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

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1. INTRODUCTION

The term deindustrialisation refers to the process of socio-economic changes taking place due to reduction in the industrial capacity and/or the loss of industrial potential of an economy. This also connotes the secular decline in the share of industrial sector employment as observed in developed countries since 1970s. The secular shift from manufacturing to services sector reflects the impact of discrepancy in productivity growth between the said sectors. A faster rise in productivity in manufacturing sector than in services switches the employment from manufacturing to the services sector, as suggested by Rowthorn and Ramaswamy (1997).

Generally, deindustrialisation is considered as the natural outcome of economic development because it involves the transformation from primitive agriculture-based economy to the modern industrial-based. After the establishment of manufacturing sector, the long-run economic growth stimulates an innovation-based economy implying the services sector's growth [Galor (2005)]. However, the process requires a gradual shift accompanied by allied institutional and infrastructural reforms and the process of deindustrialisation occurs at the later stage of development.

The economic history of today's developed world discloses that the process of deindustrialisation started in these economies in late 1970s and the share of industrial output and employment tended to fall since then. Comparatively, in the developing world several attempts have been made for industrialisation, for sustainable economic growth. But, most of these were unable to develop their industrial sector and hence they are lagging behind the others in the pursuit of economic development. This inability can be attributed to the policy bottlenecks and the challenges faced by the industrial sector that lead toward the path of deindustrialisation, in contrast to the developed world. Such economic scenario is termed as 'premature deindustrialisation' in the literature.[1] Such deindustrialisation can have negative implications for the economy because the labour shed from industries may not be absorbed into the services sector and hence leads to

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[1]See Dasgupta and Singh (2006), p. 2 for reference.

rising unemployment in the economy. Moreover, the vulnerable growth of industrial sector may negatively affect the growth of other sectors due to its forward and backward linkages to the other sectors in economy.

The economy of Pakistan has been facing inconsistent industrial policies, liberalisation reforms and the macro-economic challenges in the form of energy crisis and political instability that ultimately reduced the potential of industrial sector. The country has been facing deindustrialisation since 1990s and the efforts to put the sector back on its trail are all in vain. 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. In this regard, deindustrialisation in Pakistan with sup-optimal industrial growth can be attributed to the energy crises that prevented the industries to operate at their capacity level and hereby lowered the output growth. A consistent attrition in the economy's growing capability and the domestic energy shortages and excessive rise of electricity prices can be considered as factors thwarting the sector's competitiveness, as well.

In view of 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 crises has played its role in deindustrialising 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 Function (IRF) and Variance Decomposition are obtained to observe the effect of shocks to selective variables on the industrial share in GDP and to forecast the future role of the factors 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 organised as follows. Second section deals with the literature review. Third part discusses the trends of industrial sector growth and evolution of power sector in Pakistan. Fourth section discusses the 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 possible impact of power sector crisis on the process of deindustrialisation is important as it provides the theoretical and empirical support to the analyses undertaken. The literature provides empirical evidence for the determinants of deindustrialisation in developed and developing economies, generally and is discussed below.

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 labour abundant developing countries [Alderson (1999); Lee and

Wolpin (2006)]. Alderson (1999) analysed the impact of globalisation on the process of deindustrialisation 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 deindustrialisation 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 deindustrialisation.

Nickell, *et al.* (2008) explained that across the OECD countries, difference in the pace of deindustrialisation 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 deindustrialisation.

2. Evidence from the Developing World

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

Noorbakhsh and Paloni (1999) considered the Structural Adjustment Programme (SAP) of IMF and World Bank as responsible for the low per capita growth of Sub-Saharan Africa claiming that SAP has resulted in the declining performance of industrial sector as compared to the period before the adoption of SAP. And SAP could not lead towards a rise in the export competitiveness of industrial sector with presumably attached technology transfer.

