Structural Change and Growth in India

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February 10, 2010

Abstract

This paper examines the link between structural change and growth in India. It constructs indices of structural change, and performs a time series analysis of the data. It finds that 1988 marks a break in the time series of growth and structural change. There is one-way causality from structural change to growth in the period 1988-2007, whereas there is no evidence for this linkage before 1988.

JEL classification: O1, O5
Keywords: Indian economy; structural change; growth; causality

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INTRODUCTION

The Indian economy has been one of the world's star growth performers in recent decades. Debates about its growth process have focused on the timing of changes in the trend rate of growth, with implications for judgments on the efficacy of market-oriented reforms (e.g., Panagariya, 2008), and on the nature of that growth in terms of skill-intensity (e.g., Kochhar et al, 2006) and services-intensity (e.g., Singh, 2006), with implications for it future pattern and sustainability. This paper examines the link between structural change and growth in India. It constructs indices of structural change, and performs a time series analysis of the data. It finds that 1988 marks a break in the time series of growth and structural change. There is one-way causality from structural change to growth in the period 1988-2007, whereas there is no evidence for this linkage before 1988. By establishing the nature of the link between structural change and growth, this analysis provides new insight into the growth process in India at the aggregate level.

DATA AND METHODOLOGY

We start by describing the two variables we use in the analysis, namely growth rates and structural change indices. Growth rates are calculated from National Accounts gross domestic product (GDP) data.[1] The data cover the period from 1951 to 2007 at 1999-2000 prices[2]. For structural change, two different indices are calculated, following Dietrich (2009). The first is the simplest measure of structural change, the Norm of Absolute Values (NAV)[3]:

$$(1) \qquad NAV = 0.5\sum_{i=1}^{n} | x_{it} - x_{is} |$$

[1] The data were obtained from the *Reserve Bank of India's* website, www.rbi.org.in.
[2] More detail regarding the data is given in the Appendix B.
[3] Also called the Michaely-Index (Michaely, 1962) or Stoikov-Index (Stoikov, 1966)

For its computation first the differences of the sector shares x_i between two points in time s and t are calculated.[4] Then the absolute amounts of these differences are summed up and divided by two (since each change is counted twice).

The second index is the modified Lilien index (MLI). The Lilien (1982) index originally measured the standard deviation of the sectoral growth rates of employment from period s to period t. Stamer (1999) modified this index in order to fulfill the characteristics of a metric. The MLI is constructed as follows:

$$(2) \qquad MLI = \sqrt{x_{it}.x_{is}\left(\ln\frac{x_{it}}{x_{is}}\right)^2} \quad \text{where } x_{is} > 0 \text{ and } x_{it} > 0.$$

The use of two indices allows us to check the robustness of our analysis with respect to the structural change measure. We constructed two annual series of structural change for the Indian economy, one for each index.

We begin with a VAR analysis of growth and structural change. The lag length is determined by the Schwarz Information Criterion (SIC) which indicates a lag of one period.[5] The VAR analysis does not indicate any significant coefficients for the period from 1951 to 2007. A possible explanation for this insignificance is structural breaks (Wallack, 2003; Balakrishnan and Parameswaran, 2007), and so we look for a structural break in the growth rate series, innovating by allowing for structural change to affect growth. We continue our investigation after splitting our period into two sub-periods at the structural break.

The standard test for structural change (Chow, 1960) requires the assumption that the break date is known a priori (Hansen, 2001). One potential solution to this problem is to treat the break date as unknown, carry out the procedure for all the possible years and then select the largest statistic over all possible break dates. However, there may also be

[4] Sectoral shares are calculated for two disaggregations of the GDP data. In the first disaggregation, there are three main sectors, namely agriculture, industry and services. In the second disaggregation, there are nine subsectors (Appendix B). We report the latter results here – the more aggregate results are qualitatively the same.

[5] The Akaike Information Criterion (AIC) also indicates to one lag. By using SIC, we penalize the models having higher number of parameters more strongly.

multiple breaks in the data. Therefore, we follow Bai and Perron's (1998) test procedure for multiple structural breaks. The first step tests for a single structural break taking the entire sample. If the test rejects the null hypothesis that there is no structural break, the corresponding year is taken as the candidate break date and the sample is split into two sub-periods around that year. The test is reapplied to each sub-sample. If we find a break date in any of the samples, the entire sample is split around this new candidate break-date and two new subsamples are tested for structural breaks. This sequence continues until each subsample test fails to find evidence for a break (Hansen 2001).

