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Impacts of Macroeconomic Variables on the U.S. Stock Market Index and Policy Implications

Yu Hsing
Southeastern Louisiana University

Abstract

This paper finds that the U.S. stock market index is positively associated with real GDP, stock earnings, the trade-weighted nominal effective exchange rate, and the U.K. stock market index and negatively influenced by the government debt/GDP ratio, the M2/GDP ratio, the real Treasury bill rate, the real corporate bond yield, the expected inflation rate, and the U.K. Treasury bill rate. The choice of an appropriate exchange rate may affect empirical outcomes. Hence, we need more economic growth and better earnings to have higher stock prices. The rising government debt/GDP ratio is expected to hurt stock prices whereas the relatively low interest rate would help stock prices. A higher M2/GDP ratio reduces stock prices partly due to its potential impacts on inflation and interest rates. The recent depreciation of the U.S. dollar would work unfavorably to the U.S. stock market index.

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1. Introduction

Due to the recent global financial crisis, many financial and real assets had declined in values. Financial stocks are no exception. The S&P 500 stock index had declined as much as 56.8% from October 2007 to March 2009. Its negative impacts on household consumption and business investments can be analyzed by the household wealth and liquidity effects, Tobin's q theory, and the balance sheet channel.

This paper attempts to reexamine the relationship between the stock market index and macroeconomic variables for the U.S. and has several focuses. First, it considers the government debt, the nominal effective exchange rate (NEER), and the foreign interest rate, which most previous articles do not incorporate in the estimated regression. Second, theoretical analysis between the stock market index and the nominal effective exchange rate is presented to determine the channels through which a change in the nominal effective exchange rate would affect the stock market index. Third, the GARCH or ARCH model is applied to determine whether the error variance may be affected by the lagged squared error and/or the lagged error variance.

2. Literature Survey

Fama (1981) finds that the U.S. stock return has a positive relationship with the growth rate of industrial production or real GDP and selected financial variables and a negative relationship with inflation rate and the growth of money. Based on a quarterly sample during 1961.Q1 – 1987.Q3, Darrat (1990b) shows that the U.S. S&P 500 index is positively affected by the lagged S&P 500 index, federal debt and non-financial corporate profits, is negatively influenced by the short-term interest rate, and is not impacted by the consumer price index, real GNP and the risk premium. Hence, the results are in contrast with the efficient market hypothesis. Kim (2003) reports that the U.S. S&P 500 index has a positive relationship with industrial production and a negative relationship with the inflation rate, the interest rate, and real appreciation of the U.S. dollar and that innovations in the interest rate mainly cause the variation in the U.S. stock price index. Bernanke and Kuttner (2005) estimate that if the Federal Reserve Bank makes an unanticipated reduction in the federal funds rate by 0.25 percentage points, the stock market return will rise approximately 1%, that monetary policy significantly influences stock prices by impacting expected excess returns, and that responses to surprised monetary policy decisions vary across sectors. In studying the behavior of the U.S. stock market index, Ratanapakorn and Sharma (2007) consider industrial production, the M1 money supply, the Treasury bill rate, the U.S. government bond yield, the inflation rate, and the yen/US dollar exchange rate. They find that the S&P 500 index is negatively associated with the Government bond yield and positively affected by the money supply, industrial production, the inflation rate, the yen/US dollar exchange rate, and the Treasury bill rate.

Several other studies have considered the relationship between stock prices or returns and long-term bonds (Fama and French, 1989), Tobin's q theory (Barro, 1990), output (Chen, Roll and Ross, 1986; Fama, 1990; Dhakal, Kandil and Sharma, 1993; Humpe and Macmillan, 2009), budget deficits (Darrat, 1990a; Abdullah and Hayworth, 1993), the money supply (Bulmash and Trivoli, 1991; Abdullah and Hayworth, 1993; Dhakal, Kandil and Sharma, 1993; Humpe and

Macmillan, 2009), interest rates (Bulmash and Trivoli, 1991; Abdullah and Hayworth, 1993; Dhakal, Kandil and Sharma, 1993; Humpe and Macmillan, 2009), the exchange rate (Abdullah and Hayworth, 1993; Choi, 1995; Ajayi and Mougoue, 1996; Nieh and Lee, 2001), the inflation rate or the consumer price index (Chen, Roll and Ross, 1986; Abdullah and Hayworth, 1993; Dhakal, Kandil and Sharma, 1993; Humpe and Macmillan, 2009), and other related variables. Their findings suggest that most of these variables are associated with stock prices or returns to varying degrees.

These and other studies have made significant contributions to the literature. Because some of these studies present different findings and because there are other explanatory variables not considered and tested by most of the previous studies, this paper extends previous works and attempts to examine whether the government debt, the nominal effective exchange rate, the foreign interest rate and other related macroeconomic variables may affect the U.S. stock market index differently from previous studies.

