Why was the participation of Indian states in the Growth Turnaround so patchy? Some evidence based on robustness analysis

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Abstract

In Ghate & Wright *Journal of Development Economics*, vol. 99 (2012) pp 58–67, we noted that there was considerable variation in the extent to which different Indian states participated in the Great Growth Turnaround. In this paper we investigate whether there was any systematic relationship between participation in the turnaround and the characteristics of Indian states, using the robustness approach originally proposed by Sali-i-Martin (1997). We supplement our robustness analysis by asking whether more recent (post-sample) experience is consistent with our results.

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Introduction

In Ghate and Wright, 2012 (henceforth GW) we used a panel dataset of annual output data, disaggregated into 14 industrial sectors and 15 major states, to identify a common factor that summarises well the properties of the Indian growth turnaround. We dubbed this common factor the "V-Factor".

The downward-sloping segment of the "V" captures the period of the "Hindu Rate of Growth", during which, in virtually all states and sectors, growth was so weak (or, in some cases, non-existent) that output per capita fell progressively relative to the global frontier (proxied by the USA). In contrast the upward-sloping segment (from around 1987) captures the turnaround, after which significant numbers of output series showed sufficiently high growth that they were converging relative to the USA.

In GW we showed that the timing of the turnaround implied by the V-Factor estimated on disaggregated data was closely related to the pattern of policy reforms (particularly trade liberalisation). Our results matched the time path of reforms much more clearly than had been found in previous research, which had mainly analysed aggregate data.

However we also showed that participation in the turnaround at state level was distinctly uneven. A number of states showed little or no tendency to a pickup in growth between the lowpoint of the "V" in 1987 and the end of our sample period, in 2004.

In GW we used our panel dataset to attempt to provide some regression-based evidence that shed at least some light on the disparate nature of statewise participation in the turnaround, by finding regressors at the state level that appeared collectively to explain statewise variation. However while we found some evidence of collective explanatory power, there was a limit to how much we could say about individual indicators using conventional regression analysis.

In this paper we supplement the findings in GW in two ways.

First, we provide evidence of the robustness of the relationship between individual indicators and participation in the turnaround. We follow a methodology originally suggested by Sala-i-Martin (1997) in relation to the econometrics of growth. It is well-known that the number of potential regressors in cross-sectional regressions far exceeds the number of regressors that can feasibly be included in any given growth regression: thus in statistical terms we simply have too many explanatory factors. A similar problem arises in our dataset: we wish to explain the range of experience across 15 states, but we have (far) too many potential state-level indicators to isolate the effects of each of these.

Following Sala-i-Martin's approach, we address this problem by running large numbers of regressions that differ according to the subset of potential explanatory factors that are included. We then examine the distribution of coefficients on individual state-level regressors in all such regressions. If a large part (or all) of the distribution of the resulting coefficients lies to the right (or left) of zero, and the coefficient is on average statistically significant, we follow Sala-i-Martin in taking this as evidence that the indicator has a robust positive (or negative) relationship with the growth turnaround in individual states.

The second contribution of this paper is to provide a provisional assessment of experience since the end of our dataset, in 2004. Strikingly, several of the states that had not participated in the turnaround from the outset have grown much more rapidly in more recent data, such that, since 2004, *all* major states have been converging on the global frontier (albeit still at distinctly different rates, such that the cross-sectional distribution of incomes still shows no sign of "sigma-convergence").

This recent pattern provides us with a rough-and-ready out-of-sample test of our techniques. We examine in particular the experience of the four poorest states, and show that this more recent pickup in growth is broadly consistent with shifts in state-level indicators that we had found to be robust on our earlier dataset: most notably, a falling dependence on agriculture, and strong improvements in literacy. But we have to acknowledge that our available indicators cannot fully explain the *relative* patterns of success: why, for example, Bihar has grown so much more rapidly since 2004 than Assam, remains a puzzle.

The "V Factor"

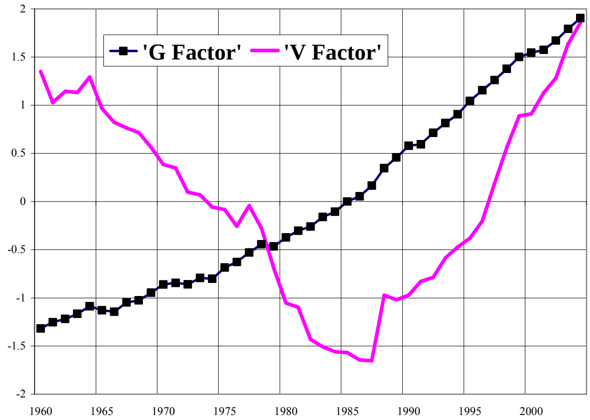
Figure 1 summarises the key results in GW. We used principal components to derive 2 common factors that summarise well the key properties of the dataset of up to 207 output series, disaggregated by both sector and by major state. The first principal component, which we dubbed the "G Factor" captures long-term growth at a rate which changes little throughout the sample. The second principal component, which we dubbed the "V Factor", captures both the period of relative decline of the "Hindu Rate of Growth", from 1960 to the mid-1980s,[3] and the subsequent turnaround, from a lowpoint in 1987. Each of our output series can be represented as a linear combination of the two factors, G_t and V_t, plus an idiosyncratic component, ie, for the ith output series, we can write

$$y_{it} = \alpha_i + \beta_{iG} G_t + \beta_{iV} V_t + \omega_{it}$$

The first "factor loading" β_{iG}, captures the long-term growth trend in the ith output series, via the G Factor, the second factor loading, β_{iV}, captures the impact of the V Factor, and ω_{it} captures the remaining idiosyncratic variation. Output series with a positive value of β_{iV} participated in the turnaround, with a degree of strength captured by the size of β_{iV} , whereas those series with β_{iV} close to zero, or negative, did not participate in the turnaround. In GW we showed (see GW Figures 5 and 6) that these two common factors capture well a large part of the pattern of growth shifts both across states and sectors.

