The Role of Power Generation and Industrial Consumption Uncertainty in De-industrializing Pakistan

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Abstract

Deindustrialization has long been considered as an indicator of economic development and maturity. The declining time path of the industrial share in GDP and employment has been viewed as a natural outcome of the matured stages of development analogous to the radical decline in agricultural sector and a persistent move towards services sector. But the situation in country like Pakistan is not so due to such structural transformation. Rather, energy crises is expected to have a detrimental role in the growth of industrial sector. The volatility in power consumption by industrial sector and a hampered power generation impediments this sector further putting devastated effects on the other interlinks sectors of the economy. This study endeavors to identify the role of power sector's status behind industrial downfall in Pakistan and tries to work out the extent to which this phenomenon may prevail in future. The attempt is made for Pakistan over a time span of 1970-2010. The Johansen Cointegration, Error Correction Model, Impulse Response Functions and Variance Decomposition techniques are applied for the short and long-run relationships. The uncertainty in industrial electricity consumption and electricity generation are identified as major factor in undermining industries whereas domestic consumption is not appeared as significantly volatile. For the future time period power generation will remain the major contributing factor in shaping time path of industrialization in Pakistan.

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1. Introduction

The term "deindustrialization" refers to the process of social and economic change which is due to the reduction in the industrial capacity or the loss of industrial potential of an economy. It is generally considered as the natural outcome of the process of economic development because it involves the transformation from primitive agriculture based economy to the modern industrial sector. After the establishment of well developed manufacturing base, the long run growth process induces the movement towards a more innovation based economy i.e. services sector (Galor, 2005). However, the process requires the gradual shift from one stage of development to the other accompanied by related institutional and infrastructural changes. Therefore the process of deindustrialization occurs at the later stage of development in an economy where the industrial sector has already been developed.

The economic history of the today's developed world reveals that the process of deindustrialization started in these economies in late 1970s and the share of industrial output in total output combined with the share of industrial employment in total employment has fallen since then. On the other hand, in the developing world several attempts have been made for industrialization or to strengthen the industrial sector so that the sustainable economic growth can be achieved along with the other macroeconomic objectives. However, there are some countries that, despite their efforts, are unable to develop their industrial sector and hence lagging behind the others in the race of economic development. This inability can be attributed to the policy bottlenecks and the severe difficulties faced by the industrial sector and hence leading to the path of deindustrialization which in contrast to developed world is the product of

economic failure and hence is termed as 'premature deindustrialization'. Such deindustrialization can have negative implications for the economy because the labor shed from industries may not be reabsorbed into the services sector and hence lead to unemployment in the economy as the services sector is less absorptive of employment with compared to industrial sector. Moreover, the vulnerable growth of industrial sector may negatively effect the growth of other sectors due to its forward and backward linkages to other sectors in the economy.

The economy of Pakistan can be considered as an example of such cases where inconsistent industrial policies, liberalization reforms and the macro economic challenges faced by industrial sector largely in the form of energy crisis and political instability has reduced the potential of industrial sector. The country has been facing deindustrialization since 1990s due to the above mentioned factors and the efforts to put the sector back on its trail are all in vain. The share of industrial sector in GDP has remained stagnant around 25 % over the decades. The declining growth rate of industrial sector is more pronounced. It has remained highly volatile and even touch negative rate for few years. The manufacturing sector, capturing 63 % share of the overall industrial sector, has been hard hit by power crises, unstable law and order situation, terrorism resulting in loss of working hours and lowering confidence of foreign investors. The acute energy shortage, continuous power breaks down and government issues with Independent Power Producers (IPPs) on payment have badly affected the sector's capacity in power generation and distribution. The growth rate of manufacturing sector has reduced from 19.9 percent in 2004-05 to 8.48 percent in 2007-08 [Pakistan, Govt. of (2011].

The deindustrialization, without taking the industrial sector to its peak level of development as observed for developed countries, can be attributed to the acute energy shortage and frequent power breakdowns that prevent industries operating at their capacity level and

hereby lowered down the output growth. As a rule of thumb, industrial sector has to face 33 percent of the production cost in terms of energy and any increase in the energy cost affects the competitiveness negatively. Over time, the manufacturing sector's competitiveness has gradually declined inspite of having comparative advantage in this sector. According to Global Competitiveness Index (2011-12) by World Economic Forum, Pakistan placed at 133 and is now 16th least competitive economy out of the 148 countries. This indicates consistent attrition in the economy's growing capability. Conclusively, the domestic energy shortages, excessive rise of electricity prices for industry, impart negative impact on the sector's competitiveness. As the output of electricity WAPDA component recorded negative growth -5.61 % as compared to 16.29 % in last year. The country is facing the worst power crisis of its history where the total generation stands at 10,000-11,000 MW (Megawatts) against the demand of 14,500 MW per day however the installed capacity of power generation stands at 22,500 MW which cannot be tapped due to the existing circular debt of more than Rs 275 billion in the energy sector [Aftab (2011)]. High cost involve in the generation of electricity has forced the governments to increase the electricity prices more than 100 percent causing further trouble for the industrial sector leading to the shutdown of more than 70 percent of industrial units. The foreign as well as domestic investors are transferring the investment to the neighboring countries i.e. Bangladesh, India and China pertaining to the unfavorable condition in the country.

Keeping in view the role of energy crises in hampering industrial sector growth, an attempt is made to empirically investigate the extent to which the most significant component of energy i.e., electricity's crises has played its role in the process of deindustrialization in Pakistan. The power generation and volatile power consumption by industrial sector along with domestic consumption, inflation and energy imports are selected as the major factors determining the time

path of industrial sector's share in GDP. The Johansen Cointegration and the Error Correction Model are applied for this purpose. The impulse response and variance decomposition are also obtained to observe the effect of shocks to selective variables on the industrial share in GDP and to forecast the future role of most important factor in determining industrial variation, respectively. The data from World Development Indicators and Economic Survey is used over the time period of 1970-2010.

