Structural transformation path across Indian states: Findings from panel data analyses

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(*Corresponding Author*)

Altaf Hussain Padder[1]
Mathavan Bommayasamys[2]

[1]*Department of Economics, Annamalai University, Chidambaram, Tamil Nadu India.*
Email: altaf057@gmail.com
[2]*Economics Wing DDE, Annamalai University Chidambaram, Tamil Nadu India.*
Email: bmecoau@gmail.com

ABSTRACT

The present study aims to examine the structural transformation path across the broad economic sectors among the states of the Indian economy which is a key feature of economic development. The movement of sectoral output is a crucial regularity of the data for this study, to examine whether the middle- and low-income states have a similar structural transformation path through which the high-income states have passed, and if not, what are the characteristics of the different paths being followed. Polynomial Regression Functions were applied to fit the association between the share of sectoral output and per-capita income. The present study identified that some middle- and low-income states are following a different path of structural transformation that deviate from those of high-income states and grow faster than high-income states in the process of structural transformation, and there is great heterogeneity within each state. In the last decade, India has seen a slight dip in its services output share but only in the states of the third phase of economic transitions under the middle- and low-income groups. High-income states have shown increasing services output shares in the starting years of the first decade and then falling drastically.

Keywords: *Gross domestic product, Indian economy, Per-capita income, Sectoral output, Structural change, Structural transformation.*

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Highlights of this paper

- The study aims to examine the structural transformation path across the broad economic sectors among the states of the Indian economy in the relevance of Simon Kuznet's perspective.
- Middle- and low-income states are following a different path of structural transformation that deviate from those of high-income states and grow faster than high-income states in the process of structural transformation.
- The pace of structural transformation in the middle- and low-income states has surpassed the pace at which the structural transformation process is going in the high-income states.

1. INTRODUCTION

Structural change refers to the reallocation of economic activities across economic sectors and changes in occupational structure. Structural changes in the economy can be viewed in veneration of different outcomes like; changes in the structure of output and occupational diversification. The perceived significance of sectors in the economy, shifts in the location of economic production, and other consequent dimensions of industrialisation are generally referred to as structural transformation in development and economic history. The problem of structural change in India has risen to the foreground of deliberations intended to transform the economy into a global manufacturing hub. Flourishing structural transformation regarding economic development and employment growth across the sectors from productivity to unproductivity is a significant concern. It emphasises that economic development accompanied by increased employment opportunities in more productive sectors is more likely to be sustained and can assuage more divergence in poverty and inequality. Researchers have provided evidence that as the Gross Domestic Product (GDP) per capita during a nation rises, the share of the agriculture sector in their GDP falls. In other words, is there a scientific relationship between agriculture, industry and the repair sector and, therefore, the level of development? "A development pattern could also be outlined as a scientific variation in any significant aspect of the economic or social organisation associated with a rising level of income or another index of development" (Garrido, 2014). The change of the connection among the elements within the entity is known as a structural change (Marjanović, 2015). According to Kuznets (1955) "structural change and economic growth are strongly interrelated in the history of economics and development. Changes in the economic transitions can move the economic growth upward if its pace is resourceful and bends it back if its pace is too slow or its direction is inefficient".

The mainstay of the process of economic development is structural change. The process of economic progress is interpreted as a sustained increase in output per capita along with structural reforms in productive capacities and employment (Roy, 2007). Economic restructuring inevitably takes place in two dimensions: first, developing the regional share of GDP and second, the development of the share of the active working population participating in each economic sector. It has been observed that the contribution growth of the manufacturing and service sectors has increased considerably, whereas the agricultural sector has been steadily declining. The migration of workers from the subsistence to productive sectors is also part of the structural transition. This has been experienced by most developed countries and some newly industrialized countries, which have spanned this threshold from agricultural to manufacturing and manufacturing to manufacturing service sectors (Bah, 2008). In the case of developing countries like India, it appears that a different pattern has emerged as opposed to developed countries which Colin Clark and others have tried to present. Between 1881 and 1911, there was a significant rise in the proportion of people employed in agriculture, which remained essentially unchanged until 1991 (Banerjee, 2019).

Kuznets (1955) recorded and evaluated economic transformation as a fundamental component of contemporary economic development. Kuznets (1955) examined that; the economy is undergoing rapid systemic changes. The transformation from agricultural to non-agricultural pursuits and the recent shift from industry to services are major

aspects of structural change. A high degree of structural shifts is inextricably related to a high rate of labour productivity growth. Changes in the shares of production and inputs in economic activity are associated with overt changes in employment status, working and living environments, business types, and the structure of international exchange and other relations with the rest of the world. Differential productivity growth is responsible for changes in the proportion of workers effectively engaged by the sector. There is an essential and strong link between growth and structural changes. Growth leads to an inconceivable without structural shifts from agriculture to manufacturing and later to services. High rates of growth are closely associated with and indeed require changes in economic structure.

The process of structural change in the Indian economy was initially driven by the secondary and services sector. Sustained economic growth changes the economic structure and shifts the primary sector to another (Soni & Subrahmanya, 2020). The overall contribution of the agricultural and its allied sectors to the gross domestic product declined steadily from the post-independence to the post-reform period (Aggarwal, 2018; Bhattacharya & Mitra, 1993; Sastry, Singh, Bhattacharya, & Unnikrishnan, 2003; Singariya, 2014; Thamarajakshi, 1989). Since the post-independence period, the growth rate of the manufacturing and services sector has increased significantly up to the imitation of the reform period (Bhattacharya & Mitra, 1993; Goldar, 2000; Padder & Mathavan, 2022; Thamarajakshi, 1989). Reforms of the 1980s did increase India's growth rate, but little evidence that they affected the rate of expansion in crucial sectors such as agriculture, manufacturing and services. Increased growth was due to a changing composition of GDP, as resources moved away from slow-growing towards faster-growing areas of the economy, more than improvements in sectoral growth rates (Wallack, 2003). After the post-liberalization period, the growth of the manufacturing sector has not shown a marginal enhancement although it recorded a negative growth rate in 2013-14, while the share of services has increased by about 8 per cent with a similar fall in agricultural (Bhattacharya & Mitra, 1993; Mazumdar, 2011; Roy, 2016).

2. METHODOLOGY

The present study will focus on the structural transformation path across the states categorised under high-, middle- and low-income states based on the average GDP per-capita income during 1999-00 to 2018-19 at 2011-12 constant prices extracted from the Handbook of Statistics on Indian Economy published by the Reserve Bank of India. The analysis covers 19 states based on a set of criteria. The first norm is to include as many different states of the Indian economy as possible. Thus, states from the North-Eastern region are excluded from the analysis due to the lack of private investment, low capital formation, and geographical isolation. The second norm to exclude the states was based on the data availability and the minimal contribution of sectors to the GDP. So, all the states and union territories sharing less than 10 per cent of sectoral output were excluded from the analysis. The movement of sectoral output is a crucial regularity of the data for this study, so to examine whether the middle- and low-income states have a similar structural transformation path through which the high-income states have passed and or passing, and if not, what are the characteristics of the different path being followed.

Across all the states, Polynomial Regression Functions are applied to fit the association between sectoral output shares and per-capita income, where the dependent variables are sectoral output shares and the explanatory variable is log GDP per-capita income. The degree of the polynomial is determined by the goodness of fit, so the coefficient of determination (R^2), F values and descriptive statistics were considered while applying this model.

Given the heterogeneity in the panel data, the linear transformation method was used to avoid the inconsistencies and anomalies commonly present in the time series data. The linear transformation does not affect the regression

model nor the standard error and coefficients but makes changes in the intercept a lot and is now interpretable based on comparison to the mean of the data (Gelman & Hill, 2006). The linear transformation is the actual deviation that is taken from the actual mean of all states: expressed as $(x_{it} - \bar{x}_i)$ = mean centred variable.

Where x_{it} is the value of an independent variable (log GDP per-capita income) of states 'i', at a time 't', and $\bar{x}_i$ is the actual mean of states, individually.

For curve fitting in each sector, the following polynomials regression was estimated:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it}^2 + \beta_3 x_{it}^3 + \epsilon_{it},$$

Where y_{it} is the sectoral output share (dependent variable) and x_{it} is the log per-capita GDP mean centred variable (independent variable) for states 'i' in period 't', and $'\alpha \; and \; \beta'$ are the regression coefficients for all selected states at the individual level.

For the states which are found insignificant at third-degree polynomials, the quadratic function was used:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it}^2 + \epsilon_{it}$$

Similarly, the states which are found insignificant at the second-and-third degree of polynomials functions were estimated on linear polynomial functions:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \epsilon_{it}$$

3. NATURE OF STRUCTURAL TRANSFORMATION IN INDIAN STATES

Kuznets (1966) showed essential regularities in the structural composition of economic growth and the transformations. Generally, the agriculture sector dominated the economy before economic transformation took place. As industrial expansion accelerates, the industry becomes increasingly more productive, while agriculture's contribution to GDP declines. As soon as the industry began to decline, the expansion of the services sector began to increase. In periods of high development, the structural gap widens because the percentage of agriculture in GDP declines considerably much faster than that of industry and services. No matter how different economies or states within countries are in terms of economic transition speed, all share the following commonalities: (1) the share of agriculture towards the GDP is decreasing as the GDP increases, (2) initially the share of industry increases then takes a dip as the output increases and (3) the share of services sector increases rapidly as the industry decreases (Bah, 2011).

The present analysis will focus on the structural transformation path across the states categorised under high-, middle- and low-income states based on the average GDP per-capita income during 1999-00 to 2018-19 at 2011-12 constant prices. The analysis covers 19 states based on a set of criteria. The first norm is to include as many different states of the Indian economy as possible. Thus, states from the North-Eastern region are excluded from the analysis due to the lack of private investment, low capital formation, and geographical isolation. The second norm to exclude the states was based on the data availability and the minimal contribution of sectors to the GDP. So, all the states and union territories sharing less than 10 per cent of sectoral output were excluded from the analysis. The movement of sectoral output is a crucial regularity of the data for this study, so to examine whether the middle- and low-income states have a similar structural transformation path through which the high-income states have passed and or passing, if not, what are the characteristics of the different path being followed.

