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Causality Between Urbanization and Economic Growth: Evidence From the Indian States

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There is an abundance of studies on the urban-rural dichotomy. In the mainstream economic and regional science literature, the urban centers have usually been described as growth machines, growth poles, or growth foci, and urbanization as a driver of economic growth. It is commonly assumed that the assemblage of factors of production in urban centers will create economies of scale, and that economic growth will trickle down from these centers to the periphery. Most of these studies hypothesize a mono-directional causal relationship between urbanization and economic growth. However, there are ample possibilities of reverse causalities in regions where the propulsive powers of urban centers are weaker and where social overhead capital (SOC) is not adequately developed in non-urban regions. In this situation, even minor economic changes in non-urban economies will cause the growth of the urban population. The present paper attempts to examine the relationship between urbanization and economic growth in India at the state level during 1971–2020 by employing a bootstrap panel Granger causality test. It is found that in India the majority of the states display a unidirectional Granger causality from economic growth to urbanization. This finding indicates not only a lower propulsive power of urban centers, but also an unbalanced development of SOC between urban centers and rural areas, hence causing a migration of people to cities with a rise in their income in order to take advantage of the urban facilities.

Keywords: urbanization, economic growth, panel granger causality, rural-urban migration, urban hierarchy

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INTRODUCTION

The geography of our planet can be characterized as the "New Urban World" (Kourtit, 2019). For a long time, the urbanization phenomenon in the development literature has been considered as an economic growth-promoting process. Among other things, urban centers or cities have been described as "engines of growth", "growth poles" fuelling economic growth (Perroux, 1955, 1970; Friedmann and Alonso, 1975; Henderson, 2005), "drivers of development" (Beall and Fox, 2009, p.84), engines of modernization, "geographical foundations of economic growth" (Scott and Storper, 2003, p. 580), and "the center of gravity of the economy", or "logistic hearts of economic activity" (Braudel, 1984, p. 27). This perspective assumes that cities through economies of scale, economies of agglomeration, or urbanization economies help in promoting economic growth. The New Economic Geography literature is equally replete with theories about how through innovations, new skills and ideas, thick labor markets, etc.,

urban centers can lead to rapid economic growth (Mumford, 1937; Bairoch, 1988; Storper and Venables, 2004). However, there have also been counter-perspectives describing cities as "by-products of economic change" (Childe, 1950) in ancient and medieval times.

After Perroux (1955), the "growth pole" theory in space was imagined through hierarchies of urban centers to create balanced regional economic development (Friedmann and Alonso, 1975), and this led to a stream of regional economic planning studies focussing on the creation of growth poles by transplanting urban centers to the backward regions of many developing countries, including India (Shaban, 2016). Even recently, the McKinsey Global Institute (2010) argued that, in India, urbanization should be a strategy for a seven-fold increase in per capita income (p. 13). The new urban strategy of smart cities initiated by the Government of India in 2015 (Shaban et al., 2020) was much influenced by this argument.

India is one of the leading economies of the world. It ranked sixth, after the USA, China, Japan, Germany and the UK, in 2020 in terms of total GDP (World Bank, 2021). The country had a strategy of planned development during 1947–1991; however, it liberalized its economy in 1992. In the pre-liberalization phase the main emphasis of the government was on rural and agricultural development, while, after the liberalization, a series of programmes were initiated for accelerated urbanization and urban development. The assumption of the government has been that a higher urbanization rate and better cities can lead to higher economic growth. However, a review of the literature, as presented in the next section, shows that the idea that urbanization drives economic growth has been more a theoretical argument than empirically tested. Many studies have brought out an association between economic growth and urbanization (see Henderson, 2005), but only a few have examined the causal relationship between urbanization and economic growth. In other words, what comes first: urbanization or economic growth, has hardly been examined empirically. The studies in India in this context have been very few using only limited evidence from the data that support hypotheses about such a "chicken-egg" problem.

The present study attempts to fill this empirical gap in the literature by examining the Granger causality between per capita income and the urbanization rate among the Indian States using long-term panel data, 1970–2020. The study can be significant both theoretically and policy-wise, as India is one of major economies of the world and empirical evidence, as such, may matter for theory and policy. In recent years, governments across the global South have increasingly focussed on the potential of cities for accelerating economic growth (Datta and Shaban, 2017) diverting scarce resource from rural to urban areas creating thereby significant rural-urban inequalities (Lipton, 1976). The Government of India has been investing significant share of resources, especially, since liberalization of Indian economy in 1992 on urban centers in the hope that urban centers will help in accelerating the economic growth (Shaban et al., 2020), specifically through manufacturing and services. Therefore, the paper also examines the causality at sectoral levels.

The economic liberalization in India in 1992, introduced structural changes in the Indian economy and it is possible that this relationship in the pre- and the post-liberalization period between urbanization and economic growth has changed. Therefore, we also examine the causality during the pre- (1971–1991) and the post- liberalization (1992–2020) period. Several studies have pointed out that the quality of urbanization may have its own peculiar causal relationship with economic growth (Bloom et al., 2008; Gross and Ouyang, 2020). To account for the quality of urbanization, we have divided the population into those living in cities with a population above 100,000, and those with a population of <100,000. The evidence shows that megacities are efficient and have different economic dynamics, in terms of SOC, governance, receiving in-migrants, congestion, crime rates, etc., than small and medium cities (Sharma and Shaban, 2006; Bhagat and Mohanty, 2009; Sharma and Sandhu, 2013). This helps to comprehensively understand the causal relationships between economic sectors and urbanization. Another advantage of this paper is that, to investigate the causality, it uses a state-of-the-art augmented bootstrap panel Granger causality method suggested by Konya (2006), which has several advantages over other methods, as it neither require stationarity of the panel data, cross-sectional independency, nor the homogeneity assumptions (Kar et al., 2011; Peng et al., 2016).

