ARTICLE IN PRESS

Research in Transportation Business & Management xxx (xxxx) xxx

Contents lists available at ScienceDirect

Research in Transportation Business & Management

journal homepage: www.elsevier.com/locate/rtbm

# Long run productivity and profitability in the British bus industry

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A R T I C L E I N F O

*Keywords:*
British bus industry
Malmquist productivity indices
Corrected ordinary least squares
Economic profits
Re-regulation
Declining technical change

A B S T R A C T

The passing of the Transport Act 1985 deregulated and privatised the bus industry in Great Britain outside of London, however failed to address the prime specified aim of reversing the long run decline in patronage. Review of the literature suggests one of the main reasons for this was due to subsequent industry consolidation that resulted in anti-competitive market structures and outcomes, i.e. inefficient production and fare levels that resulted in monopoly profits.

In the current study, the British bus industry is analysed over the period 1994 to 2016 through the estimation of long run Malmquist productivity indices and supplementary profit data in order to look for evidence of such inefficient market outcomes. From the mid-point of the period reviewed however, the results for London are entirely consistent with the opposite, i.e. efficient market outcomes. This is also found to be the case for the deregulated areas, but the most striking characteristic in these areas are consistent and continual technical change declines. This is clear evidence of long-term structural decline. The policy implications are that any policy measures should be part of a package of wider policy actions that seek to improve the underlying economics of bus service provision in Great Britain. From an albeit limited amount of past research, this would appear to lie in the direction of proactive public transport initiatives and car use limiting measures.

## 1. Introduction

The Transport Act 1985 privatised and deregulated the bus industry in Great Britain outside of London with the intention of reversing the long-term decline in bus patronage. This was to be achieved primarily through the creation of a competitive industry, which would compete for patronage through the economic principles of contestability and consumer sovereignty. Over thirty-five years and an abundance of Competition Commission inquiries later, such outcomes seem further away than ever. This has recently led to the passing of the Bus Services Act 2017 in England and the Transport Act 2019 in Scotland,[1] both of which open up the possibilities for re-establishing a regulatory framework that would control market entry through competitive tendering. 'Bus Back Better' (DfT, 2021), the main strategic policy document in England, further envisages actively implementing these powers in that part of the UK. As such, this would replace the current system of (in theory) open market entry with 'competition for the market', and thereby through competitive pressures, reverse the decline in patronage. This of course assumes that the industry is currently characterised by profiteering monopolists, and thus the solution lies in increasing competitive pressures.

Such a view is reflected in previous academic studies on the British bus industry, which over time have generally highlighted essentially anti-competitive market outcomes, in particular rising real fares; increased profit levels (White, 1997); rising real costs (White, 2009); significant reductions in seller concentrations (Cowie, 2002). Some of these studies can now be considered as dated, yet there has been no subsequent re-evaluation of the findings over the longer term. Furthermore, the potential success of any of the proposed regulatory measures outlined above are entirely based upon the rationale that the bus industry has continued to produce outcomes that reflect a monopoly rather than a competitive market structure.

Two key outcomes of a competitive market however are efficiency in production and the return of 'normal' economic profits. The main aim of the paper therefore is to examine for any such evidence of these through a long run assessment of productivity/efficiency of bus operations, supplemented by an analysis of profit margins.

The next section gives an overview of the research literature on the evolution of the British bus industry since the Transport Act 1985, structured around the key ideas of consolidation of the industry,

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[1] In this context The Bus Services (Wales) Bill 2020 should also be noted, but this was withdrawn in July of that year in light of the impact of the Covid-19 pandemic and associated lockdown.

https://doi.org/10.1016/j.rtbm.2022.100911
Received 21 July 2021; Received in revised form 3 November 2022; Accepted 9 November 2022

outcomes as a consequence of consolidation and more recent developments. The analytical framework is then developed, results presented, conclusions drawn and policy recommendations made.

## 2. Literature review - merger, acquisition and monopoly profits

Whilst the Buses Bill 1984 initially envisaged limited on road competition following privatisation and deregulation of the industry, in the main the beneficial effects of competition were predicted to emerge through the creation of contestable markets. Hence consistent with contestability theory (Baumol, 1982), it would be the threat of competition that would produce desirable market outcomes. Nevertheless, Beesley (1991) very early identified major barriers to entry in the form of bus depot location in the support of on road services; the vertical integration of bus ownership and operation; and previous vehicle and operator licensing requirements that remained in place after the 1985 Act. As such, these barriers would severely compromise contestability of the market. Thus whilst the regulatory framework had considerably opened up market entry possibilities, the author argued that competition (or the threat of it) would still not arise unless the underlying constraints were also tackled. Subsequent events proved this an astute observation, as only very limited on road competition emerged (Langridge & Sealey, 2000), in turn implying limited contestability. Perhaps significantly, McGuinness, Gillingwater, and Bryman (1994) in a study of nine British bus companies, further highlighted that the capacity of an individual bus company to achieve the level of internal stability required to meet competition (if it did emerge), adapt to changing market conditions and to expand operations was severely compromised by the underlying poor financial health of such concerns. With the benefit of hindsight, this would suggest that some form of industry consolidation was inevitable.

