

The Impact of Bus Rapid Transit on Land Development: A case study of Beijing, China

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1 Introduction

1.1 Research objectives

The research seeks to investigate the impact of Bus Rapid Transit (BRT) on land development. It is expected to make a contribution in two areas:

- 1) To better understand whether BRT systems could deliver a high quality service.
- 2) To examine whether benefits from BRT, specifically travel time savings, have influenced land development around BRT stations.



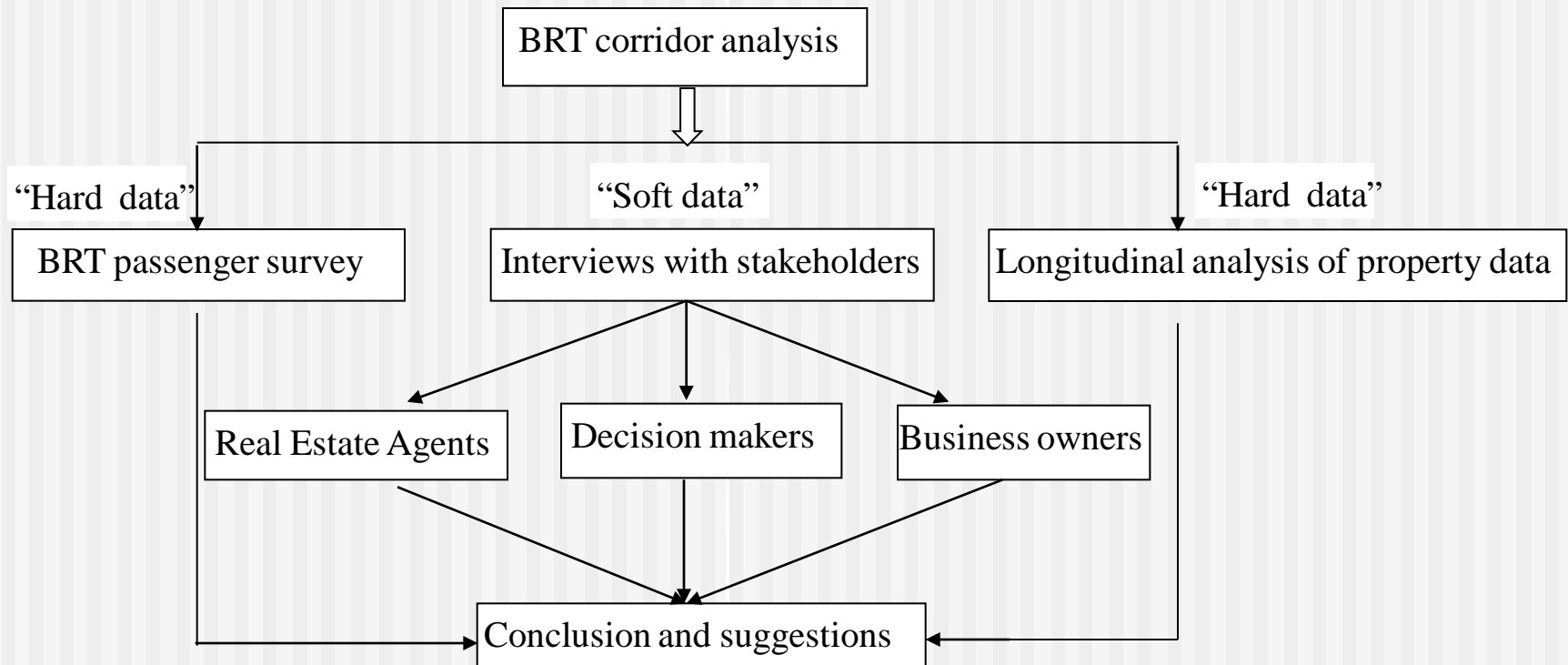
Beijing – Southern Axis BRT line 1



Quito – Trolebús

