International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2018, 8(4), 45-53.

Asymmetric Responses of Stock Prices to Money Supply and Oil Prices Shocks in Turkey: New Evidence from a Nonlinear ARDL Approach

Halil Altintas[1], Kassouri Yacouba[2]*

[1]Department of Economics, Erciyes University, Faculty of Economics and Administrative Sciences, Kayseri, 38039, Turkey.

[2]Department of Economics, Erciyes University, Faculty of Economics and Administrative Sciences, Kayseri, 38039, Turkey,
*Email: kassouri.yacou@yahoo.com

ABSTRACT

This study investigates how stock market prices react to oil prices and money supply shocks in Turkey using a nonlinear ARDL approach. We establish the time series properties of the data using both conventional linear unit root tests and the procedure advanced by Zivot and Andrews (1992) to consider the possible existence of endogenous break in the series. Empirical evidence revealed asymmetric cointegration through Wald statistics of Pesaran and Banerjee. Findings suggest asymmetric responses of Turkish stock market prices to oil prices and money supply shocks, confirming the importance of non-linearity in macro-finance variables. Namely, in the long-run, we find a significant negative relation between oil prices and stock market prices. Meanwhile, stock market prices react positively to negative (positive) shocks in money supply. The obtained evidence of the asymmetric behaviors of stock prices should be taken into account by stock market participants when dealing with their portfolio diversification strategies.

Keywords: Stock Price, Oil Price, Money Supply
JEL Classifications: C58, E44, E52, Q43

1. INTRODUCTION

Since the OPEC boycott of 1973, the impact of oil price shocks continues to play an important role in shaping the economic developments of both oil-importing and exporting countries. Consequently, oil prices become one of the major macro-economic variables causing economic instability and affecting global financial stability. Not surprisingly, the oil crises have spurred many works on the role and impact of changes in oil prices on the global economy. (See, e.g., Hamilton, 1983; Burbridge and Harrison, 1984; Mork et al., 1994). However, most previous works have reported a high negative correlation between oil prices and real economic activity, which has been accepted as an empirical fact. Recently, numerous financial studies have documented the repercussions of energy shocks on financial markets.

In the economic theory, it is generally assumed that oil prices hike might reflect inflation tax on consumption, diminishing household disposable income. These effects adversely impact company wealth, lowering their dividends and asset prices (see e.g., Huang et al., 1996). The findings are further tested and supported by Kaul and Jones (1996), Sadorsky (1999) and Cunado and Perez de Gracia (2014). Therefore, for oil exporting countries the findings might be different, stock markets may react positively when oil exporting countries experience positive oil price shocks (see e.g., Sardosky, 2001; Park and Ratti, 2008). In an oil abundant country, asset prices and stock prices may be significant channels of wealth transmission, in particular, stock prices will be affected by the price of oil through the cash flow of oil related companies. On the other hand, some empirical studies do not find a significant correlation between oil prices and stock returns (see e.g., Chen et al., 1986). Not only the fact is a lack of general consensus on the effects of oil price shocks on stock market prices, but also only few papers addressed this issue by considering key macroeconomic variables in addition to oil prices.

The Taylor rule suggests that the nominal interest rate would be changed according to a target rate of inflation and an output gap in the economy. Accordingly, the central bank primary objective is to maintain price stability and stimulate output. Thus, Central

Bank can anticipate higher inflation following oil price surges by raising short-term interest rate thereby and lowering money supply. From a financial theory perspective, an increase in money supply and the resulting drop in interest rates can improve safe assets ratio and lead to a higher stock prices while a decrease in money supply usually negatively affect stock prices. Likewise, the empirical evidence regarding the impact of variations in money supply on stock prices remains controversial among economists. From the monetarist point of view, increase in money supply induces a surplus of money and wealth balances which might be spent on stocks and bonds. Eventually, the increased demand for stocks will raise their prices (Fisher, 1911). Many empirical works find a positive effect of money supply on stock prices (see e.g., Vesela, 2007). From the Keynesian perspective, change in money supply affects future expectations of monetary policy and could adversely affect stock prices. For example, an increase in the money supply will lead to monetary contraction in the future, which could push up the current interest rates. We know that when the present interest rates increase, discount rates go up as well, which could weaken asset prices. Conversely, for the scholars who believe in the stock market efficiency, there is no correlation among stock and money markets. Undeniably, it can be stated that there is no theoretical and empirical consensus on the effects of money supply on stock prices. The focus of this paper on oil prices and money supply is motivated by several reasons. Firstly, since crude oil prices and money supply are linked to macroeconomy and the stock markets, understanding such a relation is of particular importance for portfolio managers as well investors who are planning to shift their investments in an emerging stock market like Turkey. Secondly, as an oil importer country, the reaction of Turkish stock market to changes in money supply and oil prices must be considered by policy makers in order to reduce the economy instability caused by these variables. The recent oil price surges reaching historic levels in 2008 hampered the success of the anti-inflation policy executed by the Central Bank of the Turkish Republic and thereby causing persistent signs of trouble in the stock market. Finally, numerous studies attained inconclusive results concerning the effects of crude oil prices and money supply on stock markets, there has been relatively little study done to analyze these relationships in an emerging stock market of an oil-importing country such as Turkey. Hence, this paper would shed some new light on the investigation of these issues.

