Measuring Public Transport Fare Affordability

Dr Michael Li

Nanyang Technological University

zfli@ntu.edu.sg

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Outline

- Introduction
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  - Fare Affordability Index for a Representative Family in Second Quintile Group
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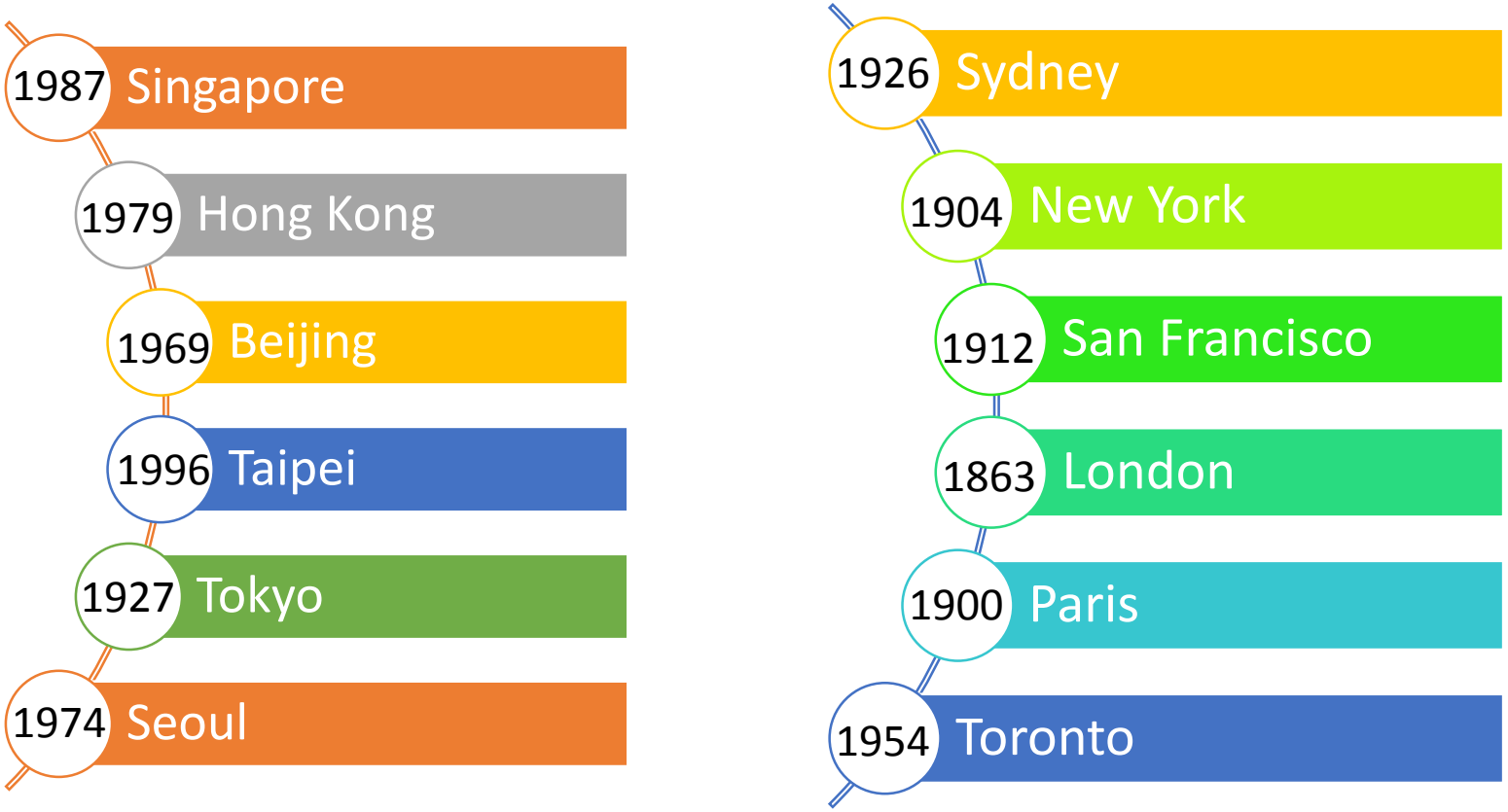
Introduction

- Keeping fares affordable while ensuring the financial sustainability of the public transport system is a major challenge for most cities.
- Commissioned by Singapore's Public Transport Council (PTC) in 2018, we conducted an international benchmarking study to understand the latest trends in public transport fares, which benchmarked Singapore's public transport fares against 11 other major cities
- This presentation focus on the methodological issues, concessionary fares, fare affordability index for a representative family in the second income quintile group, and fare revenue per passenger kilometre.