2 Methodology

2.1 Research process flowchart



2 Methodology

2.2 The transport investment life cycle

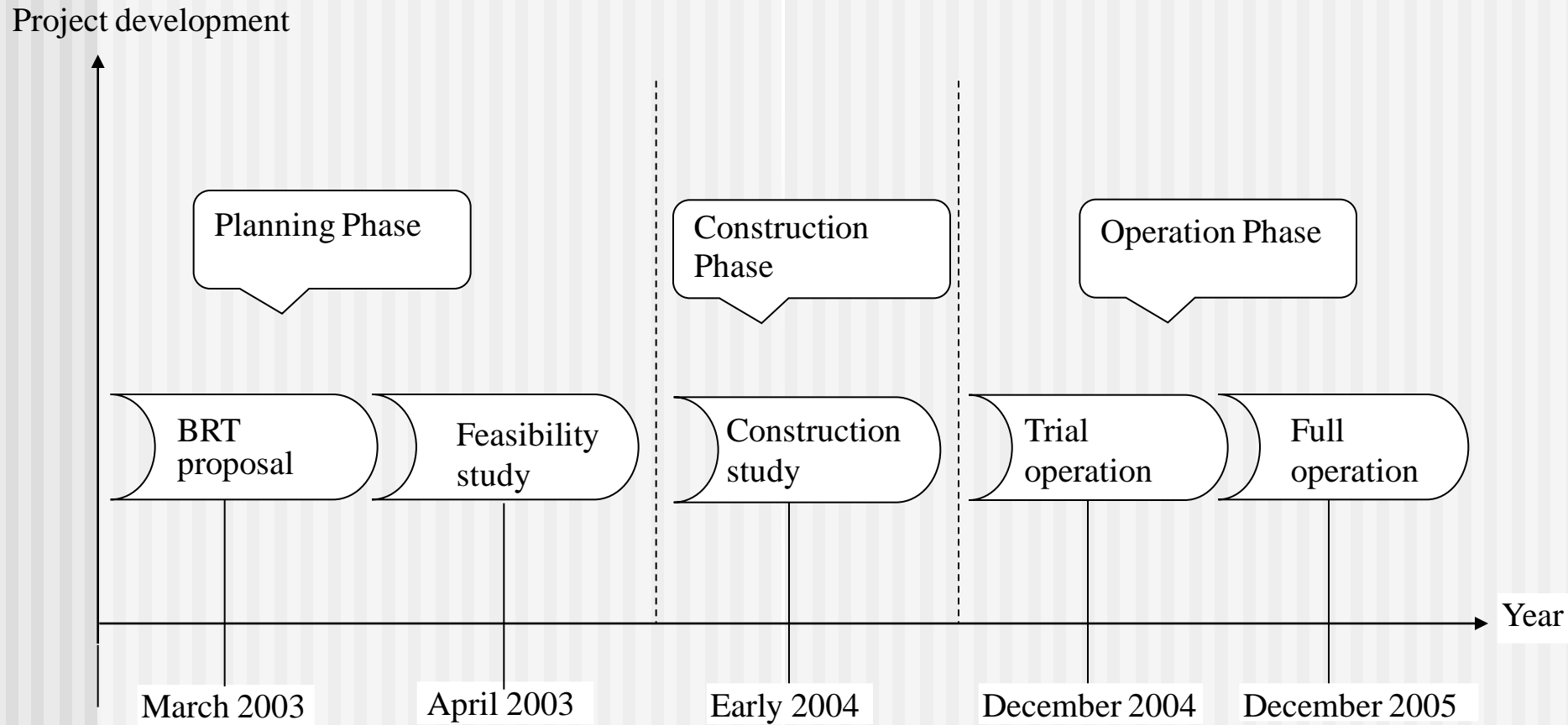


Figure: Timeline of key events in the evolution of Beijing Southern Axis BRT line 1

3 Beijing Southern BRT Line 1

3.1 Study area description

1) Economic growth

- High-speed economic development since 1978
- The per capita GDP: 63,029 Yuan/year in 2008, the second highest in China

2) Rapid Urbanization

- Population: 16.95 million in 2008
- Population density: 22,546 people per km² in urban core districts in 2008
- Tremendous urban growth: 242.2% growth from 1997 to 2007



