

OIL PRICE SHOCKS AND INDUSTRY LEVEL PRODUCTION USING VECTOR AUTOREGRESSION: EMPIRICAL EVIDENCE FROM PAKISTAN

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ABSTRACT

Industrial production is one of the leading indicators of gross domestic product and economic growth of the country. These factors exhibit the holistic enactment of any economy. Alternatively, the fluctuations in the industrial production level lead to contraction or expansion within the economy. Therefore, changes in prices of oil are the crucial inputs to the overall industrial production. This study examines the effects of oil prices shocks on the industrial production in Pakistan during the period July 2000-June 2015 by using VAR model. This research has shown that oil price shocks had a negative impact on industrial production in Pakistan to some extent. It is recommended to forecast oil prices for future that can help take precautionary steps to be flexible enough to control the impact on an industrial production level.

JEL: E30

KEYWORDS: Prices, Industrial Level Production, Granger Causality, Variance Decomposition

INTRODUCTION

Oil Price is seen as one of the major factors in the world in determining the economic activity as there is no such substitute for crude oil till date which can be crucial for most of the nation's especially those with underdeveloped economies. There are many factors that lead to an increase in oil prices such as the portion of the cost of oil, how much a country is dependent on the usage of oil which determines total value of import oil, how much oil is consumed domestically, and are there any alternatives to oil as fuel to be used in the economy. In previous studies, it was projected that by 2015 the oil demand is expected to increase to 98 million barrels per day and by 2030 it will rise to 118 million barrels per day. Therefore the price of oil will keep increasing as well until there is no proper alternative which requires allocating huge resources into R&D (Research and Development). Explanation to this in Pakistan is given by Oil and Gas Regulatory Authority (OGRA) on many ground levels. Government shifts the burden of oil price on to the customer and households as Pakistani government is already facing severe losses. Also, the consumption of kerosene oil, diesel oil and petroleum products have increased in the past decade in Pakistan due to industrialisation.

The research main purpose is to find the interdependencies between variables that are oil prices Shocks, textile, automobile, petroleum, iron & steel and paper & board industrial production level. Major reasons for taking these industries are that these industries are the Pakistan's growing industries and it contributes to GDP growth of Pakistan. These industries have high crude oil usage in their production houses. Paper & board industry is an essential industry contributing to Pakistan's domestic market highly. It implicates steady innovation and improvement because of the highly competitive market; therefore they have to keep improving their technologies in product generation ideas and its manufacturing. It accounts for almost

two-thirds of its sale to the common market. In the engineering sector, iron and steel industry is the main industry that holds the key to the better infrastructure of the country. The petroleum industry in Pakistan has a direct impact of oil prices shocks in Pakistan, and it is also one of the major leading industries in Pakistan. Lastly, the automobile industry is taken into consideration in this research, since oil is used as a fuel and there is no substitute for the automobile industry. The basic motivation of carrying out this study is to gauge the impact of Oil prices on industrial production level in Pakistan, as this will give us deeper insight about the industries in Pakistan and also will be helpful for future further studies. The drastic changes have been observed in the oil prices in Pakistan, the overall industrial production level in Pakistan varies as well with these changes. The main issues of the studies are that the topic is interesting and it can benefit the industries by predicting their production levels on the basis of changes in oil prices. The limitations of the study includes, budget to do this project as longitudinal study and availability of the data of all sectors. This study aims to find out how the fluctuations in the oil prices affect the industries that produce consumer goods. The main objective or goal of the research is to find out the impact of the oil price shocks on industrial production level in Pakistan. Specifically, the following sectors of Pakistan: textile, petroleum, automobile, iron and steel and paper and board. The remainder of the paper is organized as follows. Section two provides literature review. Sections three and four explain research methodology and results respectively. Conclusion of the study and future research directions has been discussed in section five.

LITERATURE REVIEW

The literature review section of the study explains the previous studies. Previous studies on the effects of changes in oil price shocks have been materialized as of 1973 and 1979 oil shocks. Hamilton (1983) and Hooker (1996) were the first to research in this field of study. Most of the early studies mainly were based upon the relationship between economic growth/stock market performances and oil prices. These studies mainly implemented VAR (Vector Autoregression) to find out the effects of oil and natural gas prices on the macroeconomic variables focused on US and OECD countries. However, there has been limited research in this area in Pakistan. Most of the studies such as Lee and Ni (2002), Cobo Reyes and Quirós (2005), Jiménez-Rodríguez (2007), Lippi and Nobili (2008), Bredin et al. (2008), Kumar (2009) and Tang et al. (2010) found that there was a negative relationship between industrial production and oil prices. The detailed literature studied and reviewed is given below:

