			
PHI--C	0.014535			
RSA--C	0.011529			
SIN--C	0.021690			
SWE--C	0.008701			
SWT--C	0.008575			
TAW--C	0.020112			

UK--C	0.009956		
US--C	0.009811		
R-squared	0.487703	Mean dependent var	0.008081
Adjusted R-squared	0.474823	S.D. dependent var	0.015426
S.E. of regression	0.011179	Sum squared resid	0.198823
Log likelihood	5038.822	F-statistic	37.86552
Durbin-Watson stat	1.831638	Prob(F-statistic)	0.000000

Table 7: Stock Returns and Growth: Switching regression – Asian Countries

$$y_{i,t} = \begin{cases} \alpha_i + \sum_{j=1}^{4} \beta_{0,j} y_{t-j} + \sum_{k=1}^{4} \delta_{0,j} x_{i,t-k} + \varepsilon_{i,t} & \text{if } CDR_{i,t-1} = 0 \\ (\alpha_i + \phi) + \sum_{j=1}^{4} \beta_{1,j} y_{t-j} + \sum_{k=1}^{4} \delta_{1,j} x_{i,t-k} + \varepsilon_{i,t} & \text{if } CDR_{i,t-1} > 0 \end{cases}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\beta_{0,1}$	-0.099007	0.065491	-1.511756	0.1315
$\beta_{0,2}$	-0.196415	0.059490	-3.301631	0.0011
$\beta_{0,3}$	-0.028476	0.056881	-0.500617	0.6169
$\beta_{0,4}$	0.252927	0.059420	4.256596	0.0000
$\delta_{0,1}$	0.003026	0.003597	0.841214	0.4008
$\delta_{0,2}$	0.004207	0.003389	1.241484	0.2152
ϕ	-0.025679	0.003646	-7.043292	0.0000
$\beta_{1,1}$	0.062005	0.105290	0.588899	0.5563
$\beta_{1,2}$	-0.219799	0.088397	-2.486495	0.0133
$\beta_{1,3}$	0.033380	0.099373	0.335906	0.7371
$\beta_{1,4}$	0.048208	0.099598	0.484024	0.6287
$\delta_{1,1}$	0.015699	0.006421	2.444841	0.0150
$\delta_{1,2}$	0.006066	0.007336	0.826867	0.4088
α_i				
HK--C	0.026101			
KOR--C	0.023148			
PHI--C	0.024228			
SIN--C	0.025454			
TAW--C	0.023374			
R-squared	0.623353	Mean dependent var		0.013364
Adjusted R-squared	0.605906	S.D. dependent var		0.026931
S.E. of regression	0.016906	Sum squared resid		0.104895
Log likelihood	1033.756	F-statistic		35.72868
Durbin-Watson stat	1.755005	Prob(F-statistic)		0.000000