Economic Policy Uncertainty and Industrial Activity: An Evidence from Pakistan

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"Economic Policy Uncertainty and Industrial Activity: An Evidence from Pakistan"

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Abstract

Economic Policy Uncertainty is defined as a state wherein the policymakers, or institutions are uncertain about the future course of economic policies owing to a myriad of factors ranging from economic conditions and political tensions to geo-politics. The pioneering work of Baker, Bloom and Davis (2016) brought-in a new way of thinking in economics; whereby, introducing newspaper-based uncertainty to reflect on economic policies and resulting impacts thereof on a whole lot of economic conditions including real sector activity. This paper follows Choudhary, Pasha and Waheed (2020) to check if uncertainty has negative implications for production in Pakistan. I use the VECM model to see if there exists a long-term relationship between economic policy uncertainty and real activity in Pakistan; alongside that, I also make use of a bivariate SVAR to further enrich analysis. My findings conform to this notion that uncertainty does affect production and real activity.

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Keywords: economic policy uncertainty, large-scale manufacturing, automobiles production, real activity

Introduction

Economic Policy Uncertainty is generally defined as a state in which economic policymakers can not foresee a clear path down the road, and are thus unable to make predictions, or decide about the future course of action. Generally, economic policy uncertainty has remained heightened globally during the global financial crisis of 2008; Asian financial crisis of 1997; Mexican Tequila crisis of 1990s, and all other crises. In the US, the period during the global financial crisis was marked by 2nd highest amount of uncertainty since 1985; highest being aftermath the 9/11 attacks.

Moreover, not only is economic uncertainty driven by economic events such as currency devaluation, sudden stops, and recessions, but political developments such as coups, martial laws, wars, and other events are also seen to increase uncertainty manifolds and rapidly such as Gulf war and US elections; during such politically challenging times there remains high amount of economic uncertainty as things unfold sporadically thus triggering random spells of uncertainty. Russia - Ukraine crisis is a recent example. There are also some separate indices such as 'Geopolitical Risk Index' and 'Democracy Index' that attempt to capture regional conflicts and level of democracy in countries separately. Moreover, the enormous exogenous shocks such as pandemic created unprecedented amount of uncertainty that was not seen before. The onset of the pandemic was the only event in recorded human history that disrupted the entire planet at the same time and hence uncertainty remained unparalleled. This led economic policymakers to be innovative about policy formulation both in the developed countries as well as the developing ones.

The high amount of policy uncertainty badly affects economic agents' decisions about consumption and saving. There is a fear in heightened uncertainty whether banks would go insolvent, or is it safe to keep deposits in the local currency, or have them converted into hard currencies, or gold fearing depreciation. Additionally, uncertainty affects credit and investment too. During uncertain times, firms don't want to expand production thus they have little reliance on private sector credit; due to this, production is badly affected in the economy leading to higher unemployment.

This research builds on the premise that uncertainty affects production and manufacturing by looking at the interaction of policy uncertainty and the Large-Scale Manufacturing data of Pakistan. The monthly large-scale manufacturing index of Pakistan is the country's only high frequency data that well reflects the real sector activity; it is published and computed by the Pakistan Bureau of Statistics. Unlike many developed and some emerging market economies, the GDP data of Pakistan is only available annually, so that measure of real activity cannot be used for limited observations. Nevertheless, in two separate studies i.e., Tahir et al. (2018) and Hanif et al. (2013) have attempted to quarterize GDP for the country through statistical techniques, but these are the independent studies and hence may not be as reliable as the official source.

From the production point of view, according to the State Bank of Pakistan and the World Bank share of services, industry, and agriculture in country's GDP are 53.84%, 17.72%, and 23.3% respectively as of 2020. In addition, over 50% of the labor force is concentrated in the agriculture sector. Highest contributor to the index as shown below is the textile industry with an approximate share of 21%; its highest share indicates that this industry is the country's most salient industry which also contributes to country's approximately 60% of the total exports. The underlying reason for the largest share of textile industry is that Pakistan is the world's 5th largest producer[1] of cotton according to the US Department of Agriculture.

Table1: Pakistan Large Scale Manufacturing (LSM) Index

Manufacturing Sector	Weight	(%) Change 2020-21		(%) Change 2021-22		YOY Growth Impact 2021-22	
		Dec	Jul-Dec	Dec	Jul-Dec	Monthly	Cumulative
Textile	20.9	3.3	2.6	2.6	1.1	0.6	0.3
Food, Beverages & Tobacco	12.4	18.2	20.7	5.8	3.1	1.7	0.6
Chemicals	1.7	16.5	10.9	-4.3	5.4	-0.1	0.1
Automobiles	4.6	43.8	11.1	41.5	35.7	2.0	1.9
Iron & Steel Products	5.4	11.8	-1.2	17.8	23.9	0.6	0.9
Leather Products	0.9	-40.5	-42.7	7.0	8.3	0.1	0.1
Paper & Board	2.3	-4.7	-2.7	7.7	8.3	0.3	0.3
Engineering Products	0.4	-23.9	-31.4	-0.9	1.1	0.0	0.0
Wood Products	0.6	-30.1	-60.1	478.4	292.4	0.0	0.0

Source: Pakistan Bureau of Statistics

Literature Review

The notable paper of Baker, Bloom and Davis (2016) introduced a new method of looking at policy uncertainty i.e., uncertainty about economic conditions as reflected in the daily newspaper. This led to a new way of looking at uncertainty besides the other indicators that existed before such as VIX. Along these lines, Choudhary, Pasha and Waheed (2020) create a newspaper based economic policy index for Pakistan that seeks to explain periods of high uncertainty during the past a couple of decades.

Through this publication, the authors argue that, in Pakistan, spikes in uncertainty had been associated with political chaos and massive changes in government such as massive political demonstrations and also with the country's programs with the IMF. Besides, in Pakistan, uncertainty remained highest during the pandemic as suggested by the index which is also in resonance with the similar indices of several other countries.

[1] https://www.statista.com/statistics/263055/cotton-production-worldwide-by-top-countries/

The notable contribution of Bernanke (1983) sheds light on the negative impacts of economic policy uncertainty and investment and labor market. They document that the deleterious effects of uncertainty are passed down to firms over time leading to low production and high unemployment. In another study, Fernández-Villaverde et al. (2015) provide details of how uncertainty negatively impacts spending by providing details that high amount of uncertainty pushes people to precautionary savings. Their empirical analysis involves VAR and a New Keynesian model as Christiano, Eichenbaum and Evans (2005). Their VAR model is of quarterly frequency with four-lags and a linear time trend while identifying shocks recursively. Besides, their New Keynesian model is a representative agent model with the role of fiscal policy.

