The impact of agricultural activities on urbanization: Evidence and implications for India

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The impact of agricultural activities on urbanization: Evidence and implications for India

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Abstract:
As a part of the development process, India is currently going through a transformation from agriculture based economy to industry and service lead urbanized economy. However, no formal quantitative research has been done on this phenomenon. In this perspective, based on Matsuyama's (1992) theoretical framework and using panel data model, the impact of agricultural activities on urbanization in India is analyzed in this paper. For the analysis 15 major agricultural states of India are considered for the period of 1981 to 2015 by sourcing data from mainly Census of India and Ministry of agriculture, government of India. The empirical estimations reveal that the higher share of agriculture in GDP, amount of cultivated land area, and rural male employment in agriculture have had a negative effect on urbanization in India. On the other hand, higher consumption of fertilizer, state government expenditure on agriculture, production of major crops (wheat, maize, jowar, and bajra), rural female employment in agriculture, and rural literacy rate have had a positive impact on urbanization. The results also show that the effect of agriculture productivity is positive on urbanization for a less trade open economy like India. Finally, it is suggested that there is need of higher agricultural development in order to achieve a higher level of urbanization in India. For this purpose use of technology in agriculture sector along with higher level rural education is required. Finally, we need to have balanced rural and urban policy for a smooth rural- urban transformation in India.

Key Words: Agriculture activity, Urbanization, India

JEL Classification: Q10, O13, R10

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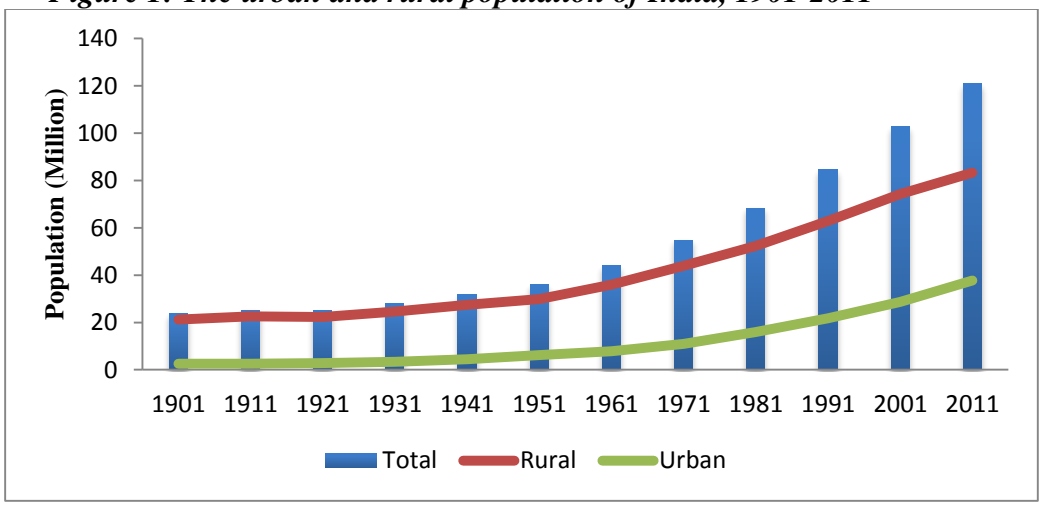
I. Introduction

In recent decades, India has been experiencing rapid urbanization, represented by significant changes in its demographic composition and large-scale expansion of its urban landscape. For instance, total urban population jumped from 78.94 million in 1961 to 377.10 million in 2011 which is about 388 % increase.[1] The percentage of urban population (or number of cities/towns) increased from 17.97 % (or 2657) in 1961 to 31.16 % (or 7935) in 2011. In contrast, increase in the country's rural population was at a much slower rate; it increased from 36 million in 1961 to 83 million in 2011, i.e. a mere 131% increase. This indicates that urban population in India is growing at a much higher rate along with a significant decline in the share of rural population..

Figure 1: The urban and rural population of India, 1901-2011



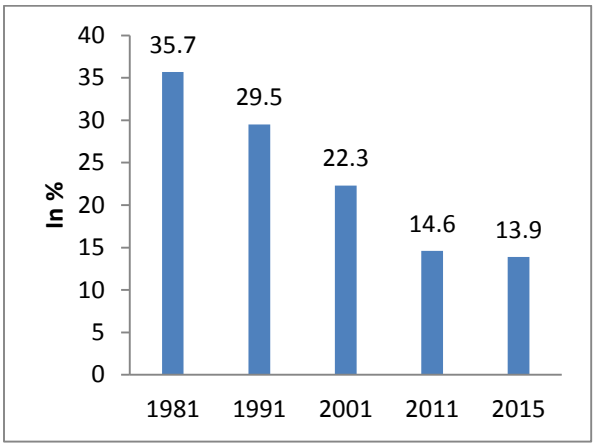
Source: Authors' using data from Census of India

Rural India is experiencing not only a decline in its rate of growth as well as share of population in the total, but also a decline in its contribution to national GDP. Figure 2 shows that the total contribution of agriculture sector to total GDP of India is declining significantly. For instance, in 1981 the contribution of agriculture to GDP was 36 % but it declined to 14 % in 2015. On the other hand, the limited urban GDP data currently available in the public domain shows that the share of urban sector's contribution to total GDP has increased significantly over time, i.e. from 38 % in 1970-71 to 52 % in 2004-05. Agriculture sector in India is majorly dependent on

[1] Data on number of cities and towns are not adjusted for definitional changes in urban areas, especially, prior to 1961 Census.

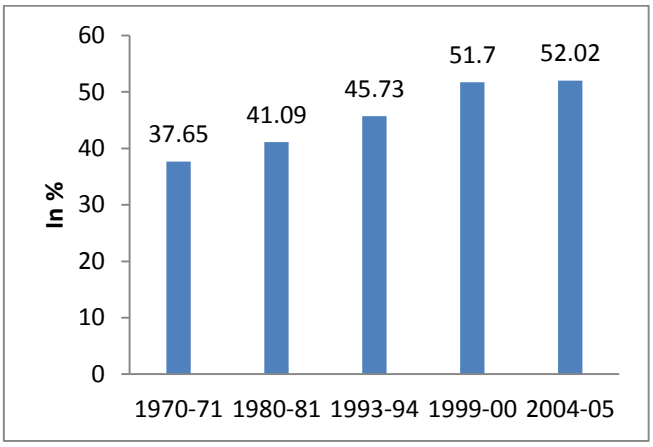
monsoon which is often unpredictable; therefore it is has been characterized by disguised and seasonal unemployment. The decline in employment opportunities in the agriculture and lower productivity level are the major reasons for the decline in the share of agriculture sector to total GDP. On the same logic, it could be construed that the increasing share of industry and service has also lead to the decline in the share of agriculture in GDP.