Among others, the study shows dominant unidirectional causality from economic growth to urbanization in a majority of the states of India and this unidirectional causality has become dominant in the post-liberalization period. This shows that with rise in income, people move to urban centers to avail better social overhead capital and other amenities, including personal freedom. This also indicates that the free play of market is paramount in shaping the relationship between urbanization and economic growth. Importantly, the results show that an imbalanced allocation of resources in favor of urban areas, as has often been advocated in policy arena (McKinsey Global Institute, 2010), may not be very helpful in achieving economic growth, but rather a balanced distribution of the same between rural and urban areas.

The rest of this paper is organized as follows. Next section presents a review of the relevant literature and is followed by discussion on data and methods used. The results of the Granger Causality, and the ensuing discussion are presented next. The last section, which underscores the theory and policy relevance of the findings, concludes the paper.

URBANIZATION AND ECONOMIC GROWTH LINKAGE

Theoretical Arguments

In the development literature, several theoretical arguments have been propounded about the relationship between urbanization on economic growth. These arguments can be classified in two closely related categories: first, those concerning the relationship between overall urbanization and economic growth;

and, second, those concerning the relationship between city-size and economic growth. Henderson (2005) emphasizes that a higher rate of urbanization represents the sectoral shift in the economy from agriculture to manufacturing and services, and thus leads to higher growth, arguing that: "The marginal product of labor in the urban sector is assumed to exceed that in the rural sector" (p. 1578). He also argues that, through an agglomeration process, and "knowledge spillover" (p. 1560) economic growth is generated. Gallup et al. (1999) believe that urbanization may cause growth rather than be a by-product of growth.

The S-shaped curve of the urbanization trajectory has been well known, but Davis and Henderson (2003), based on pooled cross-country data from 1965 to 1995, demonstrate that the "growth rate of the urban population is a concave increasing function of income level" (Henderson, 2005, p. 1560). Henderson (2003) argues that urbanization is a transitory phenomenon, and today many countries are fully urbanized, and that urbanization can happen even during a negative growth of economies. Theoretically, there may be several channels through which urbanization may impact economic growth. First, the urban centers may provide better conditions for the formation of human capital, technological development and adaptation (Bertinelli and Black, 2004; Aghion and Howitt, 2009); second, through agglomeration economies production costs can be reduced (Krugman, 1991; Fujita et al., 1999; Kumar and Kober, 2012; Banaszak et al., 2019), and, third, these costs may be reduced through entrepreneurship which grows better because of the exchange of ideas between a large growing pool of population and the better availability of finance and a large local market (Glaeser et al., 2010). Williamson (1965) argues that agglomeration may propel more economic growth in the early stages of urbanization, which may turn into diseconomies with congestion, pollution, and rising factor costs, as agglomeration grows without any improvement in technologies and the development of SOCs.

Renaud (1981), Fay and Opal (1999), and Davis and Henderson (2003) all attribute the growth of population in major cities to government policy bias toward megacities, and this leads to the growth of dominant cities. Ades and Glaeser (1995) and Henderson and Kuncoro (1996) also argue that deliberate policy manipulation by the elites in favor of the megacities where they reside can also promote excessive concentration of population in those cities, often generating slums, squatter settlements, kampongs[1], and bustees[2], and may not be optimally related to economic growth. Piano et al. (2020), Etokakpan et al. (2021), and Philip et al. (2021) argue that urbanization is often related to environmental degradation in developing countries compromising its potential to economic growth. Alam et al. (2007) argues that too rapid urbanization can create diseconomies through increased pressure on infrastructure. However, Danish and Khan (2020) argue that urbanization decreases the ecological footprint.

[1]A Kampong is a settlement on stilts.

[2]A bustee is a shanty town.

Regarding the city-size and economic growth relationship, Ades and Glaeser (1995), Junius (1999), and Davis and Henderson (2003) argue that the relative concentration of population in capital or megacities first increases with increase of income, then peaks, and at the end declines. In other words, it forms an inverted u-shaped relationship with income. About industrial concentration, Lee (1997) argues that in the initial phase of urbanization the industries are more concentrated in larger cities, but with the rise in urbanization they shift to rural areas. This argument of Lee is also supported by Henderson (2003), who with cross-country panel data of 1960–1990 demonstrates that an initial level of economic development, dominant or large cities are beneficial for economic growth, but as development proceeds the importance of large cities declines.

Duranton and Puga (2000) argue that large cities are often economically diversified, with thick labor markets, while smaller cities are specialized. A theoretical argument has also been advanced that the higher productivity of firms, among other things, in large cities is not only associated with horizontal and vertical spillovers, but also with a quick response to market changes (Dixit and Stiglitz, 1977; Abdel-Rahman and Fujita, 1990; Rauch, 1993).

Empirical Evidence

Nakamura (1985) shows that, if the urban population is multiplied with a factor of 2 in Japan, productivity can increase by 3.4%, while Ciccone and Hall (1996) find that in the USA the same can result in a productivity increase of 6%. Using data from France, Germany, Italy, Spain and England, Ciccone (2002) argues that in these countries the doubling of population can raise the aggregate productivity by 4.5%. Lewis (2014), using data from 1960 to 2009 for Indonesia, shows that urbanization is positively related to economic growth, but the rate of change of urbanization is negatively correlated with economic output, concluding that insufficient local public infrastructure spending is linked to this negative relationship.

Zi (2017) using time series data from 1982 to 2014 for China, and applying a VAR model, found a long-run unidirectional causality from land urbanization to economic growth (see also Cheng, 2013). Song et al. (2018) findings also support the urbanization to economic growth causality. Using data for 2005–2010 for China and input-out analysis, they estimate that urbanization contributed to 16.40% of the total Chinese output increment during the period.

Gross and Ouyang (2020), using cross-sectional data of 91 countries, find that urbanization due to in-migration has a positive impact on economic growth, while natural increase (due to urban births and deaths) in the urban population has no impact. Therefore, Bloom et al. (2008) and Jedwab et al. (2014) argue that distinct types of urbanization are key to understanding its impact on economic growth.