The rest of the paper is organized as follows. Second section deals with the literature review. Third part discusses the trends of industrial sector growth and policies and energy shortages. The fourth section discusses methodology and the fifth section reports and interprets the empirical findings. Final section concludes the paper with some policy suggestions.

II. Literature Review

The understanding of the possible impact of power crisis on the process of deindustrialization is important as it provides the theoretical and empirical support to the analyses undertaken. However, an array of empirical research is available on the determinants of deindustrialization in developed and developing economies but no research has been conducted to analyze the impact of power crisis exclusively on the deindustrialization for any country. Therefore, examination of the existing literature will focus on the determinants of deindustrialization in general for the various economies.

II.1 Evidence from the Developed World

The developed world has been on the path of services sector growth since 1970s and the economists have considered it as a process of "Restructuring" or "Creative Destruction". This transition has been attributed to the higher productivity growth of industrial sector, North-South

trade and outsourcing of manufacturing activities to the labor abundant developing countries (Alderson 1999; Lee and Wolpin 2006). Alderson (1999) analyzed the impact of globalization on the process of deindustrialization in the selected OECD countries. By using the panel data fixed effect regression technique, he concluded that the fall in manufacturing employment in the developed world is the result of outflow of direct investment and North-South trade. Additionally, the inverted U hypothesis has also been proven indicating the fact that the economic development in these countries has reached at a point after which there is a decline in manufacturing employment. However, Rowthorn and Ramaswamy (1999) established that deindustrialization in the advanced economies is the result of the economic development and higher productivity of manufacturing sector as compared to other sectors. The role of North-South trade and problems faced by manufacturing sector in these economies has little contribution towards the process of deindustrialization.

Nickell *et al.* (2008) explained that across the OECD countries, difference in the pace of deindustrialization can be attributed mainly to the differences in the productivity across manufacturing, agricultural and services sector. Apart from that, differences in the relative prices, technology and factor endowment also play vital role in determining the pace of deindustrialization.

II.2 Evidence from the Developing World

There has been some pessimist view regarding the phenomenon of deindustrialization in the developing part of the world. It is considered that deindustrialization is a process of betrayal to the industrialist workers and the propaganda to deprive the developing world from its industrial power (Cowie. J., and J. Heathcott, 2003).

Noorbakhsh and Paloni (1999) declare the Structural Adjustment Program of IMF and World Bank as responsible for the low per capita growth of Sub-Saharan Africa as it has not resulted in the export competitiveness of industrial sector due to technology transfer rather it has resulted in the declining performance of industrial sector as compared to the period before the adoption of SAP.

According to Palma (2005 & 2008) the developing world has been facing the declining share of industrial sector in GDP or employment because of the policy shifts faced by most of the economies. Trade liberalization along with the financial liberalization has resulted in the inverse relationship between the manufacturing employment and the income per capita. Dasgupta and Singh (2005) have provided the evidence of deindustrialization at the low level of income, jobless growth and the development of informal sector. They used the concept of "premature deindustrialization" because of its negative implications on growth as it lowers the capacity and hence growth of industrial sector.

For the Latin American countries, Brady *et al.* (2008) suggested that de-industrializing took place in these countries despite the sheer need of strong industrial base because of the MERCOSUR trade agreement, dependency on the United States, inward FDI inflows, military spending and institutional problems.

This completes the review of literature. Next section presents an overview of Pakistan's industrial sector growth performance and energy crises.

III. Deindustrialization and Power Crisis in Pakistan: An Overview

The industrialization has been considered as an engine of growth by the law of development that has held true for almost 200 years, since the start of Industrial Revolution (Chenery 1960; Kaldor 1966). It is well established that industrial sector development is fundamental for the overall economic development of a country. The historical evidence portray that currently developed countries have developed with the help of sound industrialization strategies. The industrial sector of Pakistan is the second largest sector of the economy comprising of small, medium and large scale industries. Currently, industrial sector contains 20.9 percent of GDP having sub sectors: manufacturing, construction, mining & quarrying and electricity and gas distribution. Manufacturing Sector has the largest (13.2 percent) share in GDP. According to economic survey (2012-13), the growth of the manufacturing sector is estimated at 3.5 percent compared to the growth of 2.1 percent last year. The employment share by manufacturing sector has increased from 13.2 percent in 2009-10 to 13.7 percent in 2010-11.

However, the fact remains that the performance of industrial sector has remained below potential and is impediment in the way of sustainable economic growth and development. There are various reasons for the poor performance of industrial sector but the concern of the current paper is to examine the role of acute power crisis in the industrial downfall in Pakistan. A detailed analysis of deindustrialization and power crisis trend is made in this section.

III. 1 An Overview of 1970s

The industrial performance of Pakistan was satisfactory in the first two decades from the independence by incorporating the fact that the country had a negligible industrial base. The establishment of Pakistan Industrial Development Corporation (PIDC) in 1952 helped the economy to create an industrial base for self sustained growth. In 1970s, Pakistan adopted the Indian development strategy i.e. state led and heavy industry based industrialization strategy.

However, separation of East Pakistan, war with India, oil price shocks and the public deficits reduced the manufacturing growth from 7.8 percent in 1960s to 2.8 percent in 1970s (Federal Bureau of Statistics, 2011). The dismal performance of industrial sector in 1970s can't be attributed solemnly to the power shortage as the electricity situation was quite fair that time. The cost of production and demand of electricity were quite low as the total consumption of electricity in 1970s was 7739 GWH against the generation of 11373 GWH on average (Economic Survey of Pakistan, 2010).

