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Is there a Modi effect in per Capita Income of Gujarat?

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Abstract

Using time series data on per capita income of Gujarat, we look for the presence of structural breaks in the relative per capita Income series to see if any of the significant break dates in the series correspond to Narendra Modi's tenure as Chief Minister of Gujarat. We fail to find any Modi effect in per capita income of Gujarat. We also find that the per capita income of Gujarat, albeit impressive, does not drift too far from the per capita income of India.

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1. Introduction

The current Prime Minister of India, Mr Narendra Modi, came to power with an overwhelming majority in the 2014 general elections. This meant that for the first time since 1984, a political party had a clear majority in the lower house (*lok sabha*) of the Indian parliament. One of the key factors behind this massive election victory was Modi's agenda for development and his performance as Chief Minister of Gujarat, which is among the richest of the Indian states. Modi was Gujarat's longest serving Chief Minister, holding this position for a period of twelve and a half years from 2001 to 2014. After Modi resigned to become the 15th Prime Minister of India, his Bhartiya Janata Party party (BJP) appointed Mrs Anandiben Patel as the first female Chief Minister of Gujarat on 22 May 2014.

Modi's tenure as Chief Minister of Gujarat is often branded as a period of dynamic development, economic growth and prosperity (see Bobbio 2012; Ibrahim 2007; Mehta 2010). It was this slogan of growth and development that gave the BJP under Modi's leadership a decisive victory in the 2014 general elections and installed him as India's Prime Minister.

Some of Modi's critics, however, are sceptical of these growth and development claims and remain unimpressed. One of the key criticisms raised by some economists is that despite it being one of India's richest states in terms of per capita income, Gujarat remains relatively low in terms of human development indicators, such as the poverty rate, nutrition and education attainment for children. While eminent Indian economists and political scientists such as Sen (2013) and Jaffrelot (2013) are very critical of Modi's approach towards development, for example, his perceived focus on the development of Gujarat's urban middle class, some equally prominent economists such as Bhagwati, Bhagwati and Panagariya (2013) approve of Modi's development agenda by pointing out that Gujarat's social indicators have improved from a lower baseline than that of other Indian states.

In this article, we examine these claims by looking at the longest possible time series (1960–2012) of per capita income for Gujarat. More specifically, we look at structural breaks in the per capita income of Gujarat and test for its stationarity relative to the per capita income of India. Using the Minimum LM unit root test with one and two structural breaks proposed by Lee and Strazicich (2003a, 2003b), we attempt to identify significant structural breaks in the relative per capita income of Gujarat and test for the presence of unit roots in the series to ascertain whether or not Gujarat's per capita income converges with the per capita income of India. We also conducted the test of multiple structural breaks proposed by Bai and Perron (1998a, 1998b) as a robustness check of our results.

2. Data and Methodology

We use data on per capita net state domestic product (NSDP) for Gujarat and per capita gross national product (GNP) for India for the period 1960–2012 sourced from the *Indiastat* database[1]. The per capita income data for Gujarat as well as for India are reported for different base periods in the database; however, we convert to a common base period of

[1] Available from http://www.indiastat.com/ on payment of a subscription fee. Per capita GNP for India is taken from the published sources (Indiastat database in our case, whose parent source is Central Statistical Organization (CSO) of India). The per capita net NSDP for Gujarat is calculated by dividing SDP of Gujarat by population of Gujarat and all India per capita GNP is calculated by dividing all India GNP by population of India. This ratio is population weighted average by construction.

2004–2005 (the last period used for compiling NSDP). We transform the per capita income of Gujarat into relative per capita income by applying the following formula:

$$Relative\ per\ capita\ income\ of\ Gujarat_t = \ln\left(\frac{Per\ capita\ income\ of\ Gujarat_t}{Per\ capita\ income\ of\ India_t}\right)$$

The subscript "t" in the above equation represents time, that is, year in our dataset.

