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Australia's long distance passenger train and coach services: international comparisons

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Abstract

The paper compares Australia's long distance passenger train and coach services with those of 11 countries. Comparison countries have large land area and/or high income and no high speed rail network. Australia's long distance train routes are found to be slightly shorter than the comparison country median, whereas coach routes are substantially longer. While Australia's frequencies are below comparison country medians, high frequencies apply on particular routes, connecting more closely spaced population centres, as in two other 'low frequency' countries, Canada and USA. Australia's end to end route speeds exceed comparison country medians. Australia's train fares fall below the comparison country median, while coach fares slightly exceed it.

Australia's service profile is consistent with a country situational profile of very large land area, very low population density, very high population concentration (understood as the proportion of a country's population living in its five largest cities) and high per capita income. However, many relationships between these four country indicators and service indicators are not statistically significant and historical and policy factors may also be important to outcomes. These include legacy rail gauge disconnects constraining route lengths and more recent Commonwealth and state upgrade initiatives improving route speeds. Australia's service frequency and fare profile profile are considered highly situational, the former linked to low population density and the latter to high GDP per capita. In high income nations, lower fares are a means to both differentiate and market service offerings, given competition from widely available fast air transport and convenient private vehicles. A learning for Australia, given a statistically significant association between route service frequency and route speed and drawing on Canada and USA comparisons, is the opportunity to explore putting in place frequent, faster and potentially well-patronised passenger rail services connecting Newcastle, Sydney, Wollongong and Canberra.

1. Introduction

What can we learn from the service profile of passenger trains in other countries that may assist planning of upgraded long distance passenger rail services in Australia? This paper compares Australia's long distance passenger train and coach services – the latter competing with and complementing train services – with those of 11 selected countries. 'Long distance' routes have a minimum length of 100 kilometres (km) (Stopher et al 2011). Aviation services, which dominate public transport on routes longer than 250 to 300 kilometres,[1] are out of scope.

[1] Air transport's share of Australian non-urban public transport exceeds 80 per cent of passenger kilometres travelled, with coach comprising 16 per cent and train 3 per cent (Potterton 2019).

The paper builds on a profile of Australian interstate train, coach and ferry services in Potterton (2019). The paper investigates to what extent features of that profile – coach routes longer on average than train routes, coach speeds slightly faster than train speeds, low frequencies in both modes and train fares pitched below coach fares – are replicated in comparison countries. It also investigates to what extent observed differences between Australian services and those of other nations reflect country situational (i.e. geographic and socio-economic) factors, rather than other (e.g. contingent historical, institutional or policy) factors.

The international literature on high speed rail is a point of departure for this paper. Many analyses, covering either one or a small number of high speed rail routes that compete with air transport, emphasise the importance to investment decisions and outcomes of situational aspects (Crozet 2014, Lopez Pita et al 2012, Nash 2014, Steer Davies Gleave [SDG] 2006). As Crozet puts it, in contrasting the high speed rail networks of (lower population density) France and (higher population density) Germany, "It is geography not economics that is the crucial factor". This paper, through surveying over 300 routes across multiple countries, allows more systematic attention to situational considerations than the various high speed rail studies are able to provide. Additionally, in profiling non-high speed train and coach services, it does this in a way that centres on elements of Australia's actual service mix, rather than on a possible future one. No precedents in the literature have been identified for international comparisons of train and coach services considered together, with or without Australia being included.

The paper introduces the comparison country group (Section 2) and then outlines 'in principle' expectations arising from differences in country situations (Section 3). Section 4 outlines the approach to selecting routes for each country's 'service sets'. Section 5 outlines the methodology for the service indicators and provides summary service statistics for the 12 countries, together with correlation analysis. Sector 6 analyses the comparative results for each service indicator, while Section 7 summarises Australia-relevant findings, discusses the role of country situational factors relative to other possible causal influences and identifies some key learnings. Section 8 identifies some areas for future research.

The service indicator research was conducted between June and October 2019, prior to the COVID-19 pandemic which has reduced service levels.

2. Comparison countries

Firstly, for similarity with Australia, no comparison country has a high speed rail network, with 'high speed rail' defined as rail service operating at maximum speeds in excess of 250 kilometres per hour (kph) and generally using separate, higher standard track (Preston 2013).[2]

Secondly, comparison countries are either 'large' (land area of one million square kilometres or more), or belong, like Australia, to a group of 39 'advanced economies', as classified by the International Monetary Fund [IMF] (IMF 2021a).

Thirdly, the comparison group includes at least one country that meets one or both of these criteria from each of the six principal continental groupings.

Table 1 shows land area and GDP per capita for all 12 selected countries,[3] together with population density and 'population concentration', the latter defined as the share of a country's

[2] UK has one high speed rail route, the London-Dover-Paris *Eurostar* service. UK is a comparison country, with this route excluded. While often labelled a 'high speed train', Russia's Moscow to St Petersburg *Sapsan* service operates at maximum speeds below 250 kph and is included, together with slower services on the same route.
[3] GDP per capita is shown in purchasing power parity US dollars, which show, with reference to the US economy, the relative price of a given basket of goods and services. See IMF (2020), pp. 31-33.

population living in its five largest cities. These country indicators are discussed further in the Section 3.