2018 Singapore Benchmarking Study – Selected Cities



- The Asian cities were selected as many of them have been expanding their PT services in recent years which may share similar operating characteristics as Singapore
- Cities in other major regions like Australia, Europe and North America were selected due to their established PT systems.

*Number in bubble indicates the year which the urban train system began operations

Affordability Index – Expenditure-Based Approach

- Affordability index for a particular income group *i* (AI_i) is defined as the burden of public transport costs on an average household in a specific demographic group:

$$AI_i = \frac{Average\ Expenditure\ on\ PT\ for\ Group_i}{Disposable\ Household\ Income\ of\ Group_i}$$

- System-level affordability index (AI) is defined for the whole city:

$$AI = \frac{Average\ Expenditure\ on\ PT\ for\ the\ City}{Average\ Disposable\ Household\ Income\ for\ the\ City}$$

- This measure is very intuitive and makes sense to everyone as the same approach has been used in studying housing affordability.
  - But ….

Affordability Index – Expenditure-Based Approach: Data & Methodological Issues

- Household Public Transport Expenditure Data – A Big Challenge
  - Primary sources of expenditure data is from Household Expenditure Surveys (HES)
  - Singapore & Hong Kong: every five years
  - Sydney: every six years
  - Beijing, London, New York, San Francisco, Seoul, Taipei, Tokyo, Toronto: annual data
  - Paris: expenditure data not publicly available
- Methodological Issues – A Much Bigger Challenge
  - As the household income increases, the percentage of public transport non-users usually increases.
  - Using "average" PT expenditure for a demographic group will **underestimate the affordability for PT users**.
    - In order to improve the measurement accuracy, we need the modal-split data for different demographic groups, which is not available for all cities under the study.

Affordability Index – Representative Commuter-Based Approach

- In a World Bank sponsored study by Carruthers, Dick and Saurkar (2005): Affordability of Public Transport in Developing Countries.
  - On the monthly expenditure on public transport, it uses the cost of 60 10-km trips as a proxy **for a representative full-time working adult who uses on the public transport on daily basis**
  - Use per capita income for each quintile group and for the whole city
  - Eg, Singapore during 1995 - 2004:
    - AI for first quintile = 10%
    - System level AI = 2.4%
- **Methodological issues:**
  - Ignore monthly concessionary passes
  - Affordability at the household level

Table 6. Affordability Index Values for Twenty-Seven Cities.

	City	Per Capita Income U$PPP	Bottom Quintile Income as Percent of Average	Fare for 10km Travel (PPP U$cents)	Affordability Index	
					Average	Bottom Quintile
1	Sao Paulo	8,732	10.0%	130.1	11%	107%
2	Rio de Janeiro	14,325	10.0%	125.4	6%	63%
3	Brasilia	12,985	10.0%	106.8	6%	59%
4	Cape Town	14,452	10.0%	75.8	4%	38%
5	B. Aires	15,493	15.5%	87.6	4%	26%
6	Mumbai	8,585	41.0%	112.2	9%	23%
7	Kuala Lumpur	18,351	22.0%	121.6	5%	22%
8	Mexico City	9,820	15.5%	39.3	3%	19%
9	Chennai	3,717	41.0%	39.3	8%	19%
10	Manila	9,757	27.0%	63.0	5%	17%
11	Krakow	15,579	36.5%	130.6	6%	17%
12	Amsterdam	28,170	36.5%	226.6	6%	16%
13	Moscow	16,154	24.5%	84.6	4%	15%
14	Guangzhou	9,165	30.0%	55.1	4%	14%
15	Warsaw	26,024	36.5%	142.5	4%	11%
16	New York	51,739	27.0%	200.0	3%	10%
17	Los Angeles	42,483	27.0%	160.0	3%	10%
18	Chicago	48,300	27.0%	180.0	3%	10%
19	Singapore	38,797	25.0%	130.3	2%	10%
20	Beijing	14,379	30.0%	55.1	3%	9%
21	Seoul	16,784	40.0%	85.5	4%	9%
22	Shanghai	20,814	30.0%	55.1	2%	6%
23	Cairo	7,117	43.0%	26.1	3%	6%
24	Budapest	22,106	50.0%	89.3	3%	6%
25	London	53,057	30.5%	116.4	2%	5%
26	Prague	32,757	52.0%	88.0	2%	4%
27	Bangkok	20,386	31.0%	32.2	1%	4%

