EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN PURCHASING MANAGERS INDEX AND BIST INDUSTRIAL INDEX UNDER STRUCTURAL BREAKS[1]

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Abstract

The purpose of the study is to put forward the long-term and causality relationship between the BIST Industrial Index and the Purchasing Managers Index (PMI) for the period January 2008 - December 2018 in Turkey. First of all, the existence of a long-run relationship between variables has been investigated with cointegration test. It has been determined that there is a long-run relationship between series. For this reason, the coefficient estimation for the long-run relationship between the series has been made a prediction with the Fully Modified Ordinary Least Squares cointegration coefficient estimator. Finally, the existence of causality relationship between the series has been investigated with the asymmetric causality test in the study and it has been determined that there is a unidirectional causality relationship from PMI to BIST Sinai index in terms of positive and negative shocks. Therefore, with this study it can be said that the PMI is a predictor of stock prices.

Keywords: BIST Industrial Index, PMI, Cointegration Test with Multiple Structural Breaks, Asymmetric Causality Test.

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1. Introduction

Due to changes in global economic conditions, it is essential that economists use indicators that can predict the shifts in the economy and especially in the manufacturing sector. The PMI is one of indicator that provides predictive information about the economic situation of countries.

Chien and Morris (2016) have conducted the study about PMI obtained from the monthly survey data of firms measures the developments in economic activities directly from the manufacturing sector and indirectly the whole economy of the country. PMI data is used to forecast and evaluate the economy because it's published before GDP of the country. Kauffman (1999) has claimed in his study that the PMI provides some insights about the changes in economic activities in the United States and, therefore, PMI can be considered as strategic purchasing decisions. Koenig (2002) has stated in his study that the PMI has power to forecast GDP changes. Smirnov (2010) has investigated the leading indicators of the 2008 crisis in Russia, determined that one of the two main indicators as the undeniable marker of the upcoming crisis is PMI. De Bondt (2012), in his study, has stated that it will be beneficial to scrutinize the PMI data before making the GDP estimate.

Kılınc and Yucel (2016) have claimed that the PMI could be used to forecast the current and next quarter growth rate. In view of this, the PMI is one of the indices used to predict production trends and activities. The PMI is one of the most closely monitored indices in the world in production control, inventory management, and effective marketing analysis by economic organizations, including central banks and local businesses (Khundrakpam and George 2012, 2). The PMI hold the title of the most followed job survey in the world due to its capacity to produce current, accurate, and mostly unique monthly economic trend indicators (Istanbul Chamber of Industry 2019, 4).

In collaboration with the US Department of Commerce, the US National Association of Purchasing Managers (NAPM) has launched a production survey in the 1930s for purchasing managers in production enterprises. The main objective of the survey has been to obtain better business knowledge surrounding production activities in the economy. The PMI has been officially founded in 1982 by Theodore S. Torda, together with the ISM (Institute for Supply Management) formerly known as NAPM (Mudgal 2014, 7). The PMI is a seasonally adjusted monthly composite diffusion index of five indicators from the economic activity in the manufacturing sector. These five indicators are weighted as follows: new orders—30%, output—25%, employment—20%, suppliers' delivery times—15%, and stock of items purchased—10%. This index is subjective since it is based on survey data obtained from purchasing executives of enterprises in the manufacturing sector. The PMI is considered a predictor for changes in industrial production, real GDP, real stocks, real sales, sales/stock ratio, federal fund rate, foreign exchange return, and monetary policy.

The PMI survey asks respondents (purchasing manager) that how the current level of the five key economic activity indicators (new orders, output, employment, suppliers' delivery times, and stock of items purchased) compares to the previous month. The responses are simply "higher," "lower," or "the same." Then the unweighted ratio of firms in each category is sorted, and a diffusion index is formed by calculating the sum of the ratio of positive responses and half of "the same" responses. A reading above 50 in a diffusion index indicates that more companies have an expansion in their activities. Finally, the current data is seasonally adjusted and converted into a single weighted composite index (Harris 1991, 61-62; Bose 2015, 42; Cho and Ogwang 2005, 25). The diffusion index is a leading indicator and practical summary of measurement shows the direction of change. The fact that the diffusion index is below 50 indicates that there is decrease in the variable and reading above 50 indicates that there is increase (Istanbul Chamber of Industry, 2019, 4). Ultimately, it has considered that the purchasing in the manufacturing sector is made based on consumer demand, it is also cleared that the PMI is the first visible indicator of an economic slowdown. Furthermore, since it is the first major survey data released each month, it is among the most followed economic indicator in the market (Adelekan et al. 2019, 4).