Across all the states, polynomial regression functions are applied to fit the association between sectoral output shares and per-capita income, where the dependent variables are sectoral output shares and the explanatory variable is log GDP per-capita income explained in the methodology chapter. The degree of the polynomial is determined by

the goodness of fit, so the coefficient of determination (R^2), F values and descriptive statistics were considered while applying this model. The regression results are explained below under the following sub-headings:

4. REGRESSION RESULTS FOR THE HIGH-INCOME STATES

The results of regression and descriptive statistics for the high-income states are portrayed in Table 1, respectively. For the pattern of structural transformation path in the high-income states, six states are selected under this category: Haryana, Maharashtra, Kerala, Tamil Nadu, Gujrat and Himachal Pradesh. The agriculture sector among all the states under the high-income group has shown declined trend subsequently over the period from 1999-00 to 2018-19. In Haryana, the agriculture output has decreased at the rate of -23.107 per cent; likewise, in Maharashtra, it shows -31.242, Kerala (-6.895), Tamil Nadu (-13.802), Gujrat (-4.443) and in Himachal Pradesh, it has declined at -14.691 per cent. Whereas in terms of the industrial sector, the share has decreased in Kerala (-11.598) and has increased in Haryana (7.166), Maharashtra (6.841), Tamil Nadu (7.122), Gujrat (15.792) and in Himachal Pradesh, the share has increased 14.814 per cent. Except for the two states, Tamil Nadu (-12.581) and Gujrat (-11.349), the share of the services sector has shown an increasing trend under the high-income group in Haryana (19.830), Maharashtra (58.593) and Kerala (14.098) during 1999-00 to 2018-19.

The above analysis shows that the services sector is a significant contributor and grew faster than the agriculture and industrial sector except for Tamil Nadu, Himachal Pradesh and Gujrat, where the services sector has decreased during the last two decades. That means the reallocation of resources is moving away from the traditional sector to the services sector. In Tamil Nadu, Himachal Pradesh and Gujrat, the sectoral output has shifted from the traditional sector to the industrial sector as the GDP per-capita income increased from 1999-00 to 2018-19.

4.1. Comparing Fitted Curves (Figure 1)

The agriculture sector in the states of Haryana, Maharashtra and Tamil Nadu are best fitted on third-degree polynomials with an R^2 of 0.913, 0.805 & 0.519, respectively whereas, the Gujrat fits on second-degree polynomials with an R^2 of 0.250, and the first-degree polynomials are best fitted in the states of Kerala and Himachal Pradesh with an R^2 of 0.944 and 0.931, respectively. This suggests that the agriculture sector best fits the above-mentioned polynomial functions under the high-income group states. Himachal Pradesh is the only state among the high-income group where the variations are relatively higher than other agriculture-sector fitted curves.

For the industrial sector, the third degree-polynomials are best fitted in the state of Kerala. Haryana, Tamil Nadu, Gujrat and Himachal Pradesh were best fitted on the quadratic function with an R^2 of 0.532, 0.400, 0.825 & 0.925, respectively. Maharashtra fitted on the first degree of polynomials function with an R^2 of 0.652. Similarly, in the services sector, the cubic polynomial function is best fitted in Haryana, Maharashtra and Kerala explained by 91.8, 50.3 and 89.7 per cent of observations of the line of the best fit. The Quadratic function was best fitted in Tamil Nadu and Gujrat with an R^2 of 0.391 and 0.774. Himachal Pradesh fitted on the first degree of the polynomial function with an R^2 0.666.

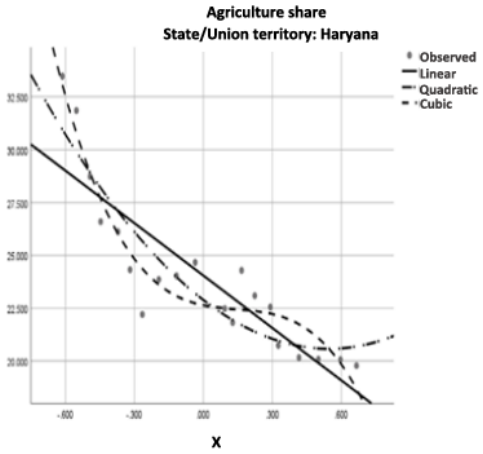
To show the heterogeneity between states that fitted under the high-income groups, simple descriptive statistics have been calculated for each state portrayed in Table 1. For high-income states, the industrial and services sector in Gujrat and all three major sectors in Himachal Pradesh have shown relatively higher fluctuations in curve fitting. The standard error and deviation of the industrial sector in Himachal Pradesh are relatively higher than in other states, with standard error and deviation equal 2.13 and 9.53, respectively. The fitted curves for each state under the high-income group are shown in Figure 1.

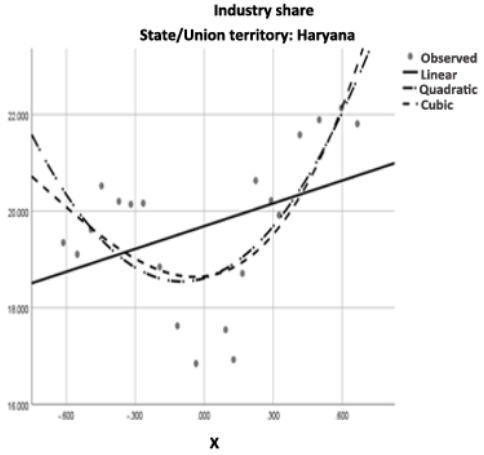
Table 1. Regression results for the high-income states during 1999-2019 at 2011-12 prices.

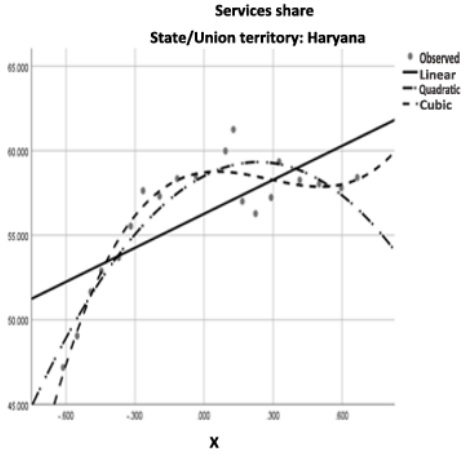
Model: $y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it}^2 + \beta_3 x_{it}^3 + \epsilon_{it}$,									**Statistics**	
States	**Sectors**	**Coefficients**						**R^2**		
		α	**X^1**		**X^2**		**X^3**			
			β_1	**Sig.**	β_2	**Sig.**	β_3	**Sig.**		**Std. deviation**	**Variance**
Haryana	Agriculture	22.638	-8.268	0.040	7.711	0.130	-23.107	0.001*	0.913	3.79	14.36
	Industry	18.612	1.573	0.870	7.166	0.002*			0.532	1.59	2.54
	Services	58.714	6.695	0.003	-14.878	0.130	19.830	0.002*	0.918	3.63	13.18
Maharashtra	Agriculture	11.368	-3.653	0.006	10.592	0.020	-31.242	0.002*	0.805	2.32	5.38
	Industry	22.979	6.841	0.000*					0.652	3.20	10.22
	Services	65.507	-3.188	0.117	-8.404	0.185	58.593	0.008*	0.503	3.32	11.03
Kerala	Agriculture	14.420	-6.895	0.000*					0.944	3.14	9.85
	Industry	9.612	1.897	0.020	3.785	0.040	-11.598	0.000*	0.886	1.27	1.62
	Services	76.164	4.998	0.003	-4.811	0.091	14.098	0.002*	0.897	2.59	6.70
Tamil Nadu	Agriculture	12.172	-1.923	0.044	5.459	0.105	-13.802	0.064**	0.519	1.83	3.35
	Industry	18.055	2.759	0.043	7.122	0.040*			0.400	2.51	6.32
	Services	69.586	-0.836	0.615	-12.581	0.005*			0.391	3.02	9.11
Gujarat	Agriculture	19.122	0.562	0.514	-4.443	0.037*			0.250	1.56	2.43
	Industry	29.111	7.829	0.005	15.792	0.000*			0.825	4.70	22.11
	Services	51.768	-8.391	0.005	-11.349	0.002*			0.774	4.63	21.40
Himachal Pradesh	Agriculture	21.182	-14.691	0.000*					0.931	5.54	30.73
	Industry	20.754	24.806	0.035	14.814	0.025*			0.925	9.53	90.83
	Services	56.084	-10.084	0.000*					0.666	4.51	20.38

Note: * and ** Indicates significance at 0.05 and 0.10 levels, respectively.

