Article

Oil Prices and Firm Returns in an Emerging Market

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ABSTRACT

This study examines the oil price effect on Turkish stock market as an emerging country on firm level data. After controlling short term interest rate, nominal exchange rate and crude oil price, we find that firms behave differently to a change in oil prices. The findings include these: i) variations in oil prices do not significantly affect Turkish firm returns. Out of 153, only 38 firms are affected significantly by oil price after controlling exchange rate and interest rate; ii) oil prices influence stock returns of Turkish firms, suggesting that under reaction and gradual information diffusion hypotheses may hold. iii) small and middle-sized firms are more affected negatively from oil price changes, where large-sized firms affected more positively. The empirical findings of this study have potential implications and offer significant insights for both practitioners and policy makers.

KEYWORDS

Oil Prices, Emerging Markets, Firm Returns, Sectors, Herd Behavior

JEL Code: G15, G14

INTRODUCTION

It has been accepted that crude oil has an essential role in the world economy and the impact of crude oil price shocks on economy has been a matter of great concern to economists since the seminal work of Hamilton (1983) (see, e.g., Barsky and Kilian, 2004; Hamilton, 1996, 2003; Hooker, 1996; Kilian, 2008, 2009; Kilian and Park, 2009). Oil price shocks exert a critical impact on world economy and have repercussions on economic activity. Oil price changes are also considered as an important factor for explaining variations in equity prices. The transmission mechanism through which the oil price affects the real economy includes both the demand and the supply channels. An increasing oil price causes a supply-side shock and thus higher input costs. The increase in production costs negatively influences firm earnings, leading to deteriorated corporate profits and depressed equity prices (Huang et al. (1996); Arouri (2011)). On the other hand, central banks typically raise interest rate to control inflation as a response to negative oil price shocks, which in turn significantly affect discount rate used in the standard equity pricing formulation (Hamilton (1983); Segal (2011); Kang et al. (2015); Kang and Ratti (2015); Lee and Chiou (2011)). The demand side effect is related to consumption and investment behavior of individuals. Fluctuations in oil prices directly influence the consumption and expenditure patterns of households (Basnet and Upadhyaya, 2015).

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Most of the previous papers have examined the impact of oil prices on aggregate stock market indices (see among others, Jones and Kaul (1996); Sadorsky (1999); Driesprong et al. (2008); Park and Ratti, 2008; Narayan and Narayan (2010); Wang et al. (2013)). Although there is abundant empirical literature on the influence of oil shocks on stock market returns, there is no empirical consensus as to whether an oil price shocks have a positive, negative or insignificant impact on equity returns. The previous findings indicate mixed results (Driesprong et al. (2008), Narayan and Narayan (2010)); the effect varies due to oil dependence, types of oil shocks and different market structure. The empirical results of Jones and Kaul (1996), Sadorsky (1999), Driesprong et al. (2008), Filis (2010), Lee and Chiou (2011), Filis and Chatziantoniou (2014) reveal a detrimental effect of oil price increases on stock returns for different countries.

In contrast to the traditional view that negative oil price shocks lead to lower stock returns, some studies document positive, little or no impact of oil price increases on stock prices (Cong et al. (2008); Al-Fayoumi (2009); Narayan and Narayan (2010); Lin et al. (2014).) There are several reasons for this inconsistency with the mainstream theoretical expectation. One of the main reasons is that oil price increases can be perceived as a signal of coming economic boom if oil price rises are due to strong oil demand. Oil price hikes may be associated with booming economy, as the rising global demand stimulates global economic activity through increased demand for resources such as labor. Rising demand for labor brings higher wages and more spending which contributes to the growth of overall economy. Thus, an increase in oil prices along with economic growth may have a positive effect on stock returns. Rising oil demand may stimulate economic activity as found in some studies (see for example, Ozturk et al. (2010); Belke et al. (2011); Park and Yoo (2014); Choi and Yoo (2016); Yurtsever and Zahor (2007); Gogineni (2010); Narayan and Narayan (2010)).

Some scholars assert that oil shocks do not have a significant influence in the economy, especially after 1980s (Bernanke et al. (1997); Hooker (2002); Nordhaus (2007)), stating that 2000s' oil shocks are different from those of 1970s. As stated by Kilian and Park (2009) "not all oil shocks are alike". Blanchard and Gali (2007) attribute the mild effect of 2000s oil shocks on economic activity to lack of simultaneous negative oil shocks, smaller share of oil in production process, more flexible labor market and improvements in monetary policy. Therefore, negative oil price shocks may not adversely affect stock returns. Besides, financial commodities may account for the positive effect. Kilian (2008) states that strong global industrial commodity demand drive oil prices in 2000s; positive commodity demand shocks may lead to both higher real oil prices and higher stock prices.

Despite many studies examining the impact of oil prices on stock returns both at the aggregate and disaggregate (industrial) level, these studies largely ignore the importance of investigating the effects of oil shocks at the firm level. A firm-level analysis provides a more nuanced and realistic picture since even the firms within the same industry have different characteristics, such as size and profitability, and different sensitivities to common (market-wide) risk factors. Therefore, firms show different responses to oil price shocks. There are few studies consider the firm level effect of oil price changes for developed countries (see Narayan and Sharma (2011); Narayan and Sharma (2014)). The purpose of this study is to investigate the relationship between oil price and stock price returns on firm level for an oil importer emerging market country as Turkey. There are two main motivations to focus on the Turkish market. First, to the best of our knowledge, this is the first and most comprehensive research about the impacts of oil prices on returns of Turkish firms. Second, owing to sound macroeconomic policies and structural reforms, Turkey is one of the fastest growing economies among EU and OECD member countries. As a result, the country has high rates of growing energy demand among over the last 15 years. Therefore, it is of particular importance to analyze the oil effect on Turkish firm returns. This

exercise will provide insight on the driving forces of the price movements of each firm. Another important contribution is to provide new evidence on the influence of oil prices on stock returns as there is no consensus about the role of changes in the oil price for understanding variations in stock returns. Following Narayan and Sharma (2011), we have three hypotheses to test. First hypothesis is that oil price affects returns of firms differently depending on their sectoral location. Second hypothesis questions that whether there is a lagged effect of oil price on firm returns or not. Third hypothesis is that the oil price affects firm returns differently based on the firm size.