Furthermore, Jovanovic and Sai Ma (2020) empirically document different impacts of uncertainty on the real economic activity. They argue that, greater economic uncertainty is linked with lower growth. In addition, they also highlight, among other facts, that higher asset volatility increases the negative impact of uncertainty on the real activity. Their empirical model endogenizes growth and uncertainty. It has a collection of agents that can raise their productivity by embracing new technologies.

Data

The variables used in this research are the following monthly variables: interest rate i.e. call money rate; large-scale manufacturing index; count of automobiles production and sale; and economic policy uncertainty index. The sources of variables are State Bank of Pakistan, Pakistan Bureau of Statistics, and policyuncertainty.com respectively. Due to seasonality, as can be seen in the graphs at *Annexure-III*, two series namely large-scale manufacturing index and auto production have been seasonally adjusted with ARIMA 13 SEATS. The large-scale manufacturing follows a certain pattern over the year; it is low during January to March and later accelerates until July. Moreover, all the variables are integrated of order 1 i.e. I (1); differencing them once makes all the variables stationary. The Dicky Fuller test of stationarity further provides evidence of stationarity suggesting that differencing the variables once makes them stationary; *Annexure-I* provide test results for stationarity.

Tracing drastic surge in uncertainty through pulse dummies'

Although multiple up and down movements in uncertainty could be seen in the graph below, but there are two notable periods i.e., April 2020 and August 2014 where a drastic surge in uncertainty was seen. In the case of the former, uncertainty was due to the lockdowns that were imposed in the wake of COVID-19 and rising cases. In the month of April, an emergency Monetary Policy Committee meeting was convened and drastic measures were taken such as greater supply of credit and export refinance for purchase of priority healthcare equipment. Prior to that, in March 2020 alone, Monetary Policy Committee met twice to beef up measures for the extraordinarily challenging times.

In usual circumstances, the monetary policy meetings are convened every two months. This reflects that, there was a reasonable amount of uncertainty regarding the central bank's likely steps to counter the devastating impacts on the economy. On the other hand, the uncertainty witnessed in the month of August 2014 was due to the sit-in of the opposition party in the country's capital which lasted for several days and badly affected country's logistics, transportation and supply chains. Both periods have been captured through pulse dummies for these two months. As shown below, the Autocorrelation and Partial Autocorrelation functions suggest that the likely data generating process of EPU is AR(2), so we run an ARIMA(2,0,0) model with two pulse dummies.

The coefficients of the pulse dummies are significant at 5% significance level. The increase in uncertainty in 2020 was much higher on scale than the one in the earlier episode of 2014; as we can see that there was a massive jump of 109 unit increase in April. Whereas, there had been an increase of 77 units in the month of August 2014.

The following index for Pakistan is updated every month and is available at *policyuncertainty.com*[2]**.**