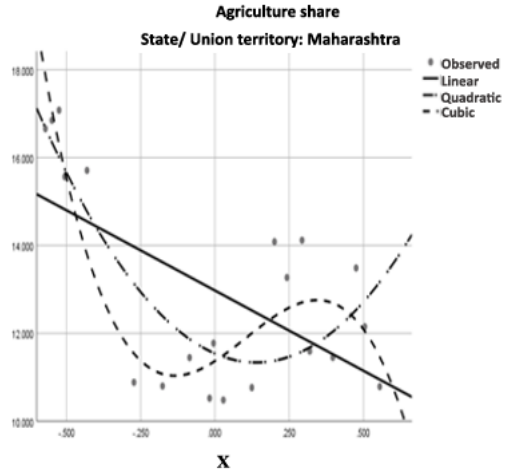
Haryana

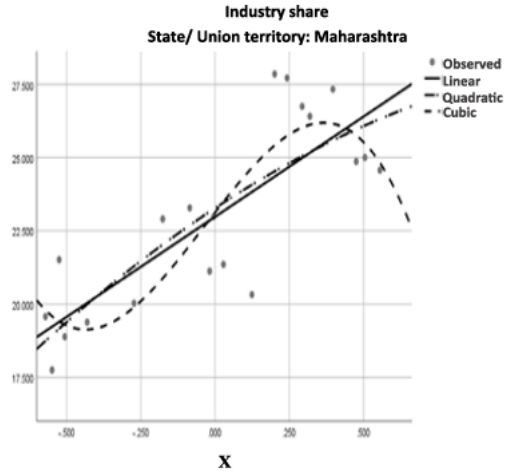


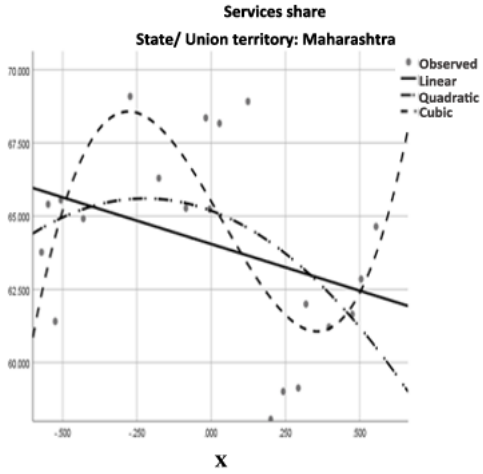




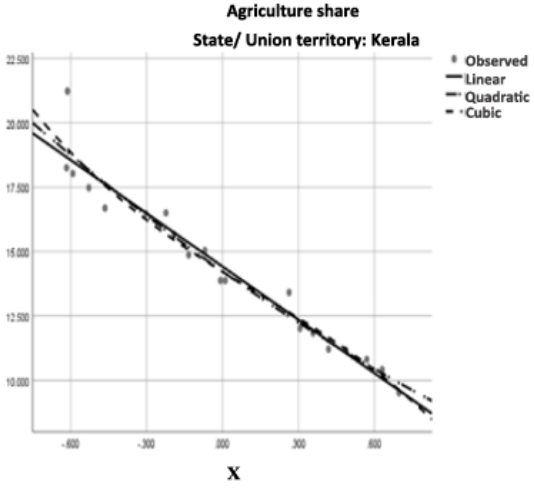
Maharashtra

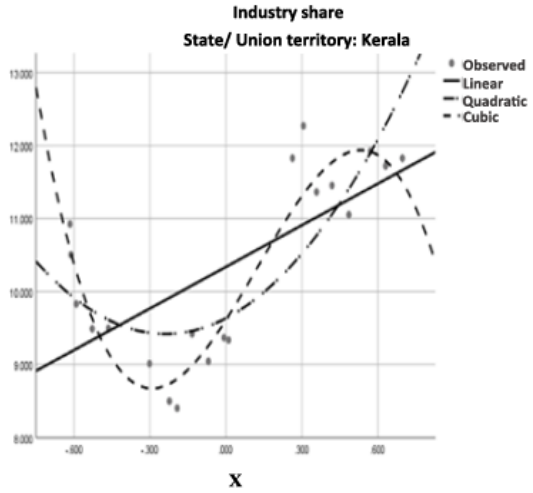


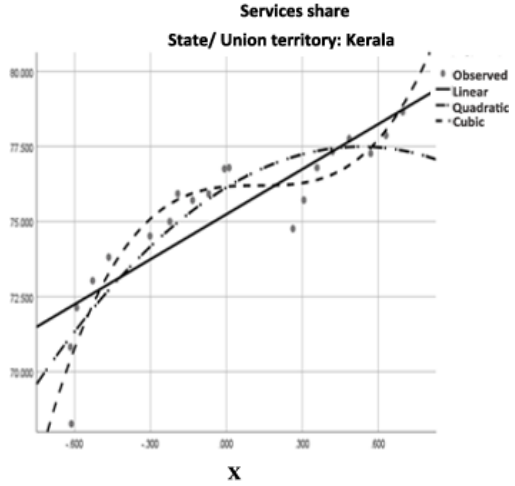




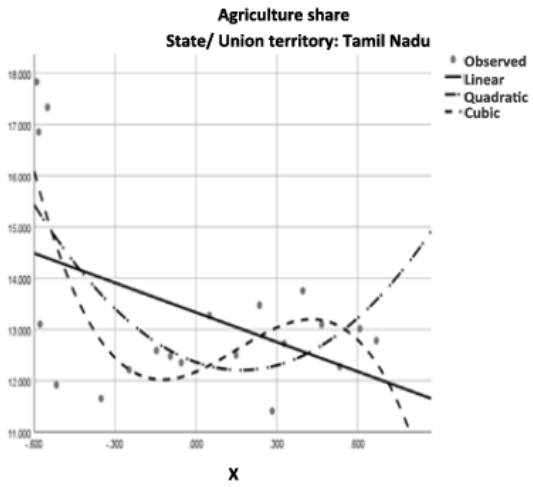
Kerala

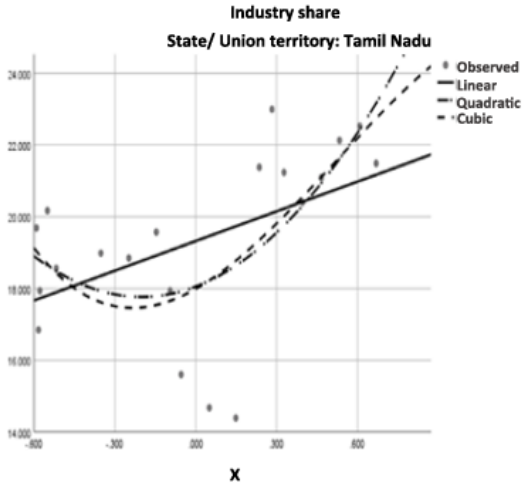


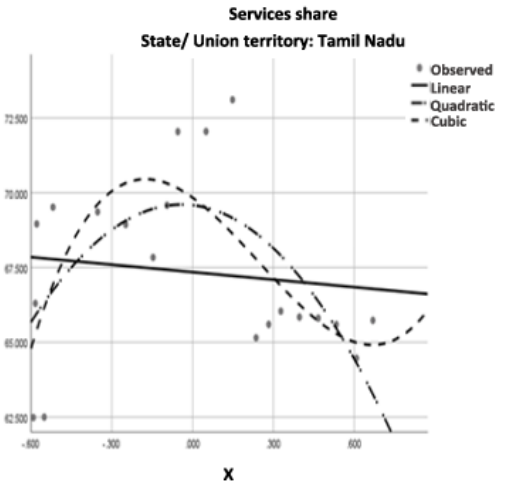


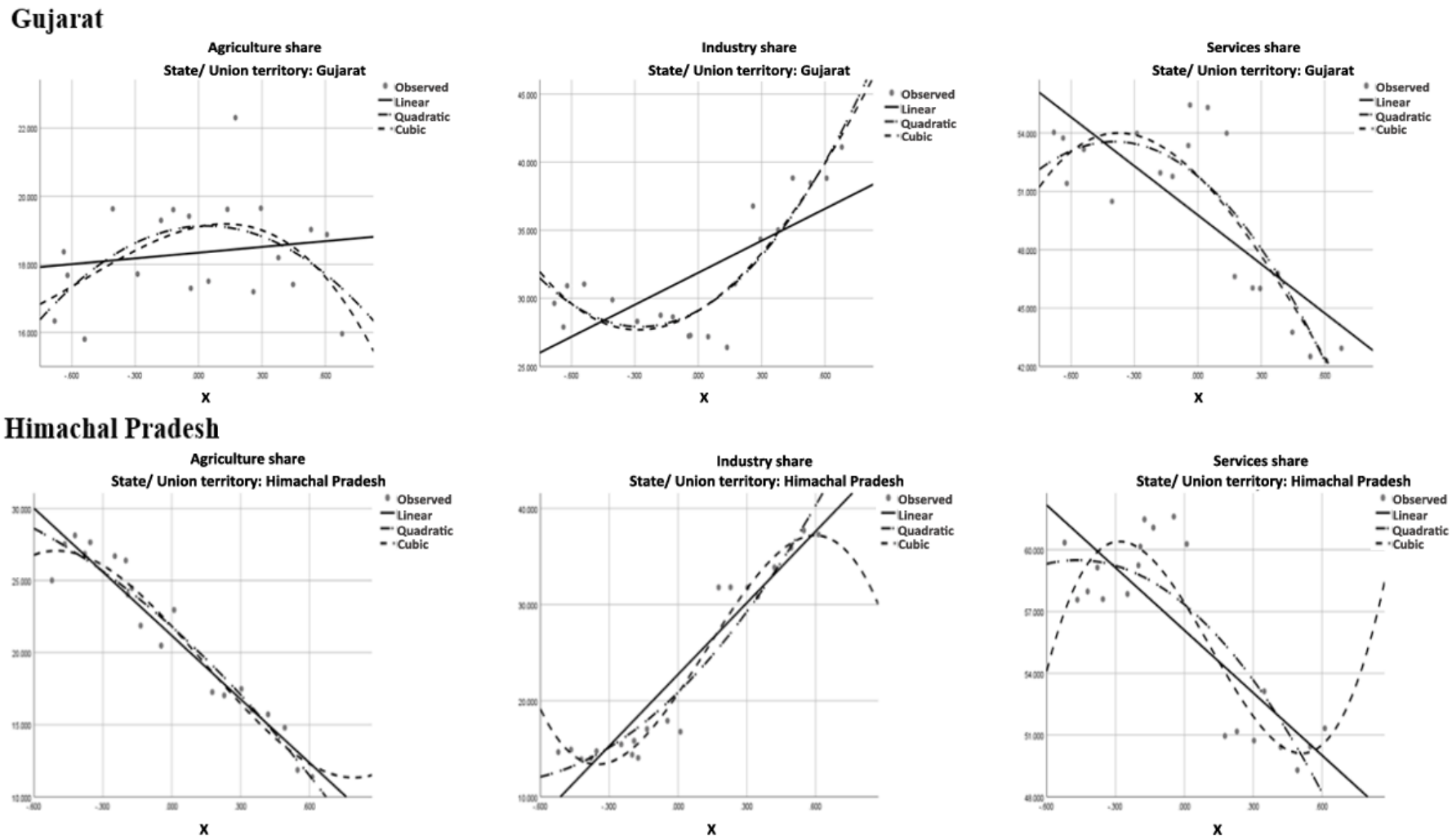


Tamil Nadu









Figures 1. High-income States.

Note: The figures of high-income States are composite of six states viz, Haryana, Maharashtra, Kerala, Tamil Nadu, Gujrat and Himachal Pradesh under Figure 1, extracted from the Table 1.

The curve fitted for the agriculture sector in the state of Haryana has shown an absolute declined slope with the increase in the GDP per-capita income whereas, in the industry, the slope is initially falling as the GDP per-capita income is increasing up to the mean-centred variable reaches to 0.000, then after, the industry has shown increasing slope. In the services sector of Haryana, the share of services output has shown an increased slope as the GDP per capita income has increased over the period. There is a slight dip in the slope of the curve when the log GDP per-capita income mean-centred reached 0.300 and then started increasing again. This suggests that the structural transformation path of the Haryana state is in the third phase of the structural transformation process.

Similarly, in terms of Maharashtra, the slope of the fitted curve in the agriculture sector has shown a declining slope as the GDP per capita income has increased up to the mean-centred variable reaches -0.200 then after it has shown an upward slope up to 0.300 and starts diminishing again whereas, in the industrial sector, the sectoral output has increased with the increase in GDP per-capita income. The slope of the sectoral output in the services of Maharashtra has shown an increasing trend up to the mean-centred variable reaches -0.250, after that there is a declining dip in the sectoral output up to the mean-centred variable reaches 0.250 and starts increasing again. This suggests that the structural transformation pattern of Maharashtra is in the initial stage of the third phase of the structural transformation process. Kerala shows a straightforward transformation process, as the reallocation of sectoral output has shifted from the agriculture sector towards the services sector. The sectoral output of the industry in Kerala has shown declined slope over the period, while the share of services has rapidly increased with the increase in GDP per-capita income. Hence, Kerala is in the third phase of the economic transition process.

Tamil Nadu, Gujrat and Himachal Pradesh are following a similar pattern of structural transformation path. In all states, the pattern of reallocation of sectoral output has shifted from the agriculture sector towards the industrial sector. The sectoral output in the services sector has fallen rapidly with the increase in the GDP per-capita income in the second stage of the structural transformation process.

The above analysis shows that Haryana, Maharashtra and Kerala have different structural transformation patterns and are in the third stage of the structural transformation process compared to Tamil Nadu, Gujrat and Himachal Pradesh which are still in the second stage of the structural transformation path.