[3] In GW we also reported results from shorter samples, with larger numbers of states; results are very similar.

Figure 1. Common Factors in Indian Output*



*First and second principal components derived from 139 real net national product per capita series, disaggregated into 14 sectors and 10 major states.

Figure 1 shows that the lowpoint of the "V", in 1987, implies that the turnaround started distinctly later than had been identified by a number of authors (see, for example, Rodrik and Subramanian (2005); Virmani (2006); Balakrishnan and Parameswaran (2007)), who had based their analysis on aggregate data. In GW we noted that this makes the pattern of the turnaround much more consistent with what we know about the historic pattern of reforms. In particular (see GW Figure 7) we showed that there was a strongly negative correlation between the V Factor and the average tariff rate, implying a particularly significant role for international trade liberalisation.

Uneven Participation in the Turnaround

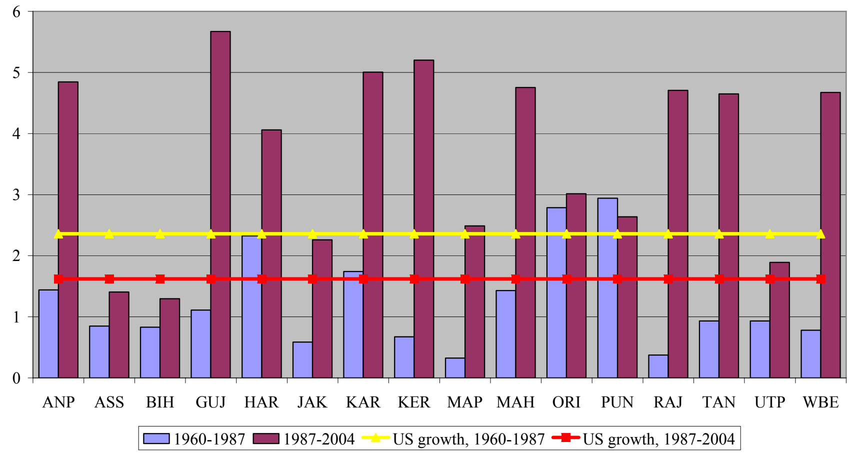
Figure 2 summarises a key feature also identified in GW: namely, the uneven nature of the growth turnaround across Indian states. Figure 2 shows output growth in two sub-samples for the 16 major states, which collectively represent 97% of the Indian population.[4] We split our data sample at the point identified as the start of the turnaround at the low point of the V Factor, in 1987, as shown in Figure 1.

The chart displays very clear dividing lines, both across time and across states. They are most revealing if expressed in terms of convergence towards the global frontier, which we proxy by the USA. Figure 2 also shows growth rates of the equivalent measure of US output per capita over the same sub-samples. Using this as the benchmark, only three Indian states, Haryana, Punjab and Orissa, showed any tendency to even marginal convergence in the first sub-period: they would be better described as just holding their own.[5] The remaining states were all growing less rapidly than the frontier - indeed some, like Madhya Pradesh, were barely growing at all - so that almost all were actually diverging systematically from the global frontier.

[4] We have made adjustments to output series to allow for changes in state definitions. The sixteen states are: Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Jammu and Kashmir, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.

[5] Of these three states, closer inspection of the data shows that the fastest growing state, Orissa, had shown extremely rapid growth during the 1960s, but thereafter showed no tendency to converge.

Figure 2. Growth in Per Capita Real NDP, by State



For the majority of states the contrast in the second period is very striking. Nine states (Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu and West Bengal) had per capita growth rates in the neighborhood of 4% to 5%, and were thus unambiguously converging; two others, Madhya Pradesh and Jammu & Kashmir, achieved significant shifts in growth, but from such a low base that they were still at best barely converging (partly due to a somewhat lower rate of growth in the USA). In the remaining states, however, growth remained at a similar rate to that in the previous sub-period. Within this group three states, Punjab, Orissa and Uttar Pradesh did achieve modest rates of convergence; but Assam and Bihar continued to lose ground.

This very disparate pattern has significant welfare implications. In GW we noted that the differences in growth rates of output growth must, with high probability, have corresponded to significant differences in consumption growth.

Regression-Based Evidence of Correlates of Statewise Participation in the Turnaround

In GW we showed that the variation in state-wise participation in the growth turnaround is strongly significant statistically. We ran simple cross-sectional regressions where the dependent variable is the change in the average growth rate of our 207 state-sectoral real NDP per capita series[6] between the two sub-samples 1970-87 and 1987-2004. If dummy variables for both individual sectors and for individual states are included, both sets of dummies are strongly significant, both in combination and in isolation (for details, see GW Table 3).