Figure2: Share of agriculture to total GDP



Source: Authors' using data from Ministry of statistics and program implications (MOSPI)

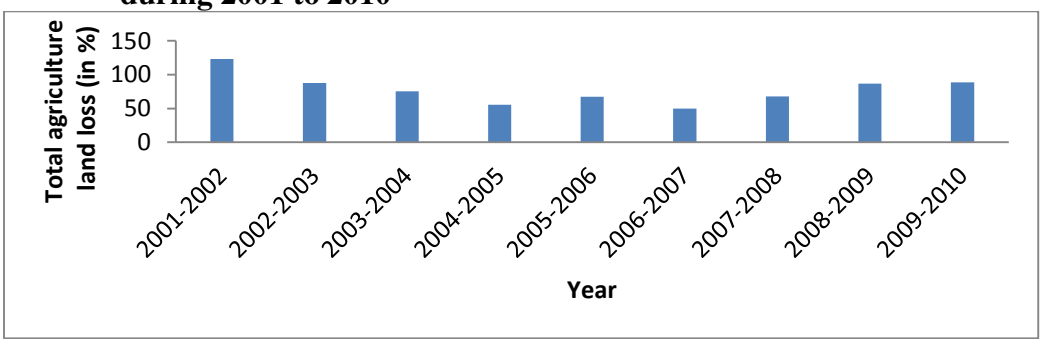
Figure2: Share of urban area to total GDP



Source: Authors' calculation by using data from National Accounts Statistics of various years.

Total extent of agricultural land also decreased from 96.98 % in 1985 to 96.78 % in 2000 90.77 % in 2010 and to 90.70 by 2012. In this perspective, it is important to note that Pandey and Seto (2014) clearly measured the total agriculture land loss due to urbanization in India. They found that the total amount of agricultural land lost in India during 2001-2010 was a staggering 0.7 million hectares. Agricultural land loss to urban expansion was the highest (0.12 million hectares) in the first one-year period of the study, June 2001 - May 2002, which decreased marginally until 2006, only to increase thereafter (Fig. 4).

Figure 4: Total area (in hectares) of agricultural land lost due urban growth in India during 2001 to 2010



Source: Pandey and Seto (2014)

The discussion clearly indicates that India is experiencing a transformation from agricultural lead economy to industry and service based urban economy. In fact, this transformation is an inevitable stage of development, which had been experienced by many developed countries in their early stage of development. The basic reason behind this phenomenon is that the resources (e.g., land, worker etc) which are excess in rural areas (mostly in developing countries) are being released and absorbed in the urban areas. Since urban area provides the advantage of higher productivity, the resource shifting from rural to urban sector leads to higher economic growth of the country through increasing rate of urbanization. In this phase of development, demand and supply side economics play an important role. Demand side factors such as higher income/job opportunity, higher level of standard of living and higher accessibility of basic infrastructure pull the rural population into urban areas. On the other hand, higher level of agricultural productivity works as a supply side factor in releasing rural resources for the urban areas.

In this perspective, the present paper examines the role of agriculture in the urbanization process in India. The empirical estimation on the role of agriculture on urbanization is mainly based on Matsuyama's (1992) theoretical contribution that links the effect of agricultural productivity on urbanization with the openness or closeness of an economy. The theoretical model argues that agricultural productivity has a ppositive effect on urbanization in closed economies, and a negative effect in open economies. However, based on Li et al. (2014) our empirical test of the effect of agriculture productivity on urbanization is allowed to vary by the degree of openness.[2]

The study considers 15 major agricultural states (Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal) for the period of 1980-81 to 2014-15. The study period was chosen principally based on the availability of various data and also as 1980-81 onwards India came to be reckoned as one of the world's leading agricultural nations due mainly to the Green Revolution initiative, which was implemented in the period from1967/68 to 1977/78. On the other hand, by 1981, the share of urbanization in India had grown beyond 20 percent, with

[2] No country can be termed as closed. Even in the history of mankind, it is difficult to find countries which were in an autarchic state except Japan for a very brief period of time. So countries has been less open or more open depending on their trade situations. Such categorization still exists in recent times with the only exception that openness of countries has increased. That is, most countries are now more open than they had been say 30 years ago.

the highest ever urban population growth rate (i.e., 3.79 % annual exponential growth rate). Panel data model is employed for the empirical estimations in this paper.

The paper is organized as follows. Section 2 presents a review of literature. Sections 3 and 4 describe the theoretical explanation and empirical framework for the estimation, respectively. Empirical results and discussion presented in sections 5 and 6, respectively. Finally section 7 summarizes the research findings and policy implications.

II. Review of literature

Modern urbanization is mainly based on higher productivity which comes from industrial and service sector activity. The "pull factor" such as, higher job or income opportunity motivate people to move from rural to urban areas. However, even if a country is highly urbanized and produces good amount of urban production, a good amount of its labour force has to remain in rural areas unless agriculture can provide the necessary productivity gains to feed the urban population (Tolley and Kripalani, 1974). In fact, Motamed et al. (2010) found that the geographical areas with more favorable natural agriculture endowments tend to get urbanized sooner. Historically, higher agricultural productivity with less manpower has helped to shift labour out of agriculture and move to industry based urban areas. Nurkse (1953) showed that Industrial Revolution would not have been possible without the Agricultural Revolution that preceded it.[3] Johnston and Mellor (1961) showed that in the following five ways agriculture contributes to over-all economic growth: (1) supply of food for urban sectors; (2) supply of foreign exchange from agricultural export; (3) supply of surplus labor for industrial sector; (4) supply of savings for industrial investment; (5) provision of domestic market for industrial expansion. It is important to note that all these mechanisms mainly rely on and also facilitate urbanization. Therefore, urbanization is the main intermediate in many models which address the role of agriculture in economic growth (e.g., Lewis, 1954; Matsuyama, 1992; Gollin et al, 2002). In brief, economic models support the positive role of agriculture on urbanization.