Affordability Index – Representative Family-Based Approach

- To better capture the affordability issue at the household level and to take into consideration of concessionary passes, in our benchmarking study, we decided to use a representative family to derive the public transport expenditure as follows:
  - **Representative family consists of 2 adults and 2 schooling children.**
  - The expenditure is computed based on **10 km average trip fares multiplied by 60 trips** or **concession pass prices** (**whichever is lower**) for each of the family member.
- The **household disposable income** was based on that of **the second quintile household** income group as this group is most likely to depend on public transport regularly.
  - Disposable income data is from **Euromonitor**.

- Major methodological challenge
  - **Derive consistent fixed-distance fares**

Fare Structure Summary

Fare Structure		Flat fare[1]		Distance-based[2]		Zones-based[3]	
Cities		Bus	Train	Bus	Train	Bus	Train
Asia Pacific	Singapore			✓	✓		
	Hong Kong			✓	✓		
	Seoul			✓	✓		
	Beijing			✓	✓		
	Sydney			✓	✓		
	Taipei				✓	✓	
	Tokyo	✓			✓		
Europe	Paris					✓	✓
	London	✓					✓
Americas	New York	✓	✓				
	San Francisco	✓	✓		✓		
	Toronto	✓	✓				

✓ San Francisco's Train includes Muni (flat fare) and BART (distance-based)

✓ Taipei Bus - Depends on routes/zones crossed

✓ Tokyo Bus - Flat fare only if traveling on same bus, to pay again if changing to another

✓ Paris Bus & Train - Flat fare across the Zones 1-2 on Metro & RER Zone. Flat fare is not applicable for RER and Noctilien Nightbus if crossing zones 3 onwards

✓ London Bus - Flat fare but if transferring to another bus must be within one hour from boarding first bus to the subsequent bus.

Definitions of Fare Structure:

1: **Flat Fare** denotes fare that is fixed regardless of distance or zone traveled

2: **Distance-based** denotes fare that is charged based on distance traveled. The type of fare includes step-up fares where a flat fare is charged for each distance range specified and increases by distance.

3: **Zone-based** denotes fare that is charged based on zones traveled, regardless of actual distance traveled

- Singapore had one of the more equitable fare structures with fares pegged to the distance travelled and charged in a granular manner
- Singapore was one of the four cities that had implemented a fully integrated public transport fare structure. The other three cities were New York, Seoul and Toronto

Fixed-Distance Fare Data Collection Methodology

Primary Methodology - Min-Max-Mean (MMM) Fare

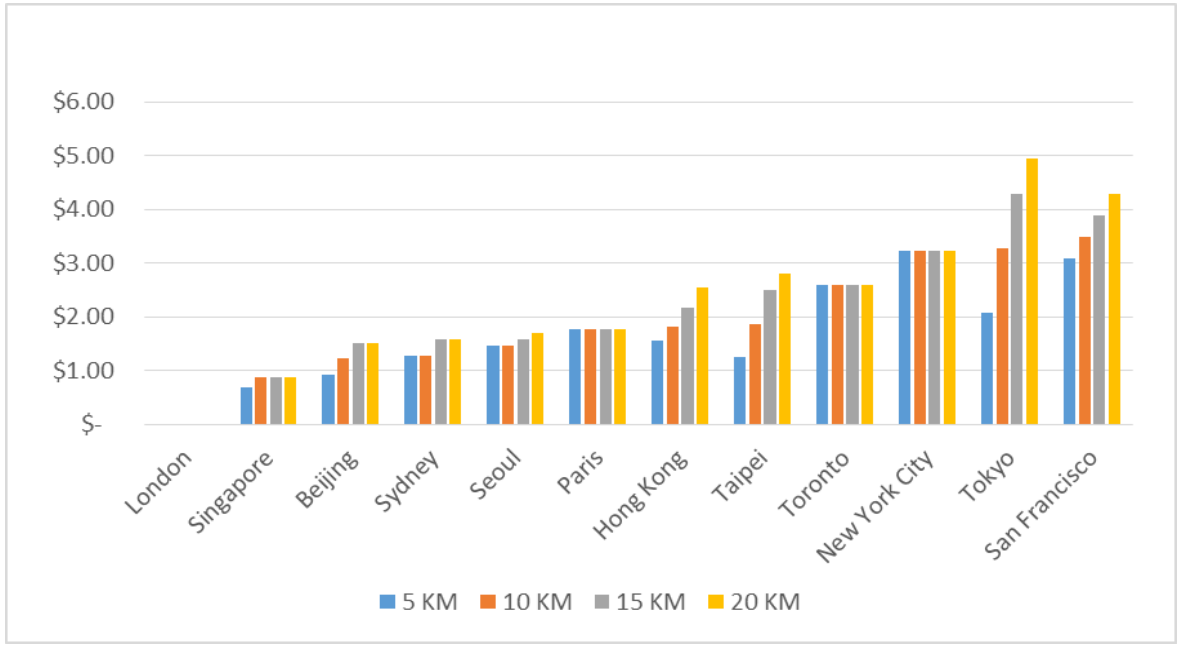
The comparison of fares is done across the 12 cities on the minimum, mean and maximum fare at each distance group, i.e. 5KM, 10 KM, 15KM and 20KM.