5. REGRESSION RESULTS FOR THE MIDDLE-INCOME STATES

Econometric analyses and descriptive statistics for the middle-income states are portrayed in Table 2 during 1990-00 to 2018-19 at constant prices 2011-12. The analysis covers six states based on the average per-capita GDP from 1999-00 to 2018-19. The states falling under this category are Uttarakhand, Karnataka, Punjab, Andhra Pradesh, Rajasthan and Jammu & Kashmir.

Among the middle-income states, the agriculture sector has shown a declined rate among all the states like Uttarakhand (-4.742), Karnataka (-10.527), Punjab (-8.999) and Jammu & Kashmir (-17.775) except Andhra Pradesh which has shown an increasing trend at 24.337 per cent during the analyses period. In Rajasthan, the agriculture sector did not fit the data well and was insignificant in all the polynomial functions. The sectoral output of the industry among all the states except Andhra Pradesh under the middle-income group has shown an increasing trend over the period. Andhra Pradesh does not show a clear path in the industrial sector on all polynomial functions. The value of coefficients estimated at Uttarakhand (10.472), Karnataka (1.643), Punjab (86.216), Rajasthan (5.098) and Jammu & Kashmir (14.399) from the last two decades. Between 1999-00 to 2018-19, the share of the services sector declined in Uttarakhand (-15.108), Andhra Pradesh (-21.321) and Rajasthan (-4.317) while it increased in Karnataka (8.884), Punjab (8.233) and Jammu & Kashmir (13.605) with the increase in the GDP per-capita income.

The above analysis shows that the services sector is the major contributor in Karnataka only, whereas, in Punjab and Jammu & Kashmir, services contribute less than the industrial sector. In Uttarakhand and Rajasthan, the major contributor is the industrial sector, while the service sector has gone down during the last two decades. In Andhra Pradesh, agriculture is still the dominating sector.

5.1 Comparing Fitted Curves (Figure 2)

Figure 2 shows that the slope of the fitted curve in the agriculture sector for the state of Uttarakhand has constantly fallen as the GDP per-capita income had increased and is best fitted on the third-degree of polynomials functions with an R^2 of 0.991 whereas, the industrial sector has shown as upward slope and is best fitted on the quadratic function with an R^2 of 0.899. Similarly, the sectoral share of services has shown a downward slope and fitted on quadratic function with an R^2 of 0.692. It emphasises that the reallocation had moved towards the industrial sector from the agriculture sector while the services sector is going down over the period with relatively higher variations for the state of Uttarakhand under the middle-income group on the curve fitting Table 2. Hence, it suggests that Uttarakhand is in the second stage of the structural transformation process.

In the state of Karnataka, all the sectors are best fitted on the first-degree polynomial function with an R^2 of 0.725 (agriculture), 0.225 (industry) and 0.789 (services), respectively. From Figure 2 for Karnataka, the agriculture sector has shown a declining path in contrast to the services sector, which has shown an upward path in the structural change process whereas, in the industrial share, the curve is flatter than the service sector. This suggests that the economic transitions are shifted away from the agriculture sector more to the services than the industrial sector and reveals the third stage of the structural transformation process with relatively higher variation in agriculture and services than industry. The standard error and deviation for Karnataka in agriculture (1.40 & 6.26), industry (0.39 & 1.75) and services (1.13 & 5.07) respectively Table 2.

The curve fitted of the agriculture sector for Punjab has shown a downward slope with the increase in per-capita GDP and best fitted on the first-degree polynomial function with an R^2 of 0.703, while in terms of industry and services, the slope is steeper in services than in the industry and best fitted on the third-degree, and first-degree polynomials function with an R^2 of 0.530 and 0.598, respectively. The resources flow from the agriculture sector towards the services sector more than the industrial sector over the period. It is clearly shown in the graph that only in the early few years of the first decade, the industry shows an upward trend while services have gone down up to the per-capita GDP mean centred variable was -0.300 after that industry has started declining while services adopt the upward trend. Which inclined that Punjab has achieved the third stage of the structural change path.

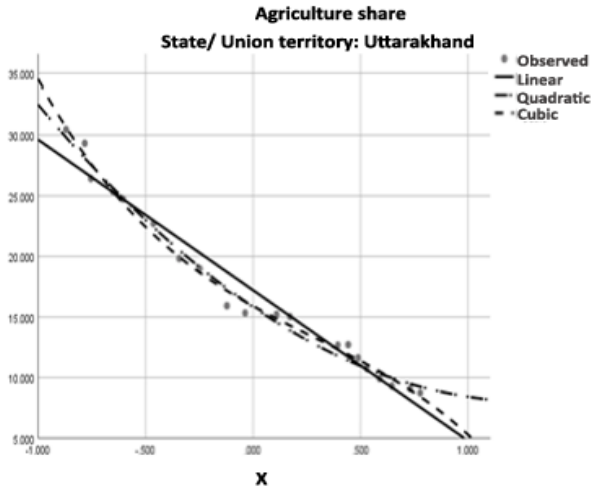
Andhra Pradesh has shown a different pattern of economic transitions compared to other states under the middle-income group over the period. The sectoral output of the agricultural sector in Andhra Pradesh initially declined with the increase in per-capita GDP up to the mean centred variable was close to 0.200 then after it has shown an upward trend and best fitted on the third-degree of polynomials functions with an R^2 of 0.831. the industry sector does not fit on any degree of polynomials, but the slope of the curve fitted has shown a declining trend while the service sector is best fitted on quadratic function with an R^2 of 0.678 and has shown an upward trend initially up to the mean centred variable was close to 0.200 and after that started falling. This suggests that there was a flow of structural change from the agriculture sector to the services sector in the early years of the first decade. After that, a reverse movement of the structural path has been seen from the analysis and is still in the first stage of the structural transformation process. The value of standard error and the standard deviation is higher in agriculture than in other sectors in Andhra Pradesh.

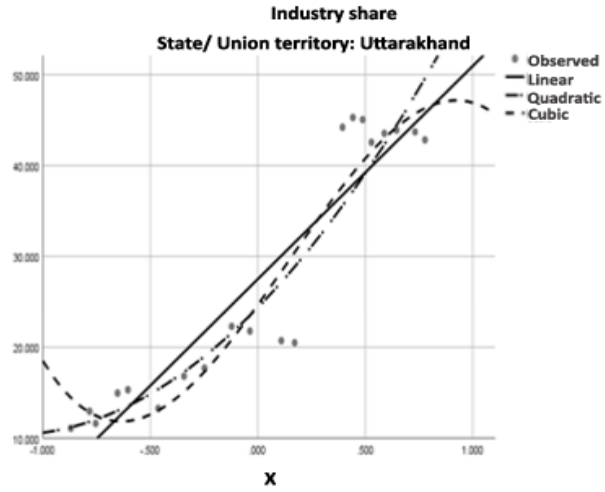
Table 2. Regression results for the middle-income states during 1999-2019 at 2011-12 prices.

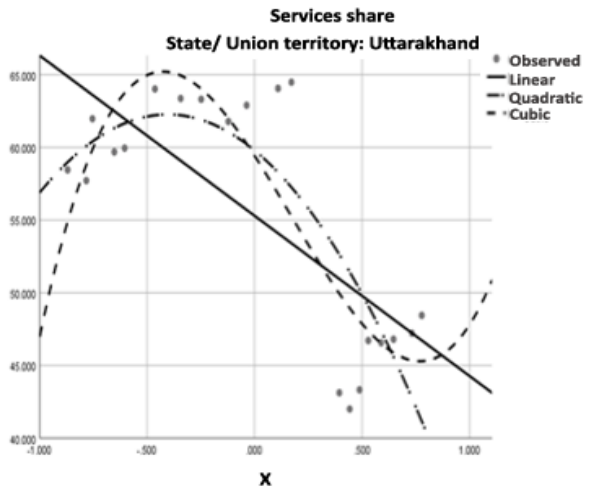
Model: $y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it}^2 + \beta_3 x_{it}^3 + \epsilon_{it}$,										**Statistics**	
States	**Sectors**	α	**Coefficients**						**R^2**		
			X^1		**X^2**		**X^3**				
			β_1	**Sig.**	β_2	**Sig.**	β_3	**Sig.**		**Std. deviation**	**Variance**
Uttarakhand	Agriculture	15.899	-12.420	0.024	4.635	0.213	-4.742	0.014*	0.991	7.08	50.14
	Industry	24.383	23.438	0.050	10.472	0.042*			0.899	14.07	197.92
	Services	59.792	-11.019	0.009	-15.108	0.008*			0.692	8.49	72.11
Karnataka	Agriculture	18.064	-10.527	0.000*					0.725	6.26	39.21
	Industry	16.863	1.643	0.034*					0.225	1.75	3.07
	Services	65.073	8.884	0.000*					0.789	5.07	25.66
Punjab	Agriculture	33.564	-8.999	0.000*					0.703	2.71	7.34
	Industry	15.953	0.765	0.494	-7.252	0.223	86.216	0.002*	0.530	1.19	1.42
	Services	50.483	8.233	0.000*					0.598	2.69	7.22
Andhra Pradesh	Agriculture	25.941	6.428	0.013	24.337	0.000*			0.831	4.54	20.60
	Industry	14.078	-1.114	0.206	-3.015	0.215	-6.343	0.431	0.296	1.45	2.09
	Services	59.559	-5.313	0.035	-21.321	0.000*			0.678	4.31	18.62
Rajasthan	Agriculture	28.070	-0.781	0.584	3.727	0.455	-12.118	0.422	0.677	2.37	5.62
	Industry	16.817	5.098	0.000*					0.735	2.35	5.53
	Services	55.113	-4.317	0.009*					0.326	2.99	8.94
Jammu & Kashmir	Agriculture	26.428	-17.775	0.000*					0.908	5.25	27.51
	Industry	8.701	14.399	0.000*					0.807	4.51	20.30
	Services	63.849	3.376	0.027	13.605	0.018*			0.461	1.93	3.71

Note: * Indicates significance at 0.05 level.