Comparing all the above previous studies with my research topic, it is safe to say that Pakistan is an agricultural country with vast industrial production does not necessarily be affected due to the changes in oil prices. As there can be many other determinants as well in Pakistan which contributed to the economic growth of Pakistan such as political stability, foreign investments, inflation rate and other indirect variables. As per this research literature review, it can be said that most of the previous researches were mainly focused on the impact of oil price fluctuations on overall economy or GDP of the country. This research mainly focuses on effects of oil price shocks on the sub-industrial level in Pakistan through supply side and demand side channels. Oil as a major factor of production in most of the industries specifically those which are selected in this research. An increase in the oil prices leads to an increase in production cost, which further leads to a reduction in output (*Jimenez-Rodriguez and Sanchez 2005*). The increase in the oil prices leads to an increase in the production cost of a commodity. Therefore the final price of the commodity for sale is high in the market. Higher prices of these products result in a decrease in demand of these of products, therefore shrinking aggregate output. (*Hunt, Isard and Laxton 2001*).

Table 1: Review of Literature

Author & Year	Economies & Sample Period	Technique /Models	Verdicts
Hamilton (1983)	United States (US) (different periods during the 1948-1980)	Correlation, Granger causality test and regression analysis	He found that there was a negative relationship between changes in oil price and economic growth.
Hooker (1996)	US (1948-1994)	Wald test and VAR estimation	He found that oil prices were Granger cause of various US macroeconomic such as GDP growth, unemployment up to 1973, but this relationship was not robust the period following 1973. The results of their study showed that there is wald effect or ganger effect among variables (i.e GDP growth and unemployment)
Lippi and Nobili (2008)	US (1973-2007)	SVAR model	They found that industrial production decreased after negative oil-supply shocks, while industrial production increased after oil demand shocks
Mehrara and Sarem (2009)	Iran, Saudi Arabia and Indonesia (1970-2005)	Gregory and Hansen cointegration and Granger causality test	They found that there was a unidirectional causality from oil price shocks to economic growth in Iran and Saudi Arabia
Kumar (2009)	India (1975-2004)	VAR model	He found that oil price shocks had negative effect on the industrial production growth
Fakunaga et al., (2010)	US and Japan (1973-2008)	VAR model	They concluded that Japanese industrial production in response to the changes in oil supply was insignificant whereas, in response to the global demand shock of oil was significant in comparison to the US
Harrera, Gupta and Wada (2011)	US (different periods from Pre and Post 1973)	Regression analysis	They concluded that there is a non-linear relationship between oil prices and industrial production
Jiménez-Rodríguez (2007)	OECD countries (1975-1998)	VAR model	The results of the study encuded that there is inverse relationship between oil prices and manufacturing output (aggregate)
Kilian and Vigfusson (2009)	US (1973-2007)	VAR model	They concluded that changes in oil prices lead to having an asymmetric impact on overall industrial production
Aaron Gonzalez (2009)	Us and Sweden (1980-2006)	Simple regression	He concluded that there was a strong negative correlation between the oil prices and economic growth in us than Sweden
Yilmaz buyer (2013)	18 European countries (1970-2010)	VAR model	He found that there was a negative relationship between changes in oil price and industrial production
Sidra and Abdul (2014)	Pakistan (1980-2012)	Multivariate analysis	They concluded that changes in oil prices have a significant impact on Pakistan's economy and balance of payment
Sultan and Waqas (2014)	Pakistan (1980-2012)	Granger causality test and error correction model	They concluded that there was a minimal impact in the short term and significant impact in the long term of oil prices on economic growth
Nazir and Qayyum (2014)	Pakistan (1972-2011)	Multivariate causality analysis	She concluded that oil price has positive impact on real GDP in short term and negative impact on real GDP in long term in context of Pakistan
Malik (2008)	Pakistan (1990-2008)	Linear regression model	She concluded that balance of payment will continue to be in deficit due to increasing oil imports and it will burden the economy of Pakistan with inflation and rise in debt from IMF (International monetary fund)
Chughtai and Kazmi (2014)	Pakistan (1971 to 2013)	Linear regression model	They concluded that oil demand, oil supply, oil price, public sector investment, private sector investment have significant impact on economic growth of Pakistan except for trade balance

This table shows the detailed review of the literature in tabular form related to the area of the current study.