III. 2 Moving towards Denationalization of Industrial Sector: 1980s

With the change in the government, the decade of 1980s witnessed the reversal of the policies of nationalization with the mixed economy and import substitution industrialization strategy.

There was denationalization in few industries but the public sector continued to invest in heavy industries. The expansion in domestic demand led to the industrial growth in that period almost equal to that of 1960s. With the outbreak of Afghan war, the country had inflow of foreign capital in form of assistance from United States of America and other financial institutions which helped the economy to progress. However, the industrial sector growth was unbalanced and so inefficient as most of the investment was concentrated in the textile and sugar industries and hence the value addition of industrial sector in GDP was 23.2 percent which was slightly above as compared to the 22.7 percent of 1970s (World Development Indicators, 2010).

On the other hand, with the increase in demand, the need for additional generation capacity was realized in the power sector in mid 1980s. The concept of Integrated Energy Planning and Policy Formulation (IEP) and the institutional structure was introduced in early 1980s as tried by developed and developing countries but over time IEP lost favor with

international institutions on the presumption that market forces would lead to the right policy choices. And the task was given to private sector in the form of Independent Power plants (IPPs) gradually, instead of adding the additional capacity in public sector, which was the first step towards the power crisis to be emerged in the following years.

III. 3 Low Growth of Industrial Sector and Rising Energy Shortages in 1990s

The industrial sector performance was disappointing in the 1990s as the growth of large scale manufacturing reduced to 4.7 percent in the first half and 2.5 percent in the second half of the decade from the 8.2 percent in 1989 (Federal Bureau of Statistics, 2011). The implementation of reforms suggested by the "Washington Consensus" and Structural Adjustment Program by International Monetary Fund (IMF) lead to the privatization, liberalization and deregulation which created an anti-industrialization bias in the country as the economy moved to more service sector based economy. The value addition of industrial sector in GDP was 24.3 percent for the decade against the 49.4 percent value addition by the services sector. Following the reforms, 1994 power policy was announced which was declared as the "Deal of the Decade" by the global investors. The policy was based on the cost-plus-return basis with 15-18 percent internal rate of return along with the repayment of fixed as well as variable cost of production in terms of US dollars irrespective of the efficiency by the Pakistan Electric Power Company (PEPCO)/WAPDA and Karachi Electric Supply Company (KESC) (Munir and Khalid, 2012). The policy clearly marked the accumulation of the acute circular debt with the devaluation of the Rupee in the 2000s.

III. 4 Sufferings of Industrial Sector and Energy Crises: 2000 onward

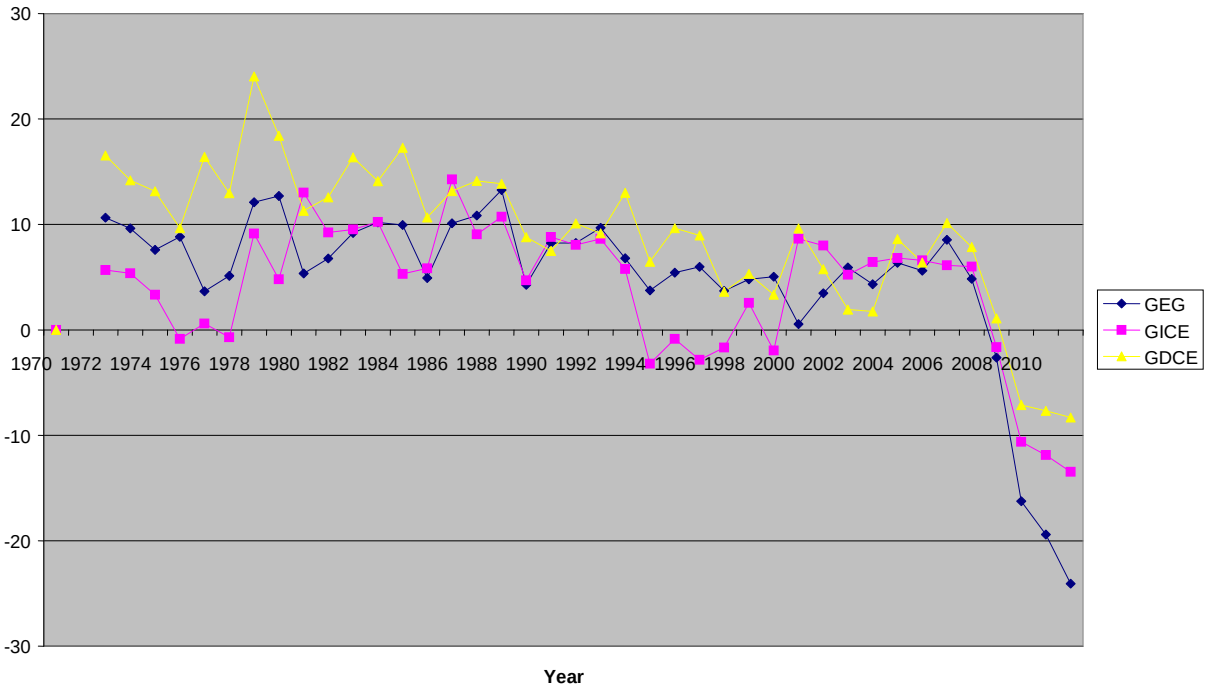
The industrial performance of Pakistan from 2000 till 2010 was highly volatile as the growth rate of industrial sector was as high as 12.1 percent in 2005 while it drastically declined to -3.6 percent in 2009. Similarly the large scale manufacturing growth declined to -7.7 percent from 19.9 percent in the same time period. On the contrary, the growth rate of services sector was satisfactory at 3.6 percent in 2009 although it also declined from 8.5 percent growth in 2005 (Economic Survey of Pakistan, 2010). The first half of the decade was accompanied by sound macroeconomic policies, strengthening domestic demand, suitable financial conditions and stable exchange rate which encouraged the industrial sector growth. However, in the late half, severe energy shortages, global recession of 2008, oil price hike and sharp depreciation of Rupee in terms of US dollar led to the decline of industrial sector growth (Jaleel, 2012).

