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Occasional Bulletin of Economic Notes

OBEN/21/01

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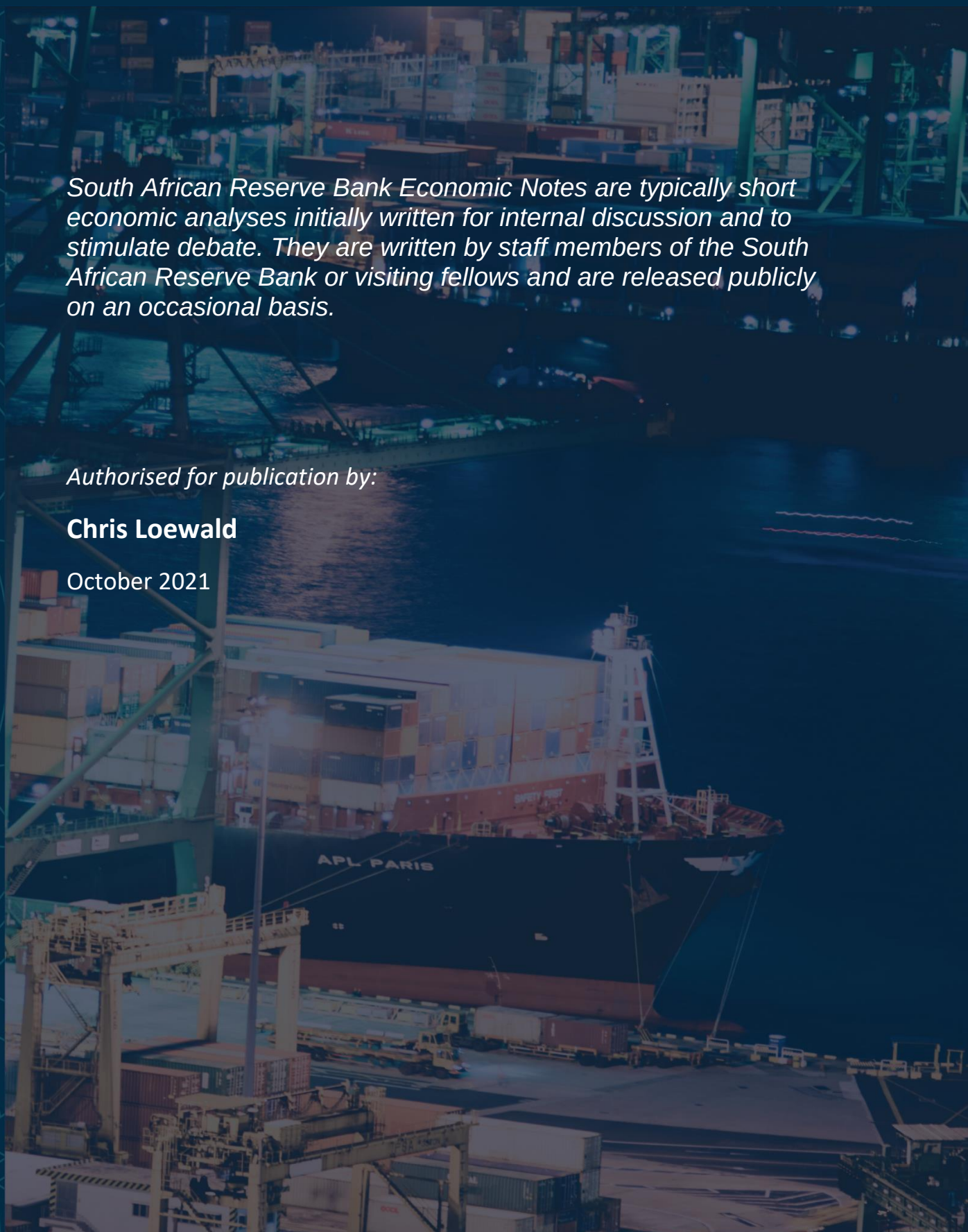
SARB 100 YEARS 1921–2021 A purposeful journey



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Authorised for publication by:

Chris Loewald

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OBEN 2101* – March 2021

A Truck-o-meter for South Africa

Byron Botha, Samkelo Duma, and Daan Steenkamp

Abstract

We produce automated daily and monthly indicators based on South African National Roads Agency traffic flow data from almost 9000 monitoring sites. Traffic volume data is available almost immediately, making such data useful for real-time assessment of economic activity. During the Covid-19 crisis, traffic flows declined dramatically, with trucking flows falling over 50 percent and light passenger flows down almost 80 percent during the initial lockdown. Although traffic flows returned to pre-crisis levels by the end of 2020, the introduction of the adjusted level three lockdown saw renewed weakness in traffic flows. We construct an index of transport activity as a coincident indicator of economic activity, and argue that it provides a useful signal of current economic activity. We argue that the recent level of trucking flows has been consistent with the January MPC GDP forecast for 2020Q4, but suggest some downside to the 2021Q1 nowcast.