3. Comparing services – what to expect

With large land area, lengthy transport routes can be expected. Lengthy 'linear infrastructure' surface transport routes are inherently costly to construct, maintain and operate, so both infrastructure performance and service frequencies may be lower than in smaller countries. Island nations, on the other hand such as Australia may possibly have shorter routes, as distances to port (for freight transport) are likely to be more limited.[4]

Low population density, as in Australia, Canada and Russia, adds to the challenge of service viability as the larger markets that enable 'economies of density' (Button 2010) and permit lower average costs per passenger may be scarce. This is especially problematic for train services, where, absent sufficient market density, "The 'lumpiness' of rail capacity means that trains provide excessive capacity and/or a low frequency" (SDG 2016).

Table 1: Country situational indicators, Australia and comparison countries

Country	Land area m sq km	GDP per capita 2018 (purchasing power parity, $US)	Population density (persons per sq km)	Population concentration (2016 share in largest 5 cities)*
AUSTRALIA	7.7	$51,563	3.1	64.1%
Argentina	2.8	$23,306	15.8	41.7%
Brazil	8.5	$15,091	24.4	22.8%
Canada	10.0	$50,367	3.6	41.9%
India	3.3	$6,675	402.8	7.9%
New Zealand	0.3	$42,618	17.9	56.6%
Norway	0.4	$64,598	13.6	51.8%
Russia	17.1	$27,389	8.5	14.2%
South Africa	1.2	$12,898	45.8	34.5%
Sweden	0.4	$54,130	22.1	60.6%
UK	0.2	$47,331	270.7	34.9%
USA	9.2	$63,056	35.3	17.6%

*'Metropolitan area' rather than 'city' populations are used for calculations.
Source: IMF 2021b, various and author analysis

Population concentration, with most people living in a small number of more or less widely separated cities, as in Australia and New Zealand, can also hamper the economics of long distance surface public transport. With population concentration, people can meet many of their transport needs within the home city. However, where there are sizeable population centres, up to around 300 km from major cities – a range at which aviation may struggle to provide a quicker door to door service than the private car or other land transport – there may be higher frequency routes, with larger markets.

Train operators are apt to serve the longest routes, if intermediate markets are large enough and/or tourism demand is sufficient, notwithstanding competition from aviation. Coach operators, with lesser economies of scale and better ability to match the number and size of vehicles to the market, may supplement train capacity on the densest routes, potentially offering very high frequencies, With general road infrastructure availability, coaches may also opt to

[4] Australian Export Grain Innovation Centre (2018, p. 52) notes Australia's short rail freight transport distances "because Australian grain ports are relatively numerous and dispersed along the coast, compared with many of its export grain competitors". Argentina, Canada, Russia and USA are the country competitors cited.

serve lengthy routes, including at very low service frequencies. Coach services can also offer direct connections across borders, in situations of differences in railway gauge and/or missing links between separate systems that hamper train services (SDG 2016).

Finally, access to fast and/or convenient long distance travel options, including air transport, car travel, fast[5] and high speed rail, is more widespread in 'advanced economies' than in 'emerging and developing ones', to apply International Monetary Fund terminology. This is due to higher per capita incomes.[6] It follows that (non-fast) train and coach operators, in countries such as Australia, may differentiate their service offerings by lowering frequencies and fares.[7] The highest non-fast frequencies and fares are likely to be found in developing economies, given a lower availability of fast and high convenience travel options.

4. Selecting routes

Eleven countries, including Australia, have long distance public transport services in both modes. Brazil has coach services only. Of 23 country and mode networks, 15, including Australia's, are extensive enough to sustain sample-based route selection. For these, service sets comprising 15 to 20 routes are selected. Tourism experience train services, where there are stops for tourism experience but not to pick up and set down passengers, are excluded.[8]

With a minimum route length of 100 km, metropolitan routes are excluded. Routes may also overlap for part of their length, where service frequency varies. For example, there are three routes between Sydney and Brisbane: Sydney-Brisbane (train, coach), Sydney-Newcastle (train) and Ballina-Brisbane (coach), each with different frequencies. In all cases, routes are 'point to point', in the sense of not requiring a service change.

Route selection includes the longest route in the mode in each country and other 'long' routes, to assist consideration of the impact of country size on route length. While short routes are also included, some overall bias towards longer routes is likely in all countries.

Train routes are selected first. Then, wherever coach services have the same start and end points and routing, the coach route is selected as well. This aids analysis of competition and complementarity between the two modes. In Australia's case, the approach weights the coach route sample towards those jurisdictions with passenger rail systems: New South Wales, Victoria, Queensland and Western Australia. Routes between regional centres and other capital cities are underrepresented in the Australian coach sample.

For countries and modes where longer distance networks are limited, a 'quasi-census' approach is adopted. Here all eligible routes that can be identified are selected, with service sets ranging from four routes (South Africa's trains) to 12 (Canada's trains and coaches).

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[5] Unlike between high speed and conventional rail, the distinction between 'fast' and 'non-fast' services is less clear. However, end to end route speeds of 100 kph generally offer journey times shorter than achievable through road travel and can be considered to provide a lower boundary of 'fast' rail.

[6] See Zhang and Graham (2020) and Dargay and Gately (1997) regarding the relationships between GDP per capita and, respectively, demand for air transport and demand for motor vehicles.