The behavior of investors can change during different events. Financial literature defines "herding" as the behavioral tendency of an investor to follow actions of others (Bikhchandani and Sharma (2001)). Under certain circumstances, market participants will simply mimic investment strategies of others, ignoring the substantive general information, and use strictly private information to initiate decisions. Herding has proven to defy traditional fundamental analysis and asset pricing models which has led to price bubbles and seemingly unexplained crashes in stocks. Therefore, the herding behavior of stock returns due to oil price shocks are also examined.

The main results can be summarized as follows: i) variations in oil prices do not significantly affect Turkish firm returns, which can be attributed to the fact that rapid economic growth and sound macroeconomic policies in Turkey may offset the detrimental effects of negative oil shocks in the last decade. Our results show that oil price does not affect the returns of most of the firms. Out of 153, only 38 firms are affected significantly by oil price changes after controlling exchange rate and interest rate. ii) oil prices influence stock returns of some Turkish firms with a lag, suggesting that under reaction and gradual information diffusion hypotheses may hold. 50 firms show response to an oil shock with a lag. iii) small and middle-sized firms are more affected negatively from oil price changes, where large-sized firms affected more positively from oil price changes. iv) herding behavior among investors exist and this effect increases with the oil price increase.

The remainder of this article is organized as follows. Section 2 examines the literature review. Section 3 presents the methodology. Section 5 describes the data and reports evidence of oil price effect on firm level data. Section 6 summarizes herding behavior and section 7 concludes.

LITERATURE REVIEW ON OIL PRICE EFFECT AT FIRM LEVEL

As stated earlier, a very limited number of studies have analyzed the role of oil prices on firm returns. In their pioneering study, Narayan and Sharma (2011) focus on 560 US firms listed on NYSE to investigate the relationship between oil prices and stock returns. Their main findings suggest that firm returns are affected from oil prices differently based on the firm's sectoral location. The returns of firms within energy and transportation industry increase when oil prices rise while the returns of firms belonging to other industries fall when oil prices increase. In addition, they analyze whether oil price changes have an impact on firm returns with a lag and find consistent results with under reaction, the gradual information diffusion and mean reversion hypotheses. Their results also provide evidence of a threshold effect, i.e., changes in oil price impact firm returns based on the turnover rate and size effect and returns of larger firms are more negatively affected from oil price increases than returns of small firms. In another study, Narayan and Sharma (2014) analyze whether oil price changes contribute volatility of 560 NYSE firm returns. Their results show that oil price is an important determinant and predictor of firm volatility. They also develop trading strategies that compare return improvements from the oil-price based variance forecasting model versus historical averages. They suggest that when using the oil price model to predict firm variance, investors can improve returns by approximately 5% per annum compared to the historical average model.

Gogineni (2010) investigate the impact of daily oil price changes on the stock returns of a wide array of industries. He finds that in addition to the stock returns of industries that depend heavily on oil, stock returns of some industries that use little oil also are sensitive to oil prices perhaps because their main customers are impacted by oil price changes. He finds that the sensitivity of industries returns to oil price changes depends on both the cost-side and demand-side dependence on oil and that the relative effects of these factors vary across industries. In a similar paper, Narayan and Narayan (2014) test for the psychological oil barrier effect (when the price of oil reaches US$100 or more per barrel) on firm returns and find evidence of negative effect on 1559 firms listed on the American stock exchange. However, when they ignore the psychological oil barrier effect and test for the oil prices on firm returns, oil prices do not seem to have a statistically significant impact on American firm returns. They also document that the oil price barrier does not significantly affect the mining sector only, while the other sectors are significantly impacted from the psychological oil barrier effect.

Narayan and Narayan (2010) argue that oil prices have a positive and statistically significant effect on stock prices in Vietnam. Sadorsky (2008) investigate the effects of oil prices on firm returns of different size, focusing on S&P 500. In a panel framework over a 17-year period, their empirical findings indicate that increases in firm size and oil prices lead to reductions in stock returns. In other words, oil price fluctuations and stock returns vary with firm size. He also finds that medium-sized firms are more prone to oil prices and more likely to be adversely affected from changes in oil prices. More recently, Tsai (2015) assesses the impacts of oil price shocks on US firm returns during pre-crisis, 2008 global financial crisis and post crisis periods and works on 682 firms. The results of his paper document that US stock returns positively respond to oil price changes during and after the crisis. Using the firm-level data, he also reports that positive and negative oil shocks lead to an adverse impact on firm returns during and after the crisis. He further documents industry and firm heterogeneity in that stock returns of some energy-intensive manufacturing industries seem to be more positively influenced by oil price shocks compared to less energy-intensive manufacturing industries.

Phan et al. (2015) focus on firm returns of crude oil consumers and producers to investigate the oil shock effect. Their empirical findings imply that changes in oil prices positively affect stock returns of oil producers. For oil consumers, the effect of oil prices is heterogeneous. They also report that negative and positive oil price shocks have an asymmetric impact on stock returns of most of the sub-sectors. Lin et al. (2014) study the relationship between oil price shocks and mainland China's stock market. They find that the impact of oil price shocks on stock prices in China has been mixed. In contrast to the conventional wisdom that higher oil prices may cause lower stock prices, positive shocks to oil-market-specific demand resulted in both higher real oil prices and higher stock prices, which helps explain the boom of the Chinese stock market as oil prices were increasing in 2007. However, global oil demand and supply shocks had no significant effects.

