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Cyclical behavior of stock exchange index by sectors: a case from Turkey

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Abstract

In this study, the relation between the cyclical behaviors of stock market indices of industry, service, finance and technology sectors at Istanbul Stock Exchange and gross domestic product of Turkey between the 1998 January and 2011 September, is analyzed. The results suggest that stock exchange indices move in the same direction with economic activity and stock market leads the economy by about one quarter. However, when the sectoral differences are considered, movements in technology sector index are transmitted to economy in two months whereas it is three months for the industrial and service sector. The slowest sector is the financial sector for which pass-through speed is four months.

*Keywords:*Business cycle, co-movement, financial cycle, Granger causality, Hodrick-Prescott Filter, Istanbul Stock Exchange, Turkey;

1. Introduction

The relation between stock exchange index and macroeconomic variables is of primary concern for policymakers and investors to predict future behavior, to increase return of their financial investments, to diversify risk and to seize alternative investment opportunities. Generally, it is observed that macroeconomic variables fluctuate overtime displaying recurring peaks and troughs known as business cycle fluctuations and analysis of these fluctuations reveals so much information about the stylized facts of the variables. Examining behavior of one time series against another regarding to periodic peaks and troughs discloses uniformity and predictability features of variables concerning the mutual relationships between them. In this respect, analysis of business cycle properties of stock exchange index poses valuable information to investors about the future course of their investments.Financial variables can be pro-cyclical (moving in the same direction), countercyclical (moving in the opposite direction) or acyclical (no relation) with respect to gross product. Also, they are called leading, coincident and lagging over the business cycle according to timing of the movements. Fama (1981) reported that there is a strong relation between stock exchange and national output in an economy.It is empirically seen that stock exchange index, as a financial indicator, is a pro-cyclical and leading variable for gross product in business cycle literature. Typically, certain sectors can lead the economy at different phases of cycles and some perform afterwards. Thus, it is important to know which sectors are leading, coincident and lagging the economy, and timing of these up and down movements to evaluate investment opportunities and their risk.

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There are various studies examining stock exchange and economic activity relation in the literature. Chauvet (2001) found that stock market can be a leading indicator in identifying turning points of an economy. Malliaris and Urrutia (1991) showed there is a positive relation between stock market index and movements of economic activity in the US. Similar studies presented parallel results for other developed countries such as Thornton (1993)for the UK; Cheung and Ng (1998)for Canada, Germany, Italy, Japan and the US; Avouyi-Dovi and Matheron (2005) for the US; Antonios (2010) for Germany. Naes et al. (2011) supported the prior studies by showing stock market liquidity's usefulness in estimating future course of economic activity. In addition, there are a number of studies for developing countries. Same relation was found for Pakistan by Shahbaz et al. (2008); for India by Deb and Mukharjee (2008); for seven sub-Saharan Africa countries, by Enisan and Olufisayo (2009); for South Africa by Muchaonyerwa (2011); for Cote D'lvoire by Herve et al. (2011); for Pakistan and Bangladesh by Ahmad et al. (2012). Wong and Zhou (2011) showed the same relation both in developing and developed countries by examples given from China, USA, UK, Japan and Hong Kong.

Within this framework, the aim of this paper is to analyze co-movement relation between the cyclical behavior of various stock market indices of Istanbul Stock Exchange (ISE) with respect to domestic output of Turkey. It is of important to state that besides using general stock market index, which are the case for studies mentioned above, our study uses stock exchange index of different sectors, too. This way, the dominant sector(s) leading the economy and the follower sector(s) lagging the economy and their stylized facts can be explored. Further, this analysis lets us investigate any uniformity in the behavior of stock exchange and national output, and allows to project future behavior of these variables. With this study, it is expected to contribute to the literature on business and financial cycle characteristics of Turkey. The organization of the paper is as follows: Section 2 explains methodology, Section 3 presents the data used and results of business cycle analysis and finally, Section 4 concludes the study.

2. Methodology

Like Lucas (1980) and Kydland and Prescott (1990), business cycles can be defined as deviations of output from trend; i.e. cyclical component of the series. Thus, to investigate business cycle features of stock exchange index, first natural logarithms of all series are taken. GDP showed a seasonal pattern so, it is deseasonalized by using Census X12, which is an enhanced version of X-11 Variant of the Census Method II seasonal adjustment program (Shiskin et al., 1967). Details of the method and related articles can be found at the Census Bureau website. Next, all series are de-trended by Hodrick and Prescott (1997) (HP) filter which separates trend and cyclical component of a time series through minimization of the following loss function:

$$\min_{\tau_t} \sum_{t=1}^{T}(y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2 \quad (1)$$

wherey_t is the series itself, τ_t is the trend component and λ is the penalty parameter related to smoothness of the trend component, which is suggested as 14,400 for monthly data. Then, cyclical component, c_t, is obtained by extracting τ_t from y_t.