[7] SDG (2016) finds coach fares in Europe's highest income ('EU15') countries are cheaper than train fares, whereas in the less economically advanced ('EU13') countries, coach fares are more expensive than train fares. While the report does not explore reasons, high speed and fast rail are widespread in the core EU15 areas of western Europe, but less so in other parts of the continent.

[8] The Sydney-Perth via Adelaide *Indian Pacific* service (not included) originated as a regular passenger service in 1970. With the Commonwealth government focusing subsequently on freight rail, as low cost air travel became established, the service was sold upon privatisation of Australian National in 1997. Following the end of government subsidies in 2016, it (and the Adelaide-Darwin *Ghan*) completed a transition to targeting exclusively target the 'higher end luxury cruise traveller' (Walters 2020a, 2020b). In contrast, the (publicly owned) Brisbane-Cairns *Spirit of Queensland* services tourists while also offering a regular stopping schedule.

5. Service indicator approach

5.1 Choosing service indicators

The service indicators analysed are: route length; return service frequency per week; end to end route speed; and fare per 100 km. Desirably, the number of intermediate stops per 100 km should be included, as in Potterton (2019). While feasible for Australia, route maps and timetables that detail places served are insufficiently available to support construction of this indicator. Route patronage data are, similarly also, not publicly available in many countries.[9]

5.2 Constructing service indicators

5.2.1 Measuring route length

Except where stated, route lengths are calculated on the basis of road distances (source: Google Maps). Unlike rail distances in many countries, 'road equivalent' route lengths are comprehensively available. They also provide a more appropriate customer service benchmark.

Research for this paper indicates average train route lengths may be up to 16 per cent longer (Norway) to 14 per cent shorter (Russia) than corresponding coach (road) route lengths. Train route lengths in the Australia sample are five per cent longer on average. Route length calculation is central to the route speed indicator and is addressed further in Section 6.3.

5.2.2 Measuring service frequency

Internet travel portals and operator booking systems comprise the core data source for the service frequency (and speed and fare) indicators.

Services between two cities are recorded on a daily, single direction basis and multiplied by seven to give the return frequency per week. With reduction in the level of weekend services commonplace, this may result in a slight overestimate of weekly frequencies. Where frequencies are less than daily, the weekly frequency is recorded directly. Services are summed across different operators, as applicable, in each mode.

5.2.3 Measuring end to end route speed

End to end route speeds are 'representative' and do not reflect either the fastest or slowest individual services on a route, except where there are only two daily or weekly services. Here the faster of the two is chosen. Speeds in both modes are calculated by reference to timetabled departure time, timetabled arrival time and road distance (see Section 5.2.1). However, to aid interpretation, some rail route length-based train speed information is included in Section 6.3.

5.2.4 Measuring service fares

Fares are based on the least expensive, changeable,[10] non-concession, adult one-way fares, except where only fully flexible fares are available. Fares are shown on a per 100 km of route length basis. Fares in national currencies are converted to Australian dollars and adjusted for difference in country price levels, using the purchasing power parity-based expenditure per capita index of the World Bank International Comparison Program (World Bank 2020).[11]

[9] In Australia, train route patronage data are published annually for Victorian and Western Australian routes. New South Wales train route and publicly operated coach route data (2017-18) were obtained on request and detailed in Potterton (2019). Private coach route data, involving numerous operators, are not publicly available.
[10] Fares selected are changeable for a fee and not refundable, except where fully flexible fares are the only available option.
[11] This index proxies differences in country GDP per capita (Table 1). To illustrate, Australians' purchasing power is just over twice that of Argentinians, rather than more than five times, as would be indicated by a comparison using market exchange rates.

5.3 Summary tables

In reporting the service indicators for each country and mode, the median is the key measure, minimising the impact of outlier values. Service indicator medians are shown for (11) countries with train services in Table 2 and (12) countries with coach services in Table 3.

Table 2: Service indicators, trains, Australia and comparison countries

Country	No routes	Median *(average)* route length* km	Median *(average)* return frequency per week	Median *(average)* end to end route speed* kph	Median *(average)* fare $A per 100 km
AUSTRALIA	20	432 *(552)*	14 *(49)*	69 *(68)*	14 *(13)*
COMPARISON GROUP	14	485 *(551)*	21 *(44)*	62 *(66)*	27 *(27)*
Argentina	8	356 *(471)*	7 *(7)*	42 *(46)*	7 *(10)*
Canada	12	511 *(913)*	7 *(24)*	55 *(62)*	26 *(27)*
India	16	545 *(716)*	53 *(82)*	59 *60)*	27 *(28)*
New Zealand	4	361 *(377)*	7 *(6)*	64 *(67)*	53 *(59)*
Norway	7	458 *(482)*	42 *(40)*	60 *(59)*	32 *(32)*
Russia	20	712 *(1,704)*	28 *(47)*	64 *(65)*	24 *(28)*
South Africa	4	1,124 *(1.036)*	3 *(3)*	53 *(51)*	32 *(33)*
Sweden	20	250 *(364)*	77 *(112)*	84 *(91)*	14 *(14)*
UK	17	379 *(435)*	203 *(268)*	105 *(103)*	42 *(40)*
USA	19	816 *(1,175)*	14 *(27)*	77 *(78)*	14 *(19)*
ALL COUNTRIES	16	458 *(543)*	14 *(42)*	64 *(66)*	26 *(26)*

* This indicator is calculated on the basis of road, rather than rail, route length. See Section 5.2.1.

