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Impact of Omicron COVID-19 restrictions on air transport and tourism to and from South Africa

Author:
Joachim Vermooten[1]

Affiliation:
[1]Department of Transport and Supply Chain Management, College of Business and Economics, School of Management, University of Johannesburg, Johannesburg, South Africa

Corresponding author:
Joachim Vermooten,
joachim@icon.co.za

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Background: The governments of important tourist source markets imposed additional travel restrictions (the Omicron restrictions) to South Africa (and neighbouring states) as a result of the identification of the Omicron variant of COVID-19 in South Africa. These restrictions interrupted and paused the recovery in international and regional passenger traffic to and from South Africa and its neighbouring states.

Objectives: To determine the impact of Omicron-related air travel restrictions on passenger demand, the number of flights operated (supply of services), average passenger loads carried and salient tourism indicators.

Method: The study identifies the monthly number of passengers and flights operated before and immediately following the imposition and lifting of Omicron-related travel restrictions. The counterfactual, to determine the traffic and tourism recovery would have been had these restrictions not been imposed is made by interpolation.

Results: Significant decreases in the annual number of passengers carried, flights operated and the average loads of passengers were identified within two geographic areas, international and regional traffic, on over-border flights affected by Omicron restrictions and the impact on tourism and employment.

Conclusion: The Omicron restrictions interrupted the recovery trend that started to emerge and caused a decline in passenger and tourism flows, tourism spending and employment.

Contribution: The study determines the impact of the Omicron restrictions on South Africa to prevent rapid government overreaction where the causation of contagion is not objectively demonstrated.

Keywords: COVID-19; Omicron; restrictions; regulations; air travel; air transport; tourism; passengers carried; flights operated; passenger load; recovery.

Introduction

Aims

The aim of this study is to determine the impact of the Omicron variant of coronavirus disease 2019 (COVID-19) on passenger air transport, travel and tourism in South Africa. The Omicron restrictions severely impacted passenger traffic and tourism flow to South Africa (IATA Economics 2022). This study determines and quantifies the impact of the foreign Omicron restrictions on the recovery of passenger traffic flow and tourism's contribution to the gross domestic product (GDP) and employment.

Social value

This study demonstrates that the recovery in international and regional passenger traffic to and from South Africa and neighbouring states from an initial complete lockdown was interrupted by the Omicron restrictions by governments of important tourism source markets, (IATA Economics 2022).

Scientific value

This study fills a gap by objectively determining the impact of the Omicron restrictions on passengers carried and tourism, compared to the recovery trend determined by the traffic and

flight volumes immediately before the imposition and after the lifting of the Omicron restrictions.

The study is based on monthly statistics published by Airports Company South Africa (ACSA) for passengers and flights operated and the calculated average load per flight for two markets, namely, international (intercontinental) and African regional routes.

As a result of local COVID-19 restrictions and the cessation of local international flights, almost all intercontinental (long-haul) flights to and from the Southern African region depend on foreign airlines. Only four Southern African and Indian Ocean State-owned airlines operate intercontinental (long-haul) routes. These are Air Austral (Reunion), Air Mauritius, Air Tanzania and TAAG Angolan Airlines (Campbell 2022).

Specific objectives

Specific objectives of this study are as follows:

- Identify the nature of Omicron restrictions related to air travel restrictions and regulatory directives.
- Identify the impact of foreign Omicron restrictions on the monthly number of air travel passengers, fights operated and average loads carried per flight for the two over-border geographic markets, representing international (intercontinental) routes and African regional routes.
- Calculation of the number of counterfactual passenger traffic volumes would have been higher had the Omicron restrictions not been imposed by a projection of the monthly number of passengers and flights operated before and immediately following the imposition and lifting of Omicron-related travel restrictions on a linear basis.
- Determine the difference between the passenger traffic carried and the counterfactual of a continued recovery during the period of the Omicron restrictions.
- Determine the impact of these Omicron measures on the monthly number of air travel passengers carried (as lost passengers).
- Determine the impact on tourism indicators like tourism spending and employment.

Literature review

Air travel restrictions and regulatory directives is the setting for this study.

Coronavirus disease 2019 was declared as a pandemic on 11 March 2020 by the World Health Organization (WHO) as it posed a global risk to human health and global economies (Sun et al. 2021).

The COVID-19 crisis quickly spread globally as governments worldwide (including the South African Government) started to implement widespread lockdown measures (Suau-Sanchez, Voltes-Dorta & Cugueró-Escofet 2020).

The South African Government declared a National State of Disaster on 15 March 2020, which initially resulted in an effective complete lockdown of all movement from 27 March 2020. The National State of Disaster remained in place for 750 days (Ramaphosa 2022).

Four significant COVID-19 variants of concern (VOCs) affected international air travel demand to and from South Africa:

- Beta variant first detected in South Africa (Epicentre 2021).
- Gamma variant first detected in Brazil (Epicentre 2021).
- Delta variant was first detected in India, which affected international air traffic from April, May to July 2021 (ACSA 2021:12).
- The Omicron variant was first identified in South Africa on 24 November 2021 but was probably detected in Western Europe prior to its identification in South Africa (Epicentre 2021).

The current VOCs are:

- The Delta version (B.1.617.2) was first documented in India in October 2020.
- Omicron variants, documented in multiple countries in November 2021 (WHO 2022), including: Omicron BA.1 documented in South Africa and Botswana in November 2021; Omicron BA.1.1 (or Nextstrain clade 21K) was documented in South Africa in November 2021 (ECDC 2022; and Omicron 'stealth' variant BA.2 (or Nextstrain clade 21L) (WHO Statement 2022).

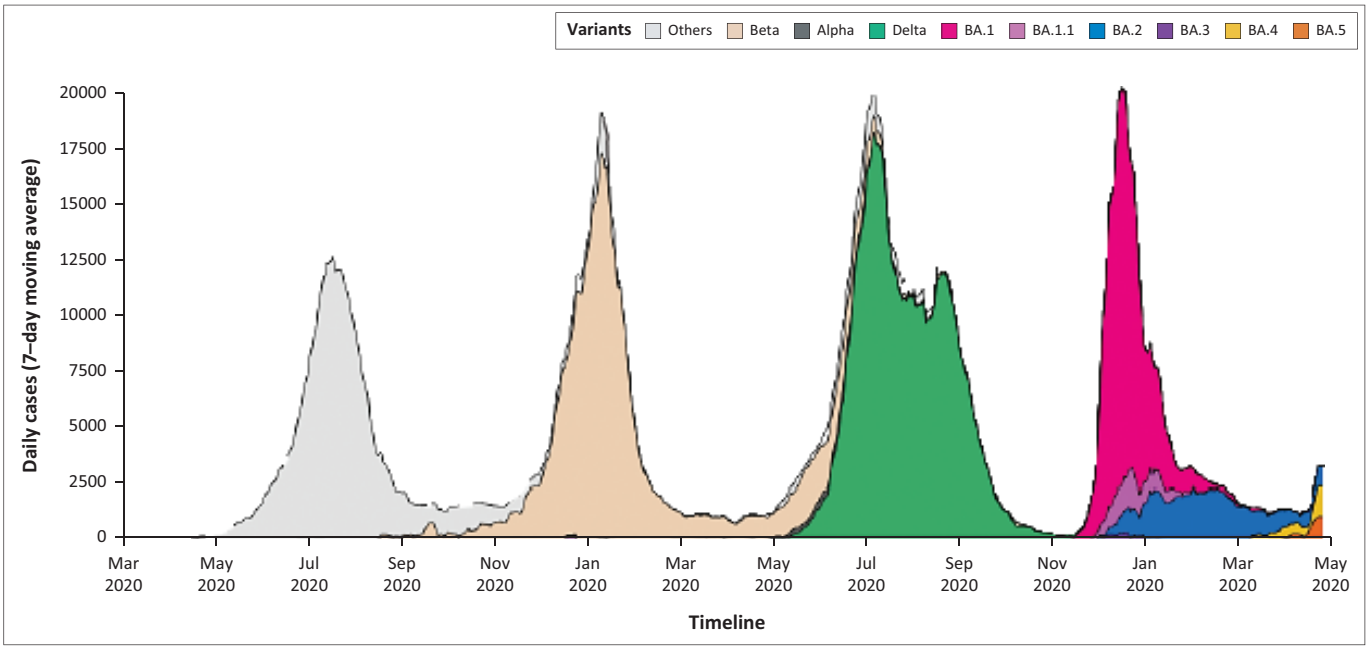
Current circulating variants of interest (VOIs) are: ß Omicron BA.4 documented in South Africa in January 2022; and ß Omicron BA.5 was documented in South Africa in February 2022 (ECDC 2022).

