Urban mobility in Lagos: Evaluating the Impact of a Large-Scale Transit Reform

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TRANSFORM DEVELOPMENT

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Motorized Trips in Lagos, Nigeria Taiwo 2015

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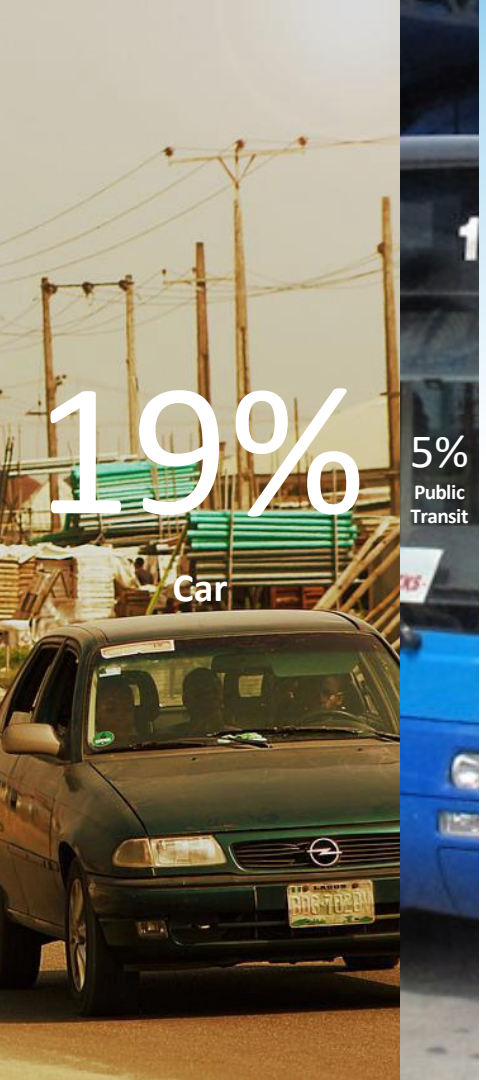

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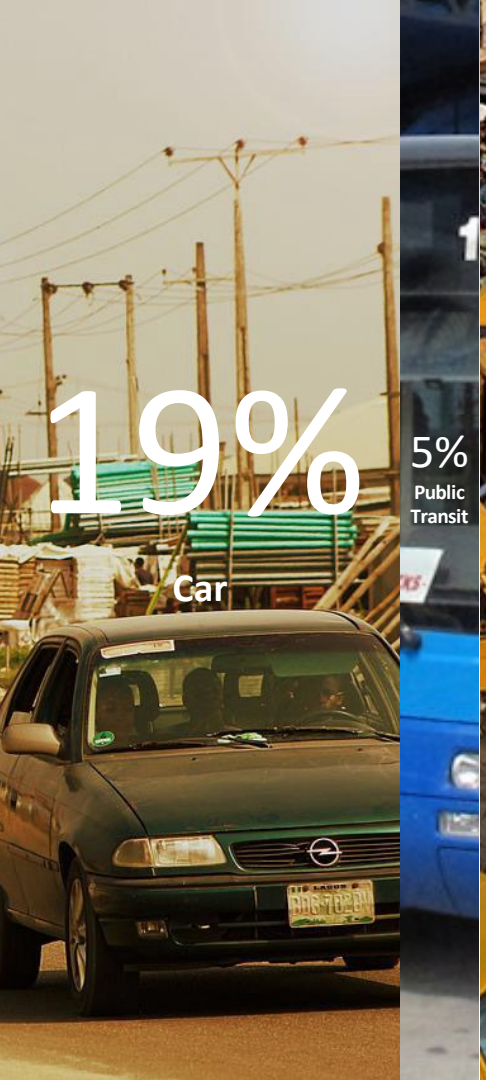
Motorized Trips in Lagos, Nigeria

Taiwo 2015



19%

Car

5%

Public Transit

72%

Private Transit

"Danfo"