The PMI data has certain advantages over official economic statistics. Most of the official series, such as the GDP released quarterly. There are often delays in the publication of the official economic data. The official data are usually revised after publication. Lastly, the use of different methods in the measurement of the official data weakens the comparability (Bose 2015, 42-43). The most significant disadvantage of the PMI is its subjective nature and the incalculable economic impacts found in the responses of the firms participating in the survey (Joseph et al. 2011, 214). While, as a diffusion index, the PMI determines the diffusion of changes in economic activity, it does not identify the intensity of the change. Also, as the responses are not weighted for the magnitude of the firms, the PMI might miss the overall shift in economic conditions resulting from movements in a few large firms (Bose 2015, 43).

The aim of the study is to investigate the existence of a long-run and causality relationship between Turkey's PMI and BIST Industrial index, i.e., whether the PMI is a predictor of the BIST Industrial index. The other sections of the study are as followed: Sections 2, literature review, Section 3, the data set and method used in this study and Section 4, findings and evaluations.

2. Literature review

Although there are many studies tested the relationship between PMI and various economic and financial indicators, the studies which examine the relationship between PMI and stock prices are fewer in literature. In this regard, Table 1 includes certain studies that test the relationship between PMI and various indicators.

Table 1

Studies testing the relationship between the PMI and various financial and economic indicators

Study	Model	Data	Conclusion
Collins (2001)	Granger Causality Test	Different years have been used for different countries.	The PMI is not a predictor of stock market performance. But the stock market performance is a predictor of the PMI.
Afshar et al. (2007)	Granger Causality Test	1980:Q1 - 2005:Q4	The PMI is a significant indicator in explaining GDP fluctuations.
Johnson and Watson (2011)	Regression Analysis	1973:1 – 2009:12	There is a positive relationship between changes in the PMI and stock returns.
Wang (2012)	VAR Model	2009:1 – 2001:7	The PMI is essential in the analysis and prediction of the stock market trend. There is a long-run cointegration relationship between the PMI and the Shanghai Composite Index.
Tsuchiya (2012)	Fisher's Exact Chi-Square Test	1991:1 – 2010:12	The PMI is a predictor of the Industrial Production Index (IP), but it is not a predictor of GDP.
Mudgal (2014)	Granger Causality Test	2000:8 - 2013:8	PMI is not a predictor of stock prices in the manufacturing sector; however, stock prices in the manufacturing sector are a predictor of PMI.

Study	Model	Data	Conclusion
Habanabakize and Meyer (2017)	Granger Causality Test	2000Q1 - 2016Q4	There is a bi-directional causality relationship between the PMI and the Manufacturing Sector Employment. The domestic revenue is a reason for PMI.
Akdag et al. (2018)	Granger Causality Test	2007:2 - 2017:12	The BIST Industry index is a predictor of PMI and is also a predictor of the Industrial Production index and Capacity Usage Rate of PMI.
Adelekan et al. (2019)	Granger Causality Test	2014:7 –2017:6	The PMI is a vital predictor of GDP improvement in Nigeria.

Source: Prepared by the authors.

Upon the literature review, it is observed that classical econometric models have been generally used in the studies. It is believed that this study will contribute to the scientific world because it differs from other studies in terms of testing the relationship between current econometric models and series.

3. Data set and method

In this study, it has been investigated the relationship between Turkey's PMI and BIST Industrial index. Accordingly, the monthly data of the PMI and the BIST Industrial indices from January 2008 - December 2018 are analyzed. In this study BIST Industrial Index data has obtained from the investing.com website, whereas the PMI data has obtained from the IHS Markit company. Subsequently, the relationship between the series have been tested using Eviews and Gauss 10 software programs, by taking the natural logarithm of the data.

Although some studies are made assuming that the series are directly linear, it is widely accepted that testing the linearity of the series is a more accurate approach before unit root and cointegration tests (Sarac and Zeren 2014, 7). First in the study has been investigated whether the series are linear or not using the Harvey et al. (2008) linearity test. Most of the linearity tests in the literature act on the assumption that the series are stationary at level. However, the employment of these tests for non-stationary series causes the results to be incorrect. Taking this into account Harvey et al. (2008) have developed a method that tests the linearity of the series, regardless of the stationarity of the series. The alternative hypothesis of Harvey's (2008) linearity test states that the series are not linear, whereas the simple hypothesis states that the series are linear. The alternative hypothesis is accepted if the test statistics determined as a result of the test are higher than the critical values set by Harvey et al. (2008), whereas the simple hypothesis is accepted if they are lower (Harvey et al. 2008, 1-24).

