RAIL BENCHMARKING – NEW PARADIGMS: A SOUTH AFRICAN POSITION

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Abstract

A benchmark of South Africa's freight rail system confirms that South Africa's export lines compare favourably globally, but that the general freight sector of the business lags in all key indicators, and there is no clear comparison as far as a rail reform agenda is concerned. Neither a path of deregulation, rationalisation, investment and efficiency, such as in North America, nor one of a development state – network growth and high relative employment, such as in the Russian, Indian and Chinese railways – has been followed in South Africa. These countries, geographically speaking, are significantly bigger than South Africa, but the challenges are similar: long transport distances, high transport demand and spatial issues. This paper indicates how benchmark analysis can be used to inform a rail reform agenda for South Africa's freight rail system. Although there is a separation in South Africa as to the business model that the railway is allowed to use, current railway management seems to be achieving a turnaround. A more supportive policy environment, informed by benchmarking, might improve this process.

Keywords: Rail Benchmarking, Infrastructure Investment, Rail Reform, South Africa

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1 Introduction

Following the economic deregulation of freight transport and the implementation of rail reform measures in industrialised countries during the latter quarter of the 20th century, the first decade of the 21st century experienced a freight rail renaissance in many of these countries (Gow, 2008; Barone, 2013). This renaissance is expected to accelerate as a result of rail's fuel efficiency (Nelder, 2012) and environmental superiority to road transport (Woodburn and Whiteing, 2012). The shift to rail is also a focus of South Africa's National Infrastructure Plan (South African Government, 2013).

South Africa's freight logistics costs are high, forming 12.8 per cent of the country's GDP (Havenga and Simpson, 2013), ranking South Africa 26th out of 33 countries for which this indicator could be calculated (Havenga and Pienaar, 2012). This is a result of disproportionate transport demand due to the country's inland mining deposits with concomitant industrial development far from the country's ports. This is compounded by a modal imbalance in serving this demand due to a rail investment backlog and limited road–rail collaboration (Simpson and Havenga, 2011). This situation is due to the historical absence of a long-term, strategic view of infrastructure planning in South Africa, exacerbated by politically motivated agendas (Frankel, 1928; Havenga, Pienaar and Simpson, 2011). The dense long-distance corridors are ideal candidates for intermodal (road–rail) solutions. Nationally, there is a will to re-invest in rail, with the national railway authorities implementing a R200 billion investment plan in

infrastructure and rolling stock over the next seven years (Transnet, 2012) as part of the National Infrastructure Plan (South African Government, 2013).

The purpose of this paper is to compare the performance of South Africa's freight rail system with its global counterparts in order to contextualise this significant rail investment. When analysing South Africa's freight rail system, the ring-fenced coal and iron-ore export lines are, where possible, split from the general freight business (GFB). The two export lines were commissioned in 1976 with a current combined annual capacity of 130 million tons and are basically an extension of the mines' production systems. Their operations, design and traction systems differ from the rest of the South African rail system. GFB is more comparable to global general freight railways with mostly unit trains between terminals and siding-to-siding for both unit train or wagon load operations (Martin, 2004).

The paper begins with an overview of rail benchmarking parameters, followed by a delineation of the research strategy. Subsequently, a comparison is made between the size and productivity indicators of global railways and those of South Africa. The key driving forces behind the discrepancies are discussed, followed by concluding remarks.

2 Overview of rail benchmarking parameters

Due to the capital intensity associated with railways, density is a key feature of railway benchmarking. Density is the relationship between ton-kilometres and route kilometres. In other words, a railway becomes increasingly productive if route distances are shorter and volumes of traffic are higher.

Beeching proposed that removing low-density lines from the British railway system would increase returns in a high fixed-cost environment and eradicate the cross-subsidisation of high- to low-density lines (British Railway Board, 1963). Keeler (1974) found 'substantial unexploited economies of traffic density…but constant long-run returns to scale'. Braeutigam et al. (1984) also advocate a clear distinction between economies of density and size. Harris (1977) confirmed Keeler's work with a much deeper analysis of the relationship between density and costs for 55 railway firms and developed a decaying exponential cost curve between cents/ton-kilometre and line density. Most recently, Eakin and Schoech (2010) illustrate the enormous productivity gains, enabled by density gains, since the implementation of the Staggers Act in the US, which drove network rationalisation.

Several measures have been identified for use in rail benchmarking. Bitzan and Keeler (2003) found crew size to be an important variable in railway benchmarking. Braeutigam et al. (1984), the OECD (2002) and Sumatra (2011) add the effect of customer service quality. Caves et al. (1981) identified length of haul and Cambridge Systematics (2007) adds longer trains and more efficient wagon loading (which could be translated into a 'heavier net train weight' variable). The UIC (2009) also identifies train productivity as a core indicator, and includes axle loading, train weight, train length, loading capacity, speed and length of haul in this measurement. Wiegmans and Donders (2007) undertook an extensive study to benchmark European railway companies, which focuses on network size, number of employees, number of locomotives and wagons on the input side, and tons, ton-kilometres and sales on the output side. Sumatra (2011) identifies detailed internal performance measures such as wagon turnaround time; equipment reliability, availability and utilisation; loads per wagon; empty haul and average haul; and labour productivity. Output indicators such as tons, ton-kilometres and revenue are also included. The OECD (2002) identifies train size/length, equipment utilisation and labour productivity as the most important factors in rail benchmarking. Customer service aspects, such as transit time, losses and ease of doing business, and detailed measures, such as equipment, wagon and locomotive availability, are also included. George and Rangaraj (2008) identify inputs (operating expenses, tractive effort, route kilometres and number of employees) and outputs (passenger train numbers and ton-kilometres) separately for measurement.

