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Co-Integration and Causality among Borsa Istanbul City Indices and Borsa Istanbul 100 Index[1]

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ABSTRACT:*Financial markets of Turkey have taken step to liberalize and develop its position in international markets and domestic environment. In this perspective, the prime aim of this paper is to underline the existence of relationship between recently formed 12 Borsa İstanbul City Indices (Adana, Ankara, Antalya, Bursa, İstanbul, İzmir, Kayseri, Kocaeli, Tekirdağ, Balıkesir, Denizli and Konya) and Borsa Istanbul 100 Index which is considered as a benchmark index of Turkey in general. In order to accomplish this purpose, Toda-Yamamoto causality test and multiple structural break co-integration test have been employed. Since data which used in this study have structural changes, we have employed unit root test with structural breakpoints. In that point, Lee & Strazicich, CiS& Sanso and Narayan & Popp procedures in unit root test that are applied to two structural breakpoints have been included in the research. It should, also, be noted that Maki's procedure has been taken into account to figure out long-term relationships between BIST City Indices and BIST 100 Index.*
Key Words: *Borsa Istanbul, City Indices, Co-Integration and Causality*
Jel Classification: *G10, G15*

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I. INTRODUCTION

The relationships among variables is a subject being investigated in applied researches. Especially, after the developing correlation, causality or co-integration testes, several studies have been conducted and significant results have been obtained. By means of these results, dynamic relationships in economic or financial environments have better understand by policy makers or financial investors.

In the terms of financial studies, relationship among different stock indexes are handled from two different perspectives. First, contemporary movements between economic and financial variables. That is, it is expressed as correlation or co-integration relationships. Second, previous movements happened in an economic or financial environment affect future decisions of this ecosystem. The relationship that happen in such way is named as causality in the literature.

From this viewpoint, we have used asymmetric causality test to determine whether BIST 100 Index which is accepted as benchmark index for Turkey's financial market, and City Indices. In order to figure out possible relationship, 12 city indices and BIST 100 Index daily closing price from 7.07.2104 to 05.02.2016, which comprises 400 observations, has been taken into account thave causality effects on city indexes or not. Asymmetric causality test separates from other causality testes in the terms of results.

II. METHODOLOGY

There are several methods in the literature in order to test causality relationships among variables. (Sims, 1972; Hsiao, 1981; Toda and Yamamoto, 1995; Hacker and Hatemi, 2006). However, these tests cannot separate effects of positive and negative shocks. When there are asymmetric information and heterogeneous participants in the financial markets, it can be said that results of these testes are misleading due to the fact that investors don't react in similar ways to negative shocks and positive shocks in the same size.

Firstly, Granger and Yoon (2002) asserted that relationship among variables may be different from relationship among positive shocks and negative shocks. According to them, when the economic series react together to shocks, they are co-integrated, although it cannot be said that they are co-integrated when they react separately to shocks. From this viewpoint, after they separated data as cumulative positive changes and cumulative negative changes, they investigated long-term relationship between these parts. Then, Hatemi-J

[1]This paper is the revised version of paper presented at ICOMEP 2016 held in Istanbul-Turkey.

(2012) developed a causality test by using this approach. In this asymmetric causality test, it is aimed to figure out structure which help to understand dynamics of series and allow to make predictions for future.
Suppose that we aim to investigate causal relationship between two integrated variables y_{1t} and y_{2t} defined as following random walk process

$$y_{1t}=y_{1t-1}+\varepsilon_{1t}=y_{10}+\sum_{i=1}^{t}\varepsilon 1t, \quad (1)$$

$$y_{2t}=y_{2t-1}+\varepsilon_{1t}=y_{20}+\sum_{i=1}^{t}\varepsilon 2t, \quad (2)$$

where t =1,2,…T, the constants $y_{1,0}$ and $y_{2,0}$ are the initial values, and the variables $\varepsilon_{1i}$and ε_{2i}signify white noise disturbance terms.
Positive and negative shocks can be described as following:

$$\varepsilon_{1i}^{+}=\text{maks}(\varepsilon_{1i}, 0), \quad \varepsilon_{1i}^{-}=\min(\varepsilon_{1i}, 0), \quad (3) \quad \varepsilon_{2i}^{+}=\text{maks}(\varepsilon_{2i}, 0), \quad \varepsilon_{2i}^{-}=\min(\varepsilon_{2i}, 0),$$