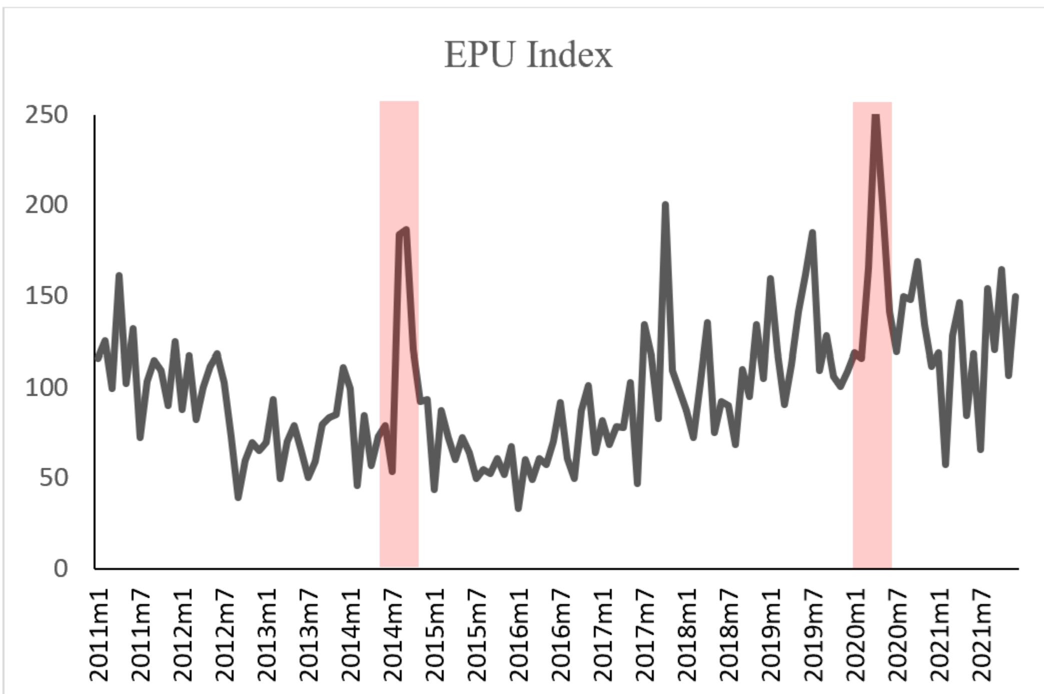


Fig. 01: Uncertainty jumps

[2] http://www.policyuncertainty.com/pakistan_monthly.html

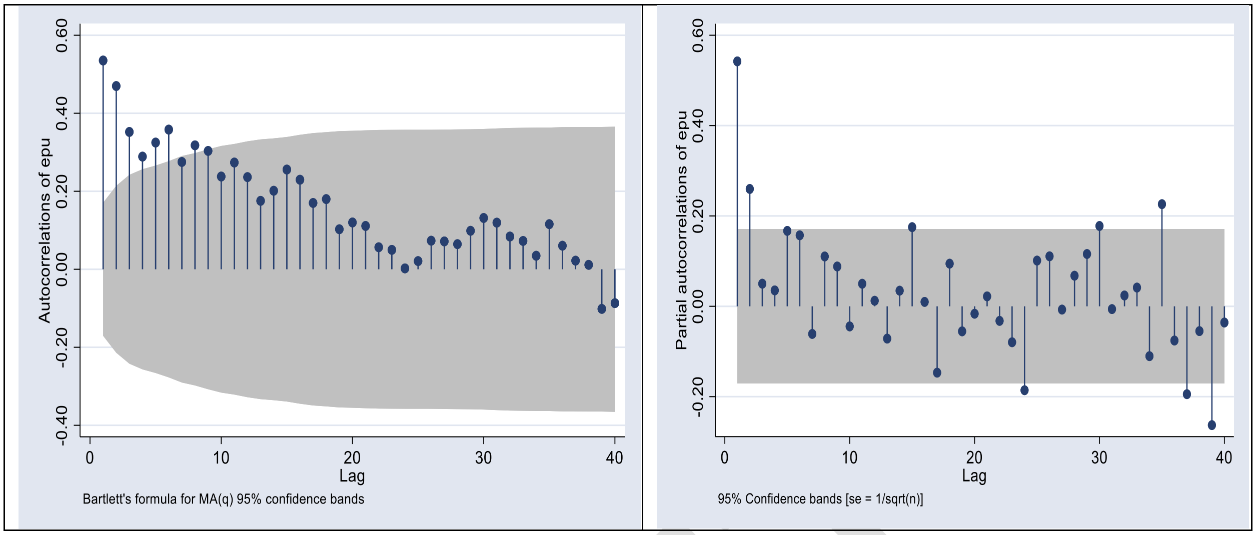


Fig. 02: Autocorrelation and Partial Autocorrelation

$$epu_t = \beta_0 + \beta_1 epu_{t-1} + \beta_2 epu_{t-2} + \beta_3 {D_t}^{2020} + \beta_4 {D_t}^{2014} + \varepsilon_t$$

```
                                                Number of obs     =        132
                                                Wald chi2(4)      =      70.73
Log likelihood = -631.7971                      Prob > chi2       =     0.0000

------------------------------------------------------------------------------
             |                 OPG
         epu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
epu          |
         t20 |   109.2945   31.86307     3.43   0.001     46.84401     171.745
         t14 |   76.99194   22.45059     3.43   0.001      32.9896    120.9943
       _cons |   99.29567   8.763737    11.33   0.000     82.11906    116.4723
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. |   .3260107   .0954983     3.41   0.001     .1388376    .5131839
         L2. |   .3512052   .0812911     4.32   0.000     .1918776    .5105329
-------------+----------------------------------------------------------------
      /sigma |   28.94222   1.773787    16.32   0.000     25.46566    32.41878
------------------------------------------------------------------------------
Note: The test of the variance against zero is one sided, and the two-sided
      confidence interval is truncated at zero.
```


Methodology

Part-I: Determining Long-run relationship through Vector Error Correction Model

The choice of VECM model comes from two fundamental factors; first one being that the variables show long-term co-movement; and the second reason is that for monthly frequency and 127 observations across time it's better to use this type of models when it is well established through empirical tests that there is co-integration amongst the variables. Since all the variables are I(1), so I can check whether there is a long-run relationship; this can be checked through co-integration tests. I check co-integration through two methods i) checking stationarity of residuals ii) Egranger test. Through the first method, after running OLS with the below specification, I obtain residuals and check whether they are stationary. The Dicky Fuller results suggest that these residuals are stationary that means there exists co-integration and hence a long-run relationship between the variables. The Null hypothesis H_0 of the Dicky Fuller test is that the series are non-stationary which implies that there is no co-integration. Rejecting the Null hypothesis gives us the reason that there is co-integration.

$$epu_t = \beta_0 + \beta_1 intrate_t + \beta_2 extrate_t + \beta_3 autoprod_t + \beta_4 lsm_t + \varepsilon_t$$

Or

$$\widehat{\varepsilon_t} = epu_t - \widehat{\beta_0} + \widehat{\beta_1} intrate_t + \widehat{\beta_2} extrate_t + \widehat{\beta_3} autoprod_t + \widehat{\beta_4} lsm_t$$

$$\widehat{\varepsilon_t} \sim I(0)$$

In order to double check, I use Egranger test for co-integration; which also shows that the variables are co-integrated. Once it's fairly established that all the five variables are co-integrated, I use the Vector Error Correction Model. Before using the VECM model, it is essential to specify the number of co-integrating relationships within the model; I have checked this through Johansen test. According to the test results, there are two co-integrating relationships. The results of this model are provided at *Annexure II*. The optimal lag length for the variables is determined to be 4 based on Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC), so I run the VECM model with four optimal lags.

$$\Delta lsm_t = \beta_{l0} + \beta_{l1} \sum_{i=1}^{4} lsm_{t-i} + \beta_{l2} \sum_{i=1}^{4} epu_{t-i} + \beta_{l3} \sum_{i=1}^{4} auto_{t-i} + \beta_{l4} \sum_{i=1}^{4} exrate_{t-i} + \beta_{l5} \sum_{i=1}^{4} irate_t + e_t \text{------}(1)$$

$$\Delta epu_t = \beta_{e0} + \beta_{e1} \sum_{i=1}^{4} lsm_{t-i} + \beta_{e2} \sum_{i=1}^{4} epu_{t-i} + \beta_{e3} \sum_{i=1}^{4} auto_{t-i} + \beta_{e4} \sum_{i=1}^{4} exrate_{t-i} + \beta_{e5} \sum_{i=1}^{4} irate_t + e_t \text{-------}(2)$$

$$\Delta auto_t = \beta_{a0} + \beta_{a1} \sum_{i=1}^{4} lsm_{t-i} + \beta_{a2} \sum_{i=1}^{4} epu_{t-i} + \beta_{a3} \sum_{i=1}^{4} auto_{t-i} + \beta_{a4} \sum_{i=1}^{4} exrate_{t-i} + \beta_{a5} \sum_{i=1}^{4} irate_t + e_t \text{------}(3)$$

$$\Delta exrate_t = \beta_{e0} + \beta_{e1} \sum_{i=1}^{4} lsm_{t-i} + \beta_{e2} \sum_{i=1}^{4} epu_{t-i} + \beta_{e3} \sum_{i=1}^{4} auto_{t-i} + \beta_{e4} \sum_{i=1}^{4} exrate_{t-i} + \beta_{e5} \sum_{i=1}^{4} irate_t + e_t \text{-------}(4)$$

$$\Delta irate_t = \beta_{r0} + \beta_{r1} \sum_{i=1}^{4} lsm_{t-i} + \beta_{r2} \sum_{i=1}^{4} epu_{t-i} + \beta_{r3} \sum_{i=1}^{4} auto_{t-i} + \beta_{r4} \sum_{i=1}^{4} exrate_{t-i} + \beta_{r5} \sum_{i=1}^{4} irate_t + e_t \text{---------}(5)$$