In this study the presence of the unit root in the series have been investigated using the multi-structural break unit root test by Carrion-i-Silvestre et al. (2009). Whether a variable is stationary in the time series is determined by unit root tests. If there is a unit root in a series, it is not stationary. If the series is not stationary, in the event of any shock or political changes that might occur, the effect of this situation on the variable will permanent (Govdeli 2016, 226). Stationary time series subjected to structural breaks in the level and/or trend are not stationary if structural breaks are not included in unit root tests. Therefore, the series that seem to be stationary will actually be seen as not stationary. Thus, the unit root tests that take into account the structural breaks in the trend function will be more convenient and useful for such series (Sevuktekin and Cınar 2017, 414-415).

The first structural break unit root test has been developed by Perron (1989) and continued by Zivot-Andrews (1992), Lumsdaine-Papell (1997), Perron (1997), Ng-Perron (2001) and Lee-Strazicich (2003). While these methods allow up to two breaks in the series, Carrion-i-Silvestre et al. (2009) have developed a unit root test which allows up to 5 breaks. Using the Bai and Perron (2003) logarithm and with the help of the quasi-GLS method, this test found points for a structural break by minimizing the sum of error frames (Carrion-i-Silvestre et al. 2009, 1754-1792; Gocer et al. 2013, 7). The process of producing stochastic data used in the Carrion-i-Silvestre et al. (2009) test is as follows:

$$y_t = d_t + u_t \quad (1)$$

$$u_t = \alpha u_{t-1} + v_t, \qquad t = 0,1,\dots,T \quad (2)$$

Carrion-i-Silvestre et al. (2009) developed the following five different test statistics (Carrion-i-Silvestre et al. 2009: 1762):

$$(\lambda^0) = \frac{[S(\bar{\alpha},\lambda^0) - \bar{\alpha}S(1,\lambda^0)]}{S^2(\lambda^0)} \quad (3)$$

$$MP_T(\lambda^0) = \frac{[c^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2 + (1-\bar{c})T^{-1}\tilde{y}_T^2]}{s(\lambda^0)^2} \quad (4)$$

$$MZ_\alpha(\lambda^0) = (T^{-1}\tilde{y}_T^2 - s(\lambda^0)^2)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \tag{5}$$

$$MSB(\lambda^0) = \left(s(\lambda^0)^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2} \tag{6}$$

$$MZ_t(\lambda^0) = (T^{-1}\tilde{y}_T^2 - s(\lambda^0)^2)\left(4s(\lambda^0)^2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2} \tag{7}$$

In this study, the existence of a long-run relationship between the series has been investigated by Maki (2012) multiple structural break cointegration tests. In the case of a structural break between the series in cointegration analysis, there may be deviations in cointegration tests just as in the unit root tests. Therefore, it is necessary to consider the effects of structural breaks when conducting cointegration tests. In view of this, Maki (2012) has developed a new test method that can allow up to five breaks compared to other structural break tests. Each period in the test is considered possible breakpoint and by calculating t statistics the points where t is the lowest are considered as break dates. According to the method, the entire series must be I (1). Maki developed four models to test whether there is a long-run relationship between the series in the event of structural breaks (Maki 2012, 2011-2015; Gocer et al. 2013, 10):

Model 0: There is break in the constant term, trendless model.

$$y_t \ = \ \mu + \sum_{i=1}^{k}\mu_i D_{i,t} + \beta x_t + u_t \tag{8}$$

Model 1: There is break in the constant term and slope, trendless model.

$$y_t \ = \ \mu + \sum_{i=1}^{k}\mu_i D_{i,t} + \beta x_t + \sum_{i=1}^{k}\beta_i x_t D_{i,t} + u_t \tag{9}$$

Model 2: There is break in the constant term and slope, trend model.

$$y_t \ = \ \mu + \sum_{i=1}^{k}\mu_i D_{i,t} + \gamma t + \beta x_t + \sum_{i=1}^{k}\beta_i x_t D_{i,t} + u_t \tag{10}$$

Model 3: There is break in the slope and trend in the constant term.