New dimensions not yet measured are the socio-economic impact of railways and their relevance in terms of sustainability (OECD, 2002; Bogetić and Fedderke, 2006; George and Rangaraj, 2008). These extend the concept of pure economic returns to a broader social context, often referred to as the 'development state', where capital is aggressively invested in industrialisation and infrastructure building (Spector, 2013). The balance between economic growth, social development and environmental protection is therefore emphasised (United Nations, 1987), with some institutions such as Sustainable Aotearoa New Zealand (2009) even advocating a 'strong' model whereby the environment is seen as more important than the economic or social dimensions. A unique contribution of this paper is a high-level comparison of the socio-economic impact of railways.

In summary, the current body of knowledge identifies key measures of output (tons, ton-kilometres, revenue and service quality) per input (route length, equipment and employees), achieved through densification, heavier/larger train pay loads and longer hauls. New dimensions are railways' contribution to the competitiveness of nations, as well as their social impact and relevance in terms of sustainability.

3 Research strategy

For the purposes of this paper, four macro rail systems were postulated. North America has mostly privatised, large, vertically integrated railway companies that are highly productive and profitable. The Russian, Indian and Chinese (RIC) railways are massive, vertically integrated, state-owned monopolistic entities with a development focus that plays an important part in the societies of these countries. In 2007, the North American and RIC rail systems constituted 58 per cent of the world's railway route kilometres, 73 per cent of the world's railway employees, 62 per cent of the world's locomotives and 93 per cent of the world's ton-kilometres (percentages include Mexico as per Piasecka, 2007). This is followed by the European rail system, dominated by France and Germany. European railways comprise smaller companies, which interact closely and have made large strides with open access. European railways also have strong environmental drivers and are heavily concerned with alleviating congestion. The southern African rail system, which is dominated by South Africa, is the focus of this research.

One of the key challenges in benchmarking exercises is publicly available disaggregated data (Keeler, 1974; Wiegmans and Donders, 2007). Detailed studies are often restricted to a specific region, such as that of Harris (1977) and others, which covers North America, George and Rangaraj (2008) (India) and Wiegmans and Donders (2007) (Europe). Studies that have attempted global comparisons mostly use the World Bank Rail Database (Piasecka, 2007), such as that of Hilmola (2009). The International Union of Railways database (UIC, 2012) was used for this study because it is more recent and complete than the World Bank Database (which was used as a secondary source). Representative countries from the various regions (for which complete data exists) were selected, rather than attempting to interpolate missing data points for aggregation of all countries. The inclusion of the US, Canada, RIC, Germany and Italy translates into 55 per cent of the world's route kilometres. Output performance for South Africa's export lines was constructed from desktop research and publicly available data. GFB output performance was then calculated as the total system performance (which was published), less the estimated export-line performance.

An important factor, especially when fixed capital productivity of route kilometres is considered, is that both passengers and freight use the fixed rail infrastructure. Foster and Briceño-Garmendia (2010) equate one passenger kilometre to one ton-kilometre, while Tochitskaya (2012) equates 0.5 passenger kilometres to one ton-kilometre. A sensitivity analysis showed no substantial difference between these two assumptions, and the Tochitskaya (2012) formula was applied in this paper.

4 Research Results

4.1 Analysis of network size indicators over time

Over the past 30 years, North American route kilometres were rationalised by 40 per cent, while ton-kilometres soared, with moderate growth in motive power and a 60 per cent drop in employment (see Figure 1). This is in sharp contrast to similar ton-kilometre growth in RIC, higher growth in motive power, an increase in route length and a 15 per cent reduction in employees. These trends support the postulation that RIC railways have a development focus, as opposed to the productivity focus of North American railways. Europe experienced moderate route kilometre rationalisation, but the highest drop in ton-kilometres with a sharp drop in employment and motive power. These trends point to the maturity of Europe's system compounded by economic growth challenges, resulting in a strong drive for rail revival.

