THE IMPERATIVE FOR COMMODITY-BASED INTERMODAL FREIGHT TRANSPORT DEMAND MODELLING: A SOUTH AFRICAN CASE STUDY

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Abstract

Container forecasting typically focuses on its intermodal nature, container sizes and port container terminals. This leads to a commodity-blind approach to container forecasting, where the twenty-foot-equivalent is the forecasting output. The standardized unit is also increasing into many non-standard forms, indicated by the three main container market segments. This research deconstructs these segments and provides methodological and actual commodity-based container forecasting results for South Africa where intermodal solutions are still in its infancy and investments need to be made based on accurate forecasting.

Keywords: Container Market, Intermodal Solutions, Forecasting, South Africa

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1 Introduction

The unitisation of general cargo (through palletisation and containerisation) is leading to a rail revival through intermodality as it combines the benefits of both surface freight transport modes – i.e. the low transport costs resulting from economies of scale on long distance rail, and the flexibility and accessibility of road transport's collection and distribution services (Van Binsbergen et al., 2013). Intermodality refers to the use of two or more modes of transport for the seamless movement of goods in the same loading unit (De Witt and Clinger: 1999:1, Jannic and Reggiani: 2001: 471) in an integrated door to door transport chain (European Commission, 1997:1). According to Rodrigue and Notteboom (2013), the shift towards containerisation in the global freight distribution system, is "the most salient example of convergence" between technology, infrastructure, modes and terminals.

Intermodal discussions however often focus on international maritime trade – limiting the dialogue to ISO container sizes, port container terminals and port/modal interfaces. However, in 2013 the domestic use of containers for inland transportation outstripped the use of import/export containers in the USA (and is now close to 50% of all containers transported) (Intermodal Association of North America: 2013) while in Europe domestic container movements are gaining popularity (Silborn: 2008). In 2013, intermodal was the biggest rail commodity in the UK (MacRae, 2013).

As such, three applications of containers in national supply chain systems need to be discussed:

1. Containers crossing the quay wall. This mainly deals with import, export and transhipment movements, as well as issues relating to container vessels and port capacity. Here, the capacity and efficiency of ports, port handling equipment and operations come into play.
2. The hinterland movement of containers that cross the quay wall. This deals with road transport, rail transport and inland waterways. Issues relating to the capacity and efficiency of the modal interfaces (port/dry port, port/rail, port/road, and road/rail) must be considered.
3. Purely domestic container movements and the capacities and efficiencies of the relevant intermodal interfaces (i.e. intermodal terminals)

Optimising these container operations, and creating sufficient future capacity, is a supply-side contribution to national logistics efficiency. This is pertinent in South Africa, where a number of factors support significant future container growth. These include:

1. The Durban-Gauteng logistics corridor will be a natural gateway for land-based freight flows to and from SADC, tying into the vision of the development of the North-South corridor into Sub-Saharan Africa (Peters, 2013);

2. The development of a number of inland container hubs and dry ports in the Gauteng area will encourage more hinterland container traffic to move onto rail (Peters, 2013);

3. South Africa's strategic position on a number of international and regional shipping trade routes remains an important advantage in establishing a transhipment hub at the port of Ngqura (Alix, 2013); and

4. The development of domestic intermodal solutions has a large potential to increase the use of containers (Havenga et al., 2012).

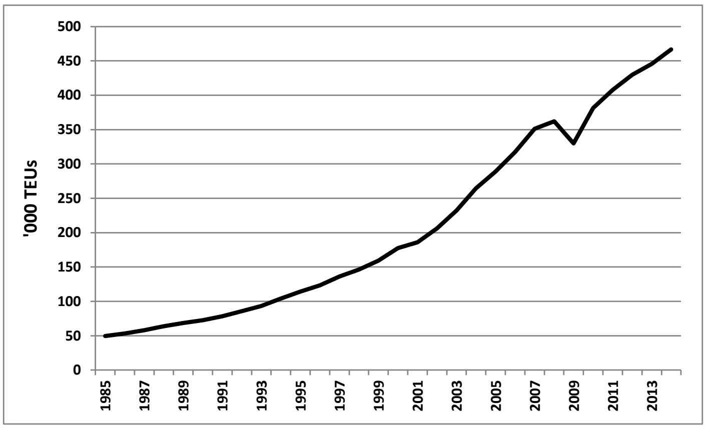
International trends, as discussed in the next section, however point to a flattening in containerisation. Informed forecasting of container volumes is therefore a critical component both for the development of port infrastructure and the hinterland logistics links. Brooks et al. (2014) emphasize that demand forecasts for major transport infrastructure projects are however frequently typified by an optimism bias and that past performance is often a poor indicator of the future. Disaggregated econometric analysis, which extends beyond extrapolation of trends or focusing on aggregate GDP as a basis for long-term forecasts, improves the understanding of growth drivers per commodity group, including the propensity to containerise (Brooks et al., 2014). Due to the data intensiveness of this approach, it has however not gained international traction, and the majority of container demand models still employ the historical correlation between GDP and containerisation growth, despite the forecasting errors that have become evident over the past decade (Havenga and van Eeden, 2011). The commodity-based approach that has been developed for South Africa to gain more accurate insight into the country-specific demand for containers and intermodal transport, is shared, together with the deeper insight gained into each of the container applications delineated earlier.