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

For the Latin American countries, Brady, *et al.* (2008) suggested that de-industrialising 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. DEINDUSTRIALISATION AND POWER CRISIS IN PAKISTAN: AN OVERVIEW

The industrialisation has been considered as engine of growth 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 overall economic development. The historical evidence portrays that currently developed countries have developed with the help of sound industrialisation 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 contributes 20.9 percent to GDP having sub-sectors: manufacturing, construction, mining and quarrying and electricity and gas distribution. According to *Economic Survey (2012-13)*, the growth of 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 deindustrialisation and power crisis trend is made in this section.

1. An Overview of 1970s

The industrial performance of Pakistan was meander in the first two decades, in view of the 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 of state-led and heavy industry based industrialisation. However, separation of East Pakistan, war with India, oil price shocks and the public deficits reduced the manufacturing growth in 1960s from 7.8 percent to 2.8 percent in 1970s [Federal Bureau of Statistics (2011)]. The dismal performance of industrial sector in 1970s cannot be attributed soley to the power shortage as the electricity situation was quite good 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 [Pakistan (2010)].

2. Moving towards Denationalisation and Industrial Sector: 1980s

With the change in government, decade of 1980s witnessed the reversal in policies which moved towards the denationalisation with the mixed economy and import substitution.

The denationalisation took place in few industries but the public sector continued to invest in the 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 USA and other financial institutions. However, the industrial sector growth was unbalanced and most of the

investment was concentrated in the textile and sugar industries. The value addition of industrial sector in GDP was 23.2 percent with a nominal rise from previous year's figure i.e., 22.7 percent [*World Development Indicators* (2010)].

On energy front, the need for additional power generation capacity was realised 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 but gradually lost its favour with international institutions on the presumption of market forces leading towards right policy choice. And the task was given to the private sector in the form of Independent Power plants (IPPs) instead of adding the additional capacity in public sector, the first step towards the power crisis emerged in the following years.

3. Declining Industrial Growth and Rising Energy Shortage: 1990s

The industrial sector performance was disappointing in the 1990s as the growth of large scale manufacturing sector that was 8.2 percent in 1989 reduced to 4.7 percent in the first half and 2.5 percent in the second half of the decade [Federal Bureau of Statistics (2011)]. The implementation of reforms suggested by "Washington Consensus" and Structural Adjustment Programme by International Monetary Fund (IMF) led to the deregulation which created an anti-industrial bias in the country and economy observed a sharp move towards services sector growth thereafter. The value addition of industrial sector in GDP was 24.3 percent for the decade against the 49.4 percent by the services sector. Following the reforms, the new power policy was announced in 1994. The policy was based on the cost-plus-return 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.

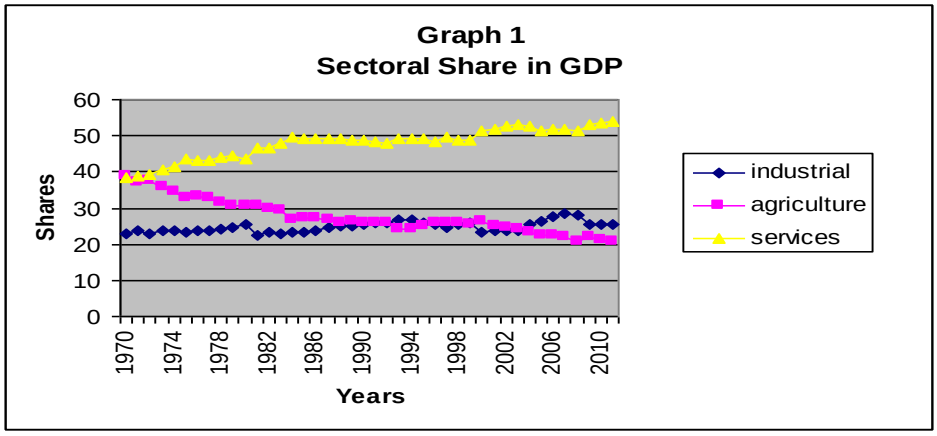
4. Sufferings of Industrial Sector and Energy Crises: 2000 Onwards

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 lower than 2005s figure i.e., 8.5 percent [Pakistan (2010)]. The first half of the decade was accompanied by sound macroeconomic policies, strengthening domestic demand, suitable financial conditions and stable exchange rate that encouraged the industrial sector growth. However, in the later half, severe energy shortages, global recession of 2008, oil price hike and sharp depreciation in the local currency led to the decline of industrial sector growth [Jaleel (2012)].