It was in this respect that competition did emerge, in the form of company merger and acquisition, hence rather than compete in the market or for the market, a competitor and associated market was subsumed by a rival, i.e. classic oligopoly behaviour. What followed therefore was a period of considerable merger and acquisition, with Cowie (2002) reporting bus company sales peaking at 96 over the period 1994 to 1996. This took place despite a high number of referrals to the then Monopolies and Mergers Commission (now the Competition and Markets Authority), but such interventions by the regulatory authorities had only a very limited impact on the process. White (1995) similarly highlights the emergence of major operators in the form of Stagecoach, GRT and Badgerline (who merged to form Firstbus), the British Bus Group (subsequently acquired by Arriva) and Go Ahead, all of which obtained stock market listings and broadly still represent the main holding companies in the industry today. The author also highlights the clear conflict between the aims of competition policy and the pattern of ownership that emerged.

In terms of outcomes from the early privatised era, White (1995, 1997) reported patronage declines in all the deregulated areas, but strong increases in London, which was partly explained by higher car accessibility growth rates in the former locations. Fares were found to have risen in real terms in all areas (i.e. including the regulated London market), as well as large reductions in costs during the immediate period following deregulation (1985/86 to 1989/90), but significantly lower savings in the three years that followed (to 1993/94). Figures on profitability suggested initially very low margins, but rapid increases over the post privatisation period, rising to 9% by 1993/94, and a stated long-term requirement of a 15% profit margin (by Stagecoach) to meet capital needs. In a comparison of the English and Scottish bus markets, similar trends in costs were found by Cowie and Asenova (1998), as well as real fare increases and increasing profitability. The authors also noted that whilst deregulation had increased competition in Scotland in the short term, privatisation had allowed consolidation to occur over the longer term, thereby reducing the level of competition and leading to a deregionalisation of bus services in Great Britain.

More recent research tends to reflect the same themes of general decline, although do provide a number of points of further interest. White (2009) for example not only confirms continued decreases in patronage outside of London, but highlights net reductions in bus kilometres in the deregulated areas and fare increases and rising costs across all areas. Cowie (2014), in an empirical study into the presence or otherwise of the theorem of consumer sovereignty in the industry, found very little evidence of it, but categorised 28% of operators as 'mature marketers', with the general perception that the sustainability of operations was based more on the revenue generated than the profit or the potential the market offered. There was also a concern that such operators could do very little to improve the situation, hence almost a position of consumer apathy rather than one of sovereignty. Van de Velde and Wallis (2013) on the other hand, noted that whilst the industry had built up a very negative image as a consequence of continued declining passenger numbers and rising real fares, did find clear evidence of proactive public transport policies (that restricted car usage) that had a significantly positive impact on patronage levels. As regards the London regulated market, Amaral, Saussier, and Yvrande-Billon (2013) found strong evidence of the tendering framework delivering competitive contract rates, with further studies suggesting that this has been maintained over time (Iossa & Waterson, 2019).

With some minor exceptions therefore, all of the above literature relating to the deregulated areas generally reflects the theory of an inefficient market in bus operations, and suggests that the reform of the provision of bus services in London has met with more success in terms of desirable market outcomes.

## 3. Operator level analysis

### 3.1. Analytical framework

In what follows, the extent to which the bus industry produces outcomes consistent with a competitive market is assessed on the basis of the following theoretical framework. In very basic terms, an economically efficient market will produce three key outcomes, as illustrated in Fig. 1.

Hence at the most basic level, this will result in efficiency in production of the output, which given prevailing (competitive) market conditions, will lead to an 'efficient' market price. This represents the lowest price that retains operators in the industry, and thus results in 'normal' (rather than excessive) economic profits. These returns maintain the capital base to allow for future investment and provide a 'fair' return for the business risk taken.

From an empirical perspective however, the above framework raises a number of questions, all mainly surrounding the extent to which each component can actually be assessed. Beginning with profits, how can it be established that a given level may or may not represent 'normal' economic profits? Whilst there is no 'absolute' measure, one simple solution is to compare profit levels between a sector of the market where it is believed strong competitive pressures exist (through for example the existence of regulated contestability, i.e. Demsetz competition

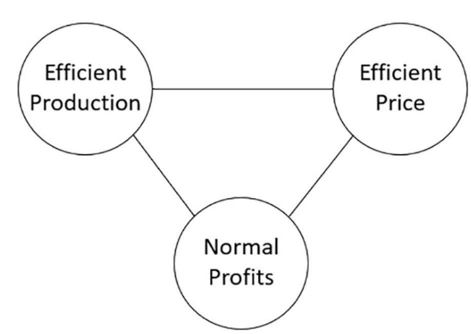


**Fig. 1.** Efficient market outcomes.

(Demsetz, 1973)), with profit levels in the sector(s) under assessment. If the two (roughly) equate, this would suggest normal profits. This is the approach taken in Section 3.4.

As regards the issue of 'efficient' production, can this only be established when all firms achieve 100% efficiency? Those familiar with efficiency assessment will understand that for a variety of reasons such a situation is simply not attainable. Rather than actual efficiency levels therefore, what is important is an assessment of the efficiency profile over time, and hence the extent to which it can be established that all 'inefficiencies' have been eradicated. At this point it is useful to draw the distinction between productivity and efficiency, where the former represents long run real productivity gains and the latter short run catch up to, or fall backs from (i.e. inefficiency), best practice. This is where use of the Malmquist Productivity Index (MPI) is key to any assessment. This breaks down total factor productivity change (TFP) into efficiency change (EC) and technical change (TC), where EC represents the change in the relative position of the individual firm to the efficiency frontier. TC on the other hand represents frontier shift, i.e. 'real' productivity gains, and provides insights into the longer-term development of the market/industry. In the case of positive frontier shifts, this also creates productive inefficiencies, as a few select innovative firms advance 'best practice'. A competitive market however will force other firms to eradicate such inefficiencies quickly (EC gains), either as a consequence of adoption of best practice or through merger, acquisition or even ultimately bankruptcy. In the current study therefore, the MPI is the tool used to assess efficiency/productivity.