Lagos Bus Reform Initiative

40 routes
820 new city buses

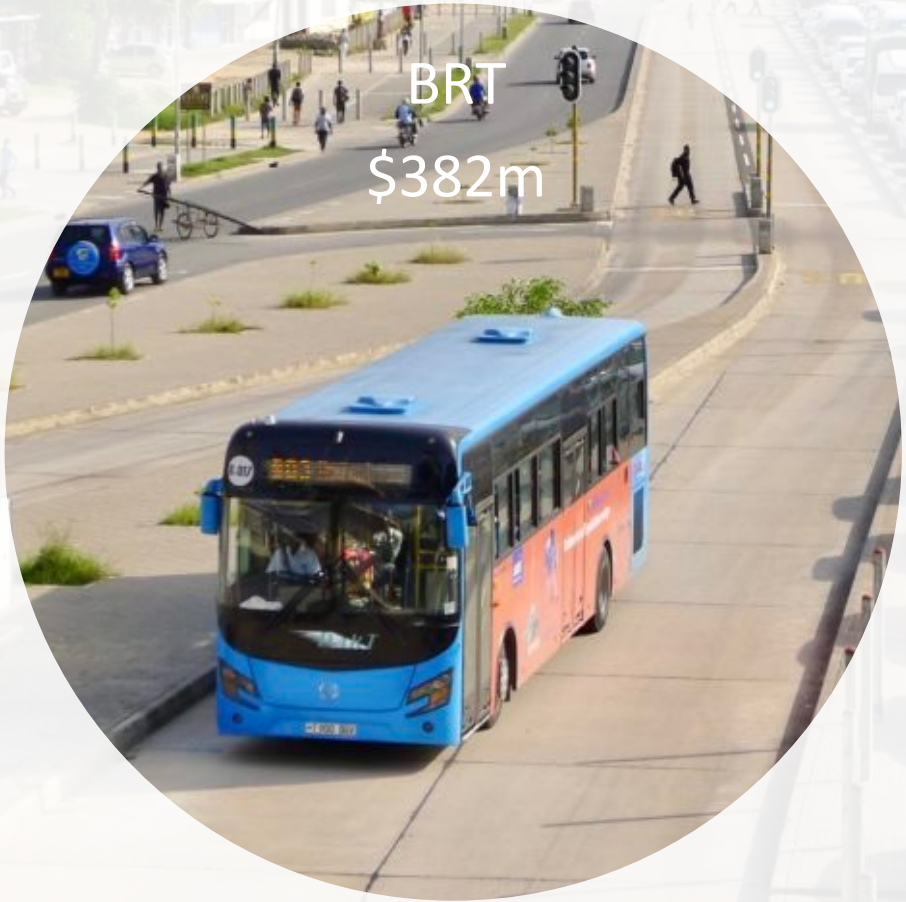
2019-2023

Lagos Bus Reform Initiative

40 routes
820 new city buses

Existing network
759 private routes
75,000 minibuses

Dar es Salaam Bus Rapid Transit



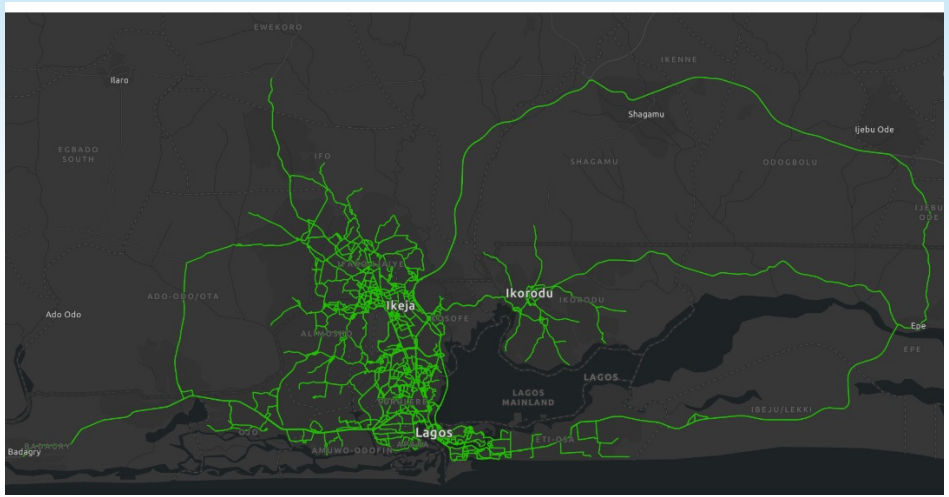

Dar es Salaam Bus Rapid Transit
BRT
$382m
1.3% of trips
Private transit: 60%

Background & Objectives

- **Collaboration with LAMATA to conduct original research on mobility in Lagos** to document the **impact of** current or planned **reforms**:
  - Understanding the impacts of the Bus Reform Initiative (BRI) on mobility
    - Do danfos compete with or complement public transit?
    - What is the response to the public transit improvement, what are the benefits to commuters?
    - How to further regulate or support the paratransit sector?
  - Understand preferences of commuters
  - Gender-specific changes in constraints to mobility
