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Gas Prices and Industrial Production Level: Empirical Evidence from Pakistan

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ABSTRACT

Pakistan has a vast industrial base which contributes a large portion in economic growth and employs a large population directly and indirectly. The purpose of this research is to examine the shocks of natural gas prices on the industries that use extensive amount of natural gas in their production as raw material and heating source. The industries taken under study are cement, cotton cloth, cotton yarn, glass, nitrogen fertilizer, phosphorus fertilizer, paper and board, sheet iron and synthetic fiber and billet iron. Vector auto regression (VAR) is applied to check the shocks using monthly data from January 2012 to September 2017, collected from Pakistan Bureau of Statistics. Impulse response function, variance decomposition and granger causality test were executed from VAR estimates to examine gas price shocks on industrial production level in short and long run. Results reveal that gas prices have shocks in short run on all major industries but in long run they seems to stabilize and the effect is minimized. The idea of the study is original and findings help investors, policymakers and regulatory authorities as lots of researches have been undertaken on oil prices shocks and industrial production, while none of research has been conducted on gas prices shocks and industrial production.

Keywords: Gas Prices, Impulse Response Function, Industrial Production Level
JEL Classifications: E30, L95, O13, O14, Q42

1. INTRODUCTION

The industrial level production is one of the most important components of any economy as it produces numerous job opportunities, increases exports, consumes domestically produced raw material, employs expertise of its workforce, helps in eradicating poverty etc., which can be directly observed in the shape of growth in GDP of that country. Economic growth will eventually make possible finances to be directed on the wellbeing of its citizens hence becoming a welfare state. The major sources of energy identified by economists are Fossil fuels (Natural gas, oil and coal), solar energy, biomass energy, tidal, wind etc. but from all of listed major sources, fossil fuels are the most widely used source of energy worldwide and the majority of share is occupied by oil and its components but this trend is gradually changing because of the high cost of oil and its volatile nature of prices. Apart from the prices prospects oil produces more hydrocarbons than natural gas when burned after coal that has the most polluting nature. To reduce the carbon emissions, it is stressed that world should reduce their consumption of coal and oil to shift on natural gas or other renewable sources. According to National Energy Technology Laboratory (2010) and officially quoted by United States Department of energy that carbon dioxide emissions from natural gas are 50 to 60 percent less than coal and also mentioned by Argonne National Laboratory (ANL) (2012) that natural gas emits 15–20% less carbons when burned in a vehicle.

World is now more stressing to use energy sources that are less damaging to the environment and encourage renewable source but the problem with renewable is the high cost of installation and ability to deliver at times most needed. So an energy mix is suggested using natural gas. According to the data published by International Energy Agency (2017), from the total production of natural gas, industry uses 37.7%, non-energy use is 11.4% and transport is industrial use of natural gas in the world is 7%. The world total final consumption of natural gas is 14.9% from the total of 9384 Million Tons of oil equivalent (MToe) in 2015. As we understand that natural gas is clean, efficient and environment friendly type of fuel; Government of Pakistan has encouraged industries to shift from more costly and environment damaging fuel to clean and efficient natural gas for both heating and electricity production. In 2017, natural gas contributed 48% of the total primary supply of energy mix in Pakistan and supplied 4 billion cubic feet of natural gas to 7.9 million consumers. The government if more emphasizing on the usage of natural gas and encouraging investments in this field to increase the production as well as the transportation, distribution, and servicing network. Till 2016, the consumption of natural gas in the country was 3387 mmcfd and 175 mmcfd of liquid natural gas. And in this period 20 new industrial natural gas connections were provided.

The natural gas prices are believed to be less volatile than oil prices but still volatility is a concern for the economy. The prices of natural gas has stabilized somewhat but its history is not as stable. In Pakistan the prices of natural gas has witnessed many fluctuations. The international prices are recorded on monthly basis, which has recorded highest price Rs. 854 per Million Metric British Thermal Unit on June 2008 to the lowest of Rs. 176.96 per Million Metric British Thermal Unit on April 2012 from the data of just 15 years.

The industries need energy to sustain and produce for the masses but prices of these sources are a major concern for the industrialist economies. Any price shock will affect the production. It is also to be noted that the prices of fossil are connected in some manner. Seth (2015) in his paper identified that the correlation between oil and natural gas prices at the time of peak was significant. If the prices of oil increases, it will also affect the prices of natural gas as well. In some trade deals between nations, the price of natural gas is linked to the price of crude oil such as the LNG import from Qatar is 13.37% of BRENT for Pakistan. The study entirely focuses on the change in natural gas prices on the industrial level production. Natural gas as being the closest substitute of oil in world places where both types are supported by market, infrastructure and technology but on the global scale oil is still the leading source. In view of some economists, natural gas is expected to grow rapidly in near future because of its low prices as compared to oil, transportability and environment friendly (as compared to oil and coal).

The focus of our study is on natural gas because in Pakistan, it is the second most utilized source of not only energy but as raw material and heating source. The industries that utilize natural gas as a source of raw material include fertilizers, antifreeze, fabrics, pharmaceuticals and plastics. As a source of heating, it is used in steel, glass, cement, tiles, ceramics, paper, bricks and food products. Apart from mentioned usages, it is also used in the production of electricity in the country.

1.1. Natural Gas as Raw Material

The natural gas is used as a source of Raw material in different industries for the production of fertilizers, fabrics, pharmaceuticals, plastics, antifreeze etc. in the fertilizer industry, natural gas is used as a source of hydrogen which combines with ammonia to form nitrogen fertilizers. Synthetic fabric is made out of natural gas through a process called polymerization where natural gas supplies sodium hydroxide and carbon disulfide. In the process to manufacturing plastics, natural gas through cracking plant turns ethane to ethylene which is basis of many chemical products. Plastics can also be produced through oil but ethane derived from natural gas is much cheaper than naphtha which is derived from crude oil. It is estimated that this feed stock make up to 70% of petrochemicals produced.

1.2. Natural Gas as Heating Source

Natural gas is used as a source of heat generation in industries such as cement, steel, glass, tiles ceramics, paper, bricks, food products etc. it is the cheapest form of heat generation through burning of natural gas to produce enormous amounts of heat to melt, dry and process industrial items mentioned above. Heat can be generated through use of electricity, burning of coal and furnace oil but what makes natural gas a better source from other heat generating sources is its cost effectiveness and ability to produce much lesser amount of carbon emissions. In Pakistan, heating is mostly done in industries through use of natural gas as it is cost effective with excellent distribution network and environment friendly. These benefits have led to the conversion of industries from other sources to natural gas but also new industrial units prefer to install gas based heating systems.

