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Does Productivity Really Matter for Profitability? Evidence from a Publicly Owned Transport Corporation

Sanjay Kumar Singh
Indian Institute of Management Lucknow,
Lucknow, Uttar Pradesh, India.
Corresponding author: sanjay@iiml.ac.in

Vijay Lakshmi Singh
Jaipuria Institute of Management,
Lucknow, Uttar Pradesh, India.
E-mail: vijaylakshmi.singh@jaipuria.ac.in

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Abstract
For many years now, a variety of studies have proven the strong relationship between productivity and profitability. However, simply earning a profit does not necessarily mean that the firm is productive. Many highly productive firms face financial losses, whereas less productive ones' experience significant profits. This paper examines the dynamics of how productivity really matters for profitability. The paper uses a non-parametric index number approach to estimate the productivity, profitability, and price performance of a publicly owned, once world's largest, bus transport corporation operating in the Indian state of Andhra Pradesh to examine these dynamics. The paper finds that when public organizations are constrained from raising the prices of their services, productivity gains may not be adequate to counterbalance the impact of rising prices of major inputs. Moreover, loss-making organizations, even if they are publicly owned, would find it hard to improve both the quality and quantity of their services.

Keywords- Productivity, Profitability, Transport, Public sector, India.

1. Introduction

In its simplest form, productivity is defined as a ratio between the output volume and the volume of inputs. When we have a single output, we can easily construct partial factor productivity indices for each input. Nevertheless, these indices that describe the average product of inputs are often misleading because what might be considered a difference in productivity may in fact just represent an altered mix of input use (Banker et al., 1993; Oum and Yu, 1995; Singh, 2014; O'Donnell, 2018; Ekerhovd and Gordon, 2020). Therefore, we cannot rely on partial factor productivity indices, say the labour productivity index or the capital productivity index, to measure the productivity of any organization. Total factor productivity (henceforth, TFP) is a better and more widely accepted measure of productivity. Unlike the partial factor productivity indices, TFP indices are constructed by taking into account all the factors of production (Caves et al., 1982a; Banker et al., 1996; Oum et al., 2005; Ekerhovd and Gordon, 2020; Walden et al., 2022).

TFP can be measured using parametric as well as non-parametric approaches. The parametric approach is largely based on econometric modelling, where productivity is estimated as the time shift in a production or cost function, whereas the non-parametric approach uses either data envelopment analysis or the index number method (Caves et al., 1982b; Windle and Dresener, 1992; Waters and Tretheway, 1999; Singh, 2006; Verma and Kaur, 2017). Measurement and interpretation of TFP may differ when it is estimated using different methods, but these differences are not crucial for this study. That's why we use an index number approach, the Tornqvist-Theil index, which is a discrete approximation to a

continuous Divisia index, to measure the level as well as the growth of TFP. The Tornqvist-Theil index possesses nice properties; it is a superlative index, i.e., it can approximate any smooth production or cost function (Diewert, 1992; O'Donnell, 2018). Moreover, it has an additional advantage: we don't need to estimate production or cost functions using econometric methods to estimate the TFP (O'Donnell, 2018).

Productivity performance can be gauged not only through quantity comparisons but also via price comparisons. Therefore, we can use Total Price Performance (henceforth, TPP), defined as a ratio of aggregate input prices to aggregate output prices, as another measure of productivity (Bailey, 1986; Antoniou, 1992; Oum and Yu, 1998; Singh, 2006; Walden et al., 2022). In a perfectly competitive market, where each firm makes zero economic profit, TPP equals TFP and the firm's productivity gains, if any, are fully passed on to consumers. But in a more realistic market, TPP and TFP may differ. Moreover, comparison of firms' TFP and TPP trends provides a very good indicator of market competitiveness (Jorgenson and Griliches, 1967; Diewert, 1992; Wang et al., 2014). It is easy to see that TFP growth empowers firms not to increase the prices of outputs in line with the rise in input factor prices. Moreover, a TPP-TFP comparison can also indicate how much productivity gains are passed on to consumers and how much is retained by the firm. That's why changes in TFP and TPP determine changes in a firm's profitability (Miller, 1984; Singh, 2009; Wang et al., 2014; Ekerhovd and Gordon, 2020).

The main aim of this study is to find out whether total factor productivity really matters for profitability by analysing evidence from a state-owned, once-world's largest passenger bus transport service provider, Andhra Pradesh State Road Transport Corporation (henceforth, APSRTC), by utilizing its annual data from 1980 to 2018.

2. Data and Methods

This study is carried out using firm-level annual data using a non-parametric index number approach, which has the advantage of not requiring econometric specification and estimation. The main source of data is "Performance Statistics of State Transport Undertakings (STUs) (1979-80 to 2017-18)," published by the Central Institute of Road Transport, Pune, India.

2.1 Background to the Study: Linking Productivity and Profitability

Productivity and profitability are closely related (Singh, 2006; O'Donnell, 2018; Ekerhovd and Gordon, 2020). We can use simple algebra to understand this relationship. Now, let us define profitability, π, as a ratio of revenues, *R*, to costs, *C*, rather than their difference. Therefore, π can be written as,

$$\pi = \frac{R}{C} = \frac{PY}{WX} = \frac{Y/X}{W/P} = \frac{TFP}{TPP} \quad (1)$$

where, *P* denotes output prices (indices), *Y* the corresponding output quantities (indices), *W* indicates input prices (indices), *X* the corresponding input quantities (indices), *TFP* denotes total factor productivity, and *TPP* indicates total price performance.

