Do Price-Earnings Ratios Drive Stock Values?

Not as great an impact as thought.

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Does a high price-earnings ratio indicate high or low future earnings growth? Does a high P/E ratio indicate higher or lower future stock prices? We investigate the relation between P/E ratios, measuring value by closing price, and subsequent price, as well as P/E ratios and subsequent earnings yield of world markets as measured by four different indexes: the Standard & Poor's 500 (S&P 500), the Morgan Stanley Composite Index (MSCI) world index, the MSCI Europe index, and the Europe, African, and Far East (EAFE) index. Our goal is to find out whether the P/E ratios drive future earnings or drive future prices.

To evaluate the relation between P/E ratios and stock values, first we test for cointegration between P/E ratios and the yield/earnings, and between P/E ratios and price levels for each index. If no cointegration is found, we use a vector autoregression (VAR) model, and if cointegration is found, we use a vector error correction (VECM) model to study the relation between the variables. If there is any relation between P/E ratio and price level or yield on these indexes, we check for dual causality through VAR/VECM analysis using a Granger methodology. This determination could be important in explaining whether P/E ratios are useful as a valuation measure.

A number of authors have addressed the relation between P/E ratios and earnings or prices. We differentiate our study from other research by analysis of world markets besides the U.S. markets. VAR analysis has not been much used in this area either. These models will help us validate earlier results on the relation between P/E ratios and earnings.

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LITERATURE REVIEW

Basu [1977] shows that portfolios formed with stocks with low P/E ratios outperform portfolios formed by stocks with high P/E ratios. Shen [2000] points out that historically very high P/E ratios have been followed by low short- and long-term returns.

Trevino and Robertson [2002] study the relation between current P/E ratios and subsequent stock returns, and find that current P/E ratios have no correlation with subsequent short-term average returns (short-term defined as three years). They further point out that investing in higher P/E ratio stocks leads to lower long-term returns for holding periods of five years or more. They also report that even though long-term average stock returns are lower after periods of high P/E ratios, average stock returns are still higher than average returns on Treasury bonds and Treasury bills.

Campbell and Shiller have written a series of articles on this topic since the mid-1980s. Campbell and Shiller [1988, 1989] report that future dividends can be forecasted by the moving average of earnings. They also find that P/E ratios are powerful predictors of long-term stock returns. Campbell and Shiller [1998] analyze mean reversion in P/E ratios. Analyzing historical data, they find that higher P/E ratios are followed by lower growth. Campbell and Shiller [1998, 2001] predict on the basis of very high P/E ratios that future stock prices will drop significantly. They conclude that P/E ratios and dividend-price ratios are poor predictors of future dividend growth, future earnings growth, or prices. Instead, these ratios are good predictors of future stock price changes.

Fama and French [1989] show that dividend yields at the beginning of a period predict a significant proportion of four-year returns, but are not good predictors of short-term return. Park [2000], on the other hand, advises that an investor should not take a high P/E ratio by itself as an alarming sign. He finds that P/E ratio is explained fairly well by future earnings and interest rates, and stock markets foresee a fairly distant future of about eight years. Thus the P/E ratio has little use as a valuation measure.

Fisher and Statman [2000] investigate the relation between P/E ratios and dividend yields and future returns. They conclude that P/E ratios and dividend yields are not good indicators of future stock prices, especially when we look at returns over short periods (one to two years). P/E ratios and dividend yields provide much better forecasts when they are used to estimate stock returns over longer periods of time (ten years).

Danielson and Dowdell [2001] use a "return-stages model" to quantify the expectations facing a firm in the case of P/B and P/E ratios. They show that the P/E ratio is related to a firm's future operating performance. They explain differing performance for different firms by dividing firms into four groups.

Bierman [2002] recognizes that the P/E ratio is very important and widely used, but it sometimes needs to be adjusted to reflect some special circumstances like extraordinary liabilities and extra cash. Keown, Pinkerton, and Chen [1987] study portfolios of stocks made up of either low or high P/E ratios. They conclude that investors who practice a P/E-based investment strategy expose themselves to very high levels of unsystematic risk.

Ramcharran [2004] points out that the P/E ratio is not better than price-to-book value ratios in explaining equity returns in 21 emerging markets.

We study the impact of P/E ratios on index prices and index yields to determine whether they have any influence on subsequent prices and returns. We use VAR and VECM analysis to study the impact and Granger causality to test whether high or low P/E ratios cause yields and price levels to rise or fall.

