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Economic policy uncertainty and sectoral level output in India: The implications on structural change

M.A. Villanthenkodath
Indian Institute of Management (IIM)
Bodh Gaya, India
Email: muhammedashiqv55@gmail.com

K. Hafsal
Madras Institute of Development Studies
Tamil Nadu, India

A. K. Dawood
School of Social Sciences and Humanities
B.S. Abdur Rahman Crescent Institute of Science and Technology, Tamil Nadu, India

N. Cheriyambadan
School of Social Sciences and Humanities
B.S. Abdur Rahman Crescent Institute of Science and Technology, Tamil Nadu, India

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- India

Abstract

This study assesses the impact of economic policy uncertainty on sectoral-level output in India during 2003M01- 2020M12. In order to do this, we execute the combined cointegration analysis to establish the long-run relationship, while the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Square (DOLS) are used for impact assessment. The results show a long-run relationship between economic policy uncertainty and sectoral-level output. Moreover, we observe that sectoral level output slows down as economic policy uncertainty increases in India. The adverse impact of economic policy uncertainty is more visible in the services sector, followed by the industry and agriculture sectors, respectively. Thus, we can infer that the process of structural change is in turmoil in the presence of economic policy uncertainty. The consistency of the findings was confirmed using canonical cointegrating regression (CCR). Besides, the study offers some valuable policy suggestions for policymakers in India.

1. Introduction

The continuous and rapid pace of integration of the world leads to economic and political instability, which in turn fosters uncertainty across the countries. Thus, the consideration of uncertainty in policy formulation associated with the economy has increased (Al-Thaqeb and Algharabali, 2019). Further, the economic outcomes are the byproducts of policy uncertainties as it plays a significant role in developmental issues like income inequality, unemployment, and fluctuations in oil price. Therefore, the sluggish economic growth is also attributed to economic policy uncertainties, especially in developing countries (Jeong, 2002; Pástor and Veronesi, 2012). As far as developing countries are concerned, low production levels, technological bottlenecks, and information asymmetry are the outcomes of economic policy uncertainties. Hence, the dependence of developing countries is more on international financial institutions and developed countries' policies and programs. Since the 1970s, the economic policy uncertainty (EPU) based debates have increased in developing countries. As a result, studies (i.e., Asteriou and Price, 2005; Bhar and Mallik, 2012; Jeong, 2002) in literature explored the uncertainty impact in developing and developed countries.

In this vein, a new EPU index that relies on newspaper coverage frequency has been developed by Baker *et al*., (2016) to measure economic uncertainty. Recently, studies have explored the uncertainty impact on output (Istiak and Serletis, 2018), employment Ghirelli *et al.*, (2021), tourism (Akadiri *et al*., 2020; Sharma, 2021), environmental quality

(Anser *et al.*, 2021; Ulucak and Khan, 2020), energy consumption (Alola and Saint Akadiri, 2021), gold (Raza *et al.*, 2018), industrial output Raza *et al.*, (2018) and exchange rate Chen *et al.*, (2020). However, thin literature explores the impact of uncertainty on sectoral-level output across countries in general, particularly in India.

As a developing country, India has been facing a slowdown in economic growth in the last few years, despite having spectacular growth performance in the past decade. This may be attributed to the prevailing uncertain economic policies in India. Thus, the Indian economy adversely suffers from uncertainty as weak financial and economic structures. However, economic policy uncertainty has driven severe economic consequences that are often overlooked in the literature. Moreover, the Asian economies have witnessed structural change (i.e., the decline in the contribution of agriculture to gross domestic product, while the steady rise in industry contribution to gross domestic product followed by the service sector). But the Indian economy cannot fetch the occupational and economic structural change (Soni and Subramanya, 2020). One of the possible channels for harming such structural transformation could be uncertainty in developing countries Wen *et al.*, (2021). Therefore, it is worth assessing the impact of economic policy uncertainty on the sectoral level output, especially in India, amid rising uncertainty.

Against the given background, the present work aims to add a new aspect to the existing empirical literature on important grounds. First, to the limited knowledge of authors, this is the first study that exposes the structural changes theory of Lewis and the hypothesis of structural change assessed in the context of uncertainty. As the movement to a service-based economy, the impacting strength on the sectoral level output may vary due to the response of different sectors towards the uncertainty. Second, existing economic uncertainty computation has flaws. Thus, our study used an EPU index constructed using news on a monthly basis for the overall economy, which is a newly developed index in the field of economics, while modelling the impact on sectoral-level output in India. Thus, EPU is regarded as a risk factor related to macroeconomic policies that result from frequent changes in national policy. Third, this study covers the period of demonetization, the outbreak of the pandemic's repeated waves, and the health crisis. Hence, such issues further worsen the situation of the Indian economy. Finally, the study's findings can offer a better insight into the thin literature on uncertainty and structural change nexus. Thus, it imparts new policy dimensions into the laboratory of economists.

The arrangement of the rest section is as follows. Section 2 contains the necessary literature review for the study. Section 3 offers the model, data and methodology. Section 4 presents empirical results and their explanation. Section 5 for the conclusions and policy implications.

2. Literature review

This section reviews studies exploring the linkages between economic policy uncertainty and economic growth either in panel or time series frameworks, which has evidence from the remarkable work by Bloom (2007), where interest increased from academia in understanding how uncertainty affects real economic activity. For instance, Segal *et al*., (2015) studied the US covering the period of 1930 to 2012 to exhibit that good uncertainty (i.e., predicts an increase in future economic activities) causes an increase in the level of economic factors, such as output, consumption, investment and asset price valuations, while bad uncertainty (a decline forecast for economic activities) has a reverse impact on the same variables.