$\varepsilon_{1i=}\ \varepsilon_{1i}^{+}+\varepsilon_{1i}^{-}$ and $\varepsilon_{2i=}\ \varepsilon_{2i}^{+}+\varepsilon_{2i}^{-}$ can be expressed in such way. From this equations, following equations can be arranged again,

$$y_{1t}=y_{1t-1}+\varepsilon_{1t}=y_{10}+\sum_{i=1}^{t}\varepsilon_{1i}^{+}+\sum_{i=1}^{t}\varepsilon_{1i}^{-} \quad (4)$$
$$y_{2t}=y_{2t-1}+\varepsilon_{2t}=y_{20}+\sum_{i=1}^{t}\varepsilon_{2i}^{+}+\sum_{i=1}^{t}\varepsilon_{2i}^{-}$$

Positive and negative shocks in all variables are stated in cumulative form in the equation (5);

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

In the Hatemi-J (2012) test, y_t^{+} variable is assumed as equal to (y_{1i}^{+}, y_{2i}^{+}) and causality relationships between these components is tested by using following p lagged vector autoregressive model (VAR);

$$y_t^{+}=a+A_1y_{t-1}^{+}+\ldots+A_py_{p-1}^{+}+u_t^{+}$$

2.2 Data Sample

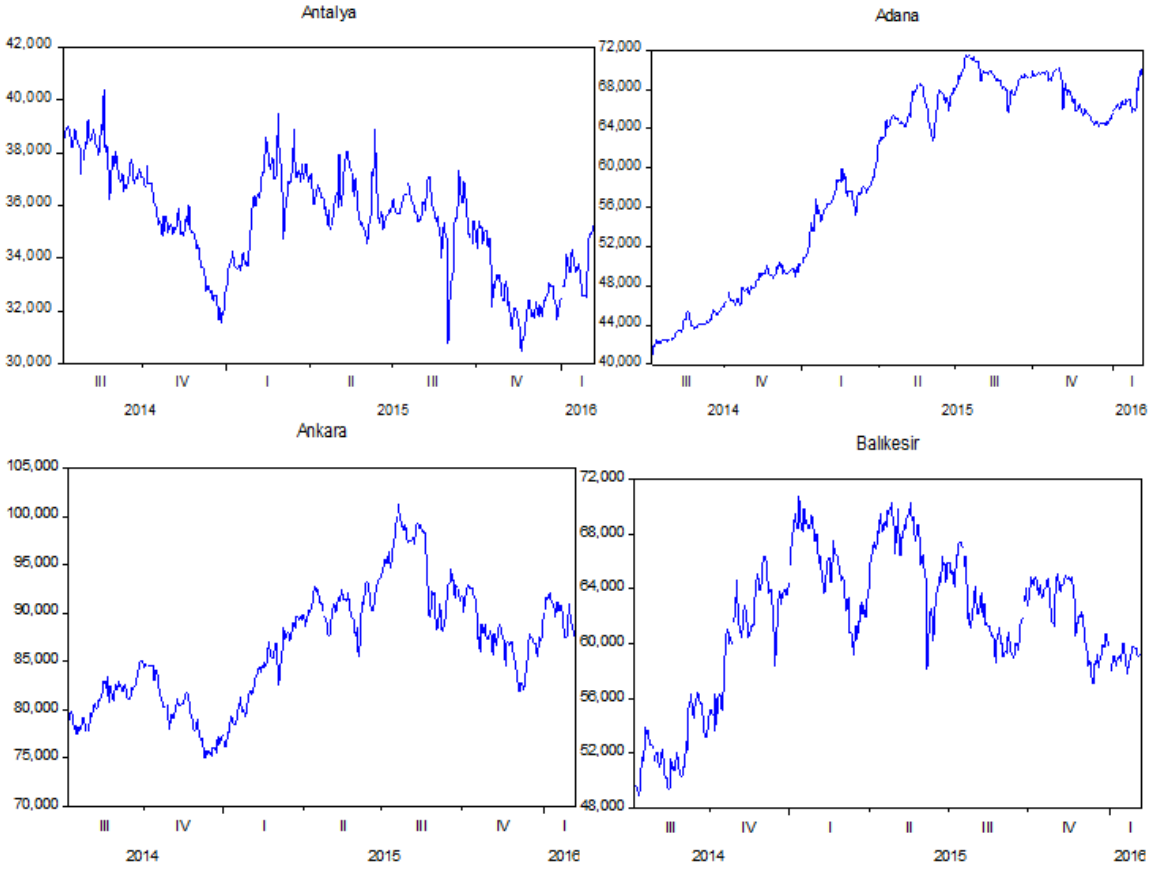
Table 1 demonstrates BIST 100 Index's and City Indices' start date, number of firms listed and initial value of index in alphabetical order apart from benchmark index named BIST 100.

