Stock Prices, Consumer Sentiment, And Economic Activity: Some Robust Bilateral Causality Tests For The US And The UK

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ABSTRACT

This paper performs robust bilateral Granger causality tests for stock prices, consumer sentiment, and economic activity for the US and the UK. The robust test procedures involve the use of recently developed time series analysis of nonstationary data with possible structural breaks. Applying a battery of such tests, the paper finds the underlying data to be generally nonstationary and noncointegrated, even after allowing for possible breaks in the data, thus implying that the standard bilateral Granger causality tests are robust. The empirical results indicate the presence of unidirectional causality from stock prices to consumer sentiment for both countries. Given that stock prices drive consumer sentiment, we perform additional causality tests to determine the effect of consumer sentiment on the economy. Our finding of a unidirectional causality from consumer sentiment to the economy in both countries is consistent with a chain of causality from stock prices to consumer sentiment to the economy. (JEL: G00, C32)

There is widespread acceptance of the proposition that consumer sentiment drives stock prices, based largely upon the casual observation that when the consumer sentiment index is announced, the market generally responds accordingly on the day of the announcement. It is, however, possible that changes in consumer sentiment are in turn a delayed response of consumer moods to previous changes in stock prices, thereby rendering the issue of the causality between stock prices and consumer sentiment an empirical one. While the evidence of causality from consumer sentiment to stock prices is sparse and largely impressionistic, the evidence of causality in the opposite direction, from stock prices to consumer sentiment, is extensive and systematic. Since movements in stock prices can impact consumer sentiment either directly through their wealth effect, or indirectly through their signaling effect for the future health of the economy, researchers have conducted empirical tests of both effects. Specifically, Bosworth (1975), Hall (1978), Starr-McCluer (1998), Ludvigson and Steindel (1999), and Shirvani and Wilbratte (2000) provide evidence that the stock market affects the economy through a wealth effect, while Romer (1990) and Poterba and Samwick (1995) conclude that the stock market affects the economy more through its effect on consumer expectations. This means that regardless of the underlying transmission mechanism, there is solid evidence that stock price changes do impact consumer sentiment and, thus, have a significant effect on the performance of the economy.

This paper provides a more systematic and robust test of bilateral causality between stock prices, consumer sentiment, and economic activity than was used in the earlier papers and extends the analysis to include a European economy with a well developed stock market. The paper finds evidence of unidirectional causality from stock prices to consumer sentiment in both countries. The finding that stock prices drive consumer sentiment raises the question of whether consumer sentiment in turn may affect the level of economic activity. We explore this possibility by performing a similar bilateral causality test between consumer sentiment and the economy, as measured by industrial production, and find a unidirectional causality from consumer sentiment to the economy.

Thus, the effect of stock prices on the economy may follow two channels, the well-established wealth effect on consumption, and the signaling effect through consumer sentiment. The two, of course, are not mutually exclusive.

Our tests for the presence of causality between stock prices, consumer sentiment, and industrial production adopt the causality concept set forth by Granger (1969). Granger causality encompasses not only the traditional causality of one variable actually driving the other, but also one variable merely carrying information about the future course of the other. This means that to test for Granger causality, we must determine whether the introduction of the past values of a causal variable into a simple auto- regressive equation for a given variable indeed significantly adds to the explanatory power of that equation. Needless to say, a pair of variables may also display a feedback process, in which each variable Granger causes the other. For this reason, we test for the presence of such a feedback process between stock prices and consumer sentiment and between consumer sentiment and the economy using bilateral causality tests.

The results of such tests, however, can be misleading if the underlying data fail to display certain desirable time series properties. Engle and Granger (1987), and Granger, Huang, and Yang (2000), for example, have shown that the original Granger causality test may be misspecified in the presence of such data properties as nonstationarity, cointegration, or structural breaks. This means that it is necessary to screen the data for such properties before any application of the standard Granger Causality test. In recognition of these possibilities, this paper sequentially tests for nonstationarity, structural breaks, and cointegration to ensure that the data possess the requisite properties for our causality tests. Having ascertained that the data possess the requisite properties, we then test for the presence of bilateral Granger causality between stock prices, consumer sentiment, and industrial production in the context of two major industrial countries, the U.S. and the U.K.

The paper is organized as follows. Section II discusses the empirical methodology. Section III presents the empirical findings. Section IV concludes.