We estimate the equation $G_t = \alpha + \beta H_{t-1} + \gamma G_{t-1} + \delta_T DU_{Tt} + u_t$ where G denotes the growth rate, H represents the structural change index and u is the random disturbance term. The break is captured by DU_{Tt} , a dummy variable, which is 1 if $t > T$ and 0 otherwise. All values of T are tried, with breaks being identified by rolling F-tests. In the case of significant structural breaks, we replicate the VAR analysis in the subsamples in order to get some significant relation between growth and structural change indices. Assuming significant results from VAR analysis for the subsamples, we test for Granger causality between growth and structural change.

EMPIRICAL FINDINGS

We first present our findings from the results of the VAR analysis for the whole sample (Table 1), for both structural change indices.

Table 1: VAR Analysis, 1951 to 2007

	GROWTH		**MLI INDEX**	
Variable	**Coefficient**	**t stat**	**Coefficient**	**t stat**
Growth(-1)	0.04	0.02	-0.0001	-0.33
MLI(-1)	59.26	1.00	-0.10	-0.69
Constant	3.85	2.62	0.018	4.92

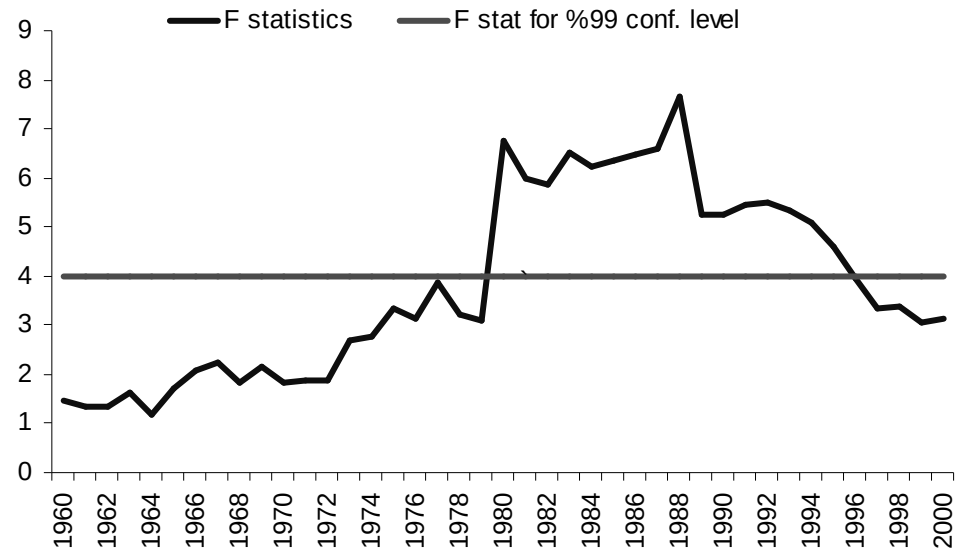
	GROWTH		**NAV INDEX**	
Variable	**Coefficient**	**t stat**	**Coefficient**	**t stat**
Growth(-1)	0.014	0.09	-0.00009	-0.27
NAV(-1)	82.85	1.27	-0.12	-0.82
Constant	3.43	2.25	0.018	5.36

As mentioned previously, no significant relation between growth and structural change is found for the period from 1951 to 2007. Hence, we next check for structural breaks in the whole sample. Exploiting the procedure described above, our results are presented here with the MLI index as the structural break measure. For robustness, we also did the same analysis with the NAV index.[6]

Structural Breaks for MLI Index

We initially find the year 1988 as a structural break over the whole sample of 1951-2007 (Figure 1). Furthermore, after splitting the whole sample of 1951-2007 into two, as 1951-1988 and 1988-2007, we continued to search for an additional break but found none.

Figure 1: Structural Break Test



Growth and Structural Change

The only structural break we find is the year 1988. Hence, we perform the VAR analysis once more to check whether a significant relationship between growth and the structural break indices exists in the period 1951 to 1988 (Table 2) and from 1988 to 2007 (Table 3). As seen from the tables, the only significant parameter is the coefficient of MLI(-1) in

[6] Results found by using NAV index can be found in the Appendix A.

the later period, at the 1% level, indicating that structural change positively affected growth in this period. Table 2 shows that there is no significant relationship between growth and structural change for the period 1951-1988.

Table 2: VAR Analysis, 1951 to 1988

	GROWTH		MLI INDEX	
Variable	**Coefficient**	**t stat**	**Coefficient**	**t stat**
Growth(-1)	-0.38	-2.00	0.00005	0.09
MLI(-1)	0.64	0.009	0.38	-0.09
Constant	5.46	3.13	0.015	3.71

Table 3: VAR Analysis, 1988 to 2007

	GROWTH		MLI INDEX	
Variable	**Coefficient**	**t stat**	**Coefficient**	**t stat**
Growth(-1)	0.28	1.38	0.0005	0.85
MLI(-1)	167.86	2.39	0.38	-1.73
Constant	2.38	1.32	0.015	2.82

Granger Causality Test:

We also performed a Granger causality test with the growth and MLI series. Table 4 below shows the results for this test.

