BRIEF PAPER #5

INDIA'S INCOME DIVERGENCE: GOVERNANCE OR DEVELOPMENT MODEL?

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IDFC Institute has been set up as a research-focused think / do tank by IDFC Ltd to investigate the political, economic and spatial dimensions of India's ongoing transition from a low-income state-led country to a prosperous market-based economy. Broadly, we support the notion of well–regulated free markets, and support inquiry into practices that result in greater, more efficient and equitable development.

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Abstract

India is an outlier in the global development story, experiencing increasing economic divergence within its borders. This paper is a follow-up to previous research ("India's curious case of economic divergence", IDFC Institute, Briefing Paper #3, October 2016) by Praveen Chakravarty and Vivek Dehejia, which highlights the puzzling issue of economic divergence among India's large states.

This paper aims to extend this study by looking at divergence within states, by testing convergence between districts of a given state. In the absence of district-level GDP figures, it introduces the Nighttime Lights (NTL) "luminosity" dataset, to be used as a proxy for economic activity . To start with, the paper tests this hypothesis by correlating state luminosity data with state GDP figures (which illustrates positive results, as expected) and the Barro and Sala-i-Martin tests show comparable divergence patterns across states using the luminosity dataset, as they do with state GDP figures. Further, using luminosity data, it is apparent that intra-state divergence across districts is as significant as inter-state economic divergence. The analysis reveals that the districts of ten out of the twelve largest states exhibit divergence within the state.

To understand this pattern further, this paper tests the relationship between GDP growth and inequality: as states get richer, divergence increases. The Economic Survey proffers quality of governance as a plausible explanation for economic divergence; however, this research suggests that perhaps the nature of economic development better explains regional disparity than quality of governance. In conclusion, this paper revisits the political economy of economic divergence, questioning whether India can ward off regional inequality before it endangers the political union of India.

India's Income Divergence: Governance or Development Model?

In our research paper ("India's curious case of economic divergence", IDFC Institute, Briefing Paper #3, October 2016[1]) and subsequent articles (including "Will GST exacerbate India's income divergence", Mint, Feb 8, 2017[2]), we highlighted the issue of puzzling economic divergence among India's large states. Using an extensive state GSDP dataset from 1960 to 2015, we showed how the income gap between India's richer states such as Tamil Nadu and Maharashtra and its poorer states such as Bihar and Uttar Pradesh is widening and not narrowing, as classical economic theory postulates[3]. While individual income inequality in India and its potentially adverse social consequences have been discussed fervently, regional inequality among the different states of India can perhaps have a greater adverse impact on the political economy of India. As we showed in our paper, India is a complete outlier in the world in experiencing such regional income divergence vis-à-vis most other large federal economic unions such as the United States, China, Canada and the European Union. The Economic Survey of 2016-17 also pondered over this issue of economic divergence of India's states as did the OECD's recent Economic Outlook for India. What is remarkable, but perhaps, not surprising, is that our research shows that 1992 is the milestone year when India started to experience income divergence among its large states. The logical next question is – what are the reasons for such economic divergence in India? Tempting as it may be to blame the economic reforms of 1991 for India's divergence, our research was insufficient to be able to offer any rigorous explanations. The Economic Survey too did not offer any evidence for the causes of such divergence but conjectured that the quality of governance across different states can be a plausible explanation. In other words, the hypothesis of the Economic Survey is that the poorer states suffer from poorer quality of governance, which impairs their ability to grow as fast as the richer states. If that were to be true– within the same state, presumably the same standards of governance would apply across the various districts of that state– then the districts within a state should experience income convergence, as economic theory would predict. Do districts within each state experience such income convergence, thereby validating this hypothesis? That is the question we investigate here, using a novel data set.

Unfortunately, we have reliable and official GDP and income data only at the state level and not at a more granular level. Not all states have official estimates of District Domestic Product (DDP) and even the ones that do, are not updated. In order to impute economic activity and income levels at a more granular level of districts, we used a proxy dataset of Nighttime Lights (NTL).