DATA DESCRIPTION

Monthly data come from Global Financial Data for the years 1980–2000. For the four indexes we study the P/E ratio, index value, and monthly yield on the index for the last 20 years. Unlike most previous researchers, who have used annual data, we use monthly data, as we believe many investors have investment horizons of a few months rather than years. Furthermore, monthly data provide more robust results.

METHODOLOGY

It is widely believed that mean reversion theory is accurate. That is, very high or very low P/E ratios will revert to the historical average. High P/E ratios should indicate that returns will decline. Also, during periods of low P/E ratios, either earnings should increase or prices should fall. Economic theory predicts that earnings should increase, and stock prices not fall as stock prices follow a random walk.

Exhibit 1 gives the historical P/E ratios for the S&P 500, MSCI World, MSCI Europe, and EAFE. It can be seen that all four indexes exhibit mean reversion behavior.

EXHIBIT 1

P/E Ratios for Various Indexes

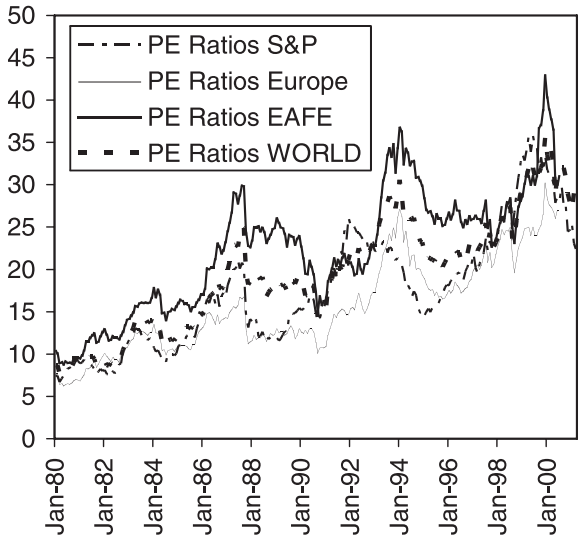

EXHIBIT 2A

Subsequent Price Regressed on P/E Ratio

Index	α	β	t-statistic	P-value	R^2
S&P 500	-337	45.77	29.38	0.00	0.779
World	-329	44.64	31.52	0.00	0.802
Europe	-397	60.04	29.08	0.00	0.775
EAFE	-375	52.17	28.57	0.00	0.769

EXHIBIT 2B

Subsequent Yield Regressed on P/E Ratio

Index	α	β	t-statistic	P-value	R^2
S&P 500	6.00	-0.158	-30.59	0.00	0.793
World	5.85	-0.153	-33.53	0.00	0.821
Europe	6.90	-0.199	-29.17	0.00	0.776
EAFE	4.63	-0.098	-25.35	0.00	0.724

Now we must conduct further tests to determine whether there is any correlation between the P/E ratio and either earnings yields or prices themselves. To evaluate the relation between the P/E ratio and subsequent yields or prices (index values), beginning-of-month P/E ratios are regressed against the period's prices and yields. The regression model is:

$$\text{Yield or Price} = \alpha + \beta(\text{P/E}) + \varepsilon$$

where

- Yield is the subsequent yield, i.e., monthly yield from the beginning of the month to the end of the month;
- Price is the subsequent price or the end-of-the-month price;
- P/E is the beginning-of-the-month P/E ratio; and
- α and β are the regression coefficients.

Exhibits 2A and 2B show the results of regression with subsequent price and subsequent yield as the dependent variable; P/E ratio is the independent variable. It can be seen that the regressions are robust. There is a positive relation between price and P/E ratios and a negative relation between P/E ratios and yield, indicating that subsequent prices increase and yields decline as the P/E ratio rises.

These regression results reaffirm mean reversion theory, but must be checked for autocorrelation and heteroscedasticity. We use the Durbin-Watson statistic and the White test for this purpose.

Exhibits 3A and 3B give results for the Durbin-Watson statistic and the White test for regressions with the P/E ratio as the independent variable and subsequent price and yield the dependent variables. From the two exhibits it can be seen that autocorrelation is present in all eight regressions and heteroscedasticity is present everywhere except when yield is regressed against P/E ratio for the S&P 500.

Autocorrelation suggests that tests for stationarity should be conducted on all three series, that is, price, yield, and P/E ratio for all four indexes. We test the time series for a unit root using the Phillips and Perron (P&P) test with four lags.

Exhibit 4 provides the results. The test is conducted for three different states: intercept, intercept with trend, and no intercept and trend, since the analysis with trend increases the risk of not rejecting the unit root hypothesis when it does not pertain. The results in Exhibit 4 show the presence of unit roots and non-stationarity.