EMPIRICAL METHODOLOGY

In testing for causality between stock prices and consumer sentiment, we draw on the standard Granger (1969) causality test, in which the first difference of the dependent variable is regressed on the lagged first differences of both the dependent and the independent variables, as shown below. First differencing of the variables is required in the presence of unit roots in the variables as is shown to be the case for the time series data utilized in this paper:

$$\Delta Y_{1t} = \gamma_0 + \sum_{i=1}^{k} \gamma_{1i}\Delta Y_{1(t-i)} + \sum_{i=1}^{k} \gamma_{2i}\Delta Y_{2(t-i)} + \varpi_{1t} \tag{1}$$

$$\Delta Y_{2t} = \delta_0 + \sum_{i=1}^{k} \delta_{1i}\Delta Y_{1(t-i)} + \sum_{i=1}^{k} \delta_{2i}\Delta Y_{2(t-i)} + \varpi_{2t} \tag{2}$$

A finding that the coefficients γ_2 (δ_1) are jointly significant indicates unidirectional Granger causality from Y_2 to Y_1 (from Y_1 to Y_2). If both coefficients y_2 and δ_1 are found to be jointly significant, then we have bilateral causality, or feedback, between Y_1 and Y_2. However, as shown by Engle and Granger (1987), the above equation is misspecified if the underlying variables are cointegrated. Under such conditions, the Granger causality equations should be modified to incorporate the so-called error correction terms associated with the cointegration equations, as follows:

$$\Delta Y_{1t} = \gamma_0 + \sum_{i=1}^{k} \gamma_{1i}\Delta Y_{1(t-i)} + \sum_{i=1}^{k} \gamma_{2i}\Delta Y_{2(t-i)} + \gamma_3(Y_{1(t-1)} - \tau_1 Y_{2(t-1)}) + \varpi_{3t} \tag{3}$$

$$\Delta Y_{2t} = \delta_0 + \sum_{i=1}^{k} \delta_{1i}\Delta Y_{1(t-i)} + \sum_{i=1}^{k} \delta_{2i}\Delta Y_{2(t-i)} + \delta_3(Y_{2(t-1)} - \tau_2 Y_{1(t-1)}) + \varpi_{4t} \tag{4}$$

In light of the foregoing, it is thus necessary to test the underlying data for the presence of both unit roots and cointegration to determine the appropriate form of the equation to employ in the causality tests. Such tests can be performed using the standard Dickey-Fuller (1979) unit root test and the Engle-Granger (1987) cointegration test.

However, as Perron (1989), Perron and Vogelsang (1992), Zivot and Andrew (1992), and Granger et. al. (2000), among others, show, both the Dickey-Fuller and Engle-Granger tests can yield misleading results in the presence of breaks in the data. In the presence of such breaks, for example, the Dickey-Fuller test may indicate the presence of a unit root in the data, while in reality the data are stationary around a shifting and/or broken trend. Likewise, such breaks in the data may lead the Engle-Granger test to incorrectly reject the existence of cointegration between the underling variables. Given that the possibility of breaks in the data is very strong in the present study, as the sample period has been characterized by major events such as oil price shocks and major fluctuations in stock prices, we also employ recently developed tests which are robust with respect to the presence of breaks in the data.

One such test, developed by Zivot and Andrew (1992), provides evidence as to whether the data are characterized by unit roots in the context of endogenously determined breaks in the level and direction of the trends in the data. Specifically, we use the following equations to perform tests for unit roots with the respective alternatives being a level shift, and a joint level and slope shift:

$$\Delta Y_t = \alpha_0 + \alpha_1 D_t + \alpha_2 T + \alpha_3 Y_{t-1} + \sum_{i=1}^{k} \alpha_{4i}\Delta Y_{t-i} + \varepsilon_{2t} \tag{5}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 D_t + \alpha_2 T + \alpha_3 DTB_t + \alpha_4 Y_{t-1} + \sum_{i=1}^{k} \alpha_{5i}\Delta Y_{t-i} + \varepsilon_{3t} \tag{6}$$

where D is a dummy variable with a value of 0 for the periods before the break and 1 thereafter, DTB = T-TB if T>TB and DTB = 0 otherwise, and TB represents the breakpoint. In both equations, the breakpoint is endogenously determined by running recursive regressions and selecting the values of TB for which the coefficient of Y_1 is most highly significant, using the critical values provided by Zivot and Andrew (1992). Note that if the dummy variables are dropped from the above equations, i.e., if we exclude the possibility of a break of either kind in the data, the above equations simply reduce to the standard Dickey-Fuller unit root test against the alternative of stationarity around a linear trend.