Although, most of the existing literature are focused on developed countries, the purpose of this paper is to analyze the effects of oil prices and money supply on stock prices in Turkey using monthly data from 1988 to 2013. This paper makes several contributions to the existing literature. First, it extends the existing literature on the stock markets by applying a nonlinear ARDL (NARDL) analysis to examine the dynamic links between oil prices, money supply and stock prices. We select NARDL analysis because it is a powerful and robust methodology that allows different orders of integration for time series. NARDL methodology has a unique advantage, allowing testing the existence of asymmetries in both the short-run and the long-run relationships between stock prices, oil prices and money supply. However, when the presence of asymmetry is detected, the asymmetric responses of stock market to positive and negative changes in oil prices and money supply is quantified by the asymmetric dynamic multipliers (Shin et al., 2014). As an energy-reliance country, oil and natural gas constitute the most important import items of Turkey, about 90% of Turkey's oil needs are met through imports (Ugurlu and Ünsal, 2009). Hence, being an oil scarce country, oil price fluctuations are of great relevance for Turkish authorities when taking national economic policy decisions. The empirical findings of this paper could reduce the country's exposure to exogenous oil shocks and reinforce the stability of the Turkish stock market. Finally, our findings show that money supply and oil price shocks have asymmetric effects on Turkish stock market. Thus, this new information about the asymmetric responses of stock market should be taken into account by the stock market participants and policy makers within making their decisions.

We organize the rest of the study as follows: Section two reports the literature, section three describes the methodology. The fourth section discusses the data and empirical findings and section 5 offers the study conclusion.

2. LITERATURE REVIEW

2.1. Oil prices and Stock Prices

Empirical studies on the dynamic links between oil prices and stock prices have shown mixed results. In the existing literature, empirical studies have employed different frameworks: Linear, time varying, and nonlinear asymmetric models.

Some research studies find positive impact of oil price changes on oil and gas stock prices. El-Shariff et al. (2005) explored the relationship between oil pricing risk and the equity returns earned by UK oil and gas firms using daily data from 1st January 1989 to 30th June 2001. Like previous works using multifactor model relating share price exposure to variability in crude oil prices, they showed a positive correlation between crude oil prices and equity values. Their results are similar to previous studies of Huang et al. (1996) for the U.S and Faff and Brailsford (1999) for Australia. Continuing the same path of research, Narayan and Narayan (2010) investigated the impact of oil prices on Vietnam's stock prices using daily data for the period 2000-2008. They analyzed long-run relationship among the variables by applying Johansen cointegration test and found that selected variables are cointegrated. They showed that both oil prices and exchange rates positively affect stock prices. Contrary to previous works concentrated on developed countries, Mohanty et al. (2011) investigated the oil prices exposure of stock markets in Bahrain, Kuwait, Oman and Qatar. They used weekly data from June 2005 to December 2009 at the country-level and the industry level. They showed that at the country and industry levels, stock markets have positive exposures to oil price variations, except for Kuwait. They also provided evidence that oil price fluctuations have asymmetric effects on stock market returns at the both level country and industry. More recently, using vector autoregressive (VAR) models, Asteriou et al. (2013) found that crude oil prices and stock prices are positively related in developed country (Australia) but negatively related in developing countries (China and India).

By contrast, Nandha and Faff (2008) use the market model augmented by the oil price factor to examine the effect of oil price shocks on stock returns with monthly data from April 1983 to September 2005. They found that positive changes in oil prices negatively affects stock returns for all examined firms except mining and oil and gas companies. Bharn and Nikolovan (2010) use bivariate AR(1)-EGARCH(1,1) model with weekly data from January 1995 to February 2007 for several countries, including Brazil, China, India and Russia. Their findings indicate that oil prices and stock prices have a negative relationship in China and India. Similar results provide by Odusami (2009) for US stock market returns, Huang and Guo (2008) for Japan as well Boyer and Filion (2007) for Canada.