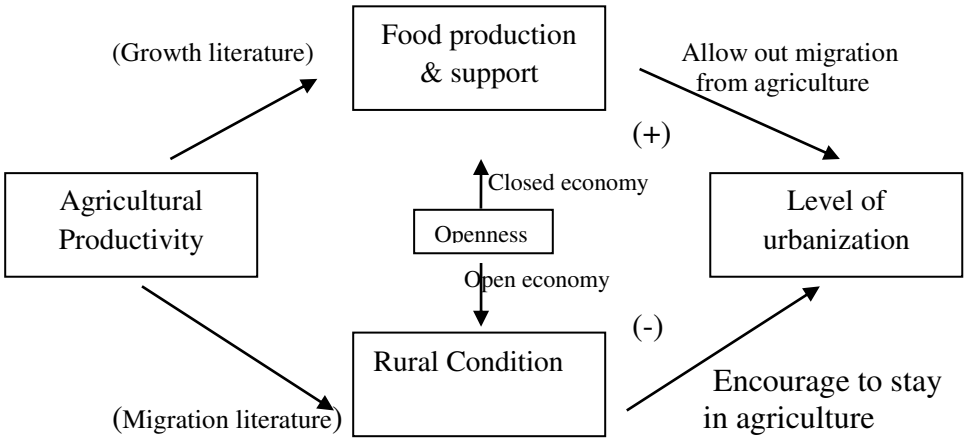
It is also seen that agricultural productivity may negatively impact urbanization. According to Lewis (1954) and Harris and Todaro (1970) model, urban/rural wage differential is the main driving force behind the rural urban migration. The improvements in agricultural productivity

[3] Urbanization and industrialization are typically seen as synonymous and being associated with economic development (Todaro and Smith, 2002).

increases rural wages and discourage rural people migrate to urban areas. This effect is similar to the resource movement effect in the “Dutch Disease" (Corden and Neary, 1982). On the other hand, adverse rural conditions (e.g., lower wage rate) encourages rural people migrate to urban areas (Kamerschen 1969; Pandey 1977; Firebaugh, 1979). The study also finds that rural poverty is one of the main contributors to rapid urban growth (Barrios et al., 2006). This indicates that it is a depressed, rather than a prosperous agriculture sector that ultimately leads to higher urbanization.

From the above review of literature it is clear that agriculture has conflicting impacts on urbanization. In this context, Matsuyama (1992) proposes that the openness of economies needed to be taken into account.[4] Matsuyama (1992) explained that if the economy is a closed system, food and other agriculture productivity has a positive effect on urbanization. But if the economy is an open trading system, it can always purchase food from outside markets, and thus economies with less rich agricultural endowment happen to possess initial comparative (not necessarily absolute) advantage in industries, and may rely on imported agricultural products and realize faster industrialization and urbanization. Thus, in open economies agricultural productivity would have a negative effect for urbanization. The forward and backward links of this cycle are illustrated in Figure 5.

Figure 5: Effect of Agriculture on Urbanization



Source: Li et al. (2014)

[4] This discussion is mainly based on Li et al. (2014).

There are some important empirical studies that have tried to link agricultural activity with urbanization. Malik and Ali (2015) examine the impact of urbanization on agriculture sector in Pakistan. Their finding is that both the percent of GDP and annual percent of growth have a negative relationship with urban population, while the size of cultivated land and urbanization has a positive relationship. Binswanger-Mkhize et al. (2016) investigate the impact of the urban growth on agricultural and rural non-farm income growth in Kenya. The study finds that urban growth has a large effect on education, followed by commercialization, and then on the use of modern varieties of crops. Winfield (1973) examined the relationship between urbanization and agriculture. The study described that the technological transformation of agriculture has much larger effects on urbanization and has operated as push-pull force on the city ward movement of people even as farm functions have moved to the city. Jiang et al. (2013) examined the impact of urban expansion on agricultural land use intensity in China. The study found that urban expansion is associated with a decline in agricultural land use intensity and GDP growth in the industrial sector negatively impacts agricultural land use intensity. Rondinelli (1986) analyzed the urban transition and agricultural development in Kenya, Mexico, Panama, and South Korea. The study revealed that the pace of the urban transfer is determined by the rate of capital accumulation in industry; increases in industrial investment would expand production and, in turn, increase the demand for labor. Iheke and Ukandu (2015) examined the effect of urbanization and other factors on agricultural production in Abia State. The OLS regression results of the effect of urbanization and other factors on agricultural productivity revealed that farm size, fertilizer-use, land tenure system, etc. have significant and positive impacts on farm productivity. On the other hand, urbanization and duration of land use have negative impact on agricultural productivity. Berry (1978) studied the effect of urbanization on agricultural activities in New York and New Jersy. The study concluded that farming activities that are considered nuisances by new suburban residents of the area may be legislated against. Li et al. (2014) analyzed the relationship between agricultural productivity and urbanization based on Matsuyama's (1992) model. The study found that for closed economies, urbanization is positively associated with agricultural productivity. Higher agriculture productivity provides surplus food with less manpower and thus allows for a shift of labor out of agriculture and into urban industries. On the other hand, relationship between agriculture and urbanization is negative for open economies.

However, in case of India very few studies have attempted to link agricultural activities with urbanization. Kalamkar (2009) tried to determine the relationship between urbanization and agriculture growth in India using data for the period from 1901to 2001. The study revealed that there were significant changes in land utilization pattern accompanied by heavy migration from rural to urban areas. Land converted to urban uses has been increasing but this has had little effect on total crop production because exchange of goods between rural and urban areas has been an important element of rural- urban linkages. Rao et al. (2006) examined agricultural diversification in India and the role of urbanization. The study found that from last two decades, India has been diversifying from agriculture to industry and service sector. HVC (High value commodities) such as fruits, vegetables and milk have a higher share in the output of urban districts. Urban surrounded districts with better road network connection to urban centers have been able to diversify towards HVCs to meet the demand in the urban centers. Pandey and Seto (2014) examined the impact of urbanization on agricultural land loss in India, taking the time period 2001 to 2010.They found the followings: first, agricultural land loss is occurring around smaller cities more than around bigger cities. Second, in the period 2001 to 2010, each state lost less than 1% of its total geographical area due to urban expansion. Third, the northeastern states experienced the least amount of agricultural land loss. Fourth, agricultural land loss is largely in states and districts which have a larger number of operational or approved SEZs. Fifth, urban conversion of agricultural land is intense and alarming in a few districts and states with high rates of economic growth. Sixth, agricultural land loss is predominantly in states with higher agricultural land suitability compared to other states.