- **Generate original geospatial and survey data to feed into the updated Lagos Masterplan:**
  - Mobility data
  - Danfo network and activity data
  - Parameters of commuters' valuation of time, sensitivity to price

Deeper dive into the data

Based on Large Scale Spatial Data Effort



Private transit: Data collection since Oct 2020

- **Danfo network census (2022)**:
  - 759 routes, 30,000km
- **Motorpark and bus stop observation surveys:**
  - Arrival and departure from 278 routes at 48 terminals + 79 bus stops
  - 15 surveys from Nov 2020 – 2023
  - *Variables*: Fares, departures, driver queues, wait times
- **Danfo driver surveys**
  - 854 drivers, 5 rounds
  - *Variables*: Demographics, trip diary, income, cost

Congestion (~500 routes, March 2020-Present)

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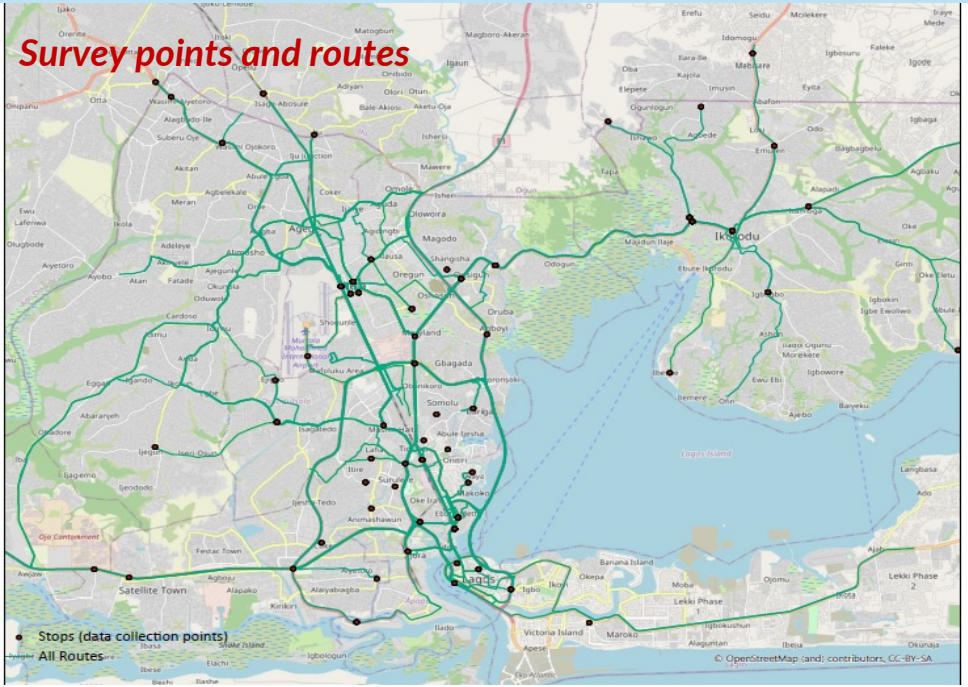
Based on Large Scale Spatial Data Effort