With the time series properties of the data established, we then test for cointegration to determine the appropriate form of the equations of the causality tests. Again recognizing the possibility of breaks in the data, we employ three different cointegrating equations. This first is the basic Engle-Granger test, which is appropriate in a simple bivariate framework, assuming no breaks in the data:

$$Y_{1t} = \beta_0 + \beta_1 Y_{2t} + \mu_{1t} \tag{7}$$

Under this test, cointegration is accepted if the hypothesis of a unit root in the estimated residuals is rejected.

The second model modifies the Engle-Granger equation to test for a level shift in the data:

$$Y_{1t} = \beta_0 + \beta_1 D_t + \beta_2 Y_{2t} + \mu_{2t} \tag{8}$$

Finally, the third model tests for both a level and a directional shift:

$$Y_{1t} = \beta_0 + \beta_1 D_t + \beta_2 Y_{2t} + \beta_3 D_1 Y_{2t} + \mu_{3t} \tag{9}$$

where the dummy variable D is defined as in equations 5 and 6. Note that here again if the dummy variables are dropped from the above equations, i.e., if we exclude the possibility of a break of either kind in the data, the above equations simply reduce to the standard Engle-Granger cointegration test.

Whether the variables of the model are found to be cointegrated or not determines the form of the equation to be employed in the causality tests. If the variables are cointegrated, it is necessary to include the estimated residuals from the above cointegrating equations in the causality tests. Otherwise, a simple VAR in first differences will suffice. With our causality tests structured in accord with these requirements, our equations test first whether stock prices cause consumer confidence and then whether consumer confidence causes stock prices. Finding that stock prices drive consumer sentiment, we then perform parallel tests for bilateral causality between consumer sentiment and the economy.

EMPIRICAL FINDINGS

We perform the tests described above for the U.K. and the U.S. The stock price data (FTSE 100 for the U.K and the S&P 500 for the U.S.) and the industrial production data are both deflated by the CPI. All data, including the consumer sentiment data, are expressed in logs, are monthly OECD time series (furnished with the RATS software package), and span the periods 1985:1-2003:5 for the UK, and 1978.1-2003.11 for the US. Since all the unit root and cointegration tests incorporate lags, we determine the appropriate leg length beginning with lags of 12 months and then use the likelihood ratio test to determine whether a shorter lag is warranted. More specifically, we test downward to see whether each lag is significant and drop the lag if it proves insignificant. However, if the Ljung-Box (1979) test statistic indicates the presence of serial correlation in the absence of an excluded lag, that lag is left in the equation.

The unit root test results are reported in Table 1. For each country, the Dickey-Fuller test, assuming no breaks in the data, indicate that all variables are I(1). However, considering the possibility that breaks in the data may account for our findings of nonstationarity, we perform additional unit root tests considering first the possibility of a level shift and then the possibility of both level and directional shifts. The test results reveal that in one instance, a break in the industrial production series accounts for the finding of nonstationarity.

Table 1: Unit Root Test Results

Country	Variable	Lags	Levels	Standard Dickey-Fuller First Differences	Intercept Shift	Intercept and Slope Shift
U.K.	Stocks	2	-1.94	-9.79*	-2.95	-3.77
	Sentiment	12	-1.79	-5.35*	-1.34	-2.18
	Production	8	-2.32	-3.77*	-4.69*	-4.40
U. S.	Stocks	5	-2.62	-6.96*	-3.65	-4.53
	Sentiment	12	-2.60	-5.58*	-3.85	-3.81
	Production	8	-3.00	-4.00*	-4.13	-3.81

*Indicates significant at the 5 percent level.

Given the finding that all of our underlying data except industrial production in the U.K. display unit root characteristics, even after allowing for the possibility of breaks in the data, we test for cointegration before performing causality tests, using the estimation methods described in the preceding section. Of course, the finding that only industrial production in the UK is trend-stationary indicates that this variable cannot be cointegrated with either of the others, but as a precaution, we nevertheless test for this possibility. This precaution is warranted, given the possibility that the low power of the unit root tests may yield invalid results. The cointegration test results appear in Table 2. In no case do we find cointegration using the standard Engle-Granger test. The absence of cointegration, however, could be due to structural changes, so we perform a test for a intercept shift and another for intercept and slope shift. Allowing for such shifts, we nevertheless find no evidence of cointegration. This indicates

that our causality tests should be performed as simple VARS in first differences, without the estimated residuals from the cointegrating equations.