The US Air Force (USAF) Defence Meteorological Satellite Program (DMSP) operates a series of satellites, which carry sensors that detect light emission from the earth surface at night. A value of "luminosity" is available for every pixel around the globe, which is recorded in a fixed range of 0 (missing or dark) to 63 (bright). There has been sufficient global research that demonstrates that luminosity is a good proxy for economic activity[4,5] including in India[6]. It is important to note that we do not estimate actual levels of district GDP using luminosity– which can be problematic– but merely use it as a proxy trend to compare economic activities across regions.

We developed a luminosity dataset for 676 districts by using the high-res, geo-referenced images from the

[1] *The paper is available for download here: http://bit.ly/2rNnU81*

[2] *The Mint Essay is available here: http://bit.ly/2kGwDmu*

[3] *For detailed references to the classical economics literature we refer to, please see our earlier Briefing Paper.*

[4] *Chen, X., & Nordhaus, W. D. (2011). Using luminosity data as a proxy for economic statistics. Proceedings of the National Academy of Sciences,108(21), 8589-8594.*

[5] *Mellander, C., Lobo, J., Stolarick, K., & Matheson, Z. (2015). Night-time light data: A good proxy measure for economic activity?. PloS one, 10(10), e0139779.*

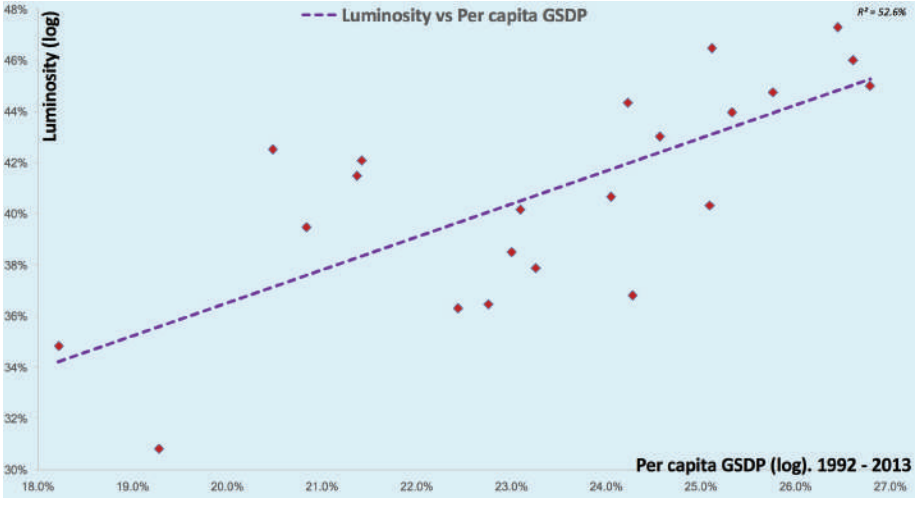
[6] *Bhandari, L., & Roychowdhury, K. (2011). Night lights and economic activity in India: A study using DMSP-OLS night time images. Proceedings of the Asia-Pacific advanced network, 32, 218-236.*

National Geophysical Data Center (NGDC), at the National Oceanic Administration Agency (NOAA)[7], which are available as annual composites, archived from 1992 to 2013. Then we overlay these with shape files of districts of India[8] to obtain a value of the sum of all illuminated pixels in the districts, normalized by the area of the district. Keeping in line with our methodology of using the 12 largest states that account for 83% of population and 80% of GDP, we measured economic convergence across the 387 districts in these twelve states using the nightlights luminosity dataset, which is perhaps the first attempt of its kind.

The nighttime light values available for 1992-2013 are constrained by sensor saturation– i.e. they are capped at a certain maximum value- which means that big cities such as Mumbai, New York, Tokyo, etc., that are very luminous, do not see their luminosity increase beyond a certain maximum value. This runs contrary to the fact that per capita GDP can grow infinitely without a ceiling. In other words, at the upper end, luminosity levels may be understating GDP. As a simple way to correct for this, our analysis excluded the five major metros of these 12 states – Mumbai, Kolkata, Chennai, Bangalore and Hyderabad.