Part-II: Determining Causal Relationship through Bi-variate Structural VAR

Structural VAR models are employed in a variety of econometric applications where measuring the causal impact of one variable on the other is of paramount importance. These models are different from simple VAR models in a sense that they allow causal interpretation, and the leeway to see the contemporaneous impact of one variable on the other. However, SVAR models require the use of restrictions as a method for Identification and these restrictions should come from the underlying economic rationale. For example, in my case, I am restricting the contemporaneous impact of Large Scale Manufacturing (LSM) on the uncertainty and not the vice versa; this is in resonance with the economic theory that a rise in production does not tend to impact uncertainty contemporaneously, but in a lagged fashion. In order to make the data more compelling, month-on-month percentage increase is computed first and then a structural model is fit-in on this data with the following restriction i.e., large scale manufacturing is not contemporaneously impacting uncertainty, however, uncertainty does contemporaneously impact large-scale manufacturing. The matrix is defined as follows:

$$B = \begin{bmatrix} 1 & 0 \\ b_{21} & 1 \end{bmatrix}$$

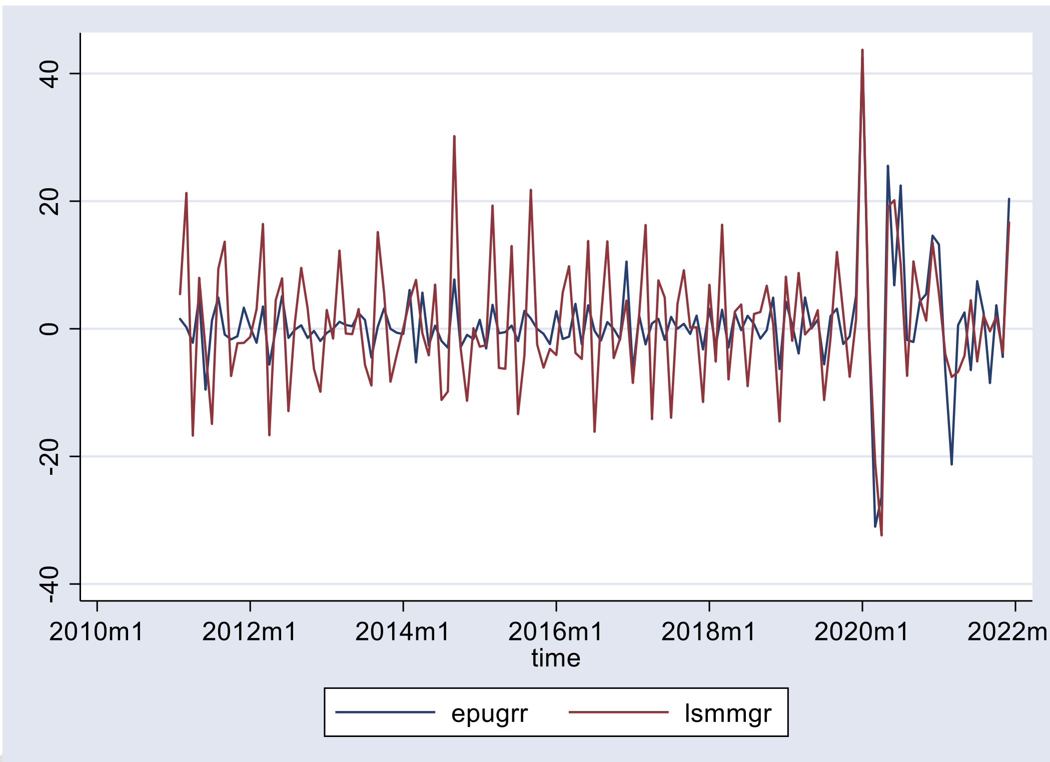


Fig. 03: Month-on-month change

```
Selection-order criteria
Sample:  2011m6 - 2021m12                          Number of obs      =       127
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 | -880.011                       3692.95   13.8899   13.9081   13.9347  |
|  1 | -873.295  13.432    4  0.009    3538.4   13.8472   13.9018   13.9815  |
|  2 | -844.408  57.774    4  0.000   2391.24   13.4552   13.5462   13.6792  |
|  3 |  -835.53  17.756    4  0.001   2214.75   13.3784   13.5058    13.692  |
|  4 | -813.573  43.914*   4  0.000   1669.64*  13.0956*  13.2594*  13.4988* |
+---------------------------------------------------------------------------+
Endogenous:  epugrr lsmmgr
 Exogenous:  _cons
```

$$epu_t = a_0 - b_{11} lsm_t - \left(\sum_{i=1}^{4} b_{1i+1} lsm_{t-i}\right) + \sum_{i=1}^{4} b_{1i+5} epu_{t-i} + \varepsilon_{eput}$$

$$lsm_t = a_1 - b_{21} epu_t + \sum_{i=1}^{4} b_{2i+1} lsm_{t-i} - \left(\sum_{i=1}^{4} b_{2i+5} epu_{t-i}\right) + \varepsilon_{lsmt}$$