Table 2: Cointegration Test Results

Country	Dependent/Independent Variable	Standard Engle-Granger	Intercept Shift	Intercept and Slope Shift
UK	Stocks/Sentiment	-1.57	-0.97	-1.25
	Sentiment/Stocks	-1.69	-2.12	-2.63
	Production/Sentiment	-2.28	-2.59	-2.40
	Sentiment/Production	-2.15	-2.20	-2.70
US	Stocks/Sentiment	-1.34	-2.91	-2.77
	Sentiment/Stocks	-2.58	-3.39	-3.32
	Production/Sentiment	-2.32	-2.65	-2.25
	Sentiment/Production	-2.50	-3.44	-3.42

* indicates significant at 5 percent level.

The causality test results appear in Table 3. As noted, we test whether stock prices Granger cause consumer sentiment and also whether consumer sentiment Granger causes stock prices. Our results are the same for both countries, indicating that there is unidirectional Granger causality from stock prices to consumer sentiment. For both countries, the asymptotic chi-squared test for Granger causality is significant at the 5 percent level or higher in every case. We thus find that in this sample of the two of the world's largest and most market oriented countries, stock prices help predict the behavior of consumer sentiment but that the reverse fails to hold.

Having found causality from stock prices to consumer sentiment, we proceed to explore the implications of this finding for the economy, performing a bilateral causality test between industrial production and consumer sentiment. These results also indicate unidirectional causality, from consumer sentiment to the economy. Thus, in both countries, there is evidence of a causal chain, running from stock prices to consumer sentiment to the economy, but not in the opposite direction.

Table 3: Granger Causality Test Results

Country	Dependent/Independent Variable	Lags	Chi-squared Test
UK	Stocks/Sentiment	2	1.45
	Sentiment/Stocks	5	11.95*
	Production/Sentiment	12	45.04*
	Sentiment/Production	1	0.89
US	Stocks/Sentiment	6	1.43
	Sentiment/Stocks	6	30.16*
	Production/Sentiment	9	59.90*
	Sentiment/Production	5	10.63

The chi-squared tests have the same degrees of freedom as the number of lags.
* indicates significant at the 5 percent level.

CONCLUSION

This paper performs robust bilateral tests of Granger causality between stock prices, consumer sentiment, and industrial production for the U.S. and the U.K. Since the standard Granger causality test, even after incorporating the possibility of nonstationarity and cointegration of the underlying data, can produce misleading results in the presence of structural breaks, we make use of more advanced unit root and cointegration techniques which test for possible breaks in the time series to determine the appropriate Granger causal relations between stock prices, consumer sentiment, and consumption.

The statistical results indicate unidirectional causality from stock prices to consumer sentiment to the economy in the cases of two industrial countries. The results are interesting in that they demonstrate the presence of a causal linkage from the financial markets to the real sector of the economy but not the reverse. It is certainly reasonable to believe that shocks to the real sector affect the financial sector, but the findings of this paper indicate that such shocks are not transmitted through consumer sentiment. However changes to the economy affect the stock market, it is probable that the economy leads the stock market and that the relationship thus does not correspond to the concept of Granger causality. It would be an interesting topic for further research to determine the mechanism through which this transmission occurs and the timing of the relationship.

If it is the case that the stock market affects the economy not only through a wealth effect but through consumer expectations as well, the widely accepted wealth effect may be quantitatively lower than previously believed. The evidence regarding the wealth effect of stock prices on consumption may actually capture the combined effect of wealth and expectations and thus overstate the size of the wealth effect. Conceivably, this may explain why more recent tests by Shirvani and Wilbratte (2000) indicate a weaker wealth effect than the earlier estimates obtained by Bosworth (1975) and would be an interesting topic for future research. The distinction between the relative importance of the wealth effect and the expectations effect would be of interest to the Federal Reserve, which has specifically taken the position that its task is to target the economy to the exclusion of the stock market. Given these policy goals, the Federal Reserve can utilize awareness of the channels through which the market affects the economy and of the magnitude of these effects would be valuable in its efforts to reduce the amplitude of economic fluctuations.

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