The decade of 2000s can be considered as the decade of power crisis as the economy faced the electricity problem which has never been experienced before. On one hand, the demand of electricity is rising enormously e.g. the number of electricity consumers has increased from the 7.9 million in 1992 to 19.9 million in 2008 while on the other hand the shortfall was recorded to be 37 percent as demand of electricity was 11,509 MW against the supply of 7237 MW (Khan, 2012). These issues are the direct outcome of poor power policy which has been adopted in 1994 and was followed in 2002 power policy. Despite knowing the fact that Pakistan has advantage in hydropower, the fuel mix between hydro and thermal was modified from 60:40 in 1980 to 30:70 in 2000 which raised the cost of generating electricity from PKR 1.03/kWh by WAPDA to PKR 9.58/kWh by IPPs thermal power plants (Munir and Khalid, 2012). Additionally, the fiscal crunch faced by the government has led to the inability to pay the debt to IPPs and further aggravated the situation as electricity generation is not meeting the demand and the industries are forced to be shut down or to move the entire set up elsewhere. The IEP is in

focus again for its effectiveness in the current shortfall in energy sources, enhancing utilization of existing resources with development of optimum energy mix.

In short, industrial sector growth has gradually inclined with the power shortage as represented by figures and facts in above discussion. Finally, the growth trend in industrial and domestic consumption of electricity with power generation is displayed in figure 1.

Figure 1
Electricity Generation and Consumption Growth



The growth rate of power generation is highly volatile and has remained lower than domestic use of electricity throughout the time. For industrial use a large gap is observed among demand and supply reinforcing rising power crises over time. The growth touched negative digits in last years and so is the case for electricity consumption.

This completed overview of Pakistan's economy for power crises and industrialization trends.

IV. Methodology and Data Description

IV.1 Model Specification and Data Description

In order to achieve the objectives of the research, variables related to power sector like power generation, domestic and industrial consumption volatility of electricity, energy imports and inflation are included in the deindustrialization equation. Following is the equation for estimation.

$$IGDP_t = \alpha_0 + \beta_1 GEG_t + \beta_2 GDCE_t + \beta_3 VGICE_t + \beta_4 INF_t + \beta_5 GIIMP_t + \mu \qquad \textbf{(1)}$$

Where,

$IGDP_t$ = Industrial share in GDP (%)

GEG_t = Growth rate of Electricity generation (Gwh)

$GDCE_t$ = Growth rate of domestic consumption of electricity (Gwh)

$VGICE_t$ = Volatility in Industrial consumption of electricity (Gwh)

INF_t = Inflation (annual CPI growth)

$GIIMP_t$ = Growth rate of industrial imports[2]

The share of industrial sector as % of GDP, dependent variable, is used to measure the deindustrialization time path for Pakistan over the period of 1970-2010. The electricity generation and consumption are measured in Gwh and are expected to have a positive relationship with industrial share in GDP. However, the disaggregated industrial and domestic need for electricity may yield variant effect as the electricity shortage makes the nature of domestic and industrial demand rivalry. The industrial use may be significant in promoting industrial sector but domestic use may or may not be significant. The power generation is

[2] Trade liberalization and industrial policy dummies were used in the model as exogenous variables. For trade liberalization and industrial policy, a value 1 is assigned to post-trade liberalization period i.e., 1988 onward and to successful 5 year industrial plans compared with base category i.e., assigned value 0, pre-trade liberalization period and unsuccessful industrial policies, respectively. The variable on electricity loss was also added but dropped in final model for being insignificant.

expected to affect industrial sector positively. The industrial consumption volatility is expected to affect industrial sector sternly.

The industrial imports are measured in million rupees and the variable is expected to promote the industrial sector due to heavy reliance on imports, import intensity of industrial production and a meager and less competitive export base. The data on all variables is collected from Handbook of Statistics (SBP) and Economic Survey (various issues).

In order to measure the uncertainty in power generation and consumption, volatility of the series was derived using Generalized Autoregressive Conditional Heteroscedasticity (GARCH) technique. Following Aizenman and Marion (1993), the forecasting equation is specified as below to determine unexpected part as measure of uncertainty for industrial consumption.[3]

$$P_t = \alpha_1 + \alpha_2 T + \alpha_3 P_{t-1} + \alpha_4 P_{t-2} + \varepsilon_t \qquad (1)$$

where *P*t is the variable under consideration, *T* is time trend; a_1 is an intercept, a_3 and a_4 are the autoregressive parameters and e_t is the error term. After estimating eq (1), the Garch term (σ^2) will be regressed on one year lag of error term square and its own lag. Following is the equation for that purpose:

$$\sigma^2 t = \gamma_0 + \gamma_t \varepsilon_{t-1}^2 + \delta_t \sigma_{t-1}^2 \qquad (2)$$

IV.2. Estimation Technique

The short and long run effect of volatile energy consumption by industrial sector, power generation and other selected variables on emerging phenomena of deindustrialization is assessed through Johansen (1998) and Johansen and Juselius (1990) cointegration technique. The non-stationary nature of time series is checked first through Augmented Dickey Fuller (1979) that serves to identify the order of integration of all variables in the model. The ADF test includes the estimation of the following regression.

