

Measuring Productivity in Manufacturing Sector

Conventional wisdom and current practice in India appear to privilege total factor productivity (TFP), as a measure of productivity, rather than labour productivity. However, labour productivity is a measure of potential consumption and, as such, a leading claimant for the indicator of standard of living, which makes it important in any programme of poverty reduction. Estimates of labour productivity also give us useful additional information in evaluating the reforms undertaken in India in the 1990s.

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Productivity did not merit much by way of attention for close to five decades since the adoption of planning in this country in 1950. Of course, I refer to the official discourse. Here there appeared to have been an unspoken adherence to the Soviet model of extensive growth with scant regard for the efficacy of resource use or, and I daresay more damagingly, for at least two decades after Indian independence, for the impact of growth on poverty. Among the communists, productivity growth had been seen as a ploy¹ to further the exploitation of the working class. As for the nationalist elite who were mostly led by the Congress Party, they were in such a hurry to industrialise the country at any cost that concern for the consequence of public policy was a byword for the predictable bad faith of losers. This of course does not explain why India's academic economists, who enjoyed an enviable status in the years soon after 1947, had ignored the issue. Indeed the intellectual culpability for the neglect must fall a little more heavily upon the academics as they tend to benchmark themselves quite closely against developments in western academia, a practice that was, for better or for worse, roundly shunned by India's communists. This neglect may have had something to do with the penchant for theory, however abstruse, of Indian academics which has led to their overlooking the vigorous innovation in applied economics in universities, independent research institutions, and even governmental agencies of the western world. This somewhat skewed approach to the subject matter of economics has cost the profession in India dearly. Within Indian academia, applied economics has generally languished and, even when emergent, has tended to get identified with a simple-minded use of econometrics propelled by the availability of tailor-made software and inexpensive computing power. By contrast, internationally, the profession has perhaps been quicker to track developments in the economy. For instance, the close concern with the slowdown in productivity growth in countries of the OECD dates back over three decades, following in the tracks of the appearance of the phenomenon after the oil shock of 1973. Equally, there is much interest in the impact of information technology on productivity growth, especially since the commercialisation of the internet in the mid-1990s, though the focus has, this time, been mostly on the US economy.

Of course, I would be failing in my duty were I to ignore such work on productivity growth in India undertaken by our profession. Foremost would be the work of the late P R Brahmananda who had for most of his life worked not far from here in Kolhapur. Piquantly subtitled 'Rising Inputs for Falling Outputs' Brahmananda (1982) clearly pointed out the dire situation with respect to productivity growth in India. As its name suggests, his work had highlighted the decline in the growth of productivity across the economy. Of course, Brahmananda was a theorist and the execution of some of the estimation may have expectedly left us a little disappointed, considering that this was the work of a most distinguished economist. However, with its publication he had revealed himself, once again, to be among the most acute observers of the Indian economy, a role into which he had first shot himself with a publication with C N Vakil in 1956 from Bombay: 'Planning for an Expanding Economy', which contained a critical evaluation of the Mahalanobis strategy. Of course it was ignored, not only by the political class of that time but also by the Indian economics establishment anxious to be seen in line with the former. A second generation of productivity studies emerged within the next decade led by the work of Bishwanath Goldar (1986) but centred on the work of Isher Judge Ahluwalia (1991). Of these, while Goldar's is perhaps the one more guided by theory it was Ahluwalia's work that was to receive wide attention due to its bold thesis that, starting in the early 1980s, productivity growth in Indian manufacturing had turned around and that this had really to do with the change in the policy regime that had by then been liberalised. I shall have more to say on this result subsequently. Finally, I must mention the essay by K L Krishna (1987). Clear and elegantly written as may be expected from so distinguished a teacher of our subject, Krishna's essay is yet mostly a survey as behoves a contribution to a festschrift, in this case to Brahmananda himself.