However, there are studies which find the reverse, that is unidirectional causality from economic growth to urbanization, or no causations. Moomaw and Shatter (1996), using panel

data for the 3 years 1960, 1970, 1980 for 90 countries, find reverse causation, that is, GDP per capita and share of sectoral incomes have a positive impact on countries' urbanization rate. Similarly, Pradhan et al. (2014), using data from 1961 to 2012, for G20 countries also find unidirectional causality from per capita GDP to urbanization. Zhao and Wang (2015), using data for 1980–2012 for China found unidirectional causality from economic growth to urbanization, while Arvin et al. (2015), using data for 1961–2012, also find reverse causation from per capita GDP to urbanization in the G20 countries.

The relationship between urbanization and economic growth can be non-linear. Urbanization may positively impact economic growth in the early stages, but as it reaches a certain threshold the impact may decline. This may be because of the more favorable development of infrastructure in rural areas and the shifting of industries to the peripheries. Nguyen and Nguyen (2017) using data for ASEAN countries for 1993–2014 and applying static and dynamic panel models, found urbanization to be non-linearly but positively impacting economic growth. However, as urbanization reaches the threshold of 69.99% for a static model and 67.94% for a dynamic model, it impedes economic growth.

There are many studies which have differed from the usual consensus on the beneficial impacts of urbanization on economic growth. Henderson (2003), using panel data at 5 year intervals from 1960 to 1995 for 70 countries, does not find any economic evidence of urbanization causing productivity growth. Bloom et al. (2008) also do not find any evidence of urbanization causing economic growth and therefore argue that: "it appears that urbanization is more an indicator than an instrument of economic development" (p. 775). Chen et al. (2014) using data for 226 countries from 1980 to 2011, and using cross-sectional and panel estimates, found that, though there is a close link between urbanization and the level of GDP per capita, there is no causality between urbanization and economic growth rates at the global level. Salim and Shafiei (2014), using data from OECD countries, and Solarin and Shahbaz (2013), using data for Angola, also find no causalities between urbanization and economic growth.

Similarly, Bao and He (2015), using data from 31 Chinese provinces from 1997 to 2013 and a vector error correction Granger causality model, find no relationship between urbanization and economic growth in most of the provinces. Only in two provinces do they find bidirectional causality, in six provinces unidirectional causality from urbanization to economic growth, and in four provinces unidirectional causality from economic growth to urbanization. Liddle and Messinis (2015) using heterogeneous panel causality tests for 100 countries from 1960 to 2009 found that, in the case of higher income countries, urbanization causes economic growth, but no causality exists in middle-income and Latin American countries. However, a bi-directional causality and equilibrium relationship exists for low-income countries, especially those in Africa.

It is noteworthy that there have only been few studies on India which examine the relationship between urbanization and economic growth. Cali (2008) using the data from the 1961 to 2001 decadal census on urbanization finds that the growth of the urban population has a negative impact on the growth of GDP in the Indian states. However, another study (Cali and Menon, 2009), which used data from a sample of Indian districts from 1981 to 1999 and using the instrumental variable estimation (two stage least squares) method, found a positive impact of urbanization on poverty reduction through the income spillover process.

The McKinsey Global Institute (2010) saw India's rapid urbanization as a great opportunity for the country to transform its economic fortunes. It forecast that more than 70% of Indian GDP and 70% of new employment by 2030 would be generated from its urban centers, while increasing urbanization could lead to a four-fold increase in per capita income (p. 13). It estimated that India's urban population will be about 590 million by 2030, rising from 290 million in 2001. It forecast that India's urban economy will provide 70% of the total tax revenue. To achieve all this, it suggested a series of measures including additional investment of about $1.2 trillion by 2030 to overcome the urban gridlock, i.e., acute congestion. But, Ghosh and Kanjilal (2014) using data from 1971 to 2008 for India and threshold cointegration tests, found unidirectional causality from per capita GDP to urbanization.

Megeri and Kengnel (2016), using inter-censal estimated data for 1996–2011 for 22 Indian states and applying a time series method, examined the Granger causality between the log of urbanization and the log of State Domestic Product (SDP). They found that 6 out of 11 states with a Human Development Index (HDI) higher than 0.5 had causality from SDP to urbanization, while 5 out of 11 states with an HDI of <0.5 had causality from urbanization to SDP. They assumed that an HDI level of 0.5 marks the threshold between the low and the higher developed states, and there was the possibility of differential causation between urbanization and economic growth in these two sets of states. Two states in each of the categories based on HDI had bi-directional causalities. Shaban (2019), using cross-sectional data of the Indian states for 2013 and the OLS method, finds that a 1% increase of the urbanization rate can lead to a per capita income increase of about INR 935. The study found that a rise in the population of the largest million-plus city had a greater impact on per capita income. Whereas, a 1% increase in the population of the million plus cities led to an increase of INR 745 per capita, a 1% increase in the population of the largest million-plus city led to an increase of INR 1843 per capita among the states.

It is clear from this discussion that, overall, the literature on the relationship between urbanization and economic growth does not provide any clear understanding about what comes first—urbanization or economic growth? There is a need, therefore, to examine the causality between them, as it can

help in reshaping existing theories and add to the design of new policies.

DATA AND METHODOLOGY

We have used data available for 15 major Indian states[3] to test the causal relationship between urbanization and real per capita income (at 2011-12 prices) at aggregate and sectoral levels (the primary, secondary, and tertiary sectors)[4]. The per capita income data was obtained from the Economic & Political Weekly Research Foundation (EPWRF, 2021), while data related to the urban population has been taken from the Census of India (1971, 1981, 1991, 2001, 2011) and the report of the Technical Group on Population Projection (TGPP, 2020). The estimated intercensal year figures for the share of total urban population in the period 1971–2011 and the share of population of the towns for the entire period 1971–2020 have been used, while the period estimated urbanization data for the states in the period 2012–2014 has been obtained from the TGPP (2020).