1 Introduction[1]

We use hourly South African National Roads Agency (SANRAL) traffic flow data from almost 9000 monitoring sites to construct automated daily and monthly indicators of traffic activity. Traffic volume data is available almost immediately, making such data useful for real-time assessment of economic activity.[2] We construct a monthly index of trucking activity to act as a coincident indicator of economic activity. We argue that recent levels of trucking traffic have been consistent with the January MPC GDP nowcast, but are more pessimistic about growth in 2021Q1 than the SARB official nowcast.

2 Creation of daily traffic flow indicators

The SANRAL data we use provides hourly traffic flow data across four categories: light passenger vehicles, short-, medium-, and long-heavy trucks and distinguishes between three types of public roads: National Roads, Provincial (i.e. specific to different provinces) and Municipal (i.e local council level), with data for some monitoring sites starting in January 1994.[3] We focus on route aggregations for the N1, N2, N3 national roads, and aggregations for all other 'N' roads, all 'R' roads, all 'M' roads and other roads (labelled 'Rest'). We aggregate hourly flows from hourly to daily frequency, summing the number of vehicles for each category of vehicle per day at station-level before averaging across all sites per route (to account for the addition of new measurement stations to the dataset over time). We create route-level aggregations for each route for five vehicle categories (passenger vehicle, light trucks, medium trucks, large trucks and total trucks). To construct monthly series, daily (unseasonally adjusted) data for each category is averaged at station-level before being aggregated to route level and being seasonally adjusted. A large number of stations on Municipal and Provincial routes stopped reporting data during the Covid crisis, so we eliminate stations without at least 90 percent observation coverage from January 2000 from our construction of monthly indicators.[4]

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[1] Thanks to the South African National Roads Agency SOC Limited for making data available, Henk Botha for help with dataset construction and Daniel Ollech for advice on seasonal adjustment.

[2] The only other 'Truckometer' we are aware of for other economies is that of ANZ (2012) for New Zealand, who produce light and heavy trucking indices based on traffic flow figures.

[3] We filter out stations outside of South Africa's borders and discard observations that have invalid time intervals.

[4] We exclude the 'Rest' category given the large proportion of non-reporting sites in this group.

2.1 Seasonal adjustment

We use the approach of Ollech (2018) for daily seasonal adjustment, and Sax and Eddelbuettel's (2018) implementation of X-13ARIMA-SEATS for monthly seasonal adjustment.[5]

For daily data, the algorithm decomposes the seasonal component into sub-components including intra-weekly, intra-monthly, intra-annual seasonal factors and a moving holiday effect. We use the default window sizes recommended by Ollech (2018) for trend-cycle decomposition and estimating seasonal factors (ie. the Loess parameter for day of the week/month/year effect estimation). In order to assist in estimating the moving holiday effect, we provide as an external regressor the dates of all observed South African public holidays. For outlier identification, we allow for additive outliers, level shifts, and transient changes, with Ollech's (2018) default critical values.

For monthly aggregates, we use the X-11 procedure to estimate seasonal adjustments, along with trading day and Easter (8) regressors to calculate calendar-related effects.[6] For outlier detection, we select all the outlier types offered by X-13ARIMA-SEATS.

To ensure that all series have been appropriately seasonally adjusted, we confirm that each series is free of residual seasonality using an F-test.

The Covid crisis is a particularly difficult period over which to estimate seasonal effects as it represents a structural break (which is clearly visible in Figure 8 in the Appendix). In this study, we hold back the data post-Covid-crisis when estimating our daily seasonal model and apply the forecasted seasonal factors to seasonally adjust the Covid period data. We present the non-seasonally adjusted data, seasonally adjusted data using the forecasted seasonal factors, forecasted seasonally adjusted data, and forecasted trend in the results (Figure 12 Appendix). We would recommend further refinement of the seasonal adjustment procedures used as more data becomes available.[7]

3 Traffic flow indicators

The purpose of this note is to create daily and monthly traffic flow indicators that can be used for like-for-like comparisons of traffic flows at different points in time and assessment of the impacts of each Covid-related lockdown. The raw daily traffic flows are very noisy and have many aberrations (e.g. missing data points or outliers, Figure 9). After cleaning (Figure 10) and seasonal adjustment clearer comparisons of daily data outturns over time are possible (Figure 11). Figure 1, for example, shows how total traffic flows evolved for each of the last three years relative to their January levels.[8] After the hard lockdown that applied from 27 March 2020, traffic flows fell by almost 80 percent year-on-year for country-wide light passenger traffic in April 2020 (Figure 1). Total truck flows fell over 50 percent in April 2020 (Figure 2). Despite the imposition of adjusted level three regulations at the end of December 2020, traffic flows have continued to improve, recovering to their pre-Covid levels by the end of 2020. There was renewed weakness in traffic flows following the introduction of the adjusted level three lockdown towards the end of 2020 (escalated from level 1). The intense volatility around the end-of-year holidays appear to have to do with poor seasonal adjustment of the daily data around that period. For this reason, we focus on monthly and quarterly frequency data for the rest of the analysis. Better daily seasonal adjustment would need to be a focus of further work as more data becomes available.