I

Theoretical Considerations

Conventional wisdom, and current practice in India, appears to privilege some measures of productivity over others. Thus total factor productivity (TFP) is often treated as a concept inherently superior to labour productivity as the former takes into account all inputs and not the input of labour alone. However, in their magisterial survey of productivity yardsticks Baumol et al (1994) argue strongly that such an implicit ranking would be unjustified, for the allegedly inferior indicator, labour productivity, has its legitimate use for which the allegedly superior index of TFP is not a substitute.

Labour Productivity

Labour productivity may be defined as the output per unit of labour. However, neither the appropriate measure of output, nor the correct indicator of labour input are preordained, so to speak. Starting with output, for the economy as a whole, we may choose among GDP, GNP or national income. For manufacturing, we may choose

among gross output or net output or value added. With respect to the labour input we may use employment measured by either the number of workers or the number of hours worked by them. Note that these alternative measures of the labour input would on occasion yield very different results. For instance, the United States has higher GDP per worker than France. However, it has lower productivity measured as output per hour. America's higher output per worker results, as one might guess, from Americans working longer hours. Nevertheless, conceptually at least, labour productivity is a relatively straightforward concept whatever may be one's choice of output and input measure. This does not always carry over to its interpretation, however. Viewed from a certain angle labour productivity does display an inadequacy. For instance, an economy where the labour force remains of the same quality in terms of performance levels, may yet record a rise in labour productivity because of technical change enhancing the quality of capital or simply because of an increase in the number of machines. In such a circumstance, it would be wrong to interpret the increase in labour productivity as labour's contribution to the expansion in output as almost all of it has come about due to the expanded input of capital. However, to see such a possibility as criticism would only raise the question of the legitimate interpretation of labour productivity. It does not de-legitimise the concept itself.

The most acceptable interpretation of labour productivity is that it is a measure of potential consumption. As suggested earlier in this paper, it cannot be an indicator of the source of that potential. It is entirely conceivable that all of an increase in potential consumption comes from a greater number of, or even just better, equipment. Now the proximate cause of the increase in the productivity of labour is the enhancement of capital. Marx would of course have seen through this semantic dance by claiming that labour is after all the only source of value, leaving behind machines as merely congealed labour! However, even as I see this as a vision of great moment, I do not have to depend upon it to rescue labour productivity as a meaningful concept. It would seem reasonable to argue that the interpretation of labour productivity as potential consumption retains it as perhaps the indicator deserving of utmost interest in the evaluation of a production process or, at a broader level, of an economic arrangement such as an economy, where each must ultimately be judged in terms of what they have managed to accomplish for human participants. The link between labour productivity and economic welfare may be seen from the following: when the ratio between the population and the labour force is constant, the rate of growth of per capita income will equal the rate of growth of labour productivity. Surely, per capita income is a claimant as a leading indicator of the standard of living.

Even as the source of an increase in labour productivity may be ambiguous in that it could originate in either an improvement in skill levels or better machines, one thing is clear. As labour productivity increases, the capacity of a productive unit whether a firm, industry, sector or economy to reward its participants has increased. This is a

matter of some relevance to any programme of poverty reduction, something to which most economists pledge allegiance. A steady rise in the productivity of labour is necessary for a sustained increase in the standard of living of a population. That at times rising labour productivity may not result in a rising standard of living, equally shared, is of course a possibility. When this occurs, straightforward accounting will be able to inform us that the outcome is owed to the distribution of the product. In any case, no other measure of productivity can serve as so direct an indicator of potential consumption as labour productivity.

Total Factor Productivity and Its Measurement

TFP is intended as a measure of the efficiency of a productive process or a production unit. It is related to the idea of the capacity to produce. Therefore, for a dynamic economy, TFP growth would measure the rate of expansion of the capacity to produce over and above what is attributable to the concurrent expansion in input quantities. This view of TFP leads naturally to the measurement procedure whereby TFP is captured by a residual of accounting. For example, assume that the doubling of all inputs leads to an increase in output by the factor 2.7. Now the residual of 0.7 would be taken to be the growth in TFP. However, the very example that we have used points to a potential problem in this approach to the measurement of TFP. First and foremost it requires the absence of scale economies. In the example above, it is the unstated premise of constant returns to scale that allowed us to read-off 0.7 as TFP having attributed an increase of 2.0 to the doubling of inputs, as implied by constant returns to scale. By contrast, in the presence of scale economies, a larger proportion of the growth in output would have been attributed to inputs and less to technical change.