Current circulating variants under monitoring (VUMs) are: ß XD, France, NTD Delta-like; remaining Omicron-like, identified in January 2022; and ß Omicron BA.3 (z) was documented in South Africa in November 2021 (ECDC 2022; WHO 2022).

Omicron has several sub-lineages monitored by WHO. The most common are BA.1, BA.1.1 (or Nextstrain clade 21K), the most common Omicron sub-lineage and BA.2 (or Nextstrain clade 21L). The proportion of reported sequences designated BA.2 increased relative to BA.1 although the global circulation of all variants is declining. BA.2 appears inherently more transmissible than BA.1, which was reported (WHO Statement 2022).

De Oliveira (2022c), T. graphically illustrated the occurrence of the different COVID-19 variants (sub-lineages) in South Africa based on the 7-day average number of daily cases.

The BA.2 variant is referred to as the 'stealth variant' because of being harder to identify. A missing gene in BA.1 allowed it to be identified through a standard polymerase chain reaction (PCR) test. However, BA.2 and BA.3, can only be identified using genomic sequencing (Rigby & Steenhuysen 2022).



Source: John Hopkins University & Medicine, Coronavirus Resource Centre, n.d., *World countries South Africa*, viewed 02 May 2022, from https://coronavirus.jhu.edu/region/south-africa

FIGURE 1: Increasing trend of waves of COVID-19 variant infections: Epidemic and variant dynamics in South Africa.

In mid-February 2022, the Institut Pasteur in Paris identified a new genetic sequence of the Coronavirus. Most of its genetic sequence was the same as Delta's, but part of the sequence came from Omicron. It is now called Deltacron and has been identified in France, the Netherlands, Denmark, the USA and the UK (O'Neill 2022). A new recombinant variant, XE, was spreading in the UK after being detected on 19 January 2022. XE has three mutations that are not present in all BA.1 or BA.2 strains and has also been found in India and Thailand on 06 April 2022 and 04 April 2022 in Mumbai. Two other recombinant lineages, namely, XF and XD (in France), formed by the recombination between Delta and Omicron BA.1 are also being monitored (Oaklander 2022).

The lifting of most COVID-19 restrictions, waning immunity from vaccines and booster shots and the spread of the more transmissible omicron subvariant, BA.2 resulted in a rise in cases (across the EU, especially in France, Denmark, Netherlands, Germany, Belgium, Italy and Austria and the UK). The omicron subvariant became the dominant lineage by week 7 of 2022. The WHO stated that this trend is most pronounced in the South-East Asia Region, followed by the Eastern Mediterranean and the Americas region (Ellyatt 2022; O'Neill 2022).

The BA.2 variant was the most common (76.1% of infections) variant in England, Wales, Northern Ireland and Scotland by 13 March 2022 (Ellyatt 2022). In the USA, the Centers for Disease Control and Prevention stated that the BA.2 cases accounted for 34.9% of US cases. However, the overall number of infections was still declining from the record highs seen in January (Ellyatt 2022). According to WHO, BA.2 represented nearly 86% of all sequenced cases. It is even more transmissible than other highly contagious Omicron siblings, BA.1 and BA.1.1 but does not cause severe disease (Rigby & Steenhuysen 2022). The BA.2 variant of Omicron officially accounted for 'almost 100% of all cases in the country' (De Oliveira 2022a).

De Oliveira, T., identified two new sub-lineages of the Omicron Coronavirus Variant, named BA.4 and BA.5 in South Africa and other countries like Botswana, Belgium, Germany, Denmark and the UK. However, these lineages did not cause a spike in infections, admissions or deaths in South Africa (De Oliveira 2022a).

Identifying the Omicron in South Africa triggered a rapid imposition of new and harsher travel restrictions in many parts of the world on South and Southern African states (IATA 2022). As a result, Omicron restrictions against Southern African states were rapidly implemented at first by 43 states, which is summarised below (Marcus & Neild 2021).

Total bans

The following are a list of countries with total bans:

- **China:** Only citizens and resident permit holders allowed into China.
- **Hong Kong:** Banned non-Hong Kong residents arriving from South Africa, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia and Zimbabwe. The list was expanded to include Angola, Ethiopia, Nigeria and Zambia and then non-residents who had been to Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Germany, Israel, Italy, Japan, Portugal and Sweden.
- **Israel:** Banned foreigners from entering the country for 14 days; Israeli citizens will be able to come back to the country but will need to quarantine, even if fully vaccinated.
- **Japan:** Closed its borders to non-citizens for 1 month. Those with resident status from 10 African nations including South Africa were also banned from entering the country.

- **Morocco:** Morocco suspended all incoming flights for 2 weeks.

Partial bans

As indicated by Aljazeera.com the following are a list of countries with partial bans:

- **Angola:** Closed its borders with countries in southern Africa including Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Tanzania and Zimbabwe.
- **Australia:** Halted all flights from Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, Seychelles, South Africa and Zimbabwe.
- **Brazil:** Closed its border to flights from Botswana, Eswatini, Lesotho, Namibia, South Africa and Zimbabwe.
- **Cambodia:** Banned travellers from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa, Zimbabwe, Malawi, Angola and Zambia.
- **Canada:** Banned non-citizens who have travelled to Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe.
- **Chile:** Halted non-residents who have travelled to Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe from entering.
- **Ecuador:** Restricted entry from Botswana, Egypt, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe.
- **Egypt:** Halted direct flights from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe.
- **Fiji:** Only citizens can enter the country.
- **France:** Stopped flights from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe.
- **Germany:** Suspended all flights from Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, Zambia and Zimbabwe.
- **Indonesia:** Banned any foreigners who spent the last 14 days in Botswana, Eswatini, Lesotho, Mozambique, Namibia, Nigeria, South Africa and Zimbabwe.
- **Italy:** Suspended the arrival of anyone who has travelled to Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe in the last 14 days.
- **Kuwait:** Halted direct flights from Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe. Non-citizens were not permitted to enter if they have travelled to those countries.
- **Malaysia:** Announced a travel ban covering South Africa, Botswana, Eswatini, Lesotho, Mozambique, Namibia and Zimbabwe.
- **Maldives:** Denied entry of foreigners who have travelled to or through Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe within the past 14 days.
- **Malta:** Banned travel to and from Botswana, Eswatini, Lesotho, Namibia, South Africa and Zimbabwe.
- **Netherlands:** Suspended flights from Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa and Zimbabwe carrying non-citizens.
- **Nepal:** Stopped issuing tourist visa to passengers from Botswana, Eswatini, Hong Kong, Lesotho, Malawi, Mozambique, Namibia, South Africa and Zimbabwe.
- **New Zealand:** Only allowed citizens into the country. Any foreign travellers from Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, Seychelles, South Africa and Zimbabwe were denied entry.
- **Oman:** Suspended flights from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe and anyone who travelled to these countries in the past 14 days will also be banned from entry.
- **Pakistan:** Closed its borders to Botswana, Hong Kong, Lesotho, Mozambique, Namibia and South Africa.
- **Panama:** Blocked travel from eight countries including Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa and Zimbabwe.
- **Paraguay:** Restricted entry from Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe.
- **Philippines:** Halted inbound flights from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe.
- **Poland:** Restricted travel from seven southern African countries.
- **Russia:** Suspended entry of non-Russians who travelled through Botswana, Eswatini, Lesotho, Madagascar, Mozambique, Namibia, South Africa, Tanzania and Zimbabwe.
- **Rwanda:** Suspended all direct flights to and from southern Africa.
- **Saudi Arabia:** Halted flights from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe. Non-citizens who have spent the past 14 days in the listed countries will be barred from entry.
- **Singapore:** Any non-citizens from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe were barred from entering.
- **Sri Lanka:** Barred entry to foreigners from Botswana, Eswatini, Lesotho, Namibia, South Africa and Zimbabwe.
- **Thailand:** Enforced a travel ban on Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa and Zimbabwe from December.
- **Turkey:** Banned arrivals from Botswana, Mozambique, Namibia, South Africa and Zimbabwe.
- **United Arab Emirates:** Restricted travellers from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe.
- **United Kingdom:** Added Botswana, Eswatini, Lesotho, Namibia, South Africa and Zimbabwe to its red list.
- **United States:** Restricted non-citizens from Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa and Zimbabwe from entering.
- **Uzbekistan:** Suspended flights from Hong Kong and South Africa.
- **Vietnam:** Restricted flights from Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa and Zimbabwe (Aljazeera.com 2021).