[3] The volatility was appeared to be statistically significant only for industrial consumption of electricity following eq (2). The significance and graph of volatility series is given in appendix Table A1 & Figure A 1.

$$\Delta X_t = \alpha + \beta t + \gamma_i X_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-1} + \epsilon_t \quad (1)$$

Where X_t is the variable under consideration, Δ is the first difference operator, t captures the time trend, ϵ_t is the random error term and n is the maximum lag length. The optimal lag length is determined to ensure that the error term is white noise, while α , β , γ and φ are the parameters to be estimated. The non rejection of the null hypothesis depicts the presence of unit root. Hereafter, the selection of an optimal lag length is essential at the onset of cointegration analysis because multivariate cointegration analysis is very sensitive to the lag length selection. This would be done with the help of two available criterions namely Akaike Information Criterion (AIC) and Schwarz Information Criterion (SC).

IV. 2. I Johansen Cointegration Test

Next step in the estimation procedure is the application of Johansen Cointegration test that proposes two tests namely Trace test (λ_{trace}) and maximum Eigen test (λ_{max}) used to determine the existence and number of cointegrating vectors in the model. The null hypothesis under the trace test is that the number of cointegrating vectors is less than or equal to r where r = 0, 1, 2, 3…, etc. While, in the null hypothesis for Eigen test the existence of r cointegrating vectors is tested against the alternative of r + 1 co-integrating vectors.[4] The multivariate co-integration test can be expressed as:

$$Z_t = K_1 Z_{t-1} + K_2 Z_{t-2} + \ldots + K_{k-1} Z_{t-k} + \mu + \nu_t \quad (2)$$

[4] In case of divergence among the results of two tests, the λ_{max} test is recommended because it is more reliable especially in small samples (see Dutta & Ahmed, 1997 for reference).

Where Z_t ($GEG_t, GDCE_t, VGICE_t, INF_t, GIIMP_t$) i.e., a 6 x 1 vector of variables that are integrated of order one [i.e. I (1)], μ is a vector of constant and v_t is a vector of normally and independently distributed error term.

IV. 2. II

Vector Error Correction Model

The next step is to estimate the long run effects through Error Correction Model.[5] These effects should only be considered as the limit to which the behavior of dependent variable will tend towards, ceteris paribus. It should be taken into account which, up to a certain point, is the regulator of the behavior of the variable in the short run, as shown by Engle and Granger (1987). Equation (2) can be reformulated in a Vector Error Correction Model (VECM) as follows:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \ldots + \Gamma_{k-1} \Delta Z_{t-k-1} + \Pi Z_{t-1} + \mu + \nu t \qquad (3)$$

Where, Γi = (I – A_1 – A_2…–A_i), i = 1, 2, 3…k – 1 and Π = – (I – A_1– A_2 – A_3 … – A_k). The coefficient matrix Π provides information about the long-run relationships among the variables in the data. Π can be factored into αβ' where α will include the speed of adjustment to the equilibrium coefficients while the β' will be the long-run matrix of coefficients. The presence of r cointegrating vectors between the elements of Z implies that Π is of the rank r, (0 < r < 5).

V. Results and Interpretation

This section deals with the empirical findings and interpretation.

[5] It is important to point out that the long-run effects should be considered with some caution in that they are not the real measures, rather they can inform of what impact would be if economy had reached its equilibrium behavior.

V.1 Test for order of Integration

The stationary properties of the individual series are examined before proceeding to establish the long-run relationship. The unit root test results reported in Table 1 yields the existence of unit roots at level but stationary at its first order.[6] All the variables in the model are integrated of order one i.e., I (1) and allows to proceed with the cointegration process.

Table 1
Unit Root Test

Variables	Level	First difference	Order of Integration
IGDP	-2.895	-6.442	I (1)
GEG	-0.457	-5.88	I (1)
GDCE	-3.475	-8.080	I (1)
VGICE	-3.527	-7.229	I (1)
INF	-3.086	-6.100	I (1)
GIIMP	-0.217	-4.331	I (1)
1 % critical value	-4.219	-4.219	

As mentioned in methodology, Johansen's maximum likelihood approach is used for the cointegration test. The optimal lag length is one according to the both criteria i.e., Akaike Information and Schwartz criterion (SIC) and is reported in Table A2.

V.2 Johansen Cointegration Test

[6] It is done with the intercept & trend option.

Table 2 reports the findings for co-integration based on Johansen-Juselius co-integration test. The maximal eigenvalue (λ_{max}) traces two cointegrating vector, suggesting a stable long-run relationship among selected variables. This implies that there exists a significant co-movement of selected variables in the long run. It is pertinent to mention that the results for error correction model are reported with 1 cointegrating vector because first, the 1st cointegrating vector has the highest eigenvalue and is therefore the "most associated with the stationary part of the model".[7] Second, the results yielded by the first cointegration vector are consistent with expectations and theory, as well. Hence, the first vector is normalized by the deindustrialization variable. The results for Johansen Cointegration in Table 2.

Table 2
Johansen's Cointegration Test Results

Null Hypothesis	Alternative Hypothesis	Trace test Maximal		Eigenvalue test	
		Statistics	95 % critical value	Statistics	95 % critical value
r = 0	r = 1	153.02*	95.75	59.47*	40.07
r ≤ 1	r = 2	93.54*	69.81	46.42*	33.87
r ≤ 2	r = 3	47.12	47.86	22.81	27.58

Note: * implies that null hypothesis is rejected at 5 % confidence level.

[7] See, Johansen and Juselius (1995) for fuller discussion on this issue.

The short-run dynamics of the industrial share in GDP was estimated following general-to-specific modeling approach. The results for the Error Correction Model for deindustrialization are reported in Table 3.

Table 3

Error Correction Results for Deindustrialization

Variables	**ECM based on Johansen Technique (se in parentheses)**
Constant	-18.13
GEG	0.46* (0.08)
GDCE	0.075 (0.07)
VGICE	-0.05** (0.02)
INF	0.25* (0.03)
GIIMP	1.26E-05* (1.4E-06)
ECT	-0.3185 (0.098)
Diagnostic Tests	
R^2	0.46
F statistic	3.00
Normality test (Cholesky)	$\chi^2(6) = 1.858$ (0.932)
Serial Correlation (LM stat)	30.44 (0.729)

Note: 1. **, * indicates statistical significance at 5 % and 1 % l, respectively.
2. p- values in parentheses of diagnostic tests.