2. RESEARCH PROBLEM

Natural gas is one of the most widely used source of raw material and heating source in the country. A sudden change in the prices of natural gas can affect the industrial production levels such as fertilizers, fabrics, plastics, pharmaceuticals, glass, ceramics, paper, steel etc., given that there is shortage of natural gas from domestic sources and a large portion is now imported in the shape of LNG. As mentioned earlier the prices are linked with international oil prices then there is a greater chance that prices may not remain stable for very long. The impact of price change has to be examined on the industrial production level in order to provide understanding to the industry and the government the predictions in industrial level due to price changes in natural gas.

3. OBJECTIVES OF RESEARCH

- To determine the gas Price shocks on industries using it as raw materials in their production.
- To investigate the natural gas price shocks industries using gas as a source of heating.

The results acquired form this study provide industrialists and government a guideline to the effect that how prices of natural gas impact industrial level of production. They can predict future production levels on the given price of natural gas. This will enable government to regulate prices so as the optimal production level is maintained and also give policy makers the choice whether to subsidize the natural gas prices to dampen the sharp effects of international gas price shocks on the Pakistani industry production. Government may also take steps to de-link the international oil prices with natural gas prices to lessen the shocks in local industry.

4. LIETRATURE REVIEW

When it comes to the literature to check the impact of gas prices on various industries or even on GDP of a country is limited or the shock is checked in combination with oil. As it was discussed earlier that Pakistani gas prices are linked with international oil prices of BRENT, especially the imported LNG, it becomes interesting to note the literature in combination of both oil and gas together. But the focus still be with the change in prices of gas affected industrial production. There is hardly any literature available where a shock of natural gas price is checked with the industrial production level and specially in the case of Pakistan there is no such research been done before. For this reason as there is no particular literature available, the researcher will review the literature that is similar to this study specially researches done on the oil price shocks on the industrial production level.

It is well understood that oil, natural gas and coal are hydrocarbons and fossil fuels and in some cases are alternate of each other specially oil and natural gas. Throughout the world economies it is stressed to shift industries where possible from oil to natural gas because of various benefits and reasons ranging from efficiency, environment friendly (as compared to other fossil fuels) and to cost effectiveness. Same scenario can also be seen in Pakistan economy where electricity generation from oil is gradually converted to natural gas and as well as the introduction of CNG to vehicles. As mentioned above that this study is quite rare and limited, so the researcher turn to other methods such as comparing other same type of studies with its literature and taking guidelines and path for this study. The closest study with respect to the price shocks is the oil, where oil price socks are gauged on the industrial production level. The study will examine same type of effects on industrial production level that resulted from oil prices and try to check the affects using natural gas prices. Both are very close substitutes and hence form the backbone of this study.

The literature review section of the study explains the previous studies based on oil price effects on industrial production level. Researches in this regard have been done and the effects of changes in oil price shocks have been materialized as of 1973 and 1979 oil shocks. This is because of the facts that this period was the most crucial as prices jumped extremely high due to some international political situations and it shocked the world specially the west and low oil producing countries. Every field of economy was badly damaged by this price hikes and industrial production level dropped significantly. The history of oil price fluctuation is very rich and in modern times where the price of natural gas is linked with the international prices of oil, it becomes a case of concern. Hamilton (1983) and Hooker (1996) were the first to research in this field of study on the oil price shocks and their effects on the economy of different regions. Most of early researches mainly were based upon the relationship between economic growth or stock market performances and oil prices. These researches mainly implemented vector auto regression (VAR) to find out the effects of oil and natural gas prices on the macroeconomic variables focused on US and OECD countries.

Here it is worth mentioning that studies on the price shocks been checked in combination on oil prices and gas prices together but individual study taking into account only natural gas prices is yet to be carried out and this study is based on the this issue. There have been limited research in this area in Pakistan with its industry and its natural gas prices shocks. Summing up the studies which are mostly based on oil price shocks such as Lee and Ni (2002), Cobo-Reyes and Quirós (2005), Jiménez-Rodríguez and Sánchez (2007), Lippi and Nobili (2008), Bredin et al. (2008), and Tang et al. (2010) found that there was a negative relationship between industrial production and oil prices. The impact of oil price shock is evident according to the above literature and we assume same for the gas price shocks on the industrial production level as well.

As per this research literature review, it can be said that most of the previous researches were mainly focused on the impact of natural gas and oil price fluctuations on overall economy or GDP of the country. This research mainly focuses on effects of natural gas price shocks on sub-industrial level in Pakistan through supply side and demand side channels. Natural gas in now a major factor of production in most of the industries specifically those which are selected in this research. An increase in the gas prices leads to an increase in production cost, which further leads to reduction in output. Increase in the natural gas prices leads to an increase in the production cost of a commodity in consideration. Therefore the final price of that commodity for sale is high in the market. Higher prices of these products results into decrease in demand of these of products, therefore shrinking aggregate output (Hunt et al., 2001).

According to Brown and Yücel (2008) the prices of gas were kept in check and aligned because of fuel switching between natural gas and fuel oil but in United States this trend has been on decline resulting an upward movement in the natural gas prices. However, the crude oil prices does shape the prices of natural gas. Specific to the UK gas market where decoupling made on the gas with other energy commodities, the data indicated a high integrated market where demand was for energy not for a particular energy source (Asche et al., 2006). This made the prices to be still linked with one another. Joskow and Kahn (2001) in their study analyzed the prices of electricity especially in the summers and it was due to the market fundaments such as rising natural gas prices. The increases in prices will lead to eventual decline in the production if not subsidized by the government to keep in check the prices for its population.

As it is discussed earlier that natural gas is also used as raw material for different industries specially fertilizer, the prices of natural gas will affect its production because natural gas provides components for the manufacture of fertilizers such as nitrogen, phosphate etc. according to Huang (2009) the prices of nitrogen increased by third and the prices of phosphate doubled, leading to the increase in the prices of fertilizers that ultimately leads to the lower production levels. Taylor and Koo (2006) studied the relationship between natural gas prices and nitrogen fertilizers based on US economy of 40 years and by estimating the relationship between variables it was found that the prices of natural gas does have a significant effect on the nitrogen fertilizers. The literature being limited in providing gas price shocks, however they do provide enough evidence about the linkage of oil and gas prices, the usage and relationship between gas prices and electricity production, effects on the fertilizer industry etc.

