The Linkage between Sentiments and Stock Market Dynamics New Evidence from Iran

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Abstract

In recent years, the issue of financial behavior and the impact of investors' sentiments on their decision making have become such a popular issue. The sentiments of financial activists affect the market price of financial assets and particularly stocks, and therefore it is included in the new pricing models of capital assets. In this article, we seek the effect of investors' sentiments on the dynamics of the Iranian stock market (TSE). To do this, among the companies accepted in the stock market we select 120, considering the research criteria and screening method, we examined TSE specifics throughout 2010-2018 using regression analysis and causality test. Our results show that firstly investors' sentiments have a direct effect on the stock returns and there is a bilateral relationship between them. Secondly, inflation has the opposite effect and economic growth has a direct and positive effect on the relationship between investor sentiment and stock returns. Finally, government spending has no significant effect on the relationship between investor sentiment and stock returns.

Keywords: sentiments, stock market return, stock price, Iran, inflation

1. Introduction

In recent years, Eugene Fama's Efficient-market hypothesis has been seriously criticized and this has led to a new approach to financial economics. Accordingly, many studies have been conducted in both economics and psychology on capital market puzzles and decision-making under uncertainty (Lee, Shleifer, and Thaler, 1991; Kumar and Lee, 2006; Baker and Wurgler, 2006, and Loewenstein et al. 2001). The view that stock prices fully reveal all necessary information should present a clear picture of investor's expectations nonetheless the presence of noise trader makes real stock price less important.

Several studies have documented that the classical theory in financial economics does not consider investor sentiment as a key factor to address the stock price (Thorbecke, 1997; Ehrmann & Fratzscher, 2004; Maio, 2014; Kurov, 2010). On the other hand, there are studies that show the behavior of participants is not entirely rational and is unpredictable and accompanied by emotions (Kunming, 2010; Thaler, 1991) and there are shreds of evidence that investor's sentiment and emotions act as a systematic factor in stock prices (Baker & Wurgler, 2006; Stambaugh, Yu, & Yuan, 2012; Shen, Yu, & Zhao, 2017).

Sentiments change the profitability of stocks and do so in the short term. For example, pessimism not only reduces stock returns but sometimes causes losses, and conversely, optimism can increase stock returns (Anusakumar et al., 2012). The stock price oscillates with the oscillation of investor's sentiment, but the impact due to positive and negative investor sentiment changes is different (Zhang & Yang, 2009).

The existing literature shows that if there is an arbitrage constraint, an increase in optimism when emotions are on the rise will cause the market to be overestimated for a long period, and stock prices will distort its reasonable discounted value of the projected cash flows. (De Long et al., 1990; Mian & Sankaraguruswamy, 2012; Kaplanski et al., 2015). Psychological studies have also found that emotions can affect the assessment of possible outcomes as well as the assessment of risk (Johnson & Tversky, 1983; Loewenstein et al., 2001). Revealing the fundamentals of the market, following mispricing is adjusted, resulting in lower stock returns. In contrast, when sentiments are low, no attention is paid to them (Yu & Yuan, 2011; Chong, Hong, & Yeh, 2012), and therefore, there is no correction of

errors about the latter sentiments (Yu & Yuan, 2011; Chung, Hung, & Yeh, 2012).

This study will try to shed some light on regional problems through the simultaneous analysis of the underlying factors making novel contributions to the literature. We aim to find a convincing answer to these questions: Does investor sentiment have a positive effect on stock returns? And does GDP have a positive impact on investor sentiment and stock exchange relationship? What are the role of Government expenditure and Inflation in the relationship between investor sentiment and stock exchange? Our approach to identifying the issue is distinct and two-fold: First, we examine the triple causality of these factors which is a new approach. Second, this study explains a challenging issue in the Tehran Stock Exchange (TSE) applying variables selected based on the state of the art theoretical foundations. We use data from the TSE data center, World Bank, and Statistical Center of Iran and with a sample of 2010–2018. The remained of this paper is organized as follows: Section 2 represents a summary and a table of literature preview. Section 3 describes the methodological framework and data sources; Section 4 reports and explains the results and, finally Section 5 offers concluding states with policy suggestions.