The review of literature clearly indicates that more quantitative research is needed to assess the effect of agricultural activity on urbanization in India. This paper tries to plug this gap.

III. Theoretical explanation

The model by Matsuyama (1992) assumes that, economy is divided into two sectors i.e. agriculture and manufacturing. Let U_t is the share of urban manufacturing labor at time t, then X_t^m is the manufacturing output at time t and X_t^A is the agricultural output at time t; this can be written as follows:

$$X_t^A = A * G(1 - U_t) \qquad G(0) = 0,\ G' > 0,\ G'' < 0 \qquad (1)$$

$$X_t^m = M_t * F(U_t) \qquad F(0) = 0,\ F' > 0,\ F'' < 0 \qquad (2)$$

Here, A and M_t are multipliers and represent the agricultural and manufacturing productivities. G ( ) and F ( ) represent the production function of agriculture and manufacturing. The standard assumption is that labor is the main input in the economy and in the manufacturing sector permits to doing work through learning by doing. If the economy is open, agriculture and urbanization are negatively related with each other.

For closed economy: $U \propto A(+)$

For open economy: $U \propto A(-)$

In the next step, Li et al. (2014) replaced the open-closed dichotomy with economies which differ along a continuum of openness. Most importantly, the specification is such that the effect of A on U is allowed to vary in accordance with a smooth transformation function, g:

$$U = (\beta + \delta * g)A + X_\eta + \varepsilon \qquad (3)$$

Where, g is the function of economic openness or trade openness different degree of openness will result in different coefficients like $\beta + \delta * g$. Li et al. (2014) used logistic function:

$$g = \frac{1}{1+e^{-\gamma(openness-c)}} \qquad (4)$$

Where γ and c are the factors for estimation and the value of g lies between 0 and 1. The impact of agricultural productivity on urbanization equals to $\beta + \delta \cdot \frac{1}{1+e^{-\gamma(openness-c)}}$ and the coefficient of closed and open economies are β and $\beta + \delta$ (or β and $\beta + \delta$ depend on $\gamma < 0 \; and > 0$). So, with increase in openness, the impact of agricultural productivity on urbanization declines.

IV. Empirical framework

Empirical explanation is based on the above theoretical explanation. This theoretical model explains that agriculture productivity and urbanization are positively correlated in a closed economy and negatively correlated in an open economy. This empirical work tries to analyze the relationship between agriculture and urbanization in major states of India. For analyzing the impact of agriculture on urbanization, following panel data model is used in the paper.

$$UP_{it} = \alpha_o + \sum_{i=1}^{15} \alpha_i X_i + \delta_t + \eta_i + \epsilon_{it} \qquad (5)$$

The dependent variable is total urban population (UP), and X is a matrix of explanatory variables. α_i is a vector of regression coefficients to be estimated and δ_t , η_i follows the standard meaning of panel data. To select the appropriate panel, econometric model diagnostic tests such as Hausman test and Brush-Pagon Lagrange test are conducted. The significant LM test result advocates the choice of fixed and random effect model over pooled regression model. On the

other hand, the significant value of Hausman test suggests choosing fixed effect model over random effect model. Table 1 summarizes the information about dependent and independent variables and their measurements. In addition, Table 1 also explains the choice of data source.

Based on the literature review and common knowledge, the study considers various independent variables to measure agricultural activity in India. Variables like total agriculture output, its growth rate and also some major crops productions (i.e., rice, wheat, maize, Jowar, Bajra and pulses) in India are used to ascertain the impact of agriculture on urbanization in India. We expect that higher level of agricultural production has positive effect on urbanization in India as it associated with higher level of agriculture productivity (Malik and Ali, 2015; Li et al., 2014). On the other hand, percentage share of agriculture to total GDP and amount of cultivated land area have a negative effect on urbanization. It is obvious that if a country tries to have higher share of agriculture GDP to its total GDP and using more land for cultivation, the country can be defined as agriculture based country, and may have lower level of urbanization rate. Higher consumption of fertilizer and higher government expenditure on agriculture increase productivity in the agriculture sector. Hence the assumption is that agriculture impacts urbanization positively. Iheke and Ukandu (2015) also found a positive impact of consumption of fertilizer on urbanization in Abia state. Higher level of rural employment in agriculture sector also reduces urbanization as it does not support rural to urban migration which is essential for higher level of urbanization. However, urban employment in agriculture sector may not have any impact on urbanization since urban workers are very small number they mainly engage themselves in industry and service sector. This idea has been formalized in Rondinelli (1986).[5] The higher deficit of rainfall promotes urbanization but good rainfall may not as it may provide better climatic condition for agriculture production and dampen rural to urban migration through higher agriculture production. So the degree of rainfall also influences urbanization. Higher level of rural literacy rate also increases the rate of urbanization as it helps rural to urban migration for higher level of education and better job opportunities. Based on the theoretical prediction by Matsuyama (1992) it can be concluded that India's present trade openness would have a positive effect on urbanization.

[5] Rondinelli (1986) argued that employment expansion would continue until all surplus labor is attracted in the urban industrial sector, at which time wages would rise, increasing workers' disposable income and creating greater internal demand for manufactured goods.