In GW we also investigated whether identifiable state characteristics can account for the disparate performance across the states. We retained the sectoral dummies, but included 11 different state characteristics (all measured just before the turnaround), in

[6] Observant readers may note that, with 15 states and 14 sectors we should have had 210 series in all; however we had to discard 3 series due to clear data problems.

place of the state dummies.[7] The overall goodness of fit of the resulting equation barely differs from the regression with state dummies: that is, the state-level regressors jointly explain all significant variation across states. However, we also showed (see GW Table 3, equation (4)) that most individual regressors in this regression are statistically insignificant. This is unsurprising since we have nearly as many regressors as states,[8] and the regressors are mostly quite strongly mutually correlated. Thus it is hard to say with any precision, from regression evidence alone, which state-level indicators are doing the work of explaining statewise participation in the turnaround. For a number of indicators it is not even possible to identify the sign of the relationship.

Robustness Evidence of Correlates of Statewise Participation in the Turnaround

We can supplement the findings in GW by following a line of research first proposed by Sala-i-Martin (1997) in the context of growth regressions. When there is an excess of explanatory factors, regression analysis may produce many different specifications with a very similar degree of explanatory power, but each with a somewhat different list of regressors. Sali-i-Martin proposed a resolution: simply estimate *all* possible regressions, each with a different combination of regressors, and then examine the properties of the coefficient estimates on different regressors, in all of the resulting regressions. If a given indicator turns out to have a notional significance level (as captured by the *p*-value, or a *t*-test of the null hypothesis that the coefficient is zero[9]) that is consistently strong, and of one sign, then this indicator is deemed to be "robust".

We consider the same set of state-level indicators as in GW, all measured before or at the turnaround in growth, as shown in Table 1

All the series, apart from the last, are taken from a new panel dataset for Indian states assembled by the authors comprising roughly 200 regional economic and social indicators for Indian states. A detailed description of the variables in this dataset is available in Ghate and Wright (2008).

As in GW, each of the regressions carried out in this exercise again has as dependent variable the change in the average growth rate of our 207 state-sectoral real NDP per capita series between the two sub-samples 1970-87 and 1987-2004. In each regression we also include dummies for each of the 14 industrial sectors. We then include 5 state-level regressors. The first is the variable of interest. The second and third are always two "top tier" regressors: the shares of agriculture and registered manufacturing, since in GW we found these always to be significant. The remaining two "second tier" regressors are picked from the set of the remaining 8 regressors.

[7] We cannot include a full set of both state dummies and state characteristics, since in a cross sectional regression the resulting matrix of regressors would be singular. Note that there are no obvious sectoral regressors that would allow us to carry out a similar exercise across the sectors.
[8] Note that, despite the fact that we have 207 observations, the best we can possibly hope to do with state-level regressors is to match the explanatory power of the state dummies. If we had 15 indicators, we would be able to match precisely the fit of the regression with dummies. Even with only 11 indicators, the fit is virtually identical – indeed the R-Bar-Squared of the regression actually increases somewhat, due to the increase in degrees of freedom.
[9] The significance level is notional because the methodology is clearly not consistent with classical hypothesis testing.

We then carry out a regression for every combination of two out of eight possible regressors: thus we run 28 regressions including each "second tier" indicator; and a total of 252 (28 times 9) regressions for each of the "top tier" indicators.[10] Given the strong mutual correlations between our regressors, 5 regressors virtually always captures the great majority of the state-wise variation.[11]

Table 1. State-level indicators included in robustness analysis

A. Solow/Malthus Indicators

Real income per capita, 1987
Population Growth, 1971-1981
Population Level, 1981

B. Climatic and Geographical Indicators

Average rainfall, 1983-87
Dummy for landlocked states (equal to unity for all series for Assam, Bihar, Haryana, Madhya Pradesh, Punjab, Rajasthan, Uttar Pradesh, and zero otherwise)

C. Social Indicators

Urbanisation in 1981 (%)
Literacy Rate in 1981 (%)

D. Composition of Output

% Share of Agriculture, 1987
% Share of Registered Manufacturing, 1987

E. Other indicators

Development spending as % of output (1981)
Aghion, Burgess, Redding, and Zilibotti's (2008) "pro-worker" dummy.

Table 2 and Figure 3 summarise the results of this exercise.

Figure 3 plots the frequency distribution, for each of the potential explanatory factors across all regressions including this factor, of the *t*-statistic on the indicator that tests the (notional) null hypothesis that the coefficient is zero. Recall that, to a good approximation, in a classical hypothesis test, the null hypothesis is rejected at conventional significance levels if this statistic is greater than 2, or less than -2. Thus, if an indicator is robust, it will tend to have a high proportion of *t*-statistics that are

[10] This is a rather modest number compared to the 30,856 regressions per indicator - 2 million in total - run by Sala-i-Martin.
[11] For more than 9 out of 10 such regressions the implied F-test of the restrictions against the equation with the full set of state dummies is not rejected at a notional 5% level

(notionally) significant on this measure; and at a minimum will have all coefficients (and hence *t*-statistics) of the same sign.