[5] The approach of Ollech (2018) provides a STL-based ('Seasonal and Trend decomposition using Loess') routine that can be used in conjunction with a RegARIMA model to identify calendar effects and seasonal outliers. Implemented using the *dsa* and *seasonal* packages in R, respectively.

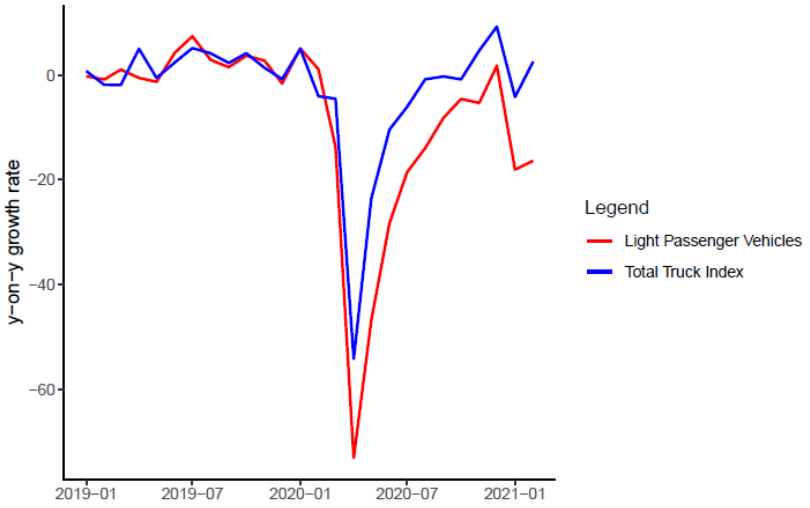
[6] Implemented using the *seas* packages in R.

[7] While our daily seasonal adjustment procedure based the adjustment on pre-Covid data, our monthly adjustment uses full sample data for estimating seasonal factors. Figure 13 in the Appendix suggests that this differing treatment does not make a material difference to the Truck-o-meter obtained: aggregating our seasonally adjusted daily data to monthly frequency produces a similar measure to aggregating unadjusted data and then seasonally adjusting at monthly frequency.

[8] Note that the dramatic drop in traffic volumes represents a fall to a trough in April 2020 of only 2 percent of January 2020 flows (on a seasonally adjusted basis). The actual number is actually 465: the average number of trucks passing ANY monitoring site was 465 on that day, which is far away from zero by a large margin.

Figure 1: Total trucking flows (all categories and routes)

Figure 2: Traffic flows during the Covid crisis



4 The truck-o-meter as a coincident indicator of activity

To construct our 'Truck-o-meter', we sum daily data for each of the three categories of trucks for 77 routes and select monitoring stations that have over 90 percent complete data and have a correlation with GDP of over 0.5. This narrows down the number of considered routes to 16 (N1-4,N6-9,N11-12,N14,N17,R60,R101,R103, R300). After summation of the daily route data across the three categories and conversion to monthly frequency by averaging across the days in the month, the series is seasonally adjusted.

Figure 3 presents the Truck-o-meter in indexed form, while Figure 4 compares our Truck-o-meter to aggregate trucking flows. Trucking flows showed a more dramatic decline during the Covid-crisis than the Truck-o-meter, which reflects the exclusion of traffic routes only weakly correlated to GDP over the full sample.[9]

[9] Understanding divergences between traffic flows between different traffic routes would be an interesting question to investigate in further work.

Figure 3: The Monthly Truck-o-meter (seasonally adjusted)

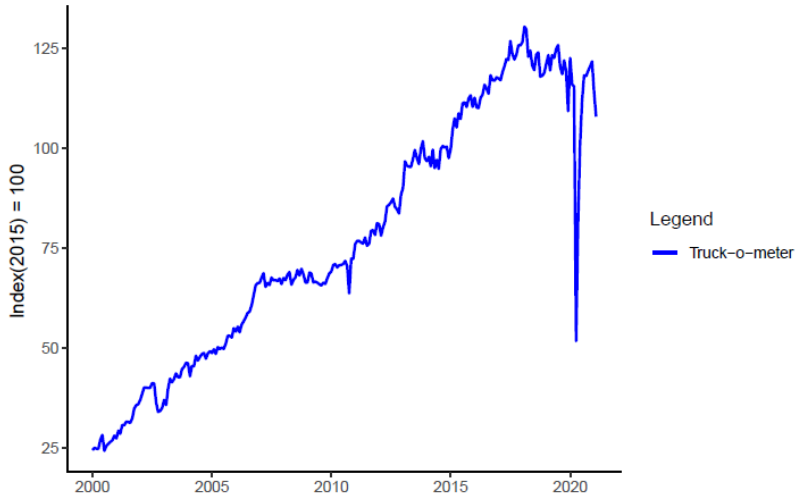


Figure 4: Monthly Truck-o-meter vs Aggregate Trucking flows

There is over a 90 percent correlation between our aggregate traffic flow indicator and GDP in quarterly frequency, as well as with the Reserve Bank's coincident indicator (Figures 5 and 6).