For two time periods, *T-1* and *T*, equation (1) can be re-written as:

$$\frac{\pi_T}{\pi_{T-1}} = \left(\frac{TFP_T}{TFP_{T-1}}\right) / \left(\frac{TPP_T}{TPP_{T-1}}\right) \quad (2)$$

Equation (2) shows that a change in a firm's profitability depends on a change in its productivity vis-à-vis total price performance. In a perfectly competitive market, *R/C* is 1, therefore, *TFP* = *TPP*. In a more realistic, imperfectly competitive market, when $\Delta TFP > \Delta TPP$, then *R/C* improves, but when $\Delta TPP > \Delta TFP$, then *R/C* worsens. However, it is important to note that the relationship among TFP, TPP, and

profitability (*R/C*), as depicted in equation (2) and Figure 1, holds whether the market is perfectly competitive or imperfectly competitive (Sink et al., 1984; Brayton, 1985; Miller and Rao, 1989; Aboganda, 1994; Singh, 2006; Ekerhovd and Gordon, 2020; Walden et al., 2022). Furthermore, the decomposition, as depicted in equation (2), is useful for identifying the extent of change in profitability due to changes in productivity and output prices in comparison to changes in input prices.

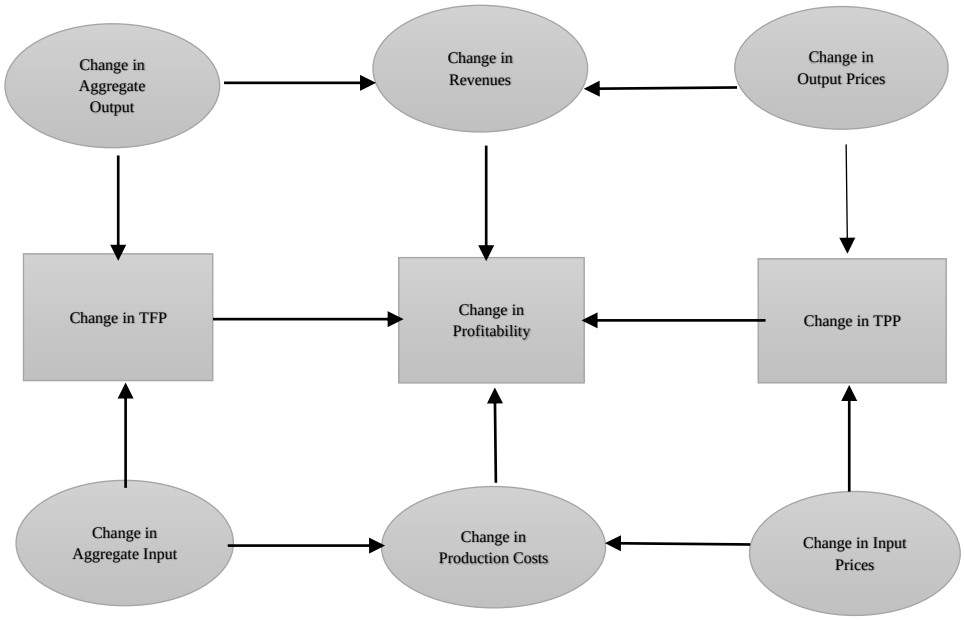

Figure 1. Linking TFP, profitability and TPP (Source: Authors' compilation).

2.2 Context: Significance of APSRTC

APSRTC, once the world's largest bus transport operator with a fleet strength of more than 22,000 buses until the year 2014, is a publicly owned corporation providing passenger bus transport services in the Indian state of Andhra Pradesh and other adjoining states in South India. After the bifurcation of the state of Andhra Pradesh into Telangana and the residuary Andhra Pradesh state in 2014, and consequently the bifurcation of APSRTC too, its fleet strength got reduced from 22,145 buses in 2014 to 11,687 buses in 2018. Presently, APSRTC operates with more than 50,000 employees and caters to the travel needs of over 6 million people every day. In 2018, the total bus kilometres (km) operated by APSRTC were more than 1.5 billion, the number of passengers carried was more than 2.4 billion, and the volume of operations was more than 54 billion passenger-km (Pkm) (CIRT, 2018).

3. Analysis and Results

3.1 Trend Analysis

Table 1 presents labour productivity indicators for APSRTC. From 1980 to 2018, APSRTC achieved notable improvements in its labour productivity. APSRTC's bus-km per employee improved at a rate of 2.9 percent per year, whereas its passenger-km per employee improved at a rate of 2.6 percent per year. Year-to-year changes in labour productivity varied significantly around bifurcation time. Bus-km per employee and passenger-km per employee decreased by around 12 percent and 13 percent from 2013 to 2014, respectively, mainly due to the 65-day strike by Seemandhra employees of APSRTC over the

bifurcation of the state. Bus-km per employee and passenger-km per employee increased by almost 24 percent and 23 percent from 2004 to 2005, respectively, due to the low base effect. Improvement in labour productivity can also be gauged from the fact that the number of employees required to work per operational bus decreased from 11.6 in 1980 to 5.0 in 2018. However, employee cost share increased from 34 percent of total operating costs in 1980 to 46 percent of total operating costs in 2018. This is because of the rapid increase in wage rates; the average employee (nominal) wage increased at a rate of 12.2 percent per year from 1980 to 2018, compared to a 6.1 percent per year inflation rate during the same period. It's clearly evident that the increase in real wages for APSRTC employees has been higher than the increase in their labour productivity. In fact, from 1980 to 2018, real wages increased at a rate of slightly more than 6 percent per year, whereas labour productivity increased only at a rate of close to 3 percent per year.