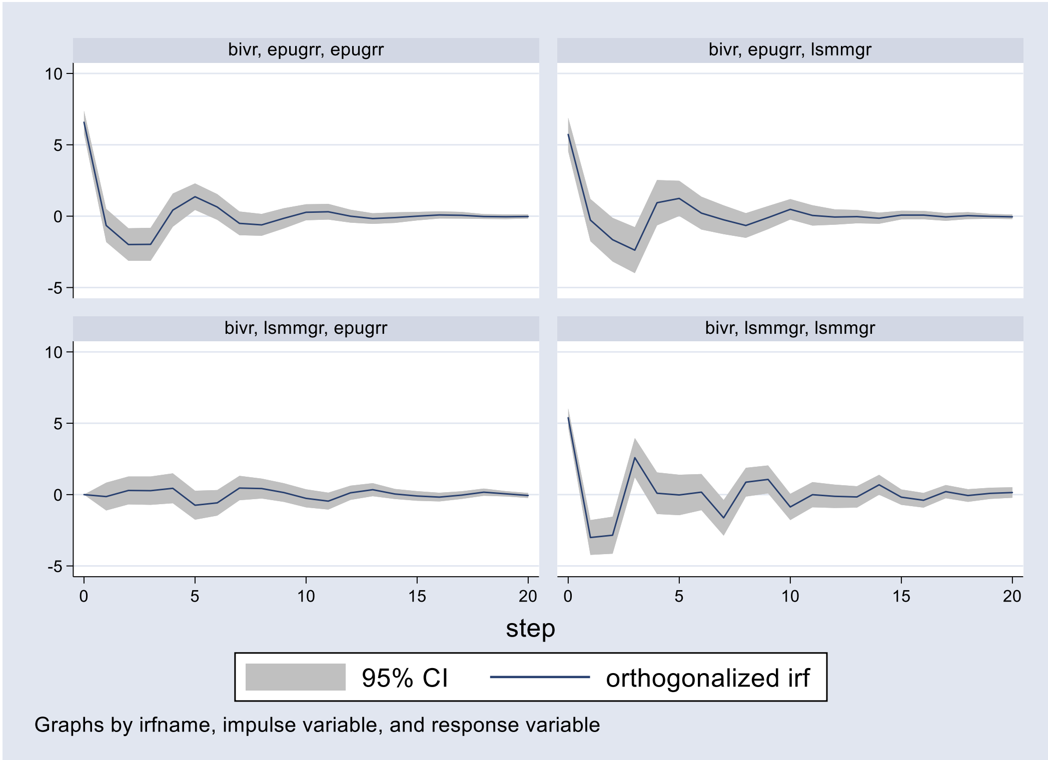


Fig. 04: Impulse responses

Interpreting Results

The VECM results give us the speed of adjustment of the co-efficient towards the long/short-run equilibrium. We started off with the assumption that the uncertainty negatively impacts the real sector activity and used two real sector variables namely auto-production and largescale manufacturing. Our results suggest uncertainty does have a negative relationship on the manufacturing, but a lagged one, this is in line with the economic rationale that firms require some time to adjust to the production processes hence an uncertain event happening today may impact production two months later as the firms have accumulated inventories and, in some cases, these are perishable, so they may want to keep production processes for some short interval. Therefore, it is plausible to assume that a surge in uncertainty will have negative repercussions after some time.

In addition, auto production and manufacturing index also seem to be having a positive relationship which is also pertinent because these both measure real-sector activity and their processes are intertwined. Furthermore, exchange rate does not play a role in the large-scale manufacturing index, however, it does explain auto-production because the auto-production in Pakistan relies on the imported parts, and hence an exchange rate depreciation does impact the production of automobiles that are reliant on imported parts. For the SVAR results in the Fig. 04, the first and fourth shocks are the shocks of the variable on itself, so we may keep them aside for a while a notice that one unit increase in uncertainty, as shown in the second shock tends to decrease production contemporaneously and also its impact lasts up to four periods, thereafter, the production sees an uptick. Hence, we can assert that the uncertainty does dampen production in the short-run. For the impact of largescale production shock on uncertainty, since the contemporaneous impact is assumed to be zero, however, in the later period we see a minor decrease, but not so significant which also conforms to our earlier stipulation that the impact translates from uncertainty to the real activity.

Conclusion

This research attempted to trace the impact of economic policy uncertainty on Pakistan's real economic activity. In doing so, I carried out the VECM analysis to ascertain if there existed any linkages between uncertainty and real activity measured in terms of large-scale manufacturing and automobiles production. Alongside that, I also used a bivariate SVAR model to see the causal relationship between uncertainty and manufacturing activity. My results for VECM suggest that there is a statistically significant long-term relationship between uncertainty and auto-production and largescale manufacturing, but more pronounced in the case of former. This could be due to the fact that auto production decisions are relatively swift to be materialized compared with the large-scale manufacturing where it is hard to cut back on the orders already placed. Additionally, as assembling of motor vehicles is done in Pakistan through imported parts, so these import orders are swiftly susceptible to an uptick in uncertainty. Moreover, since the large-scale manufacturing is a composite index comprising many different items including foods and beverages, therefore, this could be the probable reason for lesser impact than the auto-production. On the other hand, the SVAR results show that uncertainty has a short-term causal impact on the manufacturing activity which points to another valid direction. In the end, for the next iterations of this research, it would be interesting to see the impact with more observations as they become available; higher number of observations may serve to further enrich analysis. Besides, the impact of credit channel as a transmission channel of uncertainty may be looked at.

Annexure-I

```
. dfuller D.r_dl, notrend

Dickey-Fuller test for unit root                     Number of obs   =       130

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.770            -3.500            -2.888            -2.578
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
.  dfuller D.exrate, notrend

Dickey-Fuller test for unit root                     Number of obs   =       130

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.017            -3.500            -2.888            -2.578
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller D.lsm_adjusted, notrend

Dickey-Fuller test for unit root                     Number of obs   =       130

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.771            -3.500            -2.888            -2.578
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
.  dfuller D.auto, notrend

Dickey-Fuller test for unit root                     Number of obs   =       130

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.422            -3.500            -2.888            -2.578
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
.  dfuller D.epu, notrend

Dickey-Fuller test for unit root                     Number of obs   =       130

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -17.806            -3.500            -2.888            -2.578
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

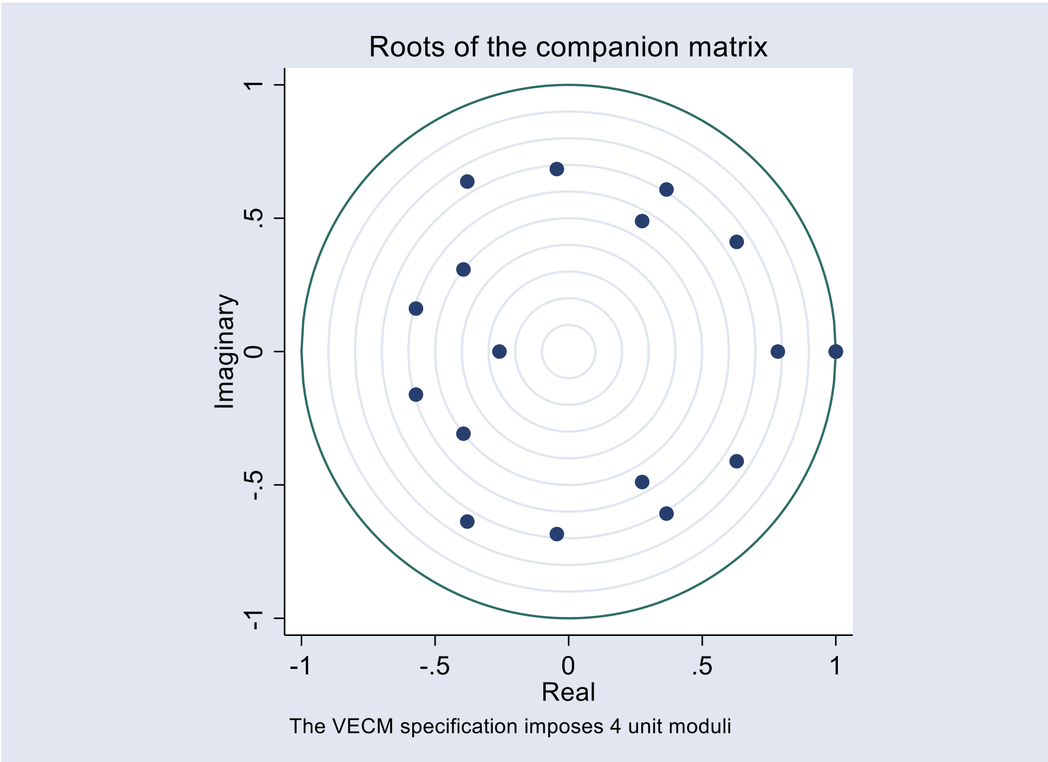
Annexure-II