Table 1: Variable descriptions

Variable	*Variables measurements*	*Source of data*	*Time Period*
Dependent variable			
Total urban population of the 15 states*	Urban population can be measured through size, growth and percentage share. However, due to data limitation we use the interpolated data only for size of urban population.	Census of India, Govt. of India	1981, 991, 2001, 2011
Independent variables			
Share of agriculture to total GDP	Share of agriculture in total GDP is measured by agricultural GDP over total GDP. The data is considered at constant 1980-81 prices.	Ministry of Statistics and Programme Implications, Govt. of India	1981-2015
Total crops production(Rice, Wheat, Maize, Bajra, Jowar, Pulses	Total crops production is obtained by multiplication of area estimates by corresponding yield estimates.	Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi. Food and Agriculture Organization (FAO).	1981-2015
Total cultivated land	Total cultivated land is calculated by adding the current fallows with net area sown.	Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.	1986-2012
Consumption of fertilizer in agriculture	Fertilizer is applied to soil or to plant tissues (usually leaves) to supply one or more plant nutrients essential for the growth of plants. We use total consumption of Nitrogenous, Phosphatic, and Potassic to measure fertilizer. This data is considered only in current prices. This data available at current prices.	Agriculture Statistics 2014, Department of agriculture and cooperation, Ministry of agriculture, Govt. of India, New Delhi.	1984-2015
Average rainfall	Annual rainfall is measured in millimeter	Indian Meteorological department. Ministry of Earth Science, New Delhi.	1981-2015
Employment in agriculture sector	Total number (per 1000) of workers according to usual status (ps+ss) employed in agriculture sector	NSSO various reports	1993-94, 1999-00, 2004-05, 2011-12
Rural literacy rate	Number of people who are literate in the state by number of literates, who are aged 15 years and over, by their population and multiplying the result by 100.	Census of India 1981, 1991, 2001, 2011	1981-2011
State government expenditure on agriculture sector	This is measured by total budgetary expenditure on revenue and capital which is the part of consolidated fund account. This expenditure is based on 1993-94 constant prices.	Department of agriculture and cooperation, Ministry of agriculture	1986-2006
Economics openness	It is a vague concept and not easily measured. Due to unavailability of state level import data, trade openness is measured as the ratio of total export in the numerator and state GDP in the denominator. As the export data available in current prices we use GDP also in current prices.	Ministry of Commerce, Govt. of India.	2006, 2007, 2010, 2011, 2012, 2013, 2014, 2015

Source: Authors'

Here, due to the scanty data currently available on urban growth and share of urbanization, this study uses total urban population as the dependent variable. Since, urban data is available only for Census period, data for this study is obtained by interpolating available data for the while study period.[6]

V. Empirical Results

Table 2 represents the descriptive statistics (means, standard deviation, minimum and maximum) of each variable used in regression analysis. As Table 2 illustrates, coefficient of variation is low for number of rural female employees in agriculture sector, rural literacy rate, share of

Table 2: Descriptive statistics of data used in the Panel model

Variable	Observ-ation	Mean	Standard Deviation	Mini-mum	Maxi-mum	C.V.
Total urban population of the 15 states (in millions) (TUP)	485	13.6	10.3	0.135	50.8	75.74
Share of agriculture to total GDP (%) (SGDP)	521	29.72	11.18	6.70	53.41	37.62
Total rice production(million tons) (TRP)	513	4.87	3.86	0.06	15.31	79.26
Total wheat production(million tons) (TWP)	411	0.75	1.22	0.00	5.95	162.67
Total maize production(million tons) (TMP)	395	0.61	0.79	0.00	6.66	129.51
Total Jowar production (million tons) (TJP)	468	0.78	0.82	0.01	4.97	105.13
Total Bajra production (million tons) (TBP)	440	4.80	6.49	0.00	30.30	135.21
Total pulses production (million tons) (TPP)	491	0.89	0.94	-0.67	5.37	105.62
Total cultivated land (thousand hectare) (TCL)	390	10014.39	5841.56	2117.19	20105.00	58.33
Use of fertilizer (thousands tons) (FERT)	465	2851.92	40014.17	13.63	863683.80	1403.06
Total number of rural male employment in agriculture sector (per 1000) (RMALE)	60	657.81	116.50	281.80	872.00	17.71
Total number of rural female employment in agriculture sector (per 1000)(RFEMALE)	60	805.05	133.66	386.90	939.00	16.60
Total number of urban male employment in agriculture sector (per 1000) (UMALE	60	75.74	37.31	25.60	223.00	49.26
Total number of urban female employment in agriculture sector (per 1000) (UFEMALE)	60	192.33	99.91	16.10	467.00	51.95
Expenditure on agriculture sector (Rs. crore) (EAS)	249	587.08	470.94	-143.00	3177.00	80.22
Rainfall(mm.) (RAIN)	539	1349.72	957.68	119.00	5554.00	70.95
Rural literacy rate (%) (RLR)	454	54.61	15.27	22.50	93.00	27.96
Total agriculture production (Rs. crore) (TAP)	553	17794.3	19482.4	1141.61	106000	1.09
Growth rate of agriculture production (%) (GRAP)	504	12.29	43.38	-42.69	348.08	352.97
Economics openness (OPEN)	120	163.81	175.23	0.51	906.07	106.97

Source: Authors'

[6] The interpolation of urban population data for 1982 is obtained by the following method of interpolation; urban population data for 1981 and 1991 is given by Census of India. The first step is to calculate the annual growth rate of urban population (r) = (Ln(P_1/P_0))/t. Here, P_1 is 1991, P_0 is 1981 and t is time interval between 1981and 1991. The second step is to calculate the exponential growth rate of urban population for the year of 1982 (i.e. e = exp $(r * t)$). Then, in last, $P_t = P_0 \exp(r * t)$, where P_t is urban population at time 1982, P_0 is urban population for the time period of 1981, r is annual growth rate of urban population, t is time interval between 1981(P_0) and 1982 (P_1). By applying this interpolation method one can generate the urban population data for other years.

Table 3: Correlation coefficient used in the regression equation

	TUP	SGDP	TRP	TWP	TMP	TJP	TBP	TPP	TCL	FERT	EAS	RAIN	RLR	TAP	GRAP	OPEN
TUP	1.00															
SGDP	-0.38	1.00														
TRP	0.29	0.53	1.00													
TWP	0.69	-0.75	-0.08	1.00												
TMP	0.16	-0.12	-0.45	-0.05	1.00											
TJP	0.02	0.27	0.58	0.16	-0.40	1.00										
TBP	0.29	0.42	0.37	-0.34	0.29	-0.40	1.00									
TPP	0.92	-0.05	0.54	0.53	0.15	0.26	0.39	1.00								
TCL	0.75	-0.14	0.15	0.46	0.61	0.19	0.21	0.82	1.00							
FERT	0.72	0.22	0.80	0.14	-0.06	0.16	0.67	0.83	0.49	1.00						
EAS	0.79	-0.63	0.11	0.89	0.03	0.31	-0.15	0.68	0.62	0.36	1.00					
RAIN	0.03	-0.34	0.05	0.35	-0.36	0.57	-0.46	-0.04	-0.07	-0.12	0.55	1.00				
RLR	0.45	-0.92	-0.32	0.67	0.13	-0.35	-0.17	0.15	0.14	0.03	0.57	0.18	1.00			
TAP	0.83	0.07	0.55	0.20	0.22	0.02	0.68	0.87	0.68	0.93	0.46	-0.12	0.10	1.00		
GRAP	0.39	-0.67	-0.24	0.31	0.21	-0.13	-0.17	0.12	0.24	0.08	0.48	0.41	0.66	0.28	1.00	
OPEN	-0.24	-0.29	-0.10	-0.14	-0.06	0.17	-0.31	-0.36	-0.23	-0.19	0.07	0.62	0.29	-0.16	0.71	1.00