5. RESEARCH METHODOLOGY

The study is purely quantitative in nature and secondary data is acquired from authentic sources such as Pakistan Bureau of Statistics (PBS), DataStream and Statistics and Warehouse Department of State Bank of Pakistan. This study is based Positivist/Post Positivist research philosophy with deductive approach. As the study is quantitative in nature, both the research philosophies of positivism and postpositive can be applied but popper's principle of refutation and falsification makes it more inclined towards post positivism. The impact and relationship of natural gas price shocks will be observed on the industrial production level using quantum index of industrial production. Monthly industrial production level for the independent variables of Large Scale Manufacturing industry including Iron and Steel, Fertilizer, cement, cotton yarn and cotton clothes, glass, paper and boards and synthetic fiber is collected from PBS from the period ranging from January 2012 till September 2017. The independent variables are in the form of LSM index or quantum index (as called by PBS) and the data of gas prices is in from of rupees but with different slabs. Each slab representing different prices so the aggregate average is used for the study which is also provided by PBS. Apart from these variables, the study will also incorporate Consumer Price index to capture inflation and 6 months T-bill rate to capture the effects of lending and interest on the production. A total of 69 observations are tested in this study from January 2012 till September 2017.

The study incorporates one dependent variable of gas prices taken as average of aggregate slabs of different prices offered to industry and twelve independent variables under seven representing industries namely cotton (cotton yarn and cotton clothes), paper and boards, fertilizer (nitrogen and phosphorus fertilizer), glass, cement, iron and steel (billets/ingots, sheets/strips/coils) and synthetic fiber. Two variables of CPI and T-bill rates is also included in the model to capture inflation and interest effects.

The step by step plan to achieve the objectives of the study; also given by Ahmed el al., (2017) is explained below:

1. Unit root test is applied to check Stationary and random walk in the data by using Augmented Dickey Fuller (ADF) test.
2. Descriptive statistics is executed to know the averages, variation and distribution in the data.
3. Unit root test results has enabled whether to use VAR model or vector error correction model that is appropriate. In our case we identified VAR model is to be executed.
4. After applying VAR we computed the estimates. On the basis of estimates, following methods are applied to achieve our research objectives:
    a. Impulse response function (IRF): It explains the shocks in long and short run).
    b. Variance decomposition; that explain those shocks in the percentage and to different period ranges.
    c. Granger causality test-block exogeneity wald test is applied under VAR environment to check the impact and causation of one variable on the other.

6. EMPIRICAL ANALYSIS

6.1. Descriptive Statistics

Table 1 explains the descriptive statistics of the data under study where mean, median, minimum values and maximum values, standard deviation in a set are given in a summarized form. It explains the characteristic of the data on which whole study is based. As the study is based on the quantum index, where a comparison is made between the production level of a months with the production level of previous year's same month. Here the value of 100 means that the production stayed at the same level as compared to the previous period. Any number above 100 represents an increase in the production of subsequent periods and any number below represents a decrease in the production of subsequent periods in comparison. The average production of Billet Iron during the study period is 122.3, this value indicates that on average this industry has flourished and produced more than the preceding periods and it has topped with the maximum value of 187.55 and the production dipped till the minimum of 69.6. The standard deviation in the production data of Billet iron is 22.36.

The cement industry average of 111.6 indicating that production on average has been on rise with the maximum of 524.0 representing a huge growth rate of more than five times the production in comparison with last year's same period and minimum of 84.12 is slight decrease in this industry production with SD of 51.04. The distribution of gas prices averaged at Rs. 410.73 per MMBTU with maximum price attaining at Rs. 685 and minimum price of Rs. 348 being offered to the industries within this time period and the SD from mean prices was recorded at 87.68.

The nitrogen fertilizer industry averaged at 108.88 that is considered to be a good production increase with the maximum value of 172.3 and lower level of 64. Nitrogen fertilizer industry growth is considered to be good and that low production values are because of seasonal variations with SD of 49.6. In case of phosphorus fertilizer, the average is much better through various months with top production level achieved more than four times at 409.20 but at the same time the minimum production level has dipped to the lowest 17.04 which is a significant drop in production with the SD of 45.84.

Six months T-bill rates and CPI is added in the model to capture the inflation and interest factors and their impact on the overall study. The CPI averaged at 194.05 with maximum of 217.98 and minimum of 162.58. The T-bill rates averaged at around 8% maximum of 8.96 and minimum of 5.83.

6.2. Stationary Test (ADF Test)

The stationary test was conducted for each of the variables used in the model and the results showed that billet iron, cement, combined gas prices, cotton cloth, glass, nitrogen fertilizer, phosphorus fertilizer, paper and board, sheet iron, synthetic fiber is stationary at zero difference level of integration with $P < 0.05$, so we reject our null hypothesis that there is unit root in the data (Table 2).

The stationary test for cotton yarn, T-bill rates and CPI did contain unit roots at $P = 0.431$, 0.557, 0.48 respectively and the data was

Table 1: Descriptive statistics of variables

Measures	BILLIR	CEMENT	COMBGP	COTCLOTH	COTYARN	CPI	GLASS	NITROFERT	PHOSFERT	PNB	SHEETIR	SYNFIB	TB6
Mean	122.30	111.60	410.73	100.40	102.43	194.05	107.25	108.88	113.99	107.47	116.87	103.81	8.312
Median	117.44	103.82	372.55	100.35	101.09	198.05	100.64	107.87	103.76	104.57	111.20	104.24	8.96
Maximum	187.55	524.0	684.98	102.16	110.45	217.98	376.18	172.33	409.20	154.20	200.38	132.17	11.94
Minimum	69.60	84.12	348.00	99.31	98.180	162.58	32.98	64.02	17.04	54.88	80.85	0.000	5.83
SD	22.36	51.04	87.68	0.513	3.12	15.69	49.60	15.95	45.84	19.44	23.61	15.86	2.03

Table 2: Stationary test- ADF test for unit roots

Series	Order of integration	P value	Hypothesis
BILLIR	I (0)	0.000	Null hypothesis rejected
CEMENT	I (0)	0.000	Null hypothesis rejected
COMBGP	I (0)	0.012	Null hypothesis rejected
COTCLOTH	I (0)	0.0026	Null hypothesis rejected
COTYARN	I (0)	0.431	Null hypothesis not rejected
DCOTYARN	I (1)	0.000	Null hypothesis rejected
GLASS	I (0)	0.000	Null hypothesis rejected
NITROFERT	I (0)	0.0037	Null hypothesis rejected
PHOSFERT	I (0)	0.000	Null hypothesis rejected
PNB	I (0)	0.0002	Null hypothesis rejected
SHEETIR	I (0)	0.0063	Null hypothesis is rejected
SYNFIB	I (0)	0.000	Null hypothesis rejected
TB6	I (0)	0.5577	Null hypothesis failed to reject
DTB6	I (1)	0.000	Null hypothesis rejected
CPI	I (0)	0.4856	Null hypothesis failed to reject
DCPI	I (1)	0.000	Null hypothesis rejected

ADF: Augmented Dickey Fuller

not stationary at zero level of integration but it become stationary at first difference with P = 0.00 for all three variables and we reject our null hypothesis at first difference.