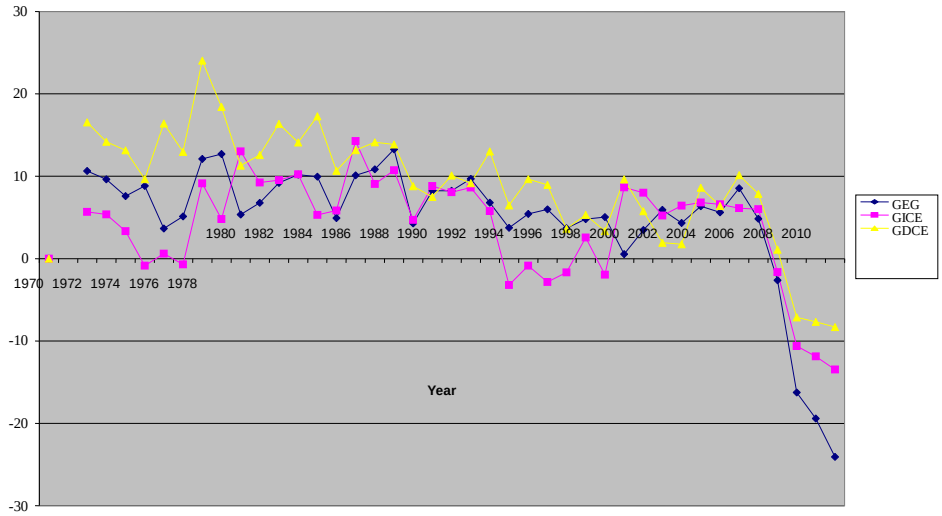
The decade of 2000s can be considered as the decade of power crisis as the economy faced such electricity problems which have never been experienced before. On the one hand, the demand of electricity is rising enormously and the number of electricity consumers increased from 7.9 million in 1992 to 19.9 million in 2008 while on the other hand, the shortfall was recorded to be 37 percent as demand for electricity was 11,509 MW against the supply of 7237 MW [Khan (2012)]. These issues are the direct outcome of poor power policy adopted in 1994 and 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 Rs 1.03 per kwh by WAPDA to Rs 9.58 per kwh by IPPs [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.

In short, industrial sector growth has gradually declined with the power shortage as represented by figures and facts discussed above. The comparison of sectoral share in GDP and growth trends in industrial and domestic consumption of electricity (gice, gdce) and power generation (geg) are displayed in Graph 1 and Graph 2, respectively. Graph 1 provides the sectoral share of industrial (ind), agricultural (agr) and services (serv) sector as percentage of GDP.



Graph 2: Electricity Generation and Consumption Growth



This portrays the emerging significance of services sector, which was taken up by traditional agricultural sector in Pakistan where agricultural sector's share declined over time while services sector's share increased on a sharp pace over the same time span. While the industrial sector has remained stagnant throughout the time period, maintaining a GDP share around 25 percent with nominal fluctuations. Such trends in sectoral shares in GDP indicate the industrial sector's status, which is functioning sub-optimally, on the one hand the services sector is replacing the other sectors of the economy.

According to Graph 2, the power generation appears highly volatile and has remained lower than domestic use of electricity throughout the time. For industrial use a wide gap is observed between demand and supply underpinning the rising power crises over time. Besides, the growth touched negative digits in last years and so is the case for electricity consumption. This completes the overview of Pakistan's economy for power crises and industrialisation trends. Now we turn to the methodology.