The results reported in Table 3 postulate a long run significant relationship among variables. A number of diagnostic tests are applied to the Error Correction Model. R^2 implies that model is a good fit. The serial correlation-Lagrange Multiplier test indicates no signs of autocorrelation of the residuals. Normality test, based on χ^2 statistic, does not reject the null hypothesis of residuals multivariate normality.

The electricity generation growth appeared to be statistically significantly positive, as expected and is highest among all variables in terms of magnitude i.e., 0.46 % in affecting the industrial share in GDP. It is obvious from the findings that the power shortage is accountable in de-industrializing Pakistan's economy in the long run as perceived in section III. Pakistan has long been relying on imported coal and furnace oil for thermal power generation that kept on adding energy bill. The level cost of electricity generation form conventional coal is 9.96 according to 'US Department of Energy Estimates 2012' published in Energy Outlook. Since 1990, the price of electricity has gone up approximately 530 % for the average consumer, as the energy mix of the country gradually turned from cheaper hydropower to thermal power.

In the 1980s, the country's electricity generation was based on a fuel mix of approximately 60:40 percent in favor of hydropower versus thermal. A dramatic change was observed in 90s in fuel mix and was switched to a fuel mix of 30:70 percent for hydropower versus thermal by the end of 2010. "According to a recent World Bank report, oil now accounts for nearly 40 percent of electricity generation with gas and hydropower at 29 percent each" (Trimble, Yoshida and Sakib, 2011).

Munir and Khalid (2012) provided, "the dramatic shift in generation source occurred because the 1994 power policy (and later the 2002 power policy) did not discriminate on the fuel source being employed and made the country hostage to fluctuations in international oil prices".

The incentives were given to Independent Power Producers in energy policy 1994 for thermal power units but economy faced a sharp rise in the price of electricity afterwards in 90s. The gap between growth rate of supply and consumption of electricity has widened afterwards till today. In this regards Asian Development Bank's Energy Outlook (2013) expressed, "despite economic rebound, the energy shortages have been constraining economic growth. Pakistan is faced with domestic energy supply shortages of coal, oil and natural gas, as well as a shortage of hydro generation capacities. These fuel constraints have severely affected the power sector, resulting in a significant decline in the power production". The lack of concern for the proper source of fuel for electricity generation has added to the existing shortage. To this end, it has raised the overall cost of electricity generation and created acute power shortage.

The new energy policy 2013 of Pakistan imposes to privatize the inefficient state owned thermal power plants like 1980s and 1990s in the wake of neo-liberalism. This is decided with the perception of reduction in reliance on expensive oil imports, new hydro power plants and pay off a chain of debt. The National Power Policy has focused on ending of load shedding and reducing electricity cost to single digit, from around Rs 15 per unit by 2017.

The power supply shortage can't be overcome till the proper measures taken up for implementation plans and operational strategies. The National Power Policy 2013-18 can be turned up as a good policy by implemented a number of proposed measures including privatization of state-owned electricity firms as they are suffering from inefficiency and are expensive, World Bank financing for hydro projects, elimination of power sector subsidy, coal corridor to generate 6,000-7,000 MW of electricity, energy conservation, restructuring of water and power ministry and formulation of regional transmission and power trading system opted for ending load shedding, reducing electricity cost to single digit and less reliance on imported

energy. From the industrial sector's perspective the new ways of power generation can enhance its contribution in total GDP, albeit the success lies in implementation

The power generation shortfalls transmitted into uncertain consumption of energy for industrial use. According to findings, the volatile industrial consumption has declined industrial share by 0.05 % in total GDP over 1970-2010.[8] The high energy prices, power breakdowns and relentless load shedding made industrial consumption highly uncertain and have long been upsetting the industrial production. The supply of power should be continuous and price competitive for industrial sector to enhance its production. According to World Bank and Asian Development Bank reports, the 3 % reduction in GDP is due to energy crises in the country where industrial sector had once its major share. But it is gradually declining its share due to energy crises. The gap in growth of demand and supply should be minimized in order to make certain and steady power flow to the most critical sector of the economy i.e., industrial sector. If not done so this can hit hard the overall economy in the long run in future. The figures say that 44 % of thermal fuel resources make electricity expensive and 25-28 % loss occurs due to mismanagement in power transmission, theft and poor infrastructure.[9] With reference to deindustrialization the growing capacity in energy can lead towards growing capacity of industries not only in its share in GDP but also in employment as the industrial sector is major employment absorbing sector more than services sector. Whatever path country opted for eventual structural transformation, the historic and momentous role of industrial sector in overall development and growth can't be abandoned.

[8] The appendix table A1 and Figure A1 depicts the significant volatility measure from GARCH in industrial energy consumption. Besides, the domestic power consumption appeared insignificant in results.

[9] In this study, the electricity loss in distribution appeared as insignificant to industrial share in GDP hence, dropped from the model.

The energy imports have a significant and positive impact on the industrial share in GDP. The result shows a nominal but significant role of industrial imports in industrial growth. The industrial sector needs imported material and technologies because of import intensity of production and consumption along with lower export upgrading and diversification. According to our findings, the role of industrial imports has appeared as positive but it is generally considered to hamper economic growth by deteriorating its external balance. With the every import bill rise the economy can face imbalance in trade. However, the positive impact is quite negligible and dependence on imports can be overcome by additional and dedicated efforts to expand export base as the reliance of economy is increasing on industrial imports inspite of opting for export-promotion policies in 90s onward. The switch from import substitution policies to export-promotion strategies could not develop industrial base and the excessive protection till 1990s made industries rather inefficient and less competitive.[10] This is worth mentioning that purpose is not only to re-industrialize the economy; it is also to enhance the capacity and growth of industrial sector to promote employment generation.