That leaves the issue of an efficient market price, but whilst this is almost impossible to determine directly, it can be assessed indirectly through examination of the other two components. To put simply, if profit levels are normal and there is efficiency in production, then it follows the market price must be efficient; in other words, we have one degree of freedom. As such, the empirical assessment reduces to examining production efficiency and profit levels.

### 3.2. Data and sources

The structure of the data reflects the structure of the bus industry in Great Britain, which consists of a number of holding companies, such as Stagecoach and Go Ahead, who wholly own a large number of subsidiaries, with operations administered through the latter. Subsidiaries also represent the legal identities used for both regulatory purposes with the Department for Transport and for financial reporting requirements. As a consequence, all data is reported at subsidiary level, i.e. fleets, staffing levels, operating revenue etc., rather than holding company level. Outside of these larger groupings, there also exist a small number of private limited operating companies and a few wholly owned (by local authorities) municipal operators, where the data is again reported at the operating company level. The period reviewed covers 1994 to 2016, with 1994 taken as the starting point as the literature strongly suggests that from that point onwards the industry may be considered to be in a more stable long-term position (e.g. Cowie, 2002; White, 1995), rather than one subject to short to medium term adjustments following deregulation/privatisation. London may be the exception, as competitive tendering was gradually rolled out from the mid-1990s onwards.

Subsidiary/operating company data was compiled from the annual TAS Bus Industry Monitor (see for example TAS (2021)), and generally represents a balanced panel that at the base includes 77 companies/subsidiaries over the full time period. Analysis is undertaken by area, hence breaks down into five areas split between 7 London based firms, 13 English Metropolitan (i.e. the former PTEs[2]), 44 English Other, 14 in Scotland and 4 in Wales. A concern however was that the English Other category may contain a high degree of heterogeneity of operations, hence a further division made which resulted in a re-classification of 10 subsidiaries operating in the larger cities e.g. Bristol, Leicester, Nottingham, Hull etc. At the modelling stage however, no significant differences were found between this grouping and the subsequently revised English Other, hence the two re-augmented and no distinction drawn between the two. One issue identified was that whilst diversity of operations does exist in the group, a high proportion of this is encapsulated within subsidiaries themselves rather than across subsidiaries.

Whilst technically a balanced panel, over the period studied there have been a number of re-organisations in terms of changes of ownership and the transfer of depots and associated operations from one subsidiary to another. In several of these cases this has been either through amalgamation of existing, or the creation of new, subsidiaries.[3] As such, the dataset cannot be considered to be entirely balanced, but in many respects this simply reflects the nature of the reality being studied.

In any productivity assessment, the output specified should reflect the aim of the firm. In the literature however, there has been considerable debate as to whether this is best encapsulated by a demand side measure, such as patronage, or a supply side measure, such as vehicle kilometres (see as an example Oum & Yu, 1994). In a deregulated bus market, it can be strongly argued that profit maximisation is far closer tied to patronage, and hence a demand side measure be used. The problem however, is that in Britain there exists a significant level of services that are directly contracted by the transport authority; virtually all services within London as well as those outside of the capital deemed by the local authority to be socially necessary but unprofitable. Over the period studied, these represent 27% to 33% of all bus kilometres provided, with London in particular accounting for a high share of the total. Whilst it can be strongly argued that for such services a supply based measure should be used, De Borger, Kerstens, and Costa (2002) highlight that there is a strong interdependency between demand and the spatial and quality attributes of supply as well as the appropriate specification of technology employed in the provision of public transport services. The basic argument is that this is best 'captured' by a demand based variable, as the level of supply (even in a planned transport market) is ultimately dependent upon demand. Hence whilst not ideal, a patronage measure may be considered to be a compromise between the primarily demand driven deregulated areas and the primarily supply specified contracted sector.

A further problem in Britain however, is that due to commercial sensitivity patronage levels are not available at the subsidiary/operating company level. What is available is annual revenue, however variations in revenue across time periods could potentially reflect changes in market power rather than any 'real' output changes. In order to correct for this, operating revenue figures have been adjusted by the bus price index by area.[4] What this should represent is real bus revenue at a constant price over the whole period, and as such, a reliable proxy for the level of passengers carried. In order to provide a degree of corroboration however, aggregated (by area) sample figures were compared with a compilation of government (total) patronage figures by area (see e.g. DfT, 2018). The highest correlations were found in London (0.90) and English Metropolitan (0.89), followed by Scotland (0.63) and Wales (0.55). The lowest was found in the English Other category (0.38), which following on from above mostly likely reflects the diversity of operations contained within subsidiaries in these areas (as is probably also true to a lesser degree in Scotland and Wales). Nevertheless, all correlations were found to be statistically significant at the 5% level and hence the variable deemed to be a reasonable proxy with regard to patronage levels across the whole time frame reviewed.

[2] Specifically these relate to six major conurbations centred on Manchester, Leeds, Birmingham, Sheffield, Newcastle and Liverpool, where in some cases the PTE has been replaced by a Combined Authority.

[3] Stagecoach Scotland being a good example, formed in 1994 it 'absorbed' the four main existing Stagecoach subsidiaries in Scotland in 1997, before being abolished in 2014 and split back into four separate subsidiary companies.