Constant returns to scale is not the only assumption required in the interpretation of TFP as the expansion in productive capacity due to technical change. If a single number, such as a calculated increase in TFP, is to describe the full range of expanded production possibilities offered by technical change it is necessary that productivity grows at the same rate for each combination of inputs. You will notice that this is strong assumption indeed. In an accurate summing-up Baumol et al (1994) speak of this as one among the, “premises [are] designed to offer [them] an expansion path for the production frontier that can be described uniquely by a scalar measure [i.e., a single number]”. There are two approaches to the measurement of TFP and I shall now turn to them in turn.

(a) *A crude index of TFP growth*: It is possible to conceive of a crude index of TFP (CTFP) growth, the increase in output that can be produced with various combinations of inputs, making no attempt to separate out the sources of the output growth. As almost all industries produce many outputs while using many inputs we would have to define CTFP growth as the difference in the rate of growth of an output index and the rate of growth of an input index. Thus we may define an output index

$Y(t)$ and an input index $X(t)$ at time t , being weighted averages of output quantities $y_i(t)$ and input quantities $x_i(t)$, respectively, with revenues shares as weights to aggregate over output quantities and cost shares to aggregate over input quantities. Now crude TFP at time t would be given by the ratio $Y(t)/X(t) = \text{CTFP}(t)$. And the growth in crude TFP would turn out to be simply $\text{CTFP}(t)/\text{CTFP}(t-1)$.

We can see right away that there are no uniquely preferable weights for either of the two indexes that go into the measurement of CTFP. Several possibilities exist. However, we also have evidence that measured CTFP is relatively insensitive to the choice of weights, so that this does not appear as such a serious issue. Of far greater significance is that the feature of this measure of productivity depends upon the actual combination of inputs used. This is problematic when we are confronted by a situation where the isoquant is not shifting uniformly for every feasible input combination. Now there is no unique measure of productivity growth independent of the input quantities that happen to have been used, as measured by CTFP for the industry. The Divisia index that we consider next at least addresses this problem. (b) *The Divisia index of TFP*: A Divisia index of TFP aims to satisfy the approach that views productivity growth as a source of growth in productive capacity due to technical change. The approach is mostly identified with Solow's original paper of 1957, which had sought a method of isolating a shift in the production function from a movement along it. However, this is achieved by adopting some highly restrictive assumptions. Hulten has demonstrated that the standard Divisia TFP index is a precise measure of TFP growth when the following conditions are satisfied: constant returns to scale, technical progress is continuous, technical progress does not require expansion of inputs, input prices are determined in competitive markets and firms are cost-minimisers. In addition it is required that the production function is quasi-concave and continuously differentiable.

It is not difficult to notice that the approach to TFP underlying the Divisia index is closely dependent upon strong assumptions. This is often overlooked by zealous practitioners among us. This apart, an attractive feature of the Divisia index is that productivity growth can be calculated from the data without econometric estimation. The data requirements are not formidable either. Its main shortcoming of course is the restrictive set of assumptions that sustain its validity as an index of productivity measuring the growth in productive capacity. However, in practice, the TFP estimates obtained by the Divisia formula can be corrected for the existence of scale (dis)economies, fixed factors and imperfect competition the absence of each of which is assumed to hold in the first instance. I shall refer to some aspects of the construction of the Divisia index in the section immediately following this one.

On Correctly Measuring Output

Most economists would recall how a very large Solow residual – interpreted as technical change – was greeted with the response that the residual was really only a

“measure of our ignorance”. Implicit in this response was the belief that the researcher was measuring output properly but the primary inputs of labour and capital were very likely mismeasured. Indeed the paper by Jorgensen and Griliches (1967) appeared to have vindicated precisely this, for having adjusted inputs for quality enhancement the residual was found by them to more or less disappear. The recent record of productivity measurement for Indian manufacturing may be seen as reflecting quite the opposite experience for researchers. While no particular attention has focused on the magnitude of the residual per se, research on India has focused almost exclusively on whether the rate of change of the residual – interpreted as (total factor) productivity growth (in the dynamic formulation that is growth accounting) – has responded to a shifting economic policy regime. In a debate associated with this research a central point of contention has been the correct measurement of output. Interestingly researchers have more or less passed over the question of correctly measuring inputs.