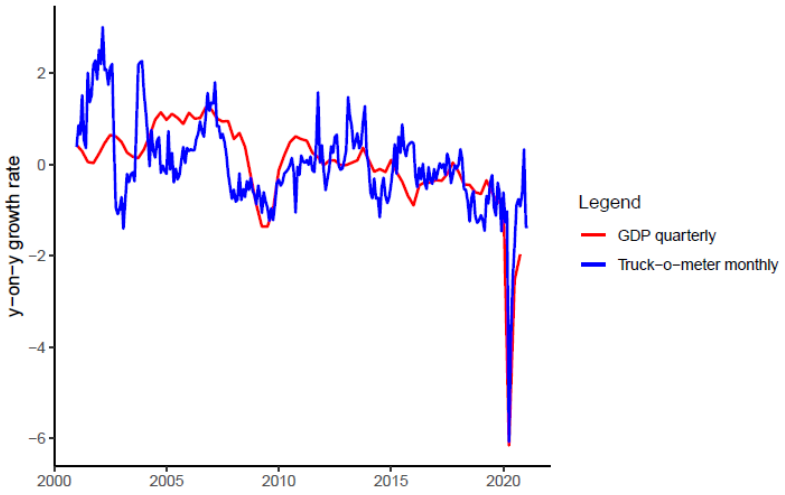
Ahead of the 2020Q4 GDP outturn, a simple model of the Truck-o-meter and GDP suggested that the current level of the index would be consistent with a GDP outturn of -4 percent year-on-year (versus -4.5 percent from the January 2021 MPC forecast and an actual outturn of -4.1, Figure 7). Adding the Truck-o-meter to simple autoregressive model allows the model to capture an additional 20 percent of the variation in South African GDP to be explained. The model suggests there is some upside to the GDP forecast for 2021Q1 relative to the official nowcast, currently predicting a -1 percent year-on-year print relative to the SARB nowcast of -3.9 percent. This is just an illustrative exercise, but suggests that adding the Truck-o-meter to one of the Reserve Bank's nowcasting models might improve their predictive accuracy - a contention worth testing in follow up work.

We have designed the Truck-o-meter to be most useful as a coinciding indicator for GDP. But Figure 14 shows that while the truck-o-meter has a high degree of contemporaneous correlation with GDP, there may also been a lead/lag correlation structure to exploit in creating a leading indicator for GDP (see also Figure 15 Appendix).[10] We intend to add our measure to a large number of other

[10] We also show in the Appendix that there is a high correlation between trucking flows and various forms of activity (such as mining, wholesale activity and vehicle sales, Figures 16 to 19).

indicators to assess its ability to enhance GDP nowcasting performance in future research, but could also construct alternative traffic flow indicators to act as leading indicators.

Figure 5: Truck-o-meter (monthly) vs GDP (quarterly)



Note: Scaled to have unit variance and zero mean. Both series have been seasonally adjusted.

Figure 6: Monthly Truck-o-meter vs SARB's Coincident Indicator

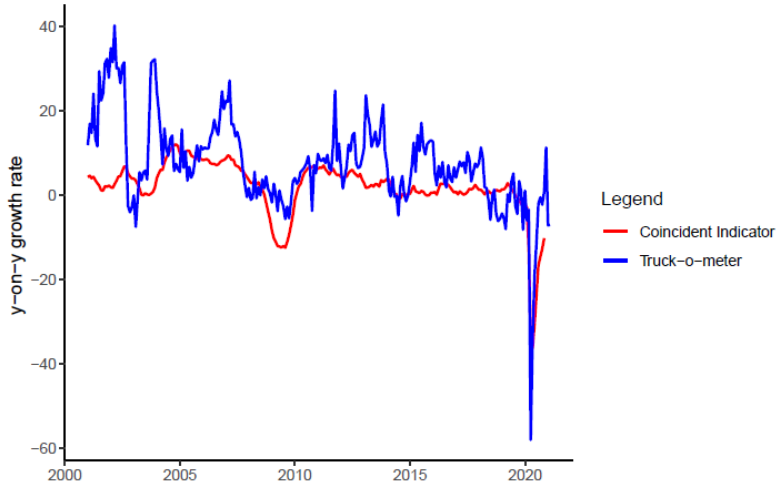
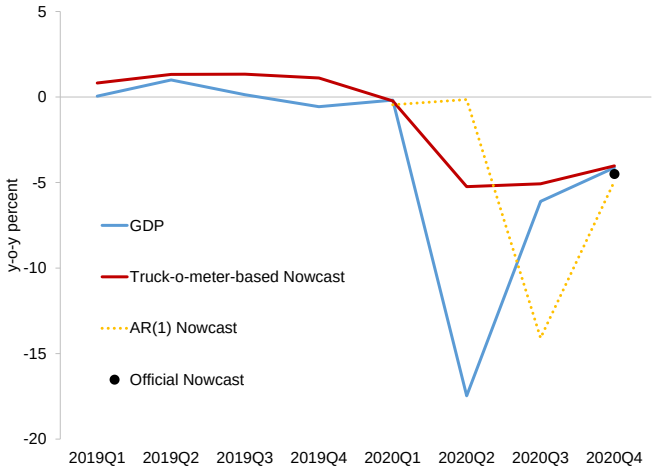