3. The Model

Extending previous studies, we can express the U.S. stock market index as:

$$SP = f(OP, ER, GD, MS, SR, LR, EX, EI, SP^*, FR) \tag{1}$$

where

SP = the stock market index in U.S.,
OP = real output in U.S.,
ER = stock earnings,
GD = the government debt,
MS = the money supply,
SR = the real short-term interest rate in U.S.,
LR = the real long-term interest rate in U.S.,
EX = the nominal effective exchange rate (NEER),
EI = the expected inflation rate,
SP^* = the foreign stock market index, and
FR = the foreign interest rate.

The partial derivative of the stock market index with respect to each of the right-hand side variables can be expressed as:

$$\begin{gathered}\frac{\partial SP}{\partial OP} > 0,\ \partial \frac{\partial SP}{\partial ER} > 0, \frac{\partial SP}{\partial GD} > or < 0, \frac{\partial SP}{\partial MS} > or < 0, \frac{\partial SP}{\partial SR} < 0,\ \frac{\partial SP}{\partial LR} < 0, \\ \frac{\partial SP}{\partial EX} > or < 0,\ \frac{\partial SP}{\partial EI} < 0,\ \frac{\partial SP}{\partial SP^*} > 0, \frac{\partial SP}{\partial FR} > or < 0.\end{gathered} \tag{2}$$

We expect that the U.S. stock market index is positively associated with real output, stock earnings and the foreign stock market index, is negatively impacted by the U.S. real short-term interest rate, the U.S. real long-term interest rate and the expected inflation rate, and may be

affected negatively or positively by the government debt, the money supply, the nominal effective exchange rate and the foreign interest rate.

The impact of more government debt on stock prices is unclear. Based on the present value approach of stock valuation, Darrat (1990b) indicates that expected earnings, the interest rate and the risk premium would affect stock prices. He also states that more government debt is likely to increase aggregate demand and potential earnings at least in the short run (Feldstein, 1982). However, increased government debt may lead to a higher interest rate (Hoelscher, 1986), greater economic uncertainty (Evans, 1984; Strongin, 1987) and a higher risk premium. Brunner (1961) and Cagan (1972) emphasize the theoretic portfolio approach in examining the relationship between fiscal policy and the stock market. Increased government debt changes the portfolio composition, and investors would increase the demand for other assets including stocks. On the other hand, the Ricardian equivalence hypothesis (Barro, 1974) suggests that increased government debt would not have any impacts on asset values including stock prices because investors discount tax liabilities in the future due to the government debt.

Increased money supply may raise the stock price through the liquidity effect and the output effect or reduce the stock price through higher inflationary expectations. Increased interest rates are expected to reduce stock prices as the present value of future earnings or stock prices will decline. Exchange rate appreciation or depreciation results in the financial and economic effects. Currency appreciation tends to attract more international capital inflows to invest in the domestic market including the stock market, lessen global competitiveness, hurt exports, and reduce import costs and the domestic price level. On the other hand, as a currency becomes weaker, the assets become less attractive, and international capital inflows including the demand for stocks tend to decrease. Currency depreciation tends to stimulate exports and increase import costs and the domestic price level. Hence, these different forces determine the sign of the nominal effective exchange rate (Choi, 1995; Ajayi and Mougoue, 1996; Abdalla and Murinde, 1997; Nieh and Lee, 2001; Ratanapakorn and Sharma, 2007).

Theoretically, the appreciation of the U.S. dollar is expected to increase international capital inflows (CF), hurt exports (XP), lower import costs (IM), and reduce the domestic price level (PR) and affects the stock market index as follows:

$$\frac{\partial CF}{\partial EX} > 0, \quad \left(\frac{\partial SP}{\partial CF} \times \frac{\partial CF}{\partial EX} \right) > 0, \tag{3}$$

$$\frac{\partial XP}{\partial EX} < 0, \quad \left(\frac{\partial SP}{\partial XP} \times \frac{\partial XP}{\partial EX} \right) < 0, \tag{4}$$

$$\frac{\partial IM}{\partial EX} < 0, \quad \left(\frac{\partial SP}{\partial IM} \times \frac{\partial IM}{\partial EX} \right) > 0, \tag{5}$$

$$\frac{\partial PR}{\partial EX} < 0, \left(\frac{\partial SP}{\partial PR} \times \frac{\partial PR}{\partial EX} \right) > 0. \tag{6}$$

Because there are positive and negative effects, the net impact of the appreciation of the U.S. dollar on the stock market index is unclear.