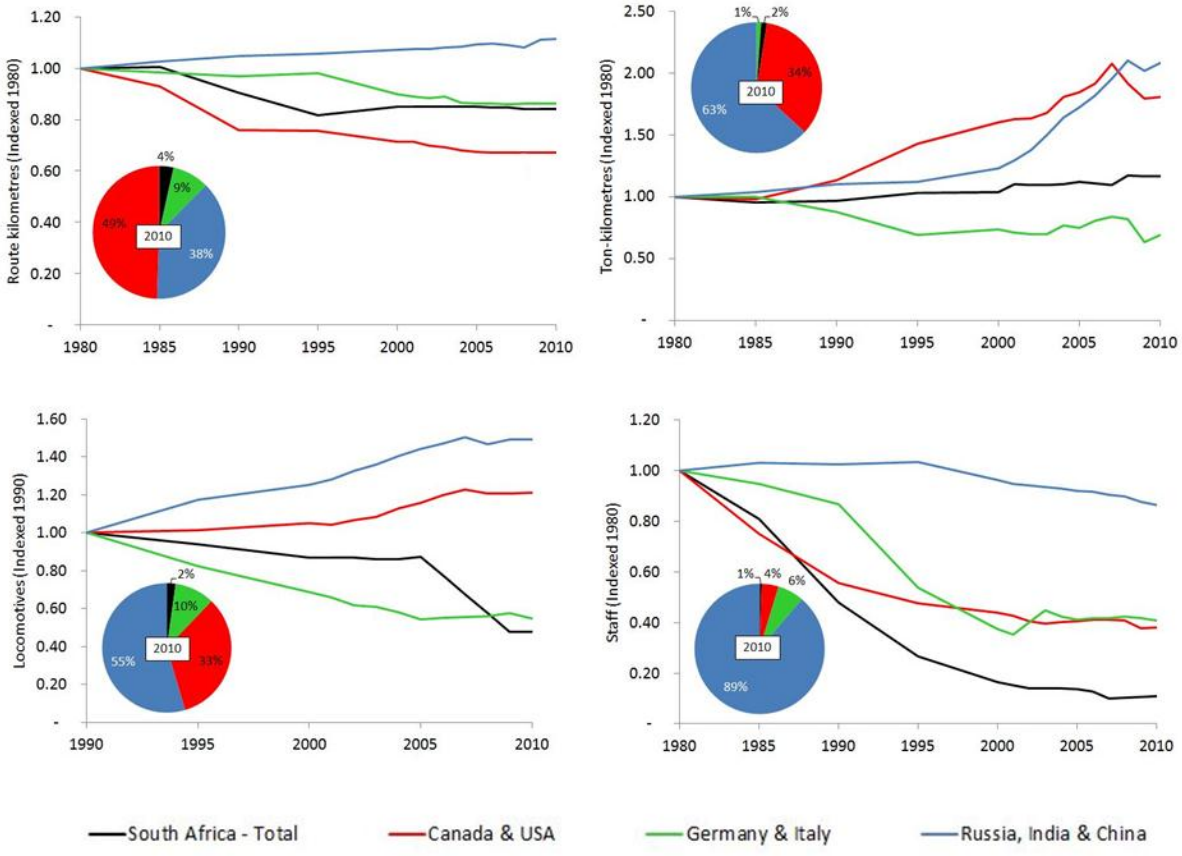
South Africa's rationalisation of motive power and employment is the highest of the rail systems analysed. The country's network size in terms of route kilometres has remained almost unchanged since 1976, placing a heavy burden of fixed costs on the railway. South Africa's relative growth in ton-kilometres is attributable to the ring-fenced export lines.

4.2 Productivity indicators

4.2.1 Density

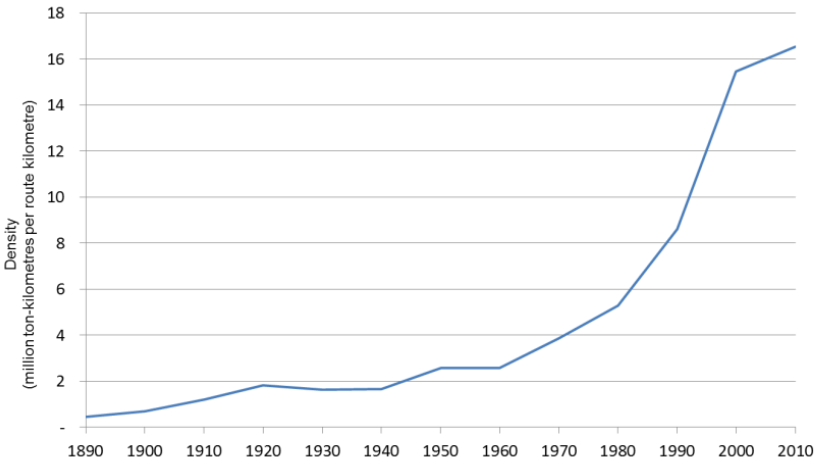
Density is expressed as ton-kilometres per route kilometre – an increase in ton-kilometres or a reduction in route kilometres, or both, improves density. The latter was the case for the US and Canadian railways (Figure 1), translating into exponential density improvements (Figure 2). This allowed for the year-on-year productivity improvements (measured as revenue ton-miles per constant dollar operating expense) achieved by these railways following the implementation of the 1980 Staggers Rail Act, with productivity peaking at levels 170 per cent higher at the turn of the century compared to 1980 (Association of American Railroads, 2012).