2. Literature Preview

A well-known set of studies of sentiment and aggregate stock returns appeared in the 1980s. They were largely theoretical, testing in various ways whether the stock market as a whole could be mispriced. In these studies, the role of sentiment was left implicit, and the statistical evidence was not usually very strong. More recent studies, such as Baker and Wurgler (2006), utilize interim advances in behavioral finance theory to provide sharper tests for the effects of sentiment. In particular, according to DeLong et al. (1990), there are two types of investors: rational arbitrageurs who are sentiment-free and irrational traders prone to exogenous sentiment. In such cases, mispricing arises out of the combination of two factors: a change in sentiment on the part of the irrational traders, and a limit to arbitrage from the rational ones. The key predictions of this framework come from its two moving parts. Consider first the possibility that sentiment-based demand shocks vary across firms, while arbitrage is equally difficult across firms. Hence when sentiment rises, we expect such "speculative" stocks to have simultaneously higher returns.

The question is what makes some stocks more profitable than others? It seems that the basic characteristics are difficulty and mental imagination in determining true value. For instance, in the case of start-ups that are unprofitable but potentially very profitable, a combination of unprofitable history and an uncertain but attractive future will allow investors to have valuations in a range of very small and very large value since emotions come into play. On the other hand, under the bubble situation when speculation tends to escalate, some young and ambiguous stocks are overvalued, while old firms with long term income, tangible assets, and stable dividends are much less assessed than mental value and may not be affected by sentiments.

2.1 Sentiment Proxies

Measuring investor sentiment is not that straightforward. Prior work suggests a number of proxies for sentiment to use as time-series conditioning variables. There are no definitive or uncontroversial measures, however. We can discuss some of the common themes in measuring sentiments and practical proxies. DeLong et al. (1990) suggested several methods of measuring sentiment including mood proxies; retail investor trades; mutual fund flows; trading volume; premium on dividend-paying stocks; closed-end fund discounts; option implied volatility; first-day returns on initial public offerings (IPOs); the volume of initial public offerings; new equity issues; and insider trading.

We follow Baker and Wurgler's (2007) six commonly employed proxies for measuring investor sentiment including: trading volume based on TSE turnover, the dividend premium, the closed-end fund discount, the first day returns on IPOs, and the equity share in new issues. We first explain each proxy singly and then discuss how they are formed into overall sentiment indexes.

The closed-end fund discount: The investor demand can cause a closed-end fund trading at a premium or a discount to its NAV (Net Asset Value). A premium price means the price of a share is above the NAV, while a discount is the opposite, below NAV, value.

Dividend premium: This is essentially a safety measure by which investors can assess the predictable flow of dividend payments. While dividends are in the high and strong stream, the company is likely to expect to disburse it, not as much of when it is on reduction (Fama & French, 2001). According to Baker and Wurgler (2004) dividend premium is the difference between the average market-to-book value ratios of dividend payers and non-payers.

Initial public offerings (IPO): It is calculated as the log of number of IPOs issued during the specified period. In the case of TSE, there are studies that suggest there is a positive abnormal return to investing in the newly accepted oil and chemical firms for stockholders and the underpricing IPO phenomenon is confirmed (Karami et al., 2014; Filsaraei et al., 2013).

IPO First day return: Often initial public offerings earn a great return on the very first day of trading that sentiment definitely is going to be involved (Zhang, 2008).

IPO volume: Investment decisions are highly dependent upon the volume of IPOs. This further relates that firms during the market enthusiasm period exploit by issuing new equity.

Trading volume: According to Elster (2003), emotions help in improve decision making by overcoming avoidable delays, hence resulting in a better quality decision without exclusive rational deliberation.

Although different studies have used different methods to measure investor sentiments, the findings of most studies show that high emotions have a negative effect on stock returns, and vice versa (Asem et al., 2016, Tran Nine, 2013; Grigaliūnienė & Cibulskiene, 2010). So in this study, we are looking to answer the question of whether investor sentiments have a significant effect on the stock market dynamics in Iran or not? This research helps to identify the determinants of stock prices in the Iranian stock market. We will take a new look at the issue of behavioral finance and use the variables related to the Iranian stock market to measure the effect.

For a more comprehensive review of the literature, we represent the following table.