[4] See ONS (2011) for a full description of the bus fare index.

In terms of inputs, De Borger et al. (2002) found a wide variability of inputs and outputs used to represent urban production technology. This suggests that there is no generally accepted set of relevant variables applicable to the bus industry. In this case, a simple two input model is specified consisting of labour and fleet sizes, the basic argument being these are the two key inputs and all other input factors are closely associated with one or the other. This two input structure has also been extensively used in other studies (see for Fazioli, Filippini, & Prioni, 1993, Farsi, Filippini, & Kuenzle, 2006, Viton, 1997 and Costa & Markellos, 1997), with some even using fewer (e.g. Lijesen, 1998; Matas & Raymond, 1998). In terms of staff, this is a head count figure that includes management and operational staff, but does not include contract labour, although its use in the bus industry is limited. Fleet sizes were compiled by TAS up until 2012, but have not been reported since, hence over time this has been periodically gathered from internet searches and other sources.[5] The measure has been regularly used as an indicator of capital in the provision of public transit services in previous studies (see for example Costa & Markellos, 1997; Nolan, Ritchie, & Rowcroft, 2002), but does not reflect the age or capacity of the vehicles. This however will be largely reflected in the productive efficiency of the firm, as older vehicles require higher maintenance and hence will have a higher level of non-productive down time.

### 3.3. Productivity and efficiency analysis

Various approaches can be taken to the assessment of productivity/efficiency in public transport operations, which (De Borger & Kertens, 1996) usefully categorises into a dichotomy of 'parametric technology' and 'non-parametric technology'. The main difference between the two being the requirement in the former of an underlying econometric model of production., i.e. underpinned by economic production theory. This dichotomy is broadly reflected in the main methods that have appeared in the academic literature. De Borger et al. (2002) for example in a review of 40 studies into the efficiency of public transit operations found eleven used stochastic frontier analysis (SFA), seven corrected ordinary least squares (COLS) (both examples of parametric technology) and fifteen employed data envelopment analysis (DEA) (an example of non-parametric technology). Likewise, Brons, Nijkamp, Pels, and Rietveld (2005) in a review of 33 efficiency studies on public transit, found 10 employed SFA, 5 used COLS and the remaining 17 some form of DEA. This would suggest there is no one 'single' method by which such systems should be assessed.

In a similar vein, various approaches can be taken to the measurement of the Malmquist Productivity Index (MPI), but following Fåre, Grosskopf, Norris, and Zhang (1994) the one most commonly applied is to estimate the underpinning efficiency levels using data envelopment analysis (DEA). Whilst this is a valid approach, it does nevertheless lack a theoretical underpinning that can lead to difficulties in interpreting and contextualising some of the results. In particularly, the method fails to distinguish between technical change as a long run concept and efficiency as a short run measure (see Cowie, 2018 for a critical case study). The approach taken here therefore is to use an econometric method, i.e. estimation of a production function, with efficiencies calculated using a corrected ordinary least squares (COLS) specification. The more commonly applied and sophisticated Stochastic Frontier Analysis (SFA) could also be used, which divides the residual into a random element (noise) and an inefficiency component. Given however that productivity analysis is a year-on-year comparison, experience tends to suggest that in this context the stochastic element to some extent models away efficiency change, which is one of the key elements under study. See Cowie (2018) and Coelli, Prasada Rao, and Battese (2005) for examples. In the course of the current study, an MPI was initially estimated underpinned by SFA efficiency estimates, and this aspect found to be present, hence the preference for the COLS specification.

Production is assessed through estimation of a production function where:

$$Q = f(X) \tag{1}$$

The level of output, Q, is a function of the inputs X. For estimation purposes, the functional form, i.e. the relationship, between the output and the inputs needs to be specified, with the two most commonly applied being the Cobb Douglas and the Translog functions. The differences between the two are related to the underlying assumptions, where the former assumes unitary elasticities of factor substitution (one factor input can be directly substituted for another across the full output range) and non-varying returns to scale. In this paper, both were initially estimated, before the most appropriate to use identified through a maximum likelihood ratio test. Given the panel nature of the data set, both functions were estimated using a fixed effects model, hence applying this directly to the current issue of two factor inputs for i firms over t time periods gives:

$$LnCAR_{it} = \beta_1 LnL_{it} + \beta_2 LnFS_{it} + \beta_3 \tfrac{1}{2}\ (LnL_{it})^2 + \beta_4 \tfrac{1}{2}(LnFS_{it})^2 +$$

$$\beta_5 LnL_{it} LnFS_{it} + \beta_6 t + \beta_7 \tfrac{1}{2} t^2 + \beta_8 t LnL_{it} + \beta_9 t LnFS_{it} + \alpha_i + e_{it} \tag{2a}$$

With the Cobb Douglas being the special case where:

$$\beta_3 = \beta_4 = \beta_5 = \beta_8 = \beta_9 = 0 \tag{2b}$$

where:

$CAR_{it}$ = Constant annual revenue (proxy for passengers carried) for firm i in year t

$L_{it}$ = no of staff employed by firm i in year t

$FS_{it}$ = Fleet size of firm i in year t

$\alpha_i$ = Unobservable individual specific effects (relating to individual operating subsidiaries/companies)