Table 2 provides a range of summary statistics of the distribution of *t*-statistics. The final column follows Sala-i-Martin (1997) in deriving the average of the analytical cumulative distribution functions evaluated at zero: i.e., for any regression we calculate the (notional) implied probability that the associated coefficient is less than zero (assuming a normal distribution, hence using only the coefficient estimate and its calculated standard error). A number close to zero (or 1) implies a very low (or very high) notional probability that the coefficient is negative. A number close to 0.5 implies a roughly equal probability that the coefficient is positive or negative.[12] Table 2 shows the average of these calculated probabilities across all regressions.[13]

The first panel of Figure 3 shows the results for the "Solow/Malthus" indicators often included in growth regressions, and provides a clear demonstration that these indicators are *not* robust explanatory factors of participation in the turnaround.

In a conventional growth regression, the initial level of output is expected to be negatively correlated with subsequent growth if there is convergence between the different output series. The first plot in Panel A shows that, in contrast, in our regressions, the coefficient on output is more or less symmetrically distributed around zero. Thus, while these regressions provide no evidence in favour of convergence between the Indian states (consistent with other evidence, see refs), nor do they provide evidence that the growth turnaround was simply restricted to a club of richer states (a feature that can also be inferred directly from the disparate performance of both rich and poor states illustrated in Figure 2).

Figure 3 shows that there is a similar lack of robustness in the evidence for a role for population growth, as would be implied by a conventional Solow growth model, with coefficients again of both signs, depending on the specification of the regression. There is somewhat more evidence, albeit still very weak, for a role for the *level* of the population; but, while the coefficient on population is always negative (indicating that large states tended, other things equal, to have a below-average shift in growth), only a small proportion of the associated *t*-statistics are even close to being notionally significant (Table 2 shows that the lowest *t*-statistic in all the regressions is -1.86).

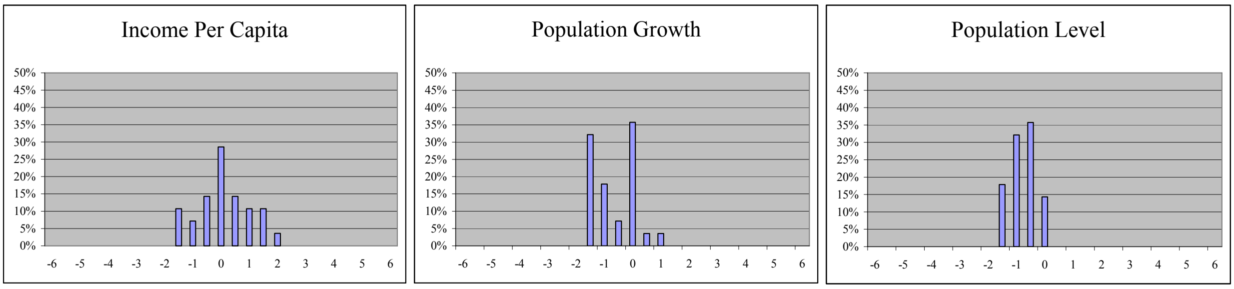
[12]We differ slightly from Sala-i-Martin in our presentation of this statistic. For any calculated probability less than 0.5, he uses 1-CDF(0), rather than CDF(0), so that whereas our probability ranges between zero and 1, his ranges between 0.5 and 1. Thus in Sala-i-Martin's calculations, a figure close to unity implies a strongly robust indicator, irrespective of sign.

[13] These figures should be viewed as useful summary statistics rather than anything resembling a true probability, given that a) the true distribution may not be normal and b) we are, as noted above, a very long way from the classical hypothesis testing framework. Note that, given the nonlinearity of the normal cumulative distribution function, any *t*-statistic greater than around 3 in absolute value implies essentially a zero probability that the true coefficient is zero.

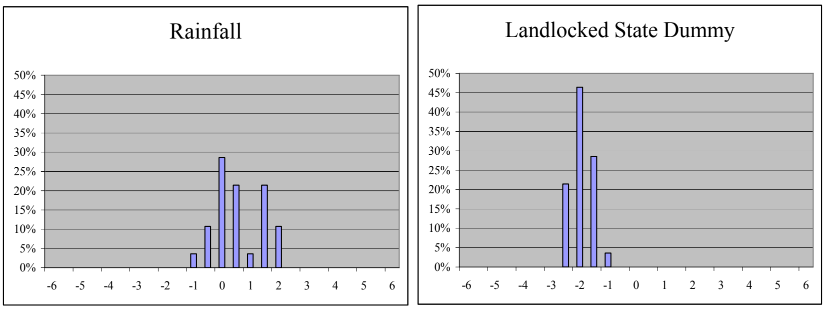
Figure 3. Robustness of state-wise correlates of the growth turnaround

Frequency distribution of t-statistics of coefficient estimates across different regressions*

