Economia Urbana

¿qué se necesita saber para gestionar mejor las ciudades?

Mobilidad y Uso del Suelo

CEPAL Santiago,

20 a 24 de noviembre de 2023

Ciro Biderman

Agenda

- A modified canonical model with two endogenous inputs: land and structure
- The equivalent to the spatial equilibrium in transport economics
- Negative externality by mode and the consequences for city management: congestion and environment
- Tariff policy in a unionized market
- Sharing economics and the new mobility
- How to innovate in public transit
- Active modes and the fight for land in mobility

Demand for Mobility

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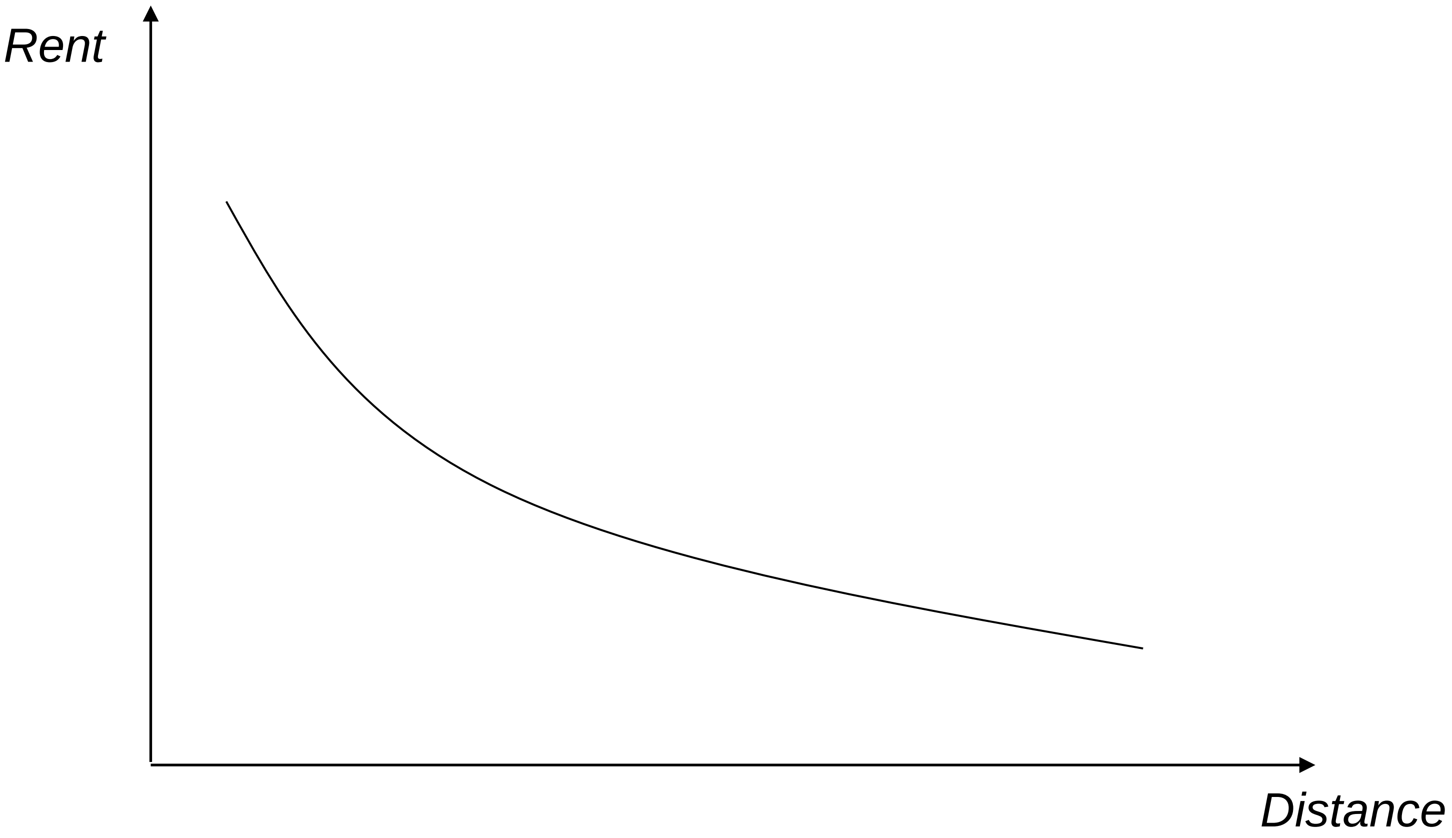
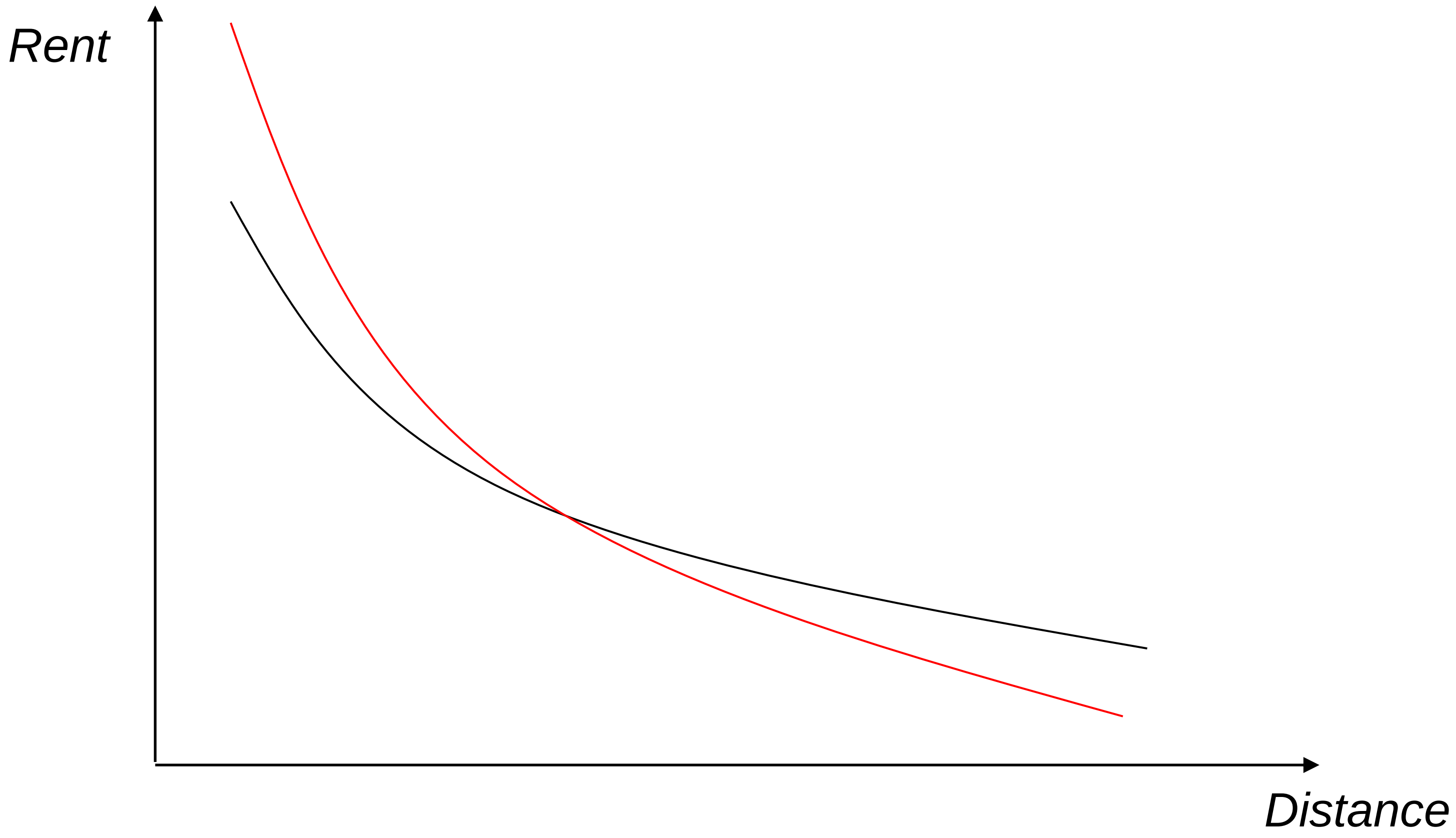
- Urban proximity ⟶ people connect with one another
- Firms and workers need to be near one another in production.
  - The growing service economy particularly relies on moving people.
- The social advantages of large cities come from proximity.