There are some studies examine the oil shock effect on Turkish sectoral data. For example, Gencer and Demiralay (2013) examine the shock and volatility spillovers between the oil market and five sectors in the Turkish equity market by employing a bivariate GARCH model. They find volatility transmission from oil market to banking, chemicals, industrials and services sectors in addition to significant unidirectional shock transmission from oil market to some of the sectors. Ordu and Soytaş (2015) investigate the effect of energy commodity price movements on market and electricity index returns in Turkey for the periods before, during, and after the year 2008. They find that oil price does not lead either electricity or market indexes. Their findings suggest that commodity dependence may be driving the link between commodity and asset prices in related sectors. Turhan et al. (2013) investigates the role of oil prices in explaining the dynamics

of selected emerging countries' exchange rates. By using daily data series, they conclude that a rise in oil prices leads to significant appreciation of emerging economies' currencies against the U.S. dollar. Gencer and Demiralay (2014) examines the relationship between crude oil prices and sectoral returns of 18 sub-indices from Borsa Istanbul for monthly data for the period between January 2002 and April 2013. by applying multivariate time series analysis by conducting Vector Auto-Regression (VAR) and Vector Error Correction Model (VECM) methodology to explore the short-run and the long-run dynamics, and impulse response and Granger causality methods to investigate the structural relationship between the variables. They find a long-run equilibrium relation and a unidirectional causality from oil prices to chemical petroleum-plastic sub-index as oil prices directly affect the revenues of the companies operating in this sector. For the other sub-indices, they find no long-run equilibrium relation. Al-Fayoumi (2009) examine the impacts of oil prices on stock returns in Turkey, Tunisia and Jordan, which are all net oil-importing countries and find that oil price changes have no significant effect on stock returns in these countries. Their results show similarities of this study under. We follow these result in motivating our paper.

METHODOLOGY

We test the first hypothesis that the oil price affects returns of different sectors firms differently by employing equation (1) and (2). The main motivation behind this hypothesis is that different firms have different degree of dependence on oil based on the need of consumption of oil. The sectors like energy, electricity, manufacturing and transportation are likely to depend on oil more than the sectors such as banking, computer, real estate. In general, stock prices of industries belonging to the manufacturing and the transportation sectors react negatively (positively) to oil price increases (decreases) while stock prices of industries belonging to the mining sector react positively (negatively) to oil price increases (decreases). Further, even among the traditional "oil-intensive" industries (i.e., industries with large cost-side dependence), there is a huge variation in the magnitude of the impact of oil prices.

The models are given as:

$$R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 R_{m,t} + \epsilon_t \quad (1)$$

$$R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gIR_t + \gamma_4 gER_t + \gamma_5 R_{m,t} + \epsilon_t \quad (2)$$

We test second hypothesis that oil price affects firm returns with a lag by employing equation (3) depending on the idea that an increase in oil prices causes volatilities and uncertainties (Friedman (1977)) and increases in economic risk (Hamilton (1983)). The model is written as follows:

$$R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gOP_{t-1} + \gamma_4 gOP_{t-2} + \gamma_5 gOP_{t-3} + \gamma_6 gOP_{t-4} + \gamma_7 gOP_{t-5} + \gamma_8 gOP_{t-6} + \gamma_9 gOP_{t-7} + \gamma_{10} gOP_{t-8} + \gamma_{11} R_{m,t} + \epsilon_t \quad (3)$$

The variance equation in all these three models is of the following form:

$$\sigma_t^2 = \omega_0 + \omega_1 \epsilon_t^2 + \omega_2 \sigma_{t-1}^2 \qquad \text{GARCH(1,1)} \quad (4)$$

In the above models, $R_{m,t}$ represents the daily stock index return, gOP_t is the daily growth rate in crude oil prices. Following Narayan and Narayan (2014), we control for interest rate and

exchange rate effects. IR_t is the short-term interest rate and ER_t is the daily nominal exchange rate of the domestic currency in USD in natural logarithms.

The third hypothesis, which is oil price -firm returns is size dependent, is motivated by Chan et al. (1985), Keim (1983), Reinghanum (1981). The main thesis is that small firms were found to earn higher risk-adjusted returns compared with large firms listed on NYSE and AMEX markets, as shown in Banz (1981) and Reinganum (1981) and Lamoureux and Sanger (1989). Small firms also pay higher interest rates and are unable to maximize advantages from early payment discounts on trade credit. In short, small firms behave different from large firms. We follow Narayan and Sharma (2011)'s suggestion and divide firms into 4 sizes based on market capitalization.

Following Narayan and Narayan (2011), the main hypotheses can be summarized as:

Hypothesis 1: changes in oil price affect returns of different sectors differently
Hypothesis 2: changes in oil price affect firm returns with a lag
Hypothesis 3: the effect of oil price changes on firm returns is size dependent

DATA

The firm level data is obtained from Datastream from October 28, 2005 to October 27, 2015 for the stock prices of Turkey, Borsa Istanbul (BIST). We have 2604 daily observations for each firm. There are 243 firms in the data set. However, we use 153 firms due to availability of data during the time of the study. We use Brent crude oil prices, as this oil price, which is used as a benchmark for determining the price of light crudes and it is closely related to other crude oil benchmarks such as those for West Texas Intermediate (WTI), Maya, Dubai, etc. (see Reboredo (2011)). The crude oil price, short term interest rate and nominal exchange rate of the domestic currency in USD are obtained from Datastream. The stock return is calculated as $R_t = 100 * [\log(P_t) - \log(P_{t-1})]$. The crude oil price and the nominal exchange rates are in natural logarithmic forms. The growth of oil price is calculated as $gOP_t = 100 * [\log(P_t) - \log(P_{t-1})]$. We categorize firms into different sectors depending on their sectoral code given in Datastream. We ended up by 11 sectors. We concentrate on sectors since different firms has different market structures and are thus heterogeneous, the oil price then affect each sector differently. The previous studies concentrate on the aggregate market index which has limitation since they assume that firms and indeed sectors making up the market are homogeneous (Narayan and Sharma (2011)).