We first establish that state luminosity is indeed correlated tightly with state GDP, i.e., richer states have higher luminosity, and poorer states, lower. There is a 75-80% correlation between luminosity and state GDP across the years, 1992 to 2013. (See Figure 1)

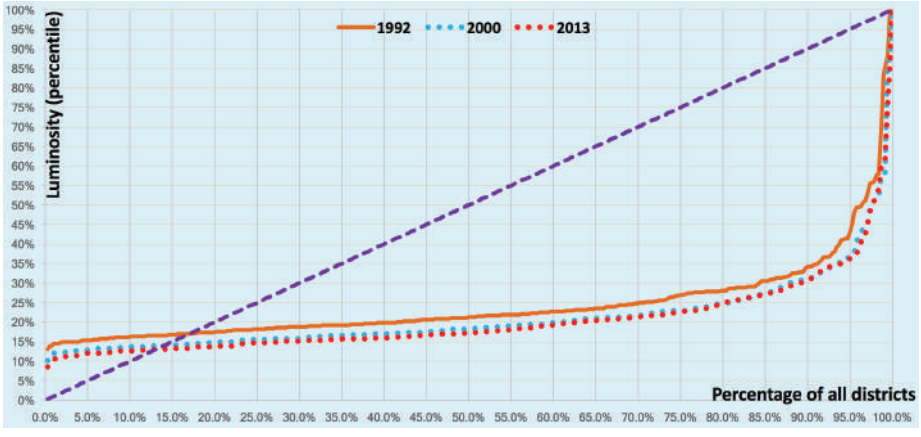
Figure 1: Correlation between Luminosity and state GDP (1992-2013)



Not so surprisingly, there is massive variation in luminosity levels across these districts, in line with income disparity (See Figure 2). 380 of the 387 districts in these twelve states are on average just one-fifth as bright as the metro cities of Mumbai and Bangalore at night. Even excluding the metros, 90% of all districts are just one-third as bright in the night as the top 10% of all districts. What is more striking is that this ratio is only worsening between 1992 and 2013 as the chart shows. It is important to note that this is different from income inequality posited by Gini calculation of a Lorenz curve, which measures cumulative share of income distribution.

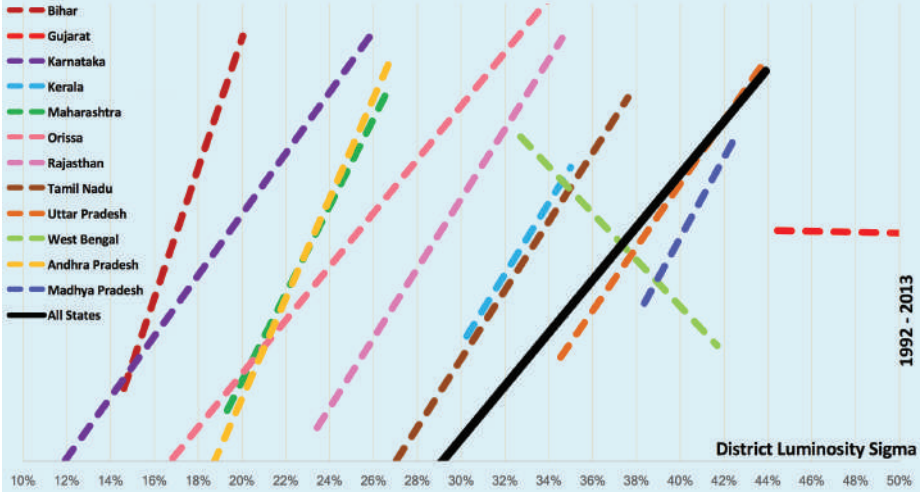
[7] Geo-referenced TIFF images for 1992 to 2013 for stable lights available here: http://bit.ly/2reql2D
[8] Shape files for districts in India: http://bit.ly/2qu8bqi