3) Striking trend of vehicles growth

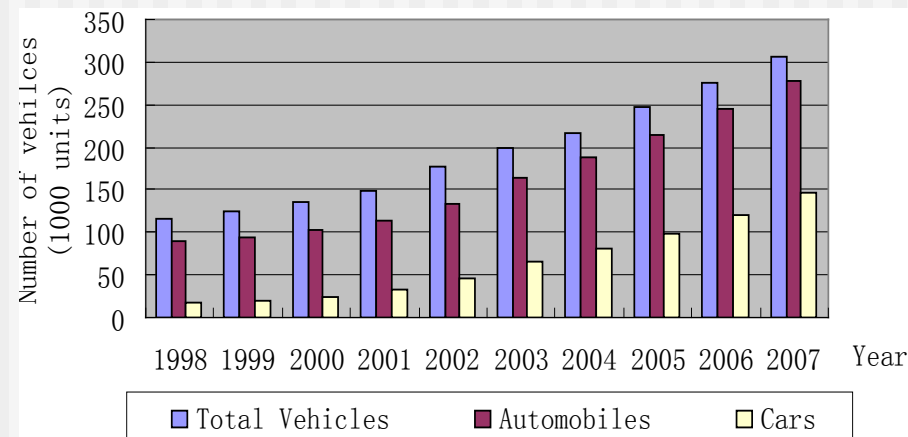


Figure 2: The striking trend of vehicle growth in Beijing from 1998 to 2007.

Source: Beijing Statistical Yearbook, 2000- 2008

- Vehicle ownership reached over 3 million in 2007
- Private cars: an eightfold increase in only 9 years

Serious traffic congestion:

Year	1994	2004
Roadway (km/h)	45	< 20
Bus (km/h)	16.7	9.2

Source: Beijing Traffic Management Bureau

3 Beijing Southern Axis BRT line 1

3.2 An Overview of BRT line 1



- ① Advanced vehicle
- ② Enhanced station
- ③ Off-board fare collection
- ④ Screen door system
- ⑤ Exclusive busway
- ⑥ Barrier
- ⑦ Overpass

- ❑ Pilot line: 5.5km, Dec. 2004 (1st in China)
- ❑ Full line: 16.5 km, Dec. 2005
- ❑ From Qianmen (City centre) to Demaozhuang (a southern residential region)
- ❑ Time span of implementing BRT: < 2 years
- ❑ Most lanes are physically segregated in the median of the road



3 Beijing Southern Axis BRT line 1

3.3 Major elements



Exclusive busway



Advanced vehicle



Enhanced Station



Bus Rapid Transit

Pre-board fare collection

Frequent service

ITS Applications



3 Beijing Southern Axis BRT line 1

3.4 Technical performance

■ Technical performance

- Ridership: Average daily trips are around 150,000 with the highest reported capacity up to 260,000 on 01/10/2007.
- Operating speed : 22km/h on peak; 26km/h off peak; almost 40% travel time reduction.
Service frequency: 1.5 min (two vehicles) on peak; 2-3min off-peak
- Fare structure: 1 Yuan by cash; 0.4 Yuan by smart card
- Capital costs: US\$ 5million/km;
1/15 of the cost of Beijing Metro Line 4