As discussed above, productivity profiles are assessed across five different areas, hence includes up to four possible step dummies and eight possible slope dummies. The latter are attached to the time variables in order to allow for differences in both the levels and pace of technical change over time across the five areas. Adding these to Eq. (2a) gives:

$$LnCAR_{it} = \beta_1 lnL_{it} + \beta_2 lnFS_{it} + \beta_3 \tfrac{1}{2}(lnL_{it})^2 + \beta_4 \tfrac{1}{2}(lnFS_{it})^2 +$$

$$\beta_5 lnL_{it} lnFS_{it} + \beta_6 t + \beta_7 \tfrac{1}{2} t^2 + \beta_8 t lnL_{it} + \beta_9 t lnFS_{it} + \tag{3a}$$

$$\sum_{k=1}^{4} \gamma_k D_{Area,k} + \sum_{k=1}^{4} \delta_k t D_k + \sum_{k=1}^{4} \tau_k \tfrac{1}{2} t^2 D_k + \alpha_i + e_{it}$$

With the Cobb Douglas again the special case where $\beta_3$ to $\beta_5$ and $\beta_8$ and $\beta_9$ are set to zero.

The four area dummies refer to companies operating in the Scottish, London, English Metropolitan and Welsh areas, hence represent deviations from those in the English Other area. In the course of the estimation however, all Welsh dummies were found to be statistically insignificant and hence dropped from the final model.

In order to assess outright productivity changes, any changes due to variable returns to scale need to be neutralised (Coelli et al., 2005; Hensher & Brewer, 2001), hence the following constraints applied:

$$\beta_1 + \beta_2 = 1 \tag{3b}$$

$$\beta_3 + \beta_5 = 0 \tag{3c}$$

$$\beta_4 + \beta_5 = 0 \tag{3d}$$

$$\beta_8 + \beta_9 = 0 \tag{3e}$$

[5] Such as fleet lists from Woolybus, which is a commercial bus enthusiast website but can be considered to be a highly reliable source for bus fleets.

Efficiency measures therefore relate to CRS efficiency, however given the length of the period under review (23 years), firms may be expected to achieve the minimum efficiency scale. As such, the assumption appears entirely appropriate, although the extent to which this can be achieved may be limited by the size of the local market.

Under a COLS assessment, technical (productive) efficiency is found by adding the largest positive residual to the constant (or in this case, the individual company fixed effect) so that the function becomes a production frontier and bounds all data from above. Each production point is then compared to the relative position on the frontier in order to derive efficiency. Given the logarithmic form of the equation, this is found by the calculation of:

$$TE_{it} = exp\left(e_{it} - e^{MAX}\right) \tag{4}$$

where $e^{MAX}$ is the largest positive residual.

And efficiency change given by a comparison of efficiency in two adjacent time periods s and t, hence:

$$EC_{it} = \frac{TE_{it}}{TE_{is}} \tag{5}$$

Following Coelli et al. (2005), technical change in a given period is derived from the geometric mean of the rate of change of the output with respect to time between adjacent time periods s and t, hence:

$$TC_{it} = \left\{\left[1 + \frac{\partial LnCAR_{is}}{\partial s}\right] \times \left[1 + \frac{\partial LnCAR_{it}}{\partial t}\right]\right\}^{0.5} \tag{6}$$

For completeness, total factor productivity change (TFP), the main overall measure of productivity, is given by the combination of the two:

$$TFP_{it} = TC_{it} \times EC_{it} \tag{7}$$

Hence productivity improvement arises through a combination of technical change and efficiency improvement, although as stated above, increases in TC create inefficiency as best practice is advanced.

### 3.3.1. *Productivity/efficiency results*

For all models estimated, the translog formulation was found to be the more appropriate specification than the Cobb Douglas function, hence only results for the former are presented in Table 1 along with the associated regression statistics.

The likelihood ratio tests indicate that the fixed effects panel data model is the most appropriate, hence all estimates of TFP, TC and EC are derived from this specification. Of the individual parameters, the singular time variable suggests (for English Other and Wales) that 'average' productivity declined by just over 1% per annum in these areas, although the squared time term indicates this was at a (very slowly) reducing rate over the period. In comparison, the time slope dummies for London and Scotland suggest positive gains, although the squared terms again suggest at a declining rate, hence certainly in the case of the latter this may have resulted in declines later in the period.

### 3.3.2. *Productivity analysis*

Results of the productivity analysis are presented in Table 2. These are broken down into each of the five areas examined, with the first figures relating to the whole time period, and then split at 2005 to give first and second half overviews. For information, a summary of the actual technical efficiency averages for the whole sample and by area are given in Appendix 1, however these should be viewed in conjunction with the underlying productivity trends (TC) outlined in this section.

From the figures presented in Table 2, of the five areas, the one that clearly stands out is the London regulated market. Across the whole period, this has experienced annual productivity gains of just under 2% per annum, which in what is a mature market represents significant improvement, particularly given these have been sustained over a relatively long time period. Most of this improvement however has been due to significant increases in technical change. To a large extent this will be due to increased patronage resulting in considerably improved utilisation rates; reviewing the relevant overall figures (e.g. DfT, 2018) suggests an increase of around 45% in terms of bus loadings over the period reviewed. Over the first half of the period, TFP gains are a result of both positive TC and EC changes, with around a 3% annual improvement in TC and just under a 1% annual improvement in EC. The second half suggests a more stable market, and whilst still showing continued TC improvements, these are at a far lower rate, whilst EC