DATA AND RESEARCH METHODOLOGY

The research is based on financial secondary data, therefore it follows positivist theory. The conclusions made are based on monthly time series data. Vector Auto regression model has been applied to check the shocks through impulse response function and variance decomposition. The vector autoregression (VAR)

model is widely used when the variables are interdependent. The sample period is from July 2005 to June 2015 as per the available data from Pakistan beaureau of Statistics and State Bank of Pakistan. Furthermore, to see the shocks, the interdependent response of variables estimated from the impulse response function are identified and then to see the percentage shock, variance decomposition is applied. The time series equation is given below:

$$Y_{i,t}(OPI_i,t) = \beta(TXT_i,t) + \beta(AUTO_i,t) + \beta(INS_i,t) + \beta(PETRO_i,t) + \beta(PNB_i,t) + \beta(CPI_i,t) + e \quad (1)$$

Where *OP* is oil prices, *TXT* is textile industrial production, *AUTO* is automobile industrial production, *INS* is iron and steel industrial production, *PETRO* is petroleum industrial production, *PNB* is paper and board industrial production, *CPI* is consumer price index and *e* is denoted by error term (Residuals).

RESULTS AND DISCUSSIONS

In Table 2, descriptive statistics show the summary of the quantitative data taken under the study as shown in the above-given Table. It gives us an idea about the Mean, Mode, Median as well as the variation in the data. By analyzing Figure 1.1, we can tell that consumer price index means is 102.46 for the last ten years, whereas its Jarque-Bera P-value is 0.005, therefore the data is not normally distributed since its less than 0.05. Figure 1.2 shows us the industrial production if Iron and Steel industry in Pakistan which was 70.75 on average and the data is not normal due to its P-value less than 0.05. Figure 1.3 shows us the production level of Textile industry in Pakistan which was 112.36 on average for the last ten years and it has the lowest standard deviation of 5.22, which means there is very less variation in the production level for the past ten years in Textile industry and the data is not normally distributed since its p-value is less than 0.05. Moving onwards to Figure 1.4, this shows the descriptive analysis of Paper and Board Industry production level in Pakistan for the past ten years. The average production was 111.12 and data is not normal since the p-value is less than 0.05. Figure 1.5 shows the petroleum industrial production in Pakistan or the past ten years, the average production level was 93.48 and the p-value is 0.430, which is higher than 0.05, therefore the data is normal. Figure 1.6 shows the Oil prices descriptive analysis, the average price was 7038.78 for the past ten years and the p-value for which is 0.005, which is again less than 0.05, therefore the data is not normally distributed. Lastly, Figure1.7 shows the production level of the Automobile industry in Pakistan for the past ten years, the average production level was 98.86 and the p-value for which is 0.887, therefore we can say the data is normal since the p-value is higher than 0.05. \

Table 2: Descriptive Statistics

Variable	Mean	Median	Max	Min	SD	Skewness	Kurtosis	JB P-Value
CPI	102.4	98.84	200.8	55.80	35.90	0.71	3.26	0.005
INS	70.75	62.56	125.9	32.59	26.53	0.64	2.05	0.002
TXT	112.3	113.3	118.1	93.01	5.22	-1.73	5.65	0.000
PNB	111.1	100.6	168.4	79.73	24.30	0.94	2.62	0.000
PETRO	93.48	93.87	116.5	64.76	10.70	-0.27	2.80	0.430
OP	7038	6514	11473	3252	2619	0.05	1.56	0.005
AUTO	98.86	99.72	138.5	53.46	17.01	-0.10	2.93	0.887

This table shows the descriptive statistics of CPI, the industrial production level of Iron & Steel (INS), textile (TXT), paper and board (PNB), petroleum products (PETRO), automobile (AUTO) and oil prices (OP).

Table 3 shows, Consumer Price index at zero difference the data is not stationary since the p-value is greater than 5% level of Significance, but it becomes stationary at first difference level. Same is the case with other variables like Iron and Steel, Petroleum, Oil prices which were non-stationary at zero difference level and stationary at first difference level. On the other hand, textile and paper and board

production level were found to be stationary at zero and first difference level. Lastly, analyzing automobile production the data was found to be stationary at zero level as well as at first difference level.

Table 3: Unit Root Test – Augmented Dickey Fuller (ADF) Test

Variables	Order of Integration	ADF Test	Hypothesis
CPI	I(0)	0.99	Null hypothesis is not rejected
	I(1)	0.00	Null hypothesis is rejected
INS	I(0)	0.34	Null hypothesis is not rejected
	I(1)	0.00	Null hypothesis is rejected
TXT	I(0)	0.003	Null hypotheses is rejected
PNB	I(0)	0.02	Null hypotheses is rejected
PETRO	I(0)	0.07	Null hypothesis is not rejected
	I(1)	0.00	Null hypothesis is rejected
OP	I(0)	0.28	Null hypothesis is not rejected
	I(1)	0.00	Null hypothesis is rejected
AUTO	I(0)	0.00	Null hypothesis is rejected

This table shows the results of a stationary test that includes augmented Dickey Fuller (ADF) test.

