

TFPG in Manufacturing: The 80s Revisited

Establishing accelerated productivity growth in the 1980s is contingent on the use of single deflation, a procedure flawed in principle. There is no credible option to double deflation when working with value added as the output measure in physical terms.

P BALAKRISHNAN, K PUSHPANGADAN

Two studies on productivity growth in manufacturing have come to our attention since our last article [see Balakrishnan, Pushpangadan and Babu 2000] on the topic. As both these studies have expressly addressed a result originally reported by us in *EPW* [see Balakrishnan and Pushpangadan, henceforth 'B-P' 1994] we respond to them in the same space.

Goldar (2000) has provided fresh estimates of total factor productivity growth (TFPG) in the 1980s. Having discovered a positive rate of growth during the 1980s he has concluded that: "This paper has shown that the finding of B-P of a deceleration of TFP growth rates in the 1980s is essentially due to the choice of the base-year price index. When they use price indices with base 1981-82 rather than price indices with base 1970-71=100 their estimates of TFP also show a significant increase in the 1980s" (p 16). As Goldar has not undertaken a test for acceleration of the rate of growth of TFP in the 1980s, his claim to have 'shown' that there is no deceleration can amount to no more than a wish. However, what concerns us is that his claim constitutes a misrepresentation of our results and reveals a misunderstanding of our project. It is a misrepresentation, for our tests for an acceleration of TFPG in the 1980s had revealed no evidence of it irrespective of the base-year of the price series [for which, see the results presented in Table 3 of B-P (1994) and in Table 2 of B-P (1995)] used in the estimation of TFP. Indeed, apart from a change in the base-year of the price index, a shift in the weights for the materials-input deflator had also been incorporated in order to reflect the changing input-output matrix. Thus, we had, under the circumstances, put our estimates through a sensitivity test involving a change in both the base-year and the weights of the price index. Significantly, this is left

unacknowledged. Goldar's comment also reveals a misunderstanding, for our project had been to demonstrate that when the double-deflation procedure is adopted there is no evidence of an acceleration of TFPG in the 1980s. That the level of TFP has actually increased in the 1980s does not detract, as Goldar suggests, from our conclusion that there has been no such acceleration. Indeed, we might add, had we not found our estimates yielding an increase in productivity in the 1980s, we would not have so much as bothered to put the time series through a test for a switch in its rate of progress!

Even though we are quite sure of the implications of the estimates of TFP provided in our original article (B-P 1994), to clear the air, we have since conducted a test for acceleration using four alternative TFP series, all estimated by us. These are based on four combinations of prices and weights in the construction of the materials-input deflator used, exhausting the possibilities relevant to the period of analysis in B-P (1994) that are currently imposed by data availability. The four series differ solely according to the measurement of value added. While value added was measured by the double deflation method in all instances, the materials-input deflator had differed. The materials-input deflator combines the price of different materials using weights implied by input-output statistics (henceforth I-O) for Indian industry. Thus we have the following four combinations that were adopted in the construction of this deflator: (1) prices with base 1970-71 and weights from I-O 1973-74, (2) prices with base 1970-71 and weights from I-O 1983-84, (3) prices with base 1981-82 and weights from I-O 1973-74, and (4) prices with base 1981-82 and weights from I-O 1983-84. Estimates of TFP from real value added based on (1) and (4) have been presented in Table 2 of B-P (1994) and Table 1 of B-P (1995), respectively. Estimates of TFP from real value added based on (2) and (3) are available from us on request. In

Table 1 here are presented the results of tests for an acceleration of TFPG in the 1980s using these alternative estimates of TFP. Notice that there is no evidence of a positive turnaround and that this is independent (of the base year or weighting scheme) of the materials-input deflator used. Indeed, where there is evidence of a statistically significant shift in TFPG in the 1980s it is of a negative one, implying deceleration.

We would like to use this opportunity to point out an error in the reporting of our results in B-P (1995). There, in the 'Note' to Table 2, where results of a test for acceleration are presented, the reader is referred to the 'Note' to Table 1 for a description of the TFP series used in each of the reported regressions. In the 'Note' to Table 1 (B-P 1995), it was stated that "'B-P: II' is TFP based on real value added computed using 1981-82 prices and input coefficients for the year 1983-84". However, under the column heading 'B-P: II' in Table 2 (B-P 1995) reported were the regression results of having used TFP estimates based on real value added arrived at by using prices base 1981-82=100 weighted by input-output

Table 1: Testing for a Turnaround in the 1980s - TFP Estimates of Balakrishnan and Pushpangadan