There is a significant improvement in APSRTC's bus productivity as well as fuel productivity (CIRT, 2018). Bus productivity, defined as bus-km per bus held, improved at a rate of approximately 0.7 percent per year from 1980 to 2018 (Table 2). Due to this, the daily utilization of APSRTC buses increased from 280 km per bus in 1980 to 367 km per bus in 2018. However, year-to-year changes in bus productivity varied significantly, particularly around bifurcation time. Daily utilization of buses decreased from 363 km per bus in 2013 to 325 km per bus in 2014 but increased to 373 km per bus in 2015. APSRTC's fleet utilization, or proportion of the number of buses on the road to the number of buses held by the corporation, has been impressive; however, there is a sharp fall in utilization of the fleet from 99.5 percent in 2008 to 92.5 percent in 2018 due to a worsening of its financial performance.

Table 1. Labour productivity in APSRTC.

Year	Bus-km per employee	Pass-km per employee	No. of employees per operational bus	Employee cost share w.r.t. total operating cost (%)	Average employee wage (in Rs. at current prices)
1980	9689	373070	11.6	34.0	6927
1985	10579	437762	10.2	43.6	15474
1990	13030	542258	8.6	44.6	26513
1995	14125	580141	8.1	46.5	47260
2000	16526	587818	7.4	46.5	77149
2001	16911	549193	6.9	44.8	82880
2002	16506	533685	6.9	45.8	91100
2003	18273	609431	6.4	46.6	104347
2004	19011	608678	6.3	46.5	110210
2005	19804	654254	6.1	44.1	115775
2006	20534	707622	6.0	40.8	121219
2007	21183	760465	6.0	43.2	151025
2008	22364	816892	5.8	40.7	145147
2009	23594	882119	5.6	38.5	156768
2010	23914	841064	5.5	44.5	206957
2011	24018	807799	5.6	42.1	212202
2012	23369	815367	5.7	39.3	218381
2013	24355	831731	5.5	37.9	234828
2014	21466	722287	6.0	42.8	244940
2015	26628	886694	5.1	39.5	321454
2016	27349	909553	5.0	45.8	402138
2017	29298	951636	4.7	47.5	481586
2018	28766	1001656	5.0	46.0	545313
CAGR (sample period)	2.9 %	2.6 %	-	-	12.2 %

Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

Fuel productivity, in bus-km per litre of diesel, of APSRTC improved considerably over the years. The fuel productivity of bus transport operators depends not only on exogenous factors such as traffic congestion and road quality but also on endogenous factors such as fleet maintenance and the driving habits of bus drivers (Singh, 2006). That's why the fuel productivity of bus transport operators can be improved by inducting fuel-efficient buses into the fleet, optimizing bus scheduling to reduce dead-kilometrage, adopting better driving practices to minimize fuel wastage, having periodic bus maintenance, and scrapping over-aged fleets (Singh, 2014). The fuel productivity of APSRTC increased from around 4 bus-km per litre of diesel in 1980 to slightly more than 6 bus-km per litre of diesel in 2018, i.e., on average, an improvement of around 1 percent per year during 1980-2018.

However, despite considerable improvement in labour, bus, and fuel productivity, APSRTC faced a precipitous increase in its average operating cost[1]. Table 2 shows that APSRTC's average operating cost increased at a higher rate than the general inflation in the economy during 1980-2018. In general, average operating costs increased at a rate of more than 8% per year, though the average annual inflation rate was only around 6 percent. This is mainly because APSRTC faced an enormous hike in labour and fuel prices. The wage rate rose at a rate of around 12 percent per year, from Rs. 6,927 per employee in 1980 to Rs. 5,45,313 per employee in 2018, while the diesel price increased at a rate of almost 10 percent per year, from Rs. 1.58 per litre in 1980 to Rs. 62.53 per litre in 2018.[2] In other words, APSRTC faced an increase in its (real) average operating cost due to the rapid rise in employees' wages and fuel prices.

Table 2. Bus productivity and average operating cost in APSRTC.

Year	Bus-km per bus held	Bus-km per bus on road	Fleet utilization (%)	Operating cost per bus-km (in Rs. at current prices)	Operating cost per pass-km (in Rs. at current prices)	WPI (2010 = 100.0)
1980	103246	112224	92.0	2.1	0.05	14.2
1985	97689	107588	90.8	3.4	0.08	19.7
1990	108163	111970	96.6	4.6	0.11	28.1
1995	110254	114134	96.6	7.2	0.18	46.3
2000	119904	121730	98.5	10.0	0.28	59.1
2001	114963	116078	99.0	10.9	0.34	61.9
2002	108402	113849	95.2	12.0	0.37	63.5
2003	116710	117569	99.3	12.3	0.37	66.9
2004	119215	120011	99.3	12.5	0.39	71.3
2005	121041	121694	99.5	13.2	0.40	74.7
2006	122099	122995	99.3	14.5	0.42	78.2
2007	126474	127250	99.4	16.5	0.46	82.1
2008	128906	129605	99.5	15.9	0.44	89.2
2009	131282	131819	99.6	17.3	0.46	91.3
2010	130397	130865	99.6	19.4	0.55	100.0
2011	132822	133440	99.5	21.0	0.62	109.5
2012	129522	134113	96.6	23.8	0.68	117.7
2013	132504	132947	99.7	25.4	0.74	124.8
2014	118429	128415	92.2	26.7	0.79	129.0
2015	136251	136885	99.5	30.5	0.92	123.9
2016	126362	136096	92.8	32.1	0.97	123.9
2017	127092	137814	92.2	34.7	1.07	128.1
2018	133772	144652	92.5	41.3	1.18	133.6
CAGR (sample period)	0.68 %	0.67 %	-	8.15 %	8.67 %	6.08 %

Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).
Note: WPI is a wholesale price index.