All studies reviewed above have assumed that there is either a positive or negative relation between stock price and oil prices. Considering the experience of China, Cong et al. (2008) use monthly data from 1996:1 to 2007:12 to explore the effect of oil price changes and oil price volatility on the real stock returns. The method of multivariate VAR revealed no statistically significant effects on the real stock returns of most Chinese stock market indices. A few research studies also revealed insignificant links the series (Henriques and Sadorsky, 2008; Jammazi and Aloui, 2010; Filis et al. 2011). Recently, several scholars showed that the relationships between oil price and stock prices are not in a linear form. Using a nonlinear autoregressive distributed lag (NARDL) model, Kisswani and Elian (2017) examined the linkage between oil prices and Kuwait Stock Exchange (KSE) price. They used different daily data periods to investigate the response of KSE prices to oil price shocks. They found evidence of long run asymmetric effects between oil prices and some Kuwait sectoral stock prices. To the best of our knowledge, only few study has examined the asymmetric responses of stock market to oil price shocks in Turkey. This appears to represent a great omission from the reviewed literature. Thus, this paper fills the gap by applying to the relation between stock market and oil price shocks, the nonlinear ARDL model. Allowing the possible nonlinearity in the response of stock markets to oil price shocks provides a better understanding of the relation, which is crucial to stock market participants.

2.2 Money Supply and Stock Market

There is also no consensus among economists regarding the theoretical and empirical relationships which purportedly exist among money supply and stock prices. Although, in the literature several studies have been devoted to the subject, the impacts of monetary developments on the stock market are inconclusive and not completely understood. As previously mentioned, there is a fundamental controversy among Keynesian and Chicago schools regarding the role of money. Since the pioneer empirical work on the link between money supply and the stock price by Sprinkel (1964), the different effects of money supply on stock markets have long been a controversial issue. Most of the empirical studies concentrated largely on developed countries.

Early researches have generally assumed linear relationship between stock prices and money. For example, using traditional Johansen's vector error-correction model for multivariate cointegration framework, Maysami and Koh (2000) identified several significant economic factors that have long-run effect on the Singapore stock market. They also found positive relation between money supply and stock prices. Similar findings have been revealed by Sprinkel, 1964 for the U.S. For Poland, Hungray, Slovakia and Czech Republic, Hanousek and Filler (2000) explored the relationship between the real economy and equity market returns. Their results of Granger causality technique showed a positive relation between money supply and equity prices. A similar result has been reported for Malaysia by Rasiah (2010) who applied the cointegration technique and vector error correction model to analyze the short-and long-run dynamic between stock markets and macroeconomic variables from 1980:01 to 2006:12. Continuing the same line of research, Caginalp and Desantis (2011) studied the influence of macroeconomic variables on investor decisions in India and China stock markets using monthly data from 26 October 1998 to 30 January 2008. They reported that increasing in money supply have a significant positive effect on stock price. Like previous works they applied multivariate cointegration and vector error correction technique. Recently, Naik (2013) also discovered that stock prices are positively associated with money supply and industrial production.

While the reviewed empirical studies have not been able to show any negative relationship between stock prices and money supply, only few studies reported negative effect of money supply on stock prices. Examples include Gan et al. (2006); Asmy et al. (2009) and Humpe and Macmillan (2009). For New Zealand Gan et al. (2006) concluded that the effect of money supply on the stock index is always negative. They determined the dynamic linkages between macroeconomic variables and the New Zealand Stock Index from January 1990 to January 2003. However, they also used Johansen Maximum Likelihood and Granger-causality tests. On the other hand, some empirical studies found no causal relationship between money supply and stock prices. (See e.g., Kraft and Kraft, 1977 and Kimura and Koruzomi, 2003). For the Malaysian Market, Habibullah and Baharumsah (1996) discovered no cointegration between money market and stock prices. Using monthly data on money supply, stock price indices and output they provided evidence that there is no correlation between the change in money supply and the stock markets. Some recent studies on macro-finance have analyzed the dynamic links between stock prices and money supply by using nonlinear and asymmetry framework (see e.g., Chen, 2007; Jansen and Tsai, 2010; Naifar, 2016). For example, using Markov switching regression models Bahloul et al. (2017) explored the effects of macroeconomic and conventional stock market variables on Islamic index returns from 2002 to 2014. Their results showed that conventional stock index and money supply explain the dynamics of both developed and emerging Islamic stock indices.

Following previous studies, this paper contributes to the literature by estimating the effects of the money supply shocks on the Turkish stock market prices. To better identify the possible presence of asymmetry we consider positive and negative money supply shocks by using the partial sum decomposition process of the nonlinear ARDL model. In this paper, a nonlinear ARDL is used to investigate the asymmetric dynamic connections between money supply shocks and stock prices. It is worth noting that most of the examined empirical studies have analyzed the effects of money supply on stock prices by using standard time series techniques.