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta x_t + \sum_{i=1}^{k} \beta_i x_t D_{i,t} + u_t \qquad (11)$$

This study estimates coefficients for the long-run model with the Fully Modified Ordinary Least Squares (FMOLS) cointegration estimator. The FMOLS model has been developed on a deviation of results when predicting the long-run relationship between the series using the least squares method. This method corrects the problem of endogeneity and autocorrelation with a non-parametric approach (Ay et al. 2016, 81-82). Descriptive variables must be in the state I(1) or I(0) to use this method. This method, which also generates good results in small samples, is not sensitive to lead values and lag numbers (Phillips and Hansen 1990, 99-125; Lebe and Akbas 2015, 201).

The presence of a causality relationship between the series has been investigated using the asymmetric causality test by Hatemi-J (2012) in the study. This test considers the effects of negative and positive shocks separately. The idea of transforming data into cumulative negative and positive changes comes from the work of Granger and Yoon (2002). The authors have used this approach in the test of cointegration, which they call hidden cointegration. Hatemi-J (2012) has developed an asymmetric causality test using this idea for causality analysis. The situation is asymmetrical since negative and positive shocks have different causal effects.

The causality relationship between y_{1t} and y_{2t} variables defined as a random walk below is formulated as follows (Hatemi-J 2012, 448-449):

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} \qquad (12)$$

and

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \qquad (13)$$

Here *t* = 1, 2,…..*T*, $y_{1,0}$ and $y_{2,0}$ constants are the initial value, and negative and positive shocks are defined as follows:

$$\varepsilon_{1i}^{+} = \max(\varepsilon_{1i}, 0),\ \ \varepsilon_{2i}^{+} = \max(\varepsilon_{2i}, 0),\ \ \varepsilon_{1i}^{-} = \min(\varepsilon_{1i}, 0),\ \ \varepsilon_{2i}^{-} = \min(\varepsilon_{2i}, 0), \qquad (14)$$

in this case,

$$\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-} \text{ and } \varepsilon_{2i} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-} \quad (15)$$

The above equations can be written after editing, as follows:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1i}^{+} + \sum_{i=1}^{t} \varepsilon_{1i}^{-} \quad (16)$$

and similarly.

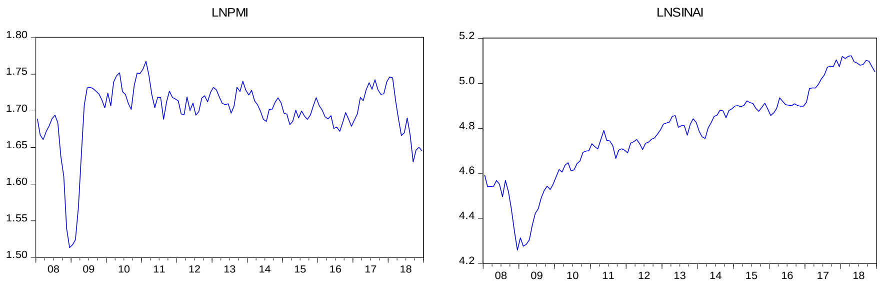
$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2i}^{+} + \sum_{i=1}^{t} \varepsilon_{2i}^{-} \quad (17)$$

4. Findings

In the study, first, graphs of the series are created, and the corresponding results are presented in Figure 1.

Figure 1

Time-way figure on purchasing managers and industry indices



Source: Prepared by the authors.

Examining the figures above, it is noticed that the related series contain trends, and there are structural breaks in specific points. In this study the linearity of the series has been examined using the linearity test of Harvey et al. (2008), and the findings are presented in Table 2.

Table 2

Linearity test results

Variables	W-Lam Statistics	Critical Values		
		10 %	5 %	1 %
LNPMI	3.71	7.63	7.65	7.70
LNINDUSTRIAL	0.64	10.43	10.55	10.77

Source: Prepared by the authors, according to Harvey et al. (2008)

According to the results from the Harvey et al. (2008) linearity test as W-lam statistical values at a 1% significance level for both series are lower than the critical values, which show that series are linear. Because the series are linear and they incorporate trend and structural breaks, the analysis has continued with linear structural break tests, and the constant and the trend findings obtained from the models have been reported in the tables.

The presence of the unit root in the series has been investigated by the multi-structural break unit root test by Carrion-i-Silvestre et al. (2009) in the study, and the findings are reported in Table 3.