ESTIMATION RESULTS

HYPOTHESIS 1 MOTIVATION AND RESULTS

Table 1 reports the regression coefficients of Equation 1, 2 and 3 for 153 publicly traded Turkish firms in BIST. Out of these 153 firms, we find 41 firms have affected by an increase in oil price positively and this effect is statistically significant in the first model. After controlling the short-term interest rate and daily exchange rate, the oil price increase affects only 34 firms positive and significantly. After we control for the lagged affect and the volatility of the firm return, 25 firms are affected positively by oil shock. This is an interesting finding since it shows there are firms displaying higher return by an increase in oil prices, which can create an investment opportunity for market participants. On the other hand, there are 15, 16 and 13 firms affected by

an increase in oil price negatively in model 1,2 and 3, respectively. Regardless of the model, almost the same number of firms are affected negatively by an oil price increase. This finding is more consistent with the literature. The interesting finding is that there are many firms whose returns are not affected by oil prices. We can conclude from the findings that an oil price shock does not have a very significant effect on the stock market prices in Turkey. Turkish firms' stock prices might be affected by other variables.

We also categorize firms into different sectors; we have 11 sectors in total. Table 2 presents the estimation results. Our empirical results suggest that, consistent with the results in Table 1, most of the sectors do not seem to be affected from oil shocks. However, changes in oil price impact firm returns differently both in terms of sign and magnitude. Therefore, the effect of oil price changes on firm returns is heterogeneous in that the effect depends on sectoral location of firms. Based on model 1, oil prices have the largest positive effect on the following sectors: food (44% of firms), computer (38% of firms), supply (36% of firms) and real estate (33%) while transportation (50% of firms) and electricity (33% of firms) sectors are most negatively influenced from oil price fluctuations. The results document that oil price shocks do not show statistically significant impact on most of the Turkish firm returns. After controlling for exchange rate and interest rate in Model 2; and for lagged oil effect in Model 3, the main results stay similar.

While there is a strong priori belief among scholars that oil price variations exert a negative influence on stock returns, our firm-level analysis suggests the opposite as most of the Turkish firm returns seem to be unaffected from changes in oil prices. Therefore, as suggested by Narayan and Sharma (2011), generalizing the impacts of oil price shocks on stock returns based on a model of only aggregate market returns and oil prices can give inaccurate results.

Turkey, as one of the leading emerging markets and 17th largest economy in the world, has great potential for sustainable long-term growth in the next years. Owing to the structural reforms and macroprudential policies, Turkish economy has had a transition from lower to higher middle income over the last decades. As a result of Turkey's policy achievements, Turkey has experienced significant gains in income and standards of living. According to the World Bank report *"with a per capita income of around $10,500, Turkey is just a few years away from crossing the threshold to high income status, if past growth rates are sustained. According to the OECD, by 2060 Turkey will be the 12th largest economy in the world (up from 18th place in 2012), with a GDP of around 4 trillion USD or just around 20 percent less than the forecast GDP of Germany" (page 9)*.[1] In this regard, both domestic and international believe that the Turkish economy keeps expanding and performing well. This may be the main reason why oil prices do not have a significant impact on Turkish firm returns. In any case, economic policy achievements and rapid economic growth would be both factors that offset the negative effects of oil prices on Turkish firms.

In conclusion, we find the relative importance of oil price variations across firms and sectors in Turkish stock market. However, oil price changes do not significantly affect most of the Turkish firm returns. The finding of sectoral heterogeneity is in line with studies of Arouri (2011), Elyasiani et al. (2011), Degiannakis et al. (2013), Moya-Martínez et al. (2014), Broadstock and Filis (2014). The heterogenous response of firm returns to oil prices is also documented in some studies (Narayan and Sharma (2011); Tsai (2015). However, that oil price changes do not have a significant impact on stock returns partially contradicts with the results of negative oil effect from some papers (Driesprong et al. (2008); Filis (2010); Lee and Chiou (2011) that focus on aggregate market indices.

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[1] See the report at http://documents.worldbank.org/curated/en/507871468306558336/pdf/90509-v2-REVISED-P133570-PUBLIC-Box393190B.pdf

HYPOTHESIS 2 MOTIVATION AND RESULTS

Hypothesis 2 relates to the predictability of firm returns by using oil prices. To this end, we investigate the lagged oil effect on stock returns of Turkish firms. We document the results from a mean equation of the GARCH (1,1) regression model in which the right-hand side variables are presented with p-lags. We follow Narayan and Sharma (2011) and Phan et al. (2015) and set the length of optimal length to eight. Table 3 reports the percentage of times the lagged oil price is statistically significant. Our findings suggest that one- period lagged oil price has a significant and positive effect in eight sectors; the effect is largest in general services sector (50% of firms) followed by electricity and food sectors (33% of firms). The significant and negative lagged oil effects are observed for nine sectors; the effect is largest in transportation sector (50% of firms) and food sector (33% of firms). The findings give mixed results regarding the lag lengths that the oil effect is maximized. The most common lag that oil price has a positive effect is three (the effect is maximized for electricity, supply, food, chemical and financial sectors) followed by four (the effect is maximized for transportation, banking and real estate). The most common lag length that changes in oil price have a negative and statistically significant effect is four (supply, computer, real estate and services sectors) followed by three (food, chemicals and transportation sectors). Furthermore, oil price changes still have an influence in some sectors at eight lags; however most of the sectors do not exhibit a significant exposure to oil prices at eight lags.