The unit root in series suggests that a cointegrating relation between the series may exist, which implies that linear combinations of non-stationary time series can be stationary. The P&P tests outlined above on the residuals from a so-called cointegrating regression are tests for cointegration. The presence of cointegration implies an error correction representation of the series involved. Cointegration is determined using Johansen's error correction methodology.

EMPIRICAL ANALYSIS

Engle and Granger [1987] suggest that if a system of variables is cointegrated, economic forces interact to bind these variables together in a long-term equilibrium relation. In this case, a vector error correction model can represent the cointegrated variables. In general, the VECM shows the dependence of this period's change on the last period's change, thus providing a measure of how far the system is out of long-term equilibrium. If cointegration is not found, vector autoregression can be used.

One test for cointegration involves a methodology developed by Johansen [1988, 1991], which enables testing for the presence of more than one cointegrating vector. We want to check for stationarity arising from a linear combination of variables.

Exhibit 5 provides the results of Johansen's cointegration test. The results show two cointegrating relationships between price and P/E ratio for the S&P 500 and one cointegrating equation between price and P/E ratio for the EAFE index. All other series do not show evidence of cointegration. Therefore, it is possible to estimate the relation between price and P/E ratio for these two indexes using the VECM. Since the other variables do not show a cointegrating relation, we can estimate the relation between these variables using the VAR model.

Exhibit 6 shows the VECM and VAR results for the relation between price levels and P/E ratio. VECM is conducted for the relation between price and P/E for the S&P 500 and EAFE, and VAR is conducted for the other indexes. For each index, the VAR or VECM is run using both the price and the P/E as dependent variables in the VAR system of equations, although we are interested more in the subsequent price as the dependent variable.

From Exhibit 6 it can be seen that when price is the dependent series for the S&P 500, the coefficients of all four lags are positive but are significant only for lag (–2). That is, if the P/E goes up, then in two

EXHIBIT 3A
Autocorrelation and Heteroscedasticity
Price Regressed on P/E Ratio: DW and White Tests

Index	DW	White test $n \times R^2$	P-value	AC and HET
S&P 500	0.034	75.75	0.00	Accept
World	0.030	103.03	0.00	Accept
Europe	0.043	81.66	0.00	Accept
EAFE	0.053	36.76	0.00	Accept

EXHIBIT 3B
Autocorrelation and Heteroscedasticity
Yield Regressed on P/E Ratio: DW and White Tests

Index	DW	White test $n \times R^2$	P-value	AC and HET
S&P 500	0.054	3.11	0.21	AC Accept*
World	0.066	24.03	0.00	Accept
Europe	0.053	43.93	0.00	Accept
EAFE	0.051	89.36	0.00	Accept

*S&P 500 heteroscedasticity is rejected in White test.

EXHIBIT 4
Tests for Unit Root and Stationarity: Phillips-Perron (P&P) Test

Index	Price			Yield			P/E		
	Intercept	Int. with Trend	None	Intercept	Int. with Trend	None	Intercept	Int. with Trend	None
S&P 500	3.26	0.32	5.34	-0.76	-3.29 (c)	-1.79	-1.08	-2.34	0.76
World	1.78	-0.91	4.01	-1.21	-2.06	-2.08 (b)	-0.83	-2.71	1.22
Europe	1.80	-1.03	3.76	-1.07	-2.41	-1.79 (c)	-0.78	-2.79	1.06
EAFE	-0.01	-2.42	2.17	-1.90	-1.93	-2.05 (b)	-1.73	-2.83	0.35

1% critical values for intercept, intercept with trend, and no intercept or trend are –3.45, –3.99, and –2.57, respectively.
(b) and (c) refer to rejection of unit root hypotheses at 5% and 10% levels.

EXHIBIT 5
Johansen Cointegration Tests

Index	Price Regressed on P/E		Yield Regressed on P/E		Critical Values	
	Eigenvalue	Max-Eigen Statistic	Eigenvalue	Max-Eigen Statistic	5% Critical Value	1% Critical Value
S&P 500						
None	0.107	27.52 [b]	0.031	7.64	14.07	18.63
At most 1	0.032	8.09	0.003	0.86	3.76	6.65
World						
None	0.052	13.10 [a]	0.026	6.40	14.07	18.63
At most 1	0.016	4.00	0.005	1.33	3.76	6.65
Europe						
None	0.046	11.59	0.031	7.64	14.07	18.63
At most 1	0.013	3.20	0.004	1.04	3.76	6.65
EAFE						
None	0.097	24.79 [c]	0.042	10.53 [a]	14.07	18.63
At most 1	0.0002	0.057	0.020	5.01	3.76	6.65

(a) Max-Eigen statistics show no cointegration on both 1% and 5% levels, but trace statistics show two cointegrating equations at 5% level and no cointegration at 1% level.
(b) Max-Eigen statistics show two cointegrating equations.
(c) Max-Eigen statistics show one cointegrating equation.
The rest of the regressions reject cointegration.