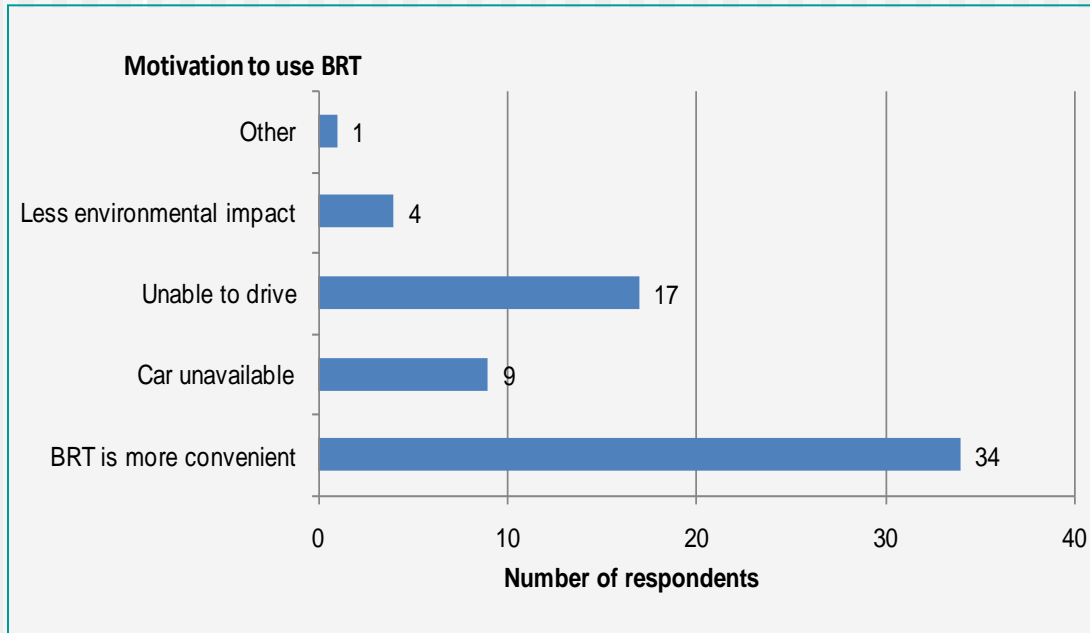
■ Evaluation of the BRT service

- Respondents generally have positive opinions of BRT services in terms of speed, reliability, safety, convenience, frequency, comfort & cleanliness.
- 85.5% of passengers (N=525) rated overall satisfaction of BRT service as “very satisfied” or “satisfied”.



3 BRT Southern Axis BRT Line 1

3.5 Passenger survey: modal shift



■ Modal shift

- 12.4% said they had a car alternative for the journey
- This surveyed modal shift from private car is encouraging, considering that car ownership in Beijing is generally lower than many western cities
- A high-quality bus-based rapid transit can attract modal shift.

■ Motivation to use the BRT

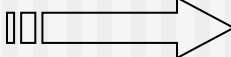
- 52.3% believed that BRT was more convenient than car for their trip
---- BRT is a competitive alternative to the private car.

4 BRT corridor analysis

4.1 Impact of BRT on the attractiveness of residential property (1)

Advance the Economy Through BRT



Beijing BRT line 1  property attractiveness

Respondents were asked to indicate whether they lived within the reasonable walking distance from BRT stations.

- 43.4% of passengers (N=228) were local residents who live near BRT stations;
- 56.6% of passengers (N=297) did not live near any BRT station.