6.3. Graphical Presentation

A random walk behavior can been clearly observed (Graph 1) representing Billet Iron. The data is stationary at zero level of integration with P = 0.00, hence we reject our null hypothesis that there is unit root in the data.

Graph 2 shows the random walk behavior in cement industry data, it can be sensed that it is showing some random walk graphically and confirmed by the P = 0.000 and we reject our null hypothesis as there is no unit root in the data and it is stationary at zero level of integration.

The Graph 3 is of combined gas prices that show less random walk behavior graphically but P = 0.012 suggests otherwise that there is no unit root in the data and it is stationary at zero level of integration. We reject our null hypothesis in the case of combined gas prices.

Paper and board shows random walk graphically (Graph 4) as well as from P = 0.0002 that is <0.05, so we reject our null hypothesis that data contains unit root. It is stationary at zero level of integration.

The P-value of sheet iron is 0.0063 that is <5% significance level, so we reject our null hypothesis as there is no unit root and data is stationary at zero level of integration (Graph 5).

Synthetic fiber industry (Graph 6) is relatively new in the country that is why level of production started from zero level and then getting consistency with random walk behavior shown in the graphical presentation. It is also confirmed from the P = 0.0001, hence we reject our null hypothesis as data contains no unit roots.

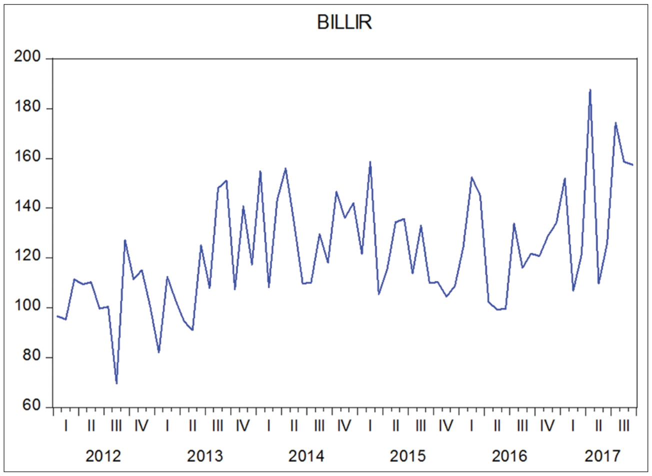
T-bill rates (Graph 7) does not show random walk in its graphical presentation and confirmed by P = 0.557 which is >0.05 level of significance, hence we fail to reject our null hypothesis as there is a unit root in the data. At first level difference this issue is resolved and we get P = 0.000 hence now we reject our null hypothesis at one level of integration. DTB6 is the variable created for this purpose which is the first difference of TB6, random walk behavior can be visually identified in the graphical presentation as well. T-bill rates are supposed to have a unit root because it follows a consistent trend, if it fluctuates very often than the economy is not performing very well or the policy makers are not sure of the current economic conditions of a country.

The CPI (Graph 8) also follows a certain path, in case of Pakistan, it has an increasing trend, starting at about 160 in 2012 and reached nearly 220 at the end of 2017. Inflation is on rise in Pakistan which CPI is clearly indicating towards. The data is not stationary at zero integration so first difference is taken which makes it stationary and we reject our null hypothesis at I(1).

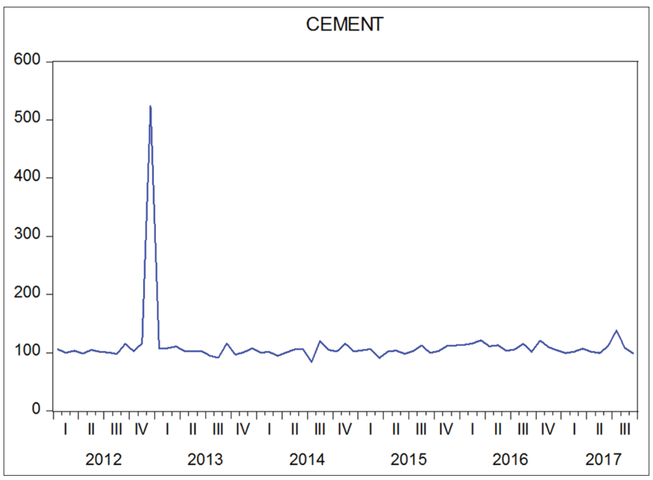
From the Table 1, where the order of integration is showing that only three variables namely COTYARN, CPI and TB6 become stationary at first difference level and all other variables were stationary at zero level of integration. Based on the results we apply VAR because VAR is applied on the time series data where data achieves stationary to the maximum of first difference.

On the basis of VAR estimates to achieve our research objectives, IRF is applied in order to explain the shocks of combined gas prices on each variable in short and long run.

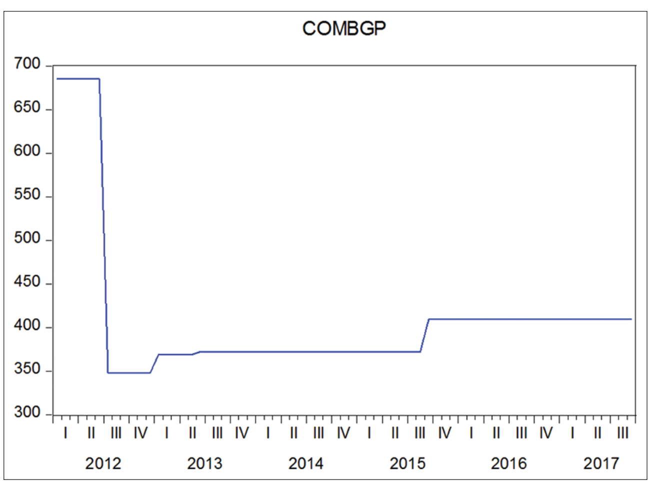
Graph 1: Random walk behavior for billet iron