Figure 1 below shows the impact of oil prices shocks on petroleum industry production level, by analyzing this Figure we can tell that there is a slight impact in short term until 3-4 years, and there is a negative impact in long term. Figure 2 shows the impact of oil prices shocks on Automobile industrial production level is explained, from which we can analyze that there is not much impact in the short term. In long term as the graph is almost parallel to the x-axis, which shows that there is not much impact of Oil Prices on Automobile industrial production level. Figure 3 shows the impact of oil prices on Iron and Steel industrial production level. By studying the Figure it can be said that there is a steady negative impact of oil prices shocks on iron and steel production level in short and long term. In Figure 4, the graphs show the relationship between oil prices shocks on paper and board industrial production level. From the graph, it can be said that there is a slight negative impact in short term and the impact increases slightly in long term of oil prices shock on paper and board industrial level production. Lastly, in Figure 5, we can see the impact of oil prices shocks on a textile industrial production level. From the Figure, it can be analysed that there is a continuous steady positive impact along the period of ten years. Apart from that, the impact is very little of oil prices shocks on the industrial production level of textile industry.

Figure 1: Response of PETRO to Cholesky One S.D. DOP Innovation

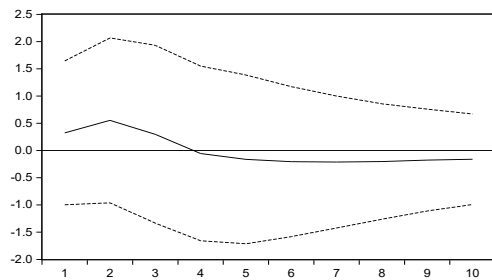


Figure 2: Response of AUTO to Cholesky One S.D. DOP Innovation

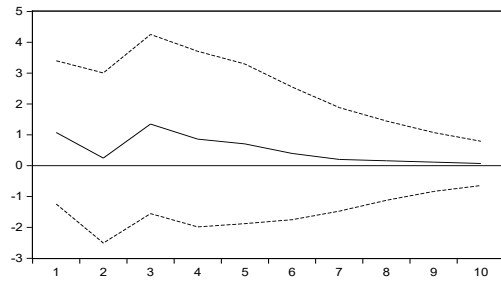


Figure 3: Response of DINS to Cholesky One S.D. DOP Innovation

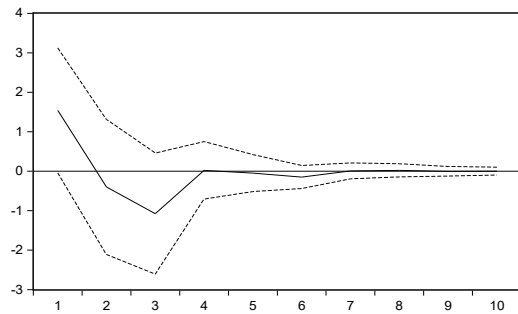


Figure 4: Responses of PNB to Cholesky One S.D. DOP Innovation

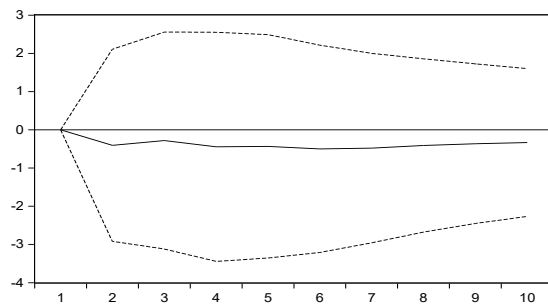
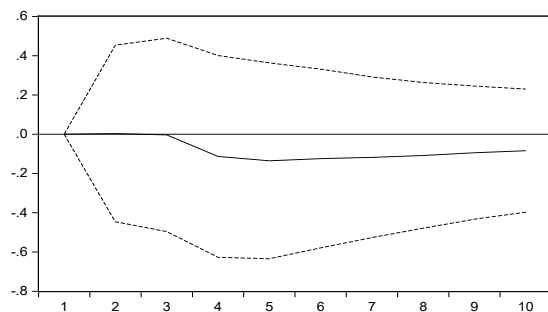