Further, most of the previous literature indicates that economic policy uncertainty harms the key macroeconomic variables (Stock and Watson 2012). Similarly, it suggested that policy uncertainty is one of the principal reasons for the depth and longevity of the 2007 financial crisis (Bloom *et al*., 2012; Jones and Olson, 2013). Moreover, Jones and Olson (2013) evaluated the correlation between economic uncertainty, output and inflation. The authors found that the sign of the correlation between uncertainty and inflation transform from negative to positive during the late 1990s, but the correlation between uncertainty and output is negative, meaning a reduction in output. Likewise, Kang *et al*., (2014) observed that firms' investments are depressed when the firm-level influences economic policy uncertainty. Moreover, economic policy uncertainty substantially negatively affects economic and financial activities (Pastor and Veronesi, 2013). Besides, it has a similar impact on the business cycle and investment choices (Bloom *et al*., 2007, 2012; Baker *et al*., 2016).

In a non-parametric quantile regression analysis, Xin *et al*., (2022) analysed the role of economic policy in the recent Chinese economic slowdown. They estimated the effects of uncertainty shocks on GDP growth, and found that China's high growth momentum is declining. Moreover, Bhagat *et al*., (2013) constructed a measure for economic policy uncertainty to analyse its impact on the Indian economy. The authors concluded that GDP growth and fixed investment are negatively related to economic policy uncertainty. However, by constructing the first news-based economic uncertainty index, Cerda *et al*., (2018) for Chile to investigate its effects on GDP, aggregate investment, and employment. The authors implemented the VAR estimation procedure and found that an increase in economic uncertainty conveys a fall in GDP, investment, and employment, even after accounting for the small open economy size. Further, the authors

extended this to the sectoral level. However, Fatima and Waheed (2014) used a small macroeconomic model to analyse the effects of economic policy uncertainty on Pakistan's growth performance. The authors constructed GARCH-based measures of economic policy uncertainty variables and showed that economic policy uncertainty negatively influences the real and nominal sectors in the economy. Besides, Wen *et al*., (2021) examined the symmetric and asymmetric impact of economic policy uncertainty on economic growth. The authors claim that positive economic policy uncertainty shocks have a negative impact on economic growth in the short run. In fact, the intensity of the positive shock is greater than the negative shock. A similar finding showing an adverse effect of economic policy uncertainty on economic growth has been reached by Sahinoz and Cosar (2018). Additionally, Jeong (2002) indicates that policy uncertainty can raise the cost of capital and may reduce production, especially in the long-run output.

Another aspect of the literature emphasises the role of economic policy uncertainty linkages at cross-country levels. Colombo (2013) studied how the impact of economic policy uncertainty in the US affects European industrial production. The findings suggest that a shock to EPU in the US leads to a significant fall in European industrial production in the short run. Similarly, Belke and Osowski (2018) analysed the impact of uncertainty shocks in 18 OECD countries and found that economic policy uncertainty affects the original country and also has a large cross-border influence. Further, Klößner and Sekkel (2014) provide evidence of significant uncertainty spillovers from the US and the UK to other countries. Besides, Balcilar *et al*., (2020) studied economic policy uncertainty transmission from the US and the EU to five Asian economies such as India, China, Hong Kong, South Korea, and Japan and found a negative effect except in Hong Kong and China.

Few studies discuss the relationship between economic policy uncertainty and its impact on the firm level. The impact of economic policy uncertainty is not limited to the global and international markets, but it is also relevant at the firm level. Boutchkova *et al*., (2011) and Baker *et al*., (2016) analysed the impact of economic policy uncertainty on the industrial sector and concluded that labour-intensive industries are more prone to the effect driven by EPU compared to other industries. However, the sectoral-level study of the commodity market by Badshah *et al*., (2019) found that economic policy uncertainty positively affected energy commodities and industrial metals, while precious metals showed a negative effect. Besides, Yu *et al*., (2017) studied the long-run effect on ten US industries, concluding that economic policy uncertainty significantly impacts industry beta. They found that the technology, financial and material sectors are most affected by changes in economic policy uncertainty related to consumer staples, energy and utility sectors.

In a nutshell, the reviewed literature hints that different studies have used uncertainty while modelling various economic relations. However, a sectoral-level impact of output due to economic policy uncertainty is strange in the literature. From a methodological perceptive, unlike prevailing studies, the study uses different unit root tests, combined cointegration, Fully Modified Ordinary Least Squares (FMOLS) and the Dynamic Ordinary Least squares (DOLS) to explore the link between sectoral output and its determinants. Besides, as a robust estimator, canonical cointegrating regression (CCR) has been used for validating the results that emanate from the FMOLS and DOLS techniques.