3. METHODOLOGY

This paper employs the nonlinear autoregressive distributed lag model (NARDL) introduced by Shin et al. (2014). The nonlinear ARDL estimation approach developed by Shin et al. (2014) and extracted from the Pesaran et al. (2001) linear autoregressive distributed lag model allows modeling and testing nonlinearity in both short-and long-run relations among macro-finance variables. Following Pesaran et al. (2001) the specification of the standard autoregressive distributed lag (ARDL) model is expressed as follows:

$$\Phi(L)y_t=\alpha_0+\alpha_1 W_t+\beta'(L)x_{it}+\mu_t \quad (1)$$

Where $\Phi(L)=1-\sum_{i=1}^{\infty}\phi L^i$ and $\beta(L)=\sum_{j=1}^{\infty}\beta_j L^j$, *(L)* is the lag length and (w_t) is a vector of deterministic variables. To capture the inherent short-run and long-run asymmetries, this model uses the positive and negative partial sums decomposition of the exogenous variable x_t, i.e., x_t^+ and of x_t^- increases and decreases. The asymmetric long-run relationship can be specified as follows:

$$y=\beta^+x_t^+ +\beta^- x_t^- +u_t, \quad (2)$$

Where and reflect the partial sum processes of positive and negative changes of the regressors (x_t), x_t is a kx1 vector of regressors which can be decomposed as $x_t=x_0+x_t^+ +x_t^-$, x_t^+ and x_t^- are calculated as follows:

$$x_t^+=\sum_{j=1}^{t}\Delta x_j^+=\sum_{j=1}^{t}\max(\Delta x_j^t,0) \quad (3)$$

ve

$$x_t^-=\sum_{j=1}^{t}\Delta x_j^-=\sum_{j=1}^{t}\max(\Delta x_j^t,0)$$

Following Shin et al. (2014), from Eq. (2) we can express a more genral asymmetric error correction model as:

$$\Delta y_t=\rho y_{t-1}+\theta^+x_{t-1}^+ +\theta^-x_{t-1}^- + \sum_{j=1}^{p-1}\varphi\Delta y_{t-j}+\sum_{j=0}^{q}(\pi_j^+\Delta x_{t-j}^+ +\pi_j^-\Delta x_{t-j}^-)+e_t \quad j=1\ldots p \quad (4)$$

Where

$\theta^+=-\rho\beta^+$ and $\theta^-=-\rho\beta^-$

The positive and negative shocks of the short-run adjustment processes can be represented by the $\pi_t^+=-\beta^+\varphi_i+\psi_{2i}$, $\pi_t^-=-\beta^-\varphi_i+\psi_{2i}$ respectively.

The signis (+) and (−) in Eq. (4) denote the positive and negative changes. p and q indicate the lag lenght for the dependent and independent variables while e_t indicates the disturbance term. The implementation of the NARDL model follows the given steps. Firstly of all we estimate by standard OLS Eq. (4) since the model is linear. Then we determine the long-run asymmetric cointegration with bound testing approach. Moreover, the null hypothesis ($\rho=\theta^+=\theta^-=0$) which refkects no cointegration between variables can be tested using F_{PSS} and t_{BDM}. Like for a linear ARDL model, the critical values for both the F_{PSS} and t_{BDM} statistics are tabulated in Pesaran et al. (2001). For instance, if the computed F_{PSS} value exceeds the tabulated upper bound value of Pesaran et al. (2001), the null hypothesis of no cointegration is rejected implying the existence of long-run asymmetric relation between the examined variables. Finally, we investigate the null hypothesis of a long-run symmetric relation ($\theta=\theta^+=\theta^-$) and the null of symmetric in the short-run dynamic [(1) $\pi_i^+=\pi_i^-$ for all *i*=1, 2, 3…q or (2) $\sum_{i=0}^{q}\pi_i^+=\sum_{i=0}^{q}\pi_i^-$] using a standard Wald test. The rejection of null hypothesis implies that our model will allow asymmetric dynamic effect. By rejecting symmetric (either in the short-run or in the long-run or in both), the cumulative dynamic multiplier effects associated with unit changes in and respectively, on can be evaluated as follows:

x_t^+ and x_t^- t respectively, on y_t can be evaluated as follows:

$$m_h^+=\sum_{j=0}^{h}\frac{\partial y_{t-j}}{\partial x_t^+},\ m_h^-=\sum_{j=0}^{h}\frac{\partial y_{t-j}}{\partial x_t^-},\ h=0,1,2 \quad (5)$$

When ($h\to\infty$), $m_h^+\to\beta^+$ and $m_h^-\to\beta^-$ where β^+ve β^- are the positive and negative asymmetric long-run coefficients, respectively $\beta^+=-\theta^+/\rho$ ve $\beta^-=-\theta^-/\rho$. The estimated multipliers capture the asymmetric adjustments to the new equilibrium following an economic pertubation. In pratice, the patterns of dynamic adjustment will depend on the model specification. (Shin et al., 2014).