Figure 5: Response of TXT to Cholesky One S.D. DOP Innovation



Figures 6 to 9 below shows that there is an increasing trend in consumer price index in percentage variance over the long term due to oil prices shocks. In Figures 10 to 13 below, there is hardly any percentage change in iron and steel production level due to oil prices shocks in short term but with time in long term the percentage variance increases. In Figures 14 to 17 below, there is minimal percentage

change in the paper and board industrial production level due to oil prices shocks, whereas, in long term, the graph shows that there is a greater percentage variance in the overall production of paper and board industry due to oil prices shocks. In Figures 18 to 21 below, we can analyze that the percentage change in the textile industrial production level is minimal due to oil prices shocks in the short term and even in the long term the percentage change is negligible, we can conclude that textile industry is hardly affected by changes in the oil prices in Pakistan. In Figures 22 to 25 below, Petroleum industry production level is compared with oil prices shocks. In this Figure, it is safe to say that there is no percentage variance in the petroleum industry production level due to oil prices shocks in short and long term. Figures 26 to 29 below show us the comparison between oil prices shocks and automobile industrial production level. In the Figure, we can analyze that there is no impact of oil prices shocks, whereas in the long-term there is a slight impact of oil prices shocks on automobile industrial production level.

Figure 6: Var. Decomp: Pct. OP Var. due to OP

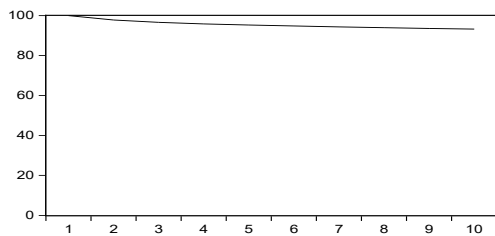


Figure 7: Var. Decomp: Pct. OP Var. due to CPI

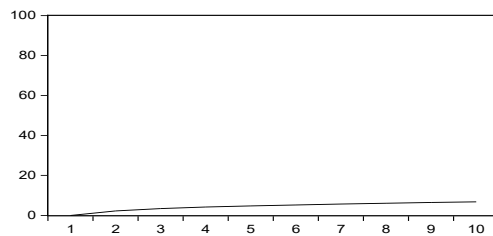


