Effect of Electricity Consumption & Pricing on Industrial Growth in India

In fulfilment of the course

ECON F266

Study Oriented Project

Submitted by
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To
Dr. Geetilaxmi Mohapatra

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I would like to thank Dr Geetilaxmi Mohapatra who guided me through this project as my instructor for the Study Oriented Project. Without her constant support & help this work would not have been complete. I am also very grateful to Dr AK Giri who helped me with the econometric analysis.

Index

Abstract

This work examines causality between electricity consumption, electricity price & Index of Industrial Productivity(IIP) using VECM for India using monthly time series data from April 2010 to December 2016. This study finds that IIP is caused by electricity consumption and price, whereas electricity consumption is not caused by IIP as well as electricity price. There is a unidirectional causality from electricity consumption to IIP. So, increasing electricity availability will lead to higher industrial growth due to supply as well as demand factors of industrial goods.

1. Introduction

Energy is a key requirement of industrial development in an economy. Electricity is the most prominent for of energy used in production activities and it should effect industrial productivity of an economy. There has been a lot of research in the past regarding effect of electricity consumption on GDP, employment, income etc. Most of the literature uses long term analysis with annual granularity. Here, the multivariate causality between electricity consumption, Index of Industrial Productivity and electricity price has been studied using very recent monthly data from April 2010 to December 2016. Previous work in this area has been briefly discussed in the next section.

2. Literature Review

Ghosh (2002) [1] studies Granger causality between GDP growth and electricity consumption in India using data from 1950-97. It concludes that there is a unidirectional relationship from GDP to electricity consumption with no feedback effect. So, energy conservation policies can be used successfully without reducing economic growth. VAR model has been used for the econometric analysis of the data. GDP/Capita and KWh/Capita are the variables of interest. GDP/capita has been found to have a chi squared distribution with 1 degree of freedom. GDP growth rate over this period has been 4.5% at an average whereas CAGR Electricity Demand growth was 8%.

The reason for this difference is that with rise in GDP, domestic demand of electricity increases as well as more substitution of conventional sources of energy in industry took place.

Asafu-Adjaye (2002) [2] suggests that either employment or growth can be used as a proxy for growth and time series properties of data involved must be considered. Commercial sector energy use has been considered instead of total energy use. This paper looks at energy consumption as a whole, so the unit has been normalized in terms of oil/capita.

Using Augmented Dickey Fuller test, it was found that real income, energy prices and energy consumption are co integrated of order 1 and thus first differencing is good enough to analyze

the effects. Data used was for 1973-95. It found unidirectional effect from energy consumption to income.
Abbas et. Al [3] found out a bidirectional causality between Agricultural Electricity Consumption and Agricultural GDP. India confirmed to conservation hypothesis at an aggregate level. It recommends using supply enhancing strategies which includes increased production balanced with a managed growth in demand. Data set is from 1972 to 2008 and is relatively new compared to previous two papers. It is clear from the data that demand increased faster than the supply in last 40 years. Agriculture accounts for 1/5th of the total electricity demand in India. Dickey Fuller and Augmented Dickey Fuller were used to check stationarity of data. Error Correction Model (ECM) was used to introduce an error correction term and Granger Causality was modelled. Correlation between total GDP and Total electricity consumption was found to be 0.95. While that between per capita values of same was 0.90. ADF suggests that GDP and Electricity consumption at both per capita and aggregate level are first difference stationary. Causality between GDP growth and Electricity Consumption has been found to be from GDP to Electricity Consumption in both aggregate and per capita levels and long as well as short term.
Ghosh (2009) [4] uses VECM to further establish the long- and short-run Granger causality running from real GDP and electricity supply to employment without any feedback effect implying that the growth in real GDP and electricity supply are responsible for the high level of employment in India.