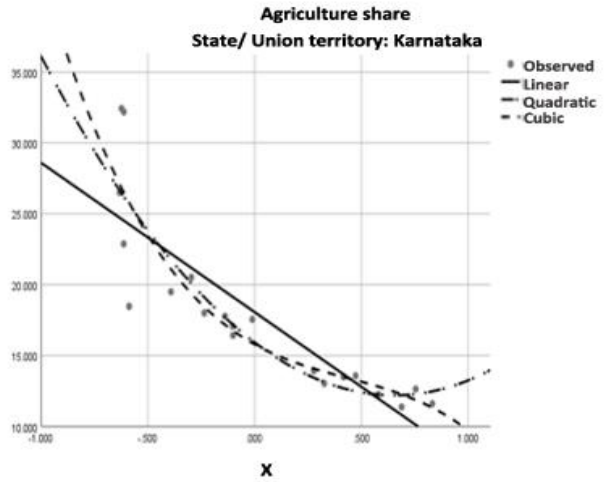
Uttarakhand

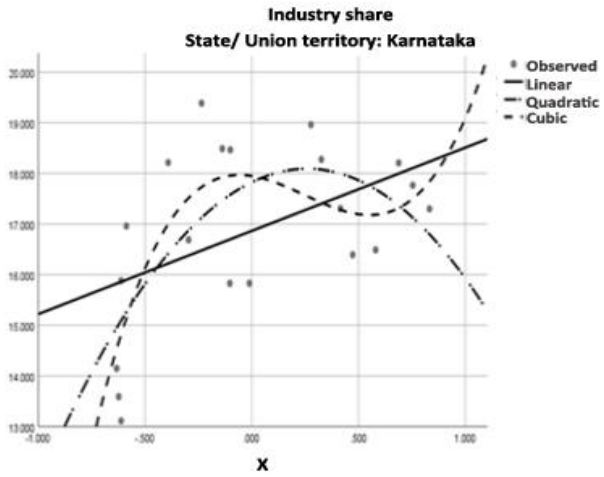


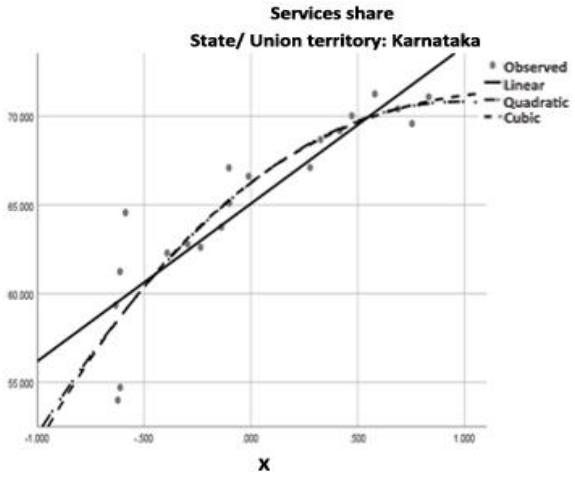




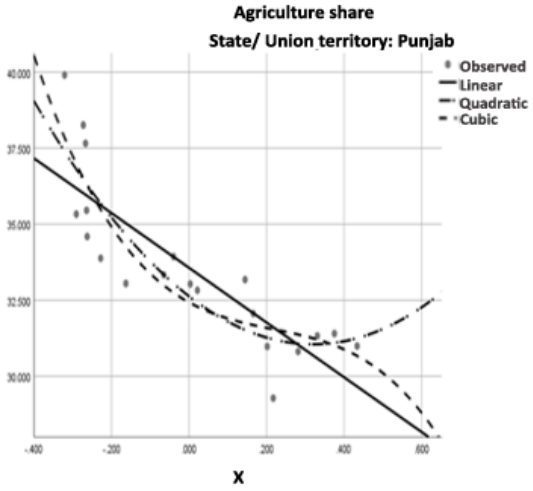
Karnataka

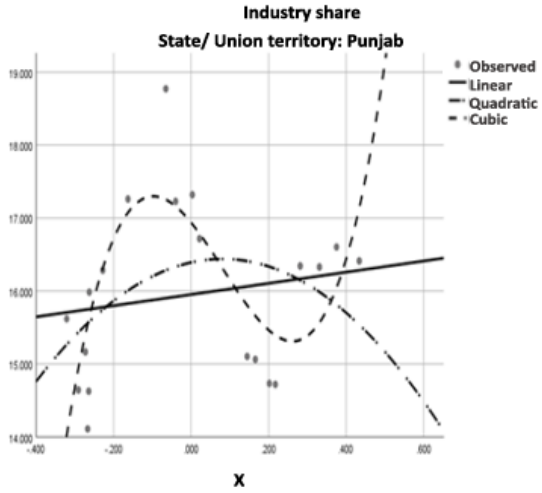


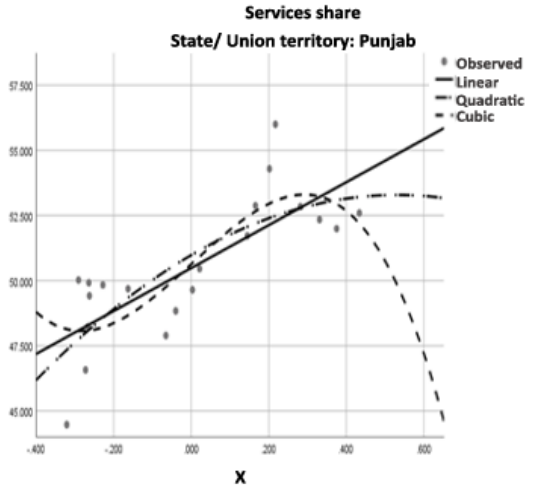




Punjab







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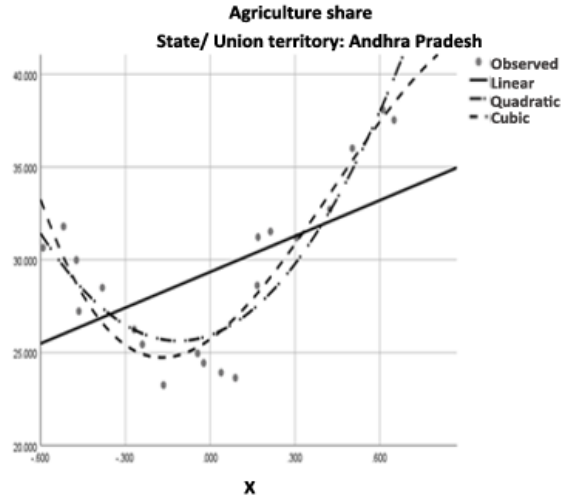
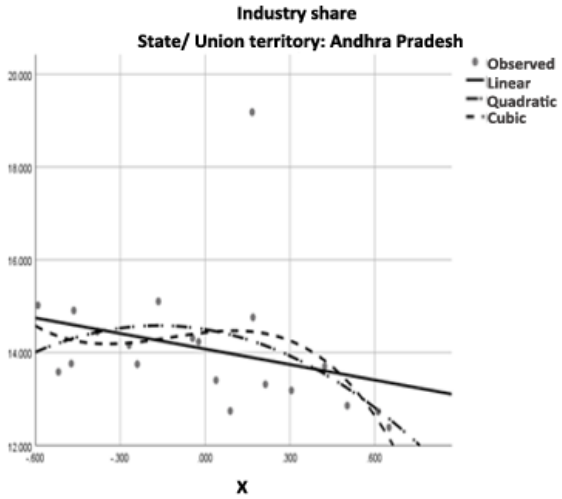
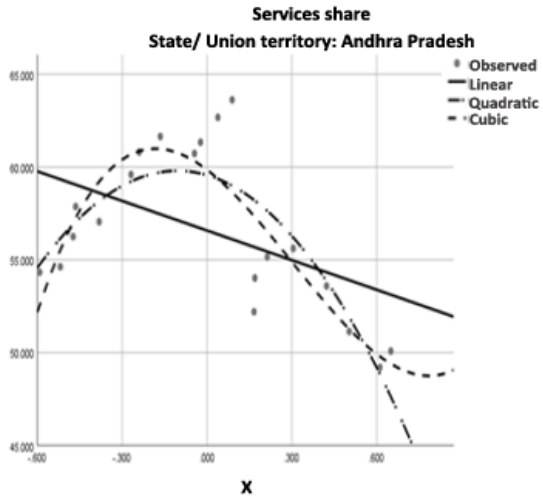
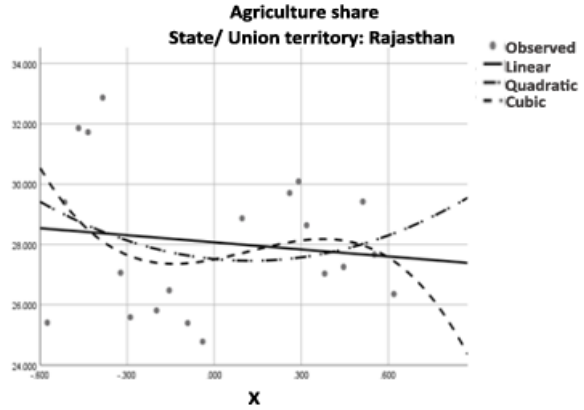
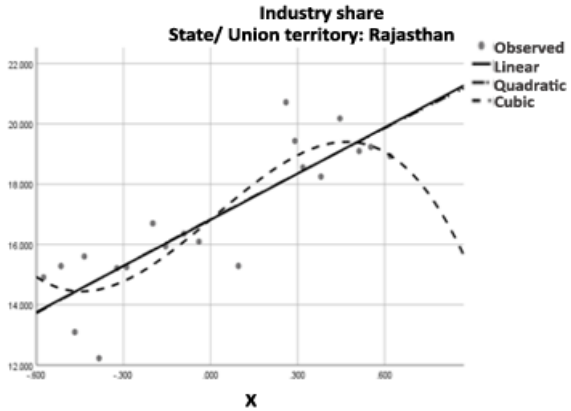


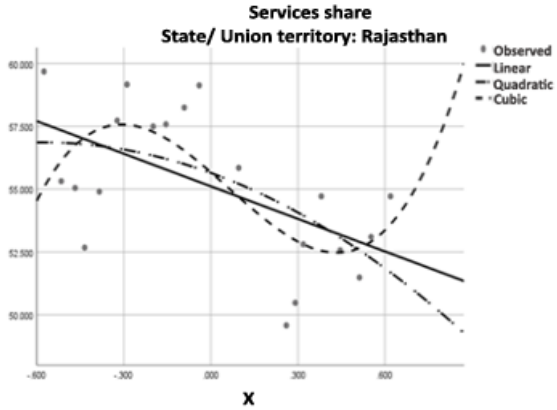




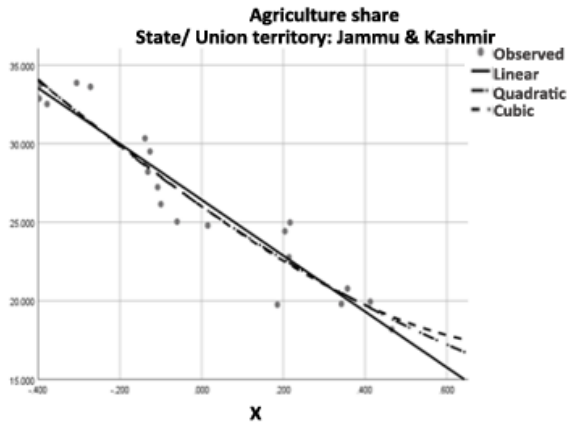
Rajasthan

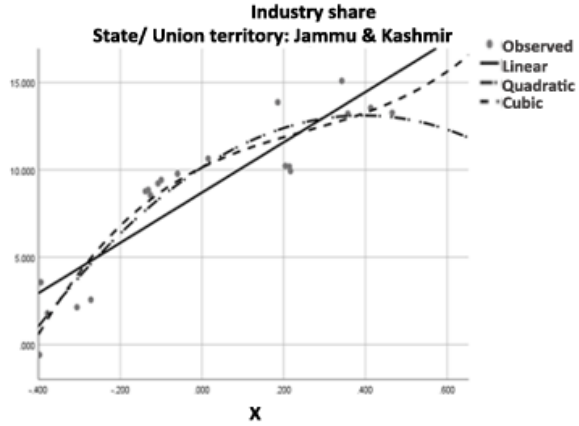


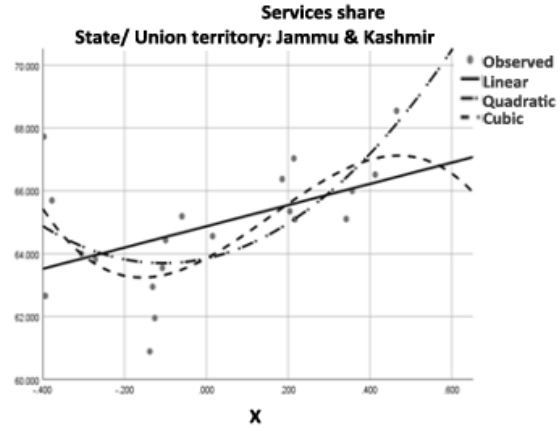




Jammu & Kashmir







Figures 2. Middle-Income States.