The fare structure of each city is considered, these can largely be clustered as Distance-based, Zone-based and Flat Fare. For the distance based and zone based fare structures where the minimum and maximum fare per distance group are likely to differ, the mean fare is computed by averaging the minimum and maximum fare.

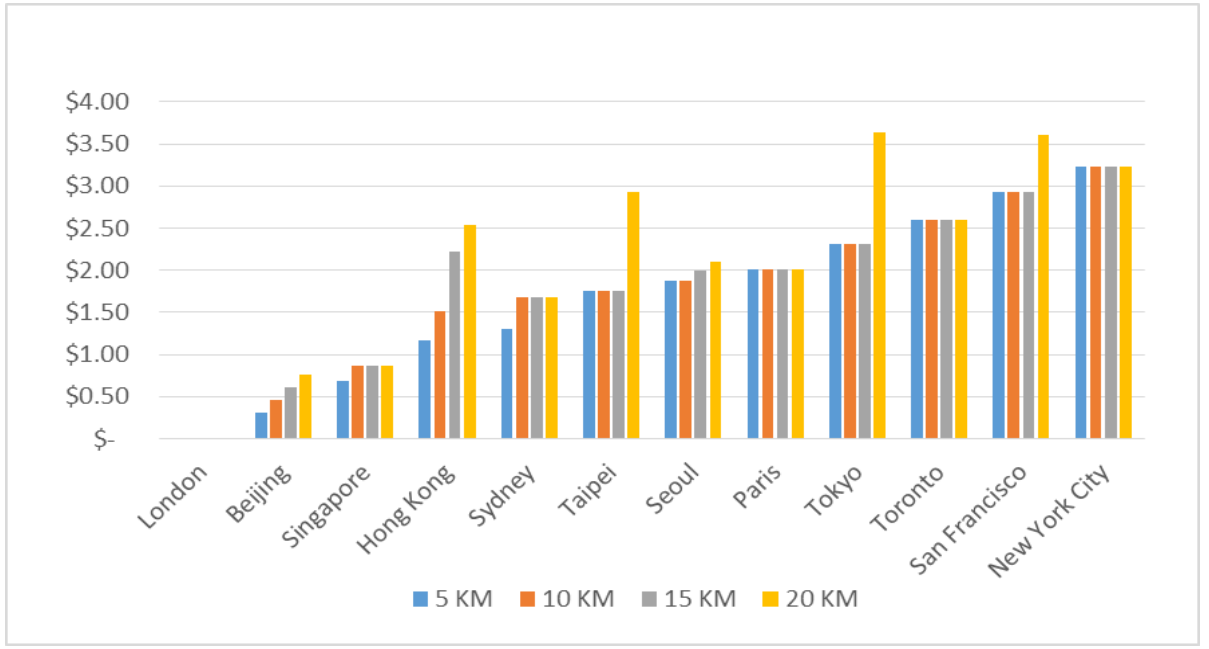
In this benchmarking study, single mode BUS fares and single mode TRAIN fares, without bus to bus and train to train or bi-mode transfers, are used.