Var\TFP Measure	(1)	(2)	(3)	(4)
Constant	4.33 (61.41)	4.33 (63.99)	4.29 (41.1)	4.33 (50.67)
D ₁	.60 (2.79)	1.00 (4.89)	-0.57 (-1.81)	-0.07 (-0.26)
Trend	0.05 (4.78)	0.08 (6.91)	0.03 (1.59)	0.05 (3.48)
D ₂	-0.06 (-3.16)	-0.09 (-5.50)	0.03 (1.32)	-0.01 (-0.46)
R ²	0.79	0.87	0.57	0.70

Note: t-ratios in parentheses. Period is 1970-71 to 1987-88. Regression is $y = a + bt$; where $y = \log$ TFP, $a =$ constant and $t =$ trend; D is a dummy taking on the value 1 for all the years starting 1980-81 and 0 for all the ones prior; D₁ = (D.a) and D₂ = (D.t). TFP measures (1) to (4) reflect use of the materials-input deflator as described in the text. Details of the data may be found in B-P (1994). Estimation done with PC-GIVE, Version 4.0.

(I-O) data for the year 1973-74. The results that ought to have appeared under the column heading 'B-P: II' in Table 2 of B-P (1995) are now reported under (4) in Table 1 of the present paper. As may be ascertained, it does not affect our argument in B-P (1995). Nevertheless, the error is regretted. With this in mind, and for easier access, results that have been presented by us over several papers are now gathered in Table 1 along with some fresh ones. The TFP estimates underlying the regressions are available from us upon request.

We conclude this section with the comment that neither the recent observations of Goldar (2000) nor the results of further sensitivity tests – reported by us in Table 1 – require us to revise the conclusion of our original paper: "...contrary to what is believed, productivity growth in the 1980s may, actually, have been slower than in the earlier decade" [see 'Abstract' to B-P (1994)].

II

That not all researchers have misrepresented and/or misunderstood our original paper is evident from the study by Trivedi, Prakash and Sinate (2000). We find that these authors represent our original position precisely when they state (p 9): "The study by Balakrishnan and Pushpangadan (1994) was the first of its kind to use the double-deflation method and to highlight the importance of changing relative prices in estimation of growth of TFP (henceforth TFPG) in the context of Indian manufacturing sector. This study carried out at the aggregate level for the manufacturing sector, refuted the claim made by Ahluwalia (1991) that there was a positive turnaround in TFPG in the Indian manufacturing sector in the 1980-81" (p 9). Note that the keyword is "positive turnaround", indication from the wider readership that we had not, as imputed to us by Goldar (2000), contested that there has been an increase in productivity in the 1980s. Trivedi et al then go on to report estimates of total factor productivity from value added arrived at by the single-deflation and the double-deflation methods, respectively, as also a measure of total productivity from gross production. They have also experimented with the use of two deflators for nominal investment in the construction of the real capital stock. This had yielded six measures of productivity which they had designated TFPS (1 and 2), TFPD (1 and 2) and TP (1 and 2), where 1 and 2 refer to inst-

ances of the use of the one or the other of the two measures of the capital input. The rationale for the nomenclature should be apparent from the foregoing discussion; further details may be found in Trivedi et al.

While the conscientiousness displayed by Trivedi et al in their estimation of so wide a range of productivity measures is noteworthy, the promise (p 4) that their exercise may "...shed some light on the Ahluwalia (1991) and Balakrishnan and Pushpangadan (1994) controversy" (sic) is belied, for the authors, tantalisingly, leave unscrutinised the rate of progress implicit in their estimates. This lacunae has not, however, prevented Goldar (p 6) from rushing to clgim: "Clearly, the productivity estimates reported by Trivedi, Prakash and Sinate indicate that the 1980s was a period of rapid productivity growth in Indian manufacturing and there was an acceleration (rather than a deceleration) in TFP growth in the decade as compared to the previous decade. These results are sharply at variance with the results reported by B-P...and support the position taken by Ahluwalia that that there was a turnaround in productivity growth in Indian manufacturing in the 1980s." As demonstrated in what follows, Goldar's claim does not hold.