Note: The correlation coefficients are based on 26 observations. See Table 2 for variable definitions.
Source: Authors'

agriculture to total GDP and total cultivated land. On the other hand, coefficient of variance is high for use of fertilizer, growth rate of agriculture production, wheat, bajra, maize and total agriculture production. Table 3 examines the correlation coefficient of agricultural variables used in the fixed and random effect models. The values of correlation coefficient (r^2) show that total urban population is negatively associated with the percent share of agriculture in total GDP (i.e. r^2-0.4) and economic openness (i.e. r^2 -0.2). On the other hand, total urban population is positively associated with total cultivated land (i.e. r^2 is 0.8), use of fertilizer (r^2 is 0.7), annual rainfall (i.e. r^2 is 0.03), total agricultural production (i.e. r^2 is 0.8), growth rate of agricultural production (r^2 is 0.7), total rice production (i.e. r^2 is 0.3), total jowar production (i.e. r^2 is 0.02) and total pulses production (i.e. r^2 is 0.9), total wheat production (r^2 is 0.7) and rural literacy rate (r^2 is 0.5).

Table 4 presents estimated results using equation 5. The significant value of chi^2 of the LM test validates the use of estimation of panel model except the regression model 2. The significant value of chi^2 of the Hausman test validates the choice of the fixed effect model over random effect model for the regression model 1 and 4. On the other hand, insignificant values chi^2 of the Hausman test entails use of random effect model over fixed effect model in regression equations 3 and 5. Log of urban population is the dependent variable of the regression models 1-5.[7] There are two main reasons behind the consideration of the different regression models; first, the availability of data in different time periods for different variables; second, the need to investigate the impact of different independent variables separately on dependent variables. Also presented is the Wald chi^2 and F Model test based on the Random effect models and Fixed effect/OLS, respectively. As OLS model is used for regression model 2, results of VIF to test the multicollineaity problem is also presented. However, the lower value of mean VIF does not indicate any multicollineraity problem. The test of normality, i.e., that the residuals are normally distributed, is confirmed by kernel density estimates, which are presented in Appendix Figures A1.

Regression model 1 shows that the share of agriculture and log of cultivated land area have a statistically significant (at 1 %) negative effect on log of urban population. This results support the expected hypothesis. In particular, 10 per cent increase in the share of agriculture (or log of

[7] As we have used interpolated data for urban population, share of urban population and growth rate of urban population are not used as the alternative dependent variables in the model.

Table 4: Impact of agricultural activity on urbanization in India

Independent variable	*Dependent variable: log of urban population*				
	FE	***OLS***	***RE***	***FE***	***RE***
	(1)	(2)	(3)	(4)	(5)
Share of agriculture	-0.018***				
	(0.004)				
Growth rate of agriculture GDP	0.097				
	(0.331)				
Log of cultivated land area	-0.296***				
	(0.145)				
Log of agricultural GDP	0.041				
	(0.031)				
Log of use of fertilizer	0.346	0.681***			
	(2.52)	(0.046)			
Log of expenditure in agriculture	0.009	0.262***			
	(0.039)	(0.031)			
Log of rainfall	0.099				
	(0.069)				
Log of rice production		-0.141***			
		(0.023)			
Log of wheat production		0.143***			
		(0.019)			
Log of maize production		-0.074***			0.064**
		(0.019)			(0.056)
Log of jowar production		0.092***		0.104**	
		(0.023)		(0.051)	
Log of bajra production		0.067***		0.278***	
		(0.012)		(0.043)	
Log of pulses production		-0.079*		-0.087*	
		(0.041)		(0.052)	
Rural male employment in agriculture sector			-0.026**		
			(0.013)		
Rural female employment in agriculture sector			0.037**		
			(0.017)		
Urban male employment in agriculture sector			0.002		
			(0.003)		
Urban female employment in agriculture sector			-0.001		
			(0.001)		
Rural literacy rate				0.011***	
				(0.002)	
Log (Agriculture production) × Open					0.371***
					(0.113)
Intercept	18.22***	10.44***	15.01***	15.63***	16.33***
	(1.58)	(0.291)	(1.09)	(0.118)	(0.301)
LM(chi^2)	120.74***	0.01	32.11***	1808.25***	22.49***
H(chi^2)/Average VIF	52.92***	4.45	0.85	33.21***	2.76
Overall R^2	0.06	0.89	0.19	0.10	0.12
Wald chi^2/F Model test	10.63***	195.45***	6.29	14.18***	15.85***
Number of observation	239	186	45	368	35

*Note: Figures in parentheses represent standard errors. *** and ** indicate statistical significance at 1% and 5% level, respectively.*
Source: Estimated by using equation (5).

cultivated land area) decreases the log of urban population by 0.18 (or 2.96) per cent. However, the growth rate of agriculture output, total agriculture GDP, use of fertilizer in agriculture and average rainfall do not show any statistically significant effect on size of urban population in regression model 1. The result supports the findings of Malik and Ali (2015) and Li et al. (2014). Regression model 2 shows very interesting and satisfactory results. Both the amount fertilizer used and amount of expenditure in agriculture have a positive (as expected) and statistically significant (1 % level) effect on log of urban population size. The estimated results show that a 10 percent increase in use of fertilizer (or expenditure in agriculture) increases urban population size by 6.8 (or 2.6) percent. This is supported by Iheke and Ukandu (2015). The result shows that production of rice, maize and pulses has a statistically negative effect on log of urban population. On the other hand, production of wheat, jower, and bajra has a positive (at 1 % level) effect on size of urban population. Regression model 1 does not find statistically significant effect of total agricultural output on urbanization, but regression model 2 shows interesting results, i.e. that some of the specific agriculture outputs have positive and some have negative impact on urbanization.