To examine the causality between the variables of the panel data, the vector autoregressive (VAR) method, Hurlin's (2008) method, and Koniya's augmented bootstrap Granger causality method are often used. However, Konya (2006) method has an advantage over the other two methods, as it overcomes all three major issues of non-stationarity of time series of individual variables, cross-sectional dependence (CSD), and heterogeneity in parameters (Breitung, 2005; Kar et al., 2011). As we have data from Indian states which have geographical contiguity, it is possible that they will display CSD. Similarly, each of the states may have their own trajectories of relationships between urbanization and economic growth, and, therefore, assuming homogeneity in the parameters may not be able to capture the state-specific characteristics. Panel VAR estimated using the generalized method of moment (GMM) is able to take into account neither CSD nor the heterogeneity (Pesaran et al., 1999; Kar et al., 2011; Peng et al., 2016). Hurlin's (2008) method is able to take into account the heterogeneity, but is not able to overcome the CSD. The method proposed by Konya (2006) estimated through the seemingly unrelated (SUR) method can take both CSD and heterogeneity into account. As Konya's method uses Wald tests with country-specific bootstrap critical values for examining the direction of causality, it requires neither the homogeneity assumption, i.e., the joint hypothesis for the entire panel, nor the assumption of the stationarity of the panel series (Konya, 2006). Given the merit of Konya's (2006) method, we have used it to examine the direction of causality among the Indian states. This method entails two sets of equations, as follows:

$$
\begin{aligned}
y_{1,t} &= \alpha_{1,1} + \sum_{i=1}^{ly_1} \beta_{1,1,i}\, y_{1,t-i} + \sum_{i=1}^{lx_1} \delta_{1,1,i} x_{k,1,t-i} + \varepsilon_{1,1,t} \\
y_{2,t} &= \alpha_{1,2} + \sum_{i=1}^{ly_1} \beta_{1,2,i}\, y_{2,t-i} + \sum_{i=1}^{lx_1} \delta_{1,2,i} x_{k,2,t-i} + \varepsilon_{1,2,t} \\
&\vdots \\
y_{N,t} &= \alpha_{N,t} + \sum_{i=1}^{ly_1} \beta_{1,N,i}\, y_{N,t-i} + \sum_{i=1}^{lx_1} \delta_{1,N,i} x_{k,N,t-i} + \varepsilon_{1,N,t} \quad (1)
\end{aligned}
$$

and,

$$
\begin{aligned}
x_{k,1,t} &= \alpha_{2,1} + \sum_{i=1}^{ly_2} \beta_{2,1,i}\, y_{1,t-i} + \sum_{i=1}^{lx_2} \delta_{2,1,i} x_{k,1,t-i} + \varepsilon_{2,1,t} \\
x_{k,2,t} &= \alpha_{2,2} + \sum_{i=1}^{ly_2} \beta_{2,2,i}\, y_{2,t-i} + \sum_{i=1}^{lx_2} \delta_{2,2,i} x_{k,2,t-i} + \varepsilon_{2,2,t} \\
&\vdots \\
x_{k,N,t} &= \alpha_{2,N} + \sum_{i=1}^{ly_2} \beta_{2,N,i}\, y_{N,t-i} + \sum_{i=1}^{lx_2} \delta_{2,N,i} x_{k,N,t-i} + \varepsilon_{2,N,t} \quad (2)
\end{aligned}
$$

where y refers to the variable, which is being "caused" (the "impulse"), while x denotes the variable which is "causing" (the "stressor"). We have examined the causal relationship between the urbanization rate, per capita income (*PCI*), per capita primary sector income (*PPCI*), per capita secondary sector income (*SPCI*), per capita tertiary sector income (*TPCI*), the percentage of population in Class 1 towns in a state of the total population in that state (*CITY*), and the percentage of population of Class 2–6 towns in a state of the total population in that state (*TOWNS*). N is the number of the members of the panel ($j = 1,\ldots, N$); t is the time period ($t = 1,\ldots, t$); and l is the lag length. As each equation in the system has different pre-determined variables while the error terms might be contemporaneously correlated (may be due to CSD), these equations are form SUR system. All the variables have been used in log form.

There would be one-way Granger (2003) causality from x to y, if not all $\delta_{1,j,i}s$ are zero, but all $\beta_{2,j,i}s$ are zero. Alternatively, there will be one-way Granger causality from y to x if all $\beta_{2,j,i}s$ are not zero, but all $\delta_{1,j,i}s$ are zero. There would be two-way Granger causality between x and y, if neither all $\delta_{1,j,i}s$ nor $\beta_{2,j,i}s$ are zero. Finally, there would be no Granger causality between x and y if all $\delta_{1,j,i}s$ and $\beta_{2,j,i}s$ are zero. Following Konya (2006), the maximal lags are allowed to differ across variables but to be the same across equations. This is done in order to minimize the computational burden which may result from a large lag structure. The pairs of x and y are used for the estimation by assuming 1–4 lags and then choosing the combinations which minimize the Schwarz

[3]During the data period, out of the 15 states, four states were bifurcated: in 1999 (Uttar Pradesh, into Uttar Pradesh and Uttarakhand; Bihar into Bihar and Jharkhand; Madhya Pradesh into Madhya Pradesh and Chhattisgarh), and in 2014 Andhra Pradesh into Andhra Pradesh and Telangana. In order to maintain data comparability over the years, the data of the divided states have been combined together.

[4]The paper uses the classification methods adopted by the National Accounts Statistics, Government of India, for grouping various economic activities in different broad sectors: the *Primary Sector* includes: (i) Agriculture, Forestry and Logging Fishing (Agriculture & Allied Activities), and (ii) Mining and Quarrying; the *Secondary Sector* comprises, (i) Manufacturing, (ii) Construction, (ii) Electricity, Gas and Water supply; the *Tertiary Sector* includes, (i) Transport, Storage and Communication, (ii) Trade, Hotels and Restaurants, (iii) Banking and Insurance,(iv) Real Estate, Ownership of Dwellings and Business Services, (v) Public Administration, and (vi) Other Services.

Bayesian Criterion. Three different tests have been carried out to find out the cross-sectional dependency. These tests will briefly be described.