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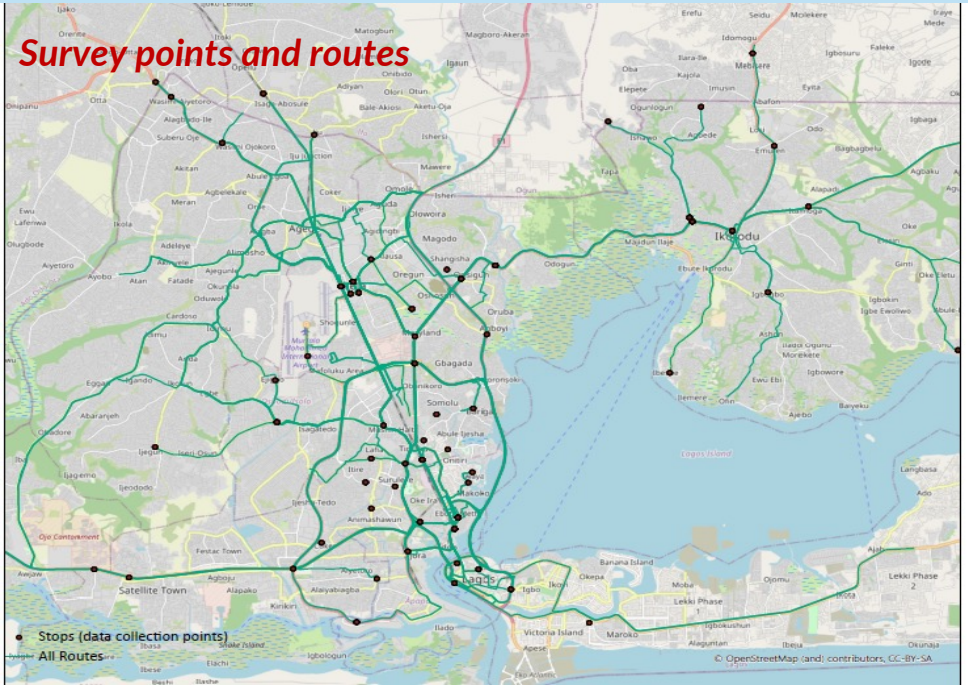

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Commuter :

- Pilot Wait Time (640)
- Commuter survey (1000)
- Public transit e-ticketing data
- MTN mobility data

Congestion (~500 routes, March 2020-Present)

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Outline of the study

Research question: commuters

1) What factors are important for commuters deciding whether to adopt new mode of transportation?
2) What is the total benefit of the BRI for commuters ?
3) What are the gender specific constraints on mobility

Data and method

- E-ticketing data
- Commuter's pilots & survey
- Mobility data from MTN
- Model of commuter choices between modes

Research question: danfos

1) What is the danfo market model?
2) How do informal operators react to the new public option?

Data and method

- Danfo network mapping
- Danfos drivers surveys and network observation
- Model of danfos drivers' decisions

Research question: congestion and pollution

1) Do congestion and pollution improve as a result of the BRI – and by how much ?

Data and method

- GPS data
- Model of CO_2 emissions

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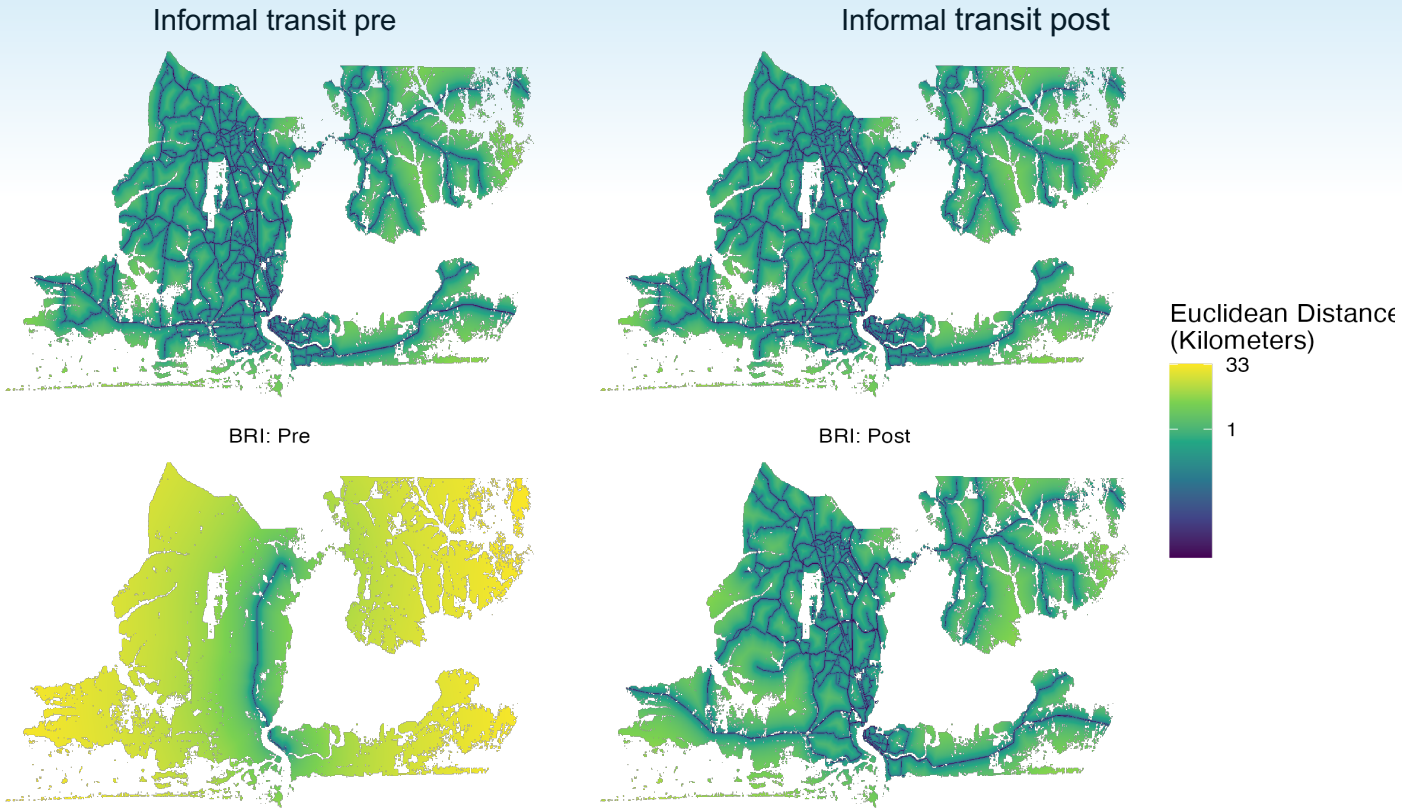
Public transit access increased but danfos are crucial for mobility