Figure 7: Nowcasting GDP using Truck-o-meter (as at 23 February 2021)



Note: OLS model with constant, AR(1) term and contemporaneous Truck-o-meter. Sample for GDP: 2000Q1 to 2020Q3.

5 Conclusion

We have created automated daily and monthly indicators of traffic flows for major transport routes that can be used for MPC presentations and analytical assessments.

We show that during the Covid-19 crisis, traffic flows declined dramatically, with trucking flows falling over 50 percent and light passenger flows down almost 80 percent during the initial lockdown. Although traffic flows returned to pre-crisis levels by the end of 2020, the introduction of the adjusted level three lockdown saw renewed weakness in traffic flows.

We construct a South African Truck-o-meter that maximizes its correlation with GDP, and argue that it provides a useful signal of current economic activity. We argue that the recent level of trucking flows has been consistent with the January MPC GDP forecast for 2020Q4, but is more pessimistic about growth in 2021Q1 than the SARB official nowcast.

This note provides a first cut of traffic flow data for South Africa. Further refinements to the seasonal adjustment routines, including the creation of additional weekly indicators is recommended. Future research should assess whether the Truck-o-meter is a useful predictor of current GDP or GDP turning points. It would also be interesting to use geolocation matching of stations to those centres of economic activity (eg mines, factories, drydocks, ports or airports) to characterise the nature of regional economic activity.

References

ANZ (2012). ANZ TRUCKOMETER. *New Zealand Economics*.

Ollech, D. (2018). Seasonal adjustment of daily time series. Deutsche Bundesbank Discussion Paper 41.

Sax, C. and D. Eddelbuettel (2018). Seasonal adjustment by x-13arima-seats in r. *Journal of Statistical Software, Articles 87*(11), 1–17.

A Appendix

Figure 8: Trucking flows (total routes since 2020)

Figure 9: Daily traffic flow example (Long Trucks, before cleaning)

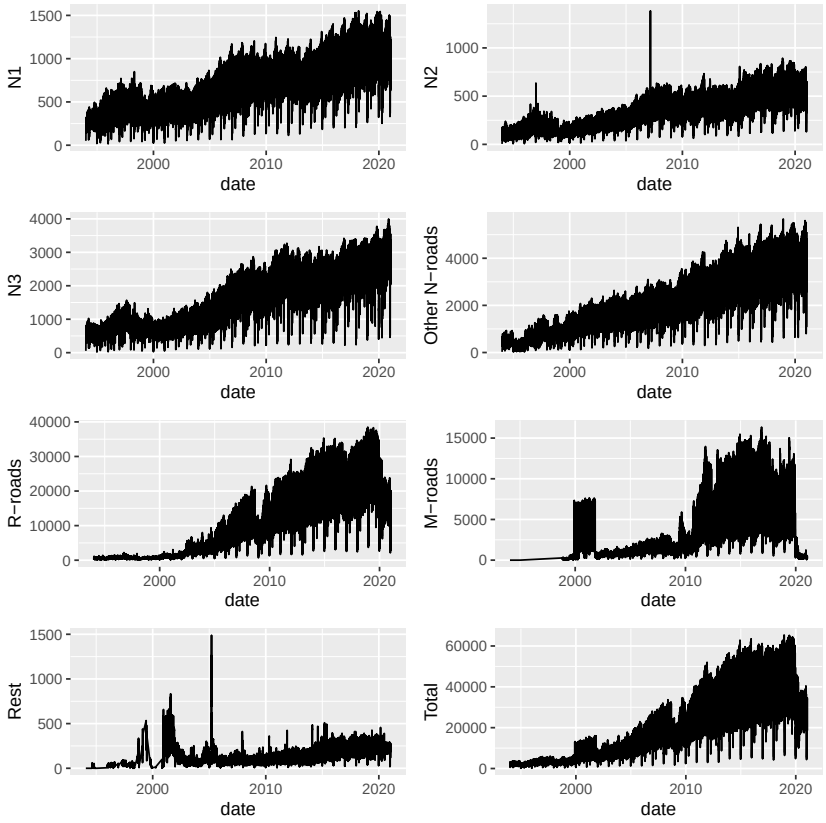


Figure 10: Daily traffic flow example (Long Trucks, after cleaning)