Table 3

Multiple structural break unit root test

Variable	Test Statistics					Break Dates
	PT	MPT	MZA	MSB	MZT	
LNPMI	18.379714 (9.1115838)	17.190048 (9.1115838)	-24.384381 (-45.182400)	0.14253373 (0.10556962)	-3.4755967 (-4.7209407)	2009/2, 2010/3, 2011/4, 2012/7, 2017/1
LNINDUSTRIAL	14.234548 (9.5097894)	13.573403 (9.5097894)	-32.-073591 (-45.178986)	0.12453462 (0.10561760)	-3.9942724 (-4.7116506)	2009/3, 2010/4, 2011/5, 2016/4, 2017/11
ΔLNPMI (I.Differences)	8.2856556 (8.5811375)	7.8741036 (8.5811375)	-50.369285 (-45.455983)	0.099632708 (0.10435557)	-5.0184283 (-4.7688038)	2009/1, 2010/2, 2011/7, 2013/8, 2017/2
ΔLNSINAI (I.Differences)	7.6855479 (8.8726299)	7.2690016 (8.8726299)	-57.800061 (-46.314129)	0.092943536 (0.10363878)	-5.3721421 (-4.8114495)	2009/1, 2011/8, 2013/5, 2014/9, 2017/10
Values in parentheses indicate critical values, while the phrases with "Δ" indicate unit root results in the first differences of the series.						

Source: Prepared by the authors, according to Carrion-i-Silvestre et al. (2009)

Examining the above results of the Carrion-i-Silvestre et al. (2009) unit root test, as the level values are higher than the critical values of test statistics in absolute values in general at the 5% significance level, the series contain a unit root. Therefore, the unit root test has been repeated by taking the first differences of the series, and as the first differences of both series at the 5% significance level are less than the critical values of the test statistics in general, it has been determined that the series are stationary. As this finding meets the prerequisite for the cointegration test, the presence of a long-run relationship between the series has been investigated by Maki (2012) multiple-structural breaks cointegration test, and the obtained findings have been presented in Table 4.

Table 4

Multiple structural breaks cointegration test results

	Critical Values			Test Statistics	Break Dates
	1 %	5 %	10 %		
MODEL 0	−5.959	−5.426	−5.131	-4.0052927	2008/12, 2011/3, 2012/8, 2013/9, 2016/3
MODEL 1	−5.708	−5.196	−4.938	-5.2154641**	2008/11, 2010/1
MODEL 2	−6.915	−6.357	−6.057	-5.6071963	2010/1, 2011/1, 2013/2, 2013/9, 2016/11
MODEL 3	−7.553	−7.009	−6.712	-7.0705788**	2009/7, 2011/5, 2013/8, 2017/1

****, ** and * respectively represent statistical meaningfulness at the level of 1%, 5%, and 10%. Critical values are obtained from Maki's (2012) study.*

Source: Prepared by the authors, according to Maki (2012)

Upon examining the results of the Maki (2012) multiple structural breaks cointegration test, as the test statistics for the trend (model 1 and model 3) models with the 5% significance level are higher than the critical values which shows that there is a cointegration relationship between the PMI and BIST Industrial Indices. In other words, the series act together in the long-run. This finding meets the requirement for the cointegration coefficient estimation. Therefore, structural breaks from all models have been included in the model, and the coefficient estimation of the long-run model has been made using the FMOLS coefficient estimator. Accordingly, through the deductive elimination method and elimination of meaningless breaks from the model, the findings obtained have been presented in Table 5.

Table 5

Test Results for FMOLS cointegration coefficient estimator

	Coefficient	Test Statistics
LNPMI	1.240512***	6.438559
C	5.433511***	7.232398
@Trend	0.011035***	23.06524
D2008-11	0.481524**	2.231677
D2009-7	-0.542785***	-2.647986
D2011-3	-0.369463*	-1.804576

****, ** and * respectively represent statistical meaningfulness at the level of 1%, 5%, and 10%.*

Source: Prepared by the authors.

The FMOLS test results in Table 5 show that the coefficient of the PMI is positive and statistically significant at the 1% level. In other words, one can say that a 1% increase in the PMI causes an increase in the BIST Industrial index by about 1.24%. In addition, it has been determined that the FMOLS estimator that structural breaks, in general, have a statistically significant and negative effect on the long-run relationship between the series, except for November 2008. In the last quarter of 2008, with the bankruptcy of Lehman Brothers and some giant companies, the global financial crisis has started to show its effect, and accordingly, some measures taken by both IMF and Central Banks of the country have made positive contributions to the economies, albeit for a short time. In other word, 1% increase in the PMI in November 2008 has caused a 0.48% increase in the BIST Industrial index. However, in conjunction with the global financial crisis deepened its impact on the real economy in the third quarter of 2009, 1% increase in the PMI has led to a 0.54% decrease in the BIST Industrial index. Finally, it can say that the impact of the European debt crisis in 2011 on the long-run relationship is statistically significant and negative at 10%, in other words, 1% increase in the PMI causes 0.36% decrease in the BIST Industrial Index.