To determine the leading-lagging relation between obtained cyclical components, pair-wise Granger causality test is applied for each ISE series. Granger (1969) defines causality as X causes Y if and only if Y(t) is better predicted by using the past history of X than by not doing so with the past of Y being used in either case. If X causes Y and Y does not cause X, it is said that there is uni-directional causality from X to Y. If X does not cause Y and Y does not cause X, then X and Y are either statistically independent or related contemporaneously but in no other way. If both X causes Y and Y causes X, it is said that there is bi-directional causality (i.e. feedback) between them. There are many ways to test Granger causality. Direct Granger method uses regression framework where each variable is regressed on lagged values of itself and the other as follows:

$$X_t = \beta_0 + \sum_{j=1}^{J} \beta_j X_{t-j} + \sum_{k=1}^{K} \alpha_k Y_{t-k} + u_t \quad (2)$$

$$Y_t = \beta_0 + \sum_{j=1}^{J} \beta_j Y_{t-j} + \sum_{k=1}^{K} \alpha_k X_{t-k} + v_t \quad (3)$$

Y (X) does not Granger cause X (Y) if and only if all α_k's are zero in eqn (2) (eqn (3)). It is known that this test is sensitive to lag number. Thus, to determine the lag numbers, following statistics are used:

i. Likelihood Ratio (LR) Test Statistic: $LR = (T - m)(\ln|\Sigma_r| - \ln|\Sigma_u|) \sim \chi^2(q)$ (4)
where T: number of usable observations; m: number of parameters estimated in each equation of the unrestricted system, including the constant; $\ln|\Sigma_r|$: natural logarithm of the determinant of the covariance matrix of residuals of the restricted system; $\ln|\Sigma_u|$: natural logarithm of the determinant of the covariance matrix of residuals of the unrestricted system; q: total number of restrictions in the system. If LR statistics is less than the critical value, reject the null hypothesis of the restricted system. It is not very useful in the small samples.

ii. Final Prediction Error (FPE; Akaike, 1969): $FPE = |\Sigma| + (T + N)/(T - N)$ (5)

iii. Information Criteria: Akaike Information Criterion (AIC; Akaike, 1974) $AIC = T\ln(|\Sigma|) + 2N$ (6)
Schwarz Criterion (SC; Schwarz, 1978) $SC = T\ln(|\Sigma|) + N\ln(T)$ (7)
Hannan-Quinn Information Criterion (HQ; Hannan and Quinn, 1979) $HQ = T\ln(|\Sigma|) + 2N\ln(\ln(T))$ (8)
where $|\Sigma|$: determinant of the covariance matrix of the residuals; N: total number of parameters estimated in all equations; T: number of usable observations. The smaller these values, the better the model is.

Then, correlation coefficients between cyclical component of stock market index of all sectors and GDP are calculated by shifting the series backward and forward up to 24 months. As in Alper (2000), a positive significant contemporaneous correlation indicates that stock exchange index is pro-cyclical with GDP, whereas a negative significant correlation indicates that stock exchange index is countercyclical.

3. Data, Analysis and Findings

The ISE is established in 1985 as per the Governmental Decree in Force of Law (KHK) No.91 and commenced to operate on January 3, 1986. ISE markets are organized under four main categories as stock, emerging companies, bonds and bills, and foreign securities market. Stocks and right coupons of companies from various sectors, exchange traded funds and warrants are traded. In this study, we look at the relation between GDP and ISE indices in terms of only timing of peaks and troughs but not in terms of amplitude. Details of the indices used in this study are given in Table 1.

Table 1. Information about the ISE stock indices used in this study

Index	Code	# of Companies	Base Value	Used Period (monthly)
ISE 100	XU100	100	01.1986 = 1	01.1998 – 09.2011
ISE All Shares	XUTUM	331	27.12.1996 = 976	01.1998 – 09.2011
ISE Industrials	XUSIN	171	31.12.1990 = 32.56	01.1998 – 09.2011
ISE Financials	XUMAL	91	31.12.1990 = 32.56	01.1998 – 09.2011
ISE Services	XUHIZ	53	27.12.1996 = 1,046	01.1998 – 09.2011
ISE Technology	XUTEK	16	30.06.2000 = 14,466.12	07.2000 – 09.2011