IV. METHODOLOGY AND DATA DESCRIPTION

1. Model Specification and Data Description

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

$$IGDP_t = \alpha_0 + \beta_1 GEG_t + \beta_2 GDCE_t + \beta_3 VGICE_t + \beta_4 INF_t + \beta_5 GIIMP_t + \mu \quad \ldots \quad (1)$$

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 deindustrialisation time path for Pakistan over the period of 1970–2010. The electricity generation and consumption are measured in Gwh and its growth rate is expected to have a positive relationship with industrial share in GDP. However, the disaggregated industrial and domestic need for electricity may yield variant effects as the electricity shortage makes the domestic and industrial sectors compete for energy. The industrial use may be significant in promoting industrial sector but domestic use may or may not be significant. The power generation is expected to affect industrial sector positively. The industrial consumption volatility is expected to affect industrial sector significantly.

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

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 meagre 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 Generalised Autoregressive Conditional Heteroscedasticity (GARCH) technique. Following Aizenman and Marion (1993), the forecasting equation is specified as below to determine the unexpected part as measure of uncertainty for industrial consumption.[3]

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

where P_t is the variable under consideration, T is time trend; α_1 is an intercept, α_3 and α_4 are the autoregressive parameters and ε_t is the error term. After estimating Equation (i), the Garch term (σ^2) will be regressed on one year lag of the error term square and its own lag. Following is the equation for that purpose:

$$\sigma^2 t = \gamma_0 + \gamma_t \varepsilon_{t-1}^2 + \delta_t \sigma_{t-1}^2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(ii)}$$

2. Estimation Technique

The short and long-run effect of volatile industrial energy consumption and power generation on emerging phenomena of deindustrialisation is assessed through Johansen (1998) and Johansen and Juselius (1990) cointegration technique. The series is checked for stationarity purpose by Augmented Dickey Fuller (1979) that serves to identify the order of integration of all variables in the model. ADF test includes the estimation of following regression equation.

$$\Delta X_t = \alpha + \beta_t + \gamma_i X_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-1} + \in_t \quad \ldots \quad \ldots \quad \ldots \quad \text{(iii)}$$

Where X_t is the variable under consideration, Δ is the first difference operator, t captures the time trend, $\in_t$ 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).

2.I. *Johansen Cointegration Test*

Next step in the estimation procedure is the application of Johansen Cointegration test. This proposes two tests namely; trace test (λ_{trace}) and maximum eigen test (λ_{max}) in order to determine the existence and number of cointegrating vectors in the model. The

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

null hypothesis under the trace test is that the number of cointegrating vectors is less than or equal to *r* where $r = 0, 1, 2, 3\ldots$, 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:

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

Where Z_t ($GEG_t, GDCE_t, VGICE_t, INF_t, GIIMP_t$) i.e., a 6 x 1 vector of variables of I (1) where I (1) refers to the integration of order 1, μ is a vector of constant and ν_t is a vector of normally and independently distributed error term.

2.2. Vector Error Correction Model

The next step is the application of the vector Error Correction Model (VECUM). The model yields the effects which are considered as the limit to which the behaviour of dependent variable will tend, ceteris paribus. The regulator of the behaviour of the variable in the short run is taken into account, up to a certain point, as shown by Engle and Granger (1987). Equation (ii) can be reformulated in a Vector Error Correction Model (VECM) as follows:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \ldots + \Gamma_{k-1} \Delta Z_{t-k-1} + \Pi Z_{t-1} + \mu + \nu_t \quad \ldots \quad \ldots \quad \text{(v)}$$

Where, $\Gamma i = (I - A_1 - A_2 \ldots - A_i)$, $i = 1, 2, 3 \ldots k - 1$ and $\Pi = -(I - A_1 - A_2 - A_3 \ldots - A_k)$. 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, $(0 < r < 5)$.[5]

V. RESULTS AND INTERPRETATION

This section deals with the empirical findings and interpretation.