Regression model 3 shows that employment in agriculture sector has an impact on urbanization in India. Most importantly, rural male employment in agriculture sector has a statistically negative (at 5 % level) impact on urbanization in India. In contrast, rural female employment in agriculture sector has statistically significant (at 5 % level) and positive impact on urbanization in India. In particular, a 10 percent increase in rural male (or female) employment in agriculture sector reduces (or increases) urbanization by about 0.26 (or 0.37) per cent. The result is in line with the finding of Rondinelli (1986).

Regression model 4 adds rural literacy rate as one of the independents variable. The estimated results show that a 100 percent increase in rural literacy rate leads to increase in urbanization in India by about 1.1 percent. The estimated coefficient is statistically significant at 1 percent level. However, the significant level of jowar production has gone down from 1 percent level in regression model 2 to 5 percent level in regression model 4. On the other hand, bajra and pulses production have a similar effect (as in regression model 2) on urbanization in India.

Finally, regression model 5 shows that the coefficient of the interaction of openness and agriculture output has a positive and statistically significant effect (at 1 % level) on urbanization

in the major agricultural states in India. The result supports the expected hypothesis and show that a 10 % increase in trade openness which is multiplied with agriculture production, increases urbanization in India by about 3.7 percent. This finding supports the main hypothesis of this research work and supports the findings of Matsuyama (1992) and Li et al. (2014).

Finally, maize production which has a negative impact in regression model 2, has a positive and significant (at 5 % level) affect on urbanization in India in regression model 5. However, the significant impact of maize production has gone down from 1 % in regression model 2 to 5 % in regression model 5.

VI. Discussion

The negative impact of the share of agriculture and cultivated land area on urbanization clearly indicates that when agriculture activity increases urbanization rate decreases. In other words, agriculture activities decrease with the rise of urbanization in India. This has been evidenced by the declining share of agriculture and cultivated land area in India. For instance, the share of agriculture declined from 35.7 in 1981 to 13.9 in 2015. On the other hand, due to urbanization total 89 thousand hectare agriculture land was lost in 2009-10. The result supports the findings of Pandey and Seto (2014).

Consumption of fertilizers and budgetary expenditure in agriculture has a positive effect on urbanization. The result indicates that more expenditure by government on agriculture sector and higher consumption of fertilizer increases the level of agricultural productivity and the rural living conditions. Public expenditure (budgetary expenditure) plays a crucial role in the development of Indian agriculture. State budgetary support to agriculture also increases private household investment in agriculture (Roy, 2001). As a sizable amount of public expenditure is meant for creating and facilitating infrastructure and as it augments productive capacity, the level of public expenditure is crucial for growth of output. Higher agricultural productivity provides surplus food and agricultural products by using fewer workforces, and thus allows rural to urban migration which actually becomes the main thrust behind higher level of urbanization. It is also very much evident that agriculture productivity has increased over the decades. For example, yield per hectare in respect all food grains increased from 5.5 quintals in 1949-50 to 18.98 quintals in 2008-09. On the other hand, the annual growth rate of all food grains, increased from

1.4 percent in 1950-1965 to 2.4 percent in1965-2009. This result supports the finding of (Davis, 1955; Tolley and Kripalani, 1974; Motamed et al, 2010; Li et al., 2014).

The result of the study shows that except rice and pulses production, others (i.e., wheat, maize, jowar, bajra and pulses) have a positive effect on urbanization in India. This also indicates that higher agricultural production caused by higher productivity, has had a positive effect on urbanization in India. It is important to note that India is one of the largest producers of rice in the world, accounting for about 20% of all world rice production. It is India's principal and the staple food of the people of the eastern and southern parts of the country. In India, one-fourth of the total cropped area is covered by rice and it provides food for about half the Indian population. Though India has witnessed spectacular progress in rice production, but the yield of 3.59 kg metric ton per hectare in 2015 is much low compared to 6.81 kg in China, 8.49 kg in America, 6.71 kg in Japan and 6.91 kg in South Korea. This means that there is still vast scope for increasing productivity/production. This will have to be done by increasing yields because scope for increasing area under rice crop is negligibly small. In fact, India's agriculture sector provides about 51 percent of total employment. Most importantly, the green revolution which was implemented with a view to increase agriculture productivity in India was mostly focused on to increasing production of what rather than rice in the states of Punjab, Haryana and Uttar Pradesh. The wheat production involved use of more technology compared to rice. This clearly indicates that rice production should be made more technology-intensive so that it increases production and also releases worker to migrate. However, if pulses are cultivated instead of rice, the high demand and income from it may motivate farmers to stick to rural areas and not to migrate to urban centers. Such a development may not be very conducive to urbanization.

The results reveal that rural male employment in agriculture sector has a negative effect on urbanization, and therefore it is principal determinant of rural-urban migration and urbanization. It means that if urbanization is to be intensified in the country, rural workers who are principally engaged in agriculture need to be encouraged to migrate to urban centers. If more women are engaged in agriculture, more and more male workers would be enabled to migrate to urban centers. For this reason rural female employment has a positive impact on urbanization in India.

Rural literacy rate also has a positive impact on urbanization in India. This is one of the crude dimensions of rural education. However, the results highlight that higher level of rural education

does have an impact on urbanization in India. Education is one the main vehicles which enables rural people to migrate to urban areas for pursuing higher levels of education and/or to get employment.

Finally, the study finds the coefficient of the interaction of openness and agriculture productivity as positive. This means that for a less open economy like India, urbanization is positively associated with agriculture productivity and the association is statistically significant. This finding is of great value to India which is not a completely closed country but less open compared to other countries such as Hong Kong SAR, Luxembourg, and Singapore etc. Trade as a percentage of GDP in 2015 for Hong Kong (or Luxembourg or Singapore) was 400 (or 392 or 360), respectively against only 49 for India in 2015.

VII. Conclusions and policy implications

The paper analyzes the impact of agricultural activities on urbanization in India. The findings of this research work empirically validates Matsuyama's (1992) theoretical model. For the empirical analysis, data relating to urbanization and agriculture was sourced from document of Census and Ministry of Agriculture for the time period of 1981 to 2015. For the estimation OLS, Fixed effect and Random effect panel data model has been used, the analysis considers data relating to 15 major agriculture states in India.