[1]Average operating cost is defined as the ratio of total operating cost (i.e., total cost net of taxes) to output.
[2] Wage rates and other input factor prices are measured at an annual rate in Indian rupees.

3.2 Measuring Profitability

The profitability performance of APSRTC can be gauged by comparing its revenue to its costs. APSRTC's revenue has two components: traffic revenue, which is earnings from passengers and non-traffic revenue, which is coming from the government subsidy, shops at bus stations, advertisements at bus stations and inside and outside of buses, and any other non-core activity. There are three key components of APSRTC's costs: personnel cost, fuel cost, and capital cost. Besides these, corporations also pay various kinds of taxes to the government, such as passenger tax, motor vehicle tax, and other miscellaneous taxes to the government. Therefore, we can use two different measures of profitability performance: first, financial profitability (defined as total revenue minus total cost or total revenue to total cost ratio) and second, economic profitability (defined as traffic revenue minus operating cost or traffic revenue to operating cost ratio). Financial as well as economic profitability of APSRTC from 1980 to 2018 are presented in Table 3. This table clearly shows that APSRTC faced financial losses in every year during the 2010s and economic losses in every year since 2002. The financial loss incurred by APSRTC in 2018 exceeded Rs. 12 billion, whereas the economic loss was in excess of Rs. 19 billion.

Table 3. Financial and economic profitability of APSRTC; monetary values in rupees million at current prices.

As on 31st March of	Total revenue	Traffic revenue	Total cost	Total operating cost	Financial profit	Economic profit
1980	1358.5	1306.7	1449.9	1229.1	-91.4	77.6
1985	2777.5	2706.2	2750.3	2424.4	27.2	281.8
1990	6750.5	6557.8	6956.7	6230.4	-206.3	327.4
1995	13675.5	13169.2	13548.5	12280.7	127.0	888.5
2000	23332.5	22448.7	24851.0	21592.0	-1518.5	856.7
2001	25402.1	24484.3	27501.6	23814.5	-2099.5	669.7
2002	25756.5	23852.6	28477.2	25119.5	-2720.7	-1266.9
2003	28799.8	26523.6	30617.2	27392.4	-1817.4	-868.9
2004	31212.0	27731.9	31632.2	28239.4	-420.2	-507.6
2005	32158.0	29374.1	34406.4	30787.5	-2248.4	-1413.4
2006	36763.7	31925.9	37191.6	34486.2	-427.8	-2560.2
2007	41873.9	36581.9	42992.1	40389.3	-1118.2	-3807.4
2008	44575.6	38791.4	43218.9	40425.4	1356.7	-1634.0
2009	50395.4	42377.0	49287.5	46202.6	1107.9	-3825.6
2010	52062.7	43985.5	57208.2	53849.0	-5145.5	-9863.6
2011	61456.9	52054.7	64630.7	60718.0	-3173.8	-8663.3
2012	66774.0	57082.7	72627.1	68306.3	-5853.1	-11223.6
2013	76391.9	65156.6	77199.0	75751.4	-807.1	-10594.9
2014	66032.4	54842.6	74459.3	69925.5	-8426.9	-15082.9
2015	48076.8	41670.4	54028.0	50238.5	-5951.2	-8568.1
2016	49431.5	42582.7	54921.8	52113.4	-5490.3	-9530.7
2017	52504.2	44477.3	60403.5	57470.9	-7899.3	-12993.6
2018	56718.8	45287.9	68772.6	64492.2	-12053.8	-19204.3
CAGR (sample period)	10.3 %	9.8 %	10.7 %	11.0 %	-	-

Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

A unit free measure of the financial and economic profitability of APSRTC from 1980 to 2018 is illustrated in Figure 2. This figure clearly reveals that the downward trend is more severe for economic profitability, particularly from the mid-1990s, though the cyclical pattern is similar to that of financial profitability. APSRTC achieved its highest profitability in 1988; the total revenue to total cost ratio was 1.042, while the traffic revenue to operating cost ratio was 1.145. In other words, APSRTC's total revenue has never exceeded 4.2 percent of its total cost since 1988. Presently, the corporation is able to recover only 82.5 percent of the total cost. APSRTC's economic profitability performance was better than its financial profitability performance until the early 2000s. A worrying trend has started since 2006: APSRTC's economic profitability has been worse than its financial profitability for the last thirteen years. In 2018, APSRTC could recover only 70 percent of its operating costs through traffic revenue, the worst in the

history of the organization since its inception in 1958. In fact, APSRTC has faced a worsening situation, as far as financial as well as economic losses are concerned, in recent years, leading to a severe financial crisis in the organization.