Really, the issue of correctly measuring output is one of measuring real value added, which is net output. While measuring gross output in real terms, i.e., in constant prices is a straightforward matter, measuring net output in real terms or real value added is not. The problem may be described as follows. Nominal value added, being the difference between the value of an industry’s output and all non-labour inputs, is easy enough to calculate. It is in the conversion of nominal value added into an index of real value added that we encounter some difficulty, so to speak. First, there is the standard index number problem. Secondly, there are some problems unique to the use of value added as the measure of output.

There are two approaches to the estimation of real value added. Under single deflation, nominal value added is deflated by an index of the price of gross output. Under double deflation, gross output and material input are first deflated separately by an output and input price index, respectively. The difference is treated as real value added. Even as the double-deflation approach may appear eminently sensible, real value added obtained by this procedure would yield negative numbers when a change in the relative price of the material inputs, from that implied by the base year output and input prices, induces substitution. Of course, it is easy to see that this potential artefact is limited by the extent of feasible substitution. The standard assumption in textbook economics is that the extent of substitution for material inputs is limited. However, the horror of discovering negative value added combined with the absence of readymade input-price deflators has tempted many a researcher to take the line of least resistance and resort to single deflation when measuring real output.

The single deflation approach offers the advantage of not requiring an index of the price of materials as, under this procedure, nominal value added is directly deflated by the output-price index. Furthermore, so long as nominal value added is positive, real value added by the single deflation method will be positive. These are really

valuable features in the context. However, there is a downside. When the relative price of inputs goes trending in either direction, under the single deflation procedure, this will tend to get reflected in measured real value added as a change in (net) output even as there has been no change in physical production nor has there been a change in the productivity of the primary factors of production. To run ahead, note that this would be disastrous for productivity measurement. The consequence of the use of single deflation in the presence of changes in the relative price of materials is akin to the terms-of-trade effect in international trade. For example, if the price of materials rises in relation to the price of output, everything else the same, measured industry output rises relative to the cost of materials and the estimate of real value added shows an increase. Now the change in the value added is reflective of the change in the relative price of materials. Shirley Cassing (1996) provides an interesting account: at the economywide level, imports are the only intermediate inputs; so when they become cheaper the economy is viewed to be better-off even without a change in productivity. Such trading gains would be a legitimate item for inclusion when we are looking to measure welfare, but not when we are seeking to spot a change in productivity. The problem of correctly measuring valued added in the context of tracking productivity growth is to keep separate gains or losses from trade from changes in physical production.

Back to a consideration of it, the double deflation procedure introduces a distortion when the Laspeyres index is used as it measures the level of real value added using base-year weights. In the context, the weights are the output price(s) to weight output(s) and the input price(s) to weight the material input(s). Were the current relative price of input(s) to output(s) to diverge from the one implicit in the base-year weights, a distorted picture emerges. Now, instead of the trading gains that are potentially captured by the single deflation procedure changes in the double-deflated Laspeyres index of value added would capture the effect of substitution and not a change in pure productivity. Use of a Paasche double-deflation index, which uses current period weights, does not help, as it assumes that the relative price of inputs are always those of the current period. It is intuitive that the true index of real value added is bounded by the Laspeyres and Paasche indexes of value added.

In national-income accounting, it is conventional while estimating real gross expenditure to use the Laspeyres formula. Consistency then requires that the same methodology be applied to production accounts. This appears to be the rationale, apart from its intrinsic merit over single deflation, for recommending the double deflation procedure in the calculation of real value added in the revised United Nations System of National Accounts. However, as we have just pointed out, this method is potentially problematic, and not only when it yields negative real value added. It may contain distortions, and it is not satisfactory to rely on a priori assertions of the limited substitution possibility with respect to material inputs, as opposed to the so-called factors of production themselves. 'Michael Bruno (1984) has, in a paper that has influenced my work with Pushpangadan, and thus I dare say

the course – to some extent – of the debate on productivity growth in Indian manufacturing, argued that the use of fixed weights and double deflation may have resulted in a misreading of the true trajectory of productivity growth in the OECD economies, following the oil shocks of the 1970s. Note that in this case the relative price of materials had risen, shifting dramatically away from the origin.