Figure 1. Relative size and change in size indicators of macro world railway systems



Sources: Global: UIC, 2012; South Africa: authors' analysis

Figure 2. North American railway densification

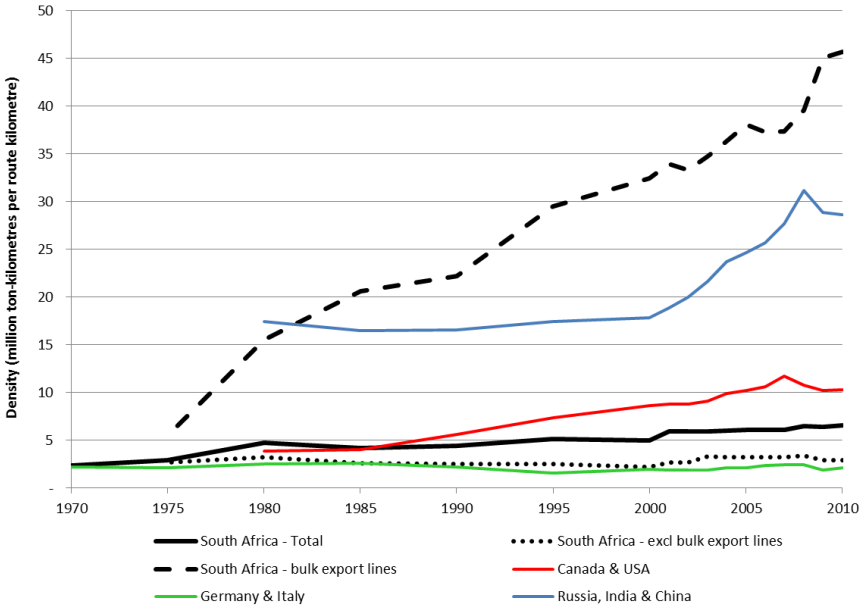


Sources: Ton-km: Association of American Railroads, 2013; route km: Grenzeback and UNECE

South Africa's density compared with that of the global macro rail systems for the past 40 years is depicted in Figure 3. South Africa did not rationalise the GFB network after deregulation in 1990 due to political pressure, and could not attract sufficient investment for the maintenance of rail-friendly traffic. Consequently, a vicious circle of underinvestment, lower service levels and loss of freight were experienced. GFB became overburdened by fixed costs due to low growth in ton-kilometres and no rationalisation of the network (see Figure 1). The country, however, still outperforms Europe on the

density indicator, but not for GFB, highlighting the fact that with non-separated reporting between GFB and the export lines, the loss in GFB density is not evident. Even though the RIC countries are often seen as less productive, it could be argued that capital productivity relating to infrastructure (i.e. improvements enabled by density) increased more over the last decade.

Figure 3. Change in density – South Africa compared with global macro rail systems

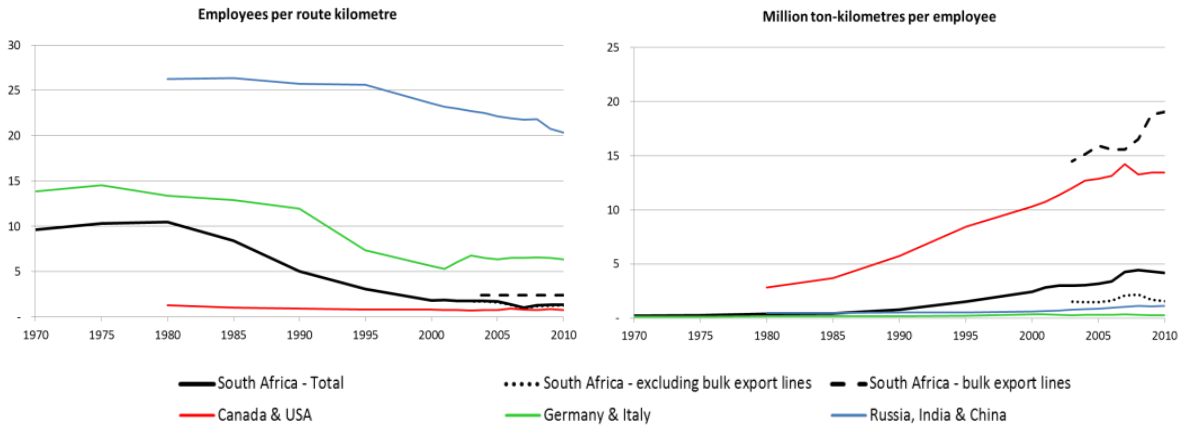


Sources: Global: UIC, 2012; South Africa: authors' analysis

4.2.2 Employee productivity

Employee productivity is considered for fixed infrastructure maintenance (employees per route kilometre) and ton-kilometre output. Despite major improvements since 1980, when the RIC railways employed more than 25 employees per route kilometre to just over 20 employees today, the figure is still high compared with global standards (see Figure 4). This higher employment ratio is, however, to be expected from development-state railways, which are in the process of increasing the railway footprint, and where social-upliftment policy treats the railways as a source of social employment. The US and Canadian railways are once again seen to use capital assets productively. The difference between these two railway systems and the national objectives for railways in comparison with South Africa is evident. For ton-kilometres per employee, South Africa's export lines fair relatively well (Figure 4). When data for South Africa's systems is combined, the country performs better than all railways except those of North America, once again disguising the challenges faced by GFB.