We now proceed to a consideration of how the estimates reported by Trivedi et al bear on the issue that had concerned us in our original paper. A strict comparison between our results is infeasible, for the time periods covered vary. B-P (1994) report estimates starting from 1970-71 while the authors start from 1973-74. Equally, our series ceases with 1988-89 while the authors concerned provide estimates up to 1997-98. Be that as it may, the estimates provided by Trivedi et al provide us with yet another opportunity to test for a positive turnaround in the 1980s. In the choice of the change point and the length of the series we are guided by Goldar's representation of the trajectory of productivity growth: "Ahluwalia found a marked increase in the growth rate of TFP in Indian manufacturing in the period 1980-85...She attributed this observed turnaround in productivity growth in Indian manufacturing in the 1980s to liberalisation of economic policies" (p 2). Thus we test for a turnaround starting 1980-81 working with the entire length of the series provided by Trivedi et al. After all, as the liberalisation process was further strengthened in the 1990s, this would only increase the chances of a validation of Ahluwalia's view re-

garding the determinants of productivity growth. There is, however, the associated problem of low 'power' of the statistical test for acceleration when the data points on either side of the breakpoint chosen are not equal. This alas is unavoidable, but no more of a problem than that associated with a similar exercise in Ahluwalia (1991). We might add that the problem was minimised in B-P (1994) where we had worked with a series yielding an almost identical number of observations on either side of 1980-81.

The results of our having analysed the estimates of Trivedi et al are reported in Table 2. From these, find that none of the measures of TFP show evidence of an acceleration in their rate of growth in the 1980s, not even the ones arrived at via single deflation. The result with respect to TFPD (1 and 2) does not alter when we exclude the 1990s – the coefficient is now positive but not statistically significant – even though there is no particular reason why we need do this, except to artificially constrict the Trivedi data set to match as closely as possible our own in terms of time span. Thus we find no acceleration in TFPG, despite the feature that in the estimates of Trivedi et al, whatever the measure, TFP is lower in 1980-81 than in any other year but the base year, implying that a statistical test for a positive turnaround revolving around 1980-81 is loaded in favour of finding one. Entirely contrary to his perception, then, the estimates of TFP reported by Trivedi et al imply a setback to Goldar's project of breathing some life into Ahluwalia's thesis.

Table 2: Testing for a Turnaround in the 1980s – TFP Estimates of Trivedi, Prakash and Sinate

Var/TFP Measure	TFPS1	TFPS2	TFPD1	TFPD2
Constant	4.63 (108.2)	4.64 (113.5)	4.69 (43.6)	4.70 (48.2)
D ₁	-0.08 (-1.35)	-0.14 (-2.54)	-0.09 (-0.59)	-0.15 (-1.13)
Trend	0.02 (2.42)	0.02 (2.09)	0.07 (2.96)	0.07 (3.08)
D ₂	0.01 (0.56)	0.01 (0.64)	-0.02 (-0.84)	-0.02 (-0.89)
R ²	0.94	0.91	0.88	0.87

Note: t-ratios in parentheses. Period is 1973-74 to 1997-98. Regression is $y = a + bt$; where $y = \log TFP$, $a = \text{constant}$ and $t = \text{trend}$; D is a dummy variable taking on the value 1 for all the years starting 1980-81 and 0 for all prior ones; $D_1 = (D.a)$ and $D_2 = (D.t)$. TFP measures are denoted as in Trivedi et al and are explained briefly in the text here. Estimation done using PC-GIVE, Version 6.01.

III

So where does this lead us? In 1999, in a remarkably open move the department of statistics of the government of India had sponsored a meeting of economists to discuss the measurement of productivity. On that occasion, the comment of one of the participants, referring to the estimates by Ahluwalia (1991), while discussing the state of the knowledge of productivity growth in Indian manufacturing had been: "Balakrishnan and Pushpangadan (1994) have sought seriously to question the foregoing estimates on methodological grounds. Criticising the limitations of 'single deflation method', they have tried to arrive at fresh estimates of value added using double-deflation method. Their TFPG estimates are quite opposite of Isher Ahluwalia's: a rising productivity growth in 1970s, and then falling steadily in 1980s. [There] ensued a major debate, without, in my view a significant advancement in neither our understanding, nor a new consensus on methodological issues" [Nagaraj 1999:5]. More than the less-than-accurate representation of our result we find precious the author's evaluation of its impact. Aware that the minefield that is the estimation of productivity is not for everyone, we had actually earlier provided a guide to existing research on productivity growth in Indian manufacturing [Balakrishnan and Pushpangadan 1998]. While hardly expecting agreement, we nevertheless take it that to be credible a commentary ought have assessed the situation smartly enough. From such a perspective, the one under consideration surely is wanting? First, it has overlooked the evolution in the methodology of productivity estimation adopted in studies on Indian industry subsequent to the question raised in B-P (1994). Within a wider convergence since, the newly accommodative stance vis-à-vis deflation procedure taken by Goldar (2000) is the clearest admission that TFP estimates based on single deflation alone are by now unlikely to be treated as acceptable by the profession. Indeed, we know of only one instance after B-P (1994) where TFP estimation for the manufacturing sector has been based on single deflation [Gangopadhyay and Wadhwa 1998]. Secondly, Nagaraj has failed to gather, from over 10 papers that followed ours in this weekly itself, that the profession no longer uncritically accepts the view that there has occurred accelerated productivity growth in the 1980s. But