Problems appear to dog us in the measurement of (net) output even before we have arrived at a juncture for the measurement of productivity growth. Nevertheless, the ingenuity of our tribe appears boundless when we recognise that we can avoid the trading gains captured by a single-deflation index and the distortion inherent in a double-deflation index by computing a Divisia index of double-deflated real value added. As it employs double deflation, it expunges trading gains from the measured value added and, as it uses shifting input-output weights, it eliminates the distortion due to the substitution effect that gets incorporated into the Laspeyres double-deflation index of the same. A Divisia index is a continuous-time index-number formula and has been used in contexts ranging from the aggregation of money supply to the study of technical change in industry. While several discrete approximations are feasible, the Tornquist approximation is the one most commonly used to replace continuous change with discrete-time counterparts. With the widespread availability of high-speed computing, the Tornquist approximation to the Divisia index is easily implemented. Note that in addition to avoiding both the capturing of trading gains and the incorporation of the substitution effect the Divisia index will not yield negative value added so long as nominal value added is positive. Now the mere possibility of a Laspeyres double-deflation value added index generating negative numbers need not lead to a rejection of the superior methodology that double deflation is; the baby may be saved even as we throw out the bath water as it were. Altogether, there is a strong case for improving the production accounts by adopting the Divisia index.

Productivity Accounting

Measured productivity actually reflects several factors. Nordhaus (2002) has addressed this issue via the idea of productivity accounting. As with growth accounting, productivity accounting is a decomposition of the measured change in productivity. It is based on the recognition that measured productivity combines several effects. While the residual under growth accounting is productivity growth itself, under productivity accounting, the change in productivity can be decomposed into three components: the pure productivity effect, the effect of the change in the composition of output termed the Baumol effect after its originator, and a levels effect due to a difference between output and input weights termed the Denison effect after its originator. I shall discuss each of these.

(a) *Pure productivity effect*: As a measure, the pure productivity effect is a weighted average of the productivity growth rate of the different sectors. The weights being the

base-year nominal output shares of each industry, it may be interpreted as the estimated change in productivity, were there no change in the composition of output during the period for which the measure is proffered.

(b) *Baumol effect*. The Baumol effect gets measured as the weighted sum of sectoral productivity growth, the weights being the change in the output share of each sector over time. It reflects the interaction between the differences in productivity growth and the changing shares of nominal output among different industries over time. The effect was recognised by Baumol in his work on unbalanced growth over four decades ago. The problem of unbalanced growth is also one of slow-growing sectors. Sectors or industries that grow slowly also tend to be ones with slow-growing productivity. This combination of features pulls down measured productivity growth. Baumol had termed this “the cost disease”. Once we recognise this possibility, the worst-case scenario imaginable is one where the share of the slow-productivity-growth industries rises over time.

(c) *Denison effect*. This is the result of the interaction between the growth of inputs and the possible difference between output and input weights of a sector at any point in time. To appreciate the latter fully, recognise that the labour input into industry X, as a share of total employment in the economy, is likely to be very different from the share of the output of industry X in economywide production. In contrast to the Baumol effect, the Denison effect is a levels effect. We were made aware of its role in productivity measurement from the work of Denison, who had pointed out in his study *Why Growth Rates Differ*, that the movement of labour from low-productivity agriculture to high-productivity industry would show up as an increase in aggregate productivity, and thus a growth in productivity, even in a situation of zero productivity growth in the two sectors.