To make comparisons across all cities, the collected fares were adjusted using PPP by Private Consumption in Singapore Dollars

Fixed-Distance Direct Train/Bus Fares for Seniors at 60 Years (PPP Adjusted)



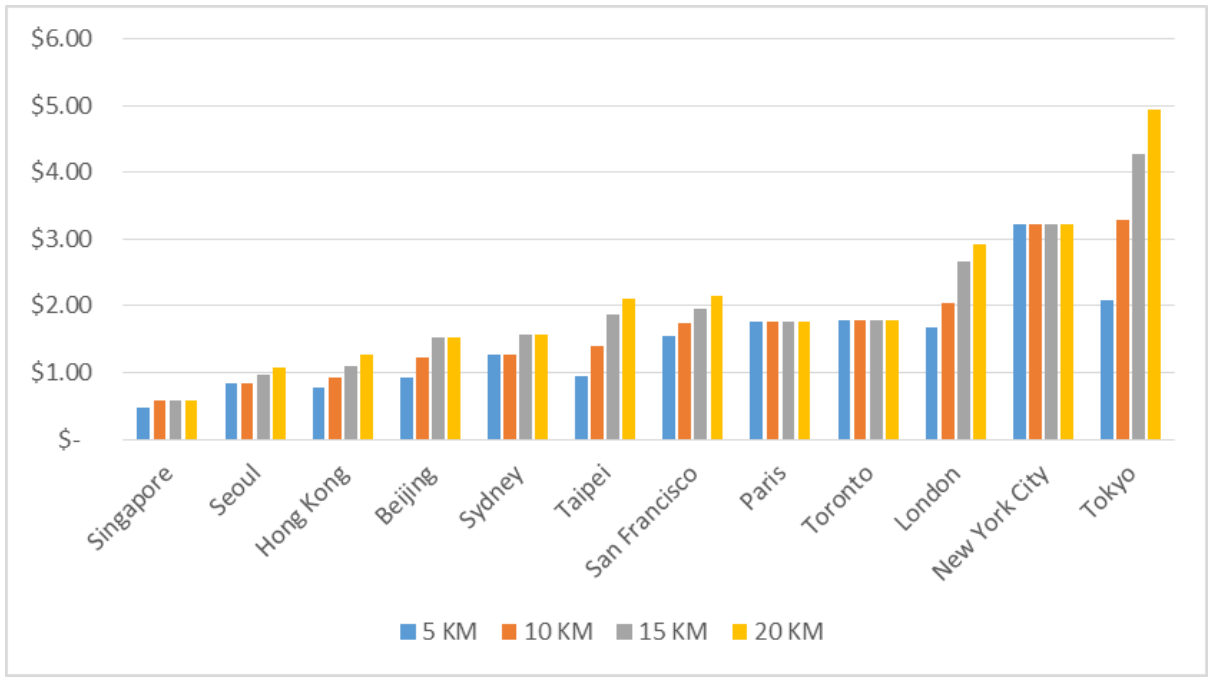
Fixed-Distance Direct Train Fares for Seniors at 60 Years Old in PPP-SGD