- The Lagrange multiplier cross-sectional dependence statistics developed by Breusch and Pagan (1980) (hereafter CD_{BP}) have been used to test the cross-sectional dependence. As CSD is also equivalent to testing for contemporaneous correlation in the errors of the systems of equations (2) an (3), CD_{BP} is computed as follows:

$$CD_{BP} = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \tag{3}$$

where the estimated correlation coefficient among residuals obtained from individual OLS estimations are represented by $\hat{\rho}_{ij}^{2}$. Under the assumption of the null hypothesis of no cross-sectional dependence with a fixed N and $T\rightarrow\infty$, CD_{BP} is asymptotically distributed as χ^2 with $N(N-1)/2$ degree of freedom (Kar et al., 2011).

- Pesaran (2004) has pointed out that CD_{BP} suffers from a drawback, when N is large or $N\rightarrow\infty$. To overcome this problem, Pesaran suggested the Lagrange multiplier statistics for CSD(CD_{lm}):

$$CD_{lm} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\rho}_{ij}^{2}-1) \tag{4}$$

Under the null hypothesis of no CSD with the first $T\rightarrow\infty$, and then $N\rightarrow\infty$, DC_{lm} is statistically distributed as standard normal. Kar et al. (2011) point out that DC_{lm} is likely *to* show substantial size distortion when N is large relative to T, and recommend using another CSD test (hereafter, CD) when N is large, and T is small:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\left(\sum_{i=1}^{N=1}\sum_{j=1+1}^{N}\hat{\rho}_{ij}^{2}\right) \tag{5}$$

The CD test is asymptotically distributed as standard normal under the null hypothesis of no cross-sectional dependence with $T\rightarrow\infty$ and $N\rightarrow\infty$ in any order.

EMPIRICAL RESULTS

There are presence of strong positive relationships or coevolution between urbanization and aggregate, tertiary and secondary sectors per capita incomes among Indian states (**Figure 1**). However, primary sector income does not show similar strength of the relationship (**Figure 1B**). Bihar, Assam, Orissa and Uttar Pradesh form the group of the least urbanized states of India and they also show the lesser strength of relationship between urbanization and total and sectoral per capita incomes incomparison to other states.

The estimated coefficients of CD and Granger causality are presented in **Tables 1**–**4**. The major findings emerging from the results are as follows. First, there is a considerable presence of CSD in the data (**Table 1**), and therefore the Konya's (2006) method is most suitable for examining Granger causality between the urbanization and economic growth in India. The cross-sectional dependence also shows that any shock to any state in terms of urbanization or in GDP is also likely to influence other states. Second, there is a significant presence of unidirectional causality from PCI, PPCI, SPCI and TPCI to URB, CITY and TOWNS during the entire period 1971–2020 (**Table 2**, see also appendix **Tables A1–A3**). Out of the 15 states, 10 states show PCI to URB, 7 states PPCI to URB (and 3 states from URB to PCI), 10 states from SPCI to URB and 10 states TPCI to URB granger causalities, while 2 states show bi-directional causalities between URB and TPCI. The unidirectional causality is present from PCI to CITY in 2 states, and TPCI to CITY in 10 states. Only 2 states show bi-directional causality between TPCI to CITY. From PCI to TOWNS causality is found in 7 states (1 state has bi-directional causality), SPCI to TOWNS in 4 states and TPCI to TOWNS in 5 states (2 states show bidirectional causality).

The direction of causality does not seem to follow per capita income levels of the state, but it is interesting to note that two states Kerala and West Bengal governed by communist parties for long time have shown bidirectional causalities in URB and TPCI, and CITY and TPIC, and West Bengal in TOWNS and TPCI. Over the years, both the states have had a smaller secondary sector but a large share of tertiary sectors, which grew rapidly. The tertiary sector share in state domestic product in Kerala and West Bengal increased from 34 and 32%, respectively, in 1970-71, to 56 and 51%, respectively, in 2019-20, while the secondary sector increased only from 16 and 23% in 1970-71 to about 25 and 27%, respectively, in 2019-20.

Third, as against the post-liberalization period, the pre-liberalization period does not show any significant presence of causality in most of the states either from urbanization and shares of population of the two categories of towns or vice versa, except a TPCI to TOWNS causality in 10 states (**Table 3**, see also appendix **Tables A4–A6**). Among other things, this indicates that: (a) the free play of market forces is important for a tighter relationship between urbanization and economic growth; and (b) the investment in urban centers through urban development programmes in the post-liberalization period in India did ease the absorptive capacity of towns of rural migrants, though urbanization did also grow by the incorporation of new areas into urban centers (Bhagat and Mohanty, 2009).

Fourth, in the post liberalization period, the unidirectional causality from PCI, PPCI, SPCI, and TPIC to URB, CITY and TOWNS has strengthened. Several states show these unidirectional causalities (**Table 4**, see also appendix **Tables A7–A9**). The tertiary sector per capita income (TPCI) has shown unidirectional causality to URB, CITY and TOWNS in most states. In this regard, it is noteworthy that, in comparison to the primary and secondary sectors, the tertiary sector has experienced a higher growth rate in almost all the states. At the national level the growth in the tertiary sector has been robust, and its share in real gross values added (at 2011-12 prices) has