3. Data Description

The variables used are Electricity consumption in terms of Mega Units, Electricity price in rupees per MWh & the IIP with base year 2004-05. Time period of focus is from April 2010 to December 2016 with monthly granularity.
Availability of electricity has been obtained from Load Generation & Balancing Reports of Central Electricity Authority. It is the sum of transmission losses & realized consumption of electricity and hence a good proxy for consumption. The actual losses are proportional to consumption and the remainder is accounted for by power theft which is basically a form of consumption.
Electricity price has been obtained from Indian Energy Exchange where electricity is traded at a national level & hence acts as a good proxy for average electricity price in India. The Indian Energy Exchange is an electronic system based power trading exchange regulated by the Central Electricity Regulatory Commission.
IIP data is use based as per RBI classification and is obtained from RBI database.

4. Analysis

The basic methodology used has the following steps:
1. Deseasonalizing the data using X12 ARIMA

2.Augmented Dickey Fuller Test for unit root
3.AIC Test for lag selection
4.Johansen Cointegration Test
5.VECM test

4.1. Deseasonalization

Data for electricity consumption, price as well as IIP follow as seasonal trend. Electricity consumption is affected by seasonal factors like temperature, harvest season, monsoon etc. IIP is also affected by these factors along with increased production to meet the demands at certain time periods like festive season. Electricity price also varies seasonally since it's a function of demand & supply of electricity, both of which happen to be seasonal.

X12 ARIMA has been used to deseasonalize the data. It is a widely used standard package developed by US Census Department and implemented in several statistical packages. All seasonal data released by US Census Department is deseasonalized where as in context of India only the actual values are available.

Logarithmic transformations of these deseasonalized variables have been used for further analysis to reduce the effect of any outliers caused by sudden shocks on supply or demand side.

4.2. Augmented Dickey Fuller Test for Unit Root

The Augmented Dickey Fuller Test (ADF) is unit root test for stationarity. Unit roots can cause unpredictable results in time series analysis. The Augmented Dickey-Fuller test can be used with serial correlation. The ADF test can handle more complex models than the Dickey-Fuller test, and it is also more powerful. [5]

The hypotheses for the test:
H0: There is a unit root in the time series
H1: Time series is stationary (or trend-stationary)
There are three models for ADF which are chosen based on the nature of data. These are:

a. No constant, no trend: $\Delta yt = \gamma yt\text{-}1 + vt$
b. Constant, no trend: $\Delta yt = \alpha + \gamma yt\text{-}1 + vt$
c. Constant and trend: $\Delta yt = \alpha + \gamma yt\text{-}1 + \lambda t + vt$

The results of ADF performed for various variables are listed below:

1. *Consumption of Electricity (logconsa)*

Consumption has been found to have unit root and follows the model with intercept and no trend term, i.e. model b as described above. As a result, first differenced values have been used for subsequent analysis. These have been confirmed to be stationary under all 3 ADF models

```
. dfuller logconsa, regress lags(0)

Dickey-Fuller test for unit root                   Number of obs   =        80

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -0.556            -3.538            -2.906            -2.588
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8806

------------------------------------------------------------------------------
  D.logconsa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    logconsa |
         L1. |  -.0129163   .0232184    -0.56   0.580    -.0591406    .0333081
             |
       _cons |   .0659447   .1138589     0.58   0.564     -.160731    .2926203
------------------------------------------------------------------------------
```

2. *Electricity Price (logpricea)*

Price has been found to have unit root following model a. with no intercept term. As a remedy, the first differences have been used for further analysis

```
. dfuller logiipa, noconstant regress lags(0)

Dickey-Fuller test for unit root                   Number of obs   =        80

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              0.438            -2.608            -1.950            -1.610

------------------------------------------------------------------------------
   D.logiipa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logiipa |
         L1. |   .0002268   .0005178     0.44   0.663    -.0008037    .0012574
------------------------------------------------------------------------------
```