Table 3: Service indicators, coaches, Australia and comparison countries

Country	No routes	Median *(average)* route length km	Median *(average)* return frequency per week	Median *(average)* end to end route speed kph	Median *(average)* fare $A per 100 km
AUSTRALIA	20	620 *(805)*	7 *(20)*	70 *(71)*	17 *(17)*
COMPARISON GROUP	15	438 *(425)*	53 *(88)*	60 *(62)*	15 *(21)*
Argentina	15	579 *(637)*	210 *(365)*	74 *(73)*	22 *(22)*
Brazil	20	438 *(714)*	53 *(123)*	58 *(57)*	42 *(45)*
Canada	12	452 *(817)*	26 *(58)*	60 *(62)*	14 *(15)*
India	14	485 *(499)*	322 *(782)*	50 *(50)*	35 *(41)*
New Zealand	14	319 *(341)*	14 *(18)*	57 *(56)*	15 *(15)*
Norway	10	305 *(325)*	28 *(43)*	59 *(60)*	21 *(22)*
Russia	15	530 *(665)*	112 *(222)*	63 *(61)*	9 *(11)*
South Africa	15	544 *(569)*	56 *(56)*	67 *(65)*	42 *(55)*
Sweden	15	310 *(335)*	56 *(76)*	70 *(73)*	14 *(14)*
UK	17	344 *(418)*	53 *(75)*	51 *(52)*	11 *(13)*
USA	18	369 *(831)*	35 *(62)*	71 *(71)*	10 *(11)*
ALL COUNTRIES	15	445 *(441)*	53 *(81)*	61 *(63)*	16 *(21)*

5.4 Correlation analysis

Despite the relatively small size of train and coach comparison groups, correlation analysis was undertaken to explore statistical relationships. Table 4 reports correlations between service indicators.

Table 5 sets out correlations between service indicators and country indicators.

Table 4: Correlations between service indicators, trains and coaches

Service indicator by mode	Median return frequency per week	Median end to end route speed kph	Median fare $A per 100 km
TRAIN			
Median route length km	-0.34	-0.25	0.00
Median return frequency per week		0.81 *(p<0.01)**	0.30
Median route speed kph			0.22
COACH			
Median route length km	0.34	0.35	0.29
Median return frequency per week		-0.21	0.33
Median route speed kph			-0.17

Table 5:Service indicator and country indicator correlations, trains and coaches

Country indicator by mode	Median route length km	Median return frequency per week	Median end to end route speed kph	Median fare $A per 100 km
TRAIN				
Land area	0.31	-0.34	-0.14	-0.36
Population density	-0.05	0.58 *(p<0.10)*	0.290	0.26
Population concentration	-0.54	-0.07	0.06	0.04
GDP per capita	-0.36	0.15	0.47	-0.04
COACH				
Land area	0.42	-0.03	0.15	-0.21
Population density	-0.06	0.56 *(p<0.05)*	-0.68 *(p<0.05)*	0.22
Population concentration	-0.15	-0.53 *(p<0.10)*	0.33	-0.33
GDP per capita	-0.54 *(p<0.10)*	-0.66 *(p<0.05)*	0.22	-0.74*(p<0.01)*

NOTE: P-values of less than 0.10, 0.05 and 0.01, in parentheses, indicate statistical significance at confidence levels of, respectively, 90 per cent, 95 per cent and 99 per cent.

In total, only a fifth of correlations are statistically significant at 90 per cent, 95 per cent or 99 per cent levels. The correlation analysis is discussed further in the following sections.

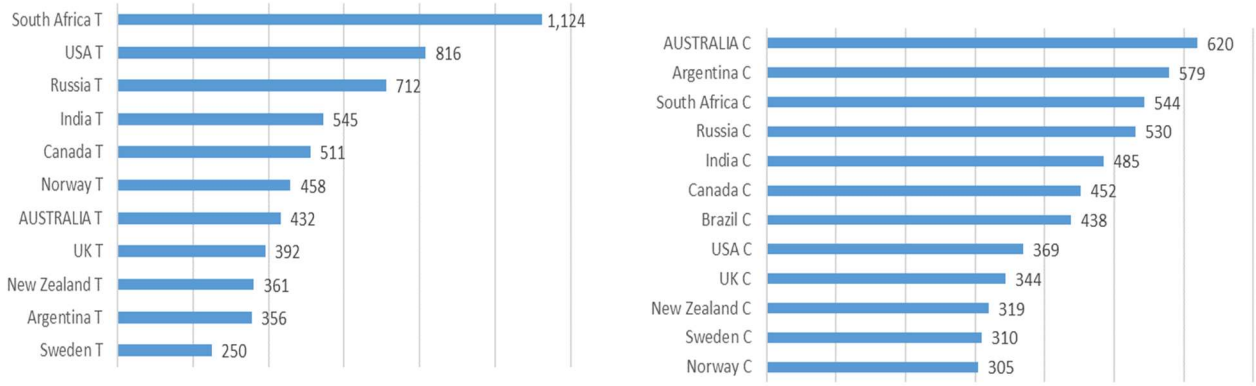
6. Service indicator analysis

6.1 Route length

Australia's train route lengths (median 432 km) are the shortest of the four countries with very large land area (Figure 1) and slightly shorter than the comparison country median at 485 kilometres. For Australia's trains, the route shortening influence of high population concentration (Section 3) appears to exceed the route lengthening impact of very large land area. Island nation geography, with its legacy of freight (and passenger-servicing) networks that link inland locations to ports within a convenient distance range (Section 3) – with less priority accorded other links – is a possible further situational factor.