Figure 1 also shows the results of Table 3. It can be seen from 11 sector graphs that each sector has different responses to lag effect of oil prices. Our main results regarding the lagged oil effects suggest that oil price changes impact firm returns with a lag. Therefore, it can be stated that oil price has persistent effects on returns of Turkish firms. This finding also indicates that oil prices can forecast stock returns. The question of whether stock returns can be predicted by oil prices has received a little attention in the existing literature. In their seminal paper, Driesprong et al. (2008) explain this predictability using several theories. One possible explanation for this predictability result is related to the under-reaction hypothesis which states that it takes time before information about oil prices become fully reflected in stock prices. This also violates market efficiency in that information in oil prices is expected to be immediately incorporated into stock prices. According to Driesprong et al. (2008), another reason of the lagged oil effect is gradual information diffusion hypothesis introduced by Hong and Stein (1999). Based on this view, investors underreact to news since private information gradually flows across investors. Narayan and Sharma (2014) assert that two conditions exist for the lagged oil price. First, investors may find it difficult to correctly assess the ramification of changes in oil prices since the prices are still uncertain and evolving. Second, investors give a reaction to information about oil prices at different points in time after it has become available. The name of the firms that have statistically significant negative and positive coefficients for oil price change is given in Appendix Section.

HYPOTHESIS 3 MOTIVATION AND RESULTS

This hypothesis that oil price-firm returns is size dependent is motivated by the idea of studies of Banz (1981); Chan et al. (1985); Keim (1983); Reinganum (1981). Their main thesis is that small firms were found to earn higher risk-adjusted returns compared with large firms listed on the NYSE and AMEX markets (Banz, 1981; and Reinganum (1981)). Firms control in risk management since small firms are also financially constrained (see Vickery (2008)). As a result, the

behavior of small firms is very different from those of large firms. Thus, it is also likely that there are size effects in terms of the effect of oil price on returns of small firms versus large firms in the Turkish stock market. Narayan and Sharma (2011) have examined this issue previously, and they find strong evidence of size effects based on the oil price.

We report the results in Table 4 and have some interesting findings. First, for the smallest firms (size 1), we notice that the percentage of firms where oil price has a statistically significant negative and positive effects on firm returns is evenly distributed. For example, results from model 3 reveal that for around 15% of firms, oil price has both statistically significant negative and positive effects. Models 1 and 2 reveal less close percentages with statistically significant positive effects marginally greater. Second, we notice that as the firm size increases, two effects dominate: (a) there are more cases of a positive and statistically significant effect of oil price on firm returns, which increases from a maximum of 25% in the case of firms in size 1 to 27.5% in the case of firms in size 4; and (b) the percentage of cases of a statistically significant negative effect declines, from a maximum of 12.5% in the case of firms in size 1 to a maximum of 6% in the case of firms in size 4. It follows that we unravel support of findings about the oil price and firm returns relationship when considered from the point of view of firm size. The first finding relates to the sign effect. Like our earlier finding suggesting that for the bulk of the firms there was a positive relationship between oil price and firm returns, here we find that for small sized firms, in the bulk of the cases, the relationship between oil price and firm returns is still positive. The second finding relates to the changing effect of oil price on firm returns. We note that as the firm size grows from small to large, firms where oil price has a statistically significant positive effect on returns than negative effects.

THE OIL PRICE EFFECT ON HERDING BEHAVIOR

In this subsection, we discuss the impact of oil price growth on stock market co-movements by analyzing how stock market dispersion is affected by the growth of oil price. We use the degree of market dispersion to measure how closely the markets move together. The larger the degree of market dispersion, the smaller the stock market co-movement. The degree of market dispersion can be proxied by the cross sectional absolute standard deviation (CSAD) index proposed by Christie and Huang (1995). Specifically, it can be defined as:

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right| \qquad (5)$$

where *N* is the number of firms in each country stock market, $R_{i,t}$ is the observed return on the firm, *i* for day *t* and $R_{m,t}$ is the return on the market portfolio for day *t*. One can then show that expected CSAD should, in theory, have a non-negative relation with the expect market return implied by non-negative first derivative with respect to expected market return, while the second derivative with respect to the market return is zero. This implies that greater cross- sectional dispersion in asset returns should, in theory, be expected for larger market movements and the relationship between market return and cross-sectional return dispersion should be linear. The herding in financial behavior literature considers the movement of firms with respect to market by the methodology of Chang et al. (2000). The methodology to detect herding follows number of studies including Chang *et al*. (2000), Tan *et al*. (2008), Demirer *et al*. (2010, 2014), Chiang and Zheng (2010), Economou *et al*. (2011), Balcilar *et al*. (2013, 2014, 2017), Babalos *et al*. (2015), Philippas *et al.* (2013) and Balcilar and Demirer (2015), among others. Originally, developed by Christie and Huang (1995) and later improved by Chang *et al.*

(2000), the test employs return data across securities of similar characteristics. Unlike other herding tests that require transaction or holding data, which is often available at quarterly basis, the use of daily return data in this particular methodology allows us to trace the time-variation in herding to gold market dynamics and is preferable in the particular context of this study. Using the CAPM specification of returns as a basis, Chang *et al*. (2000) proposes the quadratic benchmark model that is modified by adding the log oil price in this study following by:

$$CSAD_t = \alpha_0 + \alpha_1 |R_{m,t}| + \alpha_2 R_{m,t}^2 + \alpha_3 OIL_t + \varepsilon_t \qquad (6)$$

where $R_{m,t}$ is the observed equally weighted average return of the market portfolio for day *t* and *OIL* represents the log of oil price and a significant and negative estimate for α_2 is used as support for the presence of herding. As the herding test in equation (6) is based on the coefficient of the non-linear term, we focus on the herding coefficient (α_2) as a proxy for the level of herding in the market so that increasingly negative values for the herding coefficient indicate higher degree of herding. The herding model of Chang et al. (2000). More, a negative coefficient of oil price (α_3) contributes to the herding behavior among firms in the stock market.