Table 4: Granger Causality Test

Variable	**F stat**	**Prob. value**
"Growth" does not Granger Cause "MLI"	1.38	0.25
"MLI" does not Granger Cause "Growth"	7.99	0.009

Accordingly, the results indicate Granger Causality from "MLI of structural change" to growth which is consistent with the VAR analysis shown previously.

Robustness: NAV Index as a Structural Change Measure

We replicate our analysis and tests with the NAV index in order to check the sensitivity of our analysis to structural measure definitions. We find the same results: 1988 is the only structural break, and there is only one significant causality relationship from structural change (NAV) to growth (Appendix A).

Robustness: 1980 as the Structural Break

As seen in Figure 1, 1980 has the second highest F-statistic, which makes it a potential candidate for the year of structural break. We replicated all our analysis for the period of 1980-2007 and obtained the same significant impact from structural change to growth.[7]

Hence, our result is robust both to different structural change indices, and to the structural break year employed in our analysis.

CONCLUSION

Our results show that India's economy has only one structural break, which is at 1988, for the period from 1951 to 2007. This structural break allows us to identify a significant positive impact from structural change to growth, but only in the latter period. Furthermore, there we find Granger Causality from structural change to growth for this period, 1988 to 2007. However, there is no such relationship for the period 1951-1988. Therefore, one of the sources for increasing growth rates observed in the last two decades is the structural change of the Indian economy.

[7] These results are available from the authors.

APPENDIX A: Analysis Performed with NAV Index (1988-2007)

Figure A1:

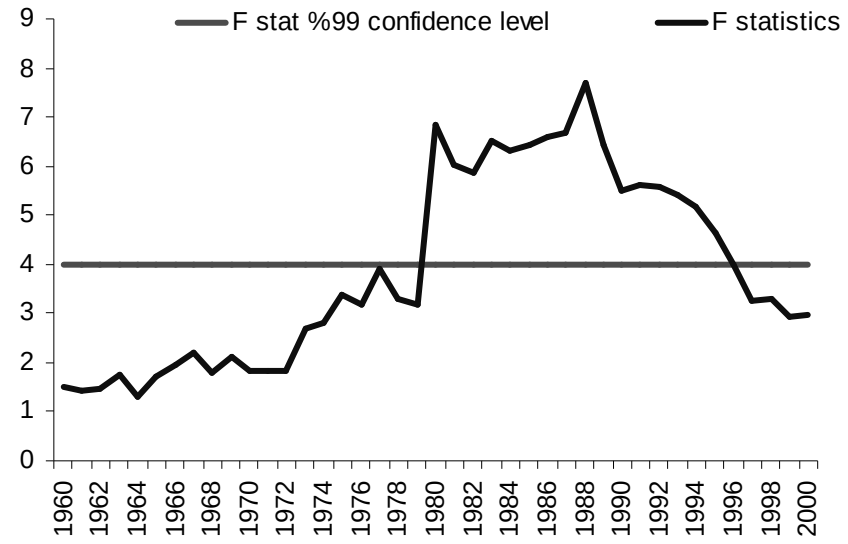


Table A1: VAR Analysis, 1988 to 2007

	GROWTH		NAV INDEX	
Variable	**Coefficient**	**t stat**	**Coefficient**	**t stat**
Growth(-1)	0.26	1.31	0.0006	1.15
NAV(-1)	205.16	2.56	-0.41	-1.96
Constant	1.90	1.02	0.016	3.39

Table A2: Granger Causality Test

Variable	**F stat**	**Prob. Value**
"Growth" does not Granger Cause "NAV"	1.66	0.21
"NAV" does not Granger Cause "Growth"	8.86	0.006

APPENDIX B: Data

GDP data have three main sectors and nine subsectors shown below:

- Agriculture and allied activities,
  - Agriculture
  - Allied activities
- Industry
  - Mining and Quarrying
  - Manufacturing
  - Electric, gas and water supply

- Services
    - Construction
    - Trade, Hotel, Transport and Communication
    - Finance, Insurance, Real Estate and Business Services
    - Community, Social and Personal Services

The time series cover 1950-1951 to 2007-2008. We have indicated this period as 1950-2007 for simplicity. The year 1950 is lost in growth calculations, so the study covers the period 1951 to 2007.

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