Table 1. Summary of empirical studies about the effect of sentiments on stock market dynamics

Author	**Subject**	**Period**	**method**	**Result**
Trichilli et al. (2020)	Middle East and North Africa (MENA)	2004 - 2018	Hidden Markov model based on the transition matrix	Sentiments effect is significant
Rupande et al. (2019)	South Africa (Johannesburg Stock Exchange)	2002 - 2018	Generalized Autoregressive Conditional Heteroscedasticity model	Sentiment effect is significant
He et al. (2019)	USA (US Stock Market)	1987-2015	TVA-GARCH-M model - Maximum Likelihood	Sentiment effect is significant through the past risk
Padungsaksawasdi (2019)	Thailand	2000 - 2018	PVAR methodology with the GMM estimation	Investor sentiment → stock returns
Liston Perez and Gutierrez (2018)	USA	1988-2009	Vector autoregressive model (VAR)	Both individual and institutional rational-based sentiment positively influence pure sin returns
Smales (2017)	NYSE	1990-2015	Causality tests	Sentiment → return (across firm-size and value)
Yang et al. (2017) and Ryu et al. (2017)	South Korea (Korean Stock Market)	2000-2015	Multivariate regression analyses for firm sizes and stock prices	Sentiment effect is significant specially on small firms
Iyer and Harper (2017)	European Union	1980-2014	Regression analysis (cash flow volatility)	Investor sentiment has little influence on safe stocks
Ben Aissia (2016)	France (French Stock Market)	2003-2013	Regression analysis	Sentiment effect is significant
Asem et al. (2016)	Australia	2000-2012	Regression analysis	Sentiments effect is significant (Specially for big firms)
Liu Sh. (2015)	NYSE and AMEX	1976-2007	Granger Causality Tests	Sentiment → market liquidity

Dalika and Seetharam (2015)	South African Market	1999-2009	Regression analysis	Investor sentiment has a strong impact on share returns
Ahmed and Ullah (2013)	Pakistan	2001-2012	Auto regressive distributive lag (ARDL)	Investor sentiments have a positive and significant effect on KSE returns
Bathia and Bredin(2013)	G7 Stock Exchange	1995-2007	Panel regression analysis	Reverse relationship between investor sentiment and future returns
Chi et al. (2012)	China (Chinese Stock Exchange)	2004-2008	Regression analysis	Sentiment effect is significant and positive
Grigaliūnienė and Cibulskiene (2010)	Sweden, Finland, Norway and Denmark	1989-2009	Regression analysis	High sentiment has a negative effect on future stock returns.
Drakos K. (2010)	Panel of 22 countries	1994-2004	Regression analysis	Sentiment effect is significant
Canbaş and Yılmaz Kandır (2009)	Turkey (Istanbul Stock Exchange)	1997-2005	Vector autoregressive (VAR) analysis and Granger causality tests	Sentiment ↔ return
W. Brown (1999)	NYSE (US Stock Market)	1993-1994	Volatility Regression	Investor's sentiment is associated with greater volatility

The sentiment is a combination of simple and complex mental evaluation process resulting in an emotional state of the body as additional mental change (Kuzmina, 2010). This can be both a reaction to certain stimuli and the human brain which prepares the body to react in certain directions. People with the goal of making the most profit in financial affairs, in addition, their sense of well-being is based on the best conjecture and experience of the past about the possible outcome. According to Kuzmina (2010) on average, emotional traders are positive about uncertainties. Therefore, they tend to buy risky assets. Noise traders are also an essential part of the price settlement mechanism. When the ratio of emotional investors is higher, the probability of return and market fluctuations is higher.

Behavioral asset pricing model conceives that irrational emotion and the market price of risk (MPR) are linked; where noise traders show melancholic, rational traders hold optimistic opinion thus risk compensation would be higher in this case to attract rational trade henceforth upward movement of MPR and likewise lower, where irrational investors are optimistic so that rational investors could do their investments (Rahul Vermaa, 2009; Ahmed & Ullah, 2013). Based on the above discussion and the deep sentimental conditions of the market and the macroeconomic conditions of Iran, we intend to answer the questions of this study.

3. Data and Methodology

The data for research variables were obtained from the Tehran stock exchange, the World Bank database, and the central bank of Iran. All these sources are highly credible and frequently used by researchers to obtain reliable and accurate data for their variables. The data was a quarterly range from the first quarter of 2010 up till the last quarter of 2018. Variables that were not available quarterly, the value of these values were calculated on a monthly basis based on Denton's interpolation method in 1971. The effect of these values attributed in no way jeopardizes the integrity of our results, as this does not eliminate the effect of the original values.