1. Test for Order of Integration

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

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 and is reported in Table A2.

[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 and Ahmed (1997) for reference].

[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 behaviour.

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

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	

2. Johansen Cointegration Test

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 the existence of 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 keeping in view that; 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 normalised by the deindustrialisation variable and the results are reported in Table 2.

Table 2

Johansen's Cointegration Test Results

		Trace Test Maximal		Eigenvalue Test	
Null Hypothesis	Alternative Hypothesis	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 percent confidence level.

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

The results reported in Table 3 postulate a long-run relationship among the 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 growth rate of electricity generation appeares as significantly positive, as expected and the coefficient is highest (0.46 percent) among all other parameters. It is obvious from the findings that

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

the power shortage is partly responsible for de-industrialising 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 the energy bill.

Table 3

Error Correction Results for Deindustrialisation

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)	χ^2 (6) = 1.858 (0.932)
Serial Correlation (LM stat)	30.44 (0.729)

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

According to 'US Department of Energy Estimates 2012', published in Energy Outlook, the price of electricity has gone up approximately 530 percent for the average consumer since 1990 due to the switch in the energy mix from cheaper hydropower to the thermal power in Pakistan.

In the 1980s, the country's electricity generation was based on a fuel mix of approximately 60:40 percent in favour 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 accounts for nearly 40 percent of electricity generation with gas and hydropower at 29 percent each.[8]

[8]C.f., 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 the 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 power generation shortfall makes the industrial power consumption uncertain. According to our findings, volatile industrial consumption has declined industrial share by 0.05 percent in total GDP over 1970-2010.[9] The high energy prices, power breakdowns and relentless load shedding made industrial consumption highly uncertain and have long been upsetting the industrial production. The gap in growth of power demand and supply is expanding due to rising population pressure and hinders the steady power flow to the most critical sector of the economy i.e., industrial sector. While the supply of power is required to be continuous and price competitive for industrial sector growth. If not done so, it can hard hit the overall economy. The figure says that 44 percent of thermal fuel resources make electricity expensive and 25–28 percent loss occurs due to mismanagement in power transmission, theft and poor infrastructure.[10] Regarding the emergence of services sector in Pakistan, the historic and momentous role of industrial sector in economic development can't be abandoned.

According to the findings, the industrial imports have 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 advanced technology due to the import-intensive nature of domestic production and consumption with a narrow export-base. Although, the industrial imports appeared as positively significant in affecting industrial sector's share in GDP but they are generally considered as an impediment to the economic growth by deteriorating its external balance. With the every rise in the import bill, the economy can face imbalance in trade. However, the

[9]The Appendix Table A1 and Figure A1 depict the significant volatility measure from GARCH in industrial energy consumption. Besides, the domestic power consumption appeared insignificant in results.

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

positive impact is quite negligible and dependence on imports can be overcome by additional and dedicated efforts to expand export base.[11] This is worth mentioning that purpose is not only to re-industrialise 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 theory of inflation indicating a link between rising cost of production and rising inflation of consumer goods. The rising prices of consumer goods can serve as an incentive to the producers to enhance industrial production and its share in GDP, consequently. Such behaviour can also be explained by the 'misperception theory' on the part of producers and also by 'Tobin effect' that explains a positive link between inflation and higher output.

From the experience of countries, the literature on inflation presents a positive impact of inflation on economic growth at low or moderate level of inflation whereas negative at higher level of inflation. Similarly, literature suggests positive impact for single-digit inflation while negative for double-digit inflation [Phillips (1958); Nell (2000); Chowdhury and Mallik (2001)]. Such evidences suggest that whenever the economy enters into double-digit inflation it will hit the industrial sector hard.