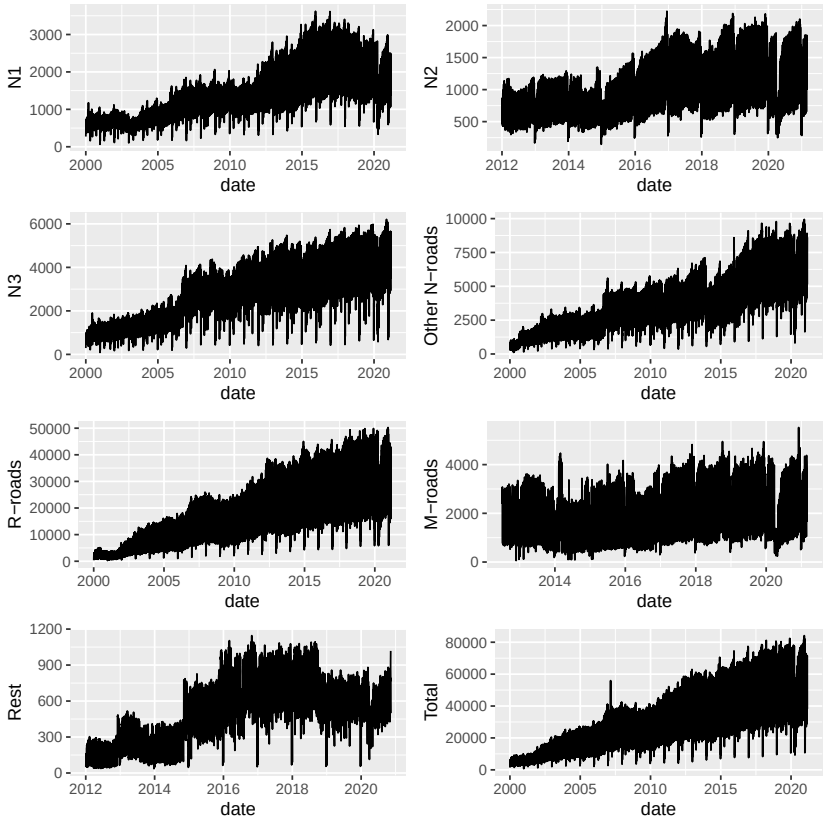


Figure 11: Daily traffic flow example (Long Trucks, after seasonal adjustment)