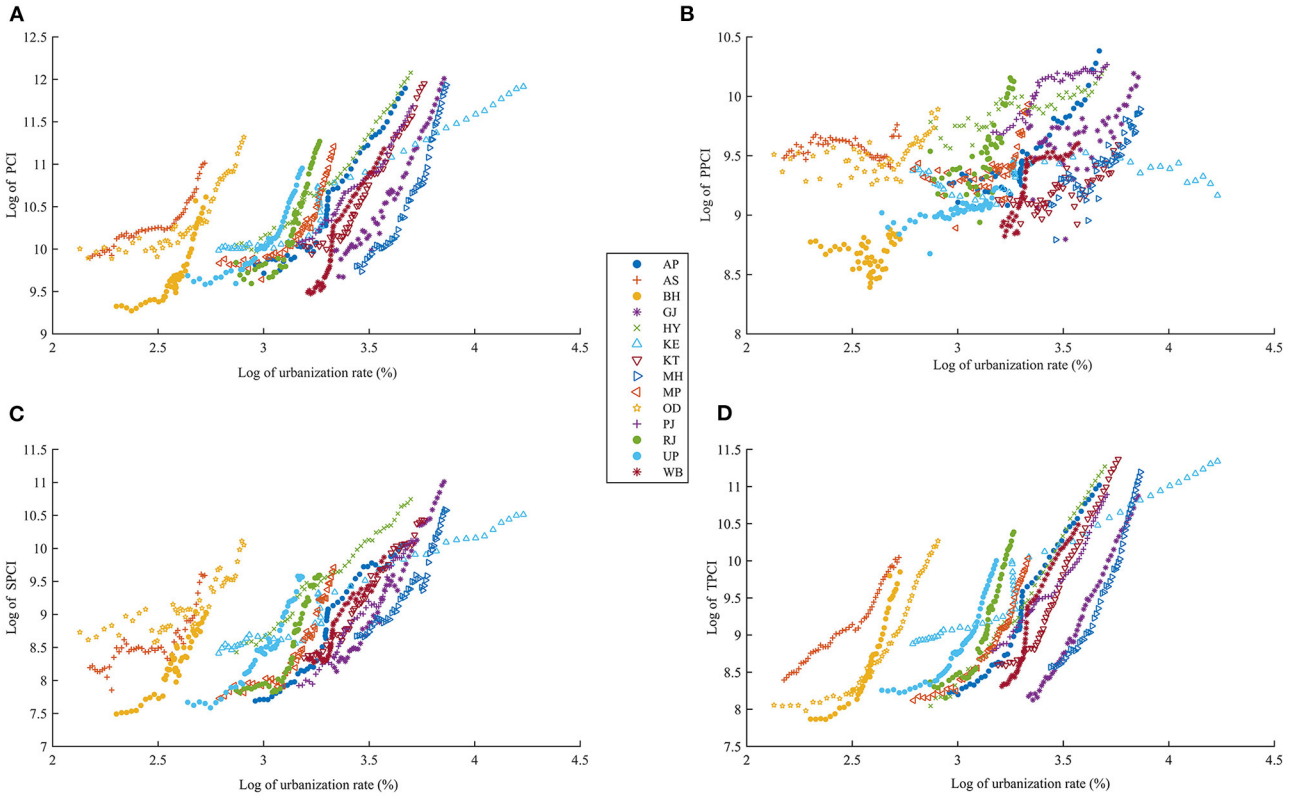

FIGURE 1 | Co-evolution of urbanization rate and total and sectoral per capita incomes among Indian states, 1971–2020. See **Table 2** for abbreviations of the states. **(A)** Evolution of urbanization and per capita income in Indian states, 1971–2020. **(B)** Evolution of urbanization and primary sector per capita income in Indian states, 1971–2020. **(C)** Evolution of urbanization and secondary sector per capita income in Indian states, 1971–2020. **(D)** Evolution of urbanization and tertiary sector per capita income in Indian states, 1971–2020.

TABLE 1 | Cross-sectional dependence test.

Test	1972–2020				1971–1992				1992–2020			
	PCI	PPCI	SPCI	TPCI	PCI	PPCI	SPCI	TPCI	PCI	PPCI	SPCI	TPCI
% of urban population (URB)												
CD_{BP}	652.365	398.983	736.015	824.979	466.294	481.579	435.247	970.916	692.248	367.322	648.669	771.452
CD_{LM}	37.772	20.287	43.544	49.683	24.932	25.986	22.789	59.754	40.524	18.102	37.517	45.99
CD	19.935	13.484	20.715	22.763	15.947	17.157	7.389	23.507	21.658	8.977	20.493	22.516
% of population of Class 1 towns (CITY)												
CD_{BP}	730.455	427.687	828.085	785.111	607.342	414.112	647.146	509.133	729.128	345.426	547.409	742.446
CD_{LM}	43.16	22.268	49.898	46.932	34.665	21.331	37.412	27.888	43.069	16.591	30.529	43.988
CD	20.6	14.036	18.37	22.585	14.013	11.796	10.529	11.474	21.163	8.32	10.994	20.648
% of population of Class 2–6 towns (TOWNS)												
CD_{BP}	444.883	391.54	467.27	310.657	440.124	483.588	451.787	391.006	256.592	262.807	296.04	295.101
CD_{LM}	23.454	19.773	24.999	14.192	23.126	26.125	23.931	19.736	10.461	10.89	13.183	13.118
CD	15.079	12.999	15.946	8.434	16.311	16.311	3.775	4.062	7.102	5.295	11.399	1.519*

*All the values are significant at the 1% level, except the one marked *, which is significant at the 10% level.*

increased from about 29.4% in 1970-71 to 55.6% in 2019-20. It is, therefore, understandable that the rise in income from the tertiary sector in rural areas may have enabled more people to move to urban areas.

DISCUSSION

In the theory of spatial economic growth, cities and towns have been assumed to play major roles as growth poles (Perroux,

TABLE 2 | Granger causality between the log of urbanization and log of per capita income in Indian states, 1971–2020.