The above transformation gives us a series that takes a value zero when Gujarat's per capita income is the same as the national average per capita income, greater than zero when Gujarat's income is higher than the national average, and negative when Gujarat's income is lower than the national average. If we find this transformed series to be stationary, then the per capita income of Gujarat is not drifting uncontrollably away from the national average and there is a stable relationship between per capita income of Gujarat and the national average. The rationale for the above transformation is that it removes the big macroeconomic national/international shocks that affected the entire nation, including the state of Gujarat. Hence, the structural breaks that we identify will be specifically due to the shocks to per capita income of Gujarat.

If we find a significant structural break (in this transformed series) that corresponds to the beginning of Modi's tenure in Gujarat, and the post break intercept and/or trend of this series are/is bigger than the pre-break intercept and/or trend, then this will provide evidence in favour of a Modi effect in Gujarat's per capita income.

As stated above, the presence of structural breaks and stationarity is tested using the minimum LM unit roots tests with one and two structural breaks proposed by Lee and Strazicich (2003a, 2003b). The conclusions drawn using LM tests are further verified by conducting the test of multiple structural breaks proposed by Bai and Perron (1998a, 1998b). ADF type unit root tests are also available to test stationarity and structural breaks (as proposed by Zivot and Andrews 1992, and Lumisdaine and Papell 1997). The main problem with ADF type unit root tests, however, is that they suffer from severe size distortions and are prone to committing a type one error in a series with unit roots in the presence of structural breaks. Conversely, the LM tests that Lee and Strazicich (2003a, 2003b) propose are free from such size distortions, and to the best of our knowledge are the most robust tests for testing unit root and detecting structural breaks.

Lee and Strazicich (2003a) propose two different specifications to model the structural break:

Model A: allows for one-time break in the intercept of the deterministic term

Model C: allows for a break in both the intercept and slope of the deterministic term

Following a similar approach, Lee and Strazicich (2003b) propose a model for the presence of two structural breaks. These are classified as models AA and CC and comprise two breaks in the intercept and two breaks in the intercept and trend, respectively. The mathematical details of the data generating process, the critical values and the simulations testing the power of each test can be found in the original article.

As a robustness check and to ensure that we are not under-identifying the number of structural breaks in the data we also used the Bai and Perron (1998a, 1998b) test of multiple structural breaks as an alternative methodology for our analysis. The procedure proposed by Bai and Perron (1998a, 1998b) is a sequential procedure that relies on fitting a one-break model by conducting a series of F-tests at each possible break point and then using highest F