3.1 Analytical Model

In order to test our hypotheses we will estimate the following baseline regression model:

$$IR = f(GDP, INF, GEXP, SENTI) \quad (1)$$

$$IR = \alpha + \beta\ 1\ GDP\ t + \beta\ 2\ INF\ t + \beta 3\ GEXP\ t + \beta\ 4\ SENTI\ t \quad (2)$$

Where:

$TSER = P_t - P_0 / P_0$ Where IR = Index returns, P_t = current closing TSE index at time t and, P_0 = closing TSE index at t-1.

GDP = Δ GDP growth rate per quarter, measured as: $GDP_t - GDP_0 / GDP_0$ where, GDP_t = GDP growth rate at time t and GDP_0 = GDP growth rate at t-1;

INF = Δ inflation rate per quarter, measured as: $CPI_t - CPI_0 / CPI_0$ where, CPI_t = inflation rate at time t and CPI_0= inflation rate at time t-1;

GEXP = Δ government expenditure rate per quarter, measured as: $GEXP_t - GEXP_0 / GEXP_0$ where $GEXP_t$ = government expenditure at time t and $GEXP_0$ = government expenditure at time t-1;

SENTI = Sentiment level is gauged by using the fluctuation of TSE total index.

4. Empirical Result

4.1 ADF Test

To prevent false regression, we first checked the variability of the variables and reported the results in the table 2 as follows.

Table 2. ADF Test Results

At level				**At first difference**		
Variable	**With intercept**	**With trend and intercept**	**None**	**With intercept**	**With trend and intercept**	**None**
TSER				-2.936942	-3.526609	-1.949319
INF	-2.936942	-3.526609	-1.949097			
GDP				-2.936942	-3.526609	-1.949319
GEXP				-2.941145	-3.533083	-1.949856
SENTI				-2.936942	-3.526609	-1.949319

Significant at 5%.

Then we examined the vectors of cointegration between the variables and no correlation was found. So we go to estimate the VAR model and then examine the causal relationships between the variables.

4.2 Causality Test

In this step, we examine the causal relationships between the variables. The most important result of the causality test is that investor sentiment has a two-way causal relationship with stock return. Also, inflation can be another factor in increasing the sentiment of capital market participants, and that is the Granger causality. Inflation can also increase stock market returns. However, no evidence was found for GDP and government spending on the causality of stock returns and sentiments. The result is shown in table 3 as follow:

Table 3. Causality test

Dependent variable	Pairwise Granger test
TSER	SENTI→ TSER
	INF→ TSER
	GDP↛ TSER
	GEXP↛ TSER
INF	GDP→ INF
	GEXP→ INF
	SENTI ↛ INF
	TSER ↛ INF
GDP	TSER→ GDP
	GEXP→ GDP
	SENTI ↛ GDP
	INF ↛ GDP
GEXP	TSER↛ GEXP
	GDP → GEXP
	SENTI ↛ GEXP
	INF ↛ GEXP
SENTI	TSER→ SENTI
	INF→ SENTI
	GDP↛ SENTI
	GEXP↛ SENTI

4.3 Impulse Response Functions

In this section, we present the results of the impulse response functions. An impulse response function shows the dynamic responses of the variables at a time to various shocks within the VAR system. These types of functions are used to analyze how shocks in any variable in the system filter thorough to affect every other variable.