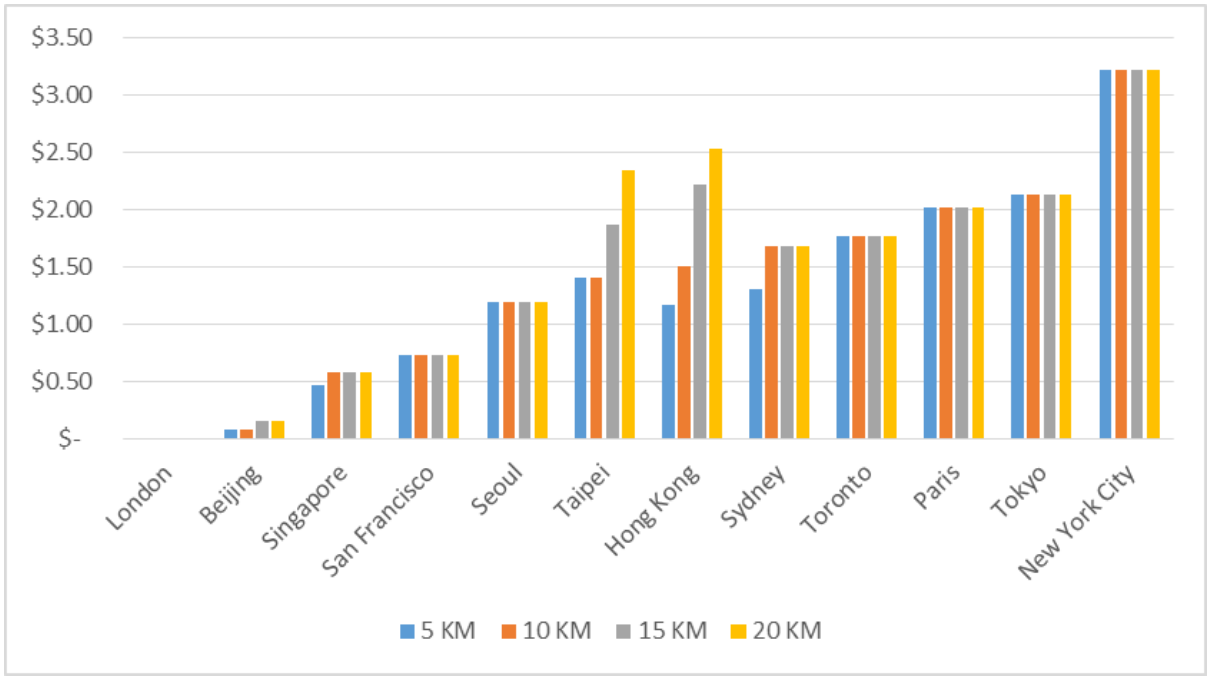
Fixed-Distance Direct Bus Fares for Seniors at 60 Years Old in PPP-SGD

- London, Singapore, and Sydney's eligibility age were the lowest at 60 years old
- In contrast, it was 65 years old in Beijing, Hong Kong, New York, Paris, San Francisco, Seoul, Taipei and Toronto.
- Tokyo had the highest eligibility rate of 70 years old
- Top three cities with the lowest bus and train fares (60 year old senior citizen): London, Singapore, Beijing

Fixed-Distance Direct Train/Bus Fares for Students (PPP Adjusted)



Fixed-Distance Direct Train Fares for Students in PPP-SGD



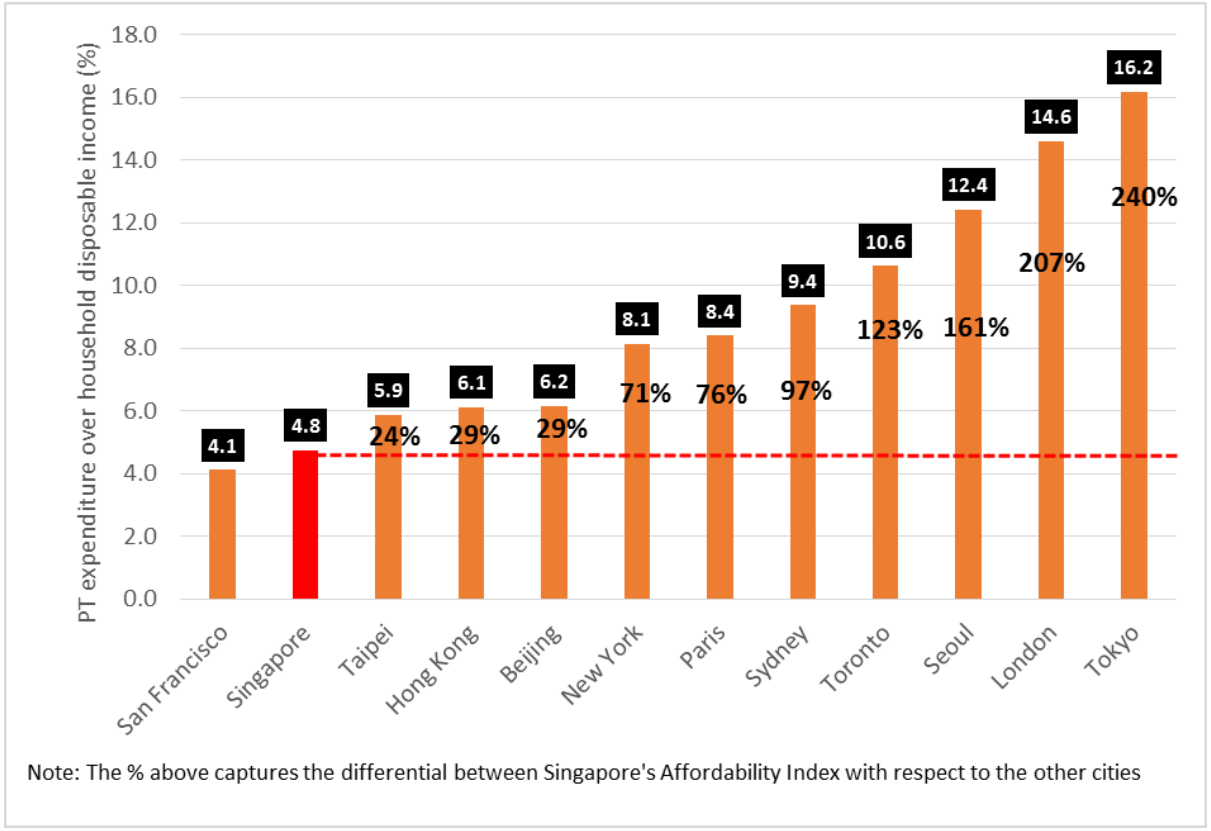
Fixed-Distance Direct Bus Fares for Students in PPP-SGD