In contrast, Australia's coach routes (median 620 km) are longer than those of comparison countries and well above the comparison country median (438 km). Australia, with Argentina and Sweden, also show median coach route lengths substantially greater than median train route lengths. This suggests that coach services in these countries play a large role in extending national coverage of surface public transport services, complementing, as well as competing with train services.

Figure 1: Median route length, trains (left) and coaches (right), all countries, km



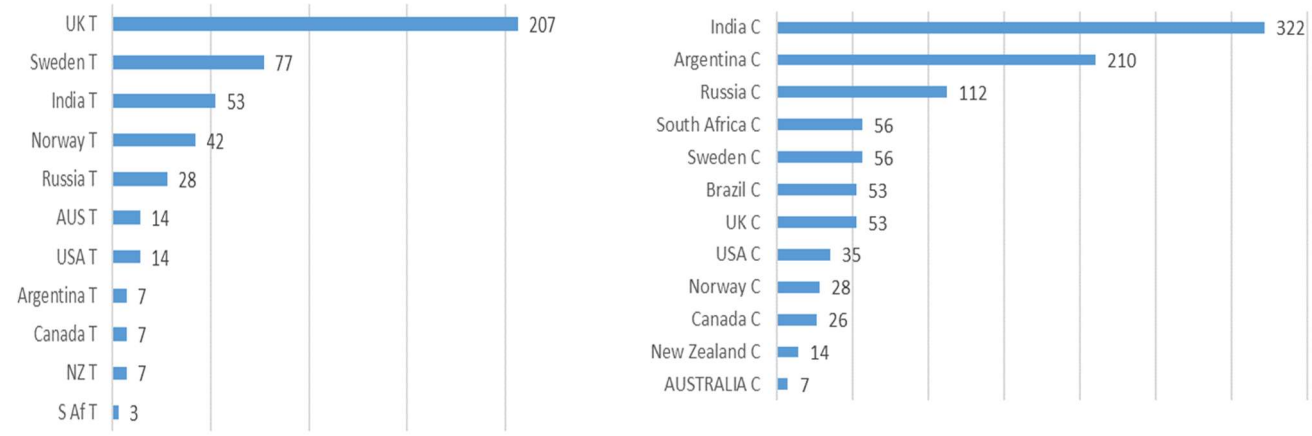
NOTE Route lengths in both modes are calculated by road distance. See also Section 5.2.1.

6.2 Frequency

Service frequency is positively correlated with country population density in both modes (statistically significant). Frequency is also negatively associated with population concentration in both modes (statistically significant for coach services).

Australia's low median weekly frequencies (14 for trains, 7 for coaches, see Figure 2)) are consistent with expectation, noting Australia's lowest population density of the 12 nations and highest population concentration (Table 1). The comparison group median train service frequency is 21 per week and the corresponding coach service frequency is 53.

Figure 2: Median route return frequency, trains (left) coaches (right), all countries, pw



Australia has individual high frequency routes, including, in the case of trains, relative to countries with high median frequencies. The Sydney-Newcastle train route (287 return services per week) provides more services than all of the comparison country train routes except those of UK.[12] Australia's highest frequency coach route, between Sydney and Canberra (161 services per week), despite a frequency more than 20 times greater than the comparison group median, is less than five per cent of the all-country highest frequency route, between Mumbai and Pune (India), at 4,221 services.

A similar pattern is evident in USA and Canada – both also low service frequency countries – with high frequency train routes between the closely spaced population centres of New York,

[12] UK has several train routes above 400 per week, with London-Cambridge the highest, at 1,015 per week.

Boston and Washington (USA) and similarly between Toronto, Ottawa and Montreal (Canada).[13]

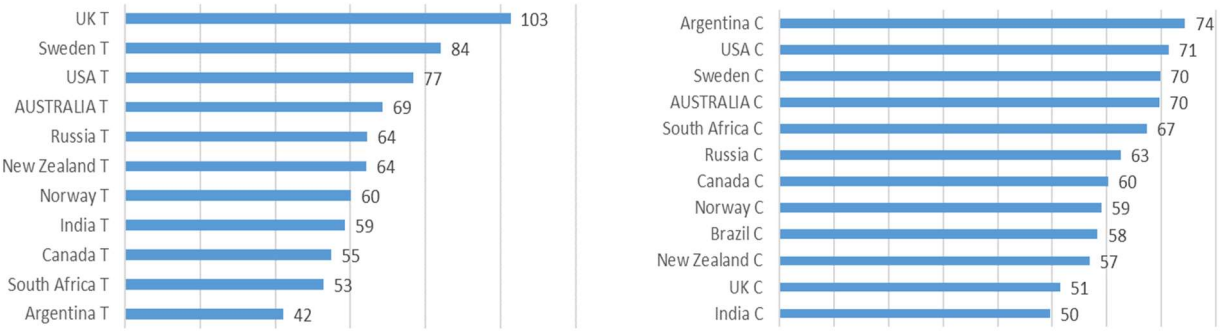
There is also a statistically significant (negative) relationship between coach service frequency and GDP per capita. Five countries, including four developing economies, have weekly coach service frequencies exceeding 50. This is consistent with expectation regarding a larger role for coach services (and non-fast trains) in developing economies, in light of lower levels of both vehicle ownership and air transport use than in advanced economies (Section 3).