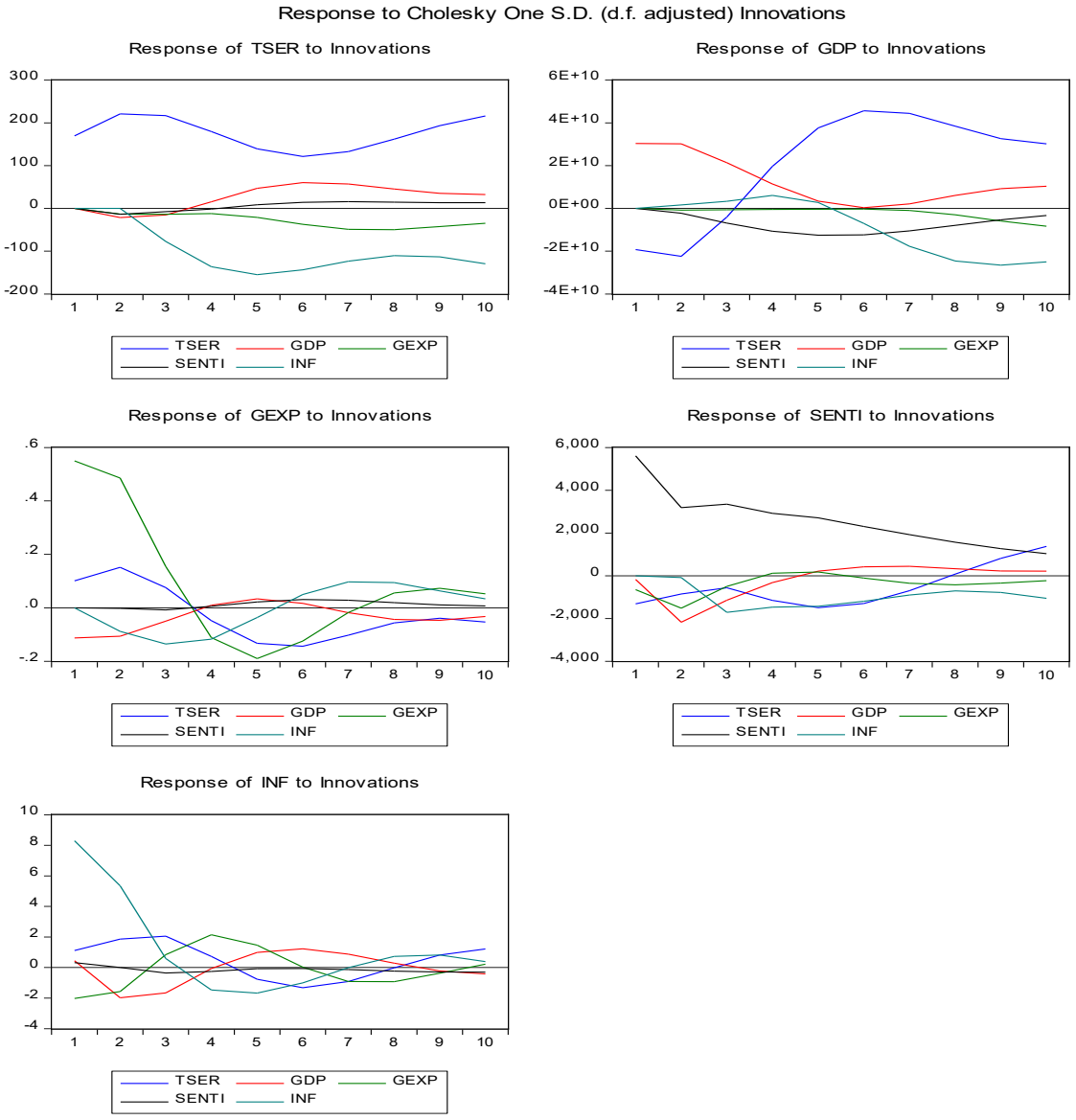

Figure 1. Impulse response functions of the VAR

In particular, based on Figure 1, we notice that investor sentiment has a positive impact on stock return and vice versa. The same holds true for the effect of market return on economic growth. Among the finding, the effect of inflation on investor sentiment is negative. Finally, results show that economic growth positively affects government spending and the inflation has an opposite effect and economic growth has a direct and positive effect on the relationship between investor sentiment and stock returns. With regard to government spending, we can report that it has no significant effect on the relationship between investor sentiment and stock returns.

5. Conclusion

In this article, we seek the effect of investors' sentiments on the dynamics of the Iranian stock market (TSE). To do this, among the companies accepted in the stock market, considering the research criteria and screening method, we examined 120 companies throughout 2011-2018 using regression analysis. Our results show that firstly investors' sentiments have a direct effect on the stock returns and there is a bilateral relationship between them. Secondly, inflation has the opposite effect and economic growth has a direct and positive effect on the relationship between investor sentiment and stock returns. Finally, government spending has no significant effect on the relationship between investor sentiment and stock returns.

These days' Iranian investors have an optimistic outlook towards investment in TSE, hence depicting positive sentiment in this otherwise seemingly depressing condition of the economy. Sentiments do fluctuate according to the economic conditions of the country. The results highlight this point as inflation, one of the most important issues of this country has been found to negatively impact stock index returns, GDP to positively impact on stock index returns and sentiment to projecting positively and significantly in the short run.