The relationship between industrial share and inflation appeared as positive. The findings are consistent with the type of inflation i.e., cost-push inflation indicating a match between a rising cost of production and herewith rising inflation of consumer goods. The rising prices of consumer goods can serve as an incentive to producers to enhance industrial production hence, its share in GDP. Such behavior can also be explained by the 'misperception theory' of on the part of producers and also by 'Tobin effect' that explains a positive link between inflation and higher output.

[10] Hypothetically, the industrial imports may have bidirectional relationship with industrialization but the empirical findings from the Granger Causality between IIMP and IGDP depicted only one-way pass through to industrial share of GDP from industrial imports.

From the experience of countries, the literature on inflation poses a positive impact of inflation on economic growth at low or moderate level of inflation whereas negative at higher level of inflation. Similarly, positive impact for single digit inflation while negative impact for double digit inflation is observed on economic growth [Phillips (1958) Nell (2000) Mallik and Chowdhury (2001)]. In that regards, this can be perceived that whenever economy enters into double digit inflation it would hit the industrial sector hard.

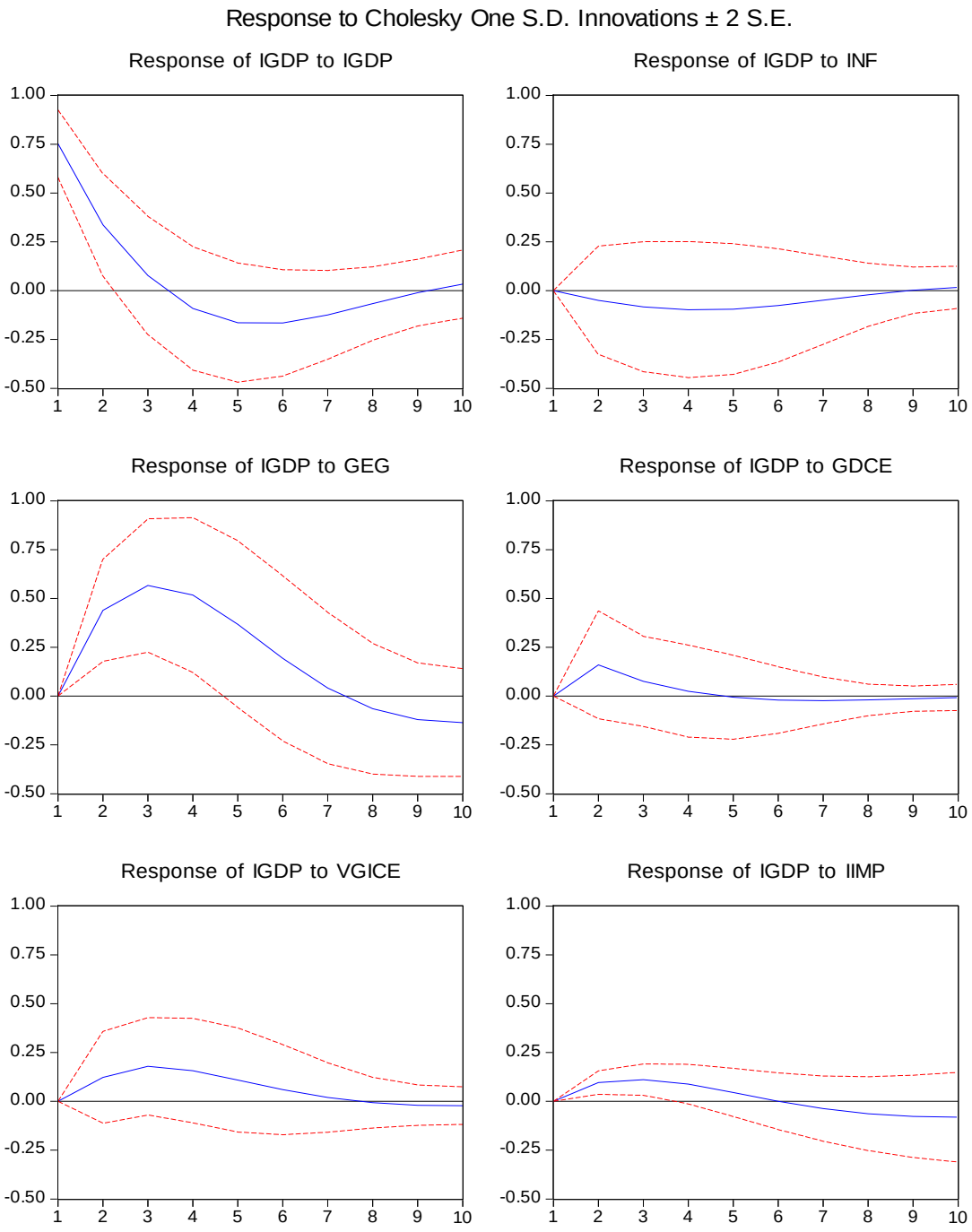
The Error Correction Term (ECT) represents the percentage of correction to any deviation in the long-run equilibrium level of deindustrialization in a single period and also represents how fast the deviations in the long-run equilibrium will be corrected. The coefficient of the ECT, measuring the speed of adjustment, appears to be negatively significant i.e., -0.318 reflecting the model stability. The value of ECT implies a marginal rate of convergence to equilibrium over a period of 10 years and implies that in any disturbance in the system of industrial share in GDP in the long run, 0.318 percent correction to disequilibrium will take place each year.