Table 5 presents the results of the herding tests based on the benchmark model presented in equation 6. The test results suggest that herding is present, indicated by the significant and negative herding coefficients (α_2) for the Turkish stock market. Moreover, the coefficient of oil price (α_3) is statistically significant and negative, contributing to have less market dispersion, which is also the sign for herding. A negative coefficient with an increase in oil price has a predictive power for herding while a negative coefficient with a decrease in oil price has a predictive power of less herding. A high level of oil price might affect investors to follow each other's actions decreasing the level of degree of market dispersion.

CONCLUSION

This paper is motivated by the lack of studies that investigate the impact of oil price changes on stock returns of individual firms. Most of the relevant studies focus on firms of developed countries, while we consider Turkish firms in this paper. We examine the effect of oil price on firm stock prices of Turkey from 2005 to 2015. We choose an oil exporter emerging market economy. Following Narayan and Sharma (2011), we form and test three hypotheses and elaborate the following findings: i) variations in oil prices do not significantly affect Turkish firm returns, which can be attributed fact that rapid economic growth and sound macroeconomic policies in Turkey may offset the detrimental effects of negative oil shocks in the last decade. ii) oil prices influence stock returns of Turkish firms, suggesting that under reaction and gradual information diffusion hypotheses may hold. iii) small and middle-sized firms are more affected negatively from oil price changes, where large-sized firms affected more positively from oil price changes. Our results show that oil price does not affect the returns of most of the firms. Out of 153, only 38 firms are affected significantly by oil price after controlling exchange rate and interest rate. Moreover, 50 firms show response to an oil shock with a lag. We also find evidence of herding behavior in stock market in Turkey, where this herding behavior is affected by an increase in oil price as well.

The empirical findings of this study have potential implications and offer significant insights for both practitioners and policy makers. Investors and portfolio managers should be aware of different firm responses to oil prices while constructing their optimal portfolios. The analysis based on aggregate market indices and industrial portfolios may not tell a complete story. Moreover, hedgers and arbitrageurs would benefit from relative sensitivities of firm returns to oil

prices for risk management practices. In addition, understanding the impacts of oil price changes on firm returns is of utmost relevance and importance to policy makers in mitigating the adverse effects of oil shocks, planning more efficient energy policies and regulating equity markets more effectively.

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TABLES AND FIGURES

Table 1. Firm Level Effect of Oil Price in Turkey

Effects of oil price on returns of different sectors. Estimation results of regression Model 1 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 R_{m,t} + \epsilon_t$; Model 2 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gIR_t + \gamma_4 gER_t + \gamma_5 R_{m,t} + \epsilon_t$; and Model 3 is based on the following GARCH(1,1) model:$R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gOP_{t-1} + \gamma_4 gOP_{t-2} + \gamma_5 gOP_{t-3} + \gamma_6 gOP_{t-4} + \gamma_7 gOP_{t-5} + \gamma_8 gOP_{t-6} + \gamma_9 gOP_{t-7} + \gamma_{10} gOP_{t-8} + \gamma_{11} R_{m,t} + \epsilon_t$ for different sectors. In these models, R is the returns for a particular at time t; *gOP* is the growth rate in crude oil prices; IR is the short-term interest rate of Turkey; and ER is the US-TL nominal exchange rate and γ_2 is the main parameter that is estimated and reported in this table. The variance equation in all these three models is the same, and has the following form: $h_t^2 = \omega_0 + \omega_1 \epsilon_t^2 + \omega_2 \sigma_{t-1}^2$; where ϵ_t= $h_t \phi_t$ and ϕ_t is distributed N(0,1). We report the number of firms in different sectors statistically significant or statistically insignificant with positive and negative sign in this table.

Coefficient γ2	+ *(significant)*	- *(significant)*	+ *(significant)*	- *(significant)*
Model 1	*41*	*15*	62	*35*
Model 2	*34*	*16*	*58*	*45*
Model 3	*25*	*13*	66	*49*

Table 2. Firm Level Effect of Oil Price in Turkey by Sectors

Effects of oil price on returns of different sectors. Estimation results of regression Model 1 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 R_{m,t} + \epsilon_t$; Model 2 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gIR_t + \gamma_4 gER_t + \gamma_5 R_{m,t} + \epsilon_t$; and Model 3 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gOP_{t-1} + \gamma_4 gOP_{t-2} + \gamma_5 gOP_{t-3} + \gamma_6 gOP_{t-4} + \gamma_7 gOP_{t-5} + \gamma_8 gOP_{t-6} + \gamma_9 gOP_{t-7} + \gamma_{10} gOP_{t-8} + \gamma_{11} R_{m,t} + \epsilon_t$ In these models, R is the returns for a particular at time t; gOP is the growth rate in crude oil prices; IR is the short term interest rate of Turkey; and ER is the US-TL nominal exchange rate and γ_2 is the main parameter that is estimated and reported in this table. The variance equation in all these three models is the same, and has the following form: $h_t^2 = \omega_0 + \omega_1 \epsilon_t^2 + \omega_2 \sigma_{t-1}^2$; where $\epsilon_t = h_t \phi_t$ and ϕ_t is distributed N(0,1). We report the number of firms in different sectors statistically significant or statistically insignificant with positive and negative sign in this table.