Considering the causality test we find that there is a bilateral relationship between investor sentiment and stock return. Government spending causes inflation and inflation can cause investor sentiments. This optimistic attitude of most of the investors in Iran depicts the significance of the sentiment factor on the country's investment potential. Investors in the quest of implementing the momentum approach in Asia and possibly elsewhere should be watchful of the sentiment established at the time of portfolio formation. The results also signify that long-run sentiment and inflation have a significant role and confirm the logic of base papers with sentiment having positive and inflation having a negative impact. These mixed results conclude the fact that sentiment is an important factor in investor decision-making of the Tehran stock exchange (TSE).

Compliance with Ethical Standards

Conflict of Interest

I Heshmatollah Asgari declare that I have no conflict of interest. I Hamed Najafi declare that I have no conflict of interest.

Ethical Approval

We declare that this article does not contain any studies with human participants or animals performed by any of the authors.

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Appendix: Table and calculations:

Calculations:

1. Cointegration test

Date: 06/26/20 Time: 17:36

Sample (adjusted): 2010Q3 2019Q4

Included observations: 38 after adjustments

Trend assumption: Linear deterministic trend

Series: TSER SENTI INF GEXP GDP

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.571014	80.56293	69.81889	0.0054
At most 1 *	0.453555	48.40232	47.85613	0.0444
At most 2	0.346889	25.43810	29.79707	0.1464
At most 3	0.118052	9.249784	15.49471	0.3428
At most 4 *	0.111121	4.476160	3.841466	0.0344

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.571014	32.16061	33.87687	0.0790
At most 1	0.453555	22.96422	27.58434	0.1750
At most 2	0.346889	16.18832	21.13162	0.2141
At most 3	0.118052	4.773624	14.26460	0.7701
At most 4 *	0.111121	4.476160	3.841466	0.0344

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

TSER	SENTI	INF	GEXP	GDP
-0.002021	4.04E-05	0.107107	0.328742	5.66E-12
0.000625	-1.55E-05	-0.013999	-1.539120	-6.06E-12
-0.002601	2.98E-05	-0.051284	-0.179212	1.36E-11
-0.000624	1.89E-06	-0.084796	-0.176603	-3.61E-12
0.000535	-7.53E-05	0.023046	0.161895	3.25E-12

Unrestricted Adjustment Coefficients (alpha):

D(TSER)	-75.41944	1.764554	48.19605	-21.82461	-32.04446
D(SENTI)	-2371.449	-114.9097	449.9758	-339.6928	1517.033
D(INF)	-4.768153	-2.514814	0.989853	1.850989	-0.316451
D(GEXP)	0.027284	0.404442	0.117145	0.021874	-0.022678
D(GDP)	-6.48E+09	2.16E+09	-2.10E+10	1.59E+09	2.05E+09

1 Cointegrating Equation(s): Log likelihood -1759.295

Normalized cointegrating coefficients (standard error in parentheses)

TSER	SENTI	INF	GEXP	GDP
1.000000	-0.019996	-53.00104	-162.6754	-2.80E-09
	(0.00530)	(11.4157)	(121.527)	(7.5E-10)

Adjustment coefficients (standard error in parentheses)

D(TSER)	0.152411
	(0.05652)
D(SENTI)	4.792330
	(1.86934)
D(INF)	0.009636
	(0.00290)
D(GEXP)	-5.51E-05
	(0.00023)
D(GDP)	13086071
	(1.3E+07)

2 Cointegrating Equation(s): Log likelihood -1747.812

Normalized cointegrating coefficients (standard error in parentheses)

TSER	SENTI	INF	GEXP	GDP
1.000000	0.000000	-179.3658	9347.818	2.57E-08
		(201.544)	(2149.50)	(1.1E-08)
0.000000	1.000000	-6319.621	475628.9	1.43E-06
		(9929.13)	(105896.)	(5.6E-07)

Adjustment coefficients (standard error in parentheses)

D(TSER)	0.153513	-0.003075
	(0.05916)	(0.00121)
D(SENTI)	4.720568	-0.094043
	(1.95608)	(0.04003)
D(INF)	0.008065	-0.000154
	(0.00288)	(5.9E-05)
D(GEXP)	0.000197	-5.17E-06
	(0.00019)	(3.9E-06)
D(GDP)	14434739	-295158.5
	(1.4E+07)	(287236.)