2 Global trends

2.1 Containers over the quay wall

International trade container volumes (in Twenty Foot Equivalent units, TEU) handled by ports increased from 71 million in 1985 to 750 million in 2012, and is estimated to grow to 818 million in 2014 (
Figure 3). In 2011, this containerised cargo translated into 3.6 billion tonnes, compared to the 1.9 billion tonnes of international cargo that was not containerised, a container penetration rate of 66% (Sooredoo, 2013).

Figure 3. Growth in global container volumes (TEUs) from 1985-2014 (Sooredoo, 2013)



The exponential growth in containerisation was driven by the increased propensity to containerise internationally traded commodities previously handled as break-bulk due *inter alia* to productivity increases attributed to ease of handling, improved security and transport economies of scale. The impact of containerisation is however flattening out, as discussed below.

International trade as a percentage of GDP grew slowly from 1% in 1820 to 10% in 1970, but has since then accelerated with globalisation and the specialisation of trade. It has however stabilised around 32% and is not forecast to rise in the foreseeable future (

Figure 4) (International Monetary Fund, 2013 and Van Den Berg and Lewer, 2007). Recent trade growth is driven by emerging economies, with advanced economies' trade not reaching the pre-recession peak by end 2013, while emerging economies surpassed the pre-recession peak by mid-2010 (Brooks et al., 2014). Global trade growth (relative to GDP) as a multiplier of container growth has, therefore, abated.

Global container penetration (i.e. the containerisation of break bulk and suitable other commodities) reached 66% in 2011, up from 39% in 1990 (Figure 5). Container penetration increased by 22 percentage points in the period 1990 to 2003 (1.6 percentage point p.a.), but only by 4 percentage points between 2003 and 2011 (less than 0.5 percentage points p.a.). The research currently estimated that the saturation point will be reached in 2017, meaning that the percentage of certain commodities transported in containers will not grow any more. This would effectively remove the container penetration multiplier relative to GDP. In addition, emphasis on cost efficiency has driven consolidation and tighter packaging solutions. As a result, the average loaded container is now fully packed, stabilising around 8.8 tonnes over the past decade (Sooredoo, 2013). Thus the contribution that the container load factor made to the container growth multiplier is also waning.

Figure 4. Historic trends in global GDP growth ($ trillion) and global trade as % of GDP (International Monetary Fund, 2013; Van Den Berg and Lewer, 2007)

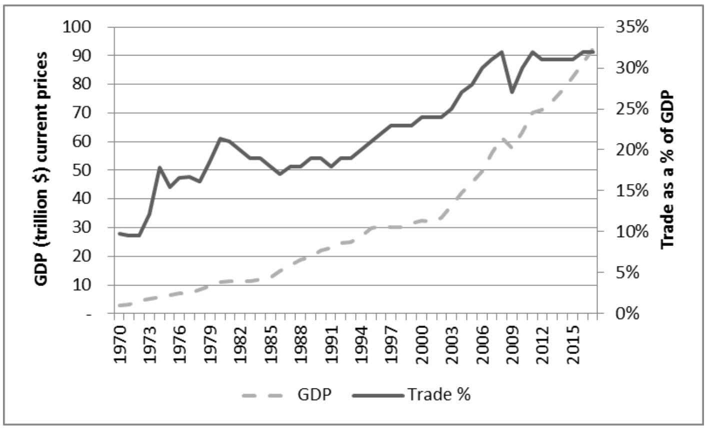
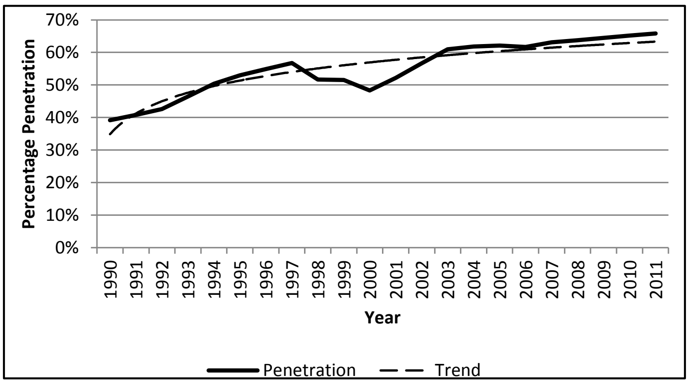


Figure 5. Percentage of global tonnes shipped in containers (Sooredoo, 2013)



The factors that caused global container volumes to grow at a more rapid rate than global GDP are diminishing, which will flatten out the rate of global container growth.

3.2 Hinterland movement of containers that cross the quay wall

The rail market share for hinterland container movements has grown significantly in the recent past and major growth is forecast for the future. Time series for the hinterland movement of containers however only exist for a few countries and global comparisons are not yet possible. Country-specific statistics however support the shift towards a rail revival.