Generally, the reaction to the Omicron variant demonstrated that states are quick to introduce travel restrictions once a variant is identified as a VOC but are slow to remove such restrictions. This is despite the objective evidence that travel restrictions were ineffective in slowing the spread of Omicron, as well as the high costs of such restrictions for passengers, the aviation sector and the economy (Oxera 2022b:5).

On 03 December 2021**,** Berthé, A., the Secretary General of the African Airlines Association (AFRAA), stated that:

> [*T*]he hasty decisions by some EU States to ban travel to South Africa and other neighbouring States in Southern Africa, is in stark contrast to the numerous unheeded appeals to the western world to ensure equitable access to vaccines around the world. (AFRAA 2021:1)

The Omicron variant was detected in several regions of the world, yet the travel bans seem to be targeted at Africa.

The AFRAA called on:

> [*A*]ll States that have issued unilateral travel restrictions to revoke them immediately and instead seek collaborative measures to address the COVID challenge holistically. Besides vaccination, tried and tested protocols have proven effective in curbing the spread of COVID-19. These must continue to apply while we work together towards neutralising or eliminating the virus. (AFRAA 2021:1)

On 08 December 2021, the International Air Transport Association (IATA) called on governments to drop the travel bans implemented in response to the Omicron variant of COVID-19 based on the World Health Organization's advice on the issue (IATA 2021). The IATA director general Willie Walsh stated that the Omicron variant induced 'instant amnesia' among governments regarding 'the inability of travel restrictions to control its spread' (IATA 2021). International Air Transport Association highlighted that travel bans in response to Omicron have tended to target southern African states where it was first identified, despite the variant already being present in the states blocking connectivity (IATA 2021). International Air Transport Association referred to the WHO's view that:

> Blanket travel bans will not prevent the international spread, and they place a heavy burden on lives and livelihoods and can adversely impact global health efforts during a pandemic by disincentivising States to report and share epidemiological and sequencing data. (Harper 2021:1)

However, by 13 December 2021, 90 states had implemented travel bans to South Africa, with five crucial tourist source states fully closing their borders that affected international air traffic recovery from December 2021 onwards (IATA 2022).

International Air Transport Association identified a swift decline in international forward bookings to South Africa, resulting in negative net bookings (refunds exceeding tickets sold) in early December 2021 (IATA 2022).

By 28 December 2021, Abdullah et al. (2022) concluded that there was a decreased severity of COVID-19 disease in the Omicron-driven fourth wave in the City of Tshwane, its first global epicentre with fewer deaths, ICU admissions and a shorter length of hospital stay. The Omicron variant infection wave initially increased at a faster rate than previous waves, completely displacing the Delta variant within weeks as illustrated in Figure 1. However, a decline in hospital admissions and fatalities was identified in the fifth week following its commencement. They predicted that if the identified pattern continues and is repeated globally, a complete decoupling of infection and death rates may be seen. Abdullah et al. (2022) predicted that Omicron might be the forerunner of the end of the epidemic phase of the COVID-19 pandemic, ushering in its endemic phase.

Decoupling the incidence of COVID-19 cases from the incidences of hospitalisation and death during the omicron-dominant wave in South Africa demonstrated a turning point in the COVID-19 pandemic, with the primary goal being protection against severe disease and death rather than prevention of infection. The 70% vaccine effectiveness against severe disease with BNT162b2 in South Africa might be because of the hybrid cell-mediated immunity induced by vaccination and natural infection. Whether the same protection against severe COVID-19 because of the omicron variant will be seen in states where immunity is mainly from vaccination remains to be determined (Abdullah et al. 2022).

According to Abdullah et al. (2022), decoupling of cases from severe disease may have been the result of:

- Cell-mediated immunity primarily because of natural infection, with or without COVID-19 vaccination.
- The omicron variant may be more adept at infecting the upper airways and less adept at infecting the lower airways, which could result in reduced virulence (Abdullah et al. 2022).

On 05 January 2022, the UK Government scrapped its pre-departure and post-arrival PCR tests as they were considered to serve no purpose once the Omicron variant became the dominant COVID-19 variant in the UK. This resulted in calls to scrap the remaining UK requirement for post-arrival lateral flow tests (Airlines UK 2022).

By 05 January 2022, 78 states still had travel bans to South Africa as states such as the USA, Malaysia, Ireland and the Netherlands lifted travel restrictions (IATA 2022).

On 10 January 2022, there was an agreement by EU member states 'to lift the emergency brake' imposed on 26 November 2021 in order to allow air traffic with seven southern African states (South Africa, Botswana, Eswatini, Lesotho, Namibia, Mozambique and Zimbabwe) to resume (Connor 2022). This set the tone for other states to follow suit. By February, there was only one EU country that still had travel restrictions in place, and by 22 February, the EU Council adopted a proposal to facilitate extra-EU travel (Oxera 2022b:5).

Research studies by Oxera and Edge Health were published by Manchester Airports Group (MAG) and Airlines UK on 21 January 2022. These studies recommended a return to restriction-free air travel, as testing was ineffective against new variants. In addition, the studies found that governments could not implement travel restrictions quickly enough to limit the spread of new, more infectious variants effectively. In particular, it was too late for travel restrictions to make any difference when a new variant was discovered and evaluated. As a result, imposing travel restrictions in response to the discovery of a new variant does not assist in limiting the spread of a new variant or protect public health (Airlines UK 2022; Oxera 2022a, 2002b; Oxera and Edge Health 2022).

In particular, Oxera's study about the effectiveness of travel restrictions in the European Economic Area (EEA) concluded that:

- Air travel restrictions do not affect the size of the peak but could delay the peak by a few days if they are introduced pre-emptively or on the day that the variant is first imported.
- Any benefits of air travel restrictions diminish quickly over time.
- Ongoing restrictions will have a significant impact on the economy.
- Monitoring the situation for the long term is essential (Oxera 2022b:13).

On 18 March 2022, the UK government removed the remaining COVID-19 international travel restrictions for all passengers (UK Government 2022).

On 21 February 2022, Johnson, B., the UK Prime Minister, published a plan for living with COVID-19 because of removing the remaining domestic restrictions in England. The essential steps people can take to reduce the risk of catching and spreading COVID-19 are:

- to be vaccinated
- let fresh air in if meeting indoors, or meet outside
- consider wearing a face covering in enclosed spaces (Johnson 2022).

On the same day, the UK Government published its COVID-19 Response in Guidance 'Living with COVID-19', which contained the UK government's detailed plan for removing the remaining legal restrictions (UK Cabinet Office 2022).

De Oliveira (2022b) concluded that South Africa has a very high population immunity and good vaccination of persons above the age of 40. South Africa also experienced very severe Beta, Delta and Omicron waves. However, BA.2 resulted in very low hospitalisation and deaths (Head 2022). In De Oliveira's opinion, vaccination remains the key intervention to protect against severe disease, hospitalisation and death from all known variants (De Oliveira 2022b; Head 2022).