Figure 8: Var. Decomp: Pct. CPI Var. due to OP

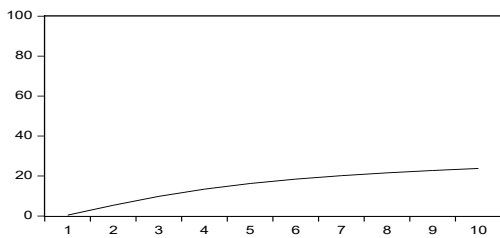


Figure 9: Var. Decomp: Pct. CPI Var. due to CPI

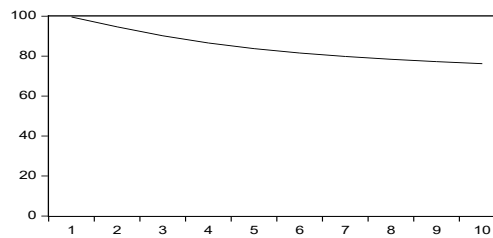


Figure 10: Var. Decomp: Pct. OP Var. due to INS

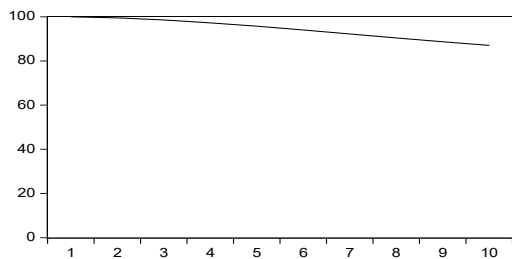


Figure 11: Var. Decomp: Pct. OP Var. due to INS

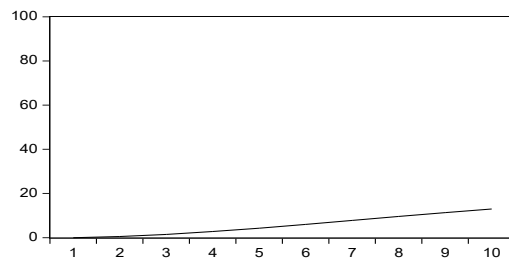


Figure 12: Var. Decomp: Pct. INS Var. due to OP

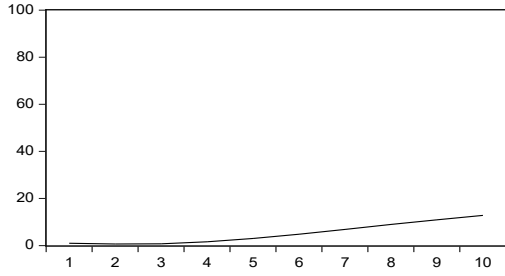


Figure 13: Var. Decomp. Pct. INS Var. due to INS

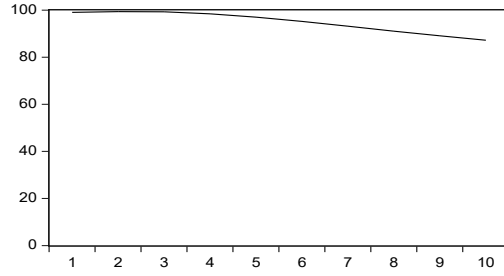


Figure 14: Var. Decomp. Pct. OP Var. due to OP

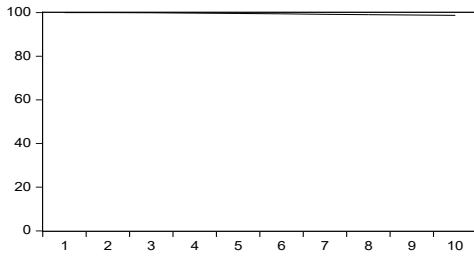


Figure 15: Var. Decomp: Pct. INS Var. due to PBN

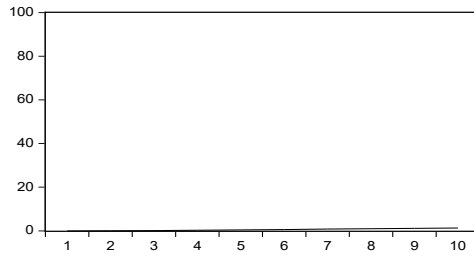


Figure 16: Var. Decomp. Pct. PBN Var. due to OP

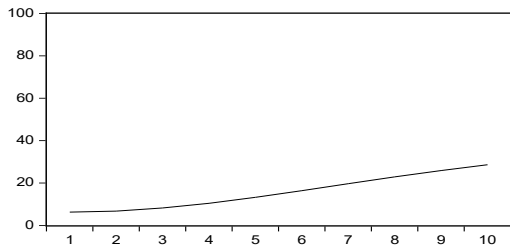


Figure 17: Var. Decomp: Pct. PBN Var. due to PBN

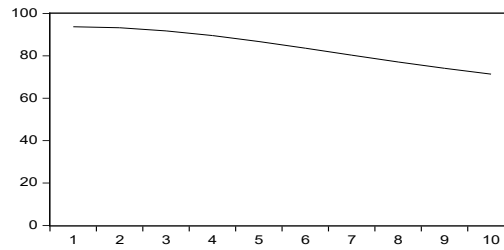


Figure 18: Var. Decomp. Pct. OP Var. due to OP

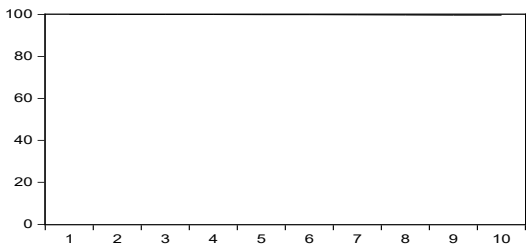


Figure 19: Var. Decomp: Pct. PBN Var. due to TXT

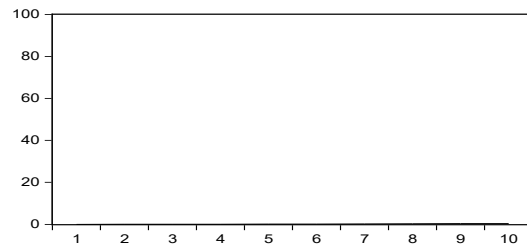


Figure 20: Var. Decomp. Pct. TXT Var. due to OP

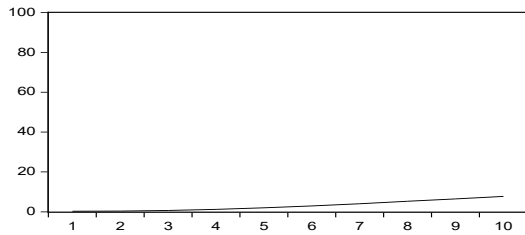


Figure 21: Var. Decomp: Pct. TXT Var. due to TXT

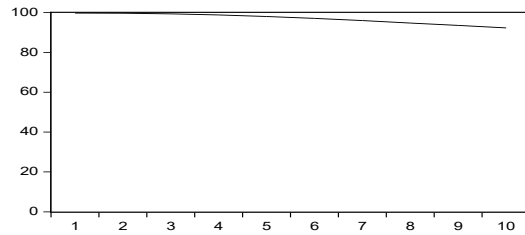


Figure 22: Var. Decomp. Pct. OP Var. due to OP

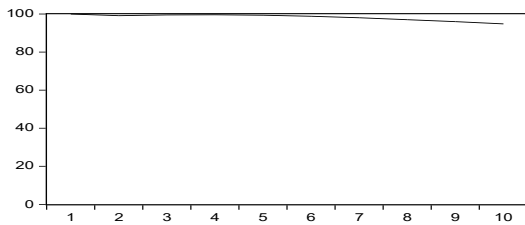


Figure 23: Var. Decomp: Pct. OP Var. due to PETRO

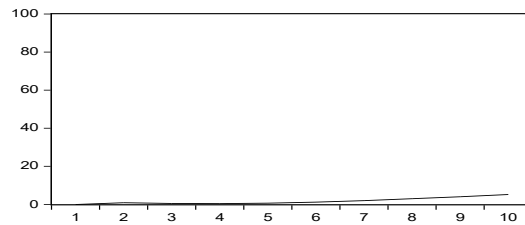


Figure 24: Var. Decomp. Pct. OP Var. due to OP

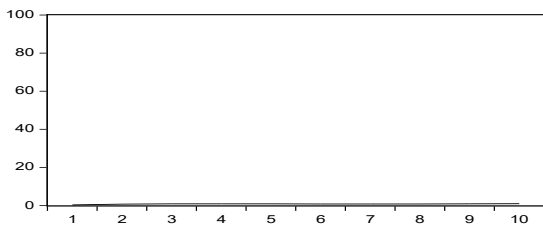


Figure 25: Var. Decomp: Pct. OP Var. due to PETRO

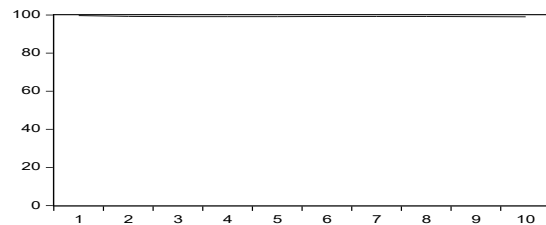


Figure 26: Var. Decomp. Pct. OP Var. due to OP

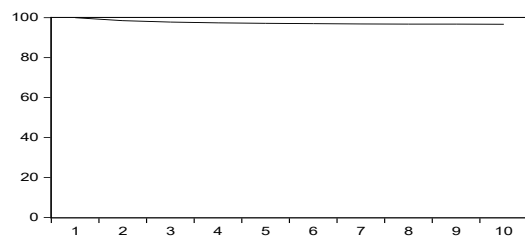