In the United Kingdom, 19% of all container tonnes imported to or exported from the ports were transported in the hinterland by rail in 2011. This is forecast to grow to 46% by 2033. Similarly, 37% of all container tonne-kilometres in the UK that originated or terminated in the port during 2011 occured on rail, and this is forecast to grow to 63% in 2033 (Plummer, 2013). In the UK, rail's share has grown over the last decade in response to road congestion, investment by train operators and infrastructure capacity enhancements supported by capital grants from government (Brooks et al., 2014). In Israel, current hinterland containers on rail is 8% and is targeted to grow to 25% by 2020 (Goldberg, 2013). Western Australia's railway market share for hinterland container movement has risen from 2% ten years ago to 14% and the short term target is to reach 30% (Buswell, 2013). The figure for Spain has grown from 3% to 12% over the last five years (Castillo-Manzano et al., 2013). The figure for Mexico is 33%, for Canada 77% on the country's West Coast and 48% on the East Coast and for the USA 67% on the West Coast and 17% on the East Coast (Ogard, 2013).

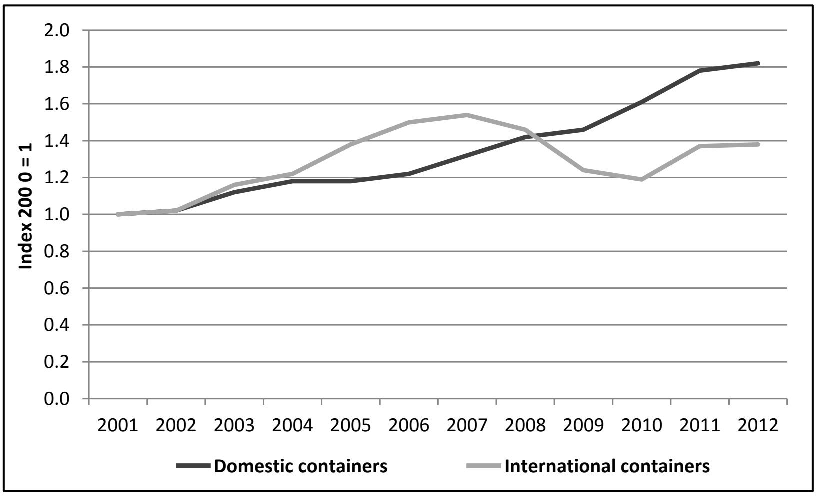
The increase in rail container transport in Europe is in large part due to voluntary coordination agreements to ensure equitable access to incumbents' rail track (it is believed that regulation would discourage investment). Examples are Hamburg, where concerted stakeholder coordination efforts (due to the presence of 92 different railway operators), resulted in 36% of containers from Hamburg port transported on rail in 2010, planned to exceed 40% by 2025, and Rotterdam where the current container rail share of 13% is targeted to reach 20% by 2035 (inland waterways are targeted to be the main mode). The Bombay Jawaharlal Port project in India reached a 30% rail share of the 4.5 million TEUs transported following development of a dedicated freight corridor, allowing double-stacking, partly financed with equity from customers (Brooks et al., 2014).

3.3Purely domestic container movements

Purely domestic container movement statistics are only available for the USA and parts of Europe.

In the USA, growth for purely domestic container movements (13.7%) from 2011 to 2012 has been four times more than that of containers that cross the quay wall (3.5%), reaching 3.6 million in 2012 compared to the 5.1 million for maritime containers. This implies that the remaining domestic containerisation propensity potential is higher than that of global trade. Notably, it has been the only rail segment that has not shown a decline on a quarterly basis over the last decade – not even in the depths of the recession. The estimated growth for 2013 is 9%, compared to the 1.3% growth forecast for containers crossing the quay wall (Malloy, 2012)

Figure 6. The rise of domestic intermodal container volumes in the USA compared to a stabilisation in import/export containers (Malloy, 2012)



European domestic intermodal has grown with 25.5% between 2005 and 2011. The equivalent of 11 million TEUs is currently being shipped domestically in Europe (Géhénot, 2013). This is a relatively high number for a continent that typically has low average transport distances. Intermodal container transport efficiencies can therefore also be garnered over shorter corridors.

3 Methodology

In 2006, the authors developed a comprehensive freight demand model (FDM) for South Africa. The purpose of the model is to gain an understanding of the current structure of and future demand for freight transport in South Africa to, *inter alia*, inform national freight policy development, direct large-scale freight logistics capital investment decisions and uncover opportunities for the reduction of national logistics costs. This model is refined and updated annually.

The FDM estimates all freight flows in South Africa (summarised into 83 commodity groups) between 372 geographical areas, with 30-year forecasts and for three growth scenarios, in tons and tonkilometres. The granularity of the FDM seems to be unique in the world (Havenga, 2013). The term commodity refers to an economic subsector as defined by the 4-digit Standard Industrial Classification (SIC) coding system (Statistics South Africa, 1993), which is based on the international SIC. The use of the SIC enables comparison with national and international data which utilise this standard (most macroeconomic data). In addition, significant value has been added to knowledge management in the South African transport sector by classifying all input data according to the SIC (this includes rail flows, imports, exports and shipping manifest data). The flow estimation is based on gravity modelling of the supply (production and imports) and demand (intermediate demand, final demand, exports and inventory investments) per geographical area per commodity group using a distance decay function as a transport resistance measure. The geographical areas refer to magisterial districts (the smallest available geographical unit on which data is published in South Africa), ports, airports and border posts. The resulting model has over 1 million records of freight flow data. Actual historic rail freight data is subtracted from the modelled flows, with the remainder providing a comprehensive, disaggregated estimate of road freight transport.