Figure 3. Employee productivity

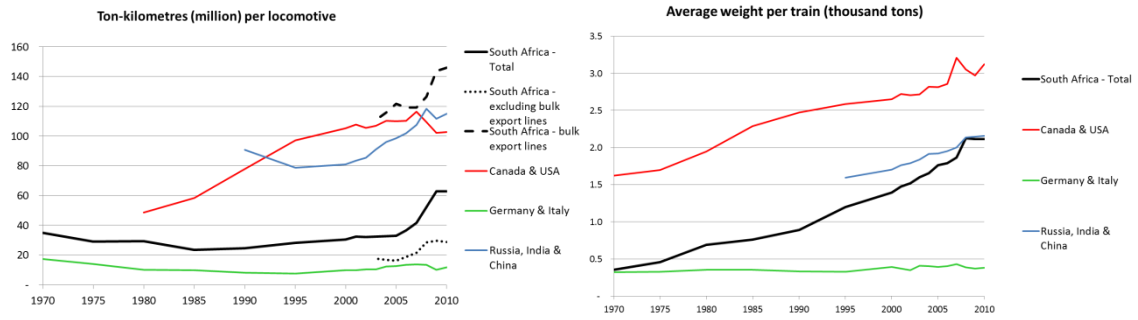


Sources: Global: UIC, 2012; South Africa: authors' analysis

4.2.3 Equipment productivity

Equipment productivity is generally expressed using two measures: payload ton-kilometre output per locomotive and payload mass per train. Comparative equipment productivity is illustrated in Figure 5. The large gap between South Africa's export lines and GFB is to be expected. Improvements in GFB are noticeable because locomotive rationalisation was possible when route rationalisation was not allowed. As South Africa aggressively invests in new rolling stock to refurbish the railway system, this measurement will have to be monitored closely. As Figure 5 shows, improvements in heavy haul in South Africa, in line with the big railways of North America and RIC, were achieved.

Figure 5. Equipment productivity

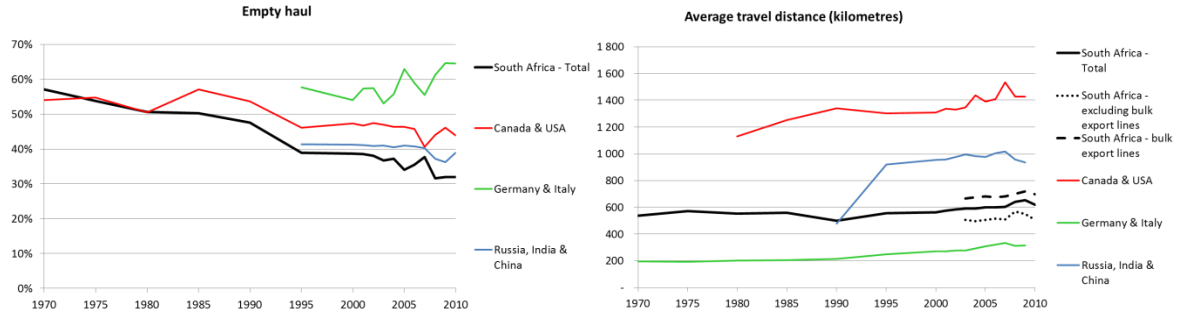


Sources: Global: UIC, 2012; South Africa: authors' analysis

4.2.4 Haul efficiency

Haul efficiency can be measured by empty haul and average length of haul (Figure 6). South Africa's haul efficiency improved markedly. Average length of haul is very much related to the geography and spatial dimensions for all the countries under analysis.