3 Cointegrating Equation(s): Log likelihood -1739.718

Normalized cointegrating coefficients (standard error in parentheses)

TSER	SENTI	INF	GEXP	GDP
1.000000	0.000000	0.000000	3918.637	5.05E-09
			(797.252)	(4.3E-09)
0.000000	1.000000	0.000000	284341.8	6.99E-07
			(56204.1)	(3.1E-07)
0.000000	0.000000	1.000000	-30.26877	-1.15E-10
			(7.04183)	(3.8E-11)

Adjustment coefficients (standard error in parentheses)

D(TSER)	0.028144	-0.001641	-10.57432
	(0.08916)	(0.00140)	(3.18006)
D(SENTI)	3.550082	-0.080653	-275.4663
	(3.08865)	(0.04839)	(110.159)
D(INF)	0.005490	-0.000124	-0.526260
	(0.00452)	(7.1E-05)	(0.16138)
D(GEXP)	-0.000107	-1.68E-06	-0.008747
	(0.00029)	(4.5E-06)	(0.01035)
D(GDP)	69013065	-919556.6	3.52E+08
	(1.8E+07)	(286926.)	(6.5E+08)

4 Cointegrating Equation(s): Log likelihood -1737.331

Normalized cointegrating coefficients (standard error in parentheses)

TSER	SENTI	INF	GEXP	GDP
1.000000	0.000000	0.000000	0.000000	-4.91E-08
				(1.8E-08)
0.000000	1.000000	0.000000	0.000000	-3.23E-06
				(1.3E-06)
0.000000	0.000000	1.000000	0.000000	3.03E-10
				(1.3E-10)
0.000000	0.000000	0.000000	1.000000	1.38E-11
				(4.6E-12)

Adjustment coefficients (standard error in parentheses)

D(TSER)	0.041757	-0.001682	-8.723680	-32.29237
	(0.08970)	(0.00138)	(3.85595)	(41.9247)
D(SENTI)	3.761955	-0.081295	-246.6617	-623.3844
	(3.13475)	(0.04832)	(134.750)	(1465.10)
D(INF)	0.004336	-0.000121	-0.683216	1.798827
	(0.00446)	(6.9E-05)	(0.19175)	(2.08483)
D(GEXP)	-0.000121	-1.64E-06	-0.010602	-0.638373
	(0.00029)	(4.5E-06)	(0.01267)	(0.13778)
D(GDP)	68021738	-916548.6	2.17E+08	-1.97E+09
	(1.9E+07)	(286720.)	(8.0E+08)	(8.7E+09)