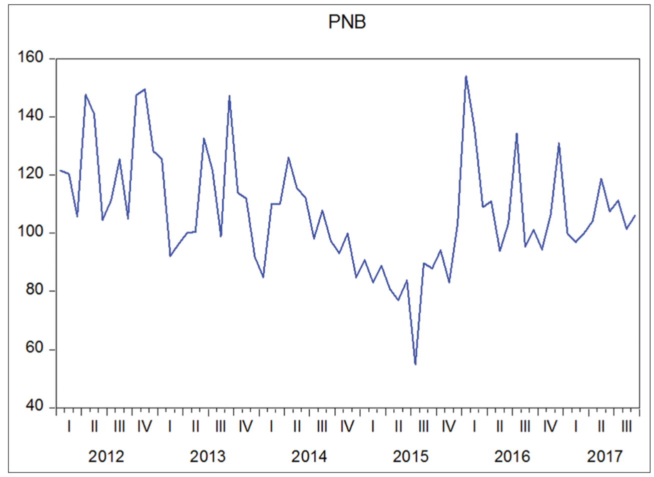
Graph 2: Random walk behavior for cement industry



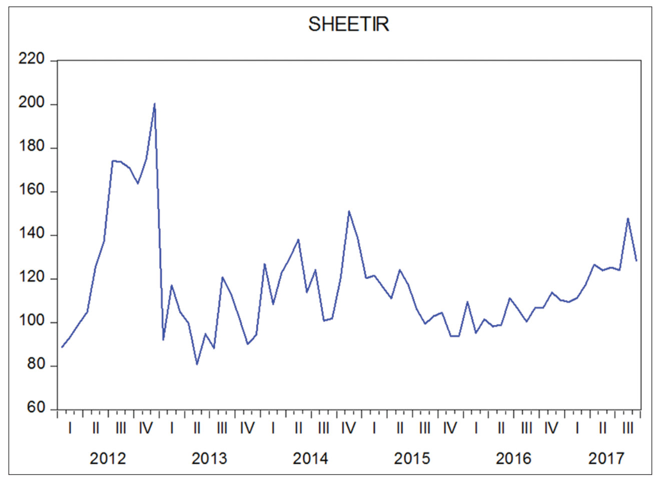
Graph 3: Random walk behavior for gas prices



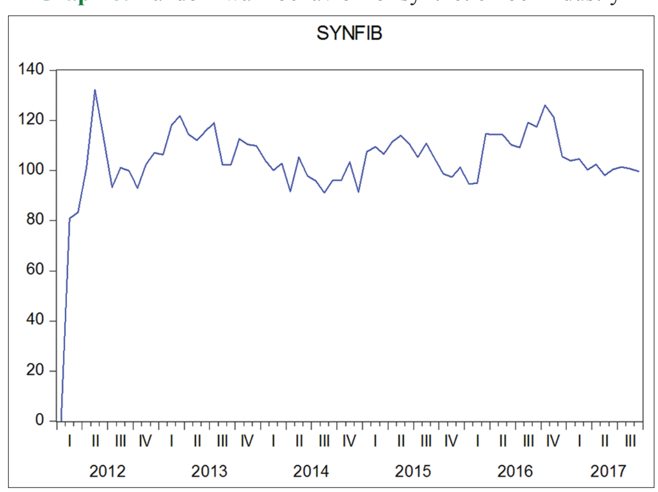
Graph 4: Random walk behavior for paper and board industry



Graph 5: Random walk behavior for sheet iron industry



Graph 6: Random walk behavior for synthetic fiber industry



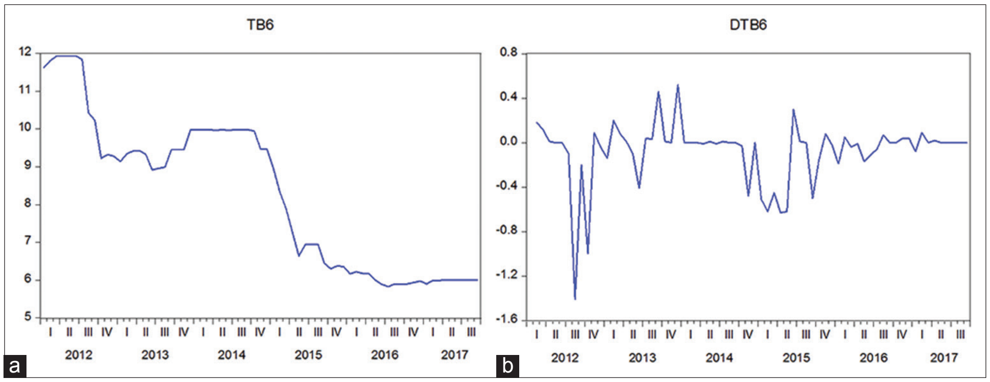
6.4. VAR Estimates-IRF

The IRF identify shock to a VAR system. In our study it identifies responsiveness of all endogenous variables when we put the sock to error term.

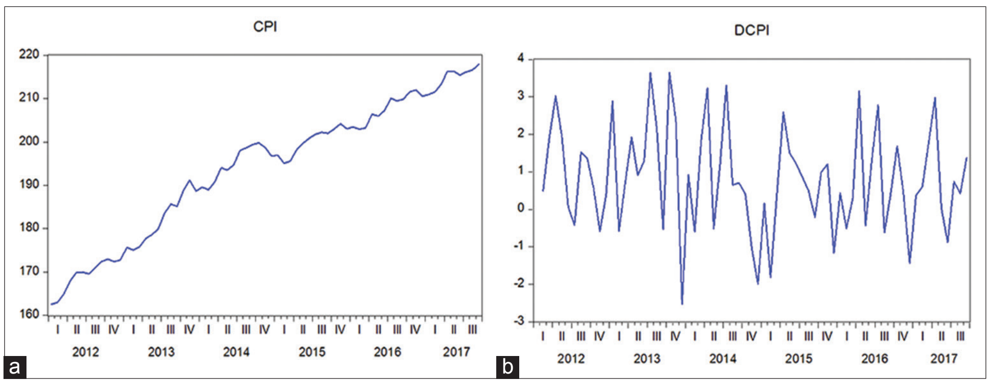
On the VAR estimates, impulse response of combined gas prices (Graph 9) is checked on Billet Iron, we by observing the graph can tell that the impact is positive but for a very short period of and it becomes negative throughout. The overall impact is in short run (first period) but in long run it does not show any significant response and stays negative.