V.3 Impulse Response Function (IRF) and Variance decomposition

The responses of deindustrialization to one standard deviation shock to selective variables are presented in Figure 2. The first graph shows model's stability and displays that one time shock toward industrial share will eventually converge to its equilibrium in next 10 years. The response of inflation, volatility of industrial consumption of electricity and domestic consumption growth has appeared as insignificant whereas the response of industrial share to one s-d shock to generation and industrial imports are significant. Notwithstanding, the electricity generation shows a rising trend in industrial share in GDP till 3rd year and than declines,

touching negative zone, but does not show tendency to converge till the end of 10^{th} year. This implies that electricity generations shocks have long run impact on industrial sector. The one time shock is persistent and sequel for deindustrialization. According to IRF, the response of industrial share in GDP to one time shock to inflation, domestic consumption of electricity and industrial consumption volatility will converge to equilibrium line after 9 years of shock.

Figure 2 Response of De-Industrialization to Power Generation, Domestic Consumption and Industrial Consumption Volatility, Inflation and Industrial Imports



Similar are the findings from variance decomposition reported in Table 4. That portrays and identifies electricity generation growth (GEG) as the major contributor for the next 10 years

towards industrial sector's worth in the economy. It is worth mentioning that its contribution in forecasted error will increase gradually over the time. The electricity generation and industrial consumption volatility contributes to industrial share standard error negligibly but at longer time horizon that explain around 50 percent of the forecasted error variance of industrial share in GDP. The industrial share is contributing 73 % in 1st year but then declining to 40 %. Industrial consumption volatility is contributing around 4 % of variations while the rest of the variations in the forecasted error of deindustrialization is due to the other variables included in model.

Table 4

Forecast Error Variance Decomposition (%)

Period	Forecasted standard error	Industrial share in GDP	Electricity Generation Growth	Industrial Consumption Volatility	Inflation
1	0.752941	100.0000	0.000000	0.000000	0.000000
2	0.961956	73.55454	20.81417	1.615167	0.264892
3	1.143897	52.47500	39.20005	3.590812	0.712668
4	1.275434	42.72156	47.96662	4.405961	1.157688
5	1.346050	39.84180	50.52904	4.615723	1.532751
6	1.373335	39.72425	50.50973	4.621744	1.779320
7	1.381248	40.07852	50.02002	4.588492	1.884827
8	1.386109	40.02647	49.88767	4.558937	1.894833
9	1.393718	39.59599	50.09299	4.529756	1.874369
10	1.403368	39.10992	50.34025	4.492912	1.863517

This completes the discussion of results and now we turn to conclude the overall study.

VI. Conclusions and Policy Suggestions

The paper endeavored to assess the role of electricity demand, supply and industrial consumption volatility on the industrial share in GDP. The declining share of industrial sector has raised question of the nature of such trend. Some regarded it as a pathological problem, where it stops the economy from being able to achieve its full potential of growth, employment and resource utilization while some other consider it a premature de-industrialization for countries. Kaldor, in seminal contribution (1966, 1967) emphasized on the spillover effects of industrial development due to its dynamic economies of scale, such that faster the growth of manufacturing output, the faster the growth of manufacturing productivity. In that regards, the industrial sector has long been considered as an engine of growth. Kaldor (1966) materialized, "on the supply side, industrial sector has greater potential for productivity growth and hence, for employment generation as compare to services sector. While on the demand side the income elasticity of demand for manufacturing products was greater than that for agriculture". This perspective classifies industrial sector a critical sector of the economy having linkages with other sectors. The industrial exports are a major source of foreign exchange earnings in Pakistan and so is the significance of industrial sector for external balance.

The share of industrial sector in GDP and hence, in employment in Pakistan is not only declining but it is also at a much lower level of per capita income than in the case of today's developed countries. Shafedin (2005) suggested that, "a premature decline in industry value added as percentage of GDP without recovering is due to re-orientation of the production structure of the economy from import substitution strategies towards production on the basis of static comparative advantage due to trade liberalization". The findings by Dasgupta (2006) suggested that manufacturing sector continues to be a critical sector in economic development,

but services sector also made a positive contribution in a number of developing countries like India. Conclusively, the services sector can be considered as an additional engine of growth provided that a well-developed and diversified industrial base has already been developed in the economy.

The findings of this study connote the role of electricity generation and industrial consumption volatility along with industrial imports in industrialization of Pakistan's economy. The power shortage and uncertain industrial consumption have significant and positive impact on the industrial share GDP. The role of energy sector in industrial share is pointed out as major by forecasted Impulse Response Functions and Variance Decomposition results also. The electricity generation will have maximum contribution to explain forecasted errors/variations in industrial share in GDP in next 10 years and may have a persistent and long lasting effect of its shock, as emerged from findings. Keeping in view the gravity of power crises and intensity of the issue in making industrial sector vulnerable to internal and external shocks, an adequate and pertinent power policy is still awaited to be implemented in Pakistan. The policy target should be focused on findings cheaper and sustainable energy alternate to electricity like small hydropower projects, lower reliance on imported oil and better provision of gas and coal to efficient power firms and extraction of new coal sources to end the power shortage. Consequently, it will made industrial consumption of electricity more certain and industrial output can come out of energy crises trap rendering a U turn in industrial sector performance..

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Appendix

Table A1
Volatility of Industrial Consumption of Electricity

*GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)*			
Variable	Coefficient	Std. Error	Prob.
C	7.137974	6.913685	0.3019
RESID(-1)^2	-0.225884	0.154326	0.1433
GARCH(-1)	0.850106	0.323772	0.0086

Table A2
VAR Lag Order Selection

Lag	SC
0	36.126
1	35.667*
2	51.97
3	52.38
* Indicates lag order selected by criterion.	

Figure A1
Industrial Power Consumption Volatility