By the first week of April 2022, the occurrence of BA.4 and BA.5 replaced BA.2, comprising more than 50% of sequenced cases in South Africa. BA.4 and BA.5 are estimated to have originated in mid-December 2021; it is unclear how large an effect this shift in the distribution of different Omicron lineages will have on the epidemic in South Africa and elsewhere in the world (De Oliveira 2022c:1, 3, 7).

Most states decided to live with the reality of Coronavirus, which questioned China's (including Hong Kong) objective of a 'Zero-Covid' goal through lockdowns and widespread testing (Tan 2022). As a result, China reverted to lockdown measures to contain the spread of the BA Stealth COVID-19 variant outbreak from Shanghai (in the southeast) to the north-eastern province of Jilin (Cheng 2022; Picheta & Khalil 2022).

On 04 April 2022, the South African Cabinet decided to terminate the National State of Disaster with effect from midnight 04 April 2022 as the requirements for the National State of Disaster in terms of the *Disaster Management Act* were no longer met. As a result, the pandemic would, in future, be managed in terms of the *National Health Act* (Ramaphosa 2022).

In summary, the Omicron restrictions were affected by the following salient events:

- On 24 November 2021, the Omicron variant was identified in South Africa.
- On 26 November 2022, EU emergency measures were imposed against South Africa and neighbouring states (South Africa, Botswana, Eswatini, Lesotho, Namibia, Mozambique and Zimbabwe).
- On 28 December 2021, a turning point in the COVID-19 pandemic was identified. A decline in hospital admission was demonstrated. The incidence of Omicron-related COVID-19 cases decoupled from the incidences of hospitalisation and deaths in South Africa. It was projected that Omicron would end the pandemic phase of COVID-19 and enter its endemic phase.
- On 21 February 2022, the UK plan for living with COVID-19 was published.
- On 22 February 2022, the EU Council adopted a proposal to facilitate extra-EU travel.
- On 18 March 2022, the UK government removed the remaining COVID-19 international travel restrictions for all passengers.
- On 04 April 2022, the South African National State of Disaster was lifted.

Study design: Outline of the type of study design

Time-series analysis is used extensively in the aviation industry. In such an analysis, the traffic variable to be forecast (the dependent variable, passenger, revenue passenger kilometres (RPKs) or cargo volumes, revenue, load factors) is plotted on the vertical axis, and time (the explanatory or independent variable) is plotted on the horizontal axis, from which the trend in traffic development is determined (Secretary-General ICAO 2006:3 [I–3]).

Then cause-and-effect relationships are used to develop forecasts (methods) in which various mathematical relationships of the dependent to the independent variables may be applied to forecast traffic (Secretary-General ICAO 2006:17 [I–17]).

The data population comprises passenger throughput and flights operated to and from ACSA airports for the two markets comprising of over-border flights: international (intercontinental) and African regional routes. Tourism was primally affected in these geographic regions.

A time-series column chart is then compiled to illustrate the recovery trends in passengers carried, compared to a linear projection of what the recovery would have been had the Omicron restrictions not been imposed. This counterfactual is calculated, and its trend is projected on the time series chart. The difference between the counterfactual recovery trend reflects passengers lost.

After that, the impact on tourism indicators, published by the World Travel & Tourism Council (WTTC) for the 2019 calendar year, is used to calculate the values of the indicators per tourist affected by the Omicron restrictions. This is then multiplied by the passengers lost to determine the impact of the Omicron restrictions on South Africa.

The study population and inclusion or exclusion criteria

The ACSA passenger carried data and flights undertaken by the ACSA Group's three internationally certified airports (at Johannesburg, Cape Town and Durban) were captured and analysed. Airports Company South Africa published data excludes data from municipal airports, privately owned airports and private airport concessions, which are not published. In addition, passengers and flights operated on a non-scheduled basis were excluded to focus on the industry comprising regular commercial flights. This study focuses on the impact of the Omicron variant of COVID-19 and the tempo and extent of recovery, not forecasts into the future.

Data collection

Airports Company South Africa's monthly published data for passengers carried and flights operated at each ACSA airport and consolidated figures for all ACSA airports: Airport Company South Africa Total Consolidated Aircraft Movements were captured for the fiscal years (April to March) 2017/2018; 2018/2019; 2019/2020 (base year); 2020/2021; 2021/2022 as well as the 3 months of April 2022 to June 2022. As summarised in Figure 2, the average passenger load per flight was calculated from these numbers.

Data analysis

Analysis of data to measure the impact of the Omicron variant-related air travel restrictions:

- The monthly data for the last fiscal year (2021/22) is used to determine the increase and decrease in passengers carried, flights and the average loads carried per flight in the international and regional geographic areas and percentages thereof.
- The chart of monthly passenger recovery demonstrates a continual recovery of passengers carried until November 2021, which level is used as the basis from which a linear projection is made (as the counterfactual recovery) until March 2022, when the international travel restrictions against South Africa were lifted. This is illustrated by the Omicron counterfactual projected curve in Figure 4 and Figure 5.
- The numbers of the projected recovery are then compared to the number of passengers carried for December 2021, January 2022 and February 2022, and the difference is calculated as 'lost passengers' as a result of the Omicron variant COVID-19 air travel restrictions.
- The impact of these 'lost passengers' on tourism's leading indicators of direct contribution of travel and tourism, total contribution to the GDP and employment is calculated on the average values of these indicators per tourist as calculated above for the 2019 base year (above).
- After that, the difference between actual passengers carried from November 2021 to March 2022, and the numbers determined for the linear recovery line (as lost passengers) are then multiplied to determine the revenue and employment (tourism indicators) lost, as is summarised in Table 5.
- After that, calculations are made to determine the extent of the lost passengers during the Omicron restriction period compared to total COVID-19 losses and the base year's compatible months.

Omicron restrictions caused passenger losses from December 2021 to March 2022, equal to 11% of the pre-COVID-19 base year's passengers' volumes (December 2019 to March 2020) and the overall COVID-19 restrictions, which represented 57% of the pre-COVID-19 base year's passengers' volumes. These are calculated in Table 6 and Table 7.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of Johannesburg Department of Transport and Supply Chain Management Research Ethics Committee (N. 2021-TSCM002).

Results

The first numerical analysis determines and analyses the number of passengers and flights and trends for fiscal years on international and regional routes.

Analysis of monthly passenger data: April 2021 to March 2022 (fiscal year)

Passenger traffic on African regional routes generally (on average) comprised about 9% of passengers on international routes.

Figure 2 illustrates the passenger numbers in the two over-border geographic areas (international and regional) and the total for the two areas. The impact of the COVID-19 lockdown on passengers carried is evident from the total collapse of traffic volumes for the period April 2020 to August 2020.

Traffic volumes increased rapidly from September 2020 to December 2020, when they reduced substantially until February 2021. From March 2021, a lower recovery trend persisted until November 2021. The Omicron restrictions took hold in December 2021, which caused a substantial reduction in passenger flow. After that, passenger traffic volumes increased until April 2022.

The Omicron restrictions were imposed between 24 November 2021 and 04 April 2022 during the post-COVID-19 lockdown recovery phase. The red rectangle in Figure 2 highlights traffic volumes during this period.

Although passenger traffic volumes increased in the post-lockdown period, the pre-COVID-19 traffic volumes have yet to be attained, as is illustrated in Figure 3. By June 2022, such traffic volumes on international and regional routes only recovered to 40% of the volumes achieved in June 2019 (of the base year). However, a clear recovery in passengers compared to the pre-COVID-19 lockdown period is evident from July 2021 to November 2021. The passenger volumes improved from 83% down on the pre-COVID-19 base year's same month of July 2019 to 61% down by November 2021. As a result of the Omicron restrictions, the passenger volumes to base year month fell back to 75% in December 2021 and improved to about 38% to 40% down on the base year months from April to June 2022.