- BRI improved access to public transit by about 85 % within the metro area
- 50% of Lagos metro territory was within 1.7 km from a public transit line in 2023
- In our survey, 62 % of motorized trips are taken via danfo post reform

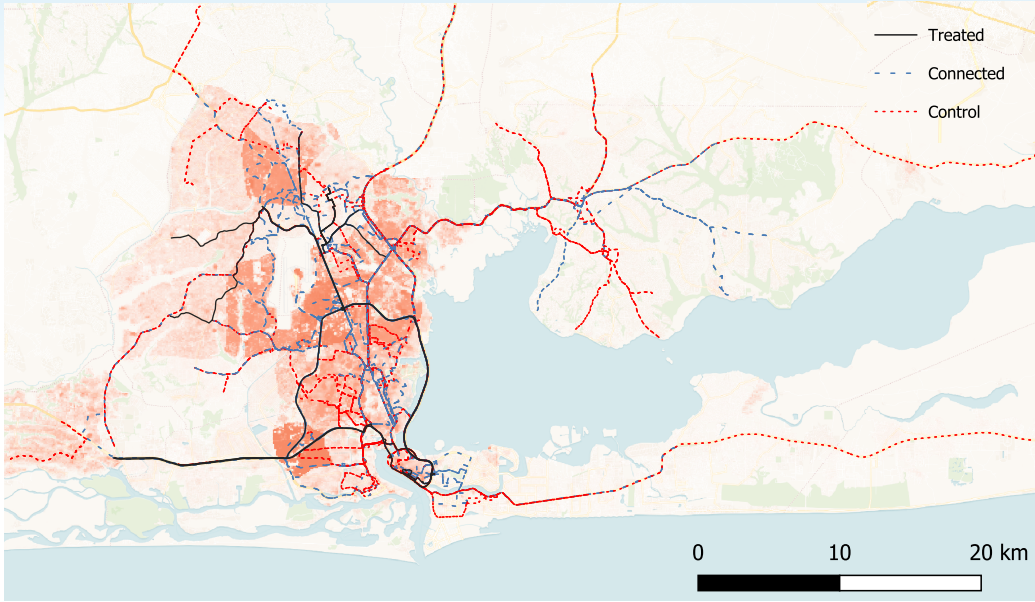


Evaluating the paratransit response

Study design: quasi-experimental and experiments combined

Leveraging the roll-out plans in a staggered differences-in-differences design and high frequency data on congestion, public buses and danfo activity