Co-movements among major national stock market indexes (Becker, Finnerty and Friedman, 1995; Cheung and Ng, 1998) suggest that the U.S. stock market is linked to and affected by foreign stock market indexes. Thus, the U.S. stock market index is affected by major foreign stock market indexes, and foreign stock market indexes are also influenced by the U.S. stock market index. As the foreign interest rate rises relative to the U.S. interest rate, investors tend to move capital overseas to enjoy a higher rate of return and reduce the demand for U.S. stocks and stock prices. On the other hand, a higher foreign interest rate tends to cause the foreign currency to appreciate, make U.S.-made products cheaper, and help raise net exports, and increase businesses and stock prices.

4. Empirical Results

GD, LR and EI were collected from the Federal Reserve Bank of St. Louis. ER was obtained from the online data prepared by Robert J. Shiller. SP, OP, MS, SR, EX, SP* and FR were taken from the International Financial Statistics. SP stands for the share price index with 2005 as the base year. OP is represented by real GDP in billions with 2005 as the base year. GD is represented by the ratio of the government debt held by the public to GDP as a percent. MS is measured as the ratio of M2 money to GDP as a percent. M2 money supply seems to be more appropriate than M1 money supply as it is broader measure. SR is measured by the U.S. Treasury bill rate minus the expected inflation rate. LR is represented by the Moody's Aaa corporate bond yield minus the expected inflation rate. EX is represented by the nominal effective exchange rate weighted by trade (NEER1) or based on the unit labor cost (NEER2). An increase means the appreciation of the U.S. dollar. EI is the expected inflation rate prepared by the University of Michigan. SP* is represented by the U.K. stock market index. FR is represented by the U.K. Treasury bill rate. Except for the U.S. real Treasury bill rate and the U.S. real corporate bond yield with negative values, other variables are expressed in the logarithmic scale. Hence, the estimated coefficient measures the elasticity of the U.S. stock market index with respect to one of the right-hand side variables. The sample ranges from 1978.Q1 to 2010.Q1 with a total of 129 observations. Earlier data for the expected inflation rate are not available.

The GARCH and ARCH models are applied in empirical work. Because the coefficient of the lagged residual variance is insignificant at the 10% level and because the coefficient of the lagged squared residual is significant at the 1% level, the ARCH model is employed in estimating regression parameters. Estimated parameters and related statistics are presented in Table 1. Numbers in the parenthesis are the t-statistics. As shown, 99.2% of the variation in the U.S. stock market index can be explained by the nine right-hand side variables. All the coefficients are significant at the 1% or 5% level. The U.S. stock market index has a positive relationship with real GDP, stock earnings, the nominal effective exchange rate (NEER1) and the stock market index in the U.K. and a negative relationship with the government debt/GDP ratio, the M2/GDP ratio, the real Treasury bill rate, the real corporate bond yield, the expected inflation rate and the U.K Treasury bill rate. The U.S. stock market index is more sensitive to a change in real GDP, the M2/GDP ratio or the U.K. stock market index than a change in one of the other variables. For example, if real GDP rises 1%, the U.S. stock market index will increase 1.012%; a 1% increase in the M2/GDP ratio will reduce the stock market index by 1.013%; and a 1%

Table I. Estimated Regressions of the U.S. Stock Market Index

	I	II	III
Real GDP	1.012 (30.187)	0.900 (8.583)	1.977 (325.389)
Stock earnings	0.061 (3.485)	-0.019 (-0.823)	0.023 (7.663)
Debt/GDP ratio	-0.384 (-12.588)	-0.628 (-13.745)	
Deficit/GDP ratio			-0.009 (-2.025)
M2/GDP ratio	-1.013 (-9.953)	-1.302 (-13.494)	-1.603 (-47.581)
U.S. real Treasury bill rate	-0.020 (-4.823)	-0.023 (-5.323)	-0.019 (-5.680)
U.S. real corporate bond yield	-0.012 (-2.174)	-0.005 (-0.973)	-0.008 (-2.073)
NEER1	0.106 (2.119)		-0.006 (-0.158)
NEER2		-0.399 (-5.689)	
Expected inflation rate	-0.109 (-3.610)	-0.157 (-5.070)	-0.171 (-7.554)
U.K. stock market index	0.616 (28.655)	0.763 (20.823)	0.318 (15.701)
U.K. Treasury bill rate	-0.060 (-6.296)	-0.058 (-4.234)	0.014 (1.525)
Constant	-2.864 (-9.622)	2.207 (1.888)	-8.990 (-146.374)
Variance equation			
RESID(-1)^2	0.775 (3.091)	0.717 (2.233)	1.338 (5.863)
GARCH(-1)			-0.041 (-3.786)
Constant	0.001 (4.093)	0.001 (2.494)	0.0007 (4.863)
AIC	-2.710	-2.731	-2.367
SC	-2.422	-2.443	-2.057
F-statistic	1377.311	1779.412	855.391
Sample	1978.Q1-2010.Q1	1978.Q1-2010.Q1	1978.Q1-2010.Q1
Sample size	129	129	129
Adjusted R-squared	0.992	0.994	0.989