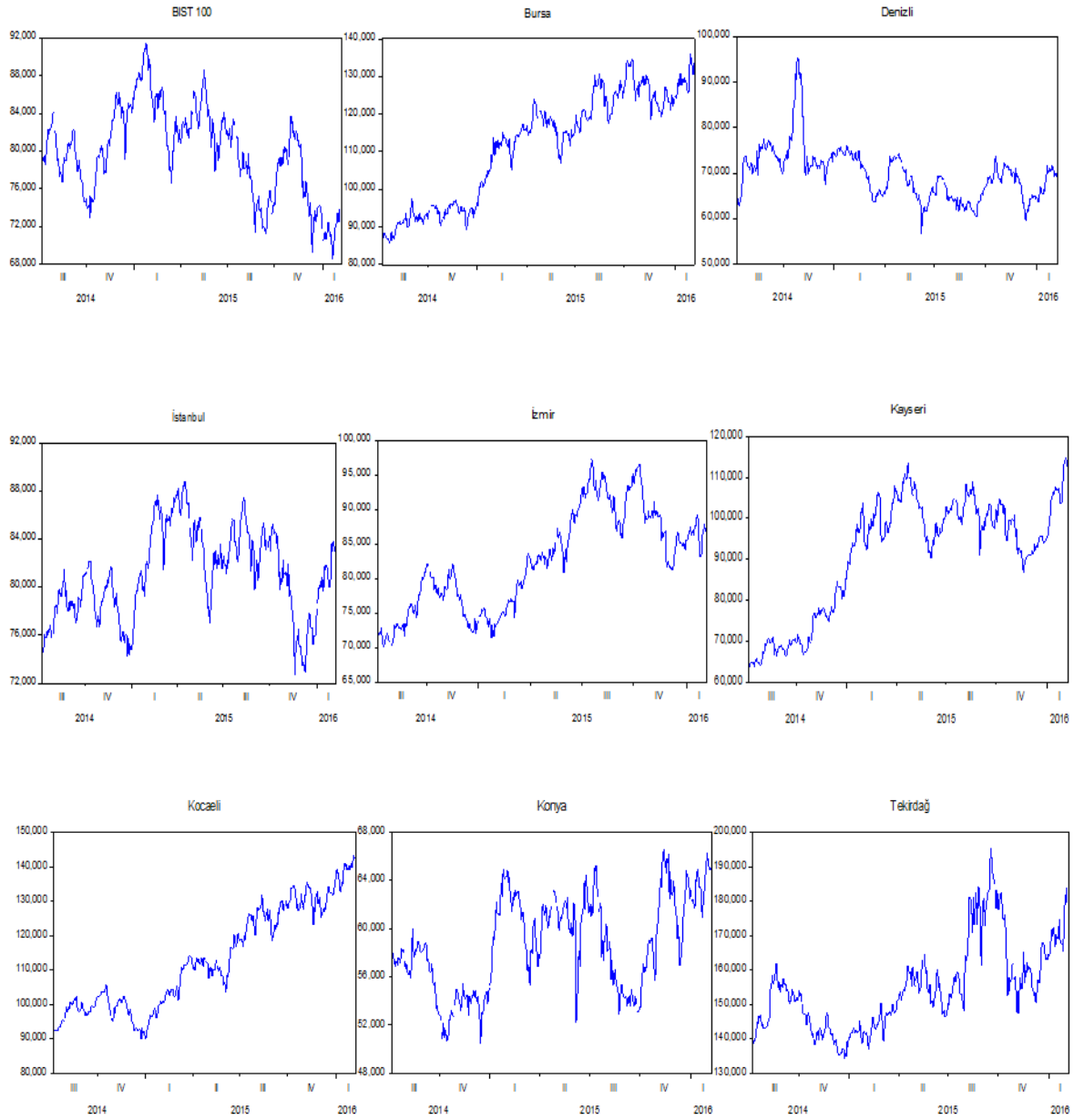
Table-1. BIST 100 Index and City Indices