The IRF in case of cement industry production (Graph 10) when impacted by combined gas price shock is shown where it seems to

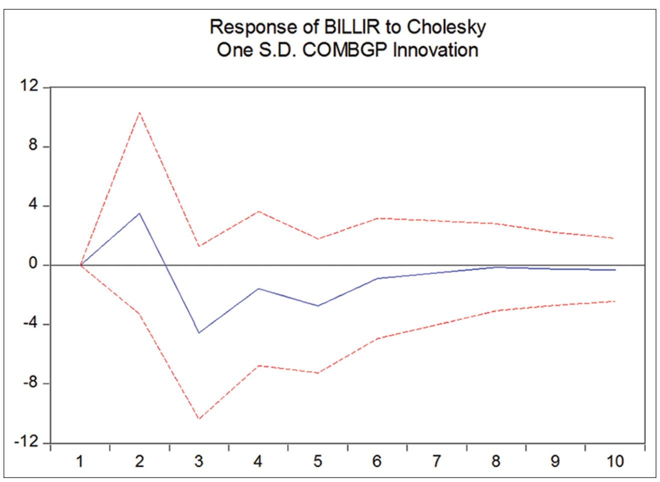
Graph 7: (a and b) Random walk behavior for T-bill rates and first difference of T-bill rates



Graph 8: (a and b) Random walk behavior for consumer price index and first difference of consumer price index



Graph 9: Impulse response function of gas prices on billet iron industry



have a negative short term impact but on long run it does become positive but the response is not significant.

The impact of gas price shocks is checked on Cotton cloth in the Graph 11. It seems to have slight impact in the short run ranging from 2 to 3 but the impact does become negative in long term. As this long term impact is very close to X-axis, it seems to be not significant.

Shocks of gas prices on cotton yarn industrial production level can be seen in Graph 12. And it indicates that there is a sharp negative impact on cotton yarn in the short run but in long run it seems to have insignificant effect.

The impact of gas price shocks on glass industrial production level can be seen in Graph 13. It does not seems to have a short run impact or long term impact as the graph is very close to the X-axis.

The impulse response of gas prices is checked on nitrogen fertilizer industry production (Graph 14). In short run the impact is negative especially from 3 to 5 months' time frame but after this short period the impact is almost nonexistent in long run.

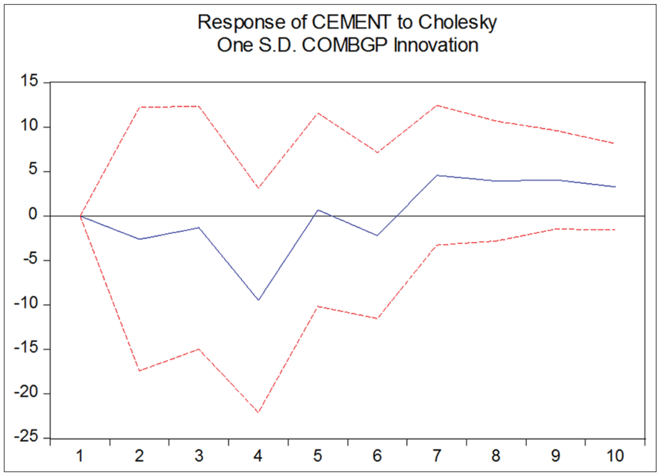
The IRF in case of phosphorus fertilizer production level is observed throughout the period, in long as well as short run. This impact is positive in very short time but quickly it becomes negative (Graph 15).

The impulse responses of gas prices on paper and board can be seen in Graph 16, we can analyze that the impulses are positive in long as well as short term. The shock almost become insignificant for a very short time but recovers quickly.

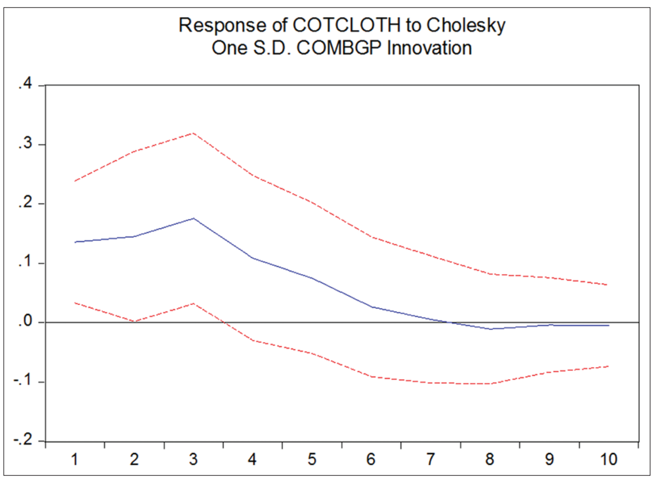
Gas price shocks on sheet iron industry production levels can be seen Graph 17. The impact on the short run is negative but does seems to be advancing and it becomes positive shock in the long run.

The IRF on the synthetic fiber seems to be insignificant in the short run as it is constantly hovering around X-axis but in the long run it does become positive but that also does not seems to be significant (Graph 18).

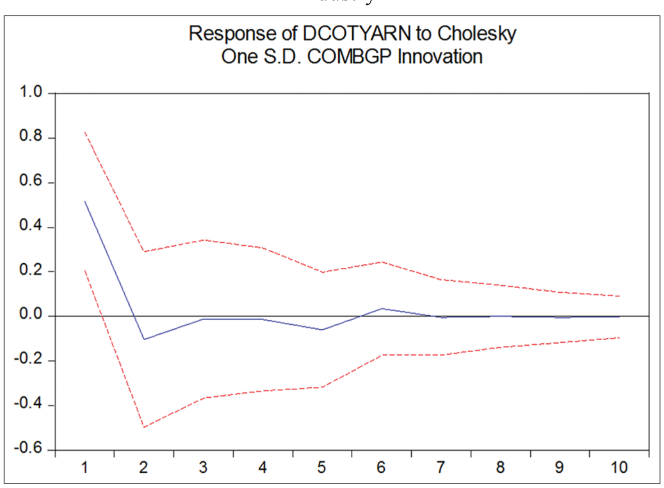
Graph 10: Impulse response function of gas prices on cement industry



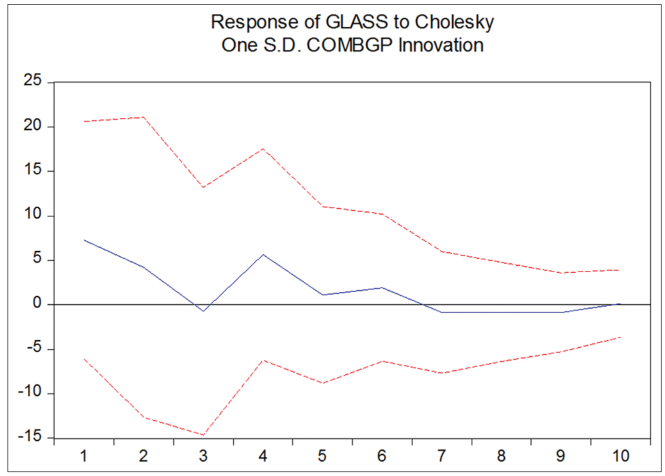
Graph 11: Impulse response function of gas prices on cotton cloth industry