3. Model, data, and methodology

3.1 The model

By following the traditional growth function, the relationship between input and output can be specified in equation 1 as follow

$$Y = AK^{\beta 1}L^{\beta 2} \quad \text{where } \beta 1\ \beta 2 \geq 1 \tag{1}$$

Where Y is the output L, and K is the labour and capital, respectively. The β1 and β2 are the elasticities of output. Thus, we hypothesise that the effectiveness of the labour force and capital stock can vary in the presence of uncertainty in the model while influencing the output of an economy. In this light, the study specified the sectoral level output function by following (Akram *et al.*, 2020) and extended the function by incorporating the uncertainty in equations 2,3 and 4 as follows:

$$AGO = AK^{\beta 1}L^{\beta 2}EPU^{\beta 3} \tag{2}$$

$$INDO = AK^{\beta 1}L^{\beta 2}EPU^{\beta 3} \tag{3}$$

$$SERO = AK^{\beta 1}L^{\beta 2}EPU^{\beta 3} \tag{4}$$

The reduced version of equations 2, 3 and 4 are in equations 5,6 and 7, which is a log-linearized format with parameters and constant on regressand.

$$lnAGO = ln\beta_0 + \beta_1 lnK_t + \beta_2 lnL_t + \beta_3 lnEPU_t + \varepsilon_t \tag{5}$$

$$lnINDO = ln\beta_0 + \beta_1 lnK_t + \beta_2 lnL_t + \beta_3 lnEPU_t + \varepsilon_t \quad (6)$$

$$lnSERO = ln\beta_0 + \beta_1 lnK_t + \beta_2 lnL_t + \beta_3 lnEPU_t + \varepsilon_t \quad (7)$$

Here, AGO, $INDO$, and $SERO$ are the agricultural output, industrial output and service sector output, respectively. Further, β_0 is the constant, while β_1, β_2 and β_3 are coefficients of labour (L), capital (K) and economic policy uncertainty (EPU), respectively.

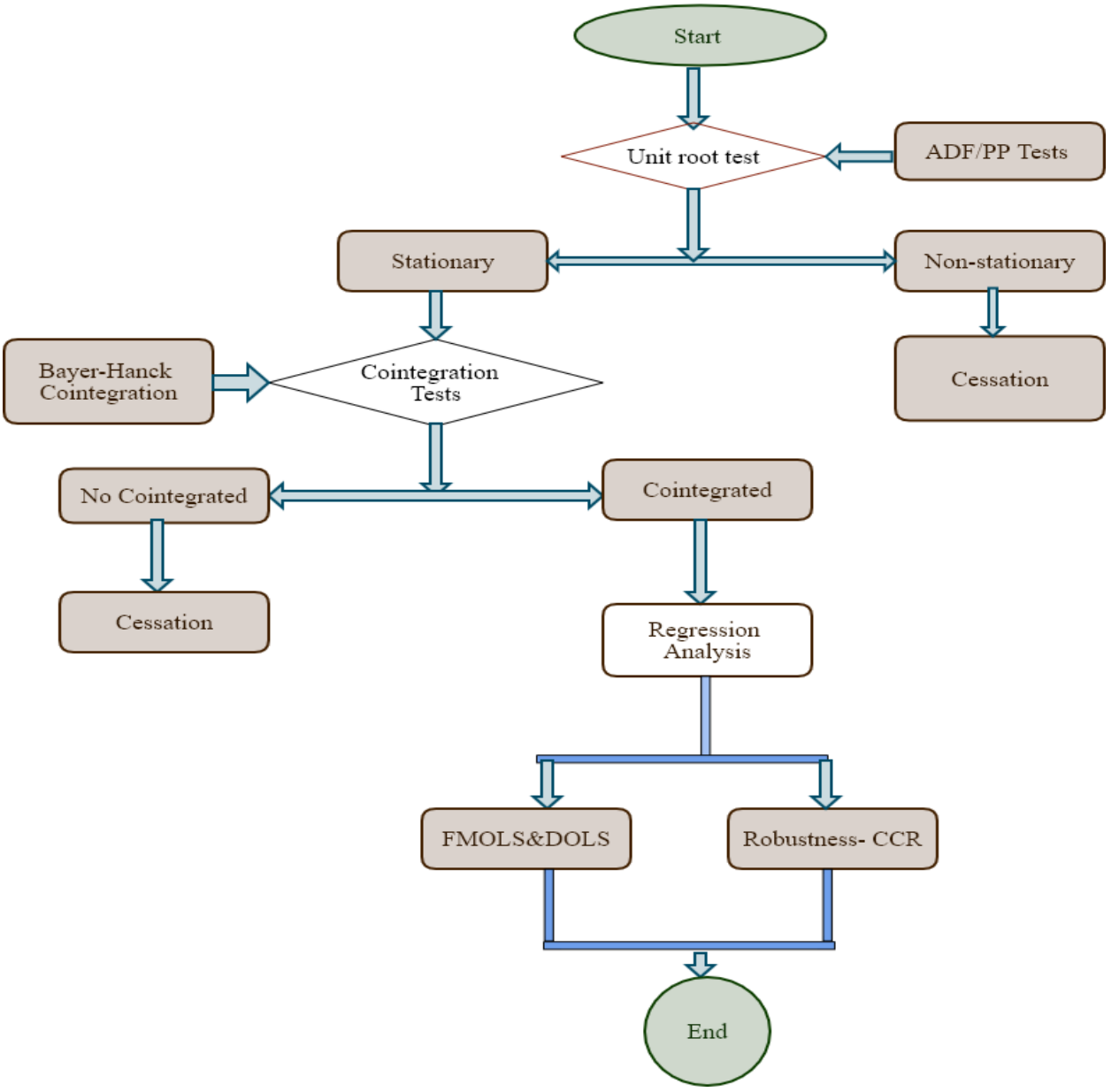
3.2 Data sources

This study investigates how economic policy uncertainty affects the sectoral level output. Thus, data for India economic policy uncertainty index was collected from Baker *et al.*, (2016) website http://www.policyuncertainty.com/ which is updated continuously. Sectoral-level output and employment data are obtained from the World Bank database. The sample period is between 2003M01 and 2020M12 for the analysis. However, the natural logarithm form of the variables is used for analyses to deal with the non-homogeneity of the data by following (Abdul *et al*., 2023; Cheriyambadan *et al*., 2023; Hussain *et al*., 2023; Shameem *et al.*, 2022; Villanthenkodath and Mahalik, 2022; Villanthenkodath and Pal, 2023).