- ***Treated*** are routes that see a new bus line open after November 2020
  - These are the lines we expect most impact
- ***Connected routes*** are routes that share a node with a treated routes
  - These are lines that may indirectly impacted, e.g. by danfo changing routes
- ***Controls*** are routes that are not part of the plans for these phases



Paratransit response to the new bus system

When public transit enters a route:

- **Reduced danfo frequency and fares**
  - Minibus departures fall by 11% - 22%
  - Suggestive evidence of 2-7% price decline due to increased competition.
- **Drivers lose and switch to other routes**
  - Make fewer trips and earn 11% less
  - 23-29% decline in minibuses waiting in queue
  - More likely to switch to another route starting at the same terminal
- **No detectable change in congestion**

New public transit also affects "connected" routes

On danfo routes connected to BRI:

- **Supply of drivers rises**
  - Drivers from treated routes switch to connected-> longer danfo queues
- **Prices for commuters fell:**
  - Up to 8% decline in prices on routes which are connected to many treated routes.
- **No change in danfo frequency**
  - Already buses waiting in these queues -> departures determined by demand

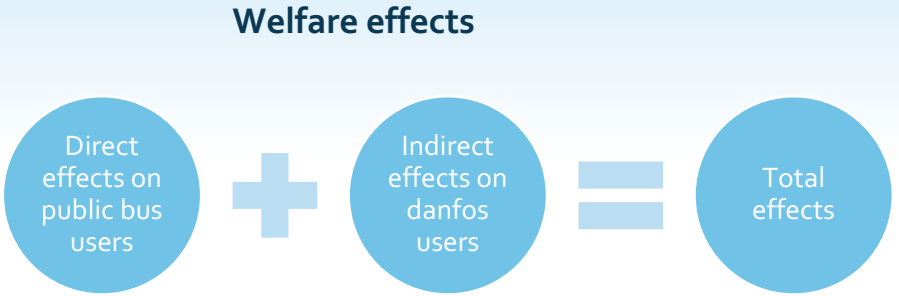
Commuters' revealed preferences and stated constraints

Recovering the time and price sensitivity of commuters

- **Value of time is key to optimize scheduling**
  - Ran a pilot asking 640 participants if they accepted a (random) offer to wait at a bus stop
  - Correcting for whether they are in a rush
  - The average cost of waiting for a commuter = ₦18.94/min
- **Sensitivity to price is key to optimize pricing within constraints**
  - Used e-ticketing data around changes in ticket price
  - Reaction to change – switching mode, less trips, …- gives us the sensitivity of commuters to price
  - 10% reduction in prices leads to 6.8% more trips on the public system.

Increased competition in transport benefits even commuters who do not use the BRI

- New system generated $1.47 million in monthly value for commuters.
- 10% of the total commuter gains come from the response of the private sector.
  - Large number of commuters on connected routes benefit from lower prices.



- Danfo drivers lose $0.75 million per month —about half the benefit to commuters.
  - Route switching among drivers drives most of these losses

Key takeaways of the study

Key findings

- The BRI increased **access to public transit** but danfos still represent 62% of the trips – 42% of Lagos city is within 500 m of a danfos line, 27% within 500 m of a blue bus line.

- Introducing **new public routes benefitted commuters directly and indirectly**: due to the new routes, danfos drivers switched to ply connecting routes and lowered their prices, benefitting commuters on connected routes

- **Overall benefits to commuters amount to 1.47 million USD/month**. 10% of the total commuter gains come from the response of the private sector.

- Danfos losses (due lost customers or quitting working) are equivalent to ½ of these benefits.

- **No clear effect on congestion** based on the data from the first phase of the BRI.

Moving forward

Next steps: Key questions for urban transit integration

- Key challenge is understanding what blend of public and private transit offers the most efficient, equitable, and scalable solution for Lagos?

- Having geospatial and survey data systems in place is critical to understanding paratransit response and developing solutions.

- Do paratransit systems reorganize naturally into feeder services when public transit is introduced? Or must planners actively guide this integration?
    - What are the routes where danfos have an advantage?
    - Could danfos drivers be incentivized to become feeders or formalize?
    - What compensation, capital expenditure for fleet upgrading, training would this require?

Thank you!

For any questions or follow-ups:

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