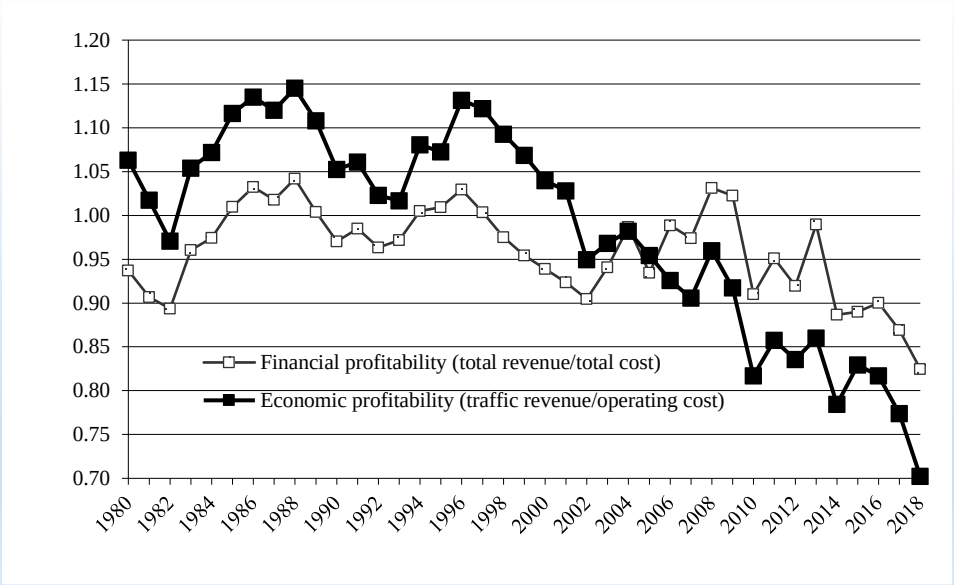

Figure 2. Fluctuations in Financial and Economic Profitability of APSRTC from 1980 to 2018.
Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

3.3 Measuring TFP of APSRTC

As explained earlier, we used the Tornqvist-Theil index[3] to measure the productivity (TFP) of APSRTC from 1980 to 2018. Equation (3) is used for the same.

$$ln\left(\frac{TFP_T}{TFP_{T-1}}\right) = ln\left(\frac{Y_T}{Y_{T-1}}\right) - \sum_j \left(\frac{S_{jT}+S_{jT-1}}{2}\right) ln\left(\frac{X_{jT}}{X_{jT-1}}\right) \quad (3)$$

where, *TFP* is total factor productivity, *T* is time period, Y_T is output index at T^{th} period, X_{jT} is input index of j^{th} input at T^{th} period, S_{jT} is input cost share of j^{th} input at T^{th} period, *j* = labour, diesel, and bus, and *T* & *T-1* are adjacent time periods.

For this study, we applied one output, passenger-km, and three inputs, total number of employees, total quantity of diesel used, and total number of buses held, to compute the annual TFP indices for APSRTC from 1980 to 2018. Equation (3) is used not only to compute the TFP indices but also to construct output and aggregate input indices. These indices are normalized so that their value in 1980 was 1. Figure 3 presents APSRTC's TFP, output, and aggregate input indices. As evident from this figure, APSRTC experienced, on average, a 1.5 percent per year increase in its TFP during 1980-2018, though TFP increased at a rate of only 1.3 percent per year in the first half of the sample period (1980-2000), but increased at a rate of close to 1.9 percent per year through the second half of the sample period (2000-2018), mainly due to rapid improvement in its productivity during 2004-2009 and 2016-2018. That's why APSRTC's TFP in 2018 was 78 percent higher than it was in 1980.

[3] For details, including the main economic theoretic properties of the Tornqvist-Theil index, please refer to Diewert, 1976; Caves et al., 1982a, 1982b; Selvanathan, 1989; Prescott, 1998; Singh, 2002; Singh, 2006; Singh, 2014; O'Donnell, 2018; Walden et al., 2022.

Nevertheless, APSRTC's TFP growth varied significantly across different time periods; TFP grew, on an average, at the rate of 2.6 percent per year during 1980s, 0 percent per year during 1990s, 2.4 percent per year during 2000s, and 1.2 percent per year during 2010s. TFP grew incessantly during 1982-1990 (4.4 percent per year), 2004-2009 (6.0 percent per year), and 2016-2018 (5.8 percent per year). Rapid growth in TFP during 1982-1990 and 2004-2009 was due to tremendous growth in output (12.1 percent and 6.6 percent per year, respectively) in comparison to aggregate input (7.4 percent and 0.6 percent per year, respectively), whereas TFP growth during 2016-2018 was mainly due to a reduction in aggregate input (5.1 percent per year) rather than an increase in output (0.4 percent per year).