Figure 4: Haul efficiency



Sources: Global: UIC, 2012; South Africa: authors' analysis

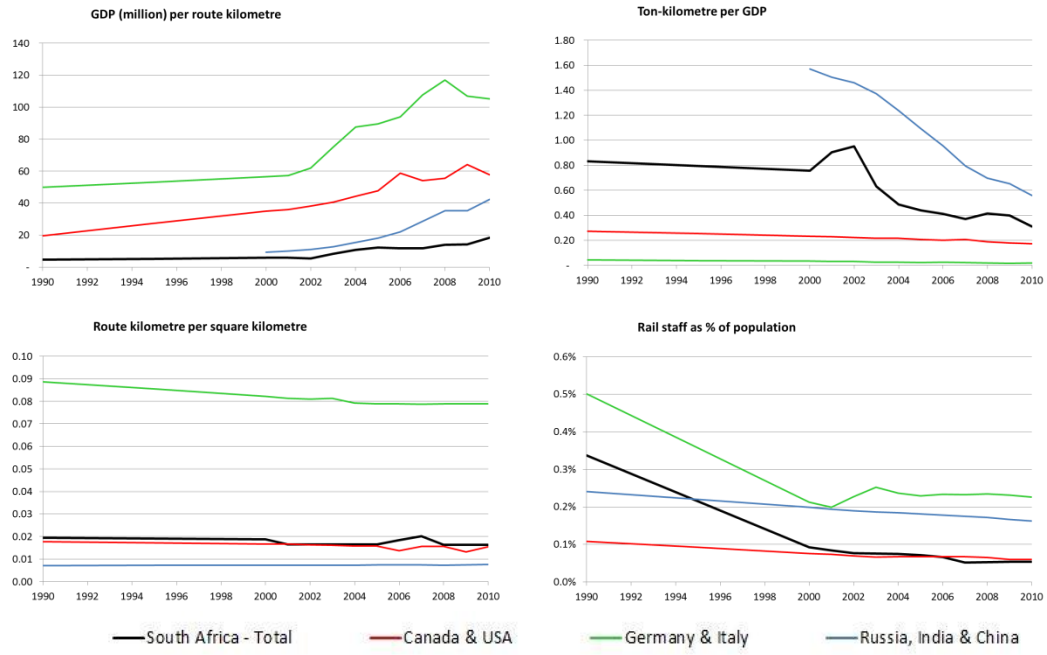
4.3 Railways' socio-economic relevance

This paper defines new measures to compare national indicators with railway size indicators. These are the relationship between (a) GDP and route kilometres and ton-kilometres (greater GDP per route kilometre and higher ton-kilometres per GDP will mean that the railway's role in the economy is higher and could play a greater sustainability role); (b) route kilometres per square kilometres of land area (indicating the railway's footprint with the same sustainability equation); and (c) percentage of the population employed by the railway (indicating the railway's social dimension) (Figure 7).

European railways play the smallest role in terms of relevance to GDP, but are more accessible, pointing to the environmental and congestion-alleviation role of these railways. The RIC railways require long-haul corridors to cover great land areas, pushing up the ton-kilometres required from the railway (i.e. more ton-kilometres per GDP). South Africa's position is lower than expected for accessibility given its relatively large network size. Recent increases in the relationship between GDP and route kilometres might have more to do with the lack of rationalisation of less utilised parts of the network. Economic relevance, as measured by ton-kilometres per GDP, has been slipping over the past 30 years, in line with lost market

share. South Africa's employee rationalisation relative to network rationalisation is significant. North America's relatively low socio-economic relevance measurement – despite these railways being financially the most successful in the world – confirms the fact that since deregulation, North American railways are not expected to play a development role. It is clear that these railways are rationalised to attain high densities and economies of scale, creating highly profitable rail companies.

Figure 5. Railways' socio-economic relevance



Sources: Global: UIC, 2012 and World Bank, 2012; South Africa: authors' analysis

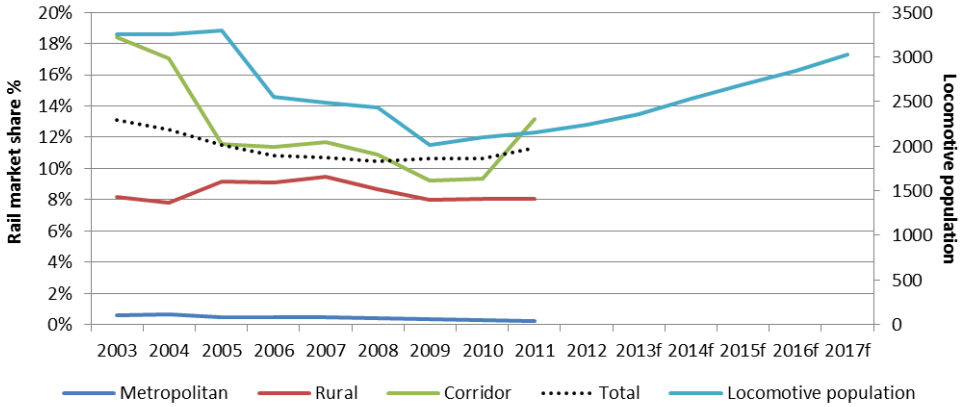
4.4 Reform agenda as driving force

Trends in the benchmark indicators for the three biggest global rail systems (North America, RIC and Europe) seem to have been driven by three distinct reform agendas. After deregulation, the North American railways were allowed to rationalise routes and staff, resulting in private companies with low cost bases, increased efficiencies and high densities. They managed to retain rail-friendly traffic in a deregulated environment, thereby attracting private-sector investment. The North American paradigm is that very low transport costs will also keep the 'social cost' of transport low.

The RIC railways were seen as tools for development, and their relative employment levels are extremely high. However, the railways remained strong and expansive, with direct government involvement. Route distances are long and the road mode relatively uncompetitive, meaning that higher rail costs (contributing directly to social spending) are tolerated.

South Africa's freight railway is big enough to develop along similar lines to a US Class 1 railway if it remains vertically and systemically integrated, and is mandated to be restructured into a rationalised, high-intensity freight carrier with resulting improved output performance. Alternatively, it could become a social instrument such as is the case in the RIC countries. Transport costs, in this case, will increase over time as the railway becomes less efficient (due to a low-density network and high employment costs) but this may be offset if the costs of modal alternatives rise because of increased fuel and environmental costs. Socio-economic obligations by the railway will require direct government involvement and investment. However, there is a middle road between these two extremes, namely to create clear 'Chinese walls' between a core and a development-state network. The core network could operate as a profitable business with returns that satisfy both shareholders' and infrastructure capacity requirements, while reducing the country's freight transport bill by means of intermodal corridor solutions, and alleviating the risk of fuel price instability and negative externalities. Despite scepticism surrounding rail's ability to recapture long-distance freight, the South African rail system's rejuvenation (indicated by the recent and planned growth in the locomotive fleet) shows the potential to have a positive impact on rail's corridor market share (Figure 8).