The paper finds that the share of agriculture and cultivated land area has a negative and statistically significant effect on urbanization in India. Similarly, the consumption of fertilizer and state government expenditure on agriculture are positively associated with increasing urbanization in India. While the impact of production of wheat, maize, jowar, and bajra is positive on urbanization, that of and rice and pulses is negative in India. Further, male (or female) employment in agriculture sector has a positive (or negative) impact on urbanization in India. Similarly, rural literacy rate also has a positive impact on urbanization. Finally, the results show that the effect of agriculture productivity is positive on urbanization for less trade open economies like India.

Based on the above findings, the following policy prescriptions are made, which it is hoped would s smoothen the required transition from agriculture based economy to industry and service lead urbanized economy in India.

First, it should be noted that initially in the process of increasing urbanization, the share of agriculture will obviously decline, but it has to be kept in mind that productivity of agriculture has to increase to ensure supply of food-grains to the urban dwellers. In order to increase productivity, it is imperative to use and advanced technology and farming techniques for the major crops such as rice. This can be done by increasing government expenditure on agriculture and increase consumption of fertilizer. It would not only increase agriculture productivity but also it will release the surplus agriculture labour, which will facilitate rural to urban migration and also urbanization.

Second, it should be borne in mind that decreasing in the extent of cultivated land area is a prerequisite for higher urbanization. It should also be remembered that we should not divert fertile land for this purpose. Instead, agriculture productivity should be increased through the use of advanced technology and innovative farming methods. It is also necessary to minimize diversion of land for urbanization.

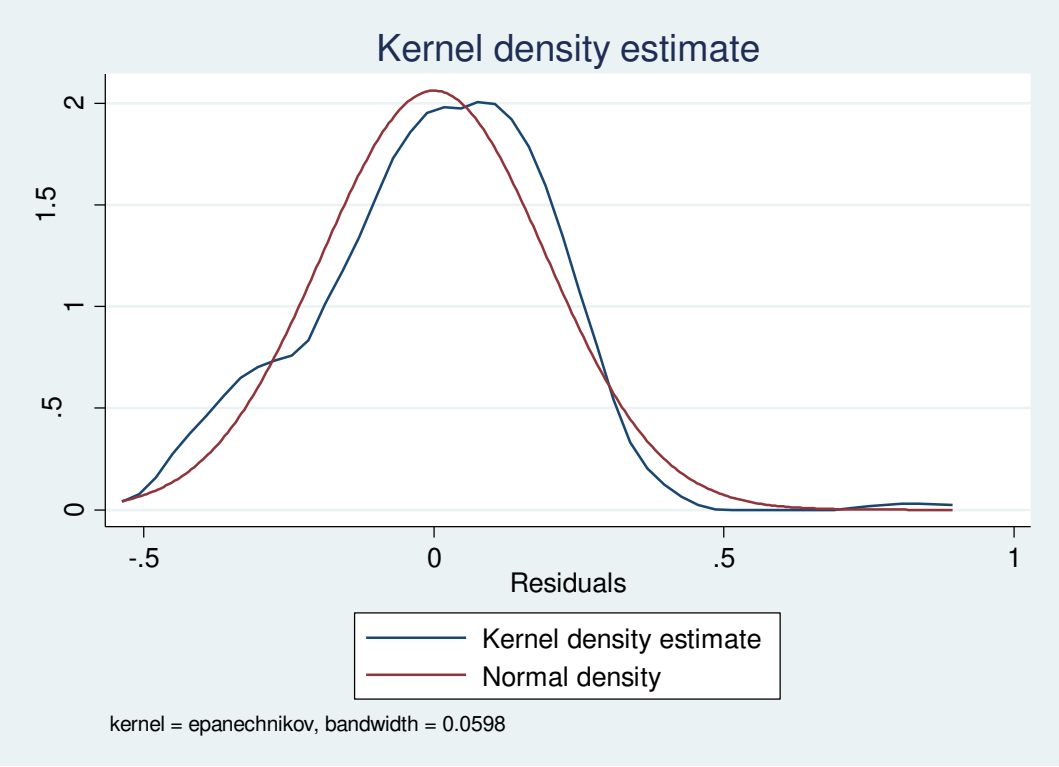
Third, rural education is necessary for the higher urbanization India. The lower level of rural education is one of the main problems behind the lower level of rural-urban migration. The migration rate of working age adult (those aged 25-49) males ranged from 4 to 5.4 percent over the period of 1961-2001. The simplest reason for India's low mobility could be the small difference between rural and urban wages. Karan and Selvaraj (2008) found that at constant 1993-94 prices, average daily wages of regular rural worker was Rs. 74.01 and Rs. 96.12 for urban worker. In contrast, for rural casual worker, it was Rs.27.04 against Rs.34.08 for urban casual worker. This indicates that the rural urban wage gap is higher only for skilled worker and not for unskilled worker. Therefore, it is suggested that in order to increase rural to urban migration it is necessary to increase the skill-level of the rural workers through providing rural education.

Fourth, the available (limited) trade data shows that agriculture productivity has a positive effect on urbanization in India. This indicates that in line with the prediction of Matsuyama's (1992) theoretical model, for the supply of food and other agricultural products, the country depends mainly Indian agriculture as the country still has a less open economy. India's global export (or import) share is currently 1.62 (or 2.34) per cent. Agricultural products constitute about 13.2 % of the country's total exports. Therefore, it is India should endeavor to perform better in the

world export market. In fact, several world-countries have faced the discomfiture of higher exports in the early stages of their development process. Eventually, developed counties have reached a position where increase of urbanization is much lower than in the developing countries. It is only natural to assume that India will need quite a long time to reach that situation. But it is necessary to promote urbanization to achieve industrialization, which in turn will increase India's export share in the world-trade. However, the increase in agricultural productivity will facilitate higher export in agricultural products besides helping urbanization.

Finally, we suggest that transformation from rural based economy to urban based economy is unavoidable phenomenon as it is the crucial stage of development. Agriculture has a positive effect on urbanization. Therefore, development in agriculture is essential for higher urbanization in India. Recently, some Indian studies (e.g., Tripathi, 2013; Tripathi and Mahey; Mitra and Mehta, 2011) found that India's urbanization has a very strong positive effect on economic growth. However, we need a planned urbanization with strong agriculture development policy for the overall development in India.

Figure A1. Appendix Figure 1 for Regression 2



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