3.1 Containers over the quay wall

The key pillars of the commodity-based container forecast for export and import TEUs, are the availability of container content data, forecasting long term growth demand for this contents and "fitting" these to the maximum propensity to containerise per commodity.

The content of trade containers is established through the capturing and analysis of shipping line manifests – a resource intensive approach, but by far the most reliable source of commodity information that could be established.

A combination of forecasting techniques was used to forecast the demand for the underlying container contents. These include expert consensus for agricultural and mining commodities, correlated with macroeconomic forecasts at the industry level. For manufacturing, established forecasting models from a major industrial bank were used. For validation, results were compared to historical trends and outliers validated.

The current containerisation per commodity was determined based on the non-containerised bulk and break bulk volumes from detail commodity data obtained from the National Ports Authority, and the containerised volumes as received from shipping lines. Assumptions on the remainder of each commodity that can potentially be containerised (the ceiling value) in the forecast years are then developed based on the current propensity to containerise, enhanced through discussions with industry experts.

3.2 The hinterland-domestic freight flow relationship

The shipping manifest data provides the ceiling value per commodity for imports and export. The FDM provides total freight flows per commodity on the long-distance corridors. If the corridor freight flow exceeds the imports/exports, the balance is domestic traffic. Clarity is therefore obtained on the maximum of freight the corridor that relates to harbour activities.

3.3 Defining domestic intermodal transport

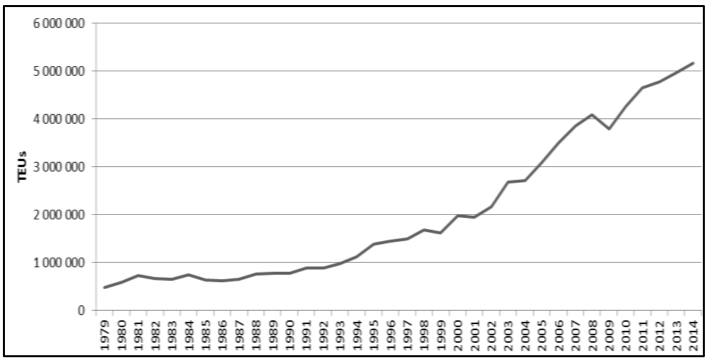
Rail freight's core competence is the transport of uniform, bulk freight over long distances between defined origin-destination (OD) pairs (defined as primary traffic). This mostly translates into bulk mineral transport, but the identification of potential market segments that behave in a similar way, is key to the rail revival described earlier. Long-distance traffic can be transformed to fewer OD pairs if the collection and distribution can be performed efficiently from a central hub at both ends of the long-distance corridor. The only way to do this effectively is through implementing intermodal solutions, which transform the corridor to a combination of primary traffic on rail (end-to-end) and metropolitan traffic on road (short-distance distribution). This implies the unitisation of freight through containerisation. Brown and Hatch (2002) highlight typical freight that fits this description, mostly fast-moving consumer goods (FMCG) transported as break bulk. The commodity-level freight flows enable the identification of these commodities on the key corridors to serve as a starting point for establishing domestic intermodal potential.

4 South African container trends

4.1 Containers over the quay wall

Total South African international trade container volumes (including transhipments and empty containers) grew from 0.47 million in 1979 to 4.77 million in 2012 and are forecast at 5.16 million in 2014 (
Figure 7).

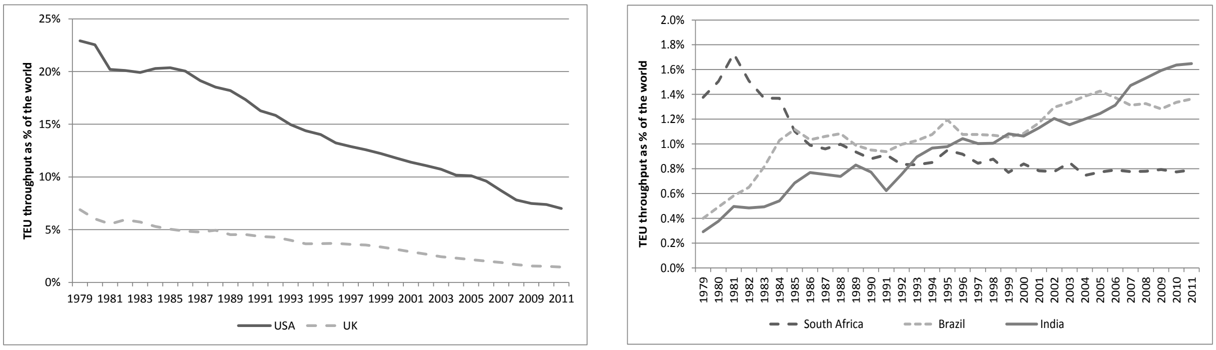
Figure 7. Total South African TEU growth 1979 – 2014 (Sooredoo, 2013)



South Africa's share of global trade has declined in line with that of developed countries (

Figure **8**). The USA's share of container flows declined from 23% in 1979 to 7% today, while the UK's share declined from approximately 7% to less than 2% over the same period. Brazil's share grew from 0.4% to 1.3% and India from 0.3% to 1.6%. South Africa's share declined over the same period from 1.4% to 0.8%. South Africa's reliance on mineral export as a growth engine partly contributes to the declining trend.