While the Denison effect is more likely to show up for economywide measures of productivity growth – as we may well expect a structural ordering of productivity levels across the sectors of an economy – the Baumol effect may actually be encountered while measuring productivity growth in the manufacturing sector itself, a topic that is central to our concern here. Differential rates of growth of productivity combined with a shifting composition of output is entirely to be expected within the manufacturing sector of any economy during any period, no matter that Baumol had himself pointed to the inherently slow growth of productivity in services. Equally, though the level of aggregation at which it may be expected to come into play makes it a little less important when we study a sector of the economy in isolation, say manufacturing, we might make the following observation about the Denison effect. Denison was studying post-war Europe in the mid-1960s at a time when the economies of that continent were industrialising rapidly. If we are to study an economy over the entire range of its structural transformation we may find that just as the Denison effect may contribute to a rising, measured economywide productivity growth as labour shifts from agriculture to manufacturing, aggregate productivity growth may slow down as labour moves from manufacturing to services with

increasing maturity of the economy. In both cases, however, we have an incentive to pursue the pure productivity effect while engaged in productivity measurement.

II

Measuring Productivity: State of the Art

Thus far I have dealt with some theoretical concerns in the measurement of productivity. This, the second part of my address is devoted to a consideration of how these issues have been addressed in the extant studies of productivity growth in Indian manufacturing. I shall also comment on the implications of these studies to a theme underlying the most recent among such studies, i e, the relationship between productivity growth and the policy regime.

Measures of Productivity

Even though Solow's paper was written close to 50 years ago, the interpretation of the residual as (total factor) productivity was to take some time in coming, not just into studies on India but also worldwide. It may be first noticed in the work of Brahmananda, who had looked at more than just the manufacturing sector. Brahmananda had estimated labour productivity too. Since Ahluwalia's well known work in the early 1990s, though, productivity in manufacturing is almost synonymous with total factor productivity. It is by now de rigueur that productivity means TFP! As I have argued, this is not necessarily true. Labour productivity is a tractable idea in its own right and one in which we may legitimately be interested. Let me cite an instance from Indian manufacturing that shows us that we could end up with different pictures according to the measure of productivity that we may use. In a review of productivity studies Goldar (2000) has observed that in every case TFP growth has been found to decline in the period since 1991. However, if we are to look at labour productivity, we find that productivity growth has accelerated, albeit mildly, since 1991 [Balakrishnan and Suresh Babu 2003]. Thus within Indian manufacturing at least, the reforms may have contributed to an higher rate of growth of potential consumption. Placed alongside the record of growth summarised by Goldar, an estimate of labour productivity growth gives us useful additional information in evaluating the consequence of the reforms. Focusing on TFP growth alone would not have yielded us information regarding the growth in potential consumption, and thus the standard of living. There is altogether a case for returning to the practice of estimating labour productivity growth in Indian manufacturing.

Before concluding this section, I shall reflect upon why we are faced with this implicit rejection by researchers of labour productivity as a worthwhile measure. Discounting at the outset any suggestion that the Indian mind has a predilection for complexity at any cost, the implicit privileging over the past two decades or so of TFP as the measure of productivity may have something to do with the altered balance of power in the market for ideas. Even before the final implosion of the Soviet Union, the pride of place appears to have been made over to the idea of free markets as the superior

economic arrangement. For instance, even in India, a certain liberalisation of the economy had been initiated by the early 1980s. Be that as it may, the move to TFP as the sole measure of productivity carries implicitly the assumption that the purpose of economic activity is accumulation. This alone can justify the near total exclusion of labour productivity from consideration in most recent studies of productivity growth in Indian manufacturing. As I have already emphasised, a rising productivity of labour alone can sustain an increase in consumption. Here we are, of course, ruling out continuous redistribution as unlikely. In real life where Hicks-neutrality is far from assured, we may envisage a rising capital productivity coterminous with declining labour productivity, yet showing up as rising TFP. Now even an improved efficiency of production does not allow for a rising standard of living. It would show up as higher profits of course, thus paving the way for higher investment. It is in this sense that focusing on TFP is tantamount to privileging accumulation over consumption, an happy meeting ground, as it were, of the erstwhile 'Soviet Planner' and the contemporary 'Davos Man'. Indian researchers need to reflect a little on why their practice differs from what is mostly adopted in studies of western economies where measurement of labour productivity over TFP is more or less the norm. A most recent example of this is the paper by Nordhaus (2002), cited earlier, on productivity growth in the US where he explicitly defends the exclusion of TFP on grounds that its estimation is based on unreasonable assumptions. But this apart, the exclusion of labour productivity growth signals from the radar reflects an inadequate concern for potential increase in consumption. Surely this is odd when we are studying an economy with substantial poverty, as is India.