Index	**Start Date**	**Num. of Firms Listed**	**Initial Value**
BIST 100	**02.01.1986**	**100**	**1**
BIST Adana	31.12.2008	6	28.864,07
BIST Ankara	31.12.2008	14	28.864,07
BIST Antalya	31.12.2008	4	28.864,07
BIST Balıkesir	12.05.2011	4	66.535,13
BIST Bursa	31.12.2008	14	28.864,07
BIST Denizli	06.07.2012	4	61.972,14
BIST İstanbul	31.12.2008	87	28.864,07
BIST İzmir	31.12.2008	22	28.864,07
BIST Kayseri	31.12.2008	4	28.864,07
BIST Kocaeli	31.12.2008	18	28.864,07
BIST Konya	04.12.2012	5	75.522,65
BIST Tekirdağ	31.12.2008	3	28.864,07

According to main context of this research, it has been analysed to reveal whether there is a relationship between BIST 100 Index which is accepted as benchmark index for Turkey's financial market, and City Indices. In order to figure out possible relationship, 12 city indices and BIST 100 Index daily closing price from 07.07.2104 to 05.02.2016 , which comprises 400 observations, has been taken into account. These data set is obtained from Thomson Reuters Datastream and the data is processed by employing E-Views and Gauss programmes.

Graph-1 Line-Plots of Raw Data





The Graph 1 indicated line-plots of raw data of BIST 100 Index and city indices. According to the graph, it can be clearly identified that raw data have upward trend. Therefore, we use unit root tests to make these time series non-stationary.

Table-2Descriptive Statistics of BIST 100 Index and City Indices

	ADANA	ANKARA	ANTALYA	BALIKESIR	BIST_100	BURSA
Mean	59235.63	86506.82	35377.84	61622.24	79894.01	111544.1
Median	64307.79	87130.82	35572.48	62111.14	80412.01	115227.4
Maximum	71511.94	101270.5	40402.43	70759.60	91412.94	136130.4
Minimum	40970.04	74969.13	30454.37	48840.99	68567.89	85666.06
Std. Dev.	9728.220	6006.301	2020.826	5140.904	4775.665	14343.95
Skewness	-0.460270	0.137092	-0.245819	-0.598879	-0.120317	-0.292438
Kurtosis	1.634511	2.304959	2.274383	2.737222	2.394394	1.668199
Jarque-Bera	45.19922	9.304319	12.80380	25.06130	7.077725	35.26289
Probability	0.000000	0.009541	0.001658	0.000004	0.029046	0.000000
Sum	23694251	34602729	14151135	24648897	31957606	44617639
Sum Sq. Dev.	3.78E+10	1.44E+10	1.63E+09	1.05E+10	9.10E+09	8.21E+10
Observations	400	400	400	400	400	400

	DENIZLI	ISTANBUL	IZMIR	KAYSERI	KOCAELI	KONYA	TEKIRDAG
Mean	69804.75	81069.59	82608.84	91312.47	113098.8	58713.31	155028.8
Median	69807.95	81040.72	82390.03	95689.50	110850.5	58618.36	153502.5
Maximum	95468.40	88834.69	97390.56	114937.9	143354.3	66620.04	195259.3
Minimum	56673.36	72729.50	70180.00	63728.01	89945.63	50501.95	134333.5
Std. Dev.	5771.462	3680.723	7160.980	14202.80	14706.50	3891.605	12825.27
Skewness	1.297545	-0.016567	0.125143	-0.609555	0.267554	-0.042635	0.789089
Kurtosis	6.814488	2.197522	1.911391	2.011083	1.720071	1.934902	2.998195
Jarque-Bera	354.7468	10.75115	20.79522	41.06981	32.07598	19.02840	41.51087
Probability	0.000000	0.004628	0.000031	0.000000	0.000000	0.000074	0.000000
Sum	27921901	32427837	33043536	36524988	45239510	23485325	62011525
Sum Sq. Dev.	1.33E+10	5.41E+09	2.05E+10	8.05E+10	8.63E+10	6.04E+09	6.56E+10
Observations	400	400	400	400	400	400	400

Table 2 illustrates the descriptive statistics of BIST 100 Index and City Indıces. As it is mentioned that we selected daily closing price include 400 observations. It can be seen from Table 2, all indices are normally distributed.