**Table 1**
British bus industry, fixed effects translog production estimates and regression statistics.

| Parameter | Variable | Estimate | T Value | Prob |
|---|---|---|---|---|
| $\beta_1$ | Labour | 0.8589 | 29.4520 | 0.0000 |
| $\beta_2$ | Bus fleet | 0.1411 | 4.8400 | 0.0000 |
| $\beta_3$ | Labour squared | 0.0193 | 1.0730 | 0.2834 |
| $\beta_4$ | Bus fleet squared | 0.0193 | 1.0730 | 0.2834 |
| $\beta_5$ | Labour/Bus fleet | −0.0193 | −1.0730 | 0.2834 |
| $\beta_6$ | time | −0.0116 | −5.5800 | 0.0000 |
| $\beta_8$ | Time squared | 0.0003 | 1.8820 | 0.0598 |
| $\beta_8$ | Time/labour | 0.0035 | 2.4330 | 0.0150 |
| $\beta_9$ | Time/Bus fleet | −0.0035 | −2.4330 | 0.0150 |
| $\gamma_1$ | Scot step dummy | −0.0879 | −1.5170 | 0.1292 |
| $\gamma_2$ | London step dummy | −0.2533 | −3.0950 | 0.0020 |
| $\gamma_3$ | Eng met step dummy | 0.1377 | 3.1570 | 0.0016 |
| $\delta_1$ | Scotland time | 0.0133 | 2.9660 | 0.0030 |
| $\delta_2$ | London time | 0.0508 | 10.1790 | 0.0000 |
| $\delta_3$ | Eng met time | −0.0051 | −1.3220 | 0.1861 |
| $\tau_1$ | Scot time squared | −0.0012 | −2.9340 | 0.0033 |
| $\tau_2$ | London time squared | −0.0044 | −9.5630 | 0.0000 |
| $\tau_3$ | Eng met time squared | −0.0002 | −0.5230 | 0.6011 |

Test statistics for the classical model

| No | Model | Log likelihood | Sum of squares | $R^2$ |
|---|---|---|---|---|
| (1) | Constant term only | −2341.49 | 1574.07 | 0.0000 |
| (2) | Group effects only | −466.31 | 172.00 | 0.8907 |
| (3) | X - variables only | 890.66 | 34.65 | 0.9780 |
| (4) | X and group effects | 1635.62 | 14.38 | 0.9909 |

Likelihood ratio tests

| Test | $\chi^2$ | df | Prob |
|---|---|---|---|
| (2) v (1) | 3750.362 | 76 | 0.0000 |
| (3) v (1) | 6464.302 | 18 | 0.0000 |
| (4) v (1) | 7954.213 | 90 | 0.0000 |
| (4) v (2) | 4203.850 | 14 | 0.0000 |
| (4) v (3) | 1489.911 | 76 | 0.0000 |

**Table 2**
GB bus industry productivity 1994 to 2016, yearly averages.

| Area | London | | | English mets | | |
|---|---|---|---|---|---|---|
| Time periods | TC | EC | TFP | TC | EC | TFP |
| Whole period | 1.0164 | 1.0032 | 1.0196 | 0.9885 | 1.0032 | 0.9917 |
| 95 to 2005 | 1.0304 | 1.0080 | 1.0386 | 0.9875 | 1.0082 | 0.9956 |
| 2005 to 2016 | 1.0039 | 0.9988 | 1.0026 | 0.9894 | 0.9988 | 0.9882 |
| Area | English Other | | | Scotland | | |
| Time periods | TC | EC | TFP | TC | EC | TFP |
| Whole period | 0.9953 | 0.9984 | 0.9937 | 0.9954 | 1.0022 | 0.9976 |
| 95 to 2005 | 0.9938 | 1.0028 | 0.9966 | 1.0003 | 1.0081 | 1.0084 |
| 2005 to 2016 | 0.9967 | 0.9989 | 0.9956 | 0.9910 | 0.9968 | 0.9879 |
| Area | Wales | | | | | |
| Time periods | TC | EC | TFP | | | |
| Whole period | 0.9951 | 0.9993 | 0.9944 | | | |
| 95 to 2005 | 0.9932 | 1.0196 | 1.0127 | | | |
| 2005 to 2016 | 0.9968 | 0.9812 | 0.9780 | | | |

gains are almost unitary. This would suggest that by the end of the period reviewed the London market would appear to produce a productivity profile that is consistent in the economic sense with a highly competitive market (by implication, as a result of competitive tendering).

In terms of overall profile, this difference between the first and second halves is also present in all the deregulated areas, but efficiency gains in the first half found to be at far more conservative levels. Nevertheless, these still represent significant improvements. To some extent this may be a consequence of industry consolidation and the earlier introduction of competition, hence a more developed market, but it does still suggest that at the margins some increase in competitive or internal pressures may have been present. In all deregulated areas however there has been consistent and prolonged TC declines, which across the whole time period average around 0.5% per year, the exception being the English Mets which have seen even more significant decreases. The 'simple' explanation for TC changes (both positive and negative) is frontier shift, however despite having been reported in many other studies on transport industries (e.g. Boame & Obeng, 2005; Odeck, 2008), the issue of declining TC has never been fully discussed. Given that once achieved, technical advances are irreversible, what does TC decline represent, particularly as in this case over a long time period? What this signifies is strong evidence of consumer sovereignty (Von Mises, 1949) in the market. Over time, patronage has been in slow decline, with the reduction in the inputs lagging behind the reduction in patronage. In other words, as patronage declines, operators respond by reducing service levels, however during the 'lag' between the two, TFP declines due to falling TC. What this represents therefore is structural decline, and in this case, over a long period. *Re*-examining London, positive gains in TC are partially due to the opposite effect,[6] with the 'lag' between the two creating positive productivity gains.