3.3. Methodology

In the prevailing standard literature, different approaches have been used to model the link between the variables of interest in growth-based studies. Thus, this study implemented different econometric tools to explore the relationship between economic policy uncertainty and sectoral-level output. First, the stationarity of the data was conducted using the unit root tests. Second, the long-run relationship was established by implementing Bayer and Hanck (2013) combined cointegration analysis. Third, we estimated FMOLS and DOLS with CCR to understand the impact of different factors on sectoral-level output. The methodological framework carried out in the study is depicted in Figure 1.

Figure 1: The methodological framework of the study



3.3.1 Unit root test

Before proceeding with the test of cointegration and regression analysis of the series, we need to examine whether the series is stationary or not (i.e., to check whether it contains a unit root or not). Therefore, we employ the Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) tests proposed by Dickey–Fuller (1979) and Phillips-Perron (1988), respectively. The rationale for using the alternative test is that the ADF test is invalid in the presence of autocorrelation. Thus, the study carried out the PP test makes non-parametric adjustments in the error term to make the test robust against any form of heteroscedasticity and autocorrelation.

3.3.2 Cointegration

The long-run equilibrium analysis among variables is tested using different cointegration techniques. Initially, Engel and Granger (1987) proposed a residual-based test. Later, several authors proposed different versions of the analysis, such as the system-based cointegration test of Johansen (1988). Furthermore, Boswijk (1994) and Banerjee *et al.* (1998) came up with ECM-based F-test and t-test analyses, respectively. The result produced from all these methods gives different conclusions. Moreover, each of these methods developed from a different theoretical background, which leads to

differing estimates. Gregory *et al.* (2004) found that the P values for different single cointegration tests are weakly correlated. Due to the inconsistency in the previous models, Bayer and Hanck (2013) proposed a new cointegration test. Since the Bayer and Hanck cointegration test is based on the Monte Carlo Simulation, the test shows better power properties than the individual tests. Additionally, an important feature of this test is that it combines various individual cointegration tests and, thus, more detailed results. The combined probability values of individual tests can be obtained using the following formula of Fisher (1932):

$$EG - JOH = -2[\ln(P_{EG}) + \ln(P_{JOH}) \tag{8}$$

$$EG - JOH - BO - BDM = -2[\ln(P_{EG}) + \ln(P_{JOH}) + \ln(P_{BO}) + \ln(P_{BDM})] \tag{9}$$

Where P_{EG}, P_{JOH}, $P_{BO,}$ and P_{BDM} represent the level of significance for individual cointegration tests.

3.3.3 Cointegration regression

After the cointegration among variables is ensured, the study employs FMOLS by Phillips and Hansen (1990) and DOLS by Saikkonen (1992) and Stock and Watson (1993) while estimating the model. Moreover, the FMOLS is a semi-parametric technique to avoid the correlation problem and is asymptotically unbiased and efficient. However, the DOLS augment regressors by adding lags and leads, making the cointegrating equation error term orthogonal to stochastic regressor innovations. FMOLS and DOLS help to eliminate the problem of serial correlation and endogeneity among the variables. Besides, CCR technique as a robustness-checking mechanism by estimating and authenticating the results derived from the FMOLS and DOLS techniques.

4. Empirical analysis and discussion

Table 1 portrays the results of summary statistics for the study variables. It is evident that the median values of all the series except capital are almost equal to their mean value. Moreover, all the variables are negatively skewed except the agriculture sector value added. However, capital is the most volatile variable since it shows a higher standard deviation, followed by service, industry and agriculture, policy uncertainty and labour, respectively. After having a preliminary understanding of the features related to considered time-series data, the stationarity tests have been executed to unveil the order of integration.

	lnAGO	lnINDO	lnSERO	lnEPU	lnL	lnK
Mean	26.477	26.838	27.346	1.476	19.957	30.945
Median	26.487	26.866	27.337	1.478	19.955	31.063
Maximum	26.800	27.267	27.924	1.731	20.024	31.497
Minimum	26.188	26.192	26.676	1.168	19.862	30.131
Std. Dev.	0.180	0.317	0.381	0.117	0.037	0.390
Skewness	0.136	-0.361	-0.066	-0.150	-0.390	-0.497
Kurtosis	1.809	2.033	1.725	2.488	2.809	-0.488
Observations	216	216	216	216	216	216

4.1 Unit root test

As a prerequisite for carrying out the advanced time series techniques, the study conducted the unit root test and reported in Table 2. The obtained results by using the ADF and PP tests affirm the non-stationary feature at levels of the series. However, all the variables are stationary after the first difference. This finding implies that there is no issue associated with the second-order of integration as the variable follows I(1).

Table 2: ADF and PP tests result

Variables	ADF		PP		
	Levels	First difference	Levels	First difference	
lnAGO	-0.195	-6.377*	0.205	-11.064*	I(1)
lnINDO	-1.981	-3.651*	2.068	-5.210*	I(1)
lnSERO	-1.645	-3.423**	-2.210	-3.423**	I(1)
lnEPU	-2.601	-9.311*	0.022	-38.596*	I(1)
lnL	0.388	-4.314*	1.374	-4.183*	I(1)
lnK	0.337	-5.179*	0.960	-5.296*	I(1)

Note: * and ** show significance at 1 and 5%, respectively.