Figure 6. Initial indications of rail turnaround in South Africa



Source: Authors' analysis

The development-state network (the current low-density branch-line network) will require government involvement, but will facilitate the ideals of rural employment and equitable access to the core transport network, while the cost to the state for subsidies will be minimal relative to the saving on the transport bill on the core network, the potential for job creation and potential future benefits derived from access to the network.

An important aspect that will require attention in such a network type is the development-state dimension that is much discussed in South Africa, but not well defined. According to Gumede (2009), the phenomenon is highly successful in East Asia, where the drive for growth, industrialisation, social upliftment and structural change allows government to selectively become directly involved in development, not crowding out private investment, but luring it in, with the aim of creating a flourishing mixed capitalistic state.

5 Conclusion

Although South Africa's export lines compare favourably globally, GFB, as currently measured, lags in all key indicators, with a negative effect on the railway's socio-economic relevance. The key cause is the lack of a clear reform agenda for the railway. The South African rail system has followed neither a path of market deregulation and network rationalisation, reinvestment and efficiency improvement, as in North America, nor a development-state route of network growth and high employment, as in the RIC countries.

If South Africa's railway were to survive on private-sector revenue, the network would have to be rationalised and follow the North American route of appropriate infrastructure investment to, firstly, lure back lost business and, secondly, persuade new rail-friendly freight to return to rail, thereby improving density, driving down costs and increasing the attractiveness of investment. In such a scenario, the export lines would energise the reform of the general freight business, as the same successful high-density core network business continues to develop, and remain integrated with the core business. The secondary (i.e. low-density) network could then become a subsidised social construct. This approach does not exclude investment in the densified core by government. That would, however, be investment in an expected, profitable, vertically integrated railway business, like the North American model. The alternative – maintaining the status quo of a mixed railway with an unclear reform agenda – is doomed to be a less effective network with direct government funding an ongoing imperative.

References

1. Association of American Railroads. 2012. Overview of America's Freight Railroads. AAR Policy and Economics Department. Available from: https://www.aar.org/keyissues/Documents/Background-Papers/Overview-US-Freight-RRs.pdf (accessed 5 June 2013).
2. Association of American Railroads. 2013. Class 1 Railroad Statistics. Available from: https://www.aar.org/StatisticsAndPublications/Documents/AAR-Stats-2013-04-17.pdf (accessed 25 June 2013).
3. Barone, M. 2013. Why Freight Rail Pays and Passenger Trains Flunk. Available from: http://www.realclearpolitics.com/articles/2013/04/01/why_freight_rail_pays_and_passenger_trains_flunk__117732.html (accessed 5 June 2013).
4. Bitzan, J.D. and Keeler, T.E. 2003. Productivity Growth and Some of Its Determinants in the Deregulated U.S. Railroad Industry. Southern Economic Journal, 70(2): 232–253.
5. Bogetić, Z. and Fedderke, J.W. 2006. International Benchmarking of Infrastructure Performance in the Southern African Customs Union Countries, World Bank Policy Research Working Paper 3987 Available from: http://ideas.repec.org/p/wbk/wbrwps/3987.html (accessed 29 May 2013).
6. Braeutigam, R.R., Daughety, A.F. and Turnqist, M.A. 1984. A Firm Specific Analysis of Economies of