Figure 2: Lorenz curve of district-level luminosity for 1992, 2000, 2013



Further, using the standard Barro and Sala-i-Martin tests, we find that states exhibit similar divergence patterns on luminosity as they do with incomes (chart in our upcoming EPW paper). Since this conforms broadly to our observations of divergence across states using income data, it is then possible with confidence to test for intra-state trends across districts using luminosity. Our research shows that intra-state divergence across districts is as significant as was the observed inter-state economic divergence. Using luminosity as a proxy for economic activity, our analysis reveals that 10 of the 12 largest states exhibit strikingly similar divergence trends to what we observed across the richer and poorer states using per capita GDP. In other words, within most of the large states, the economic gap between richer and poorer districts is widening and not narrowing. This is clearly at variance with the idea that governance differences can explain divergence across states, since this divergence is occurring within most states, not just across them. Figure 3 shows the divergence pattern from 1992 to 2013 of all the districts within each state excluding the metros. For reference, the divergence trendline of per capita GDP of all the 12 states is also shown. If the trendlines fall to the right, then it signifies a divergent trend as the variation increases from 1992 to 2013. Curiously, West Bengal is the only state to experience a

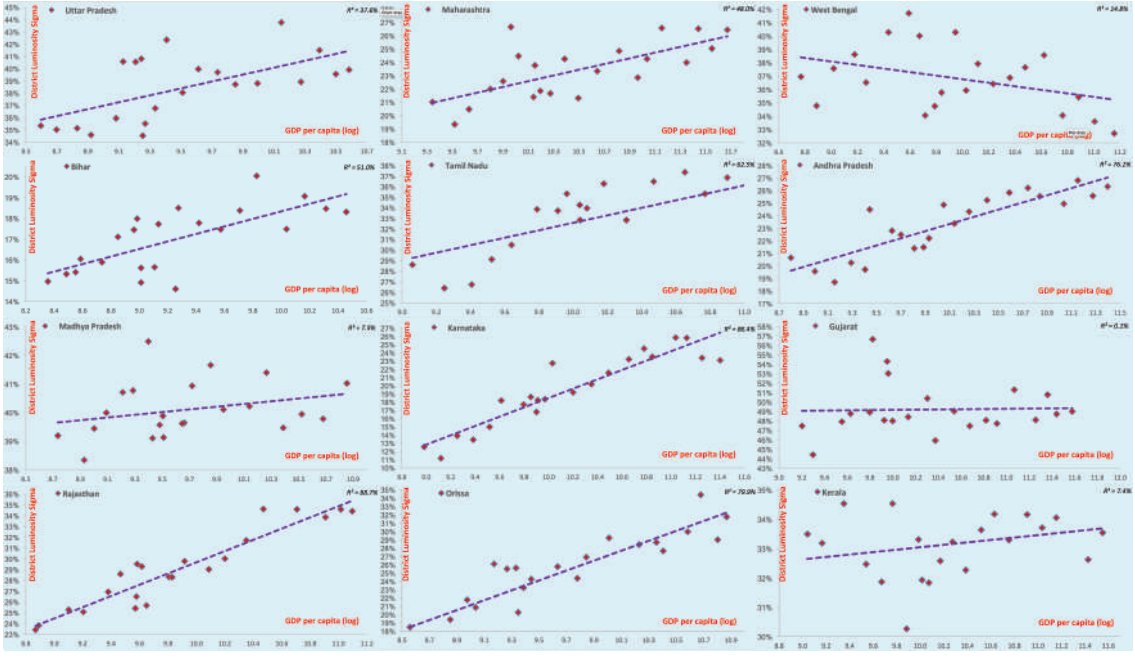
Figure 3: Trendline of district luminosity sigma for 12 largest states from 1992-2013



convergence among its districts while Gujarat shows neither divergence nor convergence. All other states show strong divergence trends, in-line with the trend observed on an inter-state basis using per capita GDP.