6.3 Speed

Median train route speeds are positively (and significantly) correlated with train service frequencies, with the latter also significantly correlated with population density (Section 6.2).

UK and Sweden have the fastest train speeds (Figure 3). UK train services (median speed of 105 kph [14]) have benefitted from introduction, commencing in the 1970s, of InterCity 125 trains with maximum speeds of up to 200 kph (Chen and Hall 2011).

Figure 3: Median end to end route speeds, trains (left) coaches (right), all countries, kph



NOTE: Train route speeds, as well as coach route speeds, are calculated with reference to road distance (Sections 5.2.1, 5.2.3).

At respectively 69 [15] and 70 kph. Australia's median train and coach speeds exceed comparison country medians (66 kph trains, 62 kph coaches). Australia's train speeds, while modest, reflect numerous initiatives: Commonwealth interstate freight rail upgrade, notably Perth-Kalgoorlie (1960s), Melbourne-Adelaide (1990s); Queensland's North Coast Line upgrade (1990s); and Victoria's passenger-oriented Regional Fast Rail (2000s) and Regional Rail Link (2010s).[16]

Median end to end coach route speeds are negatively correlated with population density (statistically significant). Coach speeds are lower than train speeds in seven countries, with the difference between the two modes most marked for UK (median speed 51 kph). Where high population density can be positive for train speeds (and frequencies), in ensuring a sufficiently large market to underwrite upgrade cost, it can be negative for coach services where, as in UK, high levels of road congestion are experienced.[17] Comparatively fast Australian coach speeds

[13] Summing train and coach weekly frequencies on these routes, totals are: New York-Washington 245; New York-Boston 357; Montreal-Toronto 175; Ottawa-Toronto 133.
[14] Train speeds are calculated using road-equivalent, rather than actual, train route lengths (Section 5.2.3). Calculating speeds using actual train route distances compresses, but does not alter, the country train speed ranking. UK's and Sweden's train routes are shorter than the corresponding road routes, so actual median speeds are lower than 'road equivalent' speeds: 87 kph and 82 kph respectively. USA's and Australia's train routes are longer than the road routes: actual median speeds are higher at 82 kph and 73 kph respectively.
[15] See Footnote 14.
[16] See Laird (2019) for Queensland and Victorian initiatives and Fischer (2011) on Commonwealth upgrades.
[17] Of the 12 nations, UK has most cities with road congestion at or above 25 per cent (Tom Traffic Index 2019). Congestion is also a concern to UK motorists on non-urban motorways (RAC 2017).

may benefit from low non-urban road congestion. This may apply similarly in other lower population density and higher speed countries, Argentina and Sweden.

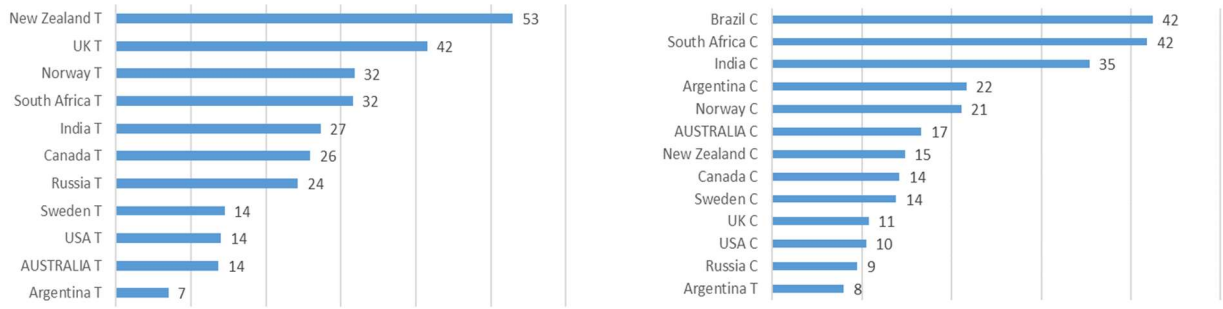
Calculated using rail route lengths rather than road ones, Canada, Sweden, UK and USA all have individual train routes with end to end speeds above 100 kph. At 166 kph, the highest speed service is the Moscow-St Petersburg (Russia) *Sapsan* train.[18] The fastest Australian train route is Melbourne-Ballarat (97 kph).

6.4 Fares

There is a statistically significant negative relationship between median coach fares and GDP per capita. No pattern is evident between median train fares and GDP per capita.

Australia's median train fares ($A14 per 100 km) sit at around half of the comparison group train fare median ($A27 per 100 km) and slightly above the comparison group coach fare median ($A15 per 100 km). Australia's coach fares are, however, below the coach fare average ($A21 per 100 km), which reflects the impact of some high ranking developing country fares (Figure 4). Across the two modes, three quarters of developing economy service sets and a third of advanced economy ones have fares above $A20 per 100 km.

Figure 4: Median route fares, trains (left) and coaches (right), $A per 100 km*



* Fares in national currencies are converted to Australian dollars and adjusted for differences in country purchasing power relative to Australia (Section 5.2.4).