EXHIBIT 6
VECM and VAR Results with Price and P/E Ratios

VECM					VAR				
	S&P 500		EAFE			Europe		World	
Independent	**Dep P**	**Dep P/E**	**Dep P**	**Dep P/E**	**Independent**	**Dep P**	**Dep P/E**	**Dep P**	**Dep P/E**
D[Price(-1)]	-0.27 [-2.64*]	-0.01 [-1.34]	-0.14 [-1.47]	0.00 [0.33]	**Price(-1)**	0.98 [10.66]	0.00 [0.18]	0.91 [7.64*]	0.00 [-0.21]
D[Price(-2)]	-0.43 [-4.26*]	-0.01 [-2.88*]	-0.31 [-3.26*]	0.00 [-0.98]	**Price(-2)**	-0.17 [-1.34]	0.00 [-1.37]	-0.13 [-0.81771]	-0.01 [-1.25]
D[Price(-3)]	-0.11 [-1.08]	-0.01 [-3.48*]	-0.11 [-1.11]	-0.01 [-2.05]	**Price(-3)**	0.19 [1.54]	0.00 [0.01]	0.38 [2.25798*]	0.01 [1.32]
D[Price(-4)]	-0.28 [-2.72*]	-0.01 [-1.73*]	-0.04 [-0.42]	0.00 [0.91]	**Price(-4)**	0.01 [0.07]	0.01 [1.95]	-0.15 [-1.19860]	0.00 [0.20]
D[P/E(-1)]	2.09 [0. 80]	-0.02 [-0.25]	1.85 [0.59]	0.10 [1.11]	**P/E(-1)**	-3.66 [-1.15]	0.99 [10.87]	-0.48 [-0.14860]	1.05 [8.78]
D[P/E(-2)]	7.85 [3.15*]	0.29 [3.05]	5.65 [1.83*]	0.05 [0.58]	**P/E(-2)**	8.79 [1.89*]	0.12 [0.90]	3.31 [0.69]	0.03 [0.14]
D[P/E(-3)]	0.67 [0.27]	0.37 [3.84]	2.49 [0.75]	0.26 [2.64]	**P/E(-3)**	-5.71 [-1.22]	-0.04 [-0.32]	-8.95 [-1.73*]	-0.07 [-0.37]
D[P/E(-4)]	2.24 [0.85]	0.09 [0.89]	-3.82 [-1.13]	-0.05 [-0.50]	**P/E(-4)**	0.51 [0.16]	-0.11 [-1.18]	5.69 [1.63]	-0.04 [-0.31]
C	10.33 [5 38*]	0.22 [3.01]	9.01 [3.09]	0.08 [0.98]	**C**	1.99 [0.28]	0.43 [2.07]	5.49 [0.85]	0.47 [1.99]
$\chi^2 = 11.91$			$\chi^2 = 5.46$			$\chi^2 = 3.72$		$\chi^2 = 3.98$	

χ^2 tests for pairwise Granger causality. HO: P/E does not Granger-cause equity price.
T-values in [ ]. *Significant at a minimum of 5%.

months' time prices will go up. Prices will go up for the other lagged months as well, but not significantly.

A Granger causality test shows that the P/E ratio Granger-causes prices to change. Also, the lags of price itself are negative and significant, indicating that high prices are followed by low prices and vice versa. Similar results are obtained for EAFE as well.

From the VAR conducted for Europe and the World index we can see negative index coefficients for Europe P/E for lags (–1) and (–3) and positive coefficients for lags (–2) and (–4). The only significant coefficient, however, is for P/E (–2), which indicates that subsequent prices rise in response to the P/E ratio. A similar result is obtained for the World index, but this time P/E (–3) is significant and negative, indicating that in the case of the World index, price may go down in response to the P/E ratio. Granger tests show a very weak causal relation.

Exhibit 7 gives results for the VAR analysis for P/E ratios and subsequent yields. No cointegration is found for any of the four indexes, and error correction was not needed. For the S&P 500 series, when yield is the dependent variable, the lagged coefficients of P/E (–1) and (–3) are negative and of (–2) and (–4) are positive, but none of the coefficients is significant. This result indicates that subsequent yields are not impacted by P/E ratio. The chi-square test shows that P/E does not Granger-cause yield.