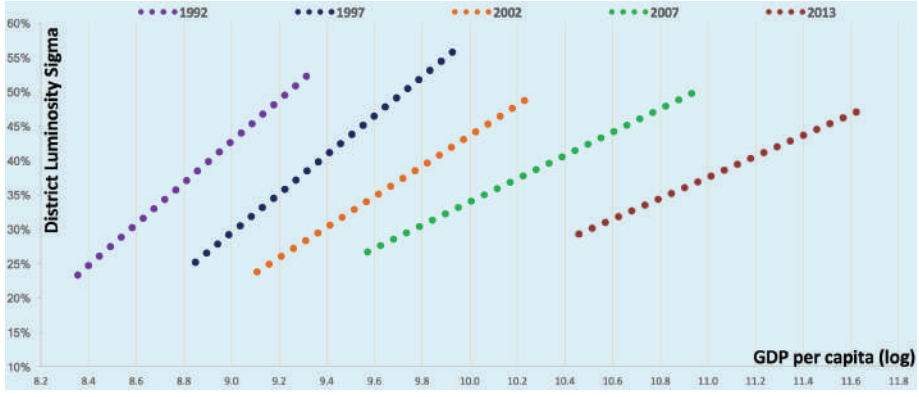
Figure 4 is the entire panel of all the 12 states that shows the sigma of luminosity across all districts within each state vis-à-vis the per capita GDP of that state from 1992 to 2013. In essence, not only is the income gap across rich and poor states of India widening but so are income gaps across rich and poor districts within each state, albeit using luminosity as a proxy for income. As we observed, if indeed the quality of governance in different states is what explained their economic divergence as mooted by the Economic Survey, then what explains a similar divergence across districts within each state that ostensibly experience similar standards of governance? Could it be a case of an economic development model that inherently exacerbates economic divergence?

Figure 4: Correlation between District Luminosity Sigma and GDP per capita of each of the 12 states



One simple test to check if economic divergence across districts within India's states is related to the level of economic development, and, by extension, perhaps the development model, is to test if there is a tight relationship between GDP growth and economic inequality. Figure 5 shows trendlines for divergence across India's districts relative to per capita GDP of that state. It is evident that, as states get richer, economic divergence across its districts also widens, suggesting that perhaps the nature of economic development is a better explanation for regional disparity than just quality of governance. Admittedly, this is not a rigorous explanation but a mere hypothesis that needs to be tested further.

Figure 5: Trendline of correlation b/w District Luminosity Sigma and GDP p.c. for 12 largest states, for every 5 years, since 1992



One simple way to understand this complex issue of economic divergence is to take the recent example of Apple wanting to set up a manufacturing base in India. Presumably, Apple's proposed investment will add significantly to the economic output of that region and add jobs that will contribute to the wealth of the economy of that region. It is likely that land and labour costs for setting up such a manufacturing unit will be much cheaper in poorer states of Bihar or Uttar Pradesh than in much richer states of Karnataka or Tamil Nadu. So, if such costs alone were decisive, Apple should choose to locate in Bihar or UP, but clearly there are other factors at play such as quality of governance, infrastructure, resource availability, access to markets, connectivity, etc. If Apple then chooses Karnataka, it can then either choose outer Bangalore where labour and land costs are much higher than in a poorer district such as Shimoga. Again, if cost considerations were decisive, Apple should choose Shimoga but for very similar reasons of network benefits has reportedly chosen Bangalore. Presumably, if the cost differential were large enough, then, at some point in time, the trade-off for Apple between lower costs in Shimoga or Bihar will offset the network benefits of Bangalore but until then, there will continue to be a divergence of economic activity between Bangalore and Shimoga or Karnataka and Bihar. The real political economy question is will Shimoga (Bihar) continue to tolerate such inequality vis-à-vis Bangalore (Karnataka) until the time it becomes economically beneficial for Apple to move to Shimoga (Bihar)? This is perhaps the big question confronting a federal polity in an extremely diverse nation with widening regional income disparities. The winner of this race between the longer run forces of economic convergence represented by Apple eventually finding it beneficial to locate in Bihar, and the medium run forces of divergen will determine the future of federalism.

In a country such as India with powerful regional political parties in almost every major state that cater exclusively to residents of their state, the tension caused by the centrifugal forces of regional economic divergence is bound to be exacerbated. Can India stave off regional inequality before it starts to threaten the political union of India?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