Lastly, in the study, the existence of a causality relationship between the PMI and the BIST Industrial Index has been investigated with the help of the Hatemi-J (2012) asymmetric causality test, and the results have been presented in Table 6.

Table 6

Asymmetric causality test results

Direction of Causality	Test Statistics	Boostrap Critical Values		
		1 %	5 %	10 %
$PMI^{+} \longrightarrow SınEndks^{+}$	19.985***	9.289	6.235	5.070
$PMI^{+} \longrightarrow SınEndks^{-}$	0.001	6.813	3.540	2.457
$PMI^{-} \longrightarrow SınEndks^{+}$	1.604	7.743	4.381	2.958
$PMI^{-} \longrightarrow SınEndks^{-}$	19.041***	11.478	5.070	3.114
$SınEndks^{+} \longrightarrow PMI^{+}$	2.672	11.554	6.448	4.730
$SınEndks^{+} \longrightarrow PMI^{-}$	1.714	7.075	3.576	2.552
$SınEndks^{-} \longrightarrow PMI^{+}$	2.459	7.695	4.298	2.892
$SınEndks^{-} \longrightarrow PMI^{-}$	1.304	8.672	3.874	2.880

****, ** and * respectively represent statistical meaningfulness at the level of 1%, 5%, and 10%.*

Source: Prepared by the authors, according to Hatemi-J (2012).

When the results of the Hatemi-J (2012) test investigating the causality relationship between the asymmetric positive and negative changes of the series are examined, one can observe a unidirectional causality relationship from the PMI to the BIST Industrial index since the test statistics on the 1% statistical significance level in terms of positive and negative shocks are higher than the critical values. A positive shock at the PMI also positively affects the BIST Industrial index, while a negative shock at the PMI causes negative shock on BIST Industrial index which mean that the PMI is a predictor of the BIST Industrial index. However, in terms of shocks, there is no causality relationship between the BIST Industrial index and PMI.

5. Conclusion

This study has been conducted with an aim to reveal the long-run relationship as well as the causality relationship between the PMI and the BIST Industrial index for the period 2008:1 - 2018:12. Accordingly, the BIST Industrial index has been used as the dependent variable, whereas the PMI indicator has been used as the independent variable.

Firstly, the existence of a long-run relationship between the series has been investigated using Maki's (2012) multiple structural breaks cointegration test, and a long-run relationship between the series has been identified. Therefore, structural breaks obtained from the cointegration test have been added to the model and the long-run coefficient estimation has been made through the FMOLS coefficient estimator. Consequently, it has been established that the coefficient for the PMI is statistically significant and positive which shows that increase of 1% in the PMI causes an increase approximately 1.24% in the BIST Industrial index. Further findings obtained from the FMOLS test show that structural breaks generally have negative effect on the long-run relationship between the series.

Finally, the existence of causality relationship between the PMI and the BIST Industrial index has been investigated by the Hatemi-J (2012) asymmetric causality test. As a result of the analysis there is unilateral causality relationship between the PMI and BIST Industrial index which is determined in terms of positive and negative shocks. In other words, it is also observed that positive shock in the PMI causes positive shock in the BIST Industrial Index and negative shock in the PMI causes negative shock in the BIST Industrial index. After the findings, it can be said that the PMI is a predictor of stock prices. This finding coincides with the findings of studies by Johnson and Watson (2011) and Wang (2012). However, this finding is different from the research findings of Collins (2001), Mudgal (2014), and Akdag et al. (2018). Collins (2001) found that stock market performance is a predictor of the PMI, Mugdal (2014) have been found that stock prices in the manufacturing sector are a predictor of the PMI, and Akdag et al. (2018) have been found that is the BIST Industry index is a predictor of the PMI.

Providing public information to the investors, the PMI is precursor indicator for investors to evaluate the historical performance of various sectors and make a profitable investment decision. In subsequent studies, the relationship between the PMI and different indices can be underlined using different methods and techniques, as well as comparison of the relationship between the PMI and selected stock portfolios traded in different indices or countries.

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