Passengers on international and regional routes from August 2021 to June 2022 and counterfactual passenger projection

There was an immediate reduction of 25% from 415 749 passengers carried in November 2021 to 311 664 passengers in December 2021.

The number of passengers on international and regional routes from August 2021 to June 2022 are identified in Table 1 and illustrated in Figure 4. The period identified in the red rectangle in Figure 2 is isolated in Figure 4. A counterfactual linear projection of what the recovery would have been had the Omicron restrictions not been imposed is drawn to connect the passenger traffic volumes of November 2021 and April 2022, as is demonstrated by the red line curve line in Figure 4. The counterfactual projected trend (the red line chart) is until February 2022, with an increased recovery in March 2022 and April 2022.

From the lower December 2021 base level onwards, passenger traffic volumes increased, almost parallel to the counterfactual

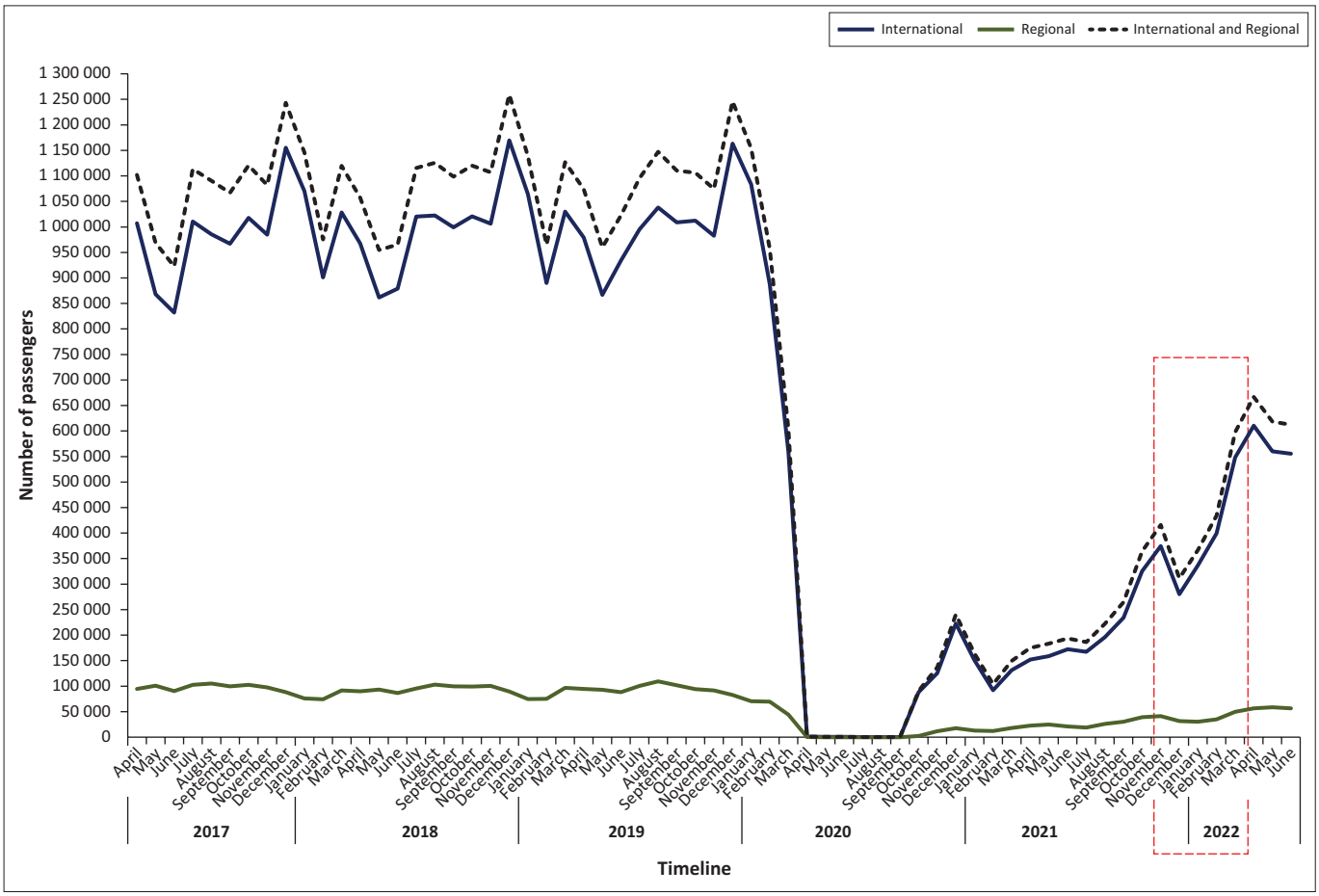


FIGURE 2: Passenger traffic carried on international and African regional routes: Passenger carried in two geographical areas (international and African Regional routes).

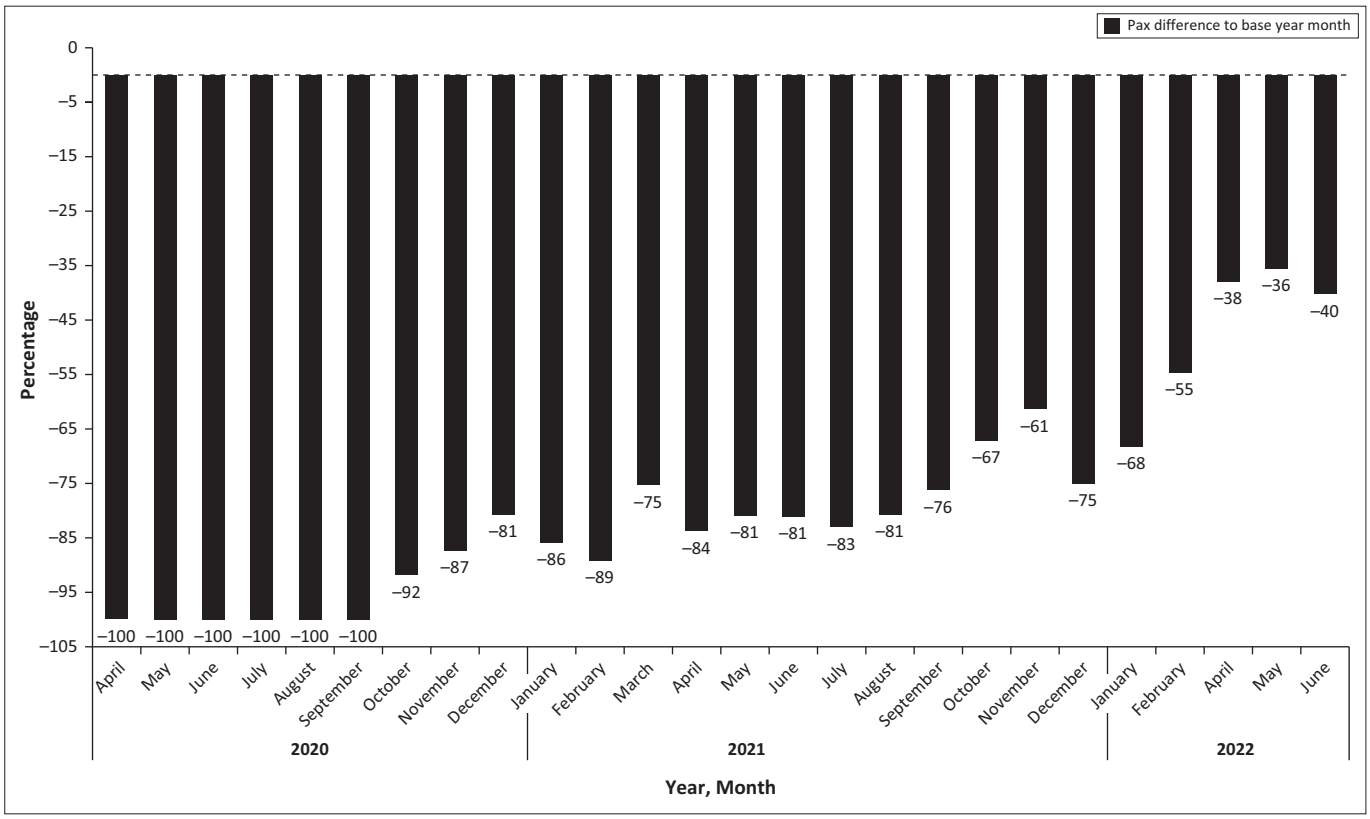


FIGURE 3: Level of Pre-COVID-19 monthly traffic volume recovery: Passengers carried on international and regional routes current month as percentage lower than the same month of base year.