Correctly Measuring Output

I have already stated in Section I of this paper that, unlike under international practice, there has been little concern for the correct measurement of inputs in the estimation of productivity for Indian manufacturing. Interestingly, there had been little concern for correctly measuring output either, till the paper by Balakrishnan and Pushpangadan (1994). Recall that there we had pointed to the feature that the best known studies of productivity growth in Indian manufacturing had used value added arrived at via single deflation (VASD) as the measure of output. Besides the fundamental flaw in the methodology, we had argued that the use of VASD for measuring output growth over 1970-80 is prone to a bias as the early 1980s lie in the cusp of a switch in the trend in the relative price of materials. Now it is possible to predict that ceteris paribus any measured productivity increase is more likely to reflect the turn around in the trend in relative prices, rather than the turnaround in productivity growth per se. Pushpangadan and I were able to demonstrate this. Using data for the 1970s and 1980s we showed that while a turnaround in TFP growth in the 1980s could be detected when using VASD, no such turnaround was evident when VADD is used. While this demonstration has a direct implication for a question of interest to a wide range of economists, namely the relation between policy regimes and productivity growth, in this section I continue to focus on how the project of

correctly measuring output has fared in studies of productivity growth in Indian manufacturing. I shall return to the issue of policy regimes in the final section of this paper.

It is a matter of some satisfaction to me that since our paper of 1994, as far as I am aware, an overwhelming majority of papers on the subject adopt double deflation when using value added or in deference to the issues raised in the debate that had followed – notably the dependence of a real value added function on separability of the production function, pointed out in Balakrishnan and Pushpangadan (1995) – have switched to using gross output. However, even when using gross output rather than net output or value added, all researchers now deflate the nominal value of materials by an index of materials prices rather than an index of final-output prices. To that extent my work with Pushpangadan appears to have had an influence on the course of research on productivity growth. I must hasten to add though that its reach has not been universal! As recently as 2003 a paper reporting research at the IMF records TFP estimates for Indian manufacturing that are based on growth accounting performed on real value added arrived at by single deflation alone [Unel 2003]. It is astounding to me that in this age of near instant communication, research results disseminated internationally take upto a decade to reach practitioners at the IMF, considered a leading centre of research in economics worldwide. In conclusion then, we see that the issue of correctly measuring output has received due attention in studies on manufacturing productivity in India. To have nudged the profession in this direction has been one useful outcome of the debate that has followed the paper by Balakrishnan and Pushpangadan (1994).

Before concluding this section, I would like to briefly draw attention to an aspect of the above paper, its philosophy as it were. In the 1980s David Hendry had attained the status of a guru on the practice of econometrics [Gilbert 1986]. Among his suggestions was that, to be counted as complete, an econometric model should be able to encompass its rivals, in the sense that it can explain other models' results. To borrow from this, in the wider field of applied economics, the practitioner ought to be able to account for the extant results. While this is a sensible proposal, it presents a somewhat stringent criterion. Therefore, it is particularly satisfying that the paper by Pushpangadan and myself passes on this score. We had been able to replicate the result of Ahluwalia (1991) while proffering an alternative estimate based on a methodology that we had argued is superior. I might mention that such instances are relatively rare in applied economics. In a sense, this is the true significance of the paper. It has on occasion been identified as an anti-liberalisation tract, which is absurd. In fact, there was no attempt made in it to link productivity performance to policy regimes in the paper. Having said that, we consider it entirely right to use its result to evaluate alternative policy regimes in manufacturing in terms of their consequence for productivity growth.