4.2 Cointegration test

Once the unique integration order has been unveiled for the series, the next step is to assess the long-run relationship. Thus, this study uses the combined cointegration proposed by Bayer-Hanck (2013). The outcome portrayed in Table 3 shows that the estimated statistics for the agriculture, industry and service sector models are far from the critical value, which is clear evidence against the null hypothesis, i.e., no cointegration. Thus, it is possible to infer a long-run relationship between the variables of interest across the estimated model.

Table 3: Bayer–Hanck test results

	EG-JOH	EG-J-BA-BO	Cointegration
lnAGO=f(lnEPU,lnL,lnK)	56.770**	57.704**	Yes
lnINDO=f(lnEPU,lnL,lnK)	19.108**	21.514**	Yes
lnSERO=f(lnEPU,lnL,lnK)	19.209**	33.865**	Yes
		5% critical value:	
	EG-JOH	10.637	
	EG-J-BA-BO	20.486	

Note: ** show the significance at 5%.

4.3 Regression estimation

In order to analyse the link between the independent variables and the outcome variable, the study implements the FMOLS and DOLS models. Table 4 delineates the output of regressions. Moreover, the outcomes are consistent across FMOLS and DOLS.

The outcomes from the FMOLS technique indicate that economic policy uncertainty reduces the growth of different sectors. Precisely, the outcome indicates a significant decrease in agricultural output (-0.07%), industrial output (-0.09%), and service sector output (-0.278%) due to a 1% increase in economic policy uncertainty. However, a strong negative effect is found in the service sector, followed by the industrial and agriculture sectors. The coefficient estimate for labour shows a statistically significant decreasing role in all the sectors except the industrial sector, which means that a 1% increase in labour reduces the output of the agriculture and service sectors by -2.652 and -4.235. But, there is no significant impact on industrial output by the labour force in India. Besides, a 1% statistical significance for the coefficient of capital across the models. It portrays that agricultural, industrial, and service sectors can increase their output by 0.694%, 0.889% and 1.391%, respectively, for a 1% rise in the capital.

The results from the DOLS technique hint that economic policy uncertainty reduces agriculture, industry and service sectors' output. Moreover, it is significant at a 1% level. Specifically, a 1% rise in economic policy uncertainty leads to a reduction of output by agriculture (-0.071%), industry (-0.047%), and service (-0.153%) sectors. The estimated coefficient of labour is negative and significant for the agriculture and service sectors, in which a 1% rise in labour decreases the agriculture and service sector output by -1.697% and -3.727%, respectively. However, industrial output shows an insignificant role in industrial output. The capital coefficient exerts a significant and positive role across the model. In short, a 1% increment of capital leads to a rise in the output of the agriculture, industry, and service sectors by 0.589%, 0.840%, and 1.430%, respectively. Thus, the proper structural transformation in India requires a reduction in economic policy uncertainty as it affects all sectors of the economy.

Table 4: Regression estimation results of FMOLS and DOLS.

Model:1 lnAGO=f(lnEPU,lnL,lnK)				
Dependent variable: lnAGO				
	FMOLS		DOLS	
	Coefficient	t-stat	Coefficient	t-stat
lnEPU	-0.070*	-6.006	-0.071*	-5.658
lnL	-2.652*	-4.677	-1.697***	-2.395
lnK	0.694*	12.780	0.589*	8.151
Con	58.238*	5.989	42.466*	3.545
Adjusted R^2	0.95		Adjusted R^2	0.97
Model:2 lnINDO=f(lnEPU,lnL,lnK)				
Dependent variable: lnINDO				
	FMOLS		DOLS	
	Coefficient	t-stat	Coefficient	t-stat
lnEPU	-0.099*	-7.199	-0.047*	-3.994
lnL	-0.257	-0.382	-0.122	-0.185
lnK	0.889*	13.831	0.840*	12.415
Con	4.878	0.424	3.485	0.311
Adjusted R^2	0.95		Adjusted R^2	0.97
Model:3 lnSERO=f(lnEPU,lnL,lnK)				
Dependent variable: lnSERO				
	FMOLS		DOLS	
	Coefficient	t-stat	Coefficient	t-stat
lnEPU	-0.278*	-8.020	-0.153*	-4.386
lnL	-4.235*	-2.504	-3.727***	-1.681
lnK	1.391*	8.586	1.430*	6.927
Con	70.048**	2.415	58.105	1.528
Adjusted R^2	0.90		Adjusted R^2	0.99

Note: *,** and *** indicate significance at 1,5 and 10% levels, respectively.
Abbreviations: DOLS, dynamic OLS; FMOLS, fully modified OLS.

4.4 Discussion

The results indicate that economic policy uncertainty reduces the growth of the agriculture, industry and service sectors. It is obvious as businessmen, producers, suppliers, service providers, and industrialists do not have clarity on legislation and policy in terms of its potential effect, content and timing. As a result, future investments and consumption may be postponed by the investors and consumers, which in turn harms the sectoral growth of the economy. Moreover, the study found a relatively strong impact of economic policy uncertainty on the service sector, and thereby it hurts the process of structural change in India. The working mechanism of such a link may be for the firm in the service sector to postpone their expansionism measures and capital-intensive investment compared to the industrial and agricultural sector firms until they reach a period in which they are more certain. Furthermore, it may be due to the employment loss arising from the uncertainty arising from the different sectors, which in turn reduces the share of a particular sector to the overall growth. Besides, the finding is consistent with Cerda *et al*., (2018) for Chile, Xin *et al*., (2022) for China, and Bhagat *et al*., (2013) for India.