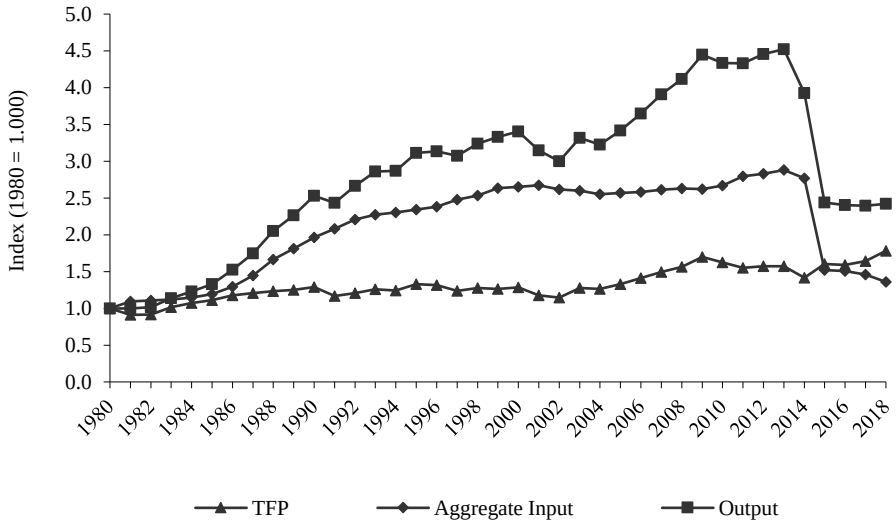

Figure 3. The rise and fall of TFP, output and aggregate input in APSRTC.
Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

It is worthwhile to note that APSRTC's output and inputs were reduced to almost half of their previous levels after its bifurcation into two corporations in 2015, one for Andhra Pradesh (APSRTC) and another for Telangana (Telangana State Road Transport Corporation, TSRTC). Due to the bifurcation of the corporation, APSRTC's employee strength reduced from 1,22,176 in 2014 to 61,806 in 2015; its fleet strength reduced from 22,145 in 2014 to 12,079 in 2015; and consequently, diesel consumption reduced from 432.8 million litres in 2014 to 263.4 million litres in 2015. As a result, the total number of passengers travelled by APSRTC buses reduced from 4,038 million in 2014 to 2,319 million in 2015, bus-km reduced from 2,623 million in 2014 to 1,646 million in 2015, and passenger-km reduced from around 88 billion in 2014 to 55 billion in 2015. This shows that the reduction in output from 2014 to 2015 was lower than that in inputs; in fact, from 2014 to 2015, APSRTC's aggregate input reduced by 45 percent whereas output, passenger-km, reduced only by 38 percent; as a result, TFP increased by 13 percent, the highest ever, due to bifurcation and consequently restructuring of the corporation.

3.4 Measuring TPP of APSRTC

As explained earlier, TPP is defined as the ratio of the input price index to the output price index, where the input price index is the ratio of the operating cost index to the aggregate input quantity index, and the output price index is the ratio of the traffic revenue index to the output quantity index. Figure 4, which shows APSRTC's input and output price indices, clearly reveals that the input price index is higher than the output price index for every year of the sample period except for 1981. Moreover, these two price

indices have diverged from each other since mid-1980s; the divergence has been very prominent from 2001 onwards. From 1980 to 2001, passenger fares charged by APSRTC increased by 496 percent, while the increase in its input prices was 625 percent. But from 2001 to 2018, the increase in input factor prices was 433 percent in comparison to only a 140 percent increase in passenger fares during the same period.

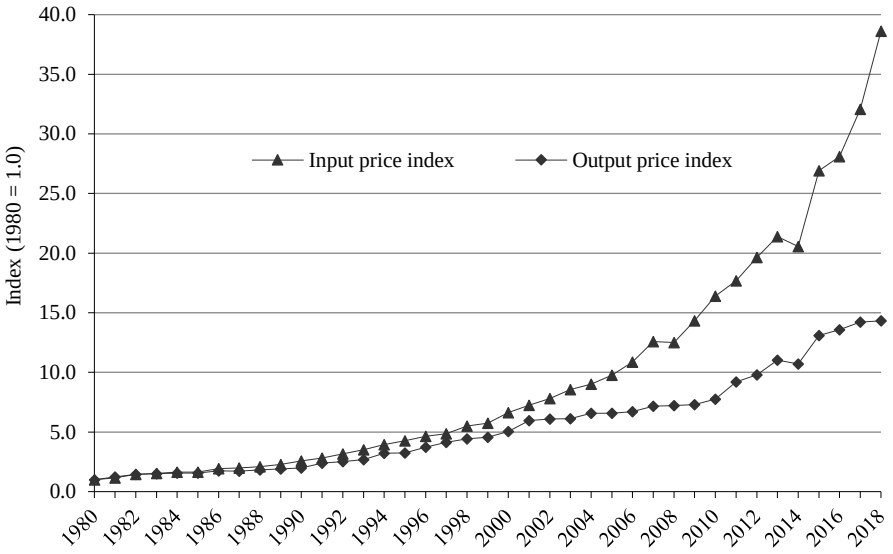

Figure 4. Divergence in input and output price indices.
Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

Figure 4 clearly reveals that APSRTC faced an enormous increase in its input factor prices, far more than the rise in passenger fares. That's why its TPP index was consistently above 1 in almost every year from 1980-2018. Figure 5 reveals that APSRTC's TPP index has an increasing trend; the TPP index increased 27 out of 38 times during the sample period. Due to this, APSRTC's TPP index in 2018 was 170 percent higher than it was in 1980. The TPP index increased only by 22 percent from 1980 to 2001, but increased by 121 percent from 2001 to 2018 due to the rapid increase in input factor prices in comparison to the fare charged by the corporation.