Productivity Accounting

Productivity accounting or the cleansing of estimated productivity growth of the composition effect due to a changing output mix – termed the Baumol effect – and of labour migration within the manufacturing sector of the economy – termed the Dennison effect – is yet to be applied to the study of manufacturing sector productivity in India. This lacuna is urgently requiring of remedy, and till we have one we can claim to understand little of the true trajectory of productivity growth in India. Of course, as I have argued in Section I the Denison effect is perhaps small for sectoral, as opposed to economywide, estimates of productivity growth.

III

Fund of Our Knowledge

Even as my chosen title for this section suggests that some kind of potential surety exists regarding a pure productivity estimate, I must hasten to add that what we have are as yet imperfect estimates. In this brief section, I shall evoke these estimates to address the question of how the liberalisation of the economy has affected productivity growth. Though the reforms had in a sense started in the 1980s, I shall focus on the 1990s, for most of us would agree that by almost every criteria the policy changes since July 1991 dwarf those of the 1980s.

As far as I am aware, growth accounting on output data from the ASI has not yielded anything thus far but a decline in the rate of growth of TFP in the 1990s. Three such studies are identified in Balakrishnan and Pushpangadan (2002). Along the track that pursues the Solow residual via estimation of a production function, decline in productivity growth in the 1990s is also reported. I refer to the studies by Srivastava (2000) and Suresh Babu (2001). These studies use firm-level data from Industrial Development Bank of India (IDBI) and Centre for Monitoring the Indian Economy (CMIE), respectively. It is to be noted that IDBI data are not available in the public domain. Of course, CMIE's firm-level are, albeit commercially. Together the results of these studies represent a confluence of research on productivity growth in Indian manufacturing. We find that the productivity estimate based on differing methodologies and differing databases all point to a decline in TFP growth. This is striking, compared to a methodology-specific nature of the results for the 1980s [Balakrishnan and Pushpangadan 1998].

All these studies estimate TFP, but what of labour productivity? After all, I had earlier in this paper gone to great lengths to point out that changes in capital and labour productivity could go in different directions, and therefore the change in labour productivity cannot readily be made out when observing the change in TFP. I had also argued that growth of labour productivity is of much interest in a country with low living standards. So what do the data show? As may be expected due to exclusive focus on the TFP, estimates of labour productivity growth in Indian manufacturing are rare on the ground. I am only aware of the estimates in Balakrishnan and Suresh

Babu (2003). Here we find a slight increase in rate of growth of labour productivity in the 1990s when compared to the period 1973-1991.

In conclusion, I cannot desist from commenting on the implication for economic reforms, so talked about in India today, in terms of the results that I have reviewed in this paper. Perhaps I should borrow from Solow's reportedly exasperated comment on the elusive role of the computer in the US economy, and state that, in India today, the reforms can be seen everywhere, but not in the productivity statistics. However while it may sound dramatic, it certainly would not be true to say that reforms, or their impact, can be seen everywhere. There is something to be said for the accurate observation made – perhaps a little discomfittingly for us economists who tend to see themselves as apart from the discourse of management. According to management guru Michael Porter and P Ghemawat² the reforms initiated in India in 1991 have been largely confined to the macroeconomic sphere, including presumably the external sector. Surely many of the drivers of productivity are microeconomic, and not even necessarily confined to the shopfloor. By the latter, I mean infrastructure and not the purely physical at that. However, microeconomic drivers need not always mean only rivalry among firms – often allegedly contained by the ubiquitous 'competition' – but also referring to factors enabling of production. We must not forget that a rising tide lifts all boats. The spread of quality electricity and education are some of these wider interventions that have received less attention than they deserve in the academic discourse on reforms. They have been relatively ignored in the pursuit of greater efficiency via what is essentially a macroeconomic approach. Though I have a long way to go before I establish this, I claim that the recent research on productivity growth in India's manufacturing sector that I have reviewed here lead us to look in that direction.

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Notes

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1 See K N Raj's recollection of an interchange with the late E M S Namboodiripad in Bhaskar (2001).

2 See 'Industrial clusters can serve as a catalyst', an interview with M Porter and P Ghemawat, *Economic Times*, September 27, 1994.

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