Notes:
All the variables except for the U.S. real Treasury bill rate and the U.S. real corporate bond yield are measured in the logarithmic scale.
NEER1: nominal effective exchange rate based on the trade-weighted measure.
NEER2: nominal effective exchange rate based on the unit labor cost.

increase in the U.K. stock market index will increase the U.S. stock market index by 0.616%. If the government debt/GDP ratio rises 1%, the U.S. stock market index will decline by 0.384%.

To determine whether the regression may be spurious, the ADF test on the regression residuals is performed. A lag length of 3 is selected by the AIC. The test statistic of -4.500 is greater than the critical value of -2.584 in absolute values at the 1% level. Therefore, the regression is not spurious, and these time series variables have a stable long-term relationship.

In Version II, when NEER2 replaces NEER1 in the estimated regression, its negative coefficient is significant at the 1% level. However, mainly due to multicollinearity, the negative coefficient of stock earnings is insignificant and has a wrong sign, and the negative coefficient of the real corporate bond yield is insignificant at the 10% level. Hence, the choice of nominal effective exchange rates may affect the signs and significance of the coefficient and other variables. Because the correlation coefficient of +0.982 between the stock market index and NEER1 is stronger than the correlation coefficient of -0.100 between the stock market index and NEER2, empirical results in Version I is better than those in Version II. When the government debt/GDP ratio is replaced by the government deficit/GDP ratio in Version III, its negative coefficient is significant at the 5% level. However, the coefficient of NEER1 becomes negative and is insignificant at the 10% level, and the coefficient of the U.K. Treasury bill rate changes the sign and is insignificant at the 10% level.

When the German stock market index is included in the estimated regression, its positive coefficient is estimated to be 0.255 and significant at the 1% level, the value of adjusted R-squared is 0.992, the negative coefficient of the real corporate bond yield is insignificant at the 10% level, and other results are similar. If the M1/GDP ratio is used to replace the M2/GDP ratio, its negative coefficient is significant at the 1% level, the value of adjusted R-squared is 0.990, the GARCH(1,1) model is suitable. The estimated coefficient of -0.600 for the M1/GDP ratio is smaller than -1.013 for the M2/GDP ratio in Version I. To safe space, these results are available upon request and are not printed here.

In comparison, the positive significant coefficient of real GDP is consistent with Fama (1981). The negative significant coefficient of the government deficit/GDP ratio is consistent with Darrat (1990a) whereas the negative significant coefficient of the government debt/GDP ratio is different from Darrat (1990b). The negative significant coefficient of the real Treasury bill rate or the real corporate bond yield is comparable with Bulmash and Trivoli (1991), Abdulla and Hayworth (1993), Kim (2003), and Humpe and Macmillan (2009). The negative coefficient of the M2/GDP ratio is in agreement with Fama (1981) and Bulmash and Trivoli (1991). The finding of a positive relationship between the stock market index and currency appreciation is consistent with Choi (1995), Ajayi and Mougoue (1996) and Ratanapakorn and Sharma (2007) and in contrast to Nieh and Lee (2001) and Kim (2003). The negative significant coefficient of the expected inflation rate is similar to Fama (1981), Chen, Roll and Ross (1986), Kim (2003), and Humpe and Macmillan (2009). Different results between this paper and some of other previous studies may be attributable to variable measurements, model specifications, estimation methodologies, types of the data, sample periods, etc.

5. Summary and Conclusions

This paper has examined the macroeconomic determinants of the U.S. stock market index. The ARCH model is used in empirical work. The sample is between 1978.Q1 and 2010.Q1. A higher real GDP, a higher stock earning, a lower government debt/GDP ratio, a lower M2/GDP ratio, a lower real Treasury bill rate, a lower real corporate bond yield, a higher nominal effective exchange rate (NEER1), a lower expected inflation rate, a higher U.K. stock index, or a lower U.K. Treasury bill rate would cause the U.S. stock market index to rise. The choice of nominal effective exchange rate measures would affect the outcomes.

There are several policy implications. To maintain a healthy stock market, the authorities need to pursue economic growth, reduce the government debt/GDP ratio, keep relatively low interest rates, and maintain a relatively strong U.S. dollar versus major currencies. The Federal Reserve Bank needs to monitor the money supply as a percent of GDP because too much money in relation to GDP may generate inflationary pressures and cause the stock market index to decline.

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