Densities in the U.S. Railroad Industry. The Journal of Industrial Economics, 33(1): 3–20.
7. British Railway Board. 1963. The Reshaping of British Railways: Part 1: Report. London: The British Railway Board.
8. Cambridge Systematics. 2007. National Rail Freight Infrastructure Capacity and Investment Study. Cambridge: American Association of Railroads.
9. Caves, D.W., Christensen, L.R and Swanson, J.A. 1981. Productivity Growth, Scale Economies, and Capacity Utilization in U.S. Railroads 1955–74, American Economic Review, 71(5): 994–1002.
10. Eakin, B.K. and Schoech, P.E. 2010. The Distribution of the Post-Staggers Act Railroad Productivity Gains. Madison: Christensen Associates.
11. Foster, V. and Briceño-Garmendia, C. 2010. Africa's Infrastructure: A Time for Transformation. Washington: The International Bank for Reconstruction and Development/World Bank.
12. Frankel, S.H. 1928. The Railway Policy of South Africa: An Analysis of the Effects of Railway Rates, Finance and Management on the Economic Development of the Union. Johannesburg: Hortors.
13. George, S.A. and Rangaraj, N. 2008. A Performance Benchmarking Study of Indian Railway Zones. Benchmarking: An International Journal, 15(5): 599–617.
14. Gow, D. 2008. Europe's Rail Renaissance on Track. Available from: http://www.guardian.co.uk/business/2008/jul/09/rail.sncf.montblancexpress (accessed 19 June 2013).
15. Grenzeback, L.R. 2002. Freight Trends and Freight Rail. Presented to Delaware Valley Goods Movement Task Force, 10th Anniversary Meeting, Philadelphia. Available from: http://www.dvrpc.org/ASP/committee/Presentations/DVGMTF/2002-10.pdf (accessed 24 June 2013).
16. Gumede, W. 2009. Delivering the Democratic Developmental State in South Africa: Development Planning Division Working Paper Series No. 9. Midrand: Development Bank of South Africa.
17. Harris, R.G. 1977. Economies of Traffic Density in the Rail Freight Industry, The Bell Journal of Economics, 8(2): 556–564.
18. Havenga, J.H. and Pienaar, W.J. 2012. Quantifying Freight Transport Volumes in Developing Regions: Lessons Learnt from South Africa's Experience during the 20th Century. Economic History of Developing Regions, 27(2): 87–113.
19. Havenga, J.H., Pienaar, W.J. and Simpson, Z. 2011. A Case for Measuring Logistics Costs on a National Level: A South African Application. Corporate Ownership and Control, 8(3): 622–631.
20. Havenga, J.H. and Simpson, Z. 2013. National Logistics Costs and Global Trends. In N. Viljoen (ed.), The 9th Annual State of Logistics Survey for South Africa: 2012. Connecting Neighbours – Engaging the World. Pretoria: CSIR Built Environment.
21. Hilmola, O.P. 2009. Contemporary Research Issues in International Railway Logistics. Lappeenranta: Department of Industrial Engineering and Management,
22. Lappeenranta University of Technology (Kouvola Research Unit, Research Report 171).
23. Keeler, T.E. 1974. Railroad Costs, Returns to Scale, and Excess Capacity. The Review of Economics and Statistics, 56 (May 1974): 201–208.
24. Martin, P. 2004. Railways in South Africa: Historic Highlights, Strategic Evolution and Transformation. Johannesburg: Spoornet.
25. Nelder, C. 2012. Rising Energy Costs May Usher in U.S. Freight Rail Revival. Scientific American. Available from http://www.scientificamerican.com/article.cfm?id=freight-rail-back-to-the-future (accessed 27 May 2013).
26. OECD (Organization for Economic Cooperation and Development). 2002. Benchmarking Intermodal Freight Transport. Paris: OECD Publications.
27. Piasecka, A. 2007. World Bank Railways Database. Available from: http://go.worldbank.org/AS6SFABKJ0 (accessed 19 June 2013).
28. Simpson, Z. and Havenga, J.H. 2011. Logistics costs – Lower Relative Costs, Higher Risk. In Gearing Up for Change: The 8th Annual State of Logistics Survey for South Africa. Imperial Logistics, Stellenbosch University and CSIR. www.csir.co.za/sol.
29. South African Government. 2013. National Infrastructure Plan. Available from: http://www.info.gov.za/issues/national-infrastructure-plan/index.html (accessed 28 May 2013).
30. Spector, J.B. 2013. South Africa, a Developmental State? No Chance, Daily Maverick, 31 May 2013. Available from: http://www.dailymaverick.co.za/article/2013-02-26-south-africa-a-developmental-state-no-chance/#.UafcAEBTDX5 (accessed 31 May 2013).
31. Sumatra (Surface and Marine Transport Regulatory Authority for Competitive, Efficient, Quality and Safe Transport Services of Tanzania). 2011. Performance Indicators and Benchmarks for Railway Subsector in Tanzania. Available from: http://www.sumatra.or.tz/index.php/component/docman/doc_view/51-performance-indicators-and-benchmarks-for-railway-subsector-in-tanzania?Itemid=323 (accessed 29 May 2012).
32. Sustainable Aotearoa New Zealand. 2009. Strong Sustainability for New Zealand: Principles and Scenarios. Nakedize Ltd.
33. Tochitskaya, I. 2012. Azerbaijan Transport Sector, 2011. Warsaw: CASE-Center for Social and Economic Research on behalf of CASE Network.
34. Transnet. 2012. Transnet Market Demand Strategy. Available from: http://www.transnet.net/InvestorRelations/Documents/20120409%20MDS%20launch%20presentation.pdf (accessed 19 June 2013).
35. UIC (International Union of Railways). 2009. Benchmarking Intermodal Rail Transport in the United States and Europe. Available from: http://www.uic.org/diomis/IMG/pdf/DIOMIS_Benchmarking_Intermodal_Rail_Transport_in_the_US_and_Europe.pdf (accessed 29 May 2013).
36. UIC. 2012. Railway Time-series Data 1970–2010. Ordered at: http://www.uic.org//spip.php?article1164 [27/5/2013].
37. UNECE (United Nations Economic Commission for Europe). 2013. Statistical Database: Transport Infrastructure. Available from: http://w3.unece.org/pxweb/?lang=1 (accessed 24 June 2013).
38. United Nations. 1987. Report of the World Commission on Environment and Development: Our Common Future. Available from: http://www.un-

documents.net/our-common-future.pdf (accessed 8 March 2013).
39. Wiegmans, B.W. and Donders, A. R. T. 2007. Benchmarking European Rail Freight Transport Companies. Transportation Journal, Spring: 19–34.
40. Woodburn, A. and Whiteing, A. 2012. In A. McKinnon, M. Browne and A. Whiteing, (eds). Green Logistics: Improving the Environmental Sustainability of Logistics, London: Kogan Page.
41. World Bank. 2012. The Little Green Data Book 2012. Available from: http://data.worldbank.org/products/data-books/little-data-book/little-green-data-book (accessed 10 December 2012).