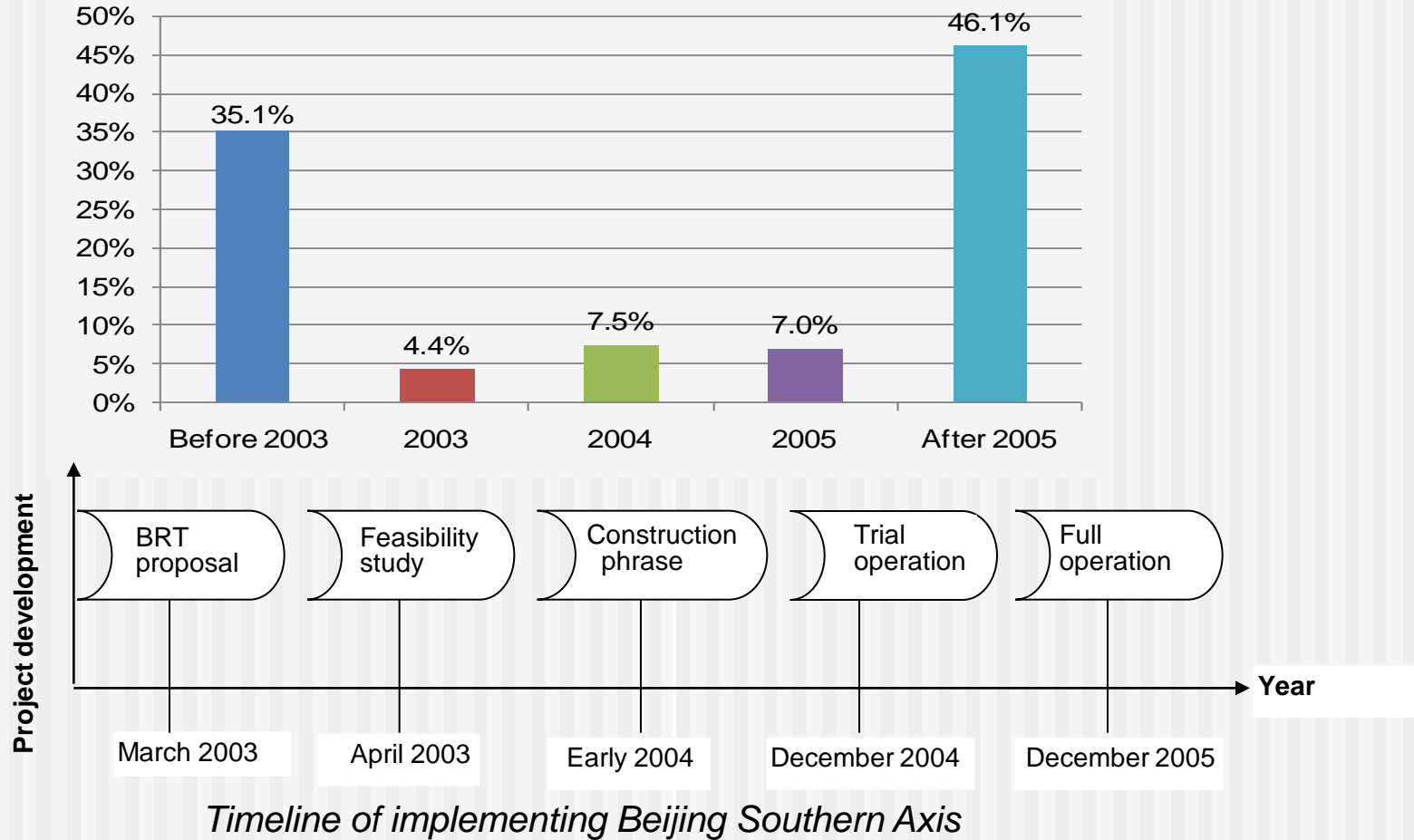
Key characteristics of the local residents' profile:
all respondents within walking distance of a BRT station

Demographics	Travel behaviour	Satisfaction of BRT
- 52.7% male	- 52.2% work-related trip	- Highly satisfied with BRT service
- 85.9% aged from 18 to 49	- 66.8% use BRT at least once a day	- Joint top 3 consideration to take BRT service: speed, reliability and convenience.
- 50.0% had college education or above	- 61.5% walk to a BRT station	
- 58.9% earned ¥ 2000-5999		

4 BRT corridor analysis

4.1 Impact of BRT on the attractiveness of residential property (2)

1) Date when residents moved to be near the BRT corridor (N=228)