4. DATA AND EMPIRICAL RESULTS

4.1. Data Overview

The main dataset in this study consists of monthly time series of the market stock prices, the world crude oil price and money supply. The time period ranges from January 1988 to December 2014. The used of a monthly frequency data reflects better the periods of high and low volatilities phases in variables (stock prices, oil prices and money supply) than do higher frequency data. Taking the information about the behavior of monthly data into account, we can now do the analysis by describing stock prices as a function of oil prices and money supply. The empirical model in the log-log form can be specified as follows:

$$\ln SP_t=\beta_0+\beta_1\ln OP_t+\beta_2\ln M_t+\varepsilon_t \quad (6)$$

Where Sp_t is the stock price index, OP_t represents world oil prices and M_t is the money supply. The share price index (2010=100) is employed as a proxy for the market stock prices. The data is sourced from the official web sites of Borsa Istanbul (www.borsaistanbul.com). The world crude oil prices are the monthly average crude oil price per barrel from International Financial Statistics (IFS) Database of International Monetary Fund (IMF). The money supply measures used in this paper is M3 the broad money obtained from IFS Database of IMF. The world crude oil price and money supply are deflated by consumer price index (CPI) with 2005=100. The selected data are seasonally adjusted using the TRAMO/SEATS method. All seasonally adjusted variables are expressed in logarithmic form to stabilize the data variability and ensure better distributional properties of the data.

4.2 Unit Root Tests

Testing the order of integration of the variables is a key procedure in an empirical analysis of the autoregressive distributed lag model since this approach does not involve I(2) variables. Specifically the conventional unit root tests such as Augmented Dickey-Fuller (ADF), Phillips Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) are performed for all variables and the findings, summarized in Table 1, indicate that ADF, PP and KPSS tests are in agrement that the variables become stationary after first differencing i.e., I(1). Since the conventional unit root tests report that series are not stationary, then we can proceed to the bounds testing procedure. This finding can lead to spurious results of bound tests of such data because the study period contain important upheavals that caused structural breaks.

Since the conventional unit root tests may fail to reject the unit root hypothesis if the series have a structural break, we will perform unit root tests that allow for the possible existence of structural breaks in the time series. Following this motivation, the present study uses the Zivot and Andrews (ZA) unit root tests that determines the break point endogenously from the data. The results of the unit root tests have been reported in Table 2. The result of ZA unit root tests show that all the variables in the series are non-stationary at level in each model: Intercept break only (Model A), trend break only (Model B) and intercept and trend breaks (Model C). However, they become stationary after first differencing. Therefore, the most important conclusion of the application of ZA unit root test in the current study is that all the examined variables are found to be I(1), indicating that a necessary condition to apply the nonlinear ARDL approach is satisfied. Additionally, the findinds of the the Zivot and Andrews (1992) unit root tests are consistent with the findings from the conventional unit root tests. However, after controlling one-break endogenously, the evidence is that the structural break periods is different for each variables implying the existence of a specific factor that affects the mean of each variable. This is an important implication for the time-series asymmetric behavior over time. In this study, most of the break dates in the Zirvot-Andrews model coincides with the Turkish financial crises in 1994, 2000 and 2001.

4.3. Cointegration Tests

Since all the series are integrated, we apply the ARDL bounds test of cointegration to identify the existence of linear cointegration

Table 1: Conventional unit root tests

Variables	ADF		Philips-Perron		KPSS	
	1st Diff.	Level	1st Diff.	Level	1st Diff.	Level
lnSP	−2.460 (5)	−5.771 (14)[a]	−1.953 (5)	−13.292 (1)[a]	1.908 (15)[a]	0.313 (6)
lnOP	−0.559 (13)	−6.059 (12)[a]	−0.966 (9)	−12.332 (14)[a]	1.763 (14)[a]	0.081 (10)
lnM	−0.682 (12)	−4.035 (15)[a]	0.799 (8)	−10.698 (20)[a]	2.023 (15)[a]	0.212 (8)
Critical values (%)						
1	−3.462	−3.462	−3.462	−3.462	°0.739	°0.739
5	−2.875	−2.875	−2.875	−2.875	°0.463	°0.463
10	−2.574	−2.574	−2.574	−2.574	°0.347	°0.347

The null hypothesis for ADF and PP is non-stationarity of series. For KPSS the null hypothesis is the series are stationary. [a]Indicates rejection of the hypothesis at 1% significance level. Lag lenght of the variables are inside the parentheses. Specifically, for ADF the lag lenght structure is determined using AIC, Bartlett kernel (default) and Newey-West Bandwidth (automatic selection) for the PP unit root tests. PP: Philips-Perron, KPSS: Kwiatkowski-Phillips-Schmidt-Shin, ADF: Augmented Dickey-Fuller, AIC: Akaike Information criterion

Table 2: Zivot and Andrews unit root test results

Variables	Model	Break periods	Lag included (k)	Minimum t-stat
ln SP	A	1993:2	3	−3.011
	B	2000:1	1	−4.419
	C	1999:2	3	−4.601
ΔlnSP	A	2000:4	2	−8.180**
	B	1996:11	4	−7.843**
	C	2000:4	4	−8.175***
ln OP	A	2003:10	1	−4.744*
	B	1998:2	1	−4.794**
	C	1999:3	1	−5.152**
ΔlnOP	A	1999:1	4	−9.235***
	B	2005:2	4	−8.940***
	C	1999:1	4	−9.224***
lnM	A	1996:5	2	−3.199
	B	1990:2	2	−3.765
	C	1994:5	2	−3.956
ΔlnM	A	1994:5	3	−10.428***
	B	1996:6	3	−9.960***
	C	1994:5	3	−10.408***