```
. dfuller resid, notrend
Dickey-Fuller test for unit root                   Number of obs   =       131

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.798            -3.500            -2.888            -2.578
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0001


Engle-Granger test for cointegration                  N (1st step)  =      132
                                                      N (test)      =      131
------------------------------------------------------------------------------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.818            -5.127            -4.523            -4.214

Critical values from MacKinnon (1990, 2010)

. varsoc lsm_adjusted auto epu r_dl exrate

   Selection-order criteria
   Sample:  2011m5 - 2021m12                       Number of obs      =       128
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -2644.61                      6.6e+11   41.4002   41.4454   41.5116  |
  |  1 | -2028.54  1232.1   25  0.000  6.4e+07   32.1648   32.4363   32.8332* |
  |  2 | -1974.42  108.25   25  0.000  4.1e+07   31.7096   32.2076   32.9351  |
  |  3 | -1934.78  79.275   25  0.000  3.3e+07   31.4809   32.2052   33.2635  |
  |  4 | -1882.84  103.88*  25  0.000  2.2e+07*    31.06*  32.0106*  33.3996  |
  +---------------------------------------------------------------------------+
   Endogenous:  lsm_adjusted auto epu r_dl exrate
    Exogenous:  _cons

. vec lsm_adjusted auto epu r_dl exrate, lag(4) rank(1)

Vector error-correction model

Sample:  2011m5 - 2021m12                          Number of obs     =        128
                                                   AIC               =   31.16449
Log likelihood = -1905.527                         HQIC              =   31.97021
Det(Sigma_ml)  =   5864803                         SBIC              =   33.14754

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_lsm_adjusted       17     8.97688   0.3610   62.69798   0.0000
D_auto               17     11.1292   0.7238   290.9268   0.0000
D_epu                17     28.1841   0.5016   111.7237   0.0000
D_r_dl               17     .542148   0.2258   32.37576   0.0135
D_exrate             17     2.39317   0.2951   46.47751   0.0001
----------------------------------------------------------------