TABLE 1: Passengers on international and regional routes from August 2021 to June 2022.

Year	Month	International pax throughput	Regional pax throughput	International & regional pax throughput	M to M (%) change international pax throughput	M to M (%) change regional pax throughput	M to M (%) change international and regional pax throughput
2021	August	196 237	25 949	222 186	17	37	19
2021	September	233 994	30 396	264 390	19	17	19
2021	October	325 519	39 037	364 556	39	28	38
2021	November	374 416	41 333	415 749	15	6	14
2021	December†	280 217	31 447	311 664	-25	-24	-25
2021	January†	336 864	30 210	367 074	20	-4	18
2021	February†	399 461	34 847	434 308	19	15	18
2021	March†	548 162	49 686	597 848	37	43	38
2021	April†	610 508	56 300	666 808	11	13	12
2021	May	560 324	58 407	618 731	-8	4	-7
2021	June	555 727	56 279	612 006	-1	-4	-1

M to M, each month in comparison to the same month of the previous year.
†, Months affected by Omicron restrictions.

projected trend (the red line chart) until February 2022, where an increased recovery is identifiable for March 2022, as is illustrated in Figure 4.

Comparison of the recovery trends between passengers carried and flights undertaken

The gaps between the trends between passengers carried and flights undertaken are illustrated in Figure 5, where the scale of the passenger line curve is changed, and a smaller secondary axis is associated with flights.

In contrast to a sharp decline in passengers carried, the airlines only reduced the number of flights by 9%, from 5416 flights in November 2021 to 4952 flights in December 2021 as identified in Table 2. After that, the airlines maintained their flight output until February 2022 and increased flights by 21% in March 2022.

The counterfactual projection is determined by the interpolation of a monthly number of passengers prior to and immediately following the imposition and lifting of Omicron-related travel restrictions. A linear projection is made between the passenger traffic volumes of November 2021 and April 2022.

Calculation of average monthly increment

The difference between the November 2021 and April 2022 traffic volumes is divided between the number of intervals (months) to determine the average increment per month,

as calculated in Table 3. This average monthly increment will be added to the actual passenger numbers for November 2021 to determine the counterfactual passenger trend line. The difference between this counterfactual passenger trend line and the actual passenger trendline reflects the passengers lost as a result of Omicron restrictions.

Calculation of the counterfactual projected passenger traffic trend line

- The calculation of the counterfactual monthly passenger traffic that would have been carried had the Omicron restrictions not been imposed is made by adding the average monthly increment (calculated above) to the base of total passengers for November 2021 as the total counterfactual for December 2021. After that, this process is repeated for months after that until the total for April 2022 is reached.
- The difference between the counterfactual monthly passenger traffic (trend line) and the monthly passengers actually carried is then calculated. This represents the number of passengers lost as a result of COVID-19 restrictions.
- The total difference between the calculated counterfactual trend line and the actual number of passengers carried on international and regional routes is 454 220 passengers lost because of the Omicron restrictions, as calculated in Table 4.
- The actual passengers carried per month, together with the difference calculated above, represent that counterfactual projection of passengers on international and regional routes from August 2021 to April 2022, as is calculated in Table 4 and illustrated in Figure 6.

The monthly increase in passenger volumes for May 2022 and June 2022 did not continue the linear trend of increases, evidenced in the months from August 2021 to April 2022. When the monthly seasonality of passenger volumes is tracked, as illustrated in Figure 7, it is evident that the seasonal trend for 3 months (May 2022 and June 2022) is similar to the historical trends although at a lower level.

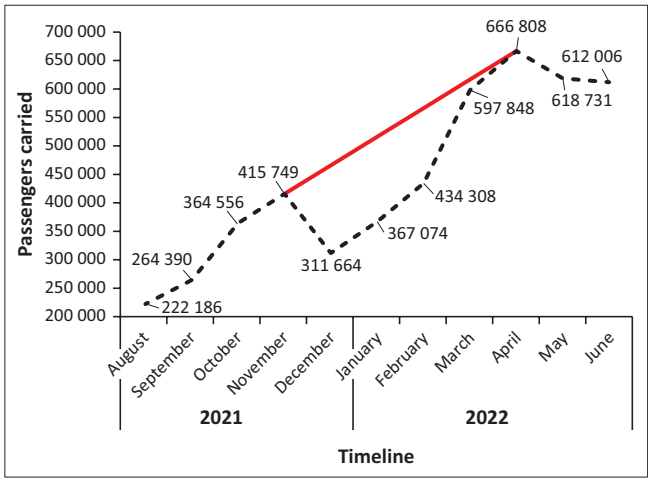


FIGURE 4: Passengers on international and regional routes from August 2021 to June 2022 and Omicron counterfactual projection.

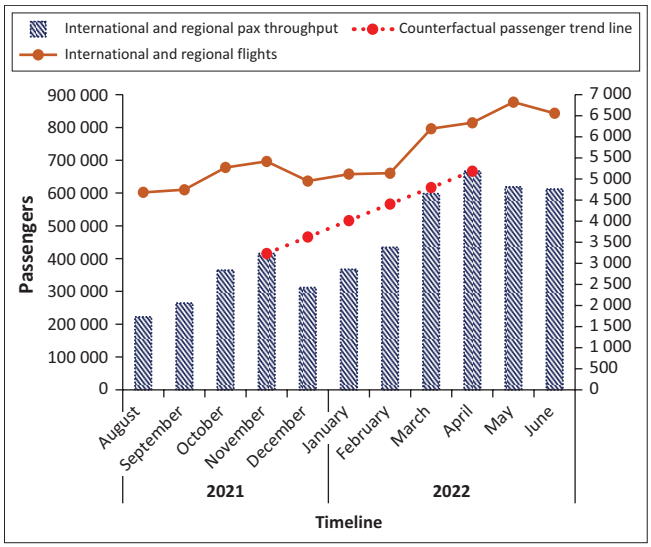


FIGURE 5: Passenger, Omicron counterfactual projection and flights operated: Actual passengers, flights and conterfactual passenger trend line.

TABLE 3: Calculation of average increment per month.

Variable	International and regional
Pax in April 2022	666 808
Pax in November 2021	415 749
Difference	**251 059**
Number of months	5
Average increment per month	**50 212**

TABLE 2: Comparison of declines in passengers carried and flights operated.

Year	Month	International flights	Regional flights	International & regional flights	M to M (%) change international pax throughput	M to M (%) change regional pax throughput	M to M (%) change international & regional pax throughput
2021	August	3 546	1 137	4 683	7	13	9
2021	September	3 676	1 069	4 745	4	-6	1
2021	October	4 098	1 176	5 274	11	10	11
2021	November	4 192	1 224	5 416	2	4	3
2021	December†	3 815	1 137	4 952	-9	-7	-9
2022	January†	4 027	1 089	5 116	6	-4	3
2022	February†	4 033	1 105	5 138	0	1	0
2022	March†	4 819	1 375	6 194	19	24	21
2022	April†	4 960	1 375	6 335	3	0	2
2022	May	5 127	1 696	6 823	3	23	8
2022	June	4 899	1 661	6 560	-4	-2	-4

M to M, each month in comparison to the same month of the previous year.
†, Months affected by Omicron restrictions.

TABLE 4: Calculation of counterfactual passenger trend line.