2. VAR estimation

Vector Autoregression Estimates

Date: 06/26/20 Time: 20:26

Sample (adjusted): 2010Q3 2019Q4

Included observations: 38 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	TSER	SENTI	INF	GDP	GEXP
TSER(-1)	1.206666	-7.908452	-0.001950	-24432307	0.000438
	(0.21293)	(7.28320)	(0.01084)	(4.5E+07)	(0.00072)
	[5.66691]	[-1.08585]	[-0.17991]	[-0.54111]	[0.61174]
TSER(-2)	-0.182045	12.48164	0.006117	93547784	-0.000571
	(0.26083)	(8.92146)	(0.01328)	(5.5E+07)	(0.00088)
	[-0.69795]	[1.39906]	[0.46062]	[1.69138]	[-0.65103]
SENTI(-1)	-0.002465	0.569454	-3.72E-05	-410136.9	2.97E-07
	(0.00496)	(0.16963)	(0.00025)	(1051641)	(1.7E-05)
	[-0.49695]	[3.35697]	[-0.14728]	[-0.39000]	[0.01777]
SENTI(-2)	0.003196	0.234983	-5.97E-05	-660473.0	-2.31E-07
	(0.00479)	(0.16396)	(0.00024)	(1016448)	(1.6E-05)
	[0.66681]	[1.43320]	[-0.24454]	[-0.64979]	[-0.01433]
INF(-1)	-0.008477	-10.19515	0.645137	1.96E+08	-0.010598
	(3.95200)	(135.176)	(0.20121)	(8.4E+08)	(0.01330)
	[-0.00214]	[-0.07542]	[3.20622]	[0.23365]	[-0.79709]
INF(-2)	-9.453696	-201.5052	-0.335646	68779449	-0.000527
	(4.07221)	(139.287)	(0.20733)	(8.6E+08)	(0.01370)
	[-2.32151]	[-1.44669]	[-1.61886]	[0.07965]	[-0.03844]
GDP(-1)	-8.20E-10	-7.60E-08	-7.68E-11	0.983133	-2.06E-13
	(9.7E-10)	(3.3E-08)	(5.0E-11)	(0.20656)	(3.3E-12)
	[-0.84143]	[-2.28214]	[-1.54785]	[4.75959]	[-0.06271]
GDP(-2)	1.01E-09	7.56E-08	7.07E-11	-0.316451	-6.57E-13
	(8.5E-10)	(2.9E-08)	(4.3E-11)	(0.17959)	(2.8E-12)
	[1.19237]	[2.60873]	[1.64009]	[-1.76208]	[-0.23070]
GEXP(-1)	-27.39596	-2115.628	-0.530298	-1.21E+09	0.845094
	(52.8905)	(1809.08)	(2.69289)	(1.1E+10)	(0.17794)
	[-0.51798]	[-1.16945]	[-0.19693]	[-0.10764]	[4.74932]
GEXP(-2)	-10.08426	1737.845	2.277894	-4.35E+08	-0.487138
	(48.6159)	(1662.87)	(2.47525)	(1.0E+10)	(0.16356)
	[-0.20743]	[1.04509]	[0.92027]	[-0.04217]	[-2.97836]
C	292.4464	8687.100	3.361992	-4.85E+10	3.224187
	(256.185)	(8762.62)	(13.0435)	(5.4E+10)	(0.86189)
	[1.14155]	[0.99138]	[0.25775]	[-0.89319]	[3.74085]

R-squared	0.982741	0.938186	0.406363	0.959914	0.651759
Adj. R-squared	0.976349	0.915292	0.186497	0.945068	0.522781
Sum sq. resids	776070.7	9.08E+08	2011.799	3.49E+22	8.784041
S.E. equation	169.5387	5798.959	8.631980	3.60E+10	0.570381
F-statistic	153.7388	40.97924	1.848234	64.65566	5.053248
Log likelihood	-242.4835	-376.7129	-129.3344	-971.0322	-26.09132
Akaike AIC	13.34124	20.40594	7.386023	51.68590	1.952175
Schwarz SC	13.81528	20.87998	7.860061	52.15994	2.426213
Mean dependent	2881.983	60208.19	19.58125	2.07E+11	3.953613
S.D. dependent	1102.402	19924.47	9.570420	1.53E+11	0.825670

Determinant resid covariance (dof adj.)	1.74E+34
Determinant resid covariance	3.15E+33
Log likelihood	-1735.093
Akaike information criterion	94.21544
Schwarz criterion	96.58563
Number of coefficients	55

3. Causality test

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 06/26/20 Time: 22:37

Sample: 2010Q1 2020Q2

Included observations: 38

Dependent variable: TSER

Excluded	Chi-sq	df	Prob.
SENTI	0.470777	2	0.0379
INF	7.035414	2	0.0297
GDP	1.625219	2	0.4437
GEXP	0.733260	2	0.6931
All		6	---

Dependent variable: SENTI

Excluded	Chi-sq	df	Prob.
TSER	2.402763	2	0.0038
INF	2.874543	2	0.0332
GDP	6.807621	2	0.2376
GEXP	1.528664	2	0.4656

All		6	---

Dependent variable: INF

Excluded	Chi-sq	df	Prob.
TSER	0.757180	2	0.4868
SENTI	0.576967	2	0.7494
GDP	2.734818	2	0.0254
GEXP	1.083398	2	0.0481
All		6	---

Dependent variable: GDP

Excluded	Chi-sq	df	Prob.
TSER	12.22226	2	0.0022
SENTI	4.063300	2	0.1311
INF	0.102923	2	0.9498
GEXP	0.031329	2	0.0098
All	12.81046	8	0.1185

Dependent variable: GEXP

Excluded	Chi-sq	df	Prob.
TSER	0.423838	2	0.8090
SENTI	0.000320	2	0.9998
INF	0.869196	2	0.6475
GDP	0.375821	2	0.0288
All		6	---

Test statistics not available for lag coefficients with restrictions