3. *Index of Industrial Productivity (logiipa)*

IIP has unit root without an intercept term. IIP has also been first differenced to prepare VAR model as discussed below.

```
. dfuller logiipa, noconstant regress lags(0)

Dickey-Fuller test for unit root                   Number of obs   =        80

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              0.438            -2.608            -1.950            -1.610

------------------------------------------------------------------------------
   D.logiipa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logiipa |
         L1. |   .0002268   .0005178     0.44   0.663    -.0008037    .0012574
------------------------------------------------------------------------------
```

4.3. Akaike's Information Criterion (AIC) test for lag selection

Akaike's information criterion (AIC) compares the quality of a set of statistical models to each other. The AIC will take each model and rank them from best to worst. The "best" model will be the one that neither under-fits nor over-fits. Performing the AIC test on logconsa, logiipa & logiipa, it is observed that suitable number of lags is 2. The results from AIC test are as follows.

. varsoc logconsa logpricea logiipa, maxlag(12)

```
   Selection-order criteria
   Sample:  1961m2 - 1966m10                        Number of obs      =        69
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 |  426.946                      9.2e-10  -12.2883  -12.2498  -12.1912  |
  |  1 |  562.149  270.41    9  0.000  2.4e-11  -15.9463  -15.7922* -15.5578* |
  |  2 |  572.272  20.247    9  0.016  2.3e-11* -15.9789* -15.7092   -15.299  |
  |  3 |  576.094  7.6431    9  0.570  2.7e-11  -15.8288  -15.4434  -14.8575  |
  |  4 |  580.266  8.3431    9  0.500  3.1e-11  -15.6889  -15.1879  -14.4261  |
  |  5 |  584.193  7.8545    9  0.549  3.7e-11  -15.5418  -14.9252  -13.9877  |
  |  6 |  590.334  12.282    9  0.198  4.1e-11   -15.459  -14.7268  -13.6134  |
  |  7 |  595.801  10.933    9  0.280  4.6e-11  -15.3565  -14.5087  -13.2196  |
  |  8 |  604.868  18.135    9  0.034  4.8e-11  -15.3585  -14.3951  -12.9301  |
  |  9 |  614.251  18.765    9  0.027  4.9e-11  -15.3696  -14.2906  -12.6498  |
  | 10 |  629.126   29.75    9  0.000  4.4e-11  -15.5399  -14.3452  -12.5287  |
  | 11 |   636.32  14.388    9  0.109  5.0e-11  -15.4875  -14.1773  -12.1849  |
  | 12 |  647.138  21.636*   9  0.010  5.2e-11  -15.5402  -14.1144  -11.9462  |
  +---------------------------------------------------------------------------+
   Endogenous:  logconsa logpricea logiipa
    Exogenous:  _cons
```

4.4 Johansen Cointegration Test

Johansen Cointegration Test has been used to find the order of Cointegration in the model. The model is cointegrated of order one according to the results below.

```
. vecrank logconsa logpricea logiipa, trend(constant) max

                       Johansen tests for cointegration
Trend: constant                                          Number of obs =      79
Sample:  1960m4 - 1966m10                                         Lags =       2
-------------------------------------------------------------------------------
                                                          5%
maximum                                        trace    critical
  rank    parms       LL       eigenvalue  statistic    value
    0      12      634.06601           .     35.2344    29.68
    1      17      644.71474     0.23631     13.9370*   15.41
    2      20      651.64815     0.16099      0.0702     3.76
    3      21      651.68323     0.00089
-------------------------------------------------------------------------------
                                                          5%
maximum                                         max     critical
  rank    parms       LL       eigenvalue  statistic    value
    0      12      634.06601           .     21.2975    20.97
    1      17      644.71474     0.23631     13.8668    14.07
    2      20      651.64815     0.16099      0.0702     3.76
    3      21      651.68323     0.00089
-------------------------------------------------------------------------------
```

4.5. Vector Error Correction Model

VECM is used to find causality in cointegrated variables. Three different VECM models have been considered for each of the three variables.