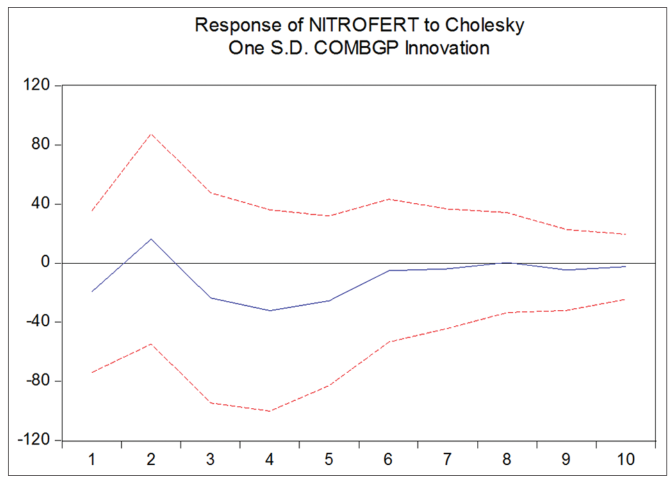
Graph 12: Impulse response function of gas prices on cotton yarn industry



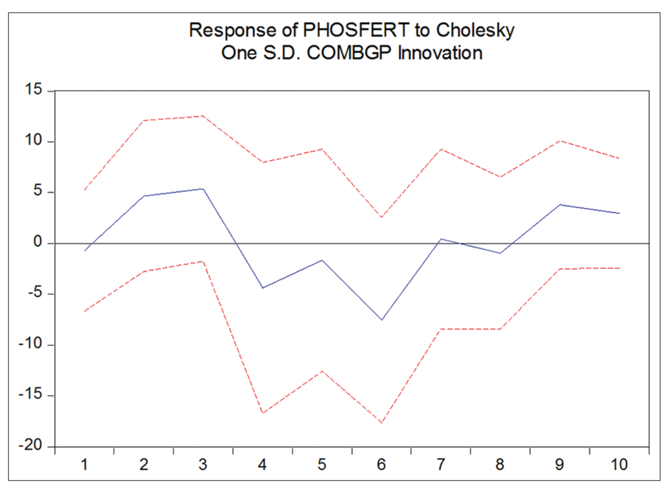
Graph 13: Impulse response function of gas prices on glass industry



Graph 14: Impulse response function of gas prices on nitrogen fertilizer



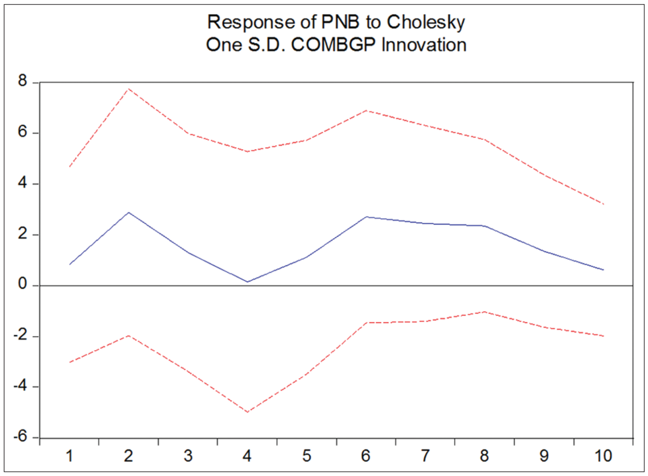
Graph 15: Impulse response function of gas prices on phosphorus fertilizer



6.5. Variance Decomposition

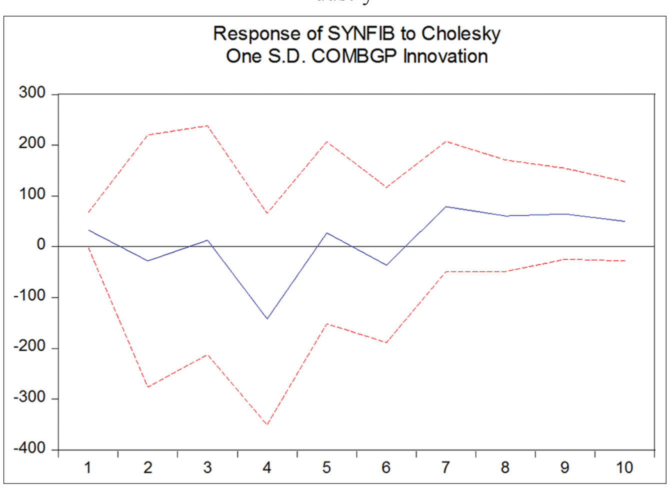
The variance decomposition tells us the shocks of gas prices on industry production in percentages. The variance decomposition of Billet iron on other variables under VAR environment. We take the period No.3 for short run, the impulse to Billet Iron accounts for about 87% in the variance of Billet Iron itself called Own shock. The value is high and it is supposed to be high as its own shock. The shock to cement contributes 5.66%, gas prices shock contributes 2.57% and 2% shock by Glass contributes to fluctuation in Billet Iron. In the long run, taking 10th period, Billet

Graph 16: Impulse response function of gas prices on paper and board industry



Graph 17: Impulse response function of gas prices on sheet iron

Graph 18: Impulse response function of gas prices on synthetic fiber industry



iron contributes 77.61% fluctuation in its own shock, Cement 5.87%, gas prices 3.25% and glass 2.52% fluctuation in the Billet iron production. Cement shocks remains almost the same, gas prices shocks increases marginally and glass industry shock also remains same for both long and short terms.

The shock to combined gas prices contributes to 2% variance in the cement production whereas 4.4% by Billet Iron, 70.4% own shock, 8.82% shock by T-bill rates in the short run of third period. In the long run of period 10th, gas prices shocks contribute 4.64% variation in cement, in the long run it does have an effect on cement production but the percentage contribution is not high. Billet Iron, T-bill rate does not show very significant change from short to long run productions. In the short run, shocks in combined gas prices does show a healthy contribution to cotton clothes at 21.39%, CPI at 5.24%, billet iron at 3.85% and about 58% being its own shock. In long run, shocks in gas prices affects 20.7% which does not show any extreme fluctuations but its shock in both periods remains significant. Same is the case with other variables.