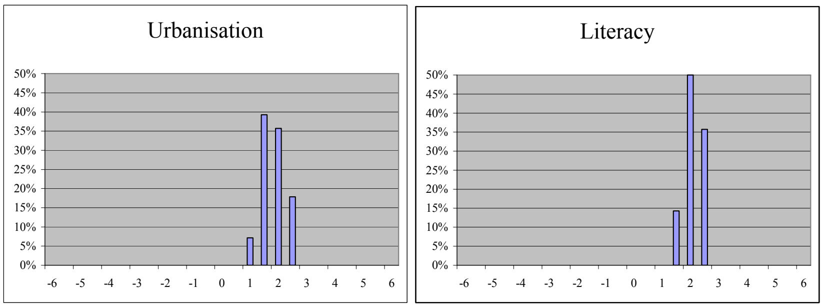
A. "Solow/Malthus" Indicators



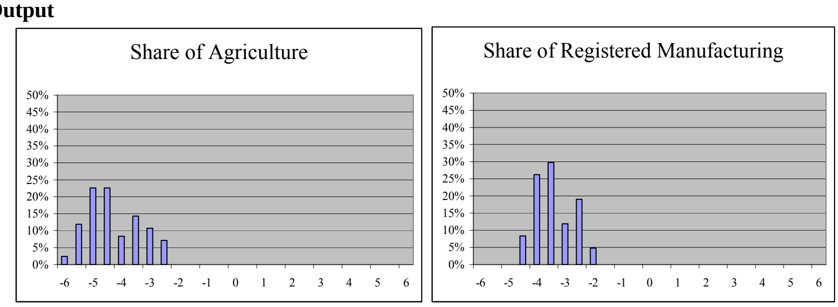
B. Climatic and Geographic Indicators



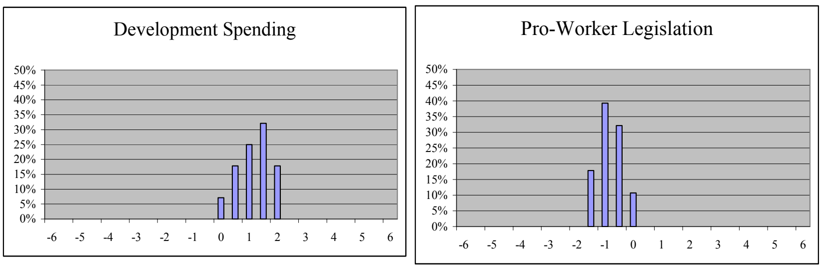
C. Social Indicators



D. Composition of Output



E. Other Indicators



* Dependent variable in all regressions is change in average log growth in state-sectoral real NDP per capita between 1970-87 and 1987-2004.

Table 2. Summary properties of coefficient estimates

Regressor	% negative coefficients	% positive coefficients	minimum t-statistic	maximum t-statistic	average t-statistic	average CDF(0)*
share of agriculture, 1987	100%	0%	-6.12	-2.76	-4.53	1.00
share of reg. manufacturing, 1987	100%	0%	-4.92	-2.21	-3.64	1.00
real state income per capita, 1987	61%	39%	-1.75	1.59	-0.18	0.56
% urban population, 1981	0%	100%	0.63	2.47	1.57	0.07
literacy rate, 1981	0%	100%	1.25	2.40	1.86	0.04
average rainfall, 1983-1987	43%	57%	-1.33	1.94	0.33	0.41
Aghion et al's pro-worker dummy	100%	0%	-1.71	-0.04	-1.08	0.84
landlocked dummy	100%	0%	-2.72	-1.47	-2.19	0.98
population, 1981	100%	0%	-1.86	-0.08	-1.05	0.83
population growth, 1971-1981	93%	7%	-1.79	0.83	-0.86	0.76
development spending, % of NDP, 1981	7%	93%	-0.27	1.73	0.91	0.21

* Average across all regressions of analytical CDF(0), given coefficient estimate and associated standard error, assuming normality (see Sala-i-Martin, 1997)

Panel B of Figure 3 shows a more mixed picture for the very limited indicators we have of geographical and climatic characteristics. While there is no evidence for any robust relationship with between the growth turnaround and rainfall (as a proxy for exogenous factors affecting agriculture in particular) there does appear to be a reasonably robust negative relationship with a simple (0,1) dummy variable that indicates whether a given state is landlocked. Given the evidence we reported above from GW that movements in the V Factor were strongly correlated with trade liberalisation measures, it is perhaps unsurprising that states with less easy access to ports may have been at a disadvantage, at least initially, in reaping the benefits of trade liberalisation.

Panel C of Figure 3 shows that there is reasonably robust evidence that both social indicators, urbanisation and literacy rates, were positively correlated with participation in the turnaround. For both indicators, Table 2 shows that coefficients were always positive, and there was a reasonably high proportion of notionally significant coefficients, with *t*-statistics greater (although not much greater) than 2. But, while the sign of coefficients of both indicators is clear, it is equally clear that the explanatory power of both is relatively weak (possibly because both are quite strongly correlated with other indicators).

Panel D of Figure 3 shows that, as noted above, there is a much stronger evidence of robustness *and* explanatory power, for our two measures of the composition of state output.

Figure 3 shows evidence that the sectoral share of agriculture in any given state's output is very strongly negatively related to participation in the turnaround. Note that this impact does not reflect any direct effect of the resulting high weight of agriculture in dampening growth of state NDP (given the relatively low growth rate of agriculture), since the regression results give each sector an equal weight. Rather it suggests that the mere fact that a state was predominantly agricultural was itself an obstacle to that state's participation in the turnaround in growth across all sectors.