Year	Month	International and regional passengers carried	Average increment of actual trendine per month	Counterfactual passenger trend line	Difference between the counterfactual trendline and the actual passengers carried
2021	August	222 186	-	-	-
2021	September	264 390	-	-	-
2021	October	364 556	-	-	-
2021	November	415 749	-	-	-
2021	December†	311 664	50 212	465 961	15 4297
2022	January†	367 074	50 212	516 173	149 099
2022	February†	434 308	50 212	566 384	132 076
2022	March†	597 848	50 212	616 596	18 748
2022	April†	666 808	50 212	666 808	-
2022	May	618 731	-	-	-
2022	June	612 006	-	-	-

Note: Total passengers projected as the counterfactual trend line and actual passengers carried ('lost' as a result of Omicron restrictions) = 454 220.

†, Months affected by Omicron restrictions.

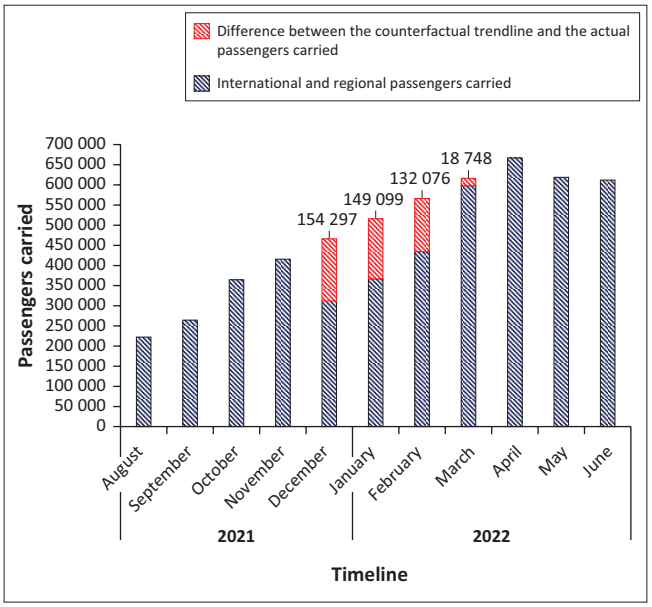


FIGURE 6: Counterfactual projection of international and regional routes passengers from August 2021 to April 2022: Counterfactual trendline and the actual passengers carried.

As a result, no adjustment is made for the levelling-off in passenger volumes for May 2022 and June 2022.

Impact of annual decline in passengers on tourism indicators

The calculation of the tourism impact is based on the WTTC's analysis of three indicators for the base calendar year of 2019 (WTTC 2022), which comprised the Direct Contribution of Travel and Tourism of R294.6 billion, Total Contribution of Travel and Tourism to GDP of R363.2bn and 1 460 900 jobs. The indicators per inbound tourist were derived by dividing the numbers for the indicators by the number of annual inbound tourists, as reflected in column A in Table 5. As a result, there is a 15% difference in the number of inbound tourists for the 2019 calendar year (14 797 000) as published by the World Bank (2022) (column A) and the number of passengers for the fiscal year of 2019/2020 (12 550 740) per ACSA (column B), defined as the base year (as published by ACSA). This is because of the latter being more aligned with the first lockdown period, as explained above.

The 454 220 passengers lost because of the Omicron restrictions were calculated in Table 4. The number reflects the total difference between the counterfactual recovery trend and actual passengers on international and regional routes.

The impact of the 454 220 passengers lost because of the Omicron restrictions is determined in column C of Table 5, calculated on the relevant unit values determined in column B of Table 5.

The relevant extent of the impact of Omicron restrictions in comparison to the impact of the overall COVID-19 restrictions

Omicron represented 20% of the passengers lost because of the overall impact of COVID-19 for the 4 months (December 2021, January 2022, February 2022 and March 2022).

Omicron restrictions caused passenger losses from December 2021 to March 2022, equal to 11% of the pre-COVID-19 base year's passengers' volumes (December 2019 to March 2020) and the overall COVID-19 restrictions, which represented 57% of the pre-COVID-19 base year's passengers' volumes. These are calculated in Table 6. The calculations are based on the passenger data in Table 7.

Discussion

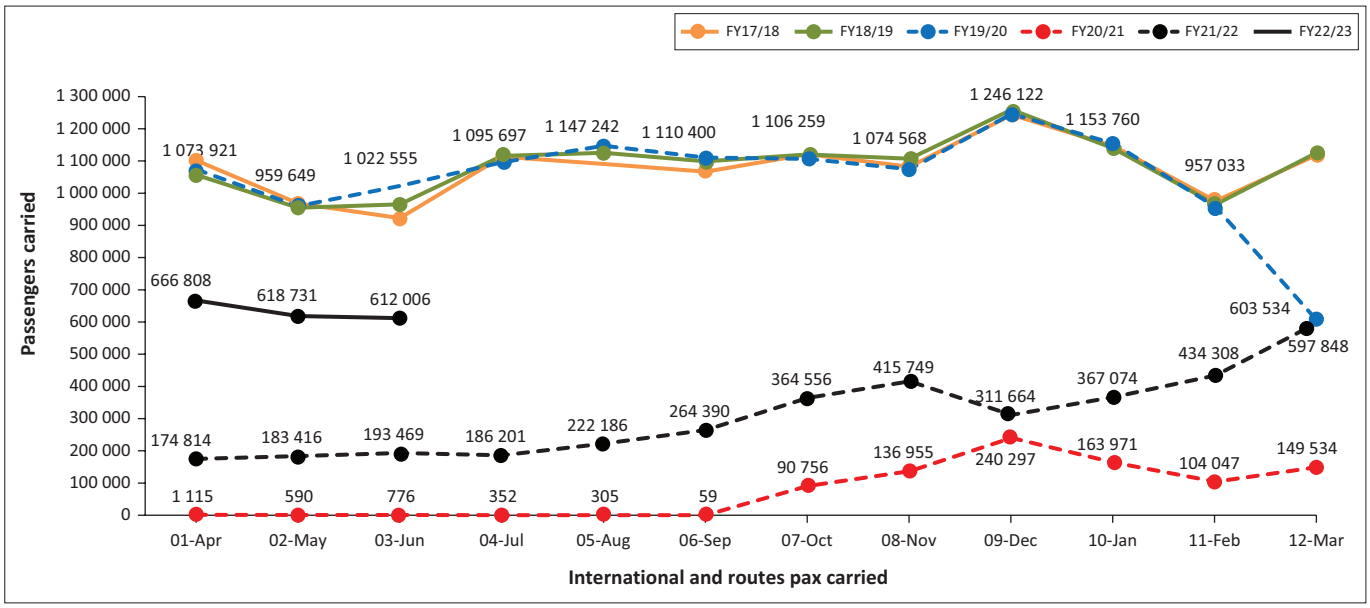
Key findings

The impact of the Omicron restrictions is as follows:

- 454 220 passengers were lost on international and regional routes.
- R10.66bn was lost in the direct contribution of travel and tourism.
- R13.14bn was lost in the total contribution of travel and tourism to the GDP.
- 52 871 jobs (employment) were affected.

Omicron restrictions caused 20% of the passengers lost because of the overall impact of COVID-19 for the 4 months (December 2021, January 2022, February 2022 and March 2022). Omicron restrictions caused passenger losses from December 2021 to March 2022, equal to 11% of the pre-COVID-19 base year's passengers' volumes (December 2019 to March 2020) compared to the overall COVID-19 restrictions, which represented 57% of the pre-COVID-19 base year's passengers' volumes.

The Omicron restrictions were imposed during which post-COVID-19 lockdown recovery was low and sluggish compared with the number of passengers carried in the pre-COVID-19 lockdown period, with the full recovery still far away. These restrictions negatively impacted the tempo of recovery of passengers carried on international and African regional (over-border) air services.



†, Inclusive of Omicron.

FY, fiscal year.

FIGURE 7: Seasonality of passengers carried on international and regional routes.

TABLE 5: Calculation of the impact of the 454 220 passengers lost because of the Omicron restrictions.