The coach services of South Africa, India and Argentina all offer faster speeds than their countries' trains and higher fares apply also. These countries, with Brazil, occupy the first four coach fare rankings. However, in three of the four developing economies with train services (South Africa, India and Russia), train fares also exceed $A20 per 100 km.

All of these results are consistent with the notion that, in lower and middle income countries, operators of non-fast train and coach services are likely to face fewer constraints in charging higher fares than may apply in advanced economies, due to higher demand and less pressing competition from fast (i.e. air, high speed rail, fast rail) modes and/or 'high convenience' car travel, given these modes' association with high per capita income levels. (Section 3). In advanced economies, operators may differentiate from both air transport and private vehicle transport by lowering fares and frequencies.

Advanced economy train services with higher fares have either targeted the tourism market, as in New Zealand and Norway, or fast speed, the latter combined with high frequency, as with UK. UK inter-city trains ($A42 per 100 km) employ an airline-style 'yield management' approach to pricing, with business, commuting and leisure the three major markets serviced (IBISWorld 2021).

[18] With many slower services also on this route, average route speed is 87 kph.

Over 80 per cent of individual train routes with the highest fares in the country and two thirds of corresponding coach routes are on routes of less than 300 km, e.g. Melbourne-Bendigo ($A26 per 100 km), Rio de Janeiro-Juiz de Fora (Argentina) and Harrisburg-New York (USA). Possible reasons include absence of air transport competition at these route lengths and a demand profile oriented to weekly or daily commuting and business travel.

7. Australia's service profile and country situation: learnings

Comparatively, Australia's long distance train and coach service profile comprises: train routes that are shorter than those of comparison countries; coach routes that are longer; frequencies that are lower, notwithstanding high frequencies on some routes close to major capitals; speeds in both modes that exceed comparison group medians; train fares that are less than the comparison group median; and coach fares that are higher – but below a comparison group average that reflects the higher fares in the developing economies of the group.

This profile can be seen as consistent with Australia's country situation of very large land area (and island nation geography), very low population density, very high population concentration and high per capita income. At the same time, many relationships between country indicators and service indicators are not statistically significant. This suggests the importance to service outcomes of other, contingent (i.e. legacy historical or policy) factors.

Regarding Australia's short train route lengths, two contingent factors should be noted. These are the impact of separate railway systems that predate the country's federation in 1901, resulting in breaks of gauge and missing links (Lee 2010, Fischer 2011) and, in the 1990s, privatisation of the country's longest passenger public transport rail route, which now operates on a tourism experience model.[19] With a (freight-oriented) 1,700 km Inland Rail standard gauge route under construction connecting three eastern states, opportunities for future public transport services, on part or all of its length, could be considered.

Australia's low service frequencies in both train and coach appear particularly situational, linked to Australia's 'lowest in class' population density. However, the service profiles of USA and Canada, both also with low service frequencies, evidence higher frequency and faster train services between closely spaced population centres that include each country's largest city and the national capital. Taking account of the relatively slow speeds on comparable high frequency routes radiating from Sydney and also of the statistically significant correlation between service frequencies and speeds across the 12 countries, opportunities for high frequency, faster and potentially well patronised passenger rail routes connecting Newcastle, Sydney, Wollongong and Canberra should be explored.[20]

The low absolute level of Australia's train and coach fares can, similarly, be viewed in situational terms. It is a 'differentiating' response to the competition that non-fast public transport services face, in many advanced economies, from aviation and the private vehicle, modes that are associated, at high uptake, with high per capita income levels. Again, there are learnings from comparison countries. In train services, charging higher fares are, in principle, feasible where route speeds approach or exceed 100 kph and service frequencies are high, as in UK, so attracting a substantial business market, or where pronounced tourism orientation applies – while still operating as a public transport stopping service – as in Norway.

[19] See Footnote 8.

[20] The relevant median train route speeds, with speed calculated according to train route distance (Section 5.2.1) shown in brackets, are: Australia sample 69 (73) kph; Sydney-Bomaderry 53 (52) kph; Sydney-Canberra 69 (80) kph; Sydney-Newcastle 59 (61) kph and Sydney-Melbourne 79 (82) kph. As part of future upgrades, alignment straightening would be important on the Sydney-Canberra and Sydney-Melbourne routes (Laird 2019).

However, in UK, higher long distance train fares apply in a setting of widespread non-urban – as well as urban – road congestion, one that affects speed and reliability performance for coach services and private car travel. This is not a usual context in Australia, so introduction of faster rail services might not necessarily enable charging of substantially higher fares. In addition, train services in both UK and Norway, depend, as in other countries, on levels of ongoing public funding.[21] Public policy commitment– drawing on an articulated social, environmental and/or economic rationale for the budget expenditure involved – would accordingly be critical in Australia.

8. Further research

Australia has numerous fast 'air shuttle' routes, with hourly or greater service frequencies. These include intercapital routes and also regional ones such as Brisbane to Rockhampton and Adelaide to Port Lincoln. A study comparing Australia's air shuttle routes, profiling their full suite of public transport services, with those of other countries – i.e. with high speed rail included where applicable – would complement this paper's analysis. Adding patronage to the set of service indicators adopted in the present paper would be beneficial, for an Australian route sample, even if this were not feasible for all countries.[22] It would also provide a platform on which to investigate the relative shares of end to end and intermediate distance passengers. With air transport generally only servicing the end to end travel market, this is an important point of difference for rail (and coach).