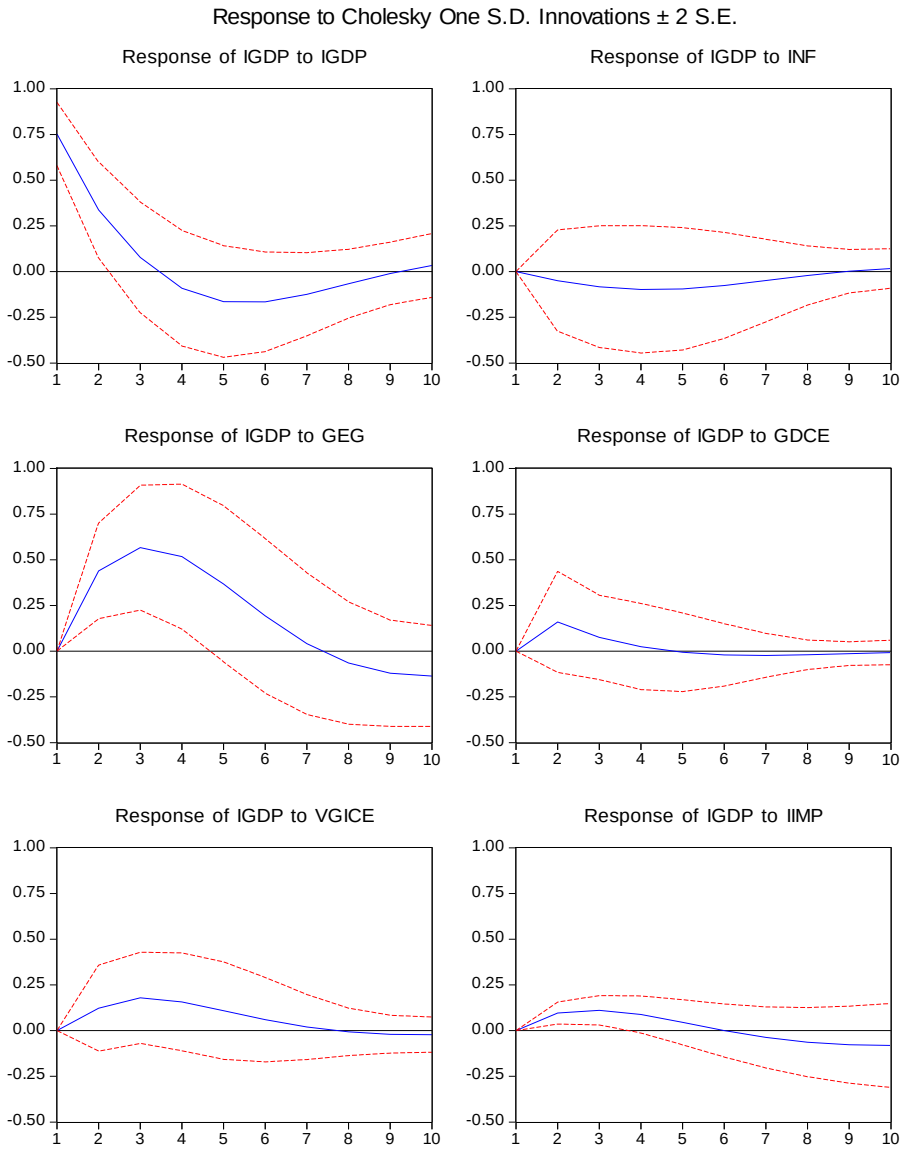
The Error Correction Term (ECT) represents the percentage of correction to the deviation in the long-run equilibrium in deindustrialisation and also represents how fast the deviations from the long-run equilibrium will be adjusted. According to the result reported in Table 3, the error correction term, 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 industrial share in GDP in the long run, 0.318 percent correction to disequilibrium will take place each year.

3. Impulse Response Function (IRF) and Variance Decomposition

The responses of deindustrialisation to one standard deviation shock to the selective variables are presented in Graph 3. The first graph shows model's stability and displays that one time shock to 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 have appeared as insignificant whereas the response of industrial share to one s-d shock to power generation and industrial imports is 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 10th year. This implies that electricity generations shocks have long-run impact on the industrial sector. The one time shock is persistent and sequel for deindustrialisation. According to IRF, the response of industrial share in GDP to one time shock to inflation, domestic consumption of electricity and industrial consumption volatility is likely to be converged towards the equilibrium after 9 years of shock.