Sectors	Coefficient	Model 1	Model 2	Model 3
Electricity Sector γ_2	+ (Significant)	1 (17%)	1 (17%)	0 (0%)
	- (Significant)	2 (33%)	1 (17%)	1 (17%)
	+ (Insignificant)	1 (17%)	0 (0%)	2 (33%)
	- (Insignificant)	2 (33%)	4 (67%)	3 (50%)
Supply Sector γ_2	+ (Significant)	12 (36%)	11(33%)	7 (21%)
	- (Significant)	3 (9%)	2 (6%)	2 (6%)
	+ (Insignificant)	10 (30%)	10 (30%)	14 (42%)
	- (Insignificant)	8 (24%)	10 (30%)	10 (30%)
Manufacturing Sector γ_2	+ (Significant)	2 (9%)	2 (29%)	2 (29%)
	- (Significant)	0 (0%)	0 (0%)	0 (0%)
	+ (Insignificant)	3 (43%)	2 (29%)	1 (14%)
	- (Insignificant)	2 (9%)	3 (43%)	4 (57%)
Food Sector γ_2	+ (Significant)	4 (44%)	3 (33%)	2 (22%)
	- (Significant)	1 (11%)	2 (22%)	1 (11%)
	+ (Insignificant)	2 (22%)	2 (22%)	3 (33%)
	- (Insignificant)	2 (22%)	2 (22%)	3 (33%)
Chemical Sector γ_2	+ (Significant)	2 (13%)	2 (13%)	2 (13%)
	- (Significant)	1 (6%)	2 (13%)	2 (13%)
	+ (Insignificant)	10 (63%)	9 (56%)	8 (50%)
	- (Insignificant)	3 (19%)	3 (19%)	4 (25%)
Computer Sector γ_2	+ (Significant)	3 (38%)	2 (25%)	2 (25%)
	- (Significant)	1 (13%)	1 (13%)	1 (13%)
	+ (Insignificant)	3 (38%)	2 (25%)	2 (25%)
	- (Insignificant)	1 (13%)	3 (38%)	3 (38%)
Transportation Sector γ_2	+ (Significant)	0 (0%)	0 (0%)	0 (0%)
	- (Significant)	1 (50%)	1 (50%)	1 (50%)
	+ (Insignificant)	1 (50%)	1 (50%)	1 (50%)
	- (Insignificant)	0 (0%)	0 (0%)	0 (0%)
Banking Sector γ_2	+ (Significant)	3 (23%)	2 (15%)	2 (15%)
	- (Significant)	1 (8%)	1 (8%)	1 (8%)
	+ (Insignificant)	8 (62%)	8 (62%)	8 (62%)
	- (Insignificant)	1 (8%)	2 (15%)	2 (15%)

Financial Sector /gamma2	*+ (Significant)*	*9 (26%)*	*6 (18%)*	*4 (12%)*
	- (Significant)	*3 (9%)*	*4 (12%)*	*2 (6%)*
	+ (Insignificant)	*16 (47%)*	*17 (50%)*	*19 (56%)*
	- (Insignificant)	*6 (18%)*	*7 (21%)*	*9 (26%)*
Real Estate γ_2	*+ (Significant)*	*5 (33%)*	*5 (33%)*	*4 (27%)*
	- (Significant)	*1 (7%)*	*1 (7%)*	*1 (7%)*
	+ (Insignificant)	*5 (33%)*	*5 (33%)*	*6 (40%)*
	- (Insignificant)	*4 (27%)*	*4 (27%)*	*4 (27%)*
General Services Sector γ_2	*+ (Significant)*	*0 (0%)*	*0 (0%)*	*0 (0%)*
	- (Significant)	*1 (10%)*	*1 (10%)*	*1 (10%)*
	+ (Insignificant)	*3 (30%)*	*2 (20%)*	*2 (20%)*
	- (Insignificant)	*6 (60%)*	*7 (70%)*	*7 (70%)*

Table 3. Lag Effect of Oil Price on Sectoral Returns

The model 3 is estimated for different sectors. We report the number of firms in different sectors that are statistically significant with positive and negative signs. In addition, this result is converted into percentage for each sector and reported in the parenthesis.

	Electricity		Supply		Manufacturing		Food	
Lags	**Sig +**	**Sign -**	**Sig +**	**Sign -**	**Sig +**	**Sign -**	**Sig +**	**Sign -**
1	2(33%)	0(0%)	4(12%)	6(18%)	0(0%)	1(14%)	3(33%)	3(33%)
2	1(17%)	0(0%)	3(9%)	8(24%)	0(0%)	2(29%)	0(0%)	1(11%)
3	2(33%)	0(0%)	8(24%)	3(9%)	0(0%)	0(0%)	3(33%)	3(33%)
4	0(0%)	0(0%)	3(9%)	9(27%)	1(14%)	0(0%)	0(0%)	0(0%)
5	0(0%)	0(0%)	5(15%)	8(24%)	0(0%)	1(14%)	0(0%)	0(0%)
6	2(33%)	0(0%)	5(15%)	7(21%)	0(0%)	1(14%)	1(11%)	1(11%)
7	1(17%)	2(33%)	4(12%)	6(18%)	2(29%)	0(0%)	0(0%)	2(22%)
8	1(17%)	0(0%)	3(9%)	6(18%)	1(14%)	3(43%)	1(11%)	0(0%)