Figure 8. TEU throughput as % of the global TEU throughput – developed vs. emerging economies (Sooredoo, 2013)



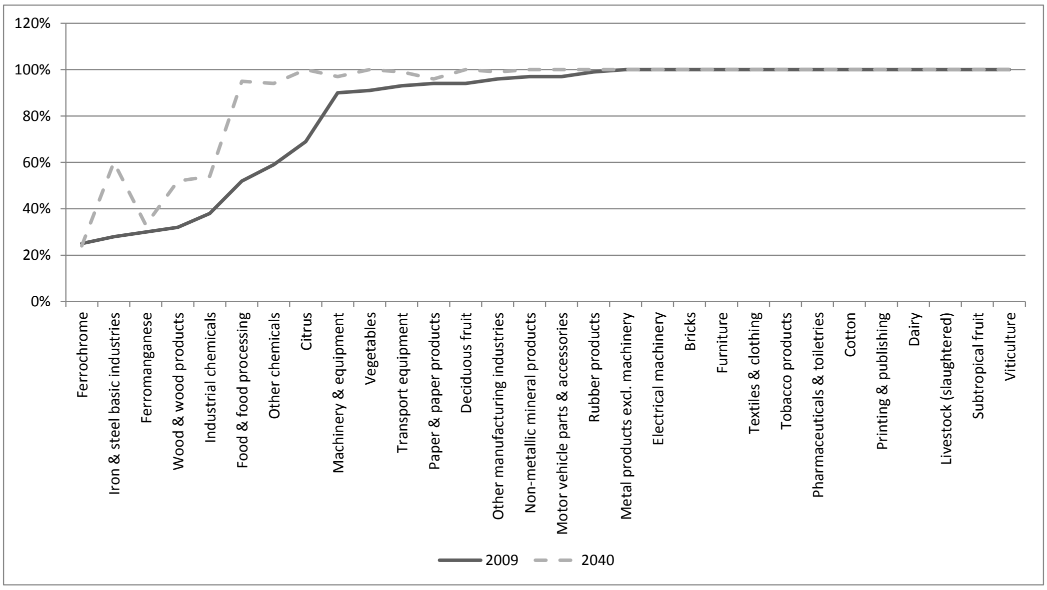
Transnet, South Africa's state-owned freight transport company, is rolling out an unprecedented capital investment plan, of which R80bn (27% of the total R300bn expenditure), will be spent on ports, port terminals and related infrastructure (Transnet, 2013). Given the flattening global containerisation trends, it is critical to determine container penetration statistics for South Africa in order to inform the magnitude and location of this spend.

4.2 International trade container penetration and demand for South Africa

Determining container penetration is far more complex than merely applying the 66% global average highlighted earlier. The vibrant mineral export lines and massive crude and fuel imports, together 136 million tonnes or 60% of total traded cargo, skew the statistics. A commodity-disaggregated approach was followed to analyse South African current container penetration and estimate future potential (

Figure **9**). It is estimated that by 2017 all commodities that could sensibly be containerised will have reached saturation point, leaving little room for further containerisation.

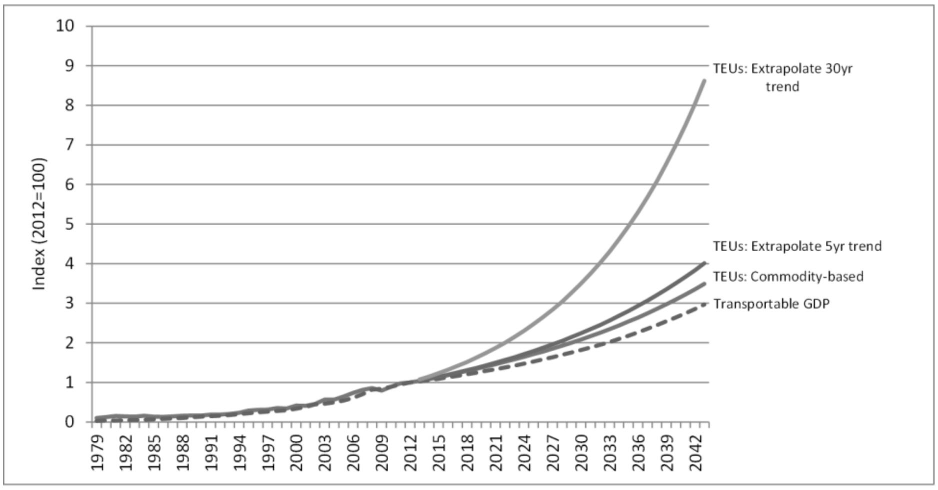
Figure 9. Commodity-disaggregated international trade container penetration for South Africa



If one was to merely extrapolate past growth curves as a basis for forecasting container volumes it would result in the artificial inflation shown in

Figure 10. A 30-year average forecasts that international TEUs will grow by 950%, while a 5-year extrapolation renders a 400% growth, up to 2042. A commodity-centric approach, however, moderates the forecast to 350% over the next 30 years, emphasising the benefit of commodity-based demand analysis in checking a forecasting optimism bias.