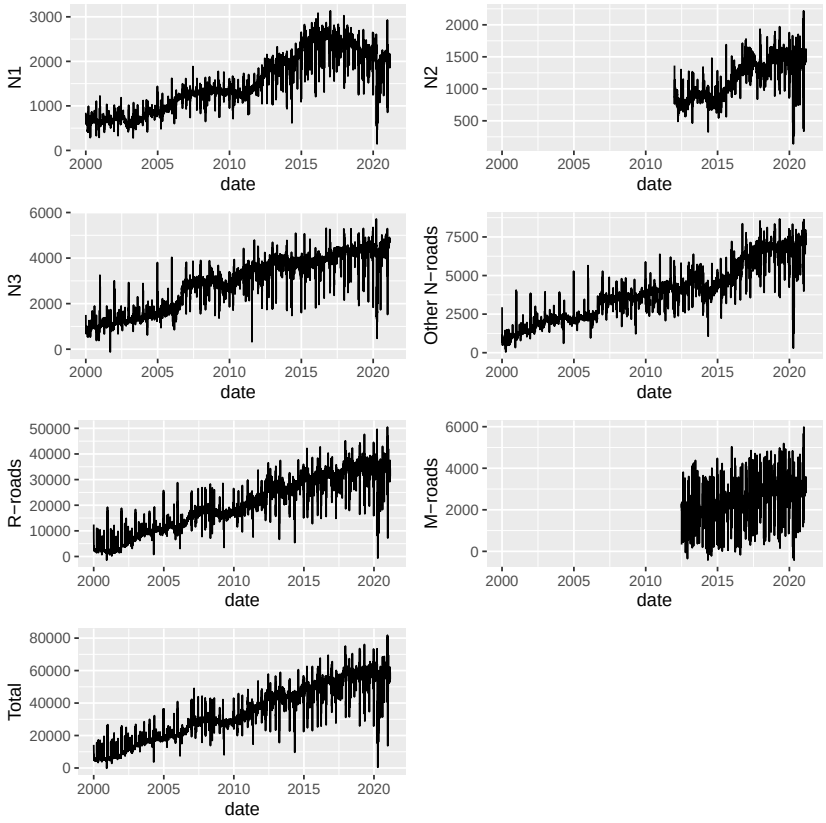


Figure 12: Seasonal adjustment of Total road flows

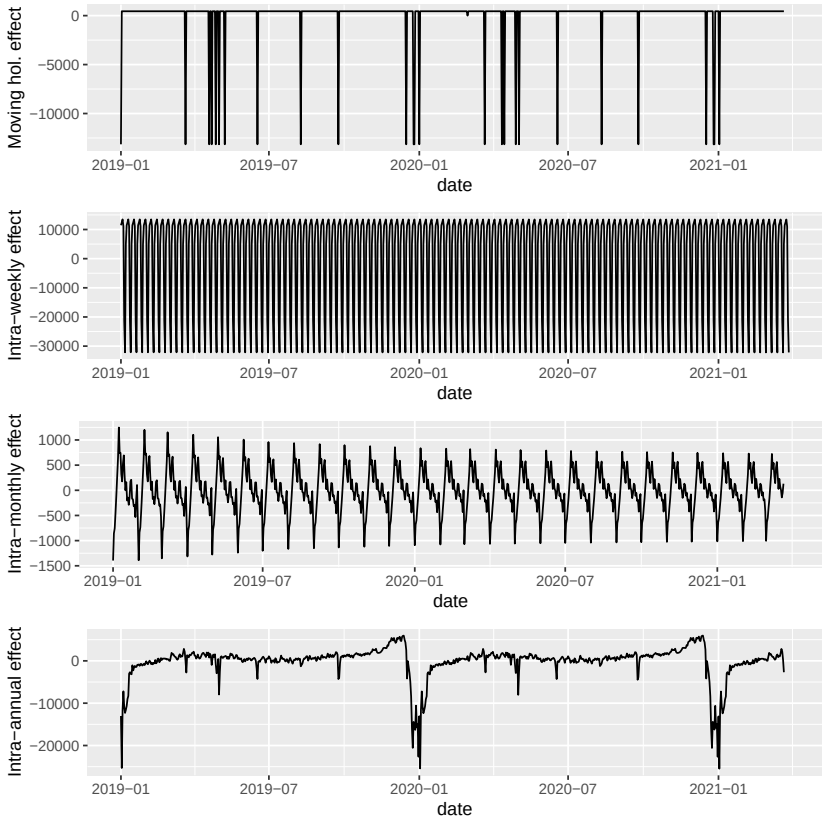


Figure 13: Total Truck Index(Daily Seasonal Adjustment vs Monthly Seasonal Adjustment)

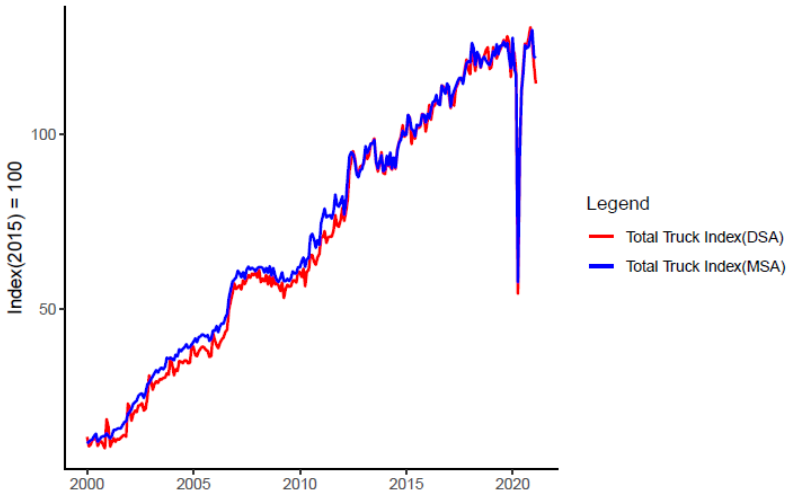


Figure 14: Cross-correlations between Truck-o-meter and GDP (Quarterly, seasonally adjusted)