A more surprising feature of the results is that there was also a strongly negative impact of the share of registered manufacturing. This result directly contradicts those of Rodrik & Subramanian (2005). They posited that the impetus for the turnaround (which, it will be recalled, they dated significantly earlier), was a shift to a probusiness orientation, which they proxied in their regressions by the share of registered manufacturing in aggregate state level data. Our results suggest that, far from having a positive effect on subsequent growth, a high share of registered manufacturing in any state just before our later estimated turnaround date actually appears to have had a significantly negative effect on growth in that state. This is clearly more striking than if it simply played no role at all.

We can only really speculate about the explanation for this negative correlation. Our best guess is that it ties up with the negative role of the state in general. Panagariya (2004) makes the forceful point that even in recent years government intervention in registered manufacturing remains extensive. If the bulk of the capital in the manufacturing sector is owned by the public sector, this makes it immobile (Marathe, 1986), keeping capital-output ratios inefficiently high. Also, if there are restrictive labour laws, private and public firms cannot fire their employees, and so inefficient labour continues to be employed (see Bhattacharjea, 2006), leading to output losses. But the evidence from Figure 3 is also consistent with evidence on the growth performance of the registered manufacturing sector itself, which was a consistently underperforming sector, across all states (see GW Figure 5). Our analysis therefore suggests that the Indian growth turnaround is not manufacture-driven, whereas most historic accelerations in output have been associated with strong growth of the manufacturing sector (Hausman et al, 2005). Paradoxically, the weak performance of manufacturing suggests that, given sufficient liberalisation, there may yet still be considerable slack in the turnaround, with the possibility for growth to further increase.

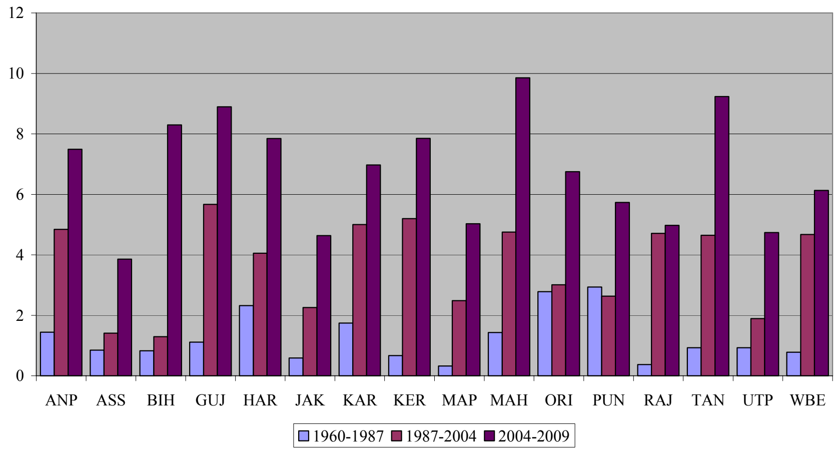
Finally, Panel E of Figure 3 provides further, if rather weaker evidence, of the mixed role of government intervention in impacting on any given state's ability to participate in the turnaround. It shows that there is very little evidence of any positive role for development spending in the turnaround: while coefficients are predominantly positive, they are, at very best, of marginal notional significance. At the same time there is somewhat stronger (but still quite weak) evidence that intervention in the labour market, as captured by Aghion et al's (2008) "pro-worker" dummy variable, had a negative effect on participation in the turnaround, consistent with Aghion et al's results.

Insights from more recent experience

One unintended consequence of the long lags involved in bringing academic research to final publication in a journal is that, very commonly, the datasets used are already more than a little out of date by the time the research is actually published. Our research is no exception. The full dataset used in the original GW publication, and which we used to conduct the robustness exercise summarised in the previous section of this paper, runs only up to 2004. While we have not been able to update the entire dataset, we do have at least some evidence for more recent years. This provides a natural (albeit only partial) out-of-sample cross-check on the results reported above. This test is all the more powerful, because the growth experience of the Indian economy in more recent years appears to have entered another phase.

Figure 4 supplements the information shown in Figure 2 above, to include data on growth rates of the 16 major states between 2004 and 2009. It shows that, in contrast to both earlier periods, in this more recent (albeit distinctly shorter) period, *all* major states have achieved sufficiently strong growth rates to put them on convergent paths relative to the USA.

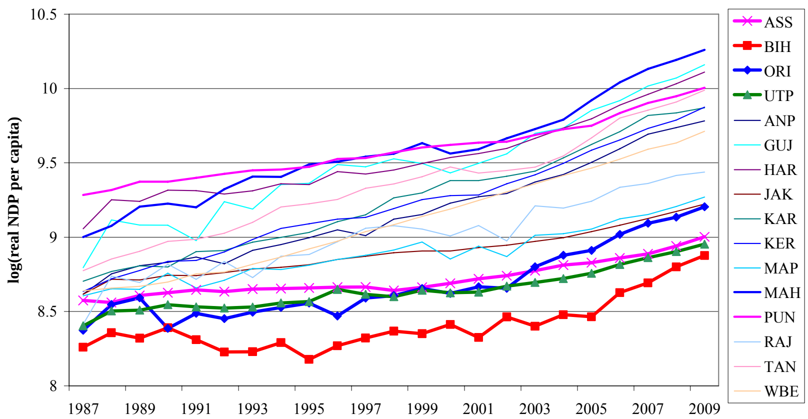
Figure 4. Growth in Per Capita Real NDP, by State



All states have also seen increases in growth, relative to the period 1987-2004, even those starting from a high base. Some increases have been very dramatic. Even the smallest shift in growth in recent years, in Rajasthan, had been preceded by a large shift in the period 1987-2004, thus giving a very strong overall growth performance since 1987.