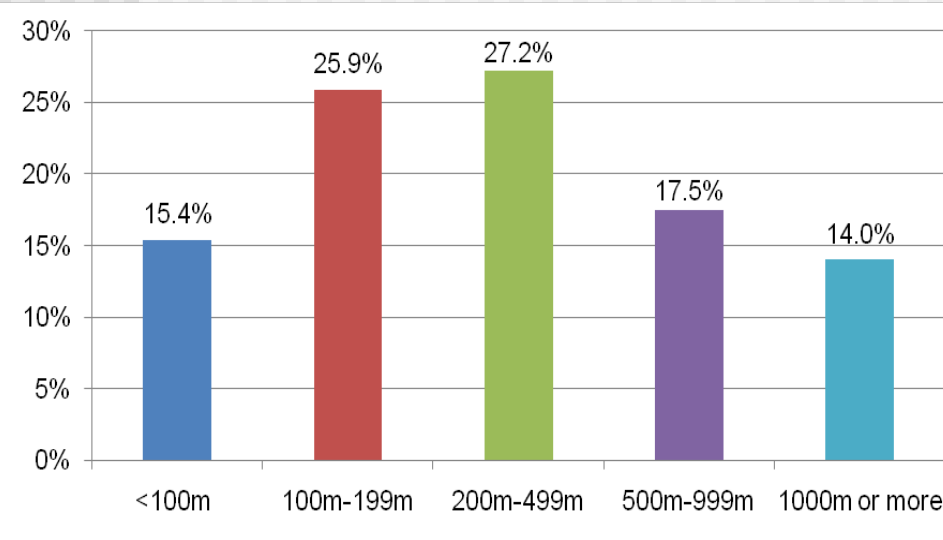


- After the full operation, residential properties became more attractive.
 - proximity to the BRT corridor can reduce the time and money cost of commuting, and this has significantly improved the property attractiveness near BRT.

4 BRT corridor analysis

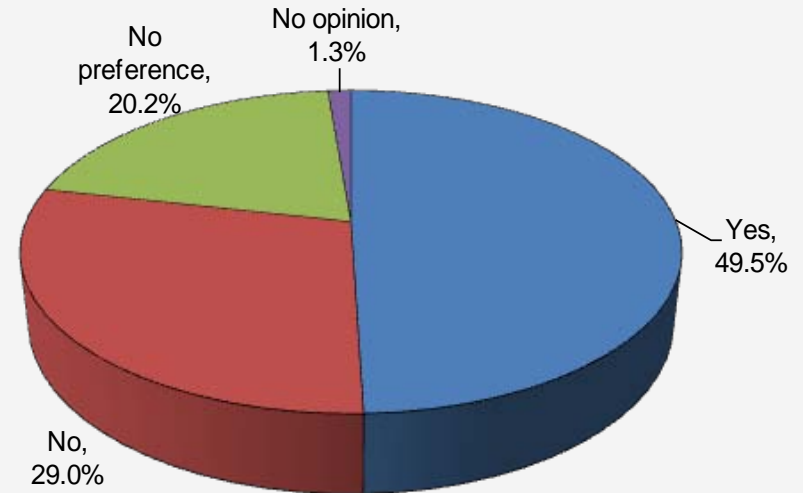
4.1 Impact of BRT on the attractiveness of residential property (3)

2) How far away from respondents' houses to their nearest stations? (N=228)



- Actual distance from respondents' houses to the BRT system, indicating that BRT has a large attractiveness distance.
- 68.5% lived within 500 metres radius around BRT stations; 14.0% of respondents travelled over 1000m to take the BRT service, 50% took bus and 31.2% walk to a BRT station.
- BRT line 1 has greatly improved accessibility for communities

3) Would you like to move nearer a BRT station? Relocation demand of respondents (N=297)



- Most people (49.5%) were interested in a house along the BRT corridor.
- 29.0% of respondents did not show interest in housing near BRT corridor, mainly 5 reasons:
 - visitors to Beijing
 - get heavily subsidized accommodation
 - workplace which was far from the BRT corridor
 - could not afford housing
 - more concerned about other public resources, such as a high-quality school et al.

4. BRT corridor analysis

4.1 Impact of BRT on the attractiveness of residential property (4)

➤ Decision makers` viewpoint

- Generally believed that BRT line 1 has a positive impact on transit- supportive land development. Many residential projects, **specifically apartments**, were built after the implementation of the BRT system, and this is mainly due to the **accessibility enhancement** in the southern area.
- Accessibility effects are significantly stronger than nuisance effects.
- The importance of **physical infrastructure** was emphasized by decision makers.
- BRT has provided **some opportunities** for joint development.

➤ Opinions from local real estate agents (N=35)

- A general consensus on the prosperous property market, such as rising property values, rents, and real estate performance, resulted from the opening of BRT.
- BRT was fundamental to **many customers` interest** in the local area. Most customers would like to pay a premium for properties near the BRT corridor.
- 85.7% of respondents believed that BRT had provided **development opportunities**, and become a driver for property development along its corridor.