Figure 27: Var. Decomp: Pct. OP Var. due to AUTO

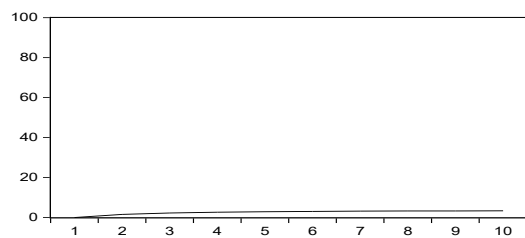


Figure 28: Var. Dec. Pct. AUTO Var. due to OP

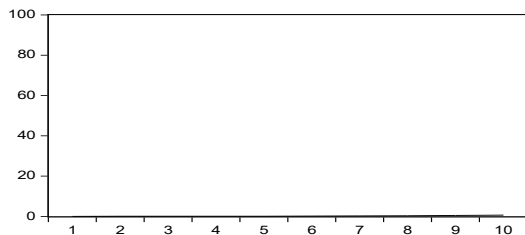


Figure 29: Var. Dec.: Pct. AUTO Var. due to AUTO

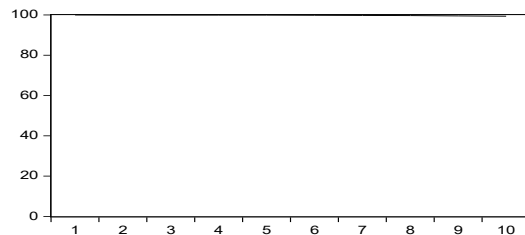


Table 4 below shows the Granger Casualty test with each variable as a dependent. Considering above hypothesis, only textile, paper and board and petroleum industrial production p-values are 0.44, 0.81 and 0.057 respectively, which are all above the 5% significance level. Therefore, we can say null hypothesis is not rejected as there is no significant relationship between textile, paper and board and petroleum industrial production level and oil prices shocks. Looking at the above hypothesis, the p-values of iron and steel, Consumer Price Index and automobile industrial production level are 0.039, 0.025 and 0.024 respectively, these p-values are all below 5% significance level, therefore null hypothesis must be rejected at this level of significance and it can be concluded that there is significant relationship between iron and steel, Consumer Price Index and automobile industrial production level and oil prices shocks. As the industries taken under this research are the major industries of Pakistan that show the overall production level of Pakistan. That is why the above hypothesis is developed to show the impact and significant relationship between the industries and oil prices shocks. As the p-value of the whole model is 0.003, which is much less than 5% level of significance, therefore, we can conclude that there is a significant relationship between textile, paper and board, petroleum, iron and steel, Consumer Price Index and automobile industrial production level and oil prices shocks.