Model A, which permits a 1-time change in the level of the series, Model B, which allows for a 1-time change in the slope of the trend funstion, and Model C which combines 1-time changes in the level and the slope of the trend function of the series. The critical values for Zivot and Andrews test are: Model A−5.34 and−4.93 at 1% and 5%, respectively; Model B−4.80 and−4.42 at at 1% and 5%, respectively; Model C−5.57 and−5.08 at 1% and 5%. The lag lenght k, is determined using AIC. AIC: Akaike information criterion among variables. Accordingly, we analyze the existence of cointegration using the linear ARDL model. We employ the bound testing approach of cointegration, developed by Pesaran et al. (2001), and we estimate the following equation using the appropriate lag order for the linear cointegration.

$$\Delta \ln SP_t = \alpha_0 + \sum_{i=1}^{p} b_i \Delta \ln SP_{t-i} + \sum_{i=0}^{p} b_i \Delta \ln OP_{t-i} + \sum_{i=1}^{q} c_i \Delta \ln M_t + \phi_1 \ln SP_{t-1} + \phi_2 \ln OP_{t-1} + \phi_3 \ln M_{t-1} + e_t \quad (7)$$

To determine for the nonlinear cointegration, we estimate Eq. 4. Table 3 displays the results of cointegration using linear and nonlinear ARDL model. The $F_{PSS\text{ -}ARDL}$ statistics of the linear ARDL model fail to reject the null hypothesis of no cointegration, indicating that there is no linear (symmetric) long-run relationship between stock prices and the explanatory variables.

However, this result can be explained by the fact that most of the macro-finance variables exhibits a nonlinear behavior, and the linear specification can be an inappropriate functional form. In this respect, the $F_{PSS\text{-}NARDL}$ for the nonlinear ARDL approach is statistically indicating that the $F_{PSS\text{-}NARDL}$ statistics exceed the upper bound critical value. The t-statistic T_{BDM} originated by Banerjee et al. (1988) also confirms the presence of cointegration between series at 1% level of significance (see Table 4, Panel C). This finding confirms the existence of nonlinear (asymmetry) cointegration between money supply, oil prices and stock prices for the period of 1988-2013 in Turkey.

4.4 Long-run and Short-run Asymmetry Tests

Having established the existence of nonlinear cointegration between money supply, oil price and stock prices, the next step consists to estimate for the existence of possible asymmetry in the long-run and the short-run relationships.

From the results in Panel A of Table 4, at first glance, it can be stated that oil price changes (OP^+ or $\Delta \ln Op^-$) have a differential impact on stock prices in Turkey while the sign attached to each variable is different. Therefore, this result of asymmetric behavior of oil price changes must be confirmed by a formal test. The Wald statistics for the long-run ($W_{LR,OP}$) and short-run ($W_{SR,OP}$) asymmetric effects of oil price on stock prices are reported in Table 5. The results indicate that long-run asymmetry is evidenced in Turkey since the $W_{LR,OP}$ is significant. Furthermore, the null hypothesis of short-run symmetry cannot be rejected, implying no short-run asymmetry impact of oil prices on stock prices. The results of this study are consistent with Park and Ratti (2008); Alsalman and Herrera (2015) and Kisswani and Elian (2017). According to this finding, unexpected changes in oil prices are perceived to have opposite sign but equal magnitude effects on the Turkey stock market in the short run but this symmetric response does not persist into longer period. Obviously, for the case of Turkey, the obtained result is not surprising. Given the highest rate of oil import dependency of Turkey, small increase in oil prices will cause greater uncertainty in individuals and firms modifying their future expectations, causing asymmetric behaviors in the long-term. It has been showed by Foerster (2014) that greater uncertainty about future prices is an important source of the asymmetric transmission mechanism, which is in line with the finding of this study.

As for the estimated effect of oil prices, the short-run estimates in Panel A (Table 4) show that positive and negative changes in money supply have short-run significant effects on the stock prices. For instance, while $\Delta \ln M^+_{t-6}$ carries a negative and significant coefficient (−1.7423), $\Delta \ln M^-_{t-1}$ and $\Delta \ln M^-_{t-6}$ carry positive and significant coefficients (+1.6219 and +1.3352), indicating that an increase in money supply leads to a decrease in stock prices, and a decrease in money supply results in an increase in the stock prices. In addition, given that the size and the length attached to the short-run coefficients (M^+ and $\Delta \ln M^-$) are different, one might conclude that money supply changes have asymmetric effects on Turkish's stock prices in the short-run. However, this result must be confirmed by a formal test. Results in Table 5 report that short-run asymmetric effect is evidenced in Turkey in the sample size since the $W_{SR,M}$ is significant.