For the agricultural sector in India, although the uncertainty about the natural factors is beyond the control of policymakers, the uncertainty related to the fluctuations in the price of agricultural products, the uncertain input prices and their quality are the main hurdles to investing in the agricultural sector in India. Regarding industrial output and economic policy uncertainty is concerned, the uncertainty about the economic policy leads to a reduction in reducing the skilled labour proportion, and technological innovation postponement leads to a reduction of output from the industries in India. As far as economic policy uncertainty and service sector output in India is concerned, the financial, health,

education and other services are prone to government policies. Therefore, the output produced in this sector is reduced if the policy uncertainty is more and vice versa.

The outcome further hints that labour is hurting the sectoral level growth. This may be attributed to many factors in a developing country like India. First, the absence of proper training and education for the labour, which in turn reduces their contribution to the total output. Second, welfare activities for the labour are not well managed in India; thereby, the willingness of the workers to work reduces in the sector, which in turn constitutes a low output share. Third, the use of obsolete machines to assist the labour in production leads to a decrease in output share from the labour. Fourth, labour exploitation makes them less productive, thereby decreasing the total output share. Finally, in the presence of economic policy uncertainty, the hiring of the skilled labour force becomes less, which in turn reduces the contribution of labour to the total output across sectors (Pindyck, 1988).

The coefficient of capital shows a positive impact on all the sectors of the economy. Thus, it is possible to argue that capital is the most important production factor in all sectors. This finding is attributed to the fact that capital can boost operational efficiency and facilities for improving production. However, capital does not bring immediate changes in the output, the investment in capital eases the process of innovation in all sectors. Hence, the application of newly introduced machinery fosters the output of all sectors of the economy. Moreover, it can assist other factors of production in the process of output generation. Therefore, capital can increase the productivity of complementary inputs. As a result, it can foster the output of different sectors of the economy.

4.5 Robustness analysis

The consistency of the estimated results of FMOLS and DOLS has been cross-checked by executing the CCR, and the outcomes for the same have been reported in Table 5. Findings are in favour of previous methods of estimations, i.e., FMOLS and DOLS. However, the findings are slightly different in terms of coefficient values. The outcomes indicate that a 1 % increase in economic policy uncertainty reduces the output of agriculture, industry and service sectors by -0.072%, -0.049%, and -0.163%, respectively. Further, it is significant at the 1% level. Besides, the estimated coefficient of labour indicates that a 1% increase in labour reduces the output of agriculture, industry and service sectors by -2.688%, -0.083%, and-3.387%, respectively. However, the coefficient of labour with respect to industrial output is not significant. Additionally, the coefficient of labour shows a positive and significant role across the models, which means a 1% increase in capital fosters the output of agriculture, industry and service sectors by 0.700%, 0.832%, and 1.293%, respectively.

Table 5: Regression estimation results of CCR

Model:1 lnAGO=f(lnEPU,lnL,lnK)		
Dependent variable: lnAGO		
	CCR	
	Coefficient	t-stat
lnEPU	-0.072*	-5.670
lnL	-2.688*	-4.012
lnK	0.700*	10.674
Con	58.786*	5.146
	Adjusted R2	0.95
Model:2 lnINDO=f(lnEPU,lnL,lnK)		
Dependent variable: lnINDO		
	CCR	
	Coefficient	t-stat
lnEPU	-0.049*	-4.609
lnL	-0.083	-0.152
lnK	0.832*	15.693
Con	2.952	0.319
	Adjusted R2	0.98

Model:3 lnSERO=f(lnEPU,lnL,lnK)		
Dependent variable: lnSERO		
	CCR	
	Coefficient	t-stat
lnEPU	-0.163*	-6.880
lnL	-3.387**	-1.683
lnK	1.293*	6.249
Con	55.638***	1.640
	Adjusted R^2	0.95

Note: *,** and *** indicate significance at 1,5 and 10% levels, respectively.CCR: canonical cointegrating regression;

5. Conclusions and policy implications

This study aims to examine the impact of economic policy uncertainty on sectoral-level output in India during 2003M01-2020M12. Besides, it controls capital and labour in the sectoral output functions. The implementation of Bayer and Hanck (2013) combined cointegration analysis, applications of Fully Modified Ordinary least square (FMOLS) and Dynamic Ordinary Least Square (DOLS) makes the study unique while exploring the link between sectoral level output and its determinants. Further, the robust analysis was conducted using canonical cointegrating regression (CCR).

Unlike previous studies exploring the impact of economic policy uncertainty on India's economic growth, this paper systematically estimates the impact of economic policy uncertainty on sectoral-level output in India. Our results indicate that sectoral level output slows down when economic policy uncertainty increases in the economy. In conclusion, the analysis shows that economic policy uncertainty reduces the growth of the agriculture, industry and service sectors. However, the empirical evidence provided by the study suggests that economic uncertainty has a varying effect at the sectoral level. Particularly, the study found a relatively strong impact of economic policy uncertainty on the service sector, and thereby it hurts the process of structural change in India. The service sector's contribution to the total GDP is higher than the other two sectors in India. Therefore, if India needs to strengthen its economic growth and progress the foundation of the economy's future performance, the service sector will need to do better.