4 BRT corridor analysis

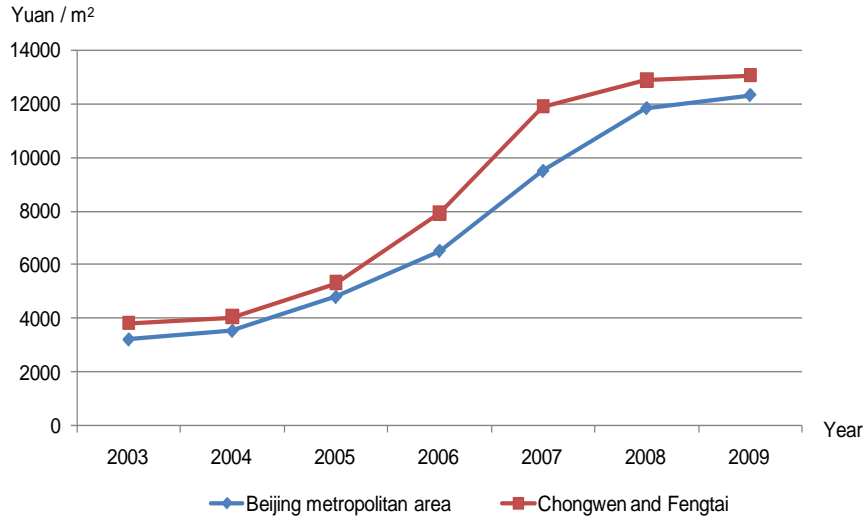
4.2 Impact of BRT on the attractiveness of commercial property



- Visits and interviews with some business owners have revealed that BRT line 1 is very likely to have improved business opportunities for people to work in BRT station areas. After the opening of BRT line 1, more customers travel from downtown to southern area.
- BRT service may attract many new trips to boost the patronage of nearby businesses.
- The survey was conducted only 4 years after the full operation of BRT line 1. Further investigation on commercial sector needs to be done after a longer period.

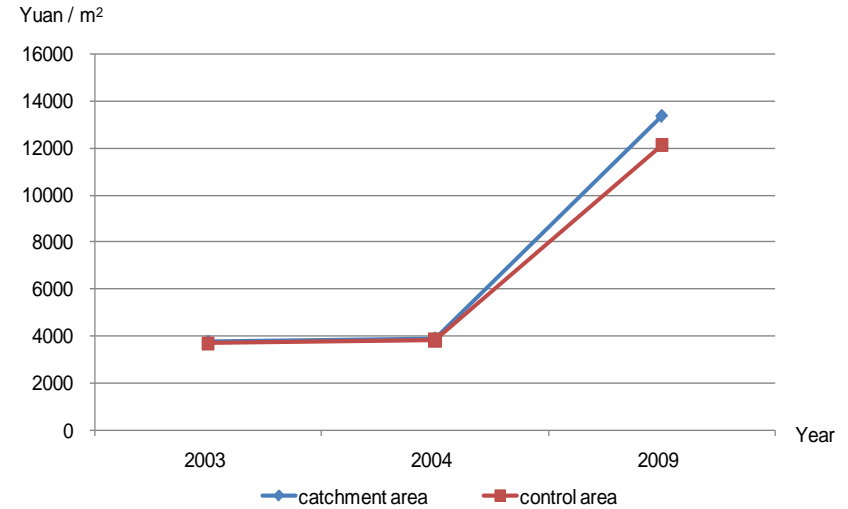
5 Property value capture analysis

5.1 Overall comparison of property price change



Trend in asking price for previously owned apartments prices change in the Beijing metropolitan area from 2003 to 2009

- Property prices rose at a high rate
- Property market in Beijing booms due to tremendous consumption demand, the Olympic Games effect and Government's support policy
- External factors, especially the 2008 Beijing Olympic Games, present economic crisis and Government policy on supporting property market, affecting both control and test units are reasonably similar.



Comparison of asking price for previously owned apartments in catchment and control areas

- Property prices for both catchment and control areas increased dramatically, benefiting from excellent regional property market.
- Properties adjacent to a BRT station gain a relatively faster increase than those not served by the BRT system.
- The asking price of apartments in the BRT catchment area (500 meters radius of the BRT system) was 1.67%, 1.84% and 10.27% higher than that in the control area in 2003, 2004 and 2009 respectively.