Some Australian traveller profile research would aid understanding of the social and economic roles of long distance passenger train and coach travel and help inform policy towards future infrastructure and service upgrades. The National Visitor Survey, which services the tourism sector, collects Australia-wide information on overnight trips of 50 kilometres or more (40 kilometres or more for daytrips), including trip purpose, mode of travel and the demographic profile of respondents (Tourism Research Australia 2021). However, the survey has limitations in a transport planning context, notably in excluding commuting and other routine trips, at both shorter and longer distances. With the survey data as a starting point, opportunities to research travel behaviour in cooperation with operators in air, rail and coach modes could be explored.

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Database

A database underpins situational indicators and service indicators (12 countries, 23 service sets, 311 routes, together with operator booking system references). It is available on request.

References

AECOM, Grimshaw, KPMG, SKM, ACIL Tasman, Booz & Co and Hyder 2013, *High Speed Rail Study Phase 2 Report*, for the Department of Infrastructure and Transport
Australian Bureau of Statistics 2017, *2016 Census*
Australian Export Grain Innovation Centre [AEGIC] 2018, *Australia's grain supply chains*, South Perth

[21] Governments purchase services from train companies in both countries (Office of Rail and Road 2020, Smith 2020). In UK, public funding provides around 25 per cent of non-urban and urban operational rail expenditure.
[22] See Section 5.1 and Footnote 9 regarding patronage data availability in Australia and internationally.

Button, K 2010, *Transport Economics*, 3rd Edition, Edward Elgar, Cheltenham UK
Chen, C-L and Hall, P 2011, "The impacts of high-speed trains on British economic geography: a study of the UK's InterCity 125/225 and its effects", *Journal of Transport Geography*, vol 19, pp. 689-704
Crozet, Y 2014, "Performance in France: From appraisal methodologies to ex-post evaluation" in OECD/International Transport Forum (ITF) 2014
Dargay, J and Gately, D 1997, *Income's Effect on Car and Vehicle Ownership, Worldwide: 1960-2015*, New York University, February
Fischer, T 2011, *Trains Unlimited in the 21st Century*, HarperCollins, Sydney
IBISWorld 2021, *Inter-City Passenger Rail Transport in the UK, March 4* Intercity Passenger Rail Transport in the UK - Industry Data, Trends, Stats | IBISWorld Accessed 24 September 2021
International Monetary Fund [IMF] 2020. *World Economic Outlook: A Long and Difficult Ascent*, October
IMF 2021a, *World Economic Outlook: Managing Divergent Recoveries*, April
IMF 2021b, *World Economic Outlook Database*, April 6
Laird, P 2019, Submission to the House of Representatives Standing Committee on Infrastructure, Transport and Cities Inquiry into options for financing faster rail, Submission 3, November
Lee 2010, *Transport An Australian History,* UNSW Press, Sydney
Lopez Pita, A, Texeira, P and Ferreira, P 2012, "High speed rail modal split on routes with high air traffic density", *Proceedings of the Institution of Civil Engineers* Transport 165, May, pp. 119-129
OECD/International Transport Forum (ITF) 2014, *The Economics of Investment in High-Speed Rail*, Roundtable Report 155
Office of Rail and Road 2020, *Rail Industry Finance (UK) 2019-20*
Nash, C 2014, "When to Invest in High Speed Rail" in OECD/ITF 2014
Potterton, P 2019, *Profiling Australia's interstate passenger train, coach and ferry services*, Australasian Transport Research Forum, September
Preston, J 2014, "Summary of discussions" in OECD/International Transport Forum 2014
RAC 2017, *RAC Report on Motoring 2017 Feeling the Squeeze*
Schwab, K 2018, *The Global Competitiveness Report 2018*, World Economic Forum
Smith, K 2020, "Norway set for record rail investment in 2021 budget" *International Rail Journal*, October 12
Steer Davies Gleave (SDG) 2006, *Air and Rail Competition and Complementarity*, Final Report, August, for European Commission
SDG 2016, *Comprehensive Study on Passenger Transport by Coach in Europe*, report for DG MOVE, European Commission, April
Stopher, P, Zhang, Y, Armoogum, J and Madre J-L 2011, *National Household Travel Surveys: The Case for Australia*, Australasian Transport Research Forum 2011 Proceedings
Tom Tom Traffic Index 2019, https://www.tomtom.com/en_gb/traffic-index/ Accessed 3 July 2019
Tourism Research Australia 2021, *National Visitor Survey (NVS) Methodology 2019*, National Visitor Survey (NVS) methodology | Tourism Research Australia Accessed 16 September 2021
Walters, C 2020a, "Indian Pacific 50 Part 1: Crossing a Nation – The First 25 Years", *Railway Digest*, vol 58 no 4, April
Walters, C 2020b, "Indian Pacific 50 Part 2: Journey as Destination – The Second 25 Years", *Railway Digest*, vol 58 no 5, May
World Bank Group 2020, *Purchasing Power Parities and the Size of World Economies: Results from the 2017 International Comparison Program,* Washington DC
Zhang, F and Graham, D 2020, "Air transport and economic growth: a review of the impact mechanism and causal relationships", *Transport Reviews*, vol 40, Issue 4, pp. 536-548.