Variable	**ADF**	**PP**	**ADF**	**PP**
Series in Level			**Series in First Difference**	
lnadana	-1.361003	-1.330702	-22.24408***	-22.15641***
lnankara	-2.081529	-2.060526	-20.29075***	-20.31975***
lnantalya	-2.248910	-2.579292	-23.66366***	-24.29273***
lnbalikesir	-2.033229	-1.839372	-21.05632***	-21.07994***
lnbist100	-2.473125	-2.587471	-20.20869***	-20.21095***
lnbursa	-3.304371	-3.056263	-21.73567***	-22.81237***
lndenizli	-2.556994	-2.977024	-20.66135***	-20.79467***
lnistanbul	-2.653538	-2.843077	-19.59250***	-19.61600***
lnizmir	-2.047860	-2.072463	-20.56327***	-20.56828***
lnkayseri	-1.958598	-1.995823	-19.57655***	-19.57000***
lnkocaeli	-2.933176	-2.992804	-20.14620***	-20.14826***
lnkonya	-2.933176	-2.992804	-20.14620***	-21.42686***
lntekirdag	-3.102081	-2.922320	-21.69363***	-21.73549***

Table – 3 Unit Root Test Results of Data

Note: ADF and PP denote the Augmented Dickey-Fuller unit root test and the Phillips-Perron unit root test respectively. When determining appropriate lag length for ADF test, Schwarz information criteria has been used and also Newey-West Bandwidth criteria has been used to select appropriate bandwidth for PP *,** and *** state level of significance at 10, 5 and 1 percent respectively

Before testing causality relationships among variables, it should be applied unit root testes. From this viewpoint, Augmented Dickey Fuller unit root test and Phillips-Perron unit root testes have been used. As seen from table, all of variables are not stationary at level. In the first differences, all of them are stationary at significance level of %10, %5 and %1.

III. FINDINGS AND ANALYSIS

The asymmetric causality test was applied in order to determine the possible relationship between BIST 100 Index and City Indices by using 400 closing day prices from 07.07.2104 to 05.02.2016. Table 4 shows the outcomes of asymmetric causality test.

Table -4 Asymmetric Causality Test Results

Side of Causality	Test Stats	Bootstrap Test Critical Value		
		%1	%5	%10
Bist100(+)>Adana(+)	1.585	9.923	6.595	4.816
Bist100(+)>Adana(-)	0.403	10.595	6.678	4.867
Bist100(-)>Adana(-)	0.674	9.329	6.052	4.376
*Bist100(-)>Adana(+)	6.404	9.962	6.506	5.044
Bist100(+)>Ankara(+)	2.266	10.322	6.231	4.459
Bist100(+)>Ankara(-)	0.850	9.857	6.137	4.746
Bist100(-)>Ankara(-)	0.202	9.773	5.875	4.616
Bist100(-)>Ankara(+)	0.555	10.513	6.002	4.492
Bist100(+)>Antalya(+)	2.604	11.194	6.244	4.608
Bist100(+)>Antalya(-)	3.358	10.281	6.033	4.778
Bist100(-)>Antalya(-)	0.410	10.469	5.626	4.359
Bist100(-)>Antalya(+)	0.923	9.429	5.754	4.691
Bist100(+)>Balikesir(+)	0.079	11.272	6.132	4.648
***Bist100(+)>Balikesir(-)	11.777	10.550	6.115	4.685
Bist100(-)>Balikesir(-)	2.483	10.923	6.283	4.751
***Bist100(-)>Balikesir(+)	34.808	9.071	5.747	4.483