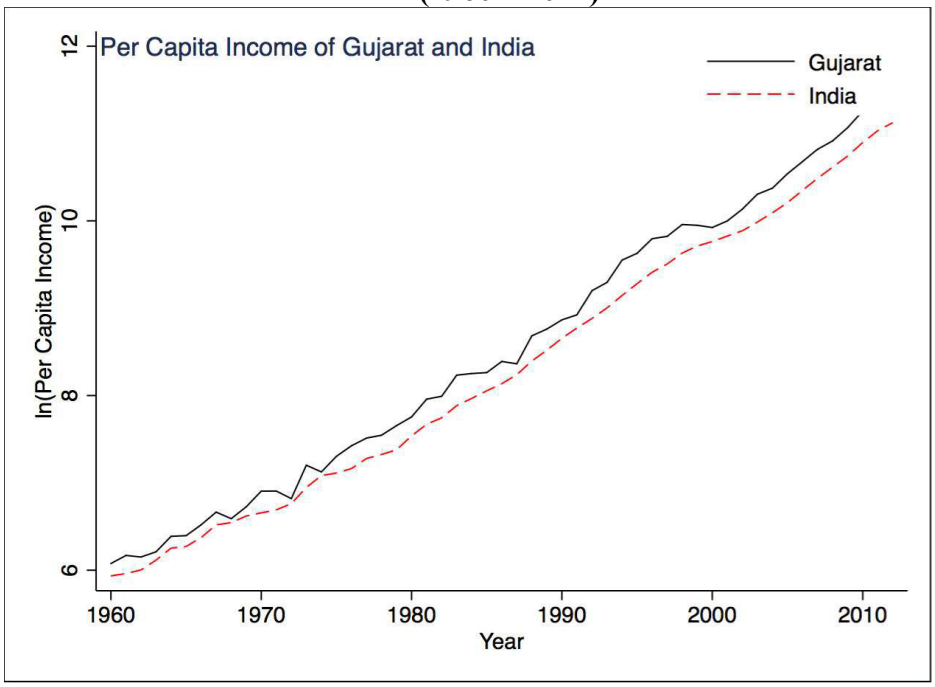
– statistics (named as SupF statistics) to determine the location and statistical significance of the break. The procedure is repeated again to fit a two-breaks model, with calculation of F statistics at every possible combination of break dates and determining the location and significance of break dates using SupF statistics. At this point a test is conducted to decide if the one break model better fits the data than the two breaks model. If two – breaks model is found to be a better fit than the test goes ahead and fits a three breaks models and checks if it's a better fit than the two-breaks model. This iterative procedure is continued until a model with *m* breaks is fitted, which is a better fit compared to a model with *m+1* breaks. As these are non-standard F- tests, the critical values of SupF statistics need to be determined experimentally using Monte carlo simulation techniques. The mathematical formulations and the critical values of SupF statistics for various numbers of breaks are provided in Bai and Perrons (1998a, 1998b).

One may ask why we do not follow an approach similar to that of Perron (1989), that is, exogenously set a break date (the beginning of Modi's tenure) and test its significance to draw a conclusion on the presence of a Modi effect on per capita income. The reason we decide against using this approach is that the exogenous break date and its specification can be quite arbitrary in the context of this type of analysis (for instance, Modi could have taken major policy decisions anytime during his tenure as chief minister of Gujarat). The other potential drawback of exogenously setting up a break date is that this approach suffers from confirmation bias. Hence, as suggested by Zivot and Andrews (1992), it is best to rely on a model that endogenously determines the structural breaks.

3. Results

Figure 1 plots the per capita income of Gujarat and India expressed in 2004–2005 base prices. We notice that in the last five decades Gujarat's per capita income moved more or less in tandem with national per capita income. Even though Gujarat's per capita income is consistently higher than the national average, it never drifts too far from the national average and follows the same general growth trend.

Figure 1: Per capita Income of Gujarat compared to per capita income of India (1960 – 2012)



The result of the Minimum LM unit root test with one structural break is presented in Table 1. The top panel presents estimate of model A (Intercept Break) and the bottom panel presents estimate of model C (Intercept and Trend Break). The LM test statistics, break date and the coefficients of dummies on intercept and slope are presented in this table. The null hypothesis of a unit root is rejected for both the models. There is a consistency in the break dates estimated by both the models. Model A estimates the break date in 1999, whereas model C estimates the break dates in 1998. We note, however, that the break date dummy is significant only in model A, suggesting that it is a better fit.

Table 1. Results of the Minimum LM Unit root test with one structural break

LM Test Statistic (S_{t-1})	Estimated Break point	B(t)	D(t)
Model A – Break in Intercept			
-0.897*** (-5.911)	1999	-0.184*** (-2.703)	-
Model C – Break in Intercept and Trend			
-0.954*** (-6.268)	1998	-0.073 (-1.104)	-0.008 (-0.371)

Notes:

Critical values for S_{t-1}			
Model A - Break in Intercept only			
	1%	5%	10%
	-4.239	-3.566	-3.211
Model C - Break in Intercept and Trend			
λ	1%	5%	10%
0.1	-5.11	-4.50	-4.21
0.2	-5.07	-4.47	-4.20
0.3	-5.15	-4.45	-4.18
0.4	-5.05	-4.50	-4.18
0.5	-5.11	-4.51	-4.17