Figure 10. South African international trade container growth estimates – extrapolation vs. commodity-based forecasts (full, transhipment and empty TEUs)

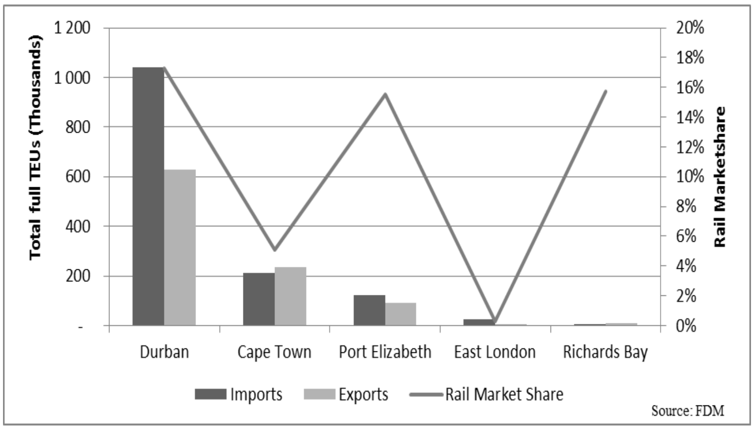


4.3 Hinterland movement of containers that crossed the quay wall

The hinterland movement of containers should consider the modal split of containers leaving the port as well the long distance movement of containers travelling on corridors. Of the 964 000 full containers that were exported through South African ports in 2012, 145 000 (15%) arrived at the ports by rail, and 202 000 of the 1 405 000 containers (14%) that were imported through South African ports in the same year, were removed by rail.

Figure **11** shows the rail market share statistics for selected South African ports. Durban, the country's major gateway port for containers, is connected to the economic heartland, Gauteng, by a well-developed corridor and is therefore expected to have the highest rail market share.

Figure 11. Rail market share of full hinterland containers that crossed the quay wall at South African ports



When analysing the corridor flows of hinterland movements the question of where a container was stuffed or destuffed arises. Import containers destined for Gauteng may be destuffed in Durban before being transported on the KwaZulu-Natal – Gauteng (Natcor) corridor, but this does not change the fact that the contents of that container still travelled on the corridor, albeit in a "virtual" container. Similarly, the contents of export containers from Gauteng that is transported via Natcor to Durban only to be stuffed into physical containers in Durban also travelled on the corridor in a virtual container. As such it is necessary to analyse hinterland content flow in order to understand hinterland intermodal potential on the corridors and not just the physical flow of boxes. The map in

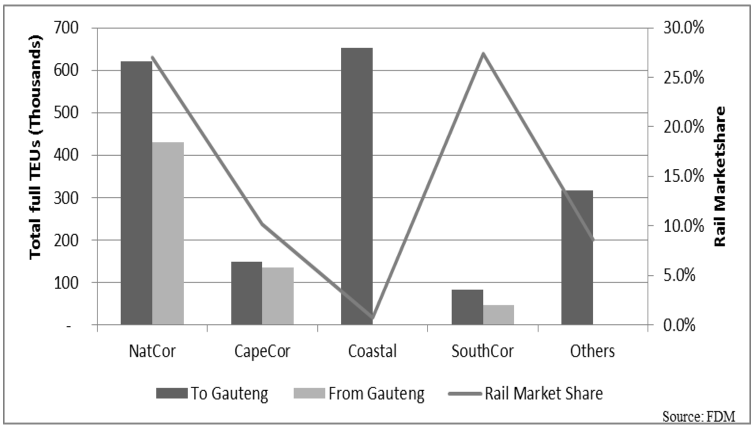
Figure 12 graphically depicts the flow of current and potential container content on the country's major corridors.

Figure 12. Flow of hinterland container content on the major corridors in 2012

Figure **13** shows the rail market share for the content of hinterland movements on the major corridors in 2012. Most contents flow on Natcor, with some contribution from the Cape Town-Gauteng corridor (Capecor) and the Gauteng-Port Elizabeth corridor (Southcor). The coastal flows are shorter regional hauls away from the ports (such as for instance Cape Town to George or Durban to Port Shepstone) and a low rail market share is expected (even though movements of the same distance is targeted in places such as Europe, the United Kingdom and Israel).

It is estimated that in 2012, 13% of export containers that travelled on Natcor were only stuffed in Durban and 33% of import cargo, destined for Gauteng, was destuffed already in Durban. The rail market share for Natcor is higher than for the other corridors at 25%, but it is still below its potential. Preliminary indications on Natcor show that currently 282 000 import/export containers are on rail and 766 000 import/export containers (or container contents) are on road – the latter volumes could be attracted to rail.