Note: The figures of Middle-Income States are composite of six states viz, Uttarakhand, Karnataka, Punjab, Andhra Pradesh, Rajasthan and Jammu & Kashmir under Figure 2, extracted from the Table 2.

Similarly, Rajasthan has shown a slight downward fall in the agricultural sector and is not best fitted on any degree of polynomials. The sectoral output of industry has been increasing over the period with an increase in the per-capita GDP, whereas the service sector shows a decreased trend and is best fitted on first-degree polynomials with an R^2 of 0.735 and 0.326, respectively. The curve fitted for Rajasthan reveals that the structural transformation has moved away from agriculture to the industry while the services sector has shown declined slope in the sectoral output with relatively fewer fluctuations. This suggests that Rajasthan is in the second stage of the structural transformation process.

Jammu & Kashmir has shown a perfect pattern of structural transformation path over the period. The industrial and services sectors have shown an increasing trend as the per-capita GDP has increased steadily and are best fitted on the linear and quadratic polynomial functions with an R^2 of 0.807 and 0.46, respectively. The sectoral output of agriculture has constantly declined over the period and is best fitted on a first-degree polynomial with an R^2 of 0.908. Figure 2 of Jammu & Kashmir reveals that the reallocation of sectoral output has shifted away from agriculture to industry and then services sectors, suggesting that Jammu & Kashmir state has entered the third phase of the structural transformation process with relatively high variation in agriculture and industry sector than the services sector.

The above analysis shows that the states follow a different structural transformation pattern under the middle-income group during 1999-00 to 2018-19. Karnataka, Punjab and Jammu & Kashmir are following a similar pattern of structural transformation path and are in the third phase of economic transitions. Uttarakhand and Rajasthan are deviating from the slope dimension, while Andhra Pradesh varies with other states in the process of structural change. Karnataka, Punjab and Jammu & Kashmir, under the middle-income group, are following a similar transformation pattern with Haryana, Maharashtra and Kerala under the high-income group and are in the third phase of the structural transformation process while Jammu & Kashmir is following the same path of transformation in the slope dimension. Similarly, Himachal Pradesh and Rajasthan are following a similar path of economic transitions. In contrast, in the transformation pattern, both Uttarakhand and Rajasthan under middle-income group states follow a similar structural change pattern with Tamil Nadu, Gujrat and Himachal Pradesh under high-income group states.

6. REGRESSION RESULTS FOR THE LOW-INCOME STATES

The regression results for the low-income states are depicted in Table 3 during 1999-00 to 2018-19 at 2011-12 constant prices. The low-income group consists of seven states grounded on an average per-capita GDP from 1999-00 to 2018-19 and represented the structural transformation path within the low-developed states comparatively to the high- and middle-income states over the analysis period. Descriptive statistics were also analysed to show the fluctuations of curve fitting within the states, Table 3.

From Table 3, it has been analysed that both agriculture and industry for Chhattisgarh have shown a drastic fall during the period while the services have shown an increasing trend with estimated coefficients as -3.490, -20.439 and 15.921, respectively. For Odisha, agriculture (-8.737) and services (-9.057) share has declined with an increase in the per-capita GDP whereas, the industry (13.651) has shown an increasing trend over the period. In contrast to the above, the sectoral output share in Madhya Pradesh has only increased in agriculture (14.970), whereas both industry (-2.594) and services (-12.790) have shown a drastic fall with the increase in per-capita GDP over the period. The sectoral output shift in terms of structural change has perfectly shown in Assam as the structural transformation has been seen from the agriculture sector (-18.498) to the industry sector (15.068) and from industry to the services sector (66.361), respectively. Jharkhand has shown no clear trend over the period. Uttar Pradesh and Bihar have shown

almost the same trend over the period. The agriculture sector in both states has decreased rapidly while the services sector has grown more rapidly than the industrial sector.

The above analysis shows that the services output share was the highest in four states out of seven states in the sample. After services, the industrial sector is the second most important sector in the sectoral output share whereas, in Odisha, the industry sector is the highest sectoral output sharer, and in Madhya Pradesh, agriculture is sharing more than other sectors.

6.1. Comparing Fitted Curves (Figure 3)

The agriculture sector for Chhattisgarh has shown a downward slope as the per-capita GDP is increasing and is best fitted on the first-degree polynomial with an R^2 of 0.292, whereas the slope of the industry and services sector is moving in the opposite direction as the mean centred variable in moving on. Both the sectors are best fitted on quadratic function with an R^2 of 0.512 and 0.651, respectively. From Figure 3 under the low-income states, the industry for Chhattisgarh is maximum when the mean-centred variable was 0.000, whereas the service sector was minimum just close to 0.000 (mean-centred variable) and started increasing while the industry sector started falling after the maximum point. This suggests that Chhattisgarh has entered the third phase of the structural transformation process.

Industrial output share is highest in Odisha and best fitted on the first-degree polynomial function with an R^2 of 0.870 whereas, agriculture and services output share has shown a declined path as the per-capita GDP mean centred variable is moving on with an R^2 of 0.751 and 0.506 and are best fitted on first and second-degree polynomials, respectively. From Figure 3 agriculture shows a steep fall while the industry shows an upward trend with increased per-capita GDP. Initially, the service output share has shown an upward trend up to the mean centred variable was 0.30 after that, the curve fitting shows a steep dropping slope with the increase in per-capita GDP. The economic transition has shifted from agriculture to industry, with the falling sectoral share of services revealing that Odisha is in the second stage of the structural transformation process.

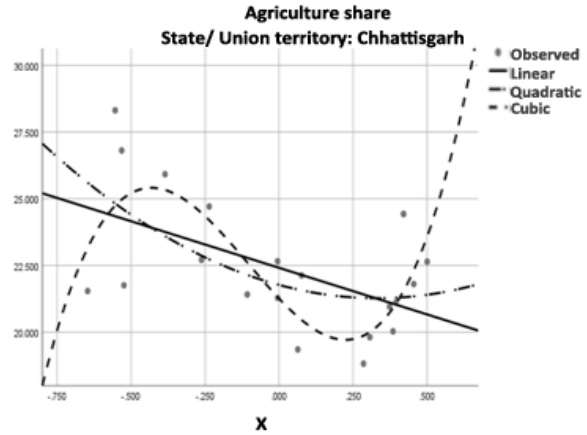
Madhya Pradesh and Jharkhand have shown different patterns of transformation paths over the period. In Madhya Pradesh, the agriculture output share alone has shown an upward path while the industry and services have gone down drastically and are best fitted on quadratic function and first-degree polynomial with an R^2 of 0.808, 0.214 and 0.834, respectively. Jharkhand shows no clear structural transformation path. The agriculture and industry fitted on the quadratic function, but the R^2 is much less to justify the transformation path compared to all other states. The R^2 is 0.166 on the quadratic function and close to zero on the first-degree polynomial, and for services, it does not fit on any of the polynomial functions. This suggests that both states are in the first stage of the structural transformation process. It clearly shows that the curve fitting for Madhya Pradesh has an upward trend with relatively higher fluctuations in the agriculture sector with a standard error equal to 1.35 and a standard deviation equal to 6.03. likewise, the industry sector of Jharkhand has higher fluctuations with standard deviation and variance are 1.11 and 4.98 on curve fitting.

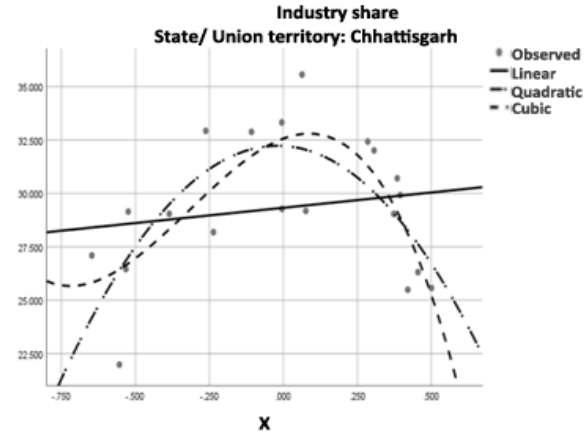
Table 3. Regression results for the low-income states during 1999-2019 at 2011-12 prices.