The above critical values reproduced from Lee and Strazicich (2004). The critical values of Model A are invariant to the location of break, however the critical values for Model C depend upon the location of the break $\left(\lambda = \frac{T_B}{T}\right)$ and are symmetric around λ and $(1-\lambda)$. * (**) *** denotes statistical significance at the 10%, 5% and 1% levels respectively

The result of the minimum LM test with two structural breaks is presented in Table 2. Similar to the test with one structural break, we notice that the null hypothesis of a unit root is rejected in both specifications of this test as well. Moreover, both specifications consistently estimate the first break to be somewhere around 1983/84 and the second break to be in 1998. Looking at the significance of the dummies on intercept and slope, we notice that only the dummy on the intercept for the second break date (in 1998) is significant.

Table 2. Results of the Minimum LM Unit root test with two structural breaks

LM Test Statistic (S_{t-1})	Estimated Break point 1	Estimated Break point 2	B1(t)	B2(t)	D1(t)	D2(t)
Model AA – Two Breaks in Intercept						
-1.067*** (-6.899)	1983	1998	0.007 (0.117)	-0.106* (-1.750)	-	-
Model CC – Two Breaks in Intercept and Trend						
-1.056*** (-6.761)	1984	1998	-0.095 (-1.495)	0.044* (1.924)	-0.069 (-1.089)	-0.040 (-1.617)

Notes:

Critical values for S_{t-1}									
Model AA (Break in Intercept only)									
1%	5%	10%							
-4.54	-3.84	-3.50							
Model CC (Break in Intercept and Trend)									
λ_2		0.4			0.6			0.8	
λ_1	1%	5%	10%	1%	5%	10%	1%	5%	10%
0.2	-6.16	-5.59	-5.27	-6.41	-5.74	-5.32	-6.33	-5.71	-5.33
0.4	-	-	-	-6.45	-5.67	-5.31	-6.42	-5.65	-5.32
0.6	-	-	-	-	-	-	-6.32	-5.73	-5.32

The LM unit root test for model AA is invariant to the location of the breaks; however, this invariance does not hold for model CC, for which the null distribution of the LM test depends on the relative location of the breaks.

* (**) *** denotes statistical significance at the 10%, 5% and 1% levels respectively.

The results presented in tables 1 and 2 show that the null of a unit root is rejected, irrespective of the specification used. This suggests that the relative per capita income of Gujarat is stationary, relative to the national average. This result further signifies that Gujarat's per capita income has a stable relationship with the national average and does not drift too far from the general growth trend of the national income.

The results of Bai and Perron (1998a, 1998b) multiple structural breaks model is presented in Table 3. Owing to differences in the assumptions related to the data generating process and the criteria used to determine the location and significance of breaks, we found that the location of breaks determined by Bai and Perron (1998a, 1998b) test is different from the break dates identified by one and two break LM tests. Using the sequential procedure the Bai and Perron (1998a, 1998b) test identifies only one break in the series that occurred around 1975, whereas, using the BIC as criteria for judging the number of breaks, two significant breaks were identified at 1975 and 1990 respectively.

Even though the break dates identified by Bai and Perron (1998a, 1998b) test are different from the break dates identified by LM test, the general conclusions that can be drawn about per capita income of Gujarat are not contradicted; First, Gujarat's per capita income has always remained above the national average, the gap between Gujarat's per capita income and national average has not widened in the last decade or so, suggesting Gujarat has not experienced out-of-the-ordinary growth, during Modi's tenure as chief minister of Gujarat. Second, based on the Bai and Perron (1998a, 1998b) and LM tests results on the estimated break dates, there can be anywhere between one to three significant structural breaks present in the series. However, none of these break dates correspond with Modi's tenure as Gujarat's chief minister. These break dates predate Modi's tenure indicating absence of any significant

Modi effect in Gujarat's per capita income. Modi became Chief Minister of Gujarat in late 2001 and, during his tenure; Gujarat's per capita income did not increase much more than the national average to cause a significant structural break in the series around that time period or later.