3.5 TFP, TPP, and Economic Profitability Patterns

As explained earlier, economic profitability depends on TFP and TPP; ceteris paribus, economic profitability is positively related to TFP and negatively related to TPP (Oum and Yu, 1998; Grifell-Tatjé and Lovell, 1999; Singh, 2001; Singh, 2006; O'Donnell, 2018; Ekerhovd and Gordon, 2020). Table 4 presents the proportionate change in APSRTC's economic profitability during different time periods and how the same is linked with the proportionate change in total factor productivity and total price performance. It's clear that TFP as well as TPP grew more or less at the same rate during the 1980s and 1990s; that's why APSRTC's economic profitability performance in 2000 was more or less the same as it was in 1980. APSRTC's traffic revenue in 2000 was 4 percent more than its operating cost, slightly lower than that in 1980, 6.3 percent. APSRTC's total price performance changed dramatically vis-à-vis its productivity performance during the 2000s and 2010s. From 2000 to 2010, TPP increased at a rate of 4.88 percent per year, significantly more than the increase in TFP during the same period (2.37 percent per year). Consequently, the economic profitability, or traffic revenue to operating cost ratio, of APSRTC worsened

from 1.04 in 2000 to 0.82 in 2010. The situation worsened further during the 2010s due to a greater increase in TPP vis-à-vis TFP; the traffic revenue to operating cost ratio went down from 82 percent in 2010 to just 70 percent in 2018.

Table 4 also reveals that APSRTC's TFP increased at a lower rate than its TPP during the 1980s, 1990s, 2000s, and 2010s, though the differential was negligible during the 1980s and 1990s whereas the differential widened significantly during the 2000s and 2010s. Due to this, APSRTC's economic profitability worsened, on average, at a rate of marginally more than 1 percent per year from 1980 to 2018, despite the fact that its TFP grew at a rate of 1.5 percent per year during the same period. That's why APSRTC has not achieved an economic profitability level of 1 or more since 2001.

Figure 5 reveals that APSRTC's TPP index exceeds 1 for every year from 1982 onward and, in general, follows an upward trend. This implies that either APSRTC's TFP growth allows it to not increase passenger fares as much as the rise in prices of input factors or it will face a deterioration in its profitability. Theoretically, when TFP growth is less than TPP growth, the profitability of the firm deteriorates. This is amply clear from the data presented in Table 4: APSRTC's economic profitability worsened for those periods when TFP growth fell behind TPP growth. For instance, from 2001 to 2010, APSRTC's TFP and TPP grew at a rate of 3.64 percent and 6.32 percent per year, respectively; as a result, its economic profitability worsened at a rate of 2.50 percent per year during the same period.

One may observe from Table 4 data that APSRTC's TFP grew in excess of 4 percent per year during 1982-1990 and around 6 percent per year during 2004-2009 and 2016-2018. However, its economic losses, the traffic revenue to operating cost ratio, worsened from 2004 (98.2 percent) to 2009 (91.7 percent) and from 2016 (81.7 percent) to 2018 (70.2 percent). From 2004 to 2009, TPP increased at a rate of 7.50 percent per year, far higher than the increase in TFP (6.04 percent per year), leading to a deterioration in the economic profitability of APSRTC at a rate of 1.36 percent per year. Similarly, from 2016 to 2018, the TPP index increased from 2.07 to 2.70, an increase of 30 percent, far more than the increase in the TFP index (12 percent), resulting in a 14 percent decrease in the economic profitability of APSRTC. It seems that during these periods, political forces constrained APSRTC from raising passenger fares when TFP growth was reasonably high but not good enough to offset the increase in input prices. As a consequence, in a span of just fourteen years from 2004 to 2018, APSRTC's economic profitability worsened by almost 28.5 percent despite the fact that its productivity increased by almost 41 percent. That's why APSRTC's traffic revenue in 2018 was hardly sufficient to cover 70 percent of its operating costs. Moreover, APSRTC's financial losses, or total revenue to total cost ratio, also worsened significantly from 98.7 percent in 2004 to 82.5 percent in 2018. In monetary terms, the financial loss incurred by APSRTC in 2018 was in excess of Rs. 12 billion, the highest ever in the history of the corporation.

Table 5 presents correlation coefficients between economic profitability and various indicators of productivity, including TFP[4]. Correlation coefficient values clearly show that TFP and partial factor productivity indicators (labour, bus, and fuel productivity) are highly positively associated with each other, with almost identical movements in TFP and labour productivity. The correlation matrix also reveals an implausible relationship between economic profitability and productivity. That is, economic profitability is statistically significantly (negatively) correlated with total factor productivity and all indicators of partial factor productivity. In other words, APSRTC's profitability and productivity have moved in opposite directions in a statistical sense. This is because, as discussed earlier, APSRTC faced growing input prices

[4] The Correlation coefficient, *r*, measures the degree of linear association between two variables. A simple way to test the null hypothesis that the correlation coefficient is zero can be obtained using the t-test. In this case, when the number of observations is 39, if $-0.37 \geq r \geq 0.37$, then we could infer that at the 1 percent level of significance, the two series are 'correlated' and the non-zero correlation did not happen by chance.

and was unable to offset them by productivity gains, though productivity increased but at a lower rate than total price performance; as a result, its profitability went down despite the increase in productivity. That's why APSRTC's profitability and productivity are highly negatively correlated.