These results are valuable for policymakers, practitioners and researchers to realize the implication of decisions by economic policymakers and investors. Since India is labour abundant country, it should pay attention to the impact of economic policy uncertainty on sectoral-level employment. Our findings are broadly consistent with the current trend of structural transformation, which emphasises the shift of labour and overall economic activity in India from the agricultural sector to the manufacturing and service sectors. The study shows the lack of efficiency of the workforce in the agricultural sector. Therefore, we suggest taking action in the sectoral level economic and labour market policies and more to improve the quality of the labour force. Further, it encourages employment-intensive growth and sectoral-level output. The governments need to emphasise shaping the skilled labour force, which helps to make a new employment pattern and relationship productive. Thus, the policymakers and government should carefully implement economic policies, reduce the uncertainty at the policy level from the root, take steps to minimize the negative effects of economic policies and stabilize the prospects of all players

Although the study contributes to the literature on economic policy uncertainty and sectoral-level output largely, the non-consideration of more control variables in the model may cause for alteration of the estimated outcome. Further, the findings are not generalizable to other countries as it is a country-specific study. Therefore, the study suggests further analysis by incorporating more control variables in the estimated model is a better avenue for future studies. Besides, further studies are possible in the context of different countries or cross-country levels to have generalized findings for other countries.

References

Abdul, R. M., Villanthenkodath, M. A., and Shibinu, S. (2023). Macroeconomic determinants of emigration from India to the United States. *International Journal of Economic Policy Studies*, *17*(1), 63–74. https://doi.org/10.1007/s42495-022-00091-8

Akadiri, S. S., Alola, A. A., and Uzuner, G. (2020). Economic policy uncertainty and tourism: Evidence from the heterogeneous panel. *Current Issues in Tourism*, 23(20), 2507–2514. https://doi.org/10.1080/13683500.2019.1687662

Akram, V., Sahoo, P. K., and Rath, B. N. (2020). A sector-level analysis of output club convergence in case of a global economy. *Journal of Economic Studies*, 47(4), 747–767. https://doi.org/10.1108/JES-03-2019-0103

Alola, A. A., and Saint Akadiri, S. (2021). Clean energy development in the United States amidst augmented socioeconomic aspects and country-specific policies. *Renewable Energy*, 169, 221–230.

Al-Thaqeb, S. A., and Algharabali, B. G. (2019). Economic policy uncertainty: A literature review. *The Journal of Economic Asymmetries*, *20*, e00133.

Anser, M. K., Apergis, N., and Syed, Q. R. (2021). Impact of economic policy uncertainty on CO2 emissions: Evidence from top ten carbon emitter countries. *Environmental Science and Pollution Research*, 28(23), 29369–29378.

Asteriou, D., and Price, S. (2005). Uncertainty, investment and economic growth: Evidence from a dynamic panel." *Review of Development Economics*, 9(2), 277–288. https://doi.org/10.1111/j.1467-9361.2005.00276.x

Badshah, I., Demirer, R., and Suleman, M. T. (2019). The effect of economic policy uncertainty on stock-commodity correlations and its implications on optimal hedging. *Energy Economics*, 84, 104553.

Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring economic policy uncertainty. *The Quarterly Journal of Economics*, 131(4), 1593-1636.

Balcilar, M., Ozdemir, Z. A., Ozdemir, H., and Wohar, M. E. (2020). *Transmission of US and EU Economic Policy Uncertainty shock to asian economies in bad and good times* (No. 13274). Institute of Labor Economics (IZA).

Banerjee, A., Dolado, J., and Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of Time Series Analysis*, 19(3), 267-283.

Bayer, C., and Hanck, C. (2013). Combining non-cointegration tests. *Journal of Time Series Analysis*, 34(1), 83-95.

Belke, A., and Osowski, T. (2019). International effects of Euro area versus US policy uncertainty: A FAVAR approach. *Economic Inquiry*, 57(1), 453-481.

Bhagat, S., Ghosh, P., and Rangan, S. (2016). Economic policy uncertainty and growth in India. *Economic and Political Weekly*, 72-81.

Bhar, R., and Mallik, G. (2012). Inflation, inflation uncertainty and macroeconomic performance in Australia. Economic Analysis and Policy, 42(3), 305–318. https://doi.org/10.1016/S0313-5926(12)50031-7

Bloom, N., Bond, S., and Van Reenen, J. (2007). Uncertainty and investment dynamics. *The Review of Economic Studies*, 74(2), 391–415.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., and Terry, S. (2012). Really uncertain business cycles. *Econometrica*, 86(3), 1031–1065.

Boswijk, H. P. (1994). Testing for an unstable root in conditional and structural error correction models. *Journal of Econometrics*, *63*(1), 37-60.

Boutchkova, M., Doshi, H., Durnev, A., and Molchanov, A. (2012). Precarious politics and return volatility. *The Review of Financial Studies*, 25(4), 1111-1154.

Cerda, R., Silva, A., and Valente, J. T. (2018). Impact of economic uncertainty in a small open economy: the case of Chile. *Applied Economics*, 50(26), 2894-2908.

Chen, L., Du, Z., and Hu, Z. (2020). Impact of economic policy uncertainty on exchange rate volatility of China. *Finance Research Letters*, 32, 101266.

Cheriyambadan, N., Villanthenkodath, M. A., and Shareef, H. (2023). Attaining environmental sustainability through cashew nut production in India: revisiting the role of energy consumption and economic growth. *Journal of Nuts*, *0*. https://doi.org/10.22034/jon.2022.1972216.1203

Colombo, V. (2013). Economic policy uncertainty in the US: Does it matter for the Euro area? *Economics Letters*, 121(1), 39-42.