I.Dependent variable as logconsa & explanatory variables as logiipa and logpricea

The VECM model obtained has a non-significant error term and hence there is no long run causality from electricity price and IIP to electricity consumption. Also there is no short run causality from either electricity price or price to consumption as shown below. This can be due to the fact that electricity availability that has been used as a proxy for electricity consumption, depends on government policy and resources available to the country. It is quite possible that developments like coal scam & transition of centre government during period of study might have affected growth in electricity availability.

```
. vec logconsa logpricea logiipa, trend(constant)

Vector error-correction model

Sample:  1960m4 - 1966m10                           No. of obs      =        79
```

```
                                                  AIC             = -15.89151
Log likelihood =  644.7147                        HQIC            = -15.68724
Det(Sigma_ml)  =  1.64e-11                        SBIC            = -15.38163

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_logconsa           5      .010983   0.2582   25.75104   0.0001
D_logpricea          5      .057993   0.1343   11.47621   0.0427
D_logiipa            5      .008421   0.3820   45.73957   0.0000
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_logconsa   |
        _ce1 |
         L1. |  -.0452799   .0407985    -1.11   0.267    -.1252434    .0346836
             |
    logconsa |
         LD. |  -.4407167   .1230534    -3.58   0.000    -.6818968   -.1995365
             |
   logpricea |
         LD. |    .003665   .0229349     0.16   0.873    -.0412866    .0486165
             |
     logiipa |
         LD. |  -.0791798   .1626831    -0.49   0.626    -.3980327    .2396732
             |
       _cons |   .0041949   .0013012     3.22   0.001     .0016446    .0067452
-------------+----------------------------------------------------------------
D_logpricea  |
        _ce1 |
         L1. |  -.5828339   .2154159    -2.71   0.007    -1.005041   -.1606264
             |
    logconsa |
         LD. |  -.5618655   .6497219    -0.86   0.387    -1.835297     .711566
             |
   logpricea |
         LD. |   .0662284   .1210962     0.55   0.584    -.1711159    .3035726
             |
     logiipa |
         LD. |  -.1245087   .8589668    -0.14   0.885    -1.808053    1.559035
             |
       _cons |   -.000223   .0068703    -0.03   0.974    -.0136885    .0132425
-------------+----------------------------------------------------------------
D_logiipa    |
        _ce1 |
         L1. |   .1178796   .0312809     3.77   0.000     .0565701    .1791891
             |
    logconsa |
         LD. |  -.0254508   .0943472    -0.27   0.787     -.210368    .1594664
             |
   logpricea |
         LD. |   .0006252   .0175846     0.04   0.972      -.03384    .0350903
             |
     logiipa |
```

```
         LD. |  -.2451641   .1247321    -1.97   0.049    -.4896345   -.0006938
             |
       _cons |   .0005088   .0009976     0.51   0.610    -.0014465    .0024642
------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                  2   120.3633   0.0000
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
    logconsa |          1          .        .       .            .           .
   logpricea |   .1159959   .0835405     1.39   0.165    -.0477405    .2797322
     logiipa |  -4.434261   .4949058    -8.96   0.000    -5.404258   -3.464263
       _cons |   4.628902          .        .       .            .           .
------------------------------------------------------------------------------


. test ([D_logconsa]: LD.logiipa)

 ( 1)  [D_logconsa]LD.logiipa = 0

           chi2(  1) =    0.24
         Prob > chi2 =    0.6265

. test ([D_logconsa]: LD.logpricea)

 ( 1)  [D_logconsa]LD.logpricea = 0

           chi2(  1) =    0.03
         Prob > chi2 =    0.8730
```

II.Dependent variable as logiipa & explanatory variables as logpricea and logconsa

There is long run causality from electricity consumption & price to IIP as coefficient of cointegrated equation is negative and significant. It gives the speed of adjustment of IIP to the dependent variables. This indicates a unidirectional long run causality running from electricity consumption to Index of Industrial Productivity. So, improving the availability of power to industries can significantly boost industrial output & growth of new industries.