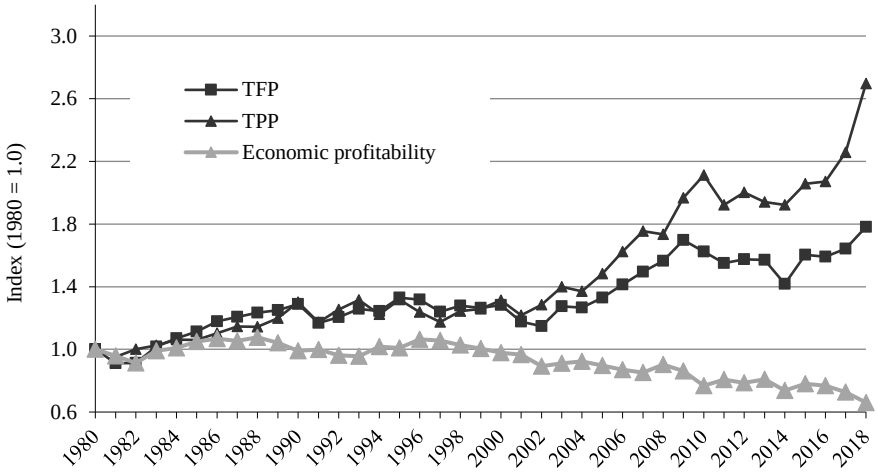

Figure 5. Comparison of APSRTC's economic profitability, TFP, and TPP.
Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

Table 4. Proportionate change in TFP, TPP, and economic profitability of APSRTC.

Year	**TFP** Compound annual growth rate (%)	**TPP** compound annual growth rate (%)	**Economic profitability** compound annual growth rate (%)
1980-1990	2.57	2.67	-0.10
1990-2000	-0.04	0.08	-0.12
2000-2010	2.37	4.88	-2.38
2010-2018	1.17	3.10	-1.87
1982-1990	4.39	3.34	1.02
2004-2009	6.04	7.50	-1.36
2016-2018	5.80	14.13	-7.30
2001-2010	3.64	6.32	-2.52
2010-2016	-0.33	-0.34	0.01
1980-2018	1.53	2.64	-1.09

Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

Table 5. Correlation matrix.

	Economic profitability	Total factor productivity	Labour productivity (Pass-km per employee)	Bus productivity (Bus-km per bus held)	Fuel productivity (Bus-km per litre of diesel)
Economic profitability	1.00				
Total factor productivity	-0.74	1.00			
Labour productivity (Pass.-km per employee)	-0.82	0.98	1.00		
Bus productivity (Bus-km per bus held)	-0.76	0.93	0.95	1.00	
Fuel productivity (Bus-km per litre of diesel)	-0.85	0.93	0.96	0.92	1.00

Source: Authors' compilation from the data extracted from the performance statistics of STUs, CIRT (2018).

4. Conclusions

This study attempts to understand whether productivity really matters for profitability by examining the annual time series data of a publicly owned bus transport corporation, APSRTC, once the world's largest bus transport corporation. We utilize firm-level annual data of STUs (CIRT, 2018) using a non-parametric index number approach, which has the advantage of not requiring econometric specification and estimation. Analysis reveals that, in spite of the productivity gains achieved by APSRTC, the prices it has to pay for the factor inputs exceed the prices it receives for its services. This indicates that APSRTC has passed on all productivity gains to its passengers. Following are the salient insights:

- From 1980 to 2018, although APSRTC achieved significant improvements in labour, fuel, and bus productivity, its average operating cost increased at a higher rate (8.67 percent per year) than the inflation rate (6.1 percent per year) in the economy. This is mainly because the average employee wage increased at a rate of 12.2 percent per year during the same period.
- The rapid rise in wage rates in APSRTC resulted in a significant increase in employee cost share, from 34 percent of total operating costs in 1980 to 46 percent of total operating costs in 2018.
- APSRTC achieved, on average, 1.5 percent per year improvement in its TFP from 1980 to 2018. Still, its economic profitability worsened at a rate of 1.1 percent per year because input prices, in comparison with fare rates, increased at a rate of 2.6 percent per year during the same period.
- As a consequence, the traffic revenue to operating cost ratio worsened from 106 percent in 1980 to 70 percent in 2018.
- In 2018, APSRTC faced a loss in excess of Rs. 12 billion despite the fact that its TFP increased at a rate of 2.5 percent per year during the last five years.

It seems that political forces constrained APSRTC from raising passenger fares when productivity gains were not good enough to offset the rise in input factor prices, particularly during the second half of the sample period, specifically just before and after the state's bifurcation in 2014. This is not sustainable; passenger fares need to be adequate to sustain the corporation in the long run. Otherwise, APSRTC will find it hard to respond to the transportation needs of the public. In general, incessant loss-making adversely affects both quality and quantity of services; without improving profitability performance, APSRTC would be forced to operate with buses, which have long outlived their utility, resulting in poor quality passenger transport services.

Future research should look into further investigating the relationship between profitability and productivity trends for other state transport undertakings and possibly analytically comparing performance across other countries to see if price performance plays a similar role in the interplay of productivity and profitability. Also, it would be interesting to see if aggregate output, input, and/or TFP series exhibit business cycles over the period by applying filtering exercises to separate the trend from the cyclical fluctuations and then computing percent deviations from the trend. Similar filtering can be done on the price series and/or TPP to check for cyclic patterns. Future research can also hypothesize a functional form of relationship involving economic profitability as the y-variable and TPP and TFP as the x-variables. Further studies could also utilize parametric approaches to estimation, including the stochastic frontier approach, as well as explore the determinants of productivity and profitability. Further research is also required to understand how sustainability can be achieved in productivity and profitability performance, both in the short and long run.

Conflict of Interest

The authors declare that there is no conflict of interest.

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