- The age of eligibility for student concessionary fares also differs from city to city.
- For the purpose of comparison, fares were based on students at secondary level with actual fares charged.

- Top three cities with the lowest student train fares: Singapore, Seoul, Hong Kong
- Top three cities with the lowest student bus fares: London, Beijing, Singapore
- New York student bus fares were the highest as they had to pay full adult fares.

Affordability Index (2nd Quintile Representative Family)

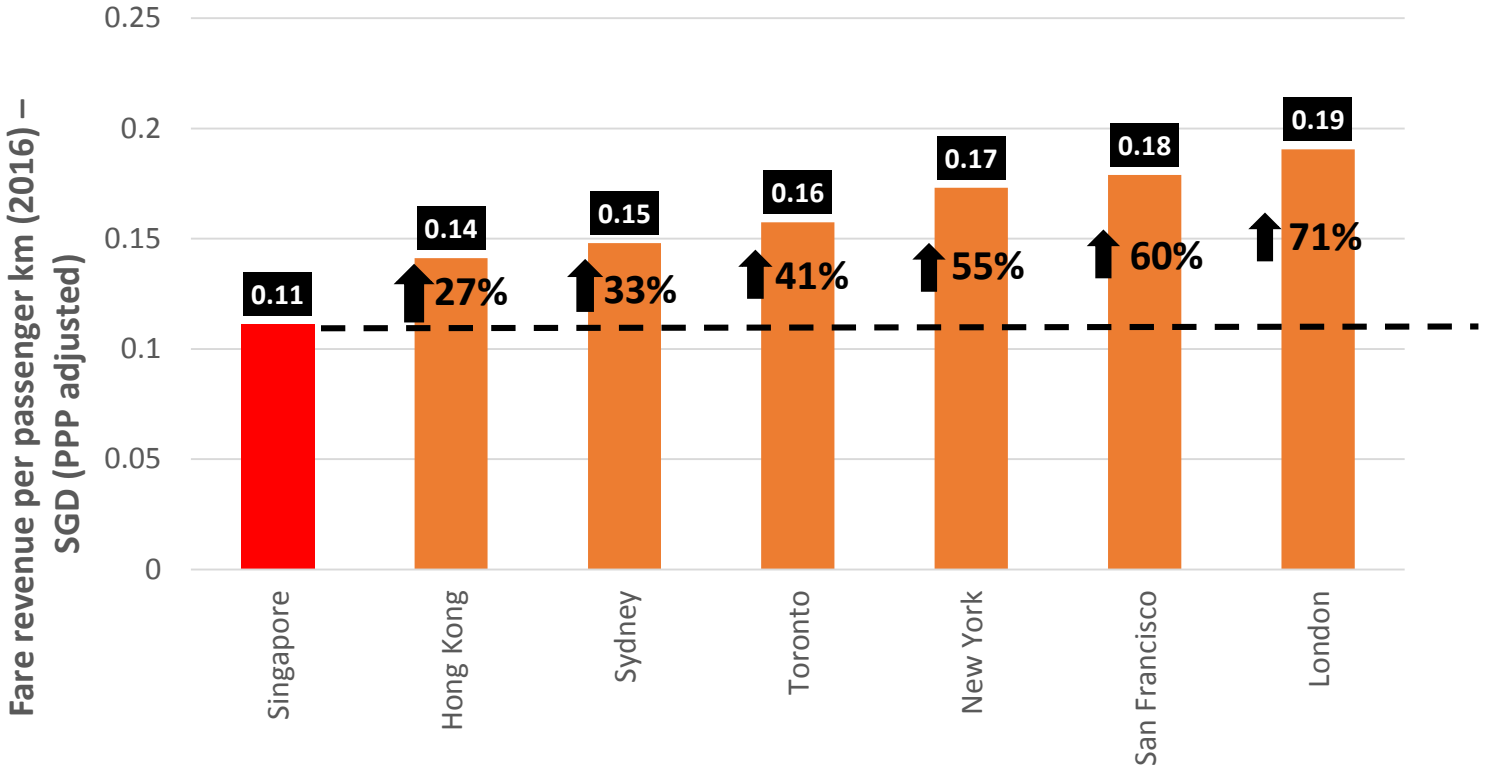
City	Affordability Index	PT Expenditure (PPP-PC-SGD)	Disposable Income (PPP-PC-SGD)	Trip or Pass or Mixed based
San Francisco	4.1	3,519	85,507	Mixed
Singapore	4.8	2,750	57,802	Trip
Taipei	5.9	4,246	72.219	Mixed
Hong Kong	6.1	3,277	53,456	Trip
Beijing	6.2	2,140	34,790	Trip
New York	8.1	4,959	60,865	Mixed
Paris	8.4	3,366	40,085	Pass
Sydney	9.4	5,317	56,733	Trip
Toronto	10.6	4,255	40,045	Pass
Seoul	12.4	3,640	29,272	Trip
London	14.6	5,270	36,114	Trip
Tokyo	16.2	5,913	36,559	Trip