Results for EAFE and the MSCI Europe index are very similar to results for the S&P 500. Results for the MSCI World index are similar to results for the other three indexes, except that the negative P/E (–3) coefficient is significant. This indicates that as P/E goes up, subsequent yield goes down after three months.

SUMMARY AND CONCLUSIONS

Our objective has been to determine whether the P/E ratio impacts subsequent prices or yields of four major indexes: the S&P 500, MSCI World, MSCI Europe, and EAFE indexes. VECM and VAR methods are used to explore the relation, and Granger causality is used to test whether the relation is causal.

Initially simple ordinary least squares regression is run, with yield or price as the dependent variable and P/E ratio as the independent variable. The regression results are robust and conform to mean reversion theory; that is, it is found that subsequent prices increase with high P/E ratios and subsequent yields decline with high P/E ratios. But simple regression analysis may have problems. Therefore we test the data for autocorrelation and heteroscedasticity, and find that autocorrelation is present in all series and heteroscedasticity in all but the S&P 500. We further test the series for unit roots and find we cannot reject the presence of unit roots, and the series are non-stationary.

We then use Johansen's technique to test whether there is cointegration, and find it only in the price of the S&P 500 and P/E and the price of EAFE and P/E. For the other six cases, there is no evidence of cointegration. Therefore, VECM is used for these two series and VAR for the remaining six series. Results for the P/E ratio and subsequent prices show that prices rise in response to P/E ratio but not as much as would be suggested by the regression analysis, as only one of the four lags is positive and significant for all four indexes (and the rest are not). Results for P/E ratio and

EXHIBIT 7
VAR Results with Yield and P/E Ratios

	S&P 500		World		Europe		EAFE	
Independent	**Dep Yield**	**Dep P/E**	**Dep Yield**	**Dep P/E**	**Dep Yield**	**Dep P/E**	**Dep Yield**	**Dep P/E**
Yield(-1)	1.02 [11.76*]	-0.32 [-0.59]	0.91 [7.64]	0.00 [-0.21]	0.98 [10.66*]	0.00 [0.18]	0.87 [9.64]	0.95 [0.99]
Yield(-2)	-0.03 [-0.29]	0.66 [0.88]	-0.13 [-0.82]	-0.01 [-1.25]	-0.17 [-1.34]	0.00 [-1.36]	0.11 [0.88]	-1.28 [-1.01]
Yield(-3)	-0.08 [-0.65]	0.50 [0.68]	0.38 [2.26]	0.01 [1.32]	0.19 [1.54]	0.00 [0.007]	-0.09 [-0.76]	1.29 [1.03]
Yield(-4)	0.08 [0.94]	-0.95 [-1.82]	-0.15 [-1.20]	0.00 [0.20]	0.01 [0.07]	0.01 [1.95]	0.08 [0.95]	-1.07 [-1.17]
P/E(-1)	0.00 [-0.29]	0.88 [10.40]	-0.48 [-0.15]	1.05 [8.78]	-3.66 [-1.15]	0.99 [10.87]	-0.01 [-0.98]	1.16 [12.92]
P/E(-2)	0.01 [0.29]	0.25 [2.18]	3.31 [0.69]	0.03 [0.14]	8.79 [1.89]	0.12 [0.89674]	0.01 [0.86]	-0.25 [-1.91]
P/E(-3)	-0.01 [-0.52]	0.10 [0.83]	-8.95 [-1.73*]	-0.07 [-0.37]	-5.71 [-1.22]	-0.04 [-0.32]	-0.01 [-0.44]	0.25 [1.83]
P/E(-4)	0.01 [0.51]	-0.26 [-3.01]	5.69 [1.63]	-0.04 [-0.31]	0.51 [0.16]	-0.11 [-1.18]	0.00 [0.24]	-0.19 [-1.98]
C	0.05 [0.44]	0.99 [1.43]	5.49 [0.85]	0.47 [1 99]	1.99 [0.28]	0.43 [2.07]	0.09 [1.03]	1.11 [1 21]
	$\chi^2 = 0.59$		$\chi^2 = 2.31$		$\chi^2 = 2.07$		$\chi^2 = 1.20$	

χ^2 tests for pairwise Granger causality. HO: P/E does not Granger-cause equity price.
t-values in [ ]. *Significant at a minimum of 5%.

subsequent yield show there is no significant relation between yield and P/E ratio.

In conclusion, we find that subsequent prices will increase and subsequent yields will decline in response to an increase in the P/E ratio. When adjustments for autocorrelation, heteroscedasticity, unit roots, and non-stationarity are made, however, P/E ratios may not have as much of an impact on prices as initially expected, and they have no impact whatsoever on subsequent yields.

ENDNOTE

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