does this constitute a consensus? We neither know nor care! On the other hand, we certainly know that no study has yet demonstrated acceleration of productivity growth in the 1980s using a procedure other than single deflation. That there is no credible option to double deflation when working with value added as your output measure in physical terms is affirmed by leading researchers internationally today [Bartelsman and Doms 2000:574]. In B-P (1994) we had argued that single deflation is a procedure flawed in principle, and having demonstrated its contingency in establishing accelerated productivity growth in the 1980s, a time when the relative price of materials is trending downward, rendered that result methodologically suspect. This is the true import of our work. It has gone unchallenged thus far. To that extent there has been no debate, really. [EW]

[We gratefully record the contribution of our young colleague M Suresh Babu to our understanding of productivity growth. For enabling the three of us to meet over a long weekend during which this paper was mostly written, we thank the Institute for Social and Economic Change at Bangalore, particularly its director M Govinda Rao. Responsibility of course is ours.]

References

Ahluwalia, I J (1991): 'Productivity and Growth in Indian Manufacturing', Oxford University Press, New Delhi.

- Balakrishnan, P and K Pushpangadan (1994): 'Total Factor Productivity Growth in Manufacturing Industry: A Fresh Look', *Economic and Political Weekly*, 29, 2028-35.
- (1995): 'Total Factor Productivity Growth in Manufacturing Industry', *Economic and Political Weekly*, 30, 462-64.
- (1996): 'TFPG in Manufacturing Industry', *Economic and Political Weekly*, 31, 425-28.
- (1998): 'What Do we Know about Productivity Growth in Indian Industry?', *Economic and Political Weekly*, 33, 2241-46.
- Balakrishnan, P, K Pushpangadan and M Suresh Babu (2000): Trade Liberalisation and Productivity Growth in Manufacturing: Evidence From Firm-Level Panel Data', *Economic and Political Weekly*, 35, 3679-82.
- Bartelsman, E J and M Doms (2000): 'Understanding Productivity: Lessons from Longitudinal Microdata', *Journal of Economic Literature*, 38, 569-94.
- Gangopadhyay, S and W Wadhwa (1998): 'Economic Reforms and Labour', *Economic and Political Weekly*, 33, L 40-48.
- Goldar, B (2000): 'Productivity Growth in Indian Manufacturing in the 1980s and 1990s', paper presented at the Conference 'Industrialisation in a Reforming Economy: A Quantitative Analysis' to honour K L Krishna, December 20-22, 2000, Institute of Economic Growth, Delhi.
- Nagaraj, R (1999): 'Productivity Measurement in Indian Manufacturing: A Brief Review', paper presented at the Workshop on 'Measurement of Productivity in India', Institute for Human Development and Department of Statistics, Government of India, July 9, Proceedings, New Delhi, pp 2-10.
- Trivedi, P, A Prakash and D Sinate (2000): 'Productivity in Major Manufacturing Industries in India: 1973-74 to 1997-98', Development Research Group Study No 20, Reserve Bank of India, Mumbai.

National Foundation for Communal Harmony, an autonomous organization under Ministry of Home Affairs, Govt. of India, invites applications for grant of Six Fellowships for a duration of two years for undertaking research in the field of comparative religion and field situation in the communally sensitive districts from Indian nationals, registered for Ph.D. Degree, preferably below 30 years of age having Ist or second class Masters Degree with not less than 55% marks or equivalent grade with a second class Bachelor's Degree in sociology, social work, psychology, public administration, political science or any allied discipline. Candidates having passed NET or SLET conducted by UGC will be preferred. The value of Fellowship is Rs. 5000/- P.M. in addition to contingency grant and departmental assistance besides other benefits. Application form for Fellowship may be obtained from the office of the Foundation located at 9th Floor, C-Wing, Lok Nayak Bhavan, Khan Market, New Delhi. *Application duly completed should reach this office by the 31st March, 2002.*