Also electrification of the country leads to higher demand for industrial goods by stimulating the economic activities & creating new market for industrial goods. Thus, there is both a demand pull & supply push for industrial output due to electricity consumption.

Government must focus on increasing electricity production & improving transmission under the *Make in India* initiative. Electricity is the key input for manufacturing sector and its availability needs to be improved.

It is worth noting that there is no short run causality from either electricity consumption or electricity price to IIP. So, effects of improved electricity production on industry might not be immediate due the delay caused by setting up of new industries and gradual growth in new markets for industrial output.

```
. vec logiipa  logconsa logpricea, trend(constant)

Vector error-correction model

Sample:  1960m4 - 1966m10                         No. of obs      =         79
                                                  AIC             = -15.89151
Log likelihood =  644.7147                        HQIC            = -15.68724
Det(Sigma_ml)  =  1.64e-11                        SBIC            = -15.38163

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_logiipa             5     .008421   0.3820   45.73957   0.0000
D_logconsa            5     .010983   0.2582   25.75104   0.0001
D_logpricea           5     .057993   0.1343   11.47621   0.0427
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_logiipa    |
         _ce1 |
          L1. |  -.5227089   .1387078    -3.77   0.000    -.7945711   -.2508467
             |
      logiipa |
          LD. |  -.2451641   .1247321    -1.97   0.049    -.4896345   -.0006938
             |
     logconsa |
          LD. |  -.0254508   .0943472    -0.27   0.787     -.210368    .1594664
             |
    logpricea |
          LD. |   .0006252   .0175846     0.04   0.972      -.03384    .0350903
             |
        _cons |   .0005088   .0009976     0.51   0.610    -.0014465    .0024642
-------------+----------------------------------------------------------------
D_logconsa   |
         _ce1 |
          L1. |   .2007828    .180911     1.11   0.267    -.1537963    .5553618
             |
      logiipa |
```

```
         LD. |  -.0791798   .1626831    -0.49   0.626    -.3980327    .2396732
             |
    logconsa |
         LD. |  -.4407167   .1230534    -3.58   0.000    -.6818968   -.1995365
             |
   logpricea |
         LD. |    .003665   .0229349     0.16   0.873    -.0412866    .0486165
             |
       _cons |   .0041949   .0013012     3.22   0.001     .0016446    .0067452
-------------+----------------------------------------------------------------
D_logpricea  |
        _ce1 |
         L1. |   2.584437   .9552103     2.71   0.007     .7122594    4.456615
             |
     logiipa |
         LD. |  -.1245087   .8589668    -0.14   0.885    -1.808053    1.559035
             |
    logconsa |
         LD. |  -.5618655   .6497219    -0.86   0.387    -1.835297     .711566
             |
   logpricea |
         LD. |   .0662284   .1210962     0.55   0.584    -.1711159    .3035726
             |
       _cons |   -.000223   .0068703    -0.03   0.974    -.0136885    .0132425
------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                  2   71.91566   0.0000
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
     logiipa |          1          .        .       .            .           .
    logconsa |  -.2255167   .0277307    -8.13   0.000     -.279868   -.1711655
   logpricea |   -.026159   .0185208    -1.41   0.158    -.0624591    .0101411
       _cons |  -1.043895          .        .       .            .           .
------------------------------------------------------------------------------

. test ([D_logiipa]: LD.logconsa)

 ( 1)  [D_logiipa]LD.logconsa = 0

           chi2(  1) =    0.07
         Prob > chi2 =    0.7873

. test ([D_logiipa]: LD.logpricea)
```

```
 ( 1)  [D_logiipa]LD.logpricea = 0

           chi2(  1) =    0.00
         Prob > chi2 =    0.9716
```

III.Dependent variable as logpricea & explanatory variables as logiipa and logconsa