4 Property value capture analysis

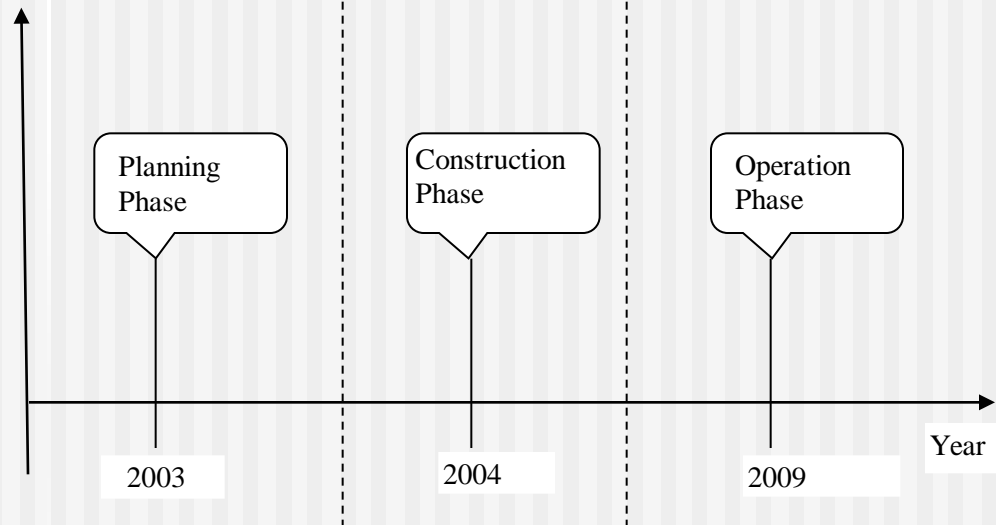
5.2 longitudinal analysis (1)



● BRT station ■ Catchment area ■ Control area

Locations of catchment areas and control areas

Project development



Timeline of evaluation of BRT

Hypothesis 1:

H_0 : There is no significant difference in property prices for catchment and control area at a time point.

H_1 : There is a significant difference in property prices for catchment and control area at a time point.

Hypothesis 2:

H_0 : There is no significant difference in property prices in an area over a period of time.

H_1 : There is a significant difference in property prices in an area over a period of time.

Hypothesis 3:

H_0 : There is no significant interaction effect between time and area.

H_1 : There is a significant interaction effect between time and area

5 Property Value Capture Analysis

5.2 Longitudinal analysis (2)

- The influence of the BRT system on land development is related to time and area.
- There is no significant difference between mean prices of catchment and control areas in 2003 (before the opening of BRT line 1) and in 2004 (during the construction phase of BRT).
- BRT line 1 might not bring any more marked effect to Dahongmenxili station than its paired area
- BRT has brought about significant impact on Heyinanzhan and Liuyingmen stations.
- This finding proves that property value uplift does occur to properties adjacent to BRT stations and this effect is much more evident after a relatively short period (5 years) of BRT operation.
- Peripheral areas which previously lack the alternative mobility opportunity by a Mass Transit system have experienced greater change

5 Property Value Capture Analysis

5.3 Effect of proximity to BRT stations on property values

- 39 residential projects proximity to 14 BRT stations examined
- A total of 1200 asking prices of apartments in May, 2010 collected
- Residential properties within 300 metres of a BRT station, within 300 metres to 500 metres, and within 500 metres to 1000 metres

Table: Descriptive statistics of property prices proximity to BRT stations

Distance	N	Minimum	Maximum	Mean	Std. Deviation
Within 300 m	400	13066	24600	18814.38	2747.00
300 m – 500 m	400	11826	22009	17524.50	2635.24
500 m – 1000 m	400	11362	21959	16952.39	2609.78

- The statistics analysis shows that property price was generally higher (7.2%) for parcels within 500 metres of a BRT station than those within 500 to 1000 metres
- Property price within 300 metres of a BRT station was higher (7.4%) than those within 300 to 500 metres.

Thank you for your attention.
Questions and Comments?

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