--------------------------------------------------------------------------------
               |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
D_lsm_adjusted |
```

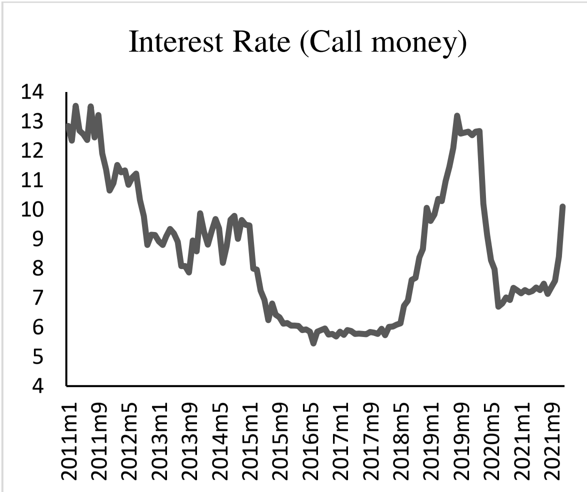
_ce1						
L1.	-.0794664	.0340862	-2.33	0.020	-.1462742	-.0126586
lsm_adjusted						
LD.	.0220775	.1004202	0.22	0.826	-.1747423	.2188974
L2D.	-.4637702	.1074329	-4.32	0.000	-.6743348	-.2532057
L3D.	-.1948521	.1118807	-1.74	0.082	-.4141341	.02443
auto						
LD.	.1284691	.0591392	2.17	0.030	.0125584	.2443798
L2D.	.0367308	.0516505	0.71	0.477	-.0645023	.1379639
L3D.	.0407	.0513735	0.79	0.428	-.0599903	.1413903
epu						
LD.	-.0674974	.0375295	-1.80	0.072	-.1410538	.006059
L2D.	-.0846546	.036058	-2.35	0.019	-.1553269	-.0139823
L3D.	-.0500674	.0300155	-1.67	0.095	-.1088966	.0087618
r_dl						
LD.	4.165576	1.711721	2.43	0.015	.8106641	7.520487
L2D.	1.677553	1.628501	1.03	0.303	-1.51425	4.869356
L3D.	.0355016	1.58541	0.02	0.982	-3.071846	3.142849
exrate						
LD.	-.1792399	.326657	-0.55	0.583	-.8194758	.4609961
L2D.	.1381503	.3563269	0.39	0.698	-.5602377	.8365383
L3D.	-.4058688	.3667201	-1.11	0.268	-1.124627	.3128894
_cons	.5875335	.8969874	0.66	0.512	-1.170529	2.345596
D_auto						
_ce1						
L1.	-.1024046	.0422588	-2.42	0.015	-.1852303	-.019579
lsm_adjusted						
LD.	.4716944	.1244969	3.79	0.000	.227685	.7157039
L2D.	-.2111599	.133191	-1.59	0.113	-.4722094	.0498897
L3D.	-.7406905	.1387052	-5.34	0.000	-1.012548	-.4688333
auto						
LD.	-.0501624	.0733184	-0.68	0.494	-.1938638	.0935391
L2D.	-.1906722	.0640342	-2.98	0.003	-.316177	-.0651674
L3D.	.0388655	.0636909	0.61	0.542	-.0859663	.1636973
epu						
LD.	-.1385578	.0465275	-2.98	0.003	-.2297501	-.0473655
L2D.	-.1085367	.0447032	-2.43	0.015	-.1961534	-.02092
L3D.	-.0482452	.037212	-1.30	0.195	-.1211794	.0246889
r_dl						
LD.	.6936102	2.122124	0.33	0.744	-3.465676	4.852896
L2D.	-2.538853	2.018951	-1.26	0.209	-6.495924	1.418217
L3D.	-6.186562	1.965529	-3.15	0.002	-10.03893	-2.334196
exrate						
LD.	-1.0266	.4049763	-2.53	0.011	-1.82034	-.2328614
L2D.	-1.027633	.4417599	-2.33	0.020	-1.893467	-.1617999
L3D.	2.033536	.454645	4.47	0.000	1.142448	2.924624
_cons	.0515766	1.112049	0.05	0.963	-2.128	2.231153
D_epu						
_ce1						
L1.	.3991798	.1070182	3.73	0.000	.1894281	.6089316

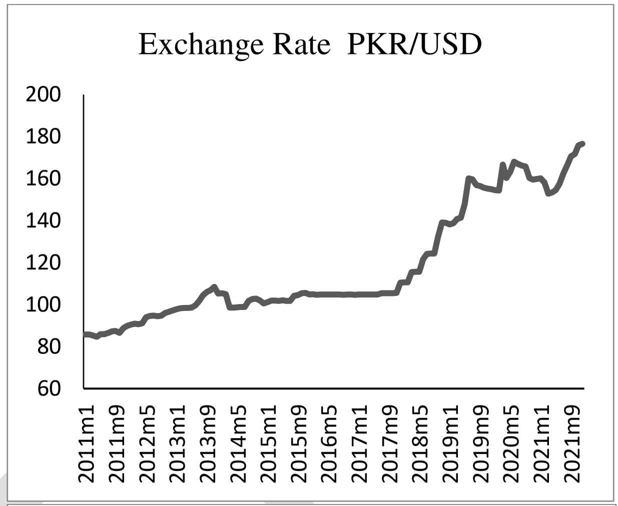
```
              |
 lsm_adjusted |
          LD. |  -.6605661   .3152822    -2.10   0.036    -1.278508   -.0426244
         L2D. |  -.2350596   .3372995    -0.70   0.486    -.8961546    .4260353
         L3D. |   .6745039   .3512639     1.92   0.055    -.0139608    1.362969
              |
         auto |
          LD. |  -.2475354   .1856752    -1.33   0.182    -.6114521    .1163812
         L2D. |   .0412062   .1621635     0.25   0.799    -.2766284    .3590407
         L3D. |   .0432837   .1612939     0.27   0.788    -.2728465     .359414
              |
          epu |
          LD. |   -.275348   .1178286    -2.34   0.019    -.5062879   -.0444081
         L2D. |  -.0231159   .1132086    -0.20   0.838    -.2450008    .1987689
         L3D. |   .0921847   .0942375     0.98   0.328    -.0925173    .2768868
              |
         r_dl |
          LD. |   5.374674   5.374171     1.00   0.317    -5.158509    15.90786
         L2D. |  -12.93287   5.112891    -2.53   0.011    -22.95395   -2.911788
         L3D. |  -6.621417   4.977603    -1.33   0.183    -16.37734    3.134506
              |
       exrate |
          LD. |   3.526522   1.025582     3.44   0.001     1.516418    5.536626
         L2D. |  -.4776017   1.118735    -0.43   0.669    -2.670282    1.715078
         L3D. |   .3012779   1.151366     0.26   0.794    -1.955357    2.557913
              |
        _cons |   .0866191   2.816209     0.03   0.975    -5.433049    5.606287
--------------+----------------------------------------------------------------
D_r_dl        |
         _ce1 |
          L1. |   .0014709   .0020586     0.71   0.475    -.0025639    .0055057
              |
 lsm_adjusted |
          LD. |   .0010805   .0060648     0.18   0.859    -.0108062    .0129672
         L2D. |  -.0149791   .0064883    -2.31   0.021    -.0276959   -.0022623
         L3D. |  -.0118202   .0067569    -1.75   0.080    -.0250634    .0014231
              |
         auto |
          LD. |     .00085   .0035716     0.24   0.812    -.0061503    .0078503
         L2D. |   .0047313   .0031194     1.52   0.129    -.0013825    .0108452
         L3D. |   .0067784   .0031026     2.18   0.029     .0006974    .0128595
              |
          epu |
          LD. |    .001172   .0022665     0.52   0.605    -.0032704    .0056143