**Bist100(+)>Bursa(+)	6.971	9.275	5.934	4.476
Bist100(+)>Bursa(-)	2.118	10.247	6.084	4.628
Bist100(-)>Bursa(-)	0.839	9.332	6.167	4.587
Bist100(-)>Bursa(+)	1.099	8.841	6.279	4.773
Bist100(+)>Denizli(+)	0.850	11.606	6.209	4.453
Bist100(+)>Denizli(-)	0.829	10.090	5.956	4.453
*Bist100(-)>Denizli(-)	8.527	12.866	8.666	6.559
Bist100(-)>Denizli(+)	5.311	13.341	7.832	6.291
Bist100(+)>Istanbul(+)	6.371	10.797	5.827	4.487
Bist100(+)>Istanbul(-)	2.357	9.801	5.944	4.507
Bist100(-)>Istanbul(-)	2.021	9.101	6.072	4.976
Bist100(-)>Istanbul(+)	1.186	9.362	5.944	4.658
**Bist100(+)>Izmir(+)	6.205	10.347	6.104	4.555
Bist100(+)>Izmir(-)	3.679	9.544	5.883	4.542
Bist100(-)>Izmir(-)	4.228	9.625	6.072	4.585
Bist100(-)>Izmir(+)	1.169	10.105	6.143	4.766
Bist100(+)>Kayseri(+)	1.262	9.462	6.249	4.674
Bist100(+)>Kayseri(-)	2.463	10.457	6.604	4.786
Bist100(-)>Kayseri(-)	1.247	9.453	6.203	4.694
Bist100(-)>Kayseri(+)	1.033	10.191	5.721	4.624

Side of Causality	**Test Stats**	**Bootstrap Test Critical Value**		
%1	**%5**	**%10**		
Bist100(+)>Kocaeli(+)	3.860	10.518	6.490	4.915
Bist100(+)>Kocaeli(-)	1.339	7.916	5.925	4.437
Bist100(-)>Kocaeli(-)	0.622	10.423	6.082	4.605
Bist100(-)>Kocaeli(+)	1.211	10.382	5.651	4.225
Bist100(+)>Konya(+)	2.916	10.066	6.210	4.582
**Bist100(+)>Konya(-)	8.696	9.677	6.594	5.139
*Bist100(-)>Konya(-)	5.318	9.021	6.438	4.847
Bist100(-)>Konya(+)	37.839	9.242	5.764	4.444
Bist100(+)>Tekirdag(+)	0.344	9.542	6.059	4.848
Bist100(+)>Tekirdag(-)	1.980	8.646	6.041	4.615
Bist100(-)>Tekirdag(-)	0.558	11.038	6.496	4.844
Bist100(-)>Tekirdag(+)	1.887	10.449	6.309	4.958

Note: *, ** and *** indicate rejection of H_0 hypothesis at the significance level of 1%, 5% and 10% respectively.

According to asymmetric causality test results, BIST 100Indexdoesn't has directly causality relationships with city indices. However, positive shocks came from BIST 100 Indexhasnegative causality relationships with Balıkesir City Index at the level 1%, 5% and 10%. Also, similar effect can be seen on Konya City Index at 5% significance level. In addition, while positive shocks of BIST 100 Index have negative causality relationship with Balıkesir City Indexat the level 1%, 5%, 10%, negative shocks of that haspositive causality relationship with Balıkesir City Index. Moreover, positive shocks of BIST 100 Indexhave positive effects on İzmirCity Index at the 5%. From these results, generally positive shocks of BIST 100 Indexhave positive causality relationships with city indices. In this regard, it can be concluded that positive movements in BIST 100 Index as a benchmark

for market has positive effects on several City Indices, though negative shocks in BIST 100 Index has not had an impact on City Indices in any way.

IV. CONCLUSION

From the market perspective, the possible relationship between variables or markets in different ways has been empirically researched in finance literature. In that context, it is easy to underlined that after the developing correlation, causality or co-integration testes, several studies have been conducted and significant results have been obtained. The aim of this research is to reveal reveal whether there is a relationship between BIST 100 Index which is accepted as benchmark index for Turkey's financial market, and City Indices in period between 07.07.2104 and 05.02.2016 which includes 400 daily closing price data by employing asymmetric causality test.

According to the outcomes of the research, while the presence of a significant negative effects of BIST 100 Index's positive shocks on Balıkesir and Konya City Indices, there is positive and significant reaction to BIST 100 Index' positive movements is figured out in Bursa City Index at 5% level. Taking all into the consideration, it can be claimed that BIST 100 Index as a benchmark has impact on City Indices, but this effect is different from city to city.

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