Long run causality from IIP & electricity consumption to electricity price is indicated by a negative and significant coefficient of cointegrated equation. This can be due to inflationary causes. But there is no short run causality from either IIP or electricity consumption to price illustrating the relatively fixed nature of electricity prices in short run.

```
. vec logpricea logconsa logiipa, trend(constant)

Vector error-correction model

Sample:  1960m4 - 1966m10                         No. of obs      =        79
                                                  AIC             = -15.89151
Log likelihood =  644.7147                        HQIC            = -15.68724
Det(Sigma_ml)  =  1.64e-11                        SBIC            = -15.38163

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_logpricea          5      .057993   0.1343   11.47621   0.0427
D_logconsa           5      .010983   0.2582   25.75104   0.0001
D_logiipa            5      .008421   0.3820   45.73957   0.0000
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_logpricea  |
        _ce1 |
         L1. |  -.0676063   .0249874    -2.71   0.007    -.1165806    -.018632
             |
   logpricea |
         LD. |   .0662284   .1210962     0.55   0.584    -.1711159    .3035726
             |
    logconsa |
         LD. |  -.5618655   .6497219    -0.86   0.387    -1.835297     .711566
             |
     logiipa |
         LD. |  -.1245087   .8589668    -0.14   0.885    -1.808053    1.559035
             |
       _cons |   -.000223   .0068703    -0.03   0.974    -.0136885    .0132425
-------------+----------------------------------------------------------------
D_logconsa   |
        _ce1 |
         L1. |  -.0052523   .0047325    -1.11   0.267    -.0145277    .0040232
             |
   logpricea |
         LD. |    .003665   .0229349     0.16   0.873    -.0412866    .0486165
```

```
             |
    logconsa |
         LD. |  -.4407167   .1230534    -3.58   0.000    -.6818968   -.1995365
             |
     logiipa |
         LD. |  -.0791798   .1626831    -0.49   0.626    -.3980327    .2396732
             |
       _cons |   .0041949   .0013012     3.22   0.001     .0016446    .0067452
-------------+----------------------------------------------------------------
D_logiipa    |
        _ce1 |
         L1. |   .0136735   .0036285     3.77   0.000     .0065619    .0207852
             |
   logpricea |
         LD. |   .0006252   .0175846     0.04   0.972      -.03384    .0350903
             |
    logconsa |
         LD. |  -.0254508   .0943472    -0.27   0.787     -.210368    .1594664
             |
     logiipa |
         LD. |  -.2451641   .1247321    -1.97   0.049    -.4896345   -.0006938
             |
       _cons |   .0005088   .0009976     0.51   0.610    -.0014465    .0024642
------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                  2   17.96452   0.0001
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
   logpricea |          1          .        .       .            .           .
    logconsa |   8.620996     2.2813     3.78   0.000     4.149731    13.09226
     logiipa |  -38.22775   9.026229    -4.24   0.000    -55.91883   -20.53666
       _cons |   39.90575          .        .       .            .           .
------------------------------------------------------------------------------

. test ([D_logpricea]: LD.logconsa)

 ( 1)  [D_logpricea]LD.logconsa = 0

           chi2(  1) =    0.75
         Prob > chi2 =    0.3872


. test ([D_logpricea]: LD.logiipa)
```

```
 ( 1)  [D_logpricea]LD.logiipa = 0

           chi2(  1) =    0.02
         Prob > chi2 =    0.8847
```

5. Conclusion

From the analysis above it can be inferred that in the period from 2010-2016, there is a unidirectional causation from Electricity Consumption & Price to Index of Industrial Production. Further, electricity price does not affect its consumption indicating inelastic demand schedule for electricity.

Electricity consumption leads to higher industrial productivity owing to increased power consumption in industry as well as high household demand for industrial goods which require electricity to operate. This can be seen as a supply push effect of electricity consumption on IIP.

Increasing production as well as improving distribution networks can put India on path to growth. Electrification of the entire country will lead to higher demand for industrial products as well as start of new industries at various scales. Thus, policy makers must focus on increasing electricity availability to the country. Also, energy conservation measures like use of LEDs for lighting should be encouraged as it increases productivity per unit electricity.

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