         L2D. |  -.0006038   .0021777    -0.28   0.782     -.004872    .0036644
         L3D. |   .0000651   .0018127     0.04   0.971    -.0034878     .003618
              |
         r_dl |
          LD. |   .0115474   .1033774     0.11   0.911    -.1910686    .2141633
         L2D. |   .2504217   .0983514     2.55   0.011     .0576565    .4431869
         L3D. |  -.0539882    .095749    -0.56   0.573    -.2416528    .1336764
              |
       exrate |
          LD. |   .0212227   .0197281     1.08   0.282    -.0174436     .059889
         L2D. |   .0467727   .0215199     2.17   0.030     .0045944     .088951
         L3D. |   .0289847   .0221476     1.31   0.191    -.0144239    .0723932
              |
        _cons |  -.0680138   .0541725    -1.26   0.209    -.1741899    .0381624
--------------+----------------------------------------------------------------
D_exrate      |
         _ce1 |
          L1. |   .0253334   .0090872     2.79   0.005     .0075229    .0431439
              |
 lsm_adjusted |
```

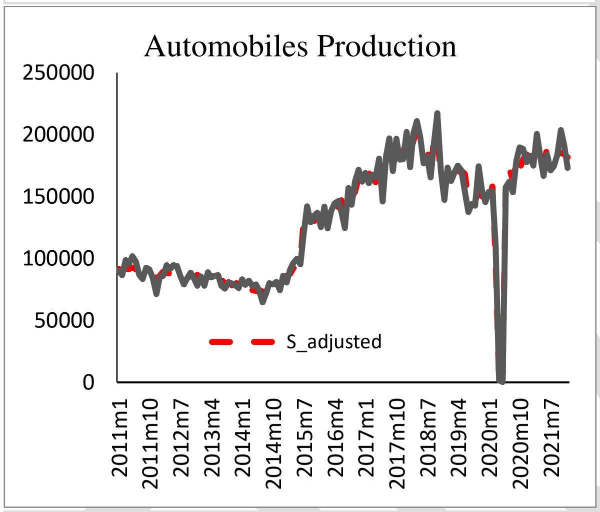
```
         LD. |  -.0217193   .0267713    -0.81   0.417    -.0741901    .0307515
        L2D. |   .0079354   .0286409     0.28   0.782    -.0481996    .0640705
        L3D. |  -.1154866   .0298266    -3.87   0.000    -.1739456   -.0570275
             |
        auto |
         LD. |   -.004918   .0157661    -0.31   0.755     -.035819     .025983
        L2D. |   .0122886   .0137697     0.89   0.372    -.0146994    .0392766
        L3D. |  -.0087447   .0136958    -0.64   0.523     -.035588    .0180986
             |
         epu |
         LD. |   .0323094   .0100051     3.23   0.001     .0126998    .0519191
        L2D. |   .0173283   .0096128     1.80   0.071    -.0015125     .036169
        L3D. |   .0029584   .0080019     0.37   0.712     -.012725    .0186419
             |
        r_dl |
         LD. |  -.0384577   .4563328    -0.08   0.933    -.9328536    .8559382
        L2D. |  -.5919011   .4341469    -1.36   0.173    -1.442813    .2590112
        L3D. |  -.1201787   .4226593    -0.28   0.776    -.9485758    .7082183
             |
      exrate |
         LD. |   .1128628   .0870845     1.30   0.195    -.0578197    .2835452
        L2D. |  -.0443227   .0949943    -0.47   0.641     -.230508    .1418627
        L3D. |   .2496275    .097765     2.55   0.011     .0580116    .4412434
             |
       _cons |   .6905483   .2391305     2.89   0.004     .2218611    1.159236
--------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                   4   46.2414   0.0000
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
lsm_adjusted |          1          .        .       .            .           .
        auto |   .4638984   .1708767     2.71   0.007     .1289863    .7988105
         epu |  -1.045444   .2046175    -5.11   0.000    -1.446487   -.6444005
        r_dl |   11.09078   2.832929     3.91   0.000     5.538345    16.64322
      exrate |  -.2627707   .2426413    -1.08   0.279    -.7383389    .2127976
       _cons |  -145.5386          .        .       .            .           .
------------------------------------------------------------------------------
```

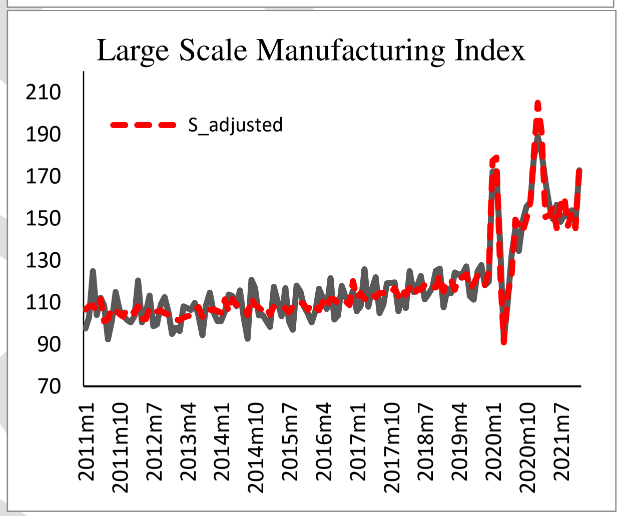

Roots of the companion matrix
Imaginary
Real
1
.5
0
-.5
-1
-1
-.5
0
.5
1
The VECM specification imposes 4 unit moduli

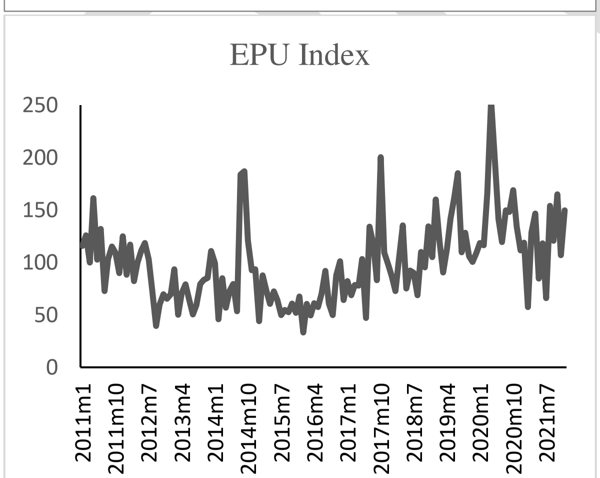
Annexure-III











References:

[1] Baker, Bloom and Davis (2016), "Measuring Economic Policy Uncertainty," The Quarterly Journal of Economics, 2016, 131 (4), 1593–1636.

[2] Bernanke, Ben S., ''Irreversibility, Uncertainty and Cyclical Investment,'' The Quarterly Journal of Economics, 97 (1983), 85–106.

[3] Boyan, Jovanovic and Sai Ma (2020). "Uncertainty and Growth Disasters. International Finance Discussion Papers 1279.

[4] Choudhary, Pasha and Waheed, "Measuring Economic Policy Uncertainty in Pakistan," State Bank of Pakistan Staff Notes, 2020.

[5] Christiano, Eichenbaum and Evans (2005), "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy", Journal of Political Economy, Vol. 113, No. 1

[6] Fernandez-Villaverde, Jesus, Pablo Guerron-Quintana, Keith Kuester, and Juan Rubio-Ramirez, ''Fiscal Volatility Shocks and Economic Activity,'' American Economic Review, 105 (2015), 3352–3384.

[7] Hanif et al. (2013), "Quarterization of National Income Accounts of Pakistan", State Bank of Pakistan Working Paper Series WP No. 54

[8] Tahir et al. (2018), "Robust quarterization of GDP and determination of business cycle dates for IGC partner countries ", International Growth Centre Working Paper-I-37400-PAK-1