Crucially, in terms of welfare, the four poor-and-slow-growing states identified in our earlier sample period have all shifted towards strong growth in the most recent period. This is most striking in the case of Bihar, which saw an increase of a full 7 percentage points in its average growth rate, with the result that recent years have seen the striking, and unprecedented phenomenon of the poorest (Bihar) and richest states (Maharashtra) growing at very similar rates.

Figure 5. Per Capita Real Output in the 16 Major Indian States



More generally, however, the fact that growth rates have increased across the board means that, despite the sharp increase in growth rates in the poorer states, the gap between rich and poor states has not in general been narrowing: indeed the cross-sectional standard deviation of output levels has actually increased somewhat. This should not in itself be surprising. As Figure 5 shows, the faster-growing states in the period 1987-2004 have typically grown even faster in more recent years, and hence are converging even more rapidly on the global frontier. If it is not premature to put an optimistic interpretation on just five years' worth of additional data, it appears that the poor-and -slower-growing states in 1987-2004 have now shifted towards a convergent path, but (for 3 out of 4) at rates closer to those seen by the faster-growing states over the period 1987-2004.

In Fic, Ghate and Wright (2010) we offered an explanation of the earlier experience of the growth turnaround that also appears consistent with this more recent experience. In a standard growth framework a rise in growth can in principle arise as a result of a shift in the long-run equilibrium level of output, or as a result of a more rapid rate of convergence to a given long-run equilibrium. The liberalisations from the centre that started in the late 1980s affected all states; hence we argued that they should in principle have affected long-run equilibrium levels of output largely symmetrically across the states. That being the case, other things being equal, we would have expected to see a symmetric participation in the turnaround. That we did not see this, we argued, must have reflected a very disparate pattern of frictions in different states, which impeded some states from being able to participate in the process of convergence to a new equilibrium. The evidence of the previous section suggested (with varying degrees of robustness) that states with lower shares of agriculture and registered manufacturing, higher literacy and urbanisation, and better access to ports, were better equipped to adjust towards the new equilibrium.

Are recent shifts in growth in this group of previously slow-growing poor states compatible with this argument? That is, have there been shifts (in the correct direction) in state-wise indicators that appeared in our earlier analysis to be correlated with relatively stronger growth? On the basis of the few indicators we have been able to update, we can tentatively answer in the affirmative, at least in terms of this group of states taken together. The data are however less revealing about their relative performance.

Figure 6 shows that, by 2004, all four states had, to varying extents, significantly reduced their dependence on agriculture. Figure 7 shows that in recent decades all four had also seen strong increases in literacy.

Figure 6. % Share of Agriculture

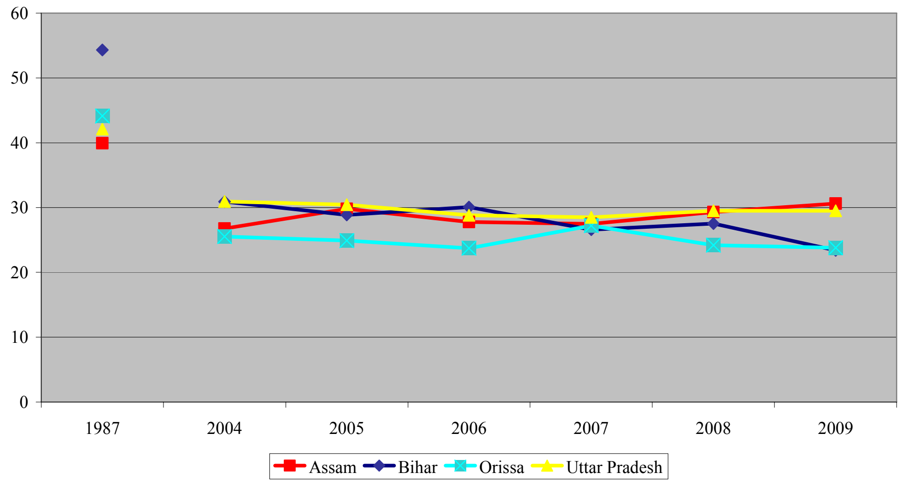
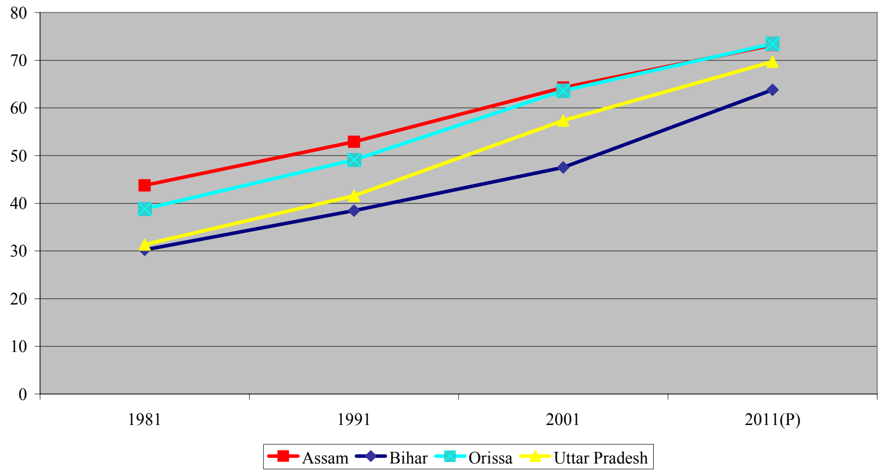
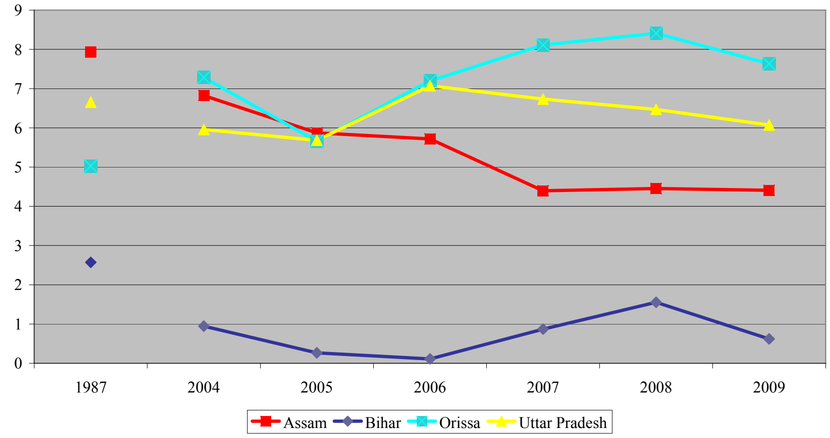