Table 3. Results of Bai and Perron test for multiple structural breaks

Sup Ft(1)	Sup Ft(2)	Sup Ft(3)	Sup Ft(4)	Sup Ft(5)
33.64***	18.93	11.35	29.04***	25.25***
Sup Ft(2/1)	Sup Ft(3/2)	Sup Ft(4/3)	Sup Ft(5/4)	
2.83	2.85	2.85	2.85	
Ud_{max}	Wd_{max}(10%)	Wd_{max}(5%)	Wd_{max}(1%)	
33.64***	39.61***	43.83***	51.65***	
The number of breaks chosen by BIC: 2				
The number of breaks chosen by Sequential Method: 1				
Break points and 95% confidence intervals				
		$\widehat{T_1}$	1975	1972 - 1977
		$\widehat{T_2}$	1990	1988 - 1993

Notes:
The Bai and Perron test for multiple structural breaks was performed with the assumption of a maximum of 5 breaks in the data series. The critical values of various test statistics reported in above table were obtained from Bai and Perron (1998) article. The estimations were performed using Gauss code available at Prof. Pierre Perron's Homepage http://people.bu.edu/perron/code/m-Break.zip * (**) *** denotes statistical significance at the 10%, 5% and 1% levels respectively.

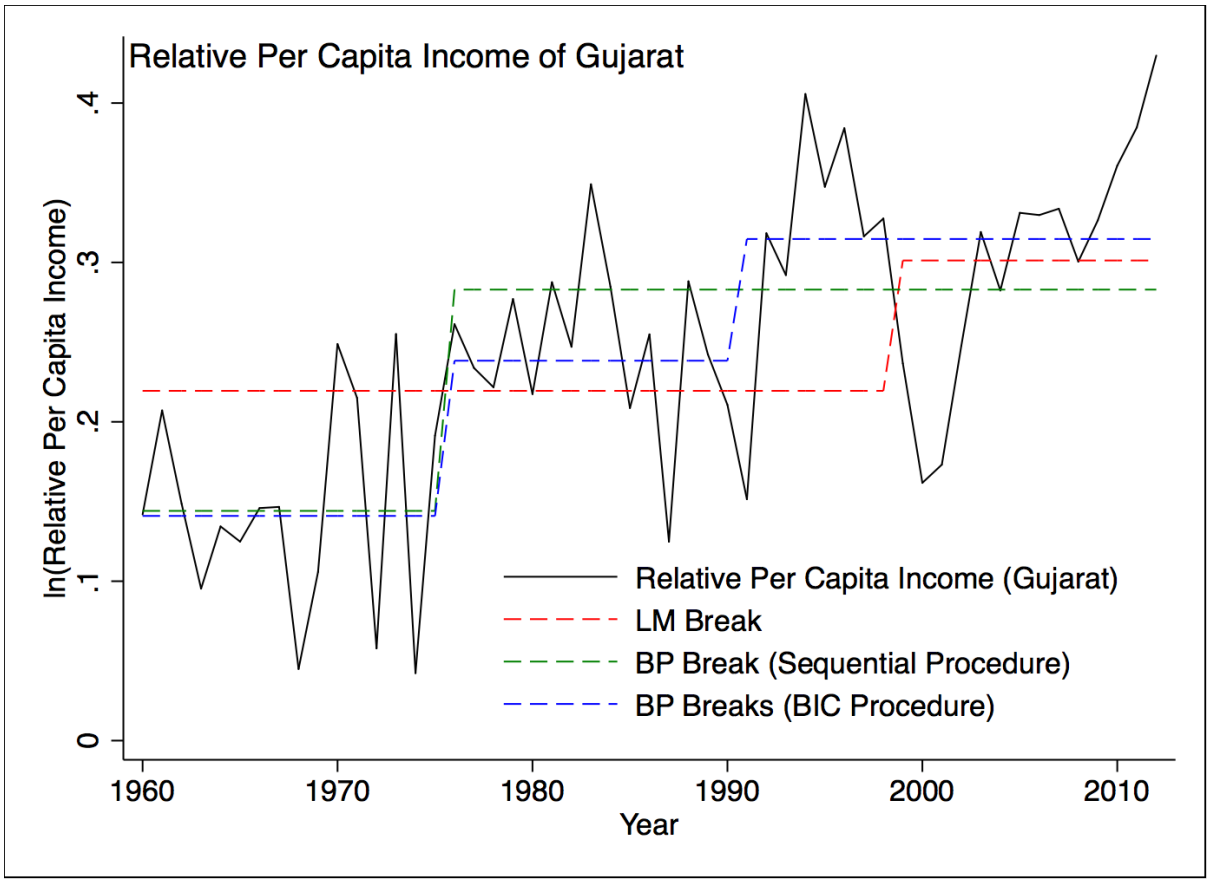
The structural break in 1975, identified by Bai and Perron tests, is probably capturing the effect of "*Nav Nirman Andolan*"(Re-invention/Re-construction movement), a socio-political mass movement that started in Gujarat in 1974, primarily lead by students and middle-class people against the elected government accused of corruption. In the history of post independence India, it remains the only successful mass agitation that resulted in dissolution of an elected government and triggered re-election in an Indian state. The second structural break, in 1990, identified by Bai and Perron test seems to the capturing the turmoil caused by the *"Mandal commission protests"*, which lead to the ousting to incumbent congress chief minister Madhavsinh Solanki in the state assembly election and instated a coalition government of BJP and Janata Dal, led by chief minister Chimanbhai Patel.