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

Graph 3. Response of De-Industrialisation to Power Generation, Domestic Consumption and Industrial Consumption Volatility, Inflation and Industrial Imports



Similar are the findings from variance decomposition reported in Table 4. Thais identifies electricity generation growth (geg) as the major contributor to industrial sector's share in the economy. It is worth mentioning that its contribution in forecasted error increases gradually over the time. The electricity generation and industrial consumption volatility contributes to the industrial share's standard error negligibly but

in the long-term horizon it explains around 50 percent of the forecasted error variance of industrial share in GDP. The industrial share is contributing 73 percent in 1st year but then declines to 40 percent. Industrial consumption volatility is contributing around 4 percent of variations while the rest of the variations in the forecasted error of deindustrialisation are due to other selective variables.

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

VI. CONCLUSIONS AND POLICY SUGGESTIONS

The paper endeavoured 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 questions about the reasons of such trends. Some regarded it as pathological problem, where it stops the economy from being able to achieve its full potential of growth, employment and resource utilisation while some other considered it as premature de-industrialisation. Kaldor (1966, 1967) in his seminal contribution, emphasised on the spillover effects of industrial development due to its dynamic economies of scale.[12] The industrial sector has long been considered as an engine of growth, in that regards. Kaldor (1966) materialised,

> "on the supply side, industrial sector has greater potential for productivity growth and hence, for employment generation as compared 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 as a critical sector of the economy. The industrial exports are a major source of foreign exchange earnings in Pakistan. The share of industrial sector in GDP and in employment is not only declining in Pakistan but also 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

[12]Faster the growth of manufacturing output, faster will be the growth of manufacturing productivity.

static comparative advantage due to trade liberalisation". 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 to the industrialisation in Pakistan. The power generation and volatile industrial consumption have significant impact on the industrial share in GDP. The electricity generation will have the highest contribution to the forecasted variations in industrial sector's share in GDP in next 10 years according to variance decomposition and will have a persistent and long lasting effect of its own shock. In view of the gravity of power crises and intensity of the issue that made 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 finding 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 make industrial consumption of electricity more certain and industrial output can come out of energy crises trap rendering a U turn in industrial sector performance.