	Chemical		Computer		Transportation		Banking	
Lags	**Sig +**	**Sign -**	**Sig +**	**Sign -**	**Sig +**	**Sign -**	**Sig +**	**Sign -**
1	1(7%)	2(14%)	2(22%)	0(0%)	0(0%)	1(50%)	0(0%)	3(23%)
2	1(7%)	1(7%)	0(0%)	0(0%)	1(50%)	0(0%)	0(0%)	0(0%)
3	2(14%)	3(21%)	0(0%)	1(11%)	0(0%)	2(100%)	2(15%)	1(8%)
4	1(7%)	0(0%)	0(0%)	3(33%)	1(50%)	0(0%)	3(23%)	3(23%)
5	1(7%)	2(14%)	0(0%)	2(22%)	0(0%)	1(50%)	1(8%)	6(46%)
6	2(14%)	1(7%)	2(22%)	2(22%)	0(0%)	0(0%)	3(23%)	2(15%)
7	0(0%)	1(7%)	0(0%)	1(11%)	0(0%)	0(0%)	0(0%)	6(46%)
8	1(7%)	1(7%)	1(11%)	2(22%)	1(50%)	0(0%)	0(0%)	5(38%)

	Financial		Real Estate		General Services	
Lags	**Sig +**	**Sign -**	**Sig +**	**Sign -**	**Sig +**	**Sign -**
1	4(9%)	8(17%)	1(7%)	1(7%)	5(50%)	1(10%)
2	2(4%)	6(13%)	2(13%)	3(20%)	0(0%)	3(30%)
3	7(15%)	4(9%)	1(7%)	1(7%)	0(0%)	0(0%)
4	6(13%)	7(15%)	3(20%)	4(27%)	0(0%)	4(40%)
5	4(9%)	9(19%)	0(0%)	3(20%)	0(0%)	4(40%)
6	7(15%)	5(11%)	0(0%)	1(7%)	3(30%)	1(10%)
7	1(2%)	11(23%)	2(13%)	1(7%)	2(20%)	0(0%)
8	2(4%)	8(17%)	2(13%)	4 (27%)	2(20%)	2(20%)

Table 4. Oil Price Effect on Firm Size

Effects of oil price on returns of different sectors. Estimation results of regression Model 1 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 R_{m,t} + \epsilon_t$; Model 2 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gIR_t + \gamma_4 gER_t + \gamma_5 R_{m,t} + \epsilon_t$; and Model 3 is based on the following GARCH(1,1) model: $R_t = \gamma_1 + \gamma_2 gOP_t + \gamma_3 gOP_{t-1} + \gamma_4 gOP_{t-2} + \gamma_5 gOP_{t-3} + \gamma_6 gOP_{t-4} + \gamma_7 gOP_{t-5} + \gamma_8 gOP_{t-6} + \gamma_9 gOP_{t-7} + \gamma_{10} gOP_{t-8} + \gamma_{11} R_{m,t} + \epsilon_t$ for different sectors. In these models, R is the returns for a particular at time t; *gOP* is the growth rate in crude oil prices; *IR* is the short-term interest rate of Turkey; and ER is the US-TL nominal exchange rate and γ_2 is the main parameter that is estimated and reported in this table. The variance equation in all these three models is the same, and has the following form: $h_t^2 = \omega_0 + \omega_1 \epsilon_t^2 + \omega_2 \sigma_{t-1}^2$; where $\epsilon_t = h_t \phi_t$ and ϕ_t is distributed N(0,1). We report the number of firms in different sectors statistically significant or statistically insignificant with positive and negative sign in this table.

	Model 1		**Model 2**		**Model 3**	
	(+) Sign. (%)	**(-) Sign. (%)**	**(+) Sign. (%)**	**(-) Sign. (%)**	**(+) Sign. (%)**	**(-) Sign. (%)**
Size 1	25	12.5	20	15	15	12
Size 2	37.5	7.5	25	12.5	21	12
Size 3	22.5	12.5	20	7.5	18	9
Size 4	27.5	5	20	5	21	6

Table 5. The Impact of Oil Price on Herding Behavior in the Stock Market

This model estimates the following equation to search the herding among firms $CSAD_t = \alpha_0 + \alpha_1 |R_{m,t}| + \alpha_2 R_{m,t}^2 + \alpha_3 OIL_t + \varepsilon_t$.

	α_0	α_1	α_2	α_3
CSAD	*3.5659****	*.4152****	*-.0209****	*-.3419****
	(.2251)	*(.03192)*	*(.0045)*	*(.04985)*
	$R^2 = 0.18$			

Note: The robust standard errors are given in parenthesis. *OIL* represents the log of oil price.

Figure 1. Percentage of Times Lagged Oil is Statistically Significant and Positive

APPENDIX

FIRM NAMES AFFECTED BY OIL PRICE SIGNIFICANTLY

Firms Affected by Oil Price ***Positively***	Firms Affected by Oil Price ***Negatively***
ATAKULE GAYMEN.YATOTA.	VAKIF GAYMEN.YATOTA.
IS GAYMEN.YATOTA.	DURAN DOGABAVEABSAN.
YPK. KORAY GAYMEN. YATOTA.	ARENA BILGISAYAR
LOGO YAZLIM	FAVORI DINLENME YER
KOZA ANADOLU MTL.MIE.	TURK HAVA YOLLARI
ALCATEL LUCENT TLT.TKS.	DENIZBANK
TOFAS TURK OTOM.FABK.	PINAR SU
PARSAN	MARSHALL BOYA
INFO MENKUL YATIRIM ORTAKLIGI	PIMAS PLASTIK INSAAT B YAPI
VE KREDI BANKASI	BOLU CIMENTO SANAYI
AKBANK	AYEN ENERJI
T TBG.BIRA VE MALT SNA.	GEDIK YAT HOL A
HEKTAS TICARET	VAKIF FINANSAL KIRALAMA
GOLTAS	
BATICIM BATI ADCT.SYI. AFYON	
CIMENTO	
ASLAN CIMENTO ANONIM SIRKETI DOGUSAN	
CIMBETON	
EGELY & CO. YATOTA.	
ISYATIRIMORTAKLIGI	
CREDITWEST FACG.HZM.	
ATA GAYRIMENKUL AS	
MIGROS TICARET	
KENT GIDA MADDELERI SANVETC.	