Model: $y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it}^2 + \beta_3 x_{it}^3 + \epsilon_{it}$,										**Statistics**	
States	**Sectors**	**Coefficients**							**R²**		
		α	**X¹**		**X²**		**X³**				
			β_1	**Sig.**	β_2	**Sig.**	β_3	**Sig.**		**Std. deviation**	**Variance**
Chhattisgarh	Agriculture	22.411	-3.490	0.014*					0.292	2.50	6.23
	Industry	32.221	1.431	0.480	-20.439	0.001*			0.512	3.29	10.85
	Services	46.008	2.059	0.158	15.921	0.000*			0.651	2.42	5.87
Odisha	Agriculture	24.626	-8.737	0.000*					0.751	4.06	16.50
	Industry	21.799	13.651	0.000*					0.870	5.90	34.77
	Services	54.972	-4.915	0.050	-9.057	0.038*			0.506	3.31	10.95
Madhya Pradesh	Agriculture	30.647	15.384	0.040	14.970	0.041*			0.808	6.03	36.40
	Industry	15.032	-2.594	0.040*					0.214	1.91	3.63
	Services	52.674	-12.790	0.000*					0.834	4.76	22.70
Assam	Agriculture	26.544	-18.498	0.000*					0.863	5.68	32.25
	Industry	18.024	15.068	0.000*					0.783	4.86	23.59
	Services	57.870	3.430	0.095	-23.062	0.189	66.361	0.018*	0.637	2.59	6.69
Jharkhand	Agriculture	16.908	-1.811	0.199	10.205	0.048*			0.282	1.85	3.44
	Industry	32.840	-0.320	0.934	-25.444	0.083**			0.166	4.98	24.79
	Services	49.340	2.131	0.494	15.239	0.203	-62.024	0.234	0.195	4.02	16.19
Uttar Pradesh	Agriculture	28.492	-11.077	0.505	13.715	0.107	-49.416	0.004*	0.922	3.68	13.53
	Industry	12.729	4.187	0.040	14.307	0.002*			0.654	2.01	4.05
	Services	58.645	6.891	0.031	-28.023	0.108	36.701	0.021*	0.896	3.15	9.89
Bihar	Agriculture	29.497	-18.256	0.000*					0.704	6.90	47.57
	Industry	4.355	3.409	0.027	11.585	0.019*			0.525	1.86	3.48
	Services	69.471	14.846	0.000*					0.553	6.33	40.09

Note: * and ** Indicates significance at 0.05 and 0.10 levels, respectively.

Chhattisgarh





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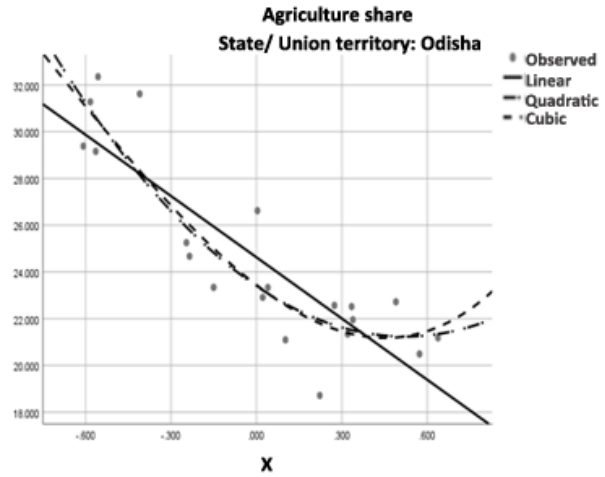

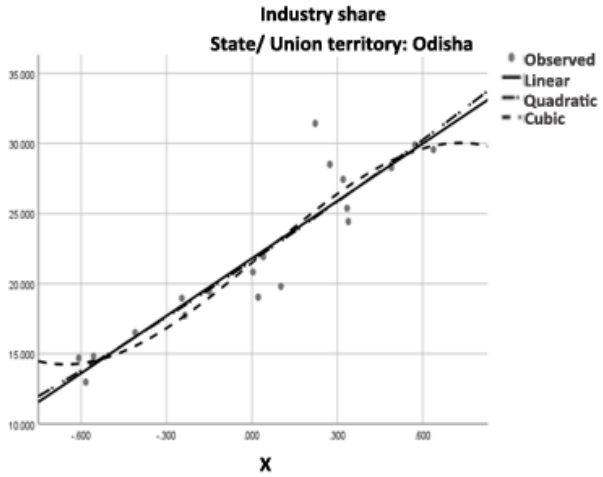

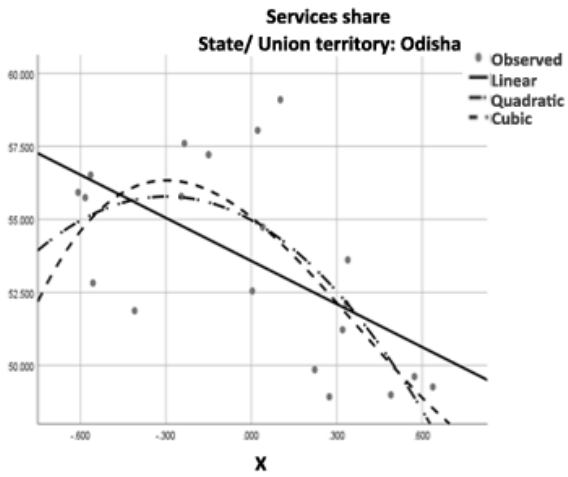

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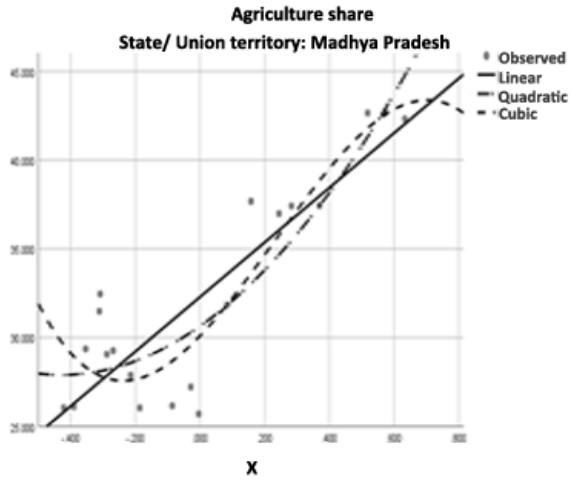
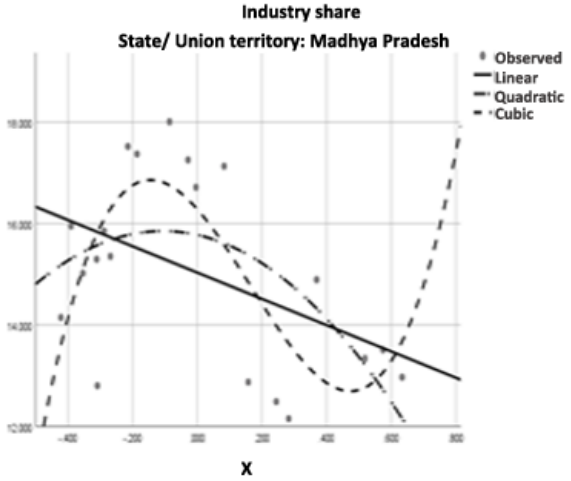
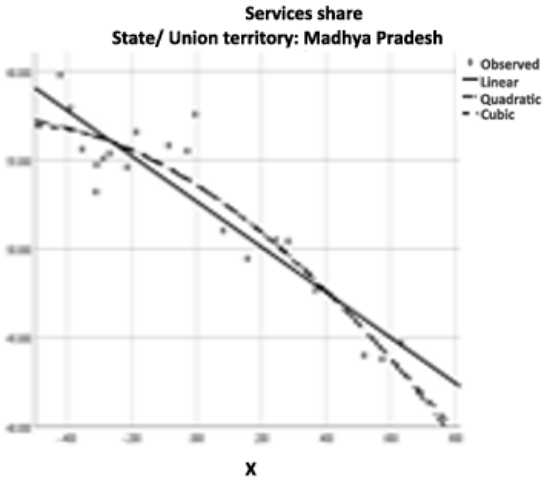
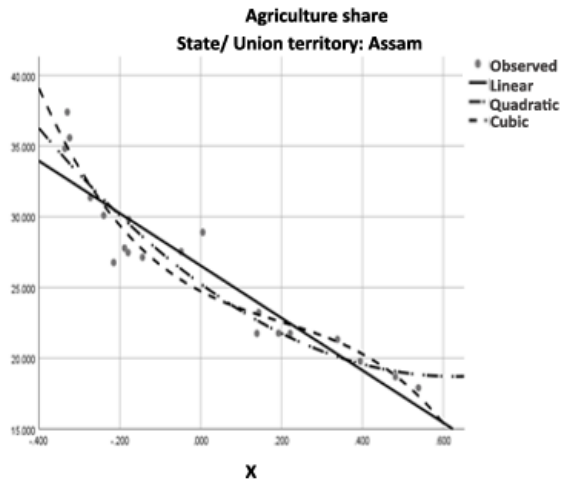
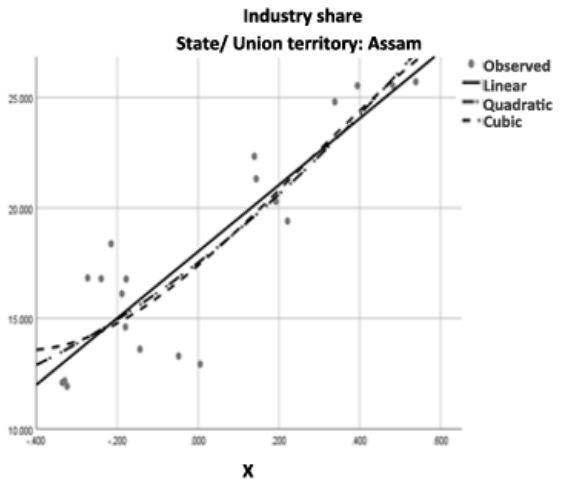