Figure 7. Literacy Rates



There is less of a clear-cut relationship with the share of registered manufacturing; but this is perhaps not entirely surprising, since the original result may well have been specific to the particular time period. But it is striking that all four states have managed strong growth with shares of registered manufacturing that have remained both low and, at best, flat: thus it is at least clear that registered manufacturing has had little or no *positive* role to play in the growth turnaround in these state

Figure 8. % Share of Registered Manufacturing



The evidence of Figures 6 to 8 appears consistent with the robustness results of statewise indicators for the earlier period, summarised in the previous section, in the sense that, on the basis of recent shifts in these indicators, all four states would have been predicted to have grown more rapidly, and have indeed done so. It also appears consistent with our arguments in Fic, Ghate and Wright (2010), that, these shifts have corresponded to reductions in frictions that had previously impeded convergence to a new long-run equilibrium.

However, we cannot make excessive claims on this score, since the *relative* size of growth shifts is not well explained by these developments. For example, these indicators do not do much to help us to explain why Bihar has been so much more successful in increasing its growth rate than have Assam or Orissa.[14] But part of this may reflect the fact that the analysis above solely relates to aggregate state figures, whereas our econometric results relate to the disaggregated data.[15] If we were to repeat our exercise on more recent disaggregated data, this might (but of course might not) tell us more about the relative success of different states in more recent periods. We would encourage other researchers to pursue these issue further.

[14] It is true that Bihar had, by 2004, seen the largest *fall* in the share of agriculture in output; but the share was still high (though it continued to fall subsequently). And despite strong improvements in literacy, it still has the lowest rate of this group of states.

[15] Thus even using the original dataset and sample, with output disaggregated into states and sectors, the state dummies convey essentially the same information as the total effect of the state-wise indicators (by construction they cannot convey less). But there is by no means a perfect match between these state dummies in disaggregated data, and relative growth shifts in *total* state output.

Conclusions

In Ghate & Wright (2012) we used a disaggregated dataset of state-sectoral real output per capita to identify a turning point in Indian output per capita around 1987. But we also noted the uneven participation of Indian states in the growth turnaround, at least up until the end of our dataset in 2004. In this paper we have extended our earlier work on the same dataset by using an approach suggested by Sala-i-Martin (1997) to test whether the relationship between a range of state level indicators has a robust relationship with participation in the turnaround, by examining the distribution of coefficients on a given indicator in a wide range of econometric specifications. Those indicators with coefficients all of one sign, and predominantly strong notional statistical significance, are deemed robust.

Both our negative and positive results using these techniques are revealing. On the negative side, we find no evidence either of convergence *or* divergence between the Indian states: thus participation in the turnaround appears to have been unrelated to initial income level. Nor do demographics appear to have played a role. But we do find strong evidence that states with a high share of agriculture participated less in the growth turnaround; in contrast higher literacy, urbanisation, and access to ports all appear to have been helpful (albeit that the evidence for some of these characteristics, while unambiguous as to sign, is distinctly less strong in terms of explanatory power).

Our results suggest that the role of the state in the turnaround was at best ambiguous; indeed the balance of evidence (most notably a negative link between the share of registered manufacturing and participation in the turnaround) suggests a negative role. This seems consistent with our earlier findings (Ghate & Wright, 2012) that the timing of the turnaround appears strongly linked to liberalising policies.

Our full dataset runs only to 2004. Since then participation in the turnaround appears to have widened significantly, most significantly in some of the poorest and previously slow-growing states. On the basis of partial evidence on state-level indicators for more recent years, this recent growth performance appears broadly consistent with our earlier results.

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