De Wind, J., and Grabska, K. (2016). The impact of uncertainty shocks: continental versus the Anglo-Saxon World. CPB Discussion Paper 335.

Dickey, D. A., and Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74(366a), 427-431.

Engle, R. F., and Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 251-276.

Fatima, A., and Waheed, A. (2014). Economic uncertainty and growth performance: a macroeconomic modeling analysis for Pakistan. *Quality and Quantity*, *48*, 1361-1387.

Fisher, R. A., Immer, F. R., and Tedin, O. (1932). The genetical interpretation of statistics of the third degree in the study of quantitative inheritance. *Genetics*, 17(2), 107.

Ghirelli, C., Gil, M., Pérez, J. J., and Urtasun, A. (2021). Measuring economic and economic policy uncertainty and their macroeconomic effects: The case of Spain. *Empirical Economics*, 60(2), 869–892. https://doi.org/10.1007/s00181-019-01772-8

Gregory, A. W., Haug, A. A., and Lomuto, N. (2004). Mixed signals among tests for cointegration. *Journal of Applied Econometrics*, *19*(1), 89-98.

Hussain, M. M., Pal, S., and Villanthenkodath, M. A. (2023). Towards sustainable development: The impact of transport infrastructure expenditure on the ecological footprint in India. *Innovation and Green Development*, *2*(2), 100037. https://doi.org/10.1016/j.igd.2023.100037

Istiak, K., and Serletis, A. (2018). Economic policy uncertainty and real output: Evidence from the G7 countries. Applied Economics, 50(39), 4222–4233. https://doi.org/10.1080/00036846.2018.1441520

Jeong, B. (2002). Policy uncertainty and long-run investment and output across countries. *International Economic Review*, 43(2), 363–392.

Johansen, S. (1988) Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12(2-3), 231-254

Jones, P. M., and Olson, E. (2013). The time-varying correlation between uncertainty, output, and inflation: Evidence from a DCC-GARCH model. *Economics Letters*, 118(1), 33-37.

Kang, W., Lee, K., and Ratti, R. A. (2014). Economic policy uncertainty and firm-level investment. *Journal of Macroeconomics*, 39, 42-53.

Klößner, S., and Sekkel, R. (2014). International spillovers of policy uncertainty. *Economics Letters*, *124*(3), 508-512.

Pástor, L., and Veronesi, P. (2012). Uncertainty about government policy and stock prices. The Journal of Finance, 67(4), 1219–1264. https://doi.org/10.1111/j.1540-6261.2012.01746.x

Phillips, P. C., and Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Pindyck, R. S. (1988). *Capital risk and models of investment behaviour* (pp. 103-117). Springer Netherlands.

Raza, S. A., Shah, N., and Shahbaz, M. (2018). Does economic policy uncertainty influence gold prices? Evidence from a nonparametric causality-in-quantiles approach. *Resources Policy*, 57(C), 61–68.

Sahinoz, S., and Erdogan Cosar, E. (2018). Economic policy uncertainty and economic activity in Turkey. *Applied Economics Letters*, *25*(21), 1517-1520.

Saikkonen, P. (1992). Estimation and testing of cointegrated systems by an autoregressive approximation. *Econometric theory*, *8*(1), 1-27.

Segal, G., Shaliastovich, I., and Yaron, A. (2015). Good and bad uncertainty: Macroeconomic and financial market implications. *Journal of Financial Economics*, 117(2), 369-397.

Shameem P., M., Chittedi, K. R., and Villanthenkodath, M. A. (2022). Transport infrastructure and manufacturing sector: An energy perspective from India. *International Journal of Energy Sector Management*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/IJESM-04-2022-0010

Sharma, C. (2021). Testing the asymmetric effects of the economic policy uncertainty on the tourism demand in India. *Tourism Economics*, 27(4), 867–873.

Soni, S., and Subramanya, M. (2020). Growth and structural change in the Indian economy: An analysis of pattern, determinants, and outcomes. *Economic and Political Weekly*, 55(26), 65–70.

Stock, J. H., and Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher-order integrated systems. *Econometrica: Journal of the Econometric Society*, 783-820.

Stock, J. H., and Watson, M. W. (2012). Disentangling the Channels of the 2007-2009 Recession (No. w18094). National Bureau of Economic Research.

Ulucak, R., and Khan, S. (2020). Relationship between energy intensity and CO2 emissions: Does economic policy matter? Sustainable Development, 28(5), 1457–1464.

Villanthenkodath, M. A., and Mahalik, M. K. (2022). Does real interest rate reduce income inequality in India? Evidence from multivariate framework analysis. *European Journal of Government and Economics*, *11*(2), Article 2. https://doi.org/10.17979/ejge.2022.11.2.8652

Villanthenkodath, M. A., and Pal, S. (2023). How economic globalization affects the ecological footprint in India? A novel dynamic ARDL simulations. *Journal of Economic and Administrative Sciences*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JEAS-01-2022-0005

Wen, J., Khalid, S., Mahmood, H., and Yang, X. (2021). Economic policy uncertainty and growth nexus in Pakistan: new evidence using NARDL model. *Economic Change and Restructuring*, 1-15.

Xin, D., and Xin, L. (2022). The impact of economic policy uncertainty on PM2.5 pollution—evidence from 25

countries. *Environmental Science and Pollution Research*, *29*(25), 38126-38142.
Yu, H., Fang, L., Du, D., and Yan, P. (2017). How EPU drives long-term industry beta. *Finance Research Letters*, 22, 249-258.