Table 4: Granger Causality Test

Variable	Chi-Sq	Prob.
Paper & Board (Pnb)		
Txt	2.079	0.353
Petro	1.424	0.49
Op	1.897	0.387
Ins	0.109	0.946
Cpi	2.014	0.365
Auto	0.212	0.899
All	15.82	0.199
Iron & Steel (Ins)		
Txt	3.217	0.2
Pnb	1.506	0.47
Petro	5.57	0.061
Op	7.348	0.025
Cpi	4.593	0.1
Auto	3.464	0.176
All	20.67	0.055
Petroleum (Petro)		
Txt	7.982	0.0185
Pnb	1.812	0.4040
Op	1.802	0.4061
Ins	18.66	0.0001
Cpi	15.25	0.0005
Auto	2.867	0.2384
All	38.98	0.0001
Consumer Price Index (Cpi)		
Txt	0.695	0.706
Pnb	8.463	0.014
Petro	1.672	0.433
Op	4.813	0.09
Ins	2.944	0.229
Auto	0.769	0.68
All	21.55	0.042
Oil Prices (Op)		
Txt	1.602	0.4488
Pnb	0.404	0.8167
Petro	5.732	0.0569
Ins	6.462	0.0395
Cpi	7.32	0.0257
Auto	7.43	0.0244
All	28.99	0.0019
Automobile (AUTO)		
Txt	7.042	0.0296
Pnb	1.000	0.6062
Petro	0.342	0.8428
Op	0.444	0.8
Ins	1.383	0.5
Cpi	6.53	0.038
All	14.62	0.262

This table shows the Granger causality results of all the time-series variables.

CONCLUSION

As per the literature review of the past relevant studies in this area, it was found that the effects of oil prices shocks can vary geographically. In a country like Japan, this was an exception to other countries as due to the rise in oil prices, Japanese industrial production rose. Pakistan's major industries were taken under consideration to project the overall industrial production level like Automobile industry, Iron and Steel industry, Petroleum industry, Paper & Board industry and textile industry. As per the research, it was found out that Textile, Paper and Board and Petroleum industry had no impact on their industrial production level due to oil price shocks in Pakistan from mid-2000 to mid-2015. This is a positive sign for Pakistan as these industries are efficient in their production. Having no impact on their industrial production level because of oil prices shocks can be due to reasons like efficiency in utilising resources, preplanning of the management, stocking up oil barrels, minimal oil requirement in their production plant and encouragement through subsidies by the government. On the other hand, considering other major industries in Pakistan like automobile and Iron and steel industry had a greater negative impact on their total output level due to the oil price shocks. As the oil prices rose, the production fell and it shows the indirect relationship in long-term between oil prices and production of iron and steel and automobile industry in Pakistan. Although there can be many other factors as well that lead to the decrease in the production level of mismanagement, the inefficiency of the production plant, rise in factory overheads. Iron and steel industry used to be the back born of Pakistan and the industry has drastically declined due to factors like political instability and other foreign entity's interference. The rise in the oil prices effect the industrial production of iron and steel and automobile industry negatively, which further leads having a greater impact on the economy of Pakistan. Slow growth in infrastructure and instability in industrial production can be unfortunate for the future of Pakistan until serious measures are taken and implemented. Consumer Price Index (CPI) also had a significant relationship with the oil price shocks. Due to the rise in the oil prices, the household goods became harder to afford.

This causes inflation when the consumer cannot afford to buy the necessary goods for living at a lower income. In order to control and stabilize the oil prices so that the industrial production level is not affected, following Government can take strong initiatives to regulate the oil prices. Oil importing treaty can be signed with the oil exporting countries such as Iran and Saudi Arabia to promote trade and to stabilize the oil prices; this will benefit both countries mutually. More researches can be carried out by the industries that are heavily involved in oil consumption for their production to create awareness among the management and financial analysts. Precautionary steps can also be taken by industries by stocking up oil in barrels for future production. A competitive market can be developed for the economic growth so that production along with product quality is not compromised. The efficiency of utilising the resources can be applied so that the productivity is maximised in minimum time. Furthermore, Forecasting oil prices for future can help take precautionary steps to be flexible enough to control the industrial production level. In continuation of the above, oil and natural gas reserves can be explored and utilised efficiently whenever there is disequilibrium in demand and supply of oil prices in order to regulate and stabilize the oil prices.

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