Note: The % above captures the differential between Singapore's Affordability Index with respect to the other cities

- In terms of a monthly PT expenditure for a family of four and for the second income quintile, **Singapore ranked 2nd**; while Tokyo was the worst. On average, 2nd quintile representative family (which represents typical PT users) in SG spent 4.8% of their disposable income on public transport.
- While San Francisco's second quintile household's PT expenditure is about 28% higher than Singapore, their household's disposable income is about 48% higher than Singapore.

Fare Revenue per Passenger-KM in 2016 PPP-SGD



- Singapore's fare revenue per passenger-km is $0.11 for the entire PT system in 2016.
- Singapore's fare revenue per passenger-km is the lowest across the cities compared.
- Hong Kong, ranked the second, about 27% higher than Singapore, at SGD 0.14.
- For London, commuters are charged SGD 0.19 or SGD 0.08 higher per pax-km when compared with Singapore.

If Singapore's fares were charged, it would result in Hong Kong and London making a loss of $713 million and $2.16 billion in fare revenue respectively.

Conclusions

- Fully integrated fare structure not commonly found among cities
  - New York, Seoul, Singapore, and Toronto
- Singapore had one of the most granular distance fares structure
- London, Singapore, and Sydney's eligibility age for senior citizen were the lowest at 60 years old
  - London most generous; free travel, followed by Beijing and Singapore
- Top three cities with the lowest student train fares: Singapore, Seoul, Hong Kong
- Top three cities with the lowest student bus fares: London, Beijing, Singapore
- In terms of fare affordability, Singapore is the second most affordable city

Conclusions

- Balancing Affordability/Concessions and financial sustainability is a constant struggle for all cities
    - London provides free travel but highly cross-subsidised by other commuters (highest fare revenue collection of SGD 0.19 pax-km)
    - Singapore affordable fares and low fare revenue per passenger kilometre (SGD 0.11) come at a cost to tax payers
    - Increasing subsidy and falling cross recovery ratio for Singapore's PT system over the years
- In view of the global trend of increasing cost to provide public transport services, a continuing divergence will result between fare revenues and the costs incurred to deliver the services
- Hence, a greater balance needs to be attained between fare affordability and financial sustainability for a more self-sufficient system

Conclusions

- Affordability and financial sustainability of the public transport systems are important to all stakeholders, especially for the policy makers.
- There are no regular or recurrent study on this matter at global scale.
- I am here making a call for a collaborative effort on this important issue:
  - Methodological developments
  - Data collection & a global database
  - Model calibration
  - Global benchmarking on regular basis

Thank You!

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