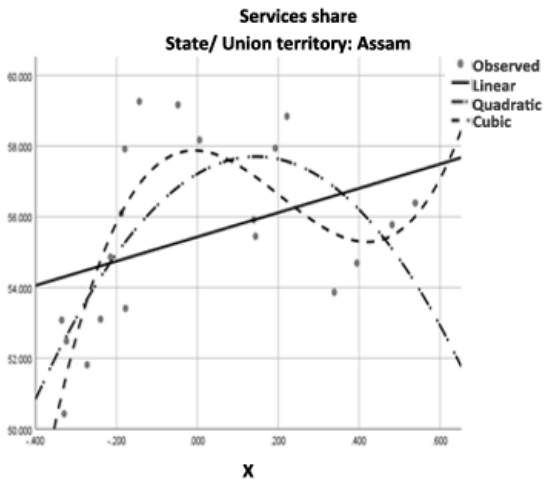




Assam







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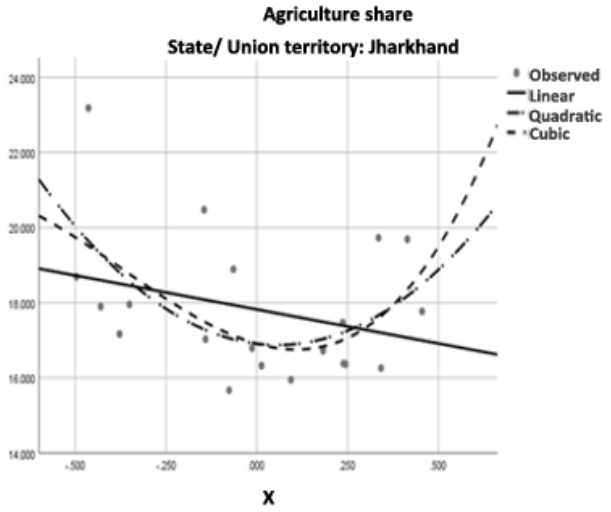
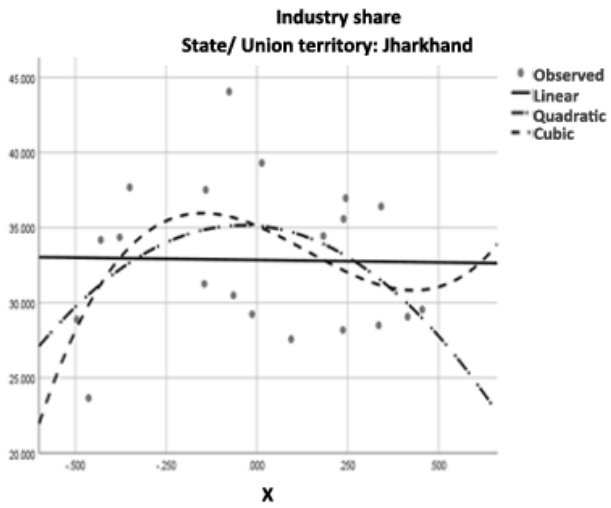
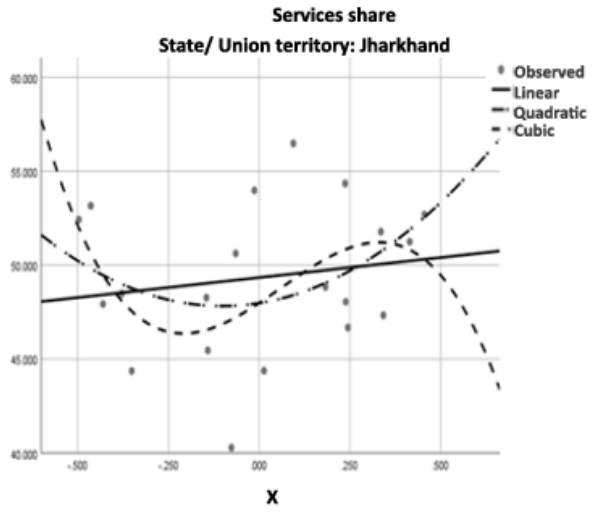
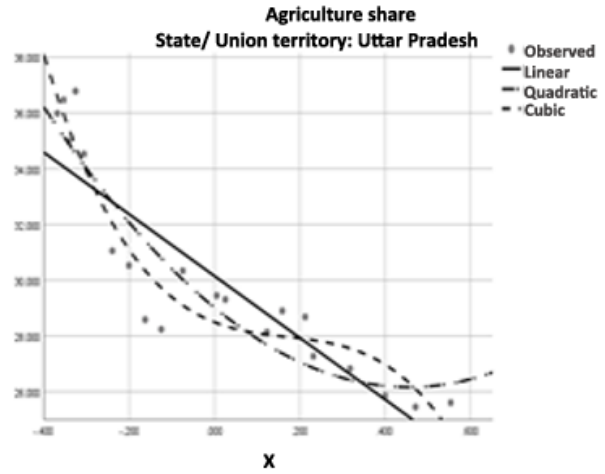
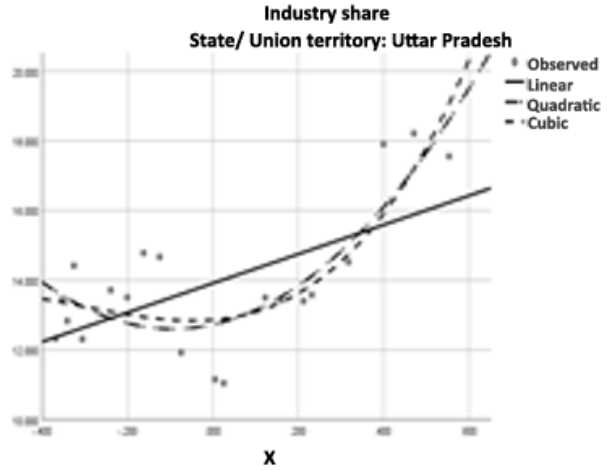


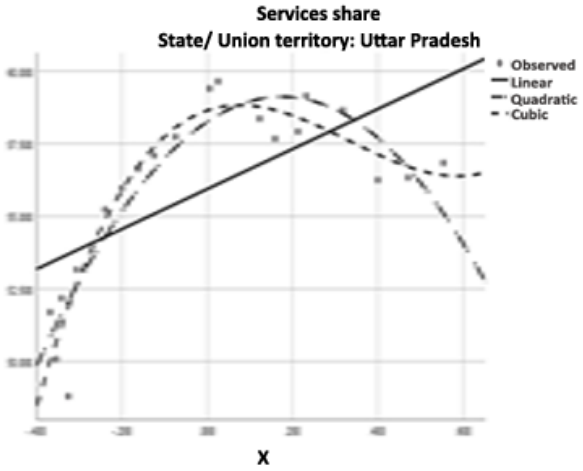




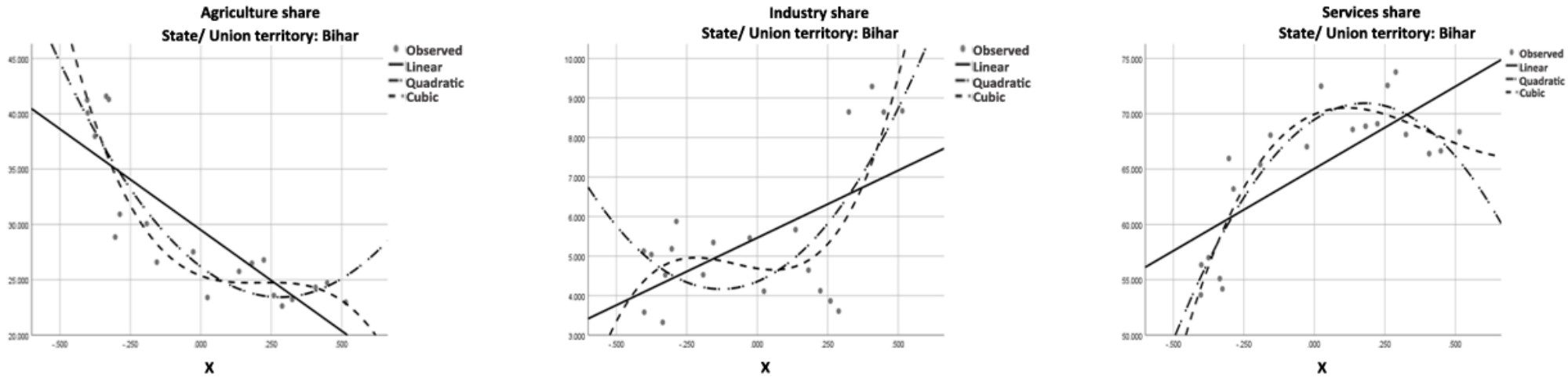
Uttar Pradesh







Bihar



Figures 3. Low-Income States.

Note: The figures of Low-Income States are composite of seven states viz, Chhattisgarh, Odisha, Madhya Pradesh, Assam, Jharkhand, Uttar Pradesh and Bihar under Figure 3, extracted from the Table 3.

Assam, Uttar Pradesh and Bihar have shown a similar pattern of the economic transition process over the period. In all the states, the agriculture output share has fallen drastically while the services output share has increased more rapidly than the share of industrial output. The agricultural sector in Assam, Uttar Pradesh and Bihar are best fitted on the first-, third- and first-degree polynomials with an R^2 of 0.863, 0.922 and 0.704, correspondingly. The industry sector of Uttar Pradesh and Bihar are best fitted on the quadratic function with an R^2 of 0.654 and 0.525, respectively, whereas, Assam fits on the first-degree polynomial with an R^2 of 0.783. Similarly, the service sector of Assam and Uttar Pradesh are best fitted on the third-degree of polynomials whereas, for Bihar, it fits on the first-degree with an R^2 of 0.637, 0.896 and 0.815, respectively. This suggests that the reallocation of sectoral output has moved away from the agriculture sector towards the services sector more than the industrial sector. Hence, Assam, Uttar Pradesh and Bihar, under the low-income group, are in the third phase of the structural transformation process. The agriculture & industrial sectors in Assam and the agriculture & services sectors in Bihar have shown relatively higher fluctuations than other states on the curve fitting module. The above analysis shows that the states Assam, Uttar Pradesh and Bihar under the low-income group are following a similar path of structural transformation and following a similar pattern with Chhattisgarh and are in the third phase of economic transitions. The reallocation is moving away from agriculture to the service sector directly more than the industry sector, with the per-capita GDP growth over the period. The curves fitted are moving almost in a similar direction among the states mentioned above. Odisha is following a different pattern of structural transformation path and is in the second phase of structural change with the increase in per-capita GDP whereas, Madhya Pradesh and Jharkhand are not following any of the states under the low-income group and have no clear structural path over the period.

7. CONCLUSION

As mentioned in the literature, structural transformations are closely associated with economic development and per-capita GDP growth. According to Syrquin, "There is a strong association of economic structure with the level of development and between growth and structural change" (Bah, 2011). Economic growth and changes in the sectoral contribution to the GDP, or structural change, go hand in hand (Soni & Subrahmanya, 2020). Despite this, structural changes can take place in the midst of economic stagnation and even decline. The pace of structural transformation in the middle- and low-income states has surpassed the pace at which the structural transformation process is going in the high-income states. An analysis of scatter plots intends, that four states out of seven have followed a similar pattern of the structural transformation process with the three states under high-income states and are in the third phase of the structural change module. What is more important here during the periods, when the Indian economy was in the grip of stagnation in the latter years of the last decade, the services output share fitted curves show a slight dip only in the latter years of the last decade in the states of the third phase of economic transitions under the middle- and low-income group, whereas, under the high-income states have shown increasing services output share in the starting years of the first decade and starts falling drastically. This led Tamil Nadu, Gujrat and Himachal Pradesh under the high-income states to fall into the second stage of the structural transformation process. During this period, states like Assam, Bihar, and UP under the low-income group and Jammu & Kashmir under the middle-income group are following the same path of the structural transformation process with Kerala under the high-income states as the per-capita GDP growth is increasing. The curve fitted for Uttarakhand almost coincides with Himachal Pradesh and follows the same path of the structural transformation process. Uttarakhand and Rajasthan under the middle-income states follow a similar structural transformation pattern with Tamil Nadu under high-income states. Haryana, Maharashtra, under high-income states and Chhattisgarh under low-income states follow a different transformation path pattern.

Karnataka is also following a similar path of transformation to Kerala over the period. Punjab and Odisha are not following any pattern and path with any other states. Andhra Pradesh under middle-income states and Madhya Pradesh & Jharkhand under low-income states are not having a clear trend and are still in the first stage of the structural transformation process. From the above analysis, it has been found that almost all the middle- and low-income states included here are growing faster than high-income states in the process of structural change except AP, MP and Jharkhand. The disparities are higher in middle- and low-income states than the high-income states.

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