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

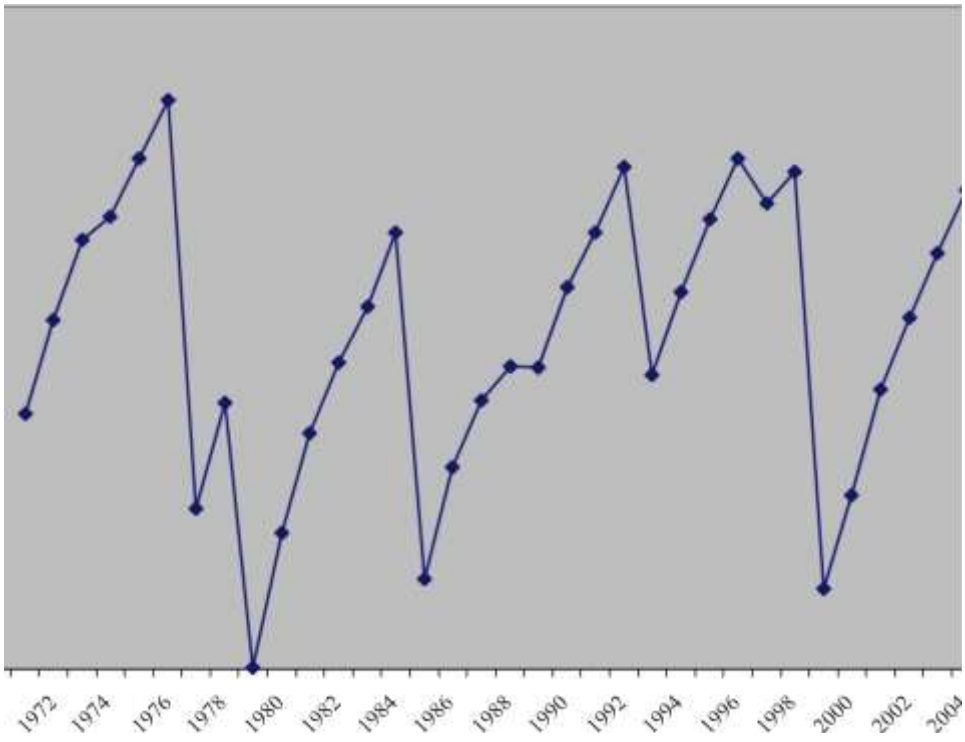
Table A2

VAR Lag Order Selection

Lag	SC
0	36.126
1	35.667*
2	51.97
3	52.38

* Indicates lag order selected by criterion.

Fig. 1. Industrial Power Consumption Volatility



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Comments

The paper titled "The Role of Power Generation and Industrial Consumption Uncertainty in De-industrialising Pakistan" is an interesting paper in the where the authors explores the reasons for reduction of manufacturing industry share in the GDP and having a lesser employment share in Pakistan.

Following are some of the observations which if incorporated may improve the quality of paper and in terms of contribution to the academic knowledge on the subject.

(i) Using terminologies like "de-industrialisation" needs a clear explanation at the very outset to make the reader more aware of what is to follow. Especially if the paper is going to extend the existing knowledge on that subject. In terms of how it should be accounted for. May be some cross country and Pakistan data tables could help more in terms of taking into account what is proposed.

(ii) When we talk specifically about the "premature de-industrialisation" then what exactly it means in terms of the variable we are referring to. e.g. if it is the industrial share in the GDP, then does that mean that some other sector is improving and why is it bad?

(iii) There are specific studies on the losses of employment and economic loss due to the load shedding. For example see our study titled " The Cost of Unserved Energy: Evidence from Selected Industrial Cities of Pakistan" published in *PDR*.

(iv) Using qualifiers such as …*as a rule of thumb, industrial sector has to face 33 percent*... needs citation. Referencing is in general weak.

(v) Data for 2014 publication needs an update especially if used from Economic Survey.

(vi) The Literature review is devoid of any study which studies the "premature de-industrialisation" the present study is discussing. I doubt it, it may be with some other name, such as the cost of unserved energy etc.

(vii) The variables in graph needs to be explained in terms of what they are referring to.

(viii) Some theoretical model has to be referred to.

(ix) The selection of variables seems arbitrary and without explanation. E.g. VGICE: volatility in industrial consumption of electricity, is not an exogenous variable or a variable of choice for the firms to take, its an out come variable, which may be due to one of the explanatory variables such as the growth of electricity generation and domestic use etc.

(x) Some other variables are missing in the specification for control such as the openness and law and order situation.

(xi) Uncertainty may not be the case here, its simply and excess demand situation with prices capped. Supply increases so will the utilisation increase.

(xii) The results for unit root test are not provided for inclusion of intercept and trend or there is no plot of the data. Further for robust results especially for data sets with structural breaks often PP test is also applied but not in this case.

(xiii) Results need a proper validation through cross referencing.

(xiv) Results such as *cost push inflation…consumer prices increase… incentives to producers…* is a bit A-theoretical. Like stagflation, but micro is more of a settled thing I guess.

(xv) Take the later half of first para and 2, 3rd paragraph in the situation analysis.

(xvi) Random thoughts should not be placed in the conclusion. References to be placed in the conclusion also needs a careful revisit. Conclusions such as employment share (it could be the absolute value) declining needs some evidence and not hard to get. Further basing policy recommendations which are not arrived at from the authors estimation should not be put forth.

(xvii) Editing is required.

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