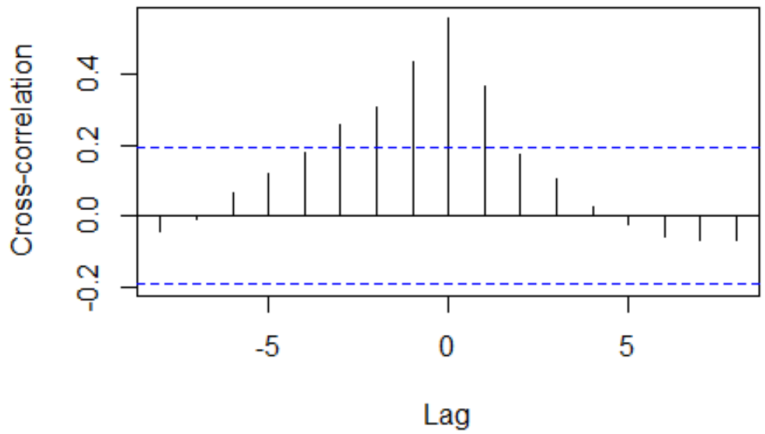


Figure 15: Monthly Truck-o-meter vs SARB's leading indicator

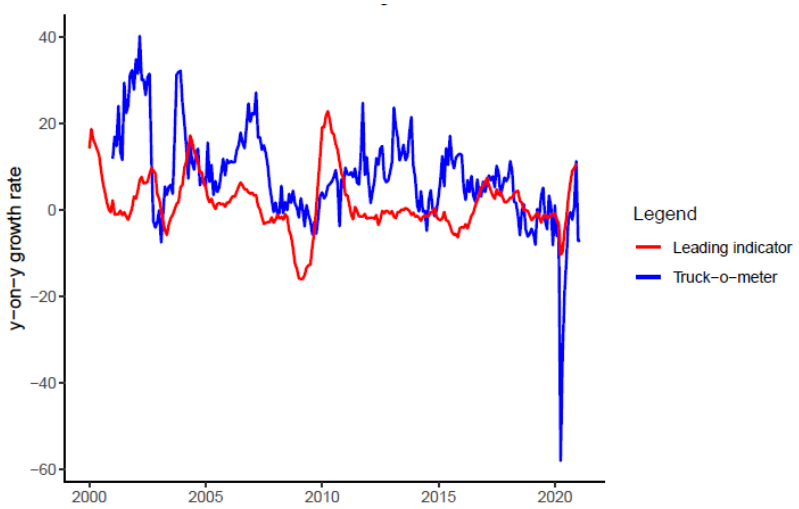


Figure 16: Truck flows vs Mining (Seasonally Adjusted))

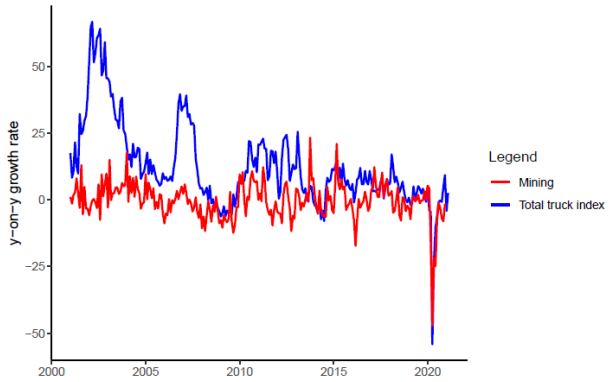


Figure 17: Total Truck flows vs Wholesale trade (Seasonally Adjusted)

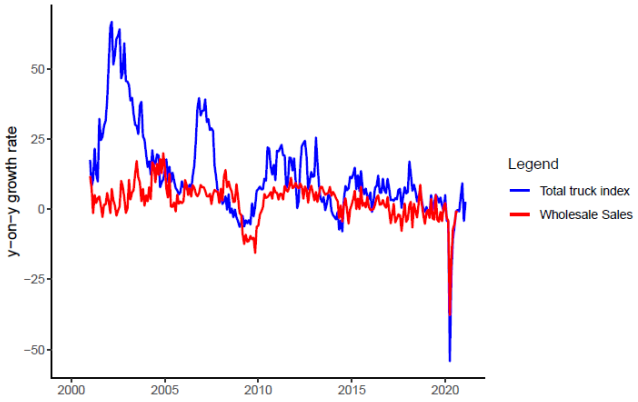


Figure 18: Short Truck flows vs light commercial vehicle sales (Seasonally Adjusted)

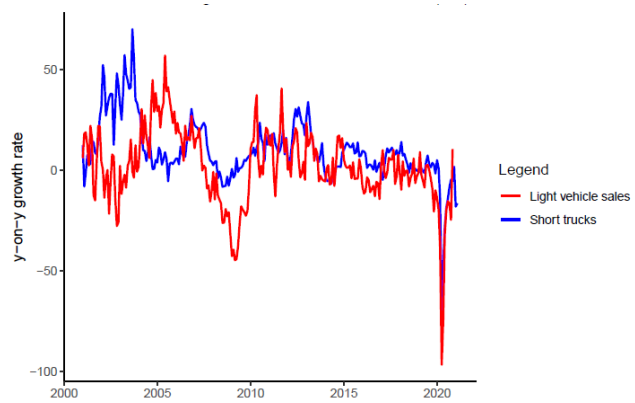


Figure 19: Truck flows vs Heavy, Medium and buses sales (Seasonally Adjusted)