States	Urbanization & per capita income				% of population in Class I towns & per capita income				% of population in Class 2–6 towns and per capita income			
	URB ↔ PCI	URB ↔ PPCI	URB ↔ SPCI	URB ↔ TPCI	CITY ↔ PCI	CITY ↔ PPCI	CITY ↔ SPCI	CITY ↔ TPCI	TOWN ↔ PCI	TOWN ↔ PPCI	TOWN ↔ SPCI	TOWN ↔ TPCI
Andhra Pradesh and Telangana (AP)	←	←	←	←				←			←	
Assam (AS)	←	←	←	←				←	←			
Bihar & Jharkhand (BH)	←			←								
Gujarat (GJ)		→	←					←			←	←
Haryana (HY)	←			←		←		←				↔
Kerala (KE)				↔	→	→	↔	↔	↔		←	→
Karnataka (KT)	←	←	←	←								
Maharashtra (MH)				←				←	←			←
Madhya Pradesh and Chhattisgarh (MP)	←	←	←	←				←	←	←		←
Odisha (OD)	←	←	←	←				←	←	→		←
Punjab (PJ)		←	←					←				
Rajasthan (RJ)	←	→	←	←		→		←				→
Tamil Nadu (TN)		←						→	←		←	←
Uttar Pradesh and Uttarakhand (UP)	←	→	←	←	←	↔		←	←	↔		→
West Bengal (WB)	←		←	↔	←			↔	←	←		↔
Summary (number of states with causalities)												
Unidirectional from URB/CITY/TOWNS	0 (1)	3 (1)	0 (1)	0 (1)	1 (1)	2 (1)	0 (1)	1 (1)	0 (1)	1 (1)	0 (1)	3 (1)
Unidirectional from PCI/PPCI/SPCI/TPIC	10 (1)	7 (1)	10 (1)	10 (1)	2 (2)	1 (2)	0 (3)	10 (1)	7 (2)	2 (2)	4 (2)	5 (2)
Bi-directional	0	0	0	2	0	1	1	2	1	1	0	2

The arrows show the directions of Granger causalities significant at the 5% or above levels. Abbreviations of states are given after the names of states. Numbers in parentheses are the lags used.

TABLE 3 | Granger causality between the log of urbanization and log of per capita income in the Indian states in the pre-liberalization period (1971–1991).

States	Urbanization and per capita income				% of population in Class I towns and per capita income				% of population in Class 2–6 towns and per capita income			
	URB ↔ PCI	URB ↔ PPCI	URB ↔ SPCI	URB ↔ TPCI	CITY ↔ PCI	CITY ↔ PPCI	CITY ↔ SPCI	CITY ↔ TPCI	TOWN ↔ PCI	TOWN ↔ PPCI	TOWN ↔ SPCI	TOWN ↔ TPCI
Andhra Pradesh and Telangana												←
Assam		←					←					←
Bihar and Jharkhand			←									←
Gujarat					→							
Haryana		→										←
Kerala							←	←				
Karnataka		←										←
Maharashtra		←										
Madhya Pradesh and Chhattisgarh										→		←
Odisha			←		→							←
Punjab									←	←	←	←
Rajasthan	→		←		→							
Tamil Nadu		←										
Uttar Pradesh and Uttarakhand	→											←
West Bengal												←
Summary (number of states with causalities)												
Unidirectional from URB/CITY/TOWNS	2 (1)	1 (1)	0 (1)	0 (1)	3 (1)	0 (1)	0 (1)	0 (1)	0 (1)	1 (1)	0 (1)	0 (1)
Unidirectional from PCI/PPCI/SPCI/TPIC	0 (1)	4 (1)	3 (1)	0 (1)	0 (1)	0 (1)	2 (1)	1 (1)	1 (2)	1 (2)	1 (2)	10 (2)
Bi-directional	0	0	0	0	0	0	0	0	0	0	0	0

The arrows show the directions of Granger causalities significant at the 5% or above level. Numbers in parentheses are the lags used.

TABLE 4 | Granger causality between the log of urbanization and log of per capita income in Indian states in post-liberalization period (1992–2020).

States	Urbanization and per capita income				% of population in Class I towns and per capita income				% of population in Class 2–6 towns and per capita income			
	URB ↔ PCI	URB ↔ PPCI	URB ↔ SPCI	URB ↔ TPCI	CITY ↔ PCI	CITY ↔ PPCI	CITY ↔ SPCI	CITY ↔ TPCI	TOWN ↔ PCI	TOWN ↔ PPCI	TOWN ↔ SPCI	TOWN ↔ TPCI
Andhra Pradesh and Telangana			←		←			←			←	↔
Assam	←		←	←	←	→		←		→	←	
Bihar and Jharkhand		→	→		←		→	←			←	←
Gujarat	←	←	←		←			←	←			←
Haryana	←		←		→			→	→		←	↔
Kerala				←	←			←	←		→	←
Karnataka		←			←			←	←		←	←
Maharashtra	←		←		←			←	←	→		←
Madhya Pradesh and Chhattisgarh					←			←	←	→	←	
Odisha				←								
Punjab	←		←	←	←			←			←	←
Rajasthan		→				↔		←				←
Tamil Nadu	←		←	←				←			←	←
Uttar Pradesh an Uttarakhand	←			←	←			↔		←		
West Bengal	←	←	←	←	←	←		←		←	←	←
Summary (number of states with causalities)												
Unidirectional from URB/CITY/TOWNS	0 (1)	2 (1)	1 (1)	0 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	3 (1)	1 (1)	0 (1)
Unidirectional from PCI/PPCI/SPCI/TPIC	8 (1)	3 (1)	8 (1)	7 (1)	11 (1)	1 (2)	0 (2)	12 (1)	5 (2)	2 (2)	9 (1)	9 (1)
Bi-directional	0	0	0	0	0	1	0	1	0	0	0	2

The arrows show the directions of Granger causalities significant at the 5% or above levels. Numbers in parentheses are the lags used.

1955; Friedmann and Alonso, 1975). The promise of the cities in the economic geography and planning literature has been assumed so much that regional development planning in many countries, including India, has aimed at creating urban centers serving as growth poles (Sharma and Shaban, 2006). However, our analysis does not support the causation of economic growth either by the total urbanization rate or the type or quality of urbanization, i.e., the share of population in smaller cities or megacities. In other words, our findings are similar to the findings of Bloom et al. (2008), Pradhan et al. (2014), Arvin et al. (2015), and Zhao and Wang (2015). That is not to say that urban centers in India are dormant in generating economic growth, but it seems that they attract more population from rural areas than their economic pull potentials. The reasons for the reverse causations may also be found in urban policies and India's economic specificities.