In the short run, shocks in combined gas prices through 8.37% fluctuation in cotton yarn production and in long run it dips slightly to 7.98 indicating a negative impact and cotton cloth shock on cotton yarn is about 5% and remains almost unchanged in 10th period as well. Other industries shocks such as glass 12%, cement 6.7% are high but logically these industries have not much in common, so we ignore their shocks on cotton yarn. In long and short runs, shocks in almost every industry production contribute a fluctuation in CPI and it is understandable as it represents inflation in the economy where all these industries operate. In short run, combined gas shock contributes nearly 5% variance in glass industry with marginal positive impact in long run at 10th period. Shocks in Billet iron contribute 11.42%, cotton cloth 4.82%, cotton yarn 4.53% in short run with no significant change in long run. Boards industry production with negative affect in long run. In the 3rd period taken as short run, the shocks in gas price show 9.57% negative variation till 8.98% in the long run. Billet Iron 15.44%, 20.87% by cement and 7.7% by cotton yarn with negative long run impulses. The impulse in short run by gas prices on Synthetic fiber takes 4.7% variation and in long run it shows positive effect at 5.69%. It is interesting to observe that own shock on synthetic fiber is just 31.53% in short run and becomes negative till 22.6%.

6.6. Granger Causality Test

The Table 3 show granger casualty test results after executing the test in VAR environment by taking each variable as dependent and specify impact of one variable on other variables. The results shown in the shape of P-values and draw conclusion by comparing results with our hypothesis. The P-values of cement 0.0625, cotton cloth 0.169, CPI 0.875, cotton yarn 0.48, glass 0.97, nitrogen fertilizer 0.329, phosphorus fertilizer 0.131, paper and board 0.217, sheet iron 0.309 and synthetic fiber 0.137 are all above the significance level of 0.05 so we fail to reject our null hypothesis that gas prices does not cause in these industrial production levels. No significant relationship is found between gas price shocks to the production levels of cement, cotton cloth, CPI, cotton yarn, glass, nitrogen fertilizer, phosphorus fertilizer, paper and board, sheet iron and synthetic fiber. The P-values of billet iron and T-bill rates were recorded as 0.0343 and 0.00 that are <5% significance level, therefore we reject our null hypothesis because we captured a significant relationship between billet iron, T-Bill to the gas price shocks.

Table 3: VAR granger causality for gas prices

Dependent variable: COMBGP			
Excluded	Chi-square	df	P
BILLIR	0.233803	2	0.8897
CEMENT	0.873013	2	0.6463
COTCLOTH	3.187494	2	0.2032
DCPI	1.525832	2	0.4663
DCOTYARN	8.915939	2	0.0116
DTB6	0.415786	2	0.8123
GLASS	2.187382	2	0.3350
NITROFERT	1.742396	2	0.4184
PHOSFERT	0.005648	2	0.9972
PNB	4.794691	2	0.0910
SHEETIR	5.937614	2	0.0514
SYNFIB	0.479945	2	0.7866
All	33.82040	24	0.0879

VAR: Vector auto regression

7. CONCLUSIONS AND RECOMMENDATIONS

The literature for gas price shocks on industrial production level is limited and gas price shocks are gauged using aggregate prices of oil and gas together in some studies and their impact has been studied. Therefore, the study took the path of similar relevant literature to explain gas price shocks on industrial production level specially taking examples from oil price shocks. In international natural gas deals, the prices are fixed and linked with the prices of oil and as we know the fluctuation in oil price is very high, it does however impact international gas prices as well. As our study is based on the Pakistan economy, the country's gas reserves are depleting rather quickly and it is facing gas shortages especially in the winter season. Government initiated some projects to import liquefied natural gas from various sources which will be eventually hit by the fluctuations in oil prices.

The research has taken major Pakistani industries where the impact of gas prices could be measured, for this reason industrial production levels of cement, cotton cloth, cotton yarn, glass, nitrogen fertilizer, phosphorus fertilizer, paper and board, sheet iron and synthetic fiber and billet iron were taken into consideration. These industries were chosen because of their considerable usage of natural gas in their production as heating and raw material from January 2012 till September 2017 period. As per our research results from IRF and variance decomposition, oil price shocks have an impact on the industrial production level in the short run but in long run the impulses become stabilize and their affect is minimized. From the results of granger causality, cement, cotton cloth, cotton yarn, glass, nitrogen fertilizer, phosphorus fertilizer, paper and board, sheet iron and synthetic fiber did not find significant causal relationship. It should be taken as a positive sign for the economy of Pakistan as these industries are believed to be efficient in their production, management, planning so that the impact of gas prices are minimized to the lowest level where their production is not affected. One major reason behind these results is that gas prices in Pakistan are relatively stable and do not fluctuate very often because still majority of natural gas is produced within the country and government subsidized the rates and does not transfer the price shocks of imported gas to the economy. But as the portion of imported gas rises into the economy, it will be hard for the government to subsidize and have to pass on the end users. In this situation, the industry has to be well prepared. Apart from this, nitrogen fertilizer uses gas as a raw material in its production, it is heavily dependent on natural gas supplies. The causal relationship was not significant but IRF showed significant short term shocks because of the reasons that there is a huge demand for fertilizers in the country, all the production is consumed within the country and government also subsidizes the rates for fertilizer to promote agriculture sector, in short run it may be affected but in long run its impact is minimum. The granger causality results for billet iron industry shows a relationship between gas prices and billet iron industry production level and this relationship is negatively in the long and short run. This is because of extensive use of gas in this industry to melt iron to produce products. Their dependency rate is very high. The IRF and variance decomposition results clearly indicate that overall there is a short term impact of gas price shocks on the industrial production level in Pakistan.

The study results are positive for the economy of Pakistan as major industrial production units are not affected significantly by the gas price shocks but this scenario can turn otherwise when the portion of imported LNG increases in the economy or gas pipeline projects to import gas are completed. It may not be possible for the government to subsidize that large portion of gas prices and keep them at stable position just like they regulate oil prices in the country. In that situation it will be challenging for the industries to sustain damages caused by gas price shocks. They will have to be prepared and planned because these are major industries of this country, when their production is affected it will hamper the overall economic growth of Pakistan. It may trigger economic instability, unemployment and inflation in the country.

The research can be expanded by using monthly data for more than 20 years to see the impact of gas prices on major industries in Pakistan. In this research it was a limitation as only data from January 2012 was made possible from PBS. Some other major industries such as electricity production from gas can also be included to see any change in their production when shocks appear. Another major industry such as CNG can be included into the study because of its entire dependency on gas to vehicles where CNG kits, cylinders, services sector, distribution, compressors etc., all are linked with this industry.

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