World Bank's number of tourism arrivals to ACSA passenger traffic	A: WTTC and WTO in rands 2019 calendar year	B: Base fiscal year FY19/20	C: Omicron
International tourism arrivals (World Bank) (i)	14 797 000	-	-
Annual passenger traffic (ii)	-	12 550 740	
Decline in annual passenger traffic from base fiscal year (iii)	-	-	-454 220
Percentage decline in annual pax traffic from base fiscal year (iv)	-	-	-
WTTC 2021 annual data:			
Visitors exports (a) in billions	134.6		
Domestic expenditure (b) in billions	160		
Direct contribution of travel and tourism (c = a+b) in billions†	294.6	294.60	-10.66
Direct contribution of travel and tourism per tourist (calc)†	19 909	23 473	23 473
Total contribution of travel and tourism to GDP in billions†	363.2	363.20	-13.14
Total contribution of travel and tourism to GDP per tourist (calc)†	24 546	28 939	28 939
Jobs†	1 460 900	1 460 900	-52 871
Jobs per tourist (calc)†	10.13	8.59	8.59

Note: Please see the full reference list of the article, 'Vermooten, J., 2023, 'Impact of Omicron COVID-19 restrictions on air transport and tourism to and from South Africa', *Journal of Transport and Supply Chain Management* 17(0), a881. https://doi.org/10.4102/jtscm.v17i0.881', for more information.

†, affected by Omicron restrictions.

WTTC, World Travel & Tourism Council WTO, FY and GDP.

Apart from the first month of immediate decline because of the Omicron restrictions, the passenger volumes after that did not reduce compared to previous months. However, it increased at a much slower pace than was experienced before the Omicron restrictions were imposed.

An immediate 25% drop in passenger traffic volumes from the previous month was experienced, while the airlines only reduced their flights by 9% in December 2021. After that, a double-digit increase in passengers carried (on a month-to-month basis) was experienced (18% in January 2022, 18% in February 2022, 38% in March 2022 and 12% in April 2022).

Apart from the initial 9% reduction in flights, the airlines maintained the number of flights for January and February 2022, increasing in March 2022. However, the maintenance of the higher level of flights despite lower levels of passengers carried caused additional financial hardship for the airlines.

Nevertheless, the impact of the Omicron restrictions, which caused an immediate 25% decrease in passengers carried on international and regional routes in December 2021, was so severe that the previous tempo of recovery could have been achieved in actual passengers carried. As a result, the pre-Omicron restriction month-to-month increases in passengers carried on international and African regional routes were 19% in August 2021, 19% in September 2021, 38% in October 2021 and 14% in November 2021.

This study calculated the counterfactual numbers of passengers that would have been carried had the Omicron restriction not been imposed. As a result, passenger number recoveries continued between November 2021 and April 2022 when the usual seasonal downturn in such passengers resumed. This is illustrated as a counterfactual passenger trend line, which linearly connected the November 2021 and April 2022 levels of passengers carried on international and African regional routes. The difference between the counterfactual recovery trend and passengers carried reflects 454 220 passengers lost.

The Omicron restrictions interrupted and postponed South Africa's tourism sector's recovery at a peak holiday and tourism season in December 2021. The Omicron restrictions demonstrate that a policy of rapid introduction of travel

TABLE 6: Comparison of impact on passengers lost because of Omicron to impact of COVID-19 from (December 2021 to March 2022) and in comparison to the passenger volumes in the pre-COVID-19 base year (December 2019 to March 2020).

Impact of Omicron vs impact of all COVID-19 restrictions	Passengers lost	Percentage of passengers lost due to Omicron restrictions	Passengers Carried	Percentage of Passengers lost due to Omicron and COVID-19 restrictions in comparison to the base year's passengers
Impact of Omicron restrictions				
Difference between the counterfactual trendline and the actual passengers carried (December 2021 to March 2022).	454 220	20	-	-
Impact of all covid-19 restrictions.				-
Difference between the actual passengers carried in base year (December 2021 to March 2022).	2 249 555	100	-	-
Passengers lost and passenger volume				
Passengers lost due to Omicron restrictions (December 2021 to March 2022)	-	-	454 220	11
Passengers lost due to COVID-19 restrictions (December 2021 to March 2022)†	-	-	2 249 555	57
Passengers volumes pre-COVID-19 base year's (December 2021 to March 2022)	-	-	3 960 449	100

†, Inclusive of Omircron.

TABLE 7: Difference between the counterfactual trendline and the actual passengers carried (December 2021 to March 2022).

Months	Passengers carried in base year (December 2019 to March 2020)	Difference between the actual passengers carried in base year and omicron period	Passengers carried (December 2021 to March 2022)	Difference between the counterfactual trendline and the actual passengers carried (December 2021 to March 2022)	Counterfactual passenger trend line (December 2021 to March 2022)
December	1 246 122	934 458	311 664	154 297	465 961
January	1 153 760	786 686	367 074	149 099	516 173
February	957 033	522 725	434 308	132 076	566 384
March	603 534	5 686	597 848	18 748	616 596
Total	**3 960 449**	**2 249 555**	**1 710 894**	**454 220**	**2 165 114**

restrictions to isolate states from pandemic infection caused isolation and severe damage to the tourism industries of destination states.

The Omicron restrictions were imposed during the period affected by the overall COVID-19 restrictions. Therefore, the negative impact of Omicron restriction represented 20% of the total impact of COVID-19 for the 4 months (December 2021, January 2022, February 2022 and March 2022) affected.

Strengths and limitations

Early reports noted alarming trends based on very early observations of the impact of the Omicron variant. These, among other things, noted a drop of 85% in forward bookings to South Africa for December 2021, compared to November 2021 and that for 10 consecutive days in early December 2021, IATA airlines recorded 'net negative bookings revenue from tickets sold as airlines had to refund would-be passengers' (IATA Economics 2022, Daniel 2022).

The strength of this study is that it is based on *ex-post facto* South African-based passenger and flight data, which were tracked for a longer period of 6 months (until the previous recovery trend was restored). Apart from quantifying the number of passengers lost, the study also calculates the impact of COVID-19 on the leading tourism indicators for South Africa, based on the tourism indicators published by the WTTC for the 2019 calendar year as the pre-COVID-19 basis. These include metrics for the: direct contribution of travel and tourism, total contribution to the GDP and the tourism impact on employment.

Implications or recommendations

The severity of the impact of the air travel restrictions to prevent the spread of contagious disease should be taken into account by regulators, especially prevention measures of contagion in the aviation industry and the lack of objective evidence that air travel contributed to the spread of the pandemic.

Conclusion

The Omicron restrictions caused a loss of 454 220 passengers on international and regional routes to South Africa, which translates into a loss of R10.66bn in the direct contribution of travel and tourism and R13.14bn in the total contribution of travel and tourism to South Africa's GDP. A total of 52 871 jobs (employment) were affected.

The determination of the severity of the impacts of Omicron restrictions on air transport and on tourism, serves as a demonstration of the tremendous damage caused by governments' non-evidenced based travel bans and adds to the knowledge base that travel restrictions are not effective in slowing the spread of Omicron and the high costs of such restrictions for passengers, the aviation sector and the economy.

Governments should recognise the contribution of the airline industry to tourism and GDP as well as employment in their consideration of future actions to address a serious contagion, especially where there is no objective evidence of causation by air travel.

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Competing interests

The author declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Author's contributions

J.V. is the sole author of this research article.

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Data availability

The data that support the findings of this study are openly available from:

- Airports Company of South Africa (ACSA) https://www.airports.co.za/business/statistics/aircraft-and-passenger; https://www.airports.co.za/news/statistics
- International Civil Aviation Organization (ICAO) https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf; https://data.icao.int/COVID-19/; https://www.icao.int/safety/pages/covid-19-airport-status.aspx
- International Air Transport Association (IATA) https://airlines.iata.org/news/the-impact-of-covid-19-on-aviation; https://www.iata.org/monthly-traffic-statistics
- World Bank https://data.worldbank.org/indicator/IS.AIR.PSGR

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The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of any affiliated agency of the author.

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