COLLEGE OF URBAN AND PUBLIC AFFAIRS
School of Urban Studies and Planning
USP537 – Economics of Urban Transportation

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Winter 2024

KEY Problem Set #3 (Due 03/13/2024 by 10a; hand in on paper at beginning of class; if you cannot attend that day, leave in my mailbox Urban 350 or email)

For full credit, please show your work!

Trimet's FX2 BRT line opened in Fall 2022 with the primary transportation goal of increasing transit capacity and performance along a 15-mile route between Gresham and downtown Portland. Using only the information provided, answer the following questions about the economic costs and benefits of the project.[1]

For your answers below, assume the following

- "typical" Division transit trip in-vehicle travel times (*Note: we'll simplify things by using a representative trip*)
  - Before: 20 minutes
  - After: 17 minutes
- ridership
  - Before (recovery adjusted[2]): 4,500 daily
  - After (actual): 5,500 daily
- Generalized cost components"
  - Fare: $2.50 before and after (*Note: assume everyone pays face value; i.e. MR=Fare=AR)*
  - In-vehicle travel time: see above
    - value of travel time (VOTT) before & after: $20.00 per hour (2022$)
  - *Ignore access time, waiting time, and transfer costs unless*

[1] Numbers adapted from Trimet (link1, link2); additional project info available from Metro, including extensive equity analysis

[2] Recovery adjustment applied the systemwide increase of 15% over the analysis period to make the before/after numbers more comparable; i.e., it's an estimate of what ridership on the old line *would have been* in 2022-2023 if it were still operating, due to ongoing ridership recovery from COVID.

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provided in question
• Project lifespan: 20 years

1. Calculate the generalized cost of a transit trip before and after BRT, including the fare and travel time:

Before:

Generalized Cost = GC = Fare + IVTT * VOTT

$GC = \$2.50 + \frac{20}{60} * \$20.00$

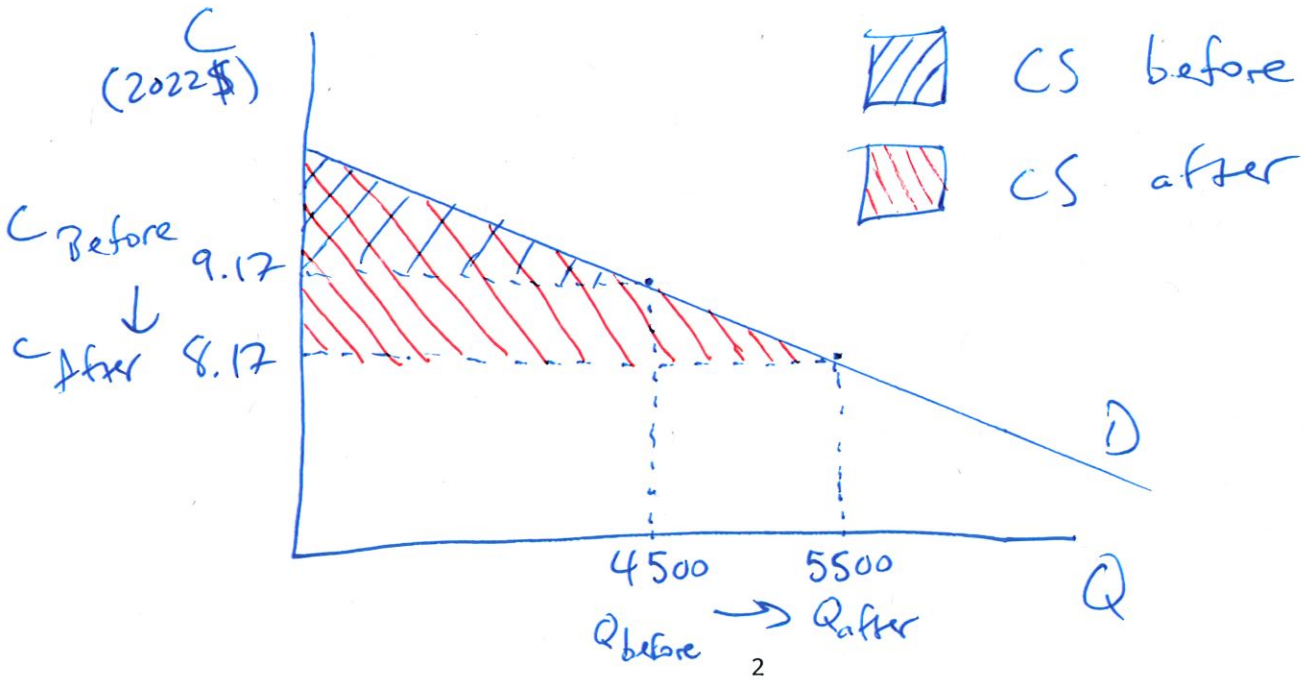
GC = $9.17 (2022$)