The structural break in 1998, identified by LM tests, seems to correspond to the devastation caused by the severe tropical cyclone in the same year, which affected coastal regions of Gujarat as well as the state of Rajasthan. Gujarat's coastal areas were hit by this cyclone in June 1998, leaving roughly 3,500 people dead, affecting around 20,000 families, and damaging most of the port and salt factories in the region. This event registers as a structural break in the relative per capita income series of Gujarat; however, as it affected only Gujarat and Rajasthan, the national average per capita was not impacted.

These findings are similar to the ones by Ghatak and Roy (2014). Using alternative measures of income and methods of computing growth rates, the authors did not find any evidence of accelerated growth performance of Gujarat during Narendra Modi's tenure in 2000 relative to 1990s. This finding holds after keeping or dropping the year 2000-01for which Gujarat suffered a negative growth rate due to earthquake. Though our conclusions are similar to those of Ghatak and Roy (2014), but based on more rigorous econometric approach incorporating structural breaks and clearly point out to a break in income series in 1998 due to the onset of earthquake. Moreover, the years of 2000-01 used by Ghatak and Roy as a robustness check were based on their exogenous observation of the growth rate of the income series while in our case the structural break detected is determined endogenously from data.

The relative per capita income series as well as the shifts in the mean (as measured by various tests) is presented in Figure 2.

Figure 2: Structural break in the relative per capita Income of Gujarat (1960 – 2012).



4. Conclusion

In this paper we look at the relative per capita income of the Indian state of Gujarat. We test for the stationarity of this series, after taking into account any possible structural breaks in the series. We test the hypotheses that the per capita income of Gujarat is drifting away from the national average, and that Gujarat's per capita income is experiencing a Modi effect. Using the LM unit root test with one and two structural breaks and the Bai and Perron (1998a,

1998b) test of multiple structural breaks, we find no evidence in support of either hypothesis. We notice that relative per capita income series of Gujarat is stationary compared to the national average, suggesting a stable relationship between national growth rate and Gujarat's growth rate. Also, we do not find any significant structural break in relative per capita income of Gujarat during Modi's tenure that provides evidence in favour of a Modi effect. All the significant structural breaks, as identified by alternative statistical methodologies pre-date Modi's term as Gujarat's chief minister.

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