Do the short run asymmetric effects of money supply on stock prices last into the long-term? To answer this question we apply Wald tests. The findings confirmed evidence of long-run asymmetric effects of money supply on stock prices, since $W_{LR,M}$ is statistically significant. This finding is consistent with Laopodis (2013) who examined the dynamic relationship between monetary policy action and stock market. His findings revealed asymmetric effects of monetary policy on stock market in different regimes of monetary policy and different stock market conditions. Overall, it is evident from the above discussion that the nonlinear ARDL model is appropriate to explain the dynamic relationships between oil prices, money supply and stock prices. Accordingly, neglecting the asymmetry effects in modelling the dynamic linkage between stock prices and macro-finance variables can yield spurious results.

4.5. Nonlinear Autoregressive Distributed Lag Estimation Results

Table 4 reports the results related to the nonlinear ARDL model. The general to specific criterion has been used to find the appropriate lag order of the model. This criterion consists to select the lag order by starting with p = 12 and q = 12 and then dropping the

Table 3: Cointegration tests for linear/nonlinear model

Model specification	*F*-statistics	Critical values (%)				Conclusion
		1		5		
		I (0)	I (1)	I (0)	I (1)	
Linear ARDL (6,2,4)	$F_{PSS\text{-}LinearARDL}$=3.935	5.15	6.36	3.79	4.85	No cointegration
Nonlinear ARDL modeli	$F_{PSS\text{ -}Nonlinear\ ARDL}$=5.547					Cointegration

Critical values are from Pesaran et al. (2001). ARDL,

Table 4: Estimation results of the NARDL

Panel A: long-run and short-run NARDL estimations			
Variables	**Coef.**	**Standard error**	**t-statistic (P)**
C_0	−0.2043***	0.0736	−2.78 (0.006)
$lnSP_{t-1}$	−0.0458***	0.0115	−3.97 (0.000)
$lnOP^{+}_{t-1}$	−0.1206***	*0.0291*	−4.15 (0.000)
$lnOP^{-}_{t-1}$	−0.0674**	0.0335	−2.01 (0.045)
lnM^{+}_{t-1}	0.2277**	0.0922	2.47 (0.014)
lnM^{-}_{t-1}	−0.2323**	0.1123	−2.07 (0.039)
$\Delta lnSP_{t-1}$	0.2442***	0.0525	4.65 (0.000)
$\Delta lnSP_{t-4}$	0.1677***	0.0535	3.14 (0.002)
$\Delta lnSP_{t-5}$	−0.1292**	0.0537	−2.41 (0.017)
$\Delta lnSP_{t-7}$	0.1161**	0.0483	2.4 (0.017)
$\Delta lnOP^{+}_{t-3}$	−0.2741	0.1466	−1.87 (0.062)
$\Delta lnOP^{+}_{t-6}$	0.3311**	0.1401	2.36 (0.019)
$\Delta lnOP^{-}_{t-1}$	−0.2533	0.1465	−1.73 (0.085)
$\Delta lnOP^{-}_{t-2}$	0.4062***	0.1502	2.7 (0.007)
$\Delta lnOP^{-}_{t-3}$	0.4036***	0.1536	2.63 (0.009)
ΔlnM^{+}_{t-6}	−1.7423***	0.5737	−3.04 (0.003)
ΔlnM^{-}_{t-1}	1.6219***	0.6016	2.7 (0.007)
ΔlnM^{-}_{t-6}	1.3352**	0.6577	2.03 (0.043)
Panel B Long-run asymmetric effects			
L^{+}_{InOP}	−2.635***	L^{+}_{InM}	4.976***
L^{-}_{InOP}	1.473	L^{-}_{InM}	5.076**
Panel C statistics and diagnostics			
F_{PSS}	5.547**	tBDM	−3.968**
CUSUM	*S*	$\bar{R}^2$	0.2023
X^2_{SC}	32.81	χ^2_{Reset}	3.155***
X^2_{NORM}	5.093	χ^2_{Het}	1.334

***,**Indicate significance at %1 ve %5. L^{+}_{lnop} L^{+}_{lnop} and L^{-}_{InOP} are long-run coefficients associated with positive and negative changes of the variable oil prices, L^{+}_{InM} and L^{-}_{InM} are long-run coefficients associated with positive and negative changes of the variable money supply. The F-test due to Pesaran *et al*. (2001) is denoted F_{PSS} for testing the null hypothesis of no cointegration. At the 5% significance level when there are two exogenous variables (k=2), its critical value is 4.85. This comes from Pesaran et al. (2001). The t-statistic (t_{BDM}) due to Pesaran et al. (2001) and Banerjee et al. (1998), respectively for testing the null hypothesis of no cointegration in the NARDL model, $\bar{R}^2$ represents the value of the adjusted coefficient of the estimated model. S denotes stable for the CUSUM tests to the residuals of the estimated model. χ^2_{Reset} is the Ramsey's test for misspecification, χ^2_{SC} and χ^2_{Het} denote the LM tests for serial correlation and heteroskedasticity, respectively. χ^2_{NORM} denotes Jarque-Bera statistic for error normality

statistically non-significant variables from the model. Therefore, the estimated nonlinear ARDL model is stable as the coefficient associated with $lnSP_{t-1}$ is negative and statistically significant, implying that any deviation from the long-run equilibrium is adjusted and corrected over time. Additionally, the results of the diagnostic checks show the adequacy of the dynamic specification as there is no serial correlation and heteroskedasticity problems in the estimated nonlinear ARDL model. Also, the model passes all diagnostic tests suggesting error normality and parameter stability, implying that the estimated NARDL model is correctly specified.