Pair-wise Granger Causality test is applied for each ISE series where the lag number is determined by the use of LR, FPE, AIC, SC and HQ statistics. To make the final decision, left autocorrelation in residuals are tested by Portmanteau and LM tests and the minimum length with no left autocorrelation is selected. The Granger Causality test results with the selected lags are given in Table 2. It can be seen from Table 2 that XU100, XUMAL, XUSIN, XUTUM Granger causes GDP; separately but the reverse is not true. Thus, there is uni-directional causality from indices to GDP indicating they lead GDP. However, XUHIZ and XUTEK have bi-directional causality; i.e. leading-lagging relation is inconclusive. Further, more lags are tried to see whether the results remains the same. Similar

results are obtained for XU100, XUMAL, XUSIN whereas uni-directional causality from XUHIZ to GDP is found as contradictory, indicating it leads GDP except 6-7 lags are used. For XUTEK, same results are obtained for small lags while uni-directional causality is found from the index to GDP for large lags. It must be noted that it is a relatively new index started to be collected by the second half of 2000. Thus, this analysis has to be repeated in future. To sum up, it can be said that financial sector leads the economy in Turkey which is parallel to the results in literature. Also, it is consistent with the relation between the acts of investors and economic activity: When investors expect an increase (decrease) in the economic activity, they tend to invest more (less) in stock exchange; resulting an increase (decrease) in the stock market prices and indices. After that, the expected increase (decrease) in the economic activity, which is in line with the acts of investors, takes place. Therefore, if economy is in the upturn (downturn), investors just anticipate this trend and these forecasts are reflected in stock exchange. This way, stock exchange leads the economy.

Table 2. Granger Causality Test Results for Selected Lags

Null Hypothesis	Lags	Obs.	P-Value	Decision
XU100 does not Granger Cause GDP	4	161	0.00002	REJECT
GDP does not Granger Cause XU100			0.49483	DO NOT REJECT
XUHIZ does not Granger Cause GDP	6	159	0.00084	REJECT
GDP does not Granger Cause XUHIZ			0.01974	REJECT
XUMAL does not Granger Cause GDP	4	161	0.00005	REJECT
GDP does not Granger Cause XUMAL			0.57788	DO NOT REJECT
XUSIN does not Granger Cause GDP	4	161	0.00005	REJECT
GDP does not Granger Cause XUSIN			0.49246	DO NOT REJECT
XUTEK does not Granger Cause GDP	6	129	0.00673	REJECT
GDP does not Granger Cause XUTEK			0.02288	REJECT
XUTUM does not Granger Cause GDP	4	161	0.00002	REJECT
GDP does not Granger Cause XUTUM			0.48680	DO NOT REJECT

It is also important to know the timing and direction of the relation. The most significant correlations between the cycles of GDP and ISE indices are found to be 0.6452, 0.6538, 0.6483, 0.6221, 0.6602 and 0.6289 at lags -4, -3, -4, -4, -3 and -2 for XU100, XUHIZ, XUTUM, XUMAL, XUSIN and XUTEK; respectively. Higher significant correlations at negative lags indicate that ISE leads the GDP. Besides, all are positive so they are pro-cyclical; i.e. move in the same direction with the economy. An increase (decrease) in the stock exchange index is followed by an expansion (contraction) in the economy roughly one quarter later. Leading period of XU100, XUTUM and XUMAL are the same, four months. XUHIZ and XUSIN lead the economy by three months, while XUTEK has a leading period of two months. This shows that movements in the technology sector are transmitted to the economy in the first place. Next, industrial and service sector come. Finally, trends in financial sector index are reflected in the economic activity. Although financial sector has the highest capitalization share (approximately 60%) in ISE, speed of pass-through to economy is lower compared to others. This implies that technology and industrial sectors are the driving forces leading the economy. Size of the pass-through from each sector to economy is as important as the speed. They are all close to each other (around 0.64) indicating they are not complete; i.e. there is no one-to-one correspondence between changes in the stock exchange indices and in GDP of Turkey.

4. Conclusion

In this study, leading-lagging relation between the cyclical behaviors of stock market index of industry, service, finance and technology sectors at ISE with respect to GDP of Turkey are investigated by cross correlations and Granger Causality test. Monthly data between the 1998 January and 2011 September is used. Since only GDP shows seasonality, it is deseasonalized by Census X12 method. Then, HP filter is used to obtain the cyclical component of each series. Results of pair-wise Granger Causality tests show that mainly finance and manufacturing sectors lead the economy. Service sector can be declared as leading, too but there exists bi-directional relation when 6-7 lags are used. Technology sector has bi-directional relation with GDP. However, since the causality goes from financial

sector to real economy, it can be said that technology sector leads the economy then feeds back. When the correlations between their cyclical components are examined, it is observed that significant ones are mostly at negative lags indicating stock indices lead GDP as in literature and since most significant ones are positive, all ISE indices are pro-cyclical with GDP; i.e. they move in the same direction. However, timing of movements are not synchronous. While leading period of XU100, XUTUM and XUMAL are four months, it is three months for XUHIZ and XUSIN and two months for XUTEK. These results suggest that making a sectoral analysis reveals differences and similarities among sectors and yields an opportunity to compare their pass-through features. A further research can be conducted by using stock exchange indices of subdivisions of sectors employed in this study.

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