In reviewing the figures in Table 2, it is also important to consider the difference between what bus companies seek to do, in other words how they seek to maximise profits, and how that aim is achieved in practice. In a deregulated market the former is realised by the carriage of passengers, however attained through the production of bus services. Declining productivity in the deregulated areas therefore may also in part represent lower utilisation rates, which in turn would suggest that during the course of the period bus companies were increasingly operating services closer to the margin. There is some evidence of this; in Scotland for example patronage levels fell by 6% more than bus kilometres over the time frame reviewed.

One final possible contributory factor is that in the most basic terms, declining productivity represents a higher level of resources being used in the production of the output, and in this case that could be as a result of greater focus on the market rather than inefficiency per se. Admittedly, such a view can only be speculative, but reference to the relevant set of consumer satisfaction statistics (Transport Scotland, 2017), show significant improvements over the years 2007 to 2016 in most of the measures assessed (for example overall satisfaction levels rose by 3%). The point being that decreasing productivity does not always automatically equate with production 'bads', particularly if a higher quality of output is being produced that leads to enhanced consumer benefits.

To summarise the above, what the productivity figures show is a TC profile that is consistent with an industry, outside of London, that is in long-term structural decline. Perhaps conversely however, the EC profile across all areas produces increases in technical efficiency over the first half of the period reviewed, and almost unitary gains over the latter. What this strongly suggests is that from the mid-point onwards all production inefficiencies had been eradicated and efficiency levels maintained over the second half.

[6] But to make clear in London it is the regulatory authority, Transport for London, rather than the operator, who follow increased patronage trends with increased frequencies.

### 3.4. Company profitability

As noted in Section 3.1, in order to determine competitive market outcomes, efficiency in production may be a necessary, but not sufficient, condition; company profitability also needs to be examined, specifically for evidence of normal economic profits. Fig. 2 therefore presents average profit margins over the same time period, where profit margin is calculated as profit after tax expressed as a percentage of revenue. The data source is as above.

Fig. 2 clearly outlines two separate time periods with reference to profitability, with the division occurring between 2006 and 2008. Prior to 2006, margins were considerably higher, although notably for the whole sample were falling almost from the outset. The year 2006 represents the low point, with several areas even showing heavy losses. Since then, margins have recovered to some extent and appear to stabilise at around 6 to 12%. The second notable characteristic from Fig. 2, and unexpected given the general perception of monopoly markets in deregulated areas and competitive tendering in London, is that London margins follow the same general pattern as the deregulated areas.

Reasons for this similarity are unclear, although may indicate that in the early years of tendering, companies in London were bidding based on financial returns made in the deregulated areas. It would also strongly imply that either the London market was not as 'competitive' as has been presumed, or the deregulated market not as monopolistic (in its economic behaviour) as perceived. This may also be evidence of an element of regionalisation on the supply side of the London bus market, hence companies only bid for routes where the on-road effort can be supported from existing depots.

What is clear from Fig. 2 and the previous productivity analysis, is that there has been a general tightening of the market in all areas studied. Furthermore, continued productivity improvement in London has been matched by significantly falling profit margins, to the point that these can probably be considered to be 'normal' in the economic sense. This would therefore suggest that the 'normal' profit margin for bus operations is in the order of 5 to 8% (the 2010 to 2016 London average). Both the English Mets and English Other were found to be higher, at around 10/11%, and similarly the Scottish market at 9%. There are however important differences which may account for such differentials. Firstly, in London the transport authority (TfL) has full responsibility for marketing, ticketing and route planning, hence reducing company working capital requirements. Secondly, contracts in London are full cost, therefore the revenue risk lies with the authority and not the operator, and finally the sheer cumulative size of such contracts; company revenue streams in London are significantly larger, by a factor of four, than those found elsewhere. All of these factors combined would suggest (normal) profit levels would be higher outside of London, and the figures illustrated in Fig. 2 indicate margins in the deregulated areas that are not excessively above those levels. Consequently, these may be considered to be at or near a level that represents normal economic profit.

## 4. Discussion and conclusions

Past research has almost without exception outlined a bus industry in the deregulated areas of Britain that has experienced rising profitability, rising costs (latterly), declining patronage and rising real fares. A highly critical perspective is that in all cases, no clear explanation has been given for these trends, and hence the implicit assumption has been that these have been as a consequence of de-regulation, and specifically the creation of an industry dominated by a few large operators, i.e. oligopolistic based on strong local monopolies.

Based on the results from the current study, over the early period the London market experienced strong growth in both technical change (TC) and efficiency change (EC), followed by continued TC growth, albeit at considerably lower rates, and almost unitary EC in the second half. Profit margins were found to have declined over the period reviewed, to the