In panel B,L^{+}_{InOP} and L^{-}_{InOP} capture the relationship between positive and negative changes in oil prices and the stock prices in the long-term. The long-run coefficients related to positive shocks (L^{+}_{Inop}) is negative and highly significant while the coefficient associated with negative shocks (L^{-}_{InOP}) is positive and statistically no significant, indicating evidence of asymmetric effects in the long-run. This finding confirm the results obtained from the Wald statistics in the previous section. This result suggests that stock market prices decrease as the oil prices increase, implying that positive shocks in oil prices adversely affect investors which is reasonable for the stock market of an oil-importing country like Turkey. For the case of Turkey, we notice that positive shocks occuring in oil prices adversely impact the stock market prices, because Turkey is an emerging smal open economy highly vulnerable to the abrupt changes in oil prices. Accordingly, increase in oil prices is viewed as a bad new for Turkish companies. Thus, the finding disccussed above has also been empirically supported by, among others, (Hamilton, 1983; Burbridge and Harrison, 1984; Driesprong et al., 2008; Bharn and Nikolovan, 2010).

Now we turn to money supply, the positive shocks L^{+}_{InM} and negative shocks L^{-}_{InM} occuring in money supply are positive and statistically significant in the long-term. This result implies that a 1% increase in money supply increases stock prices by 4.97%, while a 1% decrease in money supply also increases stock prices by 5,07% in Turkey. This finding shows that, Turkish stock market reacts favorably to shocks in money supply. Interestingly, the effects of decreasing in money supply is greater than that of increasing in money supply, indicating that Turkish stock market prices are strongly sensistive in the long-term to negative shocks occuring in money supply. In particular, in the long-term, negative changes in money supply increase stock prices with a larger magnitude than that of positive changes in money supply. From a policy perspective, Turkish authorities should consider these asymmetric effects of money supply when formulating monetary policies. Our results also showed that the portfolio balance approach is supported. For instance, an increase in the money supply causes excess demand for bonds, equivalently the interest rate falls and the prices of bonds rise, making bond yielding less attractive. Thus bond investors, like all investors shift their portfolio demand toward stocks, which could lead to increase in stock prices. This finding is consistent with the evidence of Jansen and Tsai (2010).

5. CONCLUSION

Since the global financial crisis of the period of 2008-2009, there is consensus building among researchers about possible nonlinear relationships between stock market prices, oil prices and money supply. In this context, this paper appeals to this consensus and investigates the short- and long-run asymmetries in the relation using the nonlinear ARDL model from January 1988 to December 2014.

The empirical results show asymmetric long-run effects of oil prices on the stock market prices, whereas money supply changes have asymmetric impacts on stock prices in both the short-run and long-run. In the case of Turkey, the signs of the estimated long-run effects of oil prices and money suppply on stock market prices are as expected. In particular, a negative long-run effects of oil prices is found, indicating that higher oil prices cause higher cost of production, which results in declining companies' stock market prices. Whilist, the long-run asymmetric effect of money supply implies that stock market prices go up irrespective to whether there is positive or negative shocks occuring in money supply.

Table 5: Wald tests for long-run and short-run asymmetry

Long-run asymmetry		Short-run asymmetry	
$W_{LR, OP}$	WLR, M	$W_{SR, OP}$	$W_{SR, M}$
3.895**	20.07***	2.900	14.99***

***,**Indicate significance at 1% and 5%. W_{LR} corresponds to the Wald statistic for the long-run asymmetry, which test the null hypothesis of $\sum_{i=0}^{q} \neq_i^{+} = \sum_{i=0}^{q} \neq_i^{-}$ θ=θ⁺=θ⁻ for each explanatory variable. W_{SR} corresponds to the Wald statistic for the short-run asymmetry, which test the null hypothesis of for each explanatory variable

The empirical evidence of this study has also relevant policy implications for Turkish stock markets. Investors, speculators and arbitrageurs should take into account the asymmetric behavior of stock markets within investment decisions. The knowledge of the asymmetric relationship between stock market prices, oil prices and money supply can help investors to adjust their asset allocations strategies when there is an abrupt shock. The findings of this study provide empirical evidence that stock market price is nonlinearly connected to macro-finance variables, such as oil prices and money supply.

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