It has been well documented that, since the independence in 1947 until about 2005, the year of the launch of a comprehensive urban development programme, the Jawaharlal Nehru Urban Renewal Mission (Sharma and Shaban, 2006), later replaced by the Atal Mission for Rejuvenation and Urban Transformation in 2015, and the Smart City Mission (a urban renewal and retrofitting programme of select cities by the Government of India) (Shaban et al., 2020), the Indian Government has had no comprehensive urban development programs, except for establishing in the 1950–1960s new towns in as industrial centers serving as growth poles (Shaban, 2016). A few cities like New Delhi, Chandigarh, Gandhi Nagar, Bhubneshwar, etc. were planned, but a majority of them grew haphazardly and expanded in their own ways. The emphasis was on rural development and increasing farm income. However, India also has enormous, disguised unemployment in the farm sector, and the educational, health, financial and communication infrastructures are still mainly located in urban centers. Therefore, it seems that, as the income of the families in rural areas rises, they will move to urban centers to have the advantage of these facilities. Further, there has been issues of social exclusion in villages, particularly of lower castes and also Muslims and Christians, who in search of better anonymity and effective modern governance to avoid the discrimination and violence, are moving to urban areas in greater numbers. It is also the fact that in India social customs and patriarchy are more oppressive in rural areas for the youth and especially for women. Hence, the younger generation and families seeking their social liberties with an increase in their income are migrating to urban centers which are relatively liberal spaces.

Although, the natural increase constituted the major share (50–62%) of the urban population increase during 1971–2001, the share of rural urban migration varied between 18 and 21% (Bhagat and Mohanty, 2009). With the new economic policy in 1992 and the emergence of an aspirational middle class by the turn of the new century, a large segment of the Indian rural population are also seeking better economic and social futures in urban areas through migration. In fact, Gross and Ouyang (2020) study based on data from 91 countries demonstrates that urbanization due to in-migration has a positive impact on economic growth.

Shaban and Sattar (2013) argue that industrialization-led urbanization is mainly located in western and southern Indian states, while urbanization in the northern and eastern Indian states like Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, West Bengal, Orissa, Assam, etc., is driven by the growth of administrative towns. Shaban (2019) categorizes them as propulsive (industrially growing) and sedentary towns (where people migrate to take advantage of the educational, health and other facilities using the income earned from other cities or from agriculture). It is therefore not surprising that the results in this paper show that, on average, in India it is income growth that is causing the urbanization rather than vice versa.

CONCLUSIONS

In economic and regional development theory, urbanization has been assumed to be a major factor causing economic growth. However, several studies have pointed out that urbanization may also be a product of economic growth, and/or its impact on economic growth may vary with the level or urbanization and the economic development of a country. India is one of the major economies of the world, and in recent years rapid urbanization has been considered as key to the economic growth in the country. In this context, the present study, using state-wise panel data from 1971 to 2020, attempts to examine the causality between the per capita income and the urbanization rate. To examine this relationship, the study employs the bootstrap panel Granger causality method, as it has an advantage over other methods. The results of the study show that there is: (a) the presence of unidirectional causality from per capita income to the urbanization rate, and this relationship also persists in the case of shares of population of cities, and small & medium towns; (b) in the pre-liberalization phase of the Indian economy, 1971–1992, the unidirectional causality existed only in a few states, but it has strengthened and spread to a number of states in the post-liberalization period, 1992–2020; (c) the tertiary sector income has stronger unidirectional causal relations in a majority of the states than that of the primary and secondary sectors. The study also shows that the working of liberal market seems to be essential for a stronger connection between urbanization and economic growth.

There may be several reasons for this unidirectional causality between per capita income and urbanization in India. First, given the underdeveloped SOCs in rural areas, people move to urban centers, as their income rises to take advantage of the facilities. Second, the rural areas in India are still stuck in conservative and restrictive traditional practices of caste, religion, and gender, and the latent and open violence associated with these. They provide little possibilities for of individual freedoms. Many families, especially religious minorities and lower castes do move to the urban centers where these traditional practices are less restrictive, and governance is more effective. That is why we find a higher rate of change in the urbanization rate of lower or scheduled castes than in the overall growth rate of the Indian population in recent years. And, also, the urbanization rate of Muslims, another socially and economically marginalized community in India, has

been higher than the overall urbanization rate in the country as a whole (Government of India, 2018).

Besides the theoretical implications of questioning the mainstream assumption of urbanization leading to economic growth, the findings of this paper also have policy implications. Importantly, the billions of dollars spent by the Indian Government through JnNURM, 2005, the Atal Mission for Rejuvenation and Urban Transformation, 2015, the Smart City Mission, 2015, and several other programmes for rapid urbanization and urban development may not be able to effectively achieve a faster economic growth, as several agencies including the McKinsey Global Institute (2010) have pointed out. But there is a need for a balanced spread of resources and spending in the rural sector, not only in India but in several other countries in the Global South which in recent years have embarked on disproprtionate spending on city building (Datta and Shaban, 2017) to enable the skilled population to migrate to urban areas. This may help to create an efficient labor market in urban areas leading to faster economic growth.

As mentioned above, this study offers many meaningful insights into the relationship between regional urbanization and economic growth in one of the major economies of Asia, however, frequent changes of state boundaries in India does pose problem to use long term data for analysis, and also directly attribute the findings to those newly created states, as the causal relations may be stronger in one of such splited states than the parent state from which it has been carved out. Studies have shown that adverse impact on environment (water, land, air, health, etc.) does compromise the the potential of cities and towns with regard to economic growth (Shaban et al., 2020; Kassouri, 2021; Pandey et al., 2021). In future studies the environmental aspect of urbanization can be examined in relation to economic growth in India, and can be extended to other countries as well to find out whether unidirectional cauaslity from economic growth to urbanization also holds in those in countries.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

AS, KK, and PN jointly designed the conceptual framework of the paper. AS prepared the data, performed the computations, and drafted the paper. KK and PN reviewed, wrote, and edited the paper. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frsc.2022.901346/full#supplementary-material

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