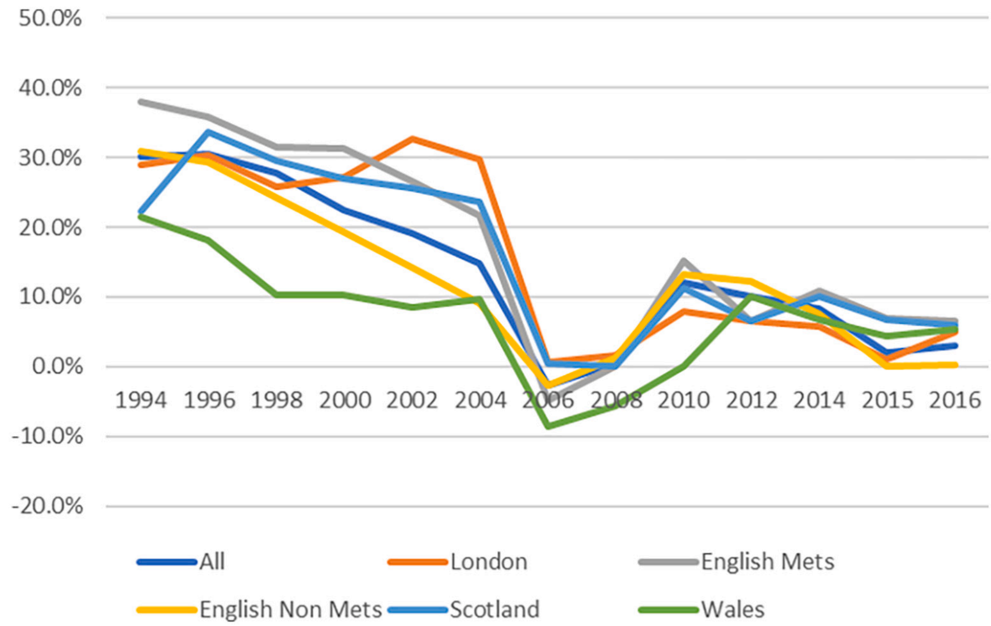


**Fig. 2.** Profit Margins, Scotland, London and England.
Source: Compiled from the TAS Bus Industry Monitor (e.g. TAS (2021)).

point where these could be taken to be at the point of normal economic profits. All of these factors are consistent with an efficient market and would appear to imply that the regulatory framework in London has been successful in delivering such outcomes.

Of more concern however, in the deregulated areas the main characteristic was found to be long and continued declines in TC, with small efficiency gains in the early period, and efficiency levels maintained over the second half. In the first instance, this clearly indicates an industry in long-term structural decline, and secondly an efficiency profile that strongly indicates the eradication of (production) inefficiencies. As regards profitability, whilst in the early part there is strong evidence of monopoly profits, profit levels were found to be falling from the outset, to such an extent that by the mid-point onwards these could be consider at, or close to, normal economic profits. When taken together, these are outcomes consistent with a (perfectly) competitive market, but not brought about through intra modal competition, but rather almost by default as a result of other factors external to the industry.

As outlined in Section 3.1, with efficiency in production and normal economic profits, by implication this strongly suggests fare levels are (generally) at an efficient market price. Any regulatory measure therefore, such as ones aimed at reducing fares or increasing service frequencies/routes served, i.e. two examples of those available under current legislation, if unaccompanied by increased levels of public finance will result in a further reduction in operator profit margins to the point where these are below normal profits. In other words, under those required to provide and maintain the operator capital base to allow for future investment and a 'fair' return for the business risk taken. As a result, operators would withdraw from the market. Even with increases in public finance, the real danger is that all this would produce is a return to the situation of the early 1980s, i.e. rising subsidy levels and falling patronage, which along with the political doctrine of the time could be strongly argued to have led to the privatisation/deregulation of the industry in the first place.

In terms of policy implications, whilst it could be strongly argued that policy over the last twenty years or so has focused solely on attempting to reverse the trends of declining patronage, the strong implication from the current research suggests that in order to be successful it needs to address the deeper issue of long term structural decline. As a consequence, any policy measures should be part of a package of wider policy actions that seek to improve the underlying economics of bus service provision in Great Britain. From an albeit limited amount of past research, this would appear to lie in the direction of proactive public transport initiatives and car use limiting measures.

## CRediT authorship contribution statement

**Jonathan Cowie:** Conceptualization, Methodology, Data curation, Visualization, Investigation, Writing – review & editing.

## Appendix 1

**Table A1**
Summary of technical efficiencies, whole sample and by area, 1994 to 2016.

| Efficiency summaries | 1994 | 1996 | 1998 | 2000 | 2002 | 2004 |
|---|---|---|---|---|---|---|
| Overall | 68.79% | 69.27% | 68.88% | 68.45% | 70.04% | 70.58% |
| London | 72.77% | 69.57% | 62.83% | 64.94% | 75.53% | 78.81% |
| English met | 65.92% | 69.13% | 69.95% | 72.31% | 71.95% | 71.50% |
| English other | 69.96% | 69.09% | 69.01% | 67.75% | 68.23% | 68.43% |
| Scotland | 66.86% | 69.87% | 70.30% | 67.19% | 70.47% | 72.50% |
| Wales | 62.59% | 68.41% | 68.59% | 69.85% | 74.00% | 76.01% |
| Efficiency summaries | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 |
| Overall | 64.27% | 67.41% | 75.31% | 71.74% | 71.22% | 69.32% |

(continued on next page)

**Table A1** (*continued*)

| Efficiency summaries | 1994 | 1996 | 1998 | 2000 | 2002 | 2004 |
|---|---|---|---|---|---|---|
| London | 62.48% | 64.13% | 70.00% | 69.36% | 70.34% | 78.30% |
| English met | 60.81% | 64.74% | 76.93% | 71.83% | 72.37% | 67.98% |
| English other | 65.05% | 68.61% | 76.21% | 72.27% | 71.19% | 66.76% |
| Scotland | 63.71% | 65.80% | 73.44% | 69.88% | 72.45% | 72.40% |
| Wales | 70.55% | 69.21% | 70.27% | 70.88% | 66.54% | 70.72% |

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