Figure 13. Rail market share of hinterland movements on the major South African corridors (2012)



4.4 Purely domestic containers

Purely domestic container movements on rail in South Africa are negligible. In order to understand the potential development of this market segment, domestic break bulk (DBB) flows (i.e. flows that are the most obvious for domestic intermodal solutions), are analysed.

Total DBB on corridors was 60mt in 2012, and is forecast at 155mt in 2043. The low-hanging fruit are the two key economic arteries namely Durban-Gauteng and Cape Town-Gauteng. DBB on these two corridors contribute 28mt and 70mt to total DBB tons in 2012 and 2043 respectively (roughly 45% in both years). The viability of intermodal facilities where break bulk reaches critical densities, is deemed to be four million tons on corridors longer than 500 kilometers, based on Harris' (1977) work (Havenga, 2013). This translated into a domestic intermodal potential of approximately 2.8 million TEUs in 2012 on the two key arteries (at an assumed average of 10 tons per TEU). Commodity-disaggregated analysis sheds further light on this potential.

Processed foods (excluding perishables and beverages) is the chief DBB commodity transported between the three major nodes of Gauteng, Durban and Cape Town, amounting to 15 million tons in 2012 and forecast to be 29 million tons by 2043 (54% and 41% of total DBB in 2012 and 2043 respectively). The research indicates that 4.23 million tons of processed foods were transported from Gauteng to Cape Town in 2012, and 4.19 million tons in the opposite direction. It further forecasts that this distribution should remain close to perfect balance up to 2043, with 8.8 million tons of processed foods flowing to Gauteng and 8 million tons to Cape Town. Four million tons of processed foods were transported from Durban to Gauteng, and 2.5 million tons in the opposite direction, during 2012. This distribution is forecast to move into closer balance by 2043, when 6.6 million tons are predicted from Durban and 5.2 million tons towards Durban. This densification of a single commodity group on two corridors with a combined length of more than 2 000 kilometres and a near perfect bidirectional flow, connected at a single congested node, i.e. Gauteng, is a clear and unambiguous indication of intermodal solutions, and of the benefits accruing from a commodity-based demand analysis.

The recent Memorandum of Understanding (MOU) between TFR and Imperial Logistics is aimed at spurring growth in the movement of domestic intermodal containers (Greve, 2013).

5 Concluding remarks

Global trends in container transport indicate that the propensity to containerise is reaching maturity and that containerisation growth will decouple from GDP. There is however still significant opportunities to intermodalise domestic freight flows, with recent growth data available for the USA and some European countries, supporting this assertion. South Africa's disaggregated freight flow model confirms that these trends also hold true for the country, and facilitates the development of more informed commodity-based container demand and forecasting models for investment in intermodal networks. The imperative for commodity-based intermodal freight transport demand modelling is clearly indicated for all three applications of container demand analysis presented in this research.

Following this understanding, an efficient intermodal network requires that hinterland transport infrastructure capacity is planned strategically and integrated seamlessly with port development, rather than as ad hoc responses to demand (Brooks et al., 2014).The planning of these intermodal networks however often has even longer lead times than other transport infrastructure due to the required coordination between numerous public and private stakeholders. In addition, intermodal transport solutions require collaboration between competitors, resting on complex pillars such as alignment of strategic objectives, coordination of services, and equitable distribution of investments and profits (Van Binsbergen et al., 2013). Spatial development is therefore to a large degree an institutional problem (Monios and Wilmsmeier, 2013).

The critical next step in South Africa's container demand forecasting certainty is the development of a national freight logistics strategy that will create the institutional framework for these negotiations. This strategy should include collaboration with industry to incorporate their current and planned demand and resulting operational requirements (Monios and Wilsmeier, 2013). Increased strategic certainty will provide positive reinforcement for higher forecasting accuracy of future container demand.

References

1. Alix, Y. 2013. Is South Africa able to become the first super global transshipment area of the Southern Hemisphere? www.sefacil.com/sites/sefacil.com/files/PMAESA%20Feb2013.pdf [18 July 2014]
2. Brooks, M.R., Pallis, T. and Perkins, S. 2014. Port Investment and Container Shipping Markets. Roundtable Summary and Conclusions. OECD/International Transport Forum Discussion Paper 2014-03.
3. Brown, T.R. & Hatch, A.B. 2002. The value of rail intermodal to the US economy. The American Association of State Highway and Transportation Officials: Special Committee on Intermodal Transportation and Economic Expansion. http://intermodal.transportation.org/Documents/brown.pdf [28/07/2014].
4. Buswell, T. 2013. State Govt adds support for rail to move freight. Government of Western Australia. http://www.mediastatements.wa.gov.au/pages/StatementDetails.aspx?listName=StatementsBarnett&StatId=7234 [25/02/2014].
5. Castillo-Manzano, J.I., González-Laxe, F. and López-Valpuesta, L. 2013. Intermodal connections at Spanish ports and their role in capturing hinterland traffic. Ocean & Coastal Management. 86(1).
6. De Witt, W. & Clinger, J. 1999. Intermodal freight transportation. Committee on Intermodal Freight Transport. US Transportation Research Board. http://onlinepubs.trb.org/onlinepubs/millennium/00061.pdf [24/07/2014].
7. European Commission. 1997. Communication from the Commission to the European Parliament and the Council: Intermodality and intermodal freight transport in the European Union. ftp://ftp.cordis.europa.eu/pub/transport/docs/intermodal_freight_transport_en.pdf [26/07/2014].
8. Géhénot, S. 2013. 2012 Report on Combined Transport in Europe. UIC. Availabe from: http://www.uic.org/com/IMG/pdf/combined_transport_en.pdf [25/02/2014].