After:

$GC = \$2.50 + \frac{17}{60} * \$20$

GC = $8.17 (2022$)

2. In the box below, carefully plot transit demand and generalized cost to users of a typical transit trip for the Division corridor before and after the FX2 opened. Be sure to label everything of interest, including consumer surplus (CS) before and after. *Ignore pandemic recovery impacts.*



3. Calculate the base year change in consumer surplus to transit riders after BRT using our box + triangle "rule of half" method.

Daily benefits to existing transit users/trips (2022$):

"Box"

$\Delta CS = (P1 - P2) * Q_1$

$\Delta CS = (\$9.17 - \$8.17) * 4500$

$\Delta CS = \$1.00 * 4500 = \$4500$ / day to existing

Daily benefits to new transit users/trips (2022$):

"Triangle"

$\Delta CS = 1/2 (P1 - P2)(Q_2 - Q_1)$

$\Delta CS = 1/2 (\$9.17 - \$8.17)(5500 - 4500)$

$\Delta CS = 1/2 * \$1.00 * 1000 = \$500$ / day to new riders

Total daily benefits (2022$):

$5,000 / day to existing and new riders

4. Use the Excel discounting worksheet to calculate the total present value (PV) of benefits (in 2022$) from 3) above over the entire 20 year analysis period. Assume annual benefits remain constant each year, starting in year 0 (2022). To convert daily benefits to annual, just multiply by 365.

Sum of benefits over 20 years (no discounting, 0%): $36.5M ($1.825M/yr)

Sum of benefits over 20 years (3.1% discount rate): $27.7M ($1.387M/yr)

Sum of benefits over 20 years (7% discount rate): $20.7M ($1.034M/yr)

5. Transit trips often include walking at one or both trip ends. Assume each additional transit trip increases walking 8 minutes per new rider per day. Use the HEAT Walking and Cycling website to calculate the annual benefits of increased physical activity from transit use due to the new BRT line over the life of the project.
   - You can use the "Basic" version of the tool
   - Current walking rate: 20 mins/day
   - Discount rate: 3.1%

- Geographic Scale: Portland, OR -> sub-city analysis
- Population: General ages 20-74, 1,000 in each scenario (the "new" transit riders)
- All others, keep HEAT defaults

(see attachment for details)

Total premature deaths avoided, over 20 years: 4.2

Total PV of health benefits over 20 years (3.1% discount rate, 2022$): $13.9M

Attach your "General Results" Sheet from HEAT to the end of your assignment. (attached)

6. In-vehicle travel time savings and health benefits from increased physical activity are just two of many potential benefits from improved transit service along Division, so it shouldn't be surprising if they don't add up to the ~$175M price tag. Describe <u>two</u> additional benefits that might also be important to capture. For each one, briefly describe the data you might need to quantify the benefit.

(answers will vary)

Additional Benefit #1:

<u>Emissions reductions</u>: assuming some of the 1,000 new daily transit trips have shifted from driving, there may be reductions in fuel consumption from reduced vehicle miles traveled.

Need (at least): proportion trips shifted from vehicles to transit, average trip length, per mile emissions rates & economic costs of key pollutants

Additional Benefit #2

<u>Safety benefits</u>:

again assuming reductions in VMT, a reduction in vehicle-related crashes might be expected

<u>need</u>: estimated crash rates along Division (preferably by severity KABCO), reduction in VMT, estimated crash costs avoided per VMT reduction by severity level

Summary of your input data

The volume data you have entered corresponds to an increase of 8 minutes per person per day. Your assessed population is 1,000.

Summary of impacts for mortality

As a result, 0.21 premature deaths are prevented per year. Over the full assessment period of 20 years, 4.2 premature deaths are prevented.

Economic value of impacts

Mortality is monetized using a Value of Statistical Life (VSL) of $5,585,000.00 (MER) per premature death.
This corresponds to an economic value of $1,180,000.00 per year.
Over the full assessment period of 20 years, the total economic impact is $23,500,000.00.
Adjusted to 2022 value (i.e. discounted/inflated), the total economic impact is $13,900,000.00.