9. Goldberg, J. 2013. Israel invests in railfreight capacity. International Railway Journal. http://www.railjournal.com/index.php/middle-east/israel-invests-in-rail-freight-capacity.html [25/02/2014].
10. Greve, N. 2013. Transnet, Imperial ratify road-to-rail alliance. Engineering News. http://www.engineeringnews.co.za/article/transnet-imperial-ratify-road-to-rail-alliance-2013-10-04 [28/07/2014].
11. Harris, R.G. 1977. Economies of Traffic Density in the Rail Freight Industry. The Bell Journal of Economics, 8(2): 556-564.
12. Havenga, J.H., Simpson, Z.P. and De Bod, A. 2012. South Africa's domestic intermodal imperative. Research in Transportation Business & Management 5 (2012): 38–47.
13. Havenga, J.H. 2013. The importance of disaggregated freight flow forecasts to inform transport infrastructure investments. Journal of Transport and Supply Chain Management; 7(1), 1-7.
14. Havenga, J.H. and Van Eeden, J. 2011. Forecasting South African containers for International trade: a commodity-based approach. Journal of Transport and Supply Chain Management, November 2011: 170-185.
15. Intermodal Association of North America. 2013. Intermodal Growth Extends Across All Markets; Trailers and ISO Containers Return to Positive Growth. http://www.intermodal.org/about/pressreleases/pr2013mts3q13.php [24/02/2014].
16. International Monetary Fund, 2013, World Economic Outlook Update: Gradual Upturn in Global Growth During 2013, viewed 08 March 2013, www.imf.org/external/pubs/ft/weo/2013/update/01/index.htm [8/07/2014].
17. Jannic, M., & Reggiani, A. 2001. Integrated transport systems in the European Union: An overview of some recent developments. Transport Reviews, 21(4), 469–497.
18. MacRae, C. 2013. Rail freight – a developing market. Rail Professional 198: 65-69.
19. Malloy, T. 2012. Thoroughbred Direct Intermodal Services. Multimodal Transport Institute Forum, Los Angeles. http://www.fiata.com/uploads/media/FIATA_World_Congress_2012_MTI_-_Presentation_by_Mr_Tom_Malloy__Thouroughbred_Direct_Intermodal_Services_02.pdf [25/02/ 2014].
20. Monios, J. and Wilmsmeier, G. 2013. The role of intermodal transport in port regionalisation. Transport Policy 30 (2013): 161–172.
21. Ogard, L. 2013. Enhancing and Expanding Containerized Commodity Movements. Export Transportation Summit. University of St. Francis in Joliet Illionois. http://www.ilsoy.org/_data/files/isa/Transportation/2013%20Summit%20Presentations/09_Logard.pdf [25/02/2014].
22. Peters, D. 2013. "Making Transport Work Better for All". Keynote Address by the Minister of Transport, International Transport Conference Gala Dinner, 3 September 2013, Midrand http://www.itssa.org/wp-content/itans2013/minster_dipuo-peters.pdf [18 July 2014].
23. Plummer, P. 2013. Long Term Planning Process: Freight Market Study. London: Network Rail. http://www.networkrail.co.uk/improvements/planning-policies-and-plans/long-term-planning-process/market-studies/freight/ [28/07/2014].
24. Rodrigue, J-P. and Notteboom, T. 2013. Containerized Freight Distribution in North America and Europe in Handbook of Global Logistics - International Series in Operations Research & Management Science, Bookbinder, J. H. (ed), 181:219-246.
25. Silborn, H. 2008. Measures promoting intermodal transport as an alternative to pure road transport — Proceedings of the international conference on heavy vehicles, Paris, 19–22 May.
26. Sooredoo, N. 2013. Key trends and future outlook of the African container port industry. (information kindly provided on request directly by Drewry). London: Drewry Maritime Advisors.
27. Statistics South Africa. 1993. Standard Industrial Classification of all Economic Activities (SIC) - Fifth Edition. http://www.statssa.gov.za/additional_services/sic/sic.htm [28/07/2014].
28. Transnet. 2013. Your guide to the Market Demand Strategy. http://www.transnet.net/PressOffice/Documents/MDS%20BOOKLET_2013.pdf [18/07/2014].
29. Van Binsbergen, A., Konings, R., Tavasszy, L. and Van Duin, R. 2013. Chapter 10: Mega-projects in intermodal freight transport: innovation adoption. In International Handbook on Mega-Projects. Priemus, H. and Van Wee, B. (eds). Edward Elgar Publishing: Cheltenham.
30. Van den Bergh, H. & Lewer, J.J., 2008, International Trade and Economic Growth, M.E. Sharpe, Armonk.