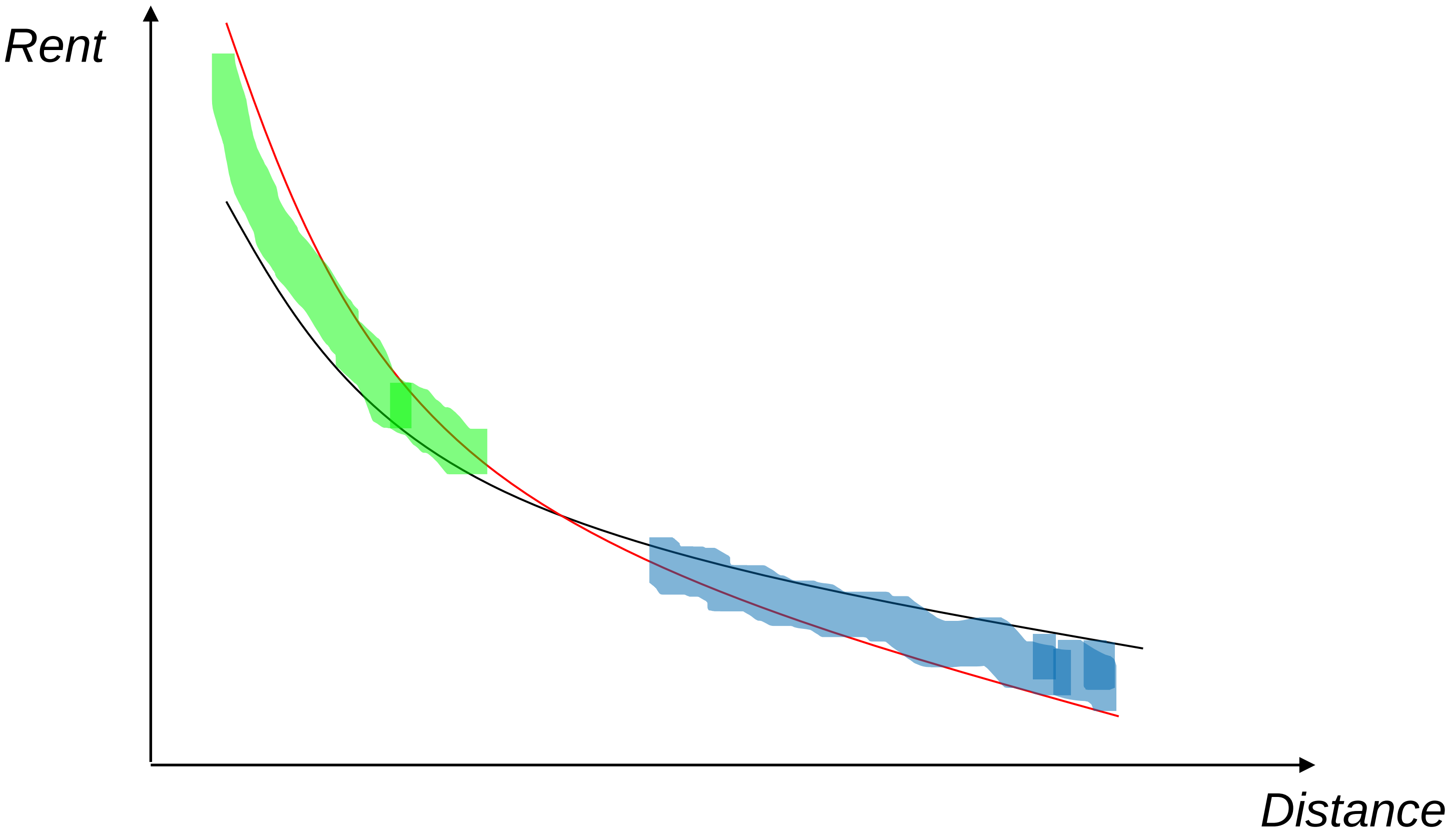
Land Rent Gradient with two inputs



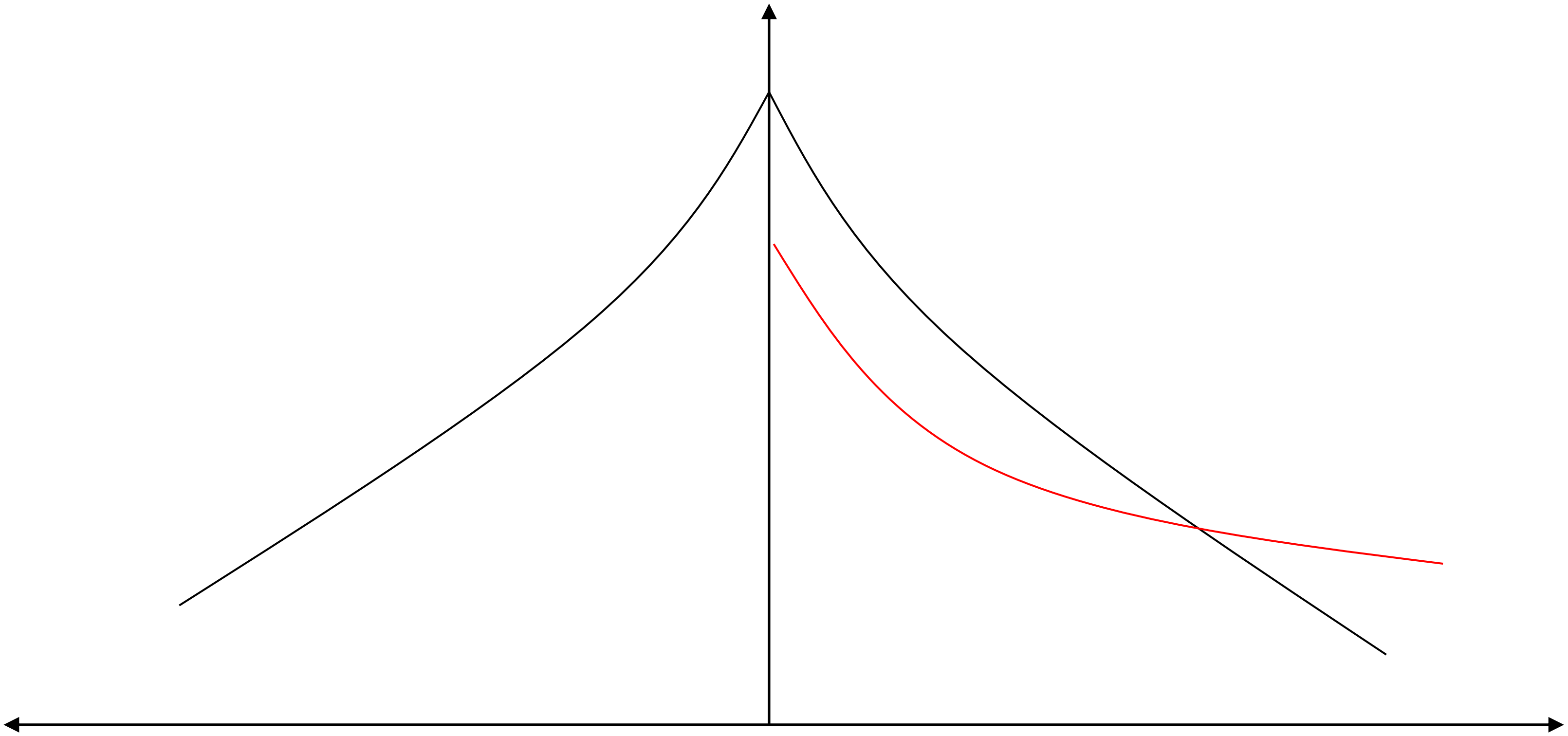
Different commuting costs



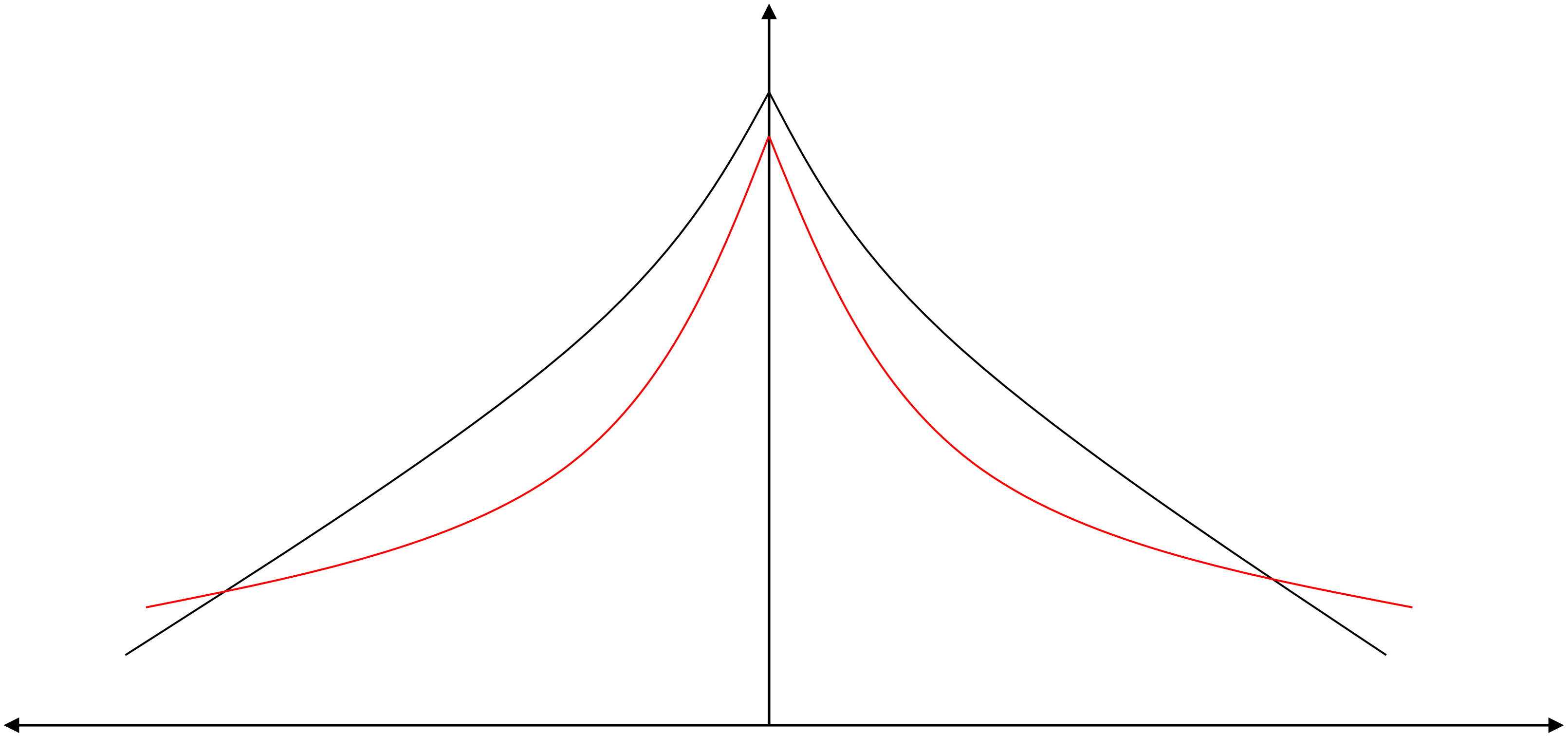
Difference in price



Investing in mobility



Investing in mobility



The Congestion Crisis

- Cars instead of feet and/or public transit is ok, but externalities from traffic are quite large.
  - It is still ok if there is a (segregated) alternative
- Main problem: drivers don’t internalize the costs they impose on other drivers and on the environment.
  - Too many drivers at peak hours

Why the spatial equilibrium is not enough?

- Land needs for the route is ignored
- There is no room for different modes
- Time costs are mixed up with all other commuting costs

- Scale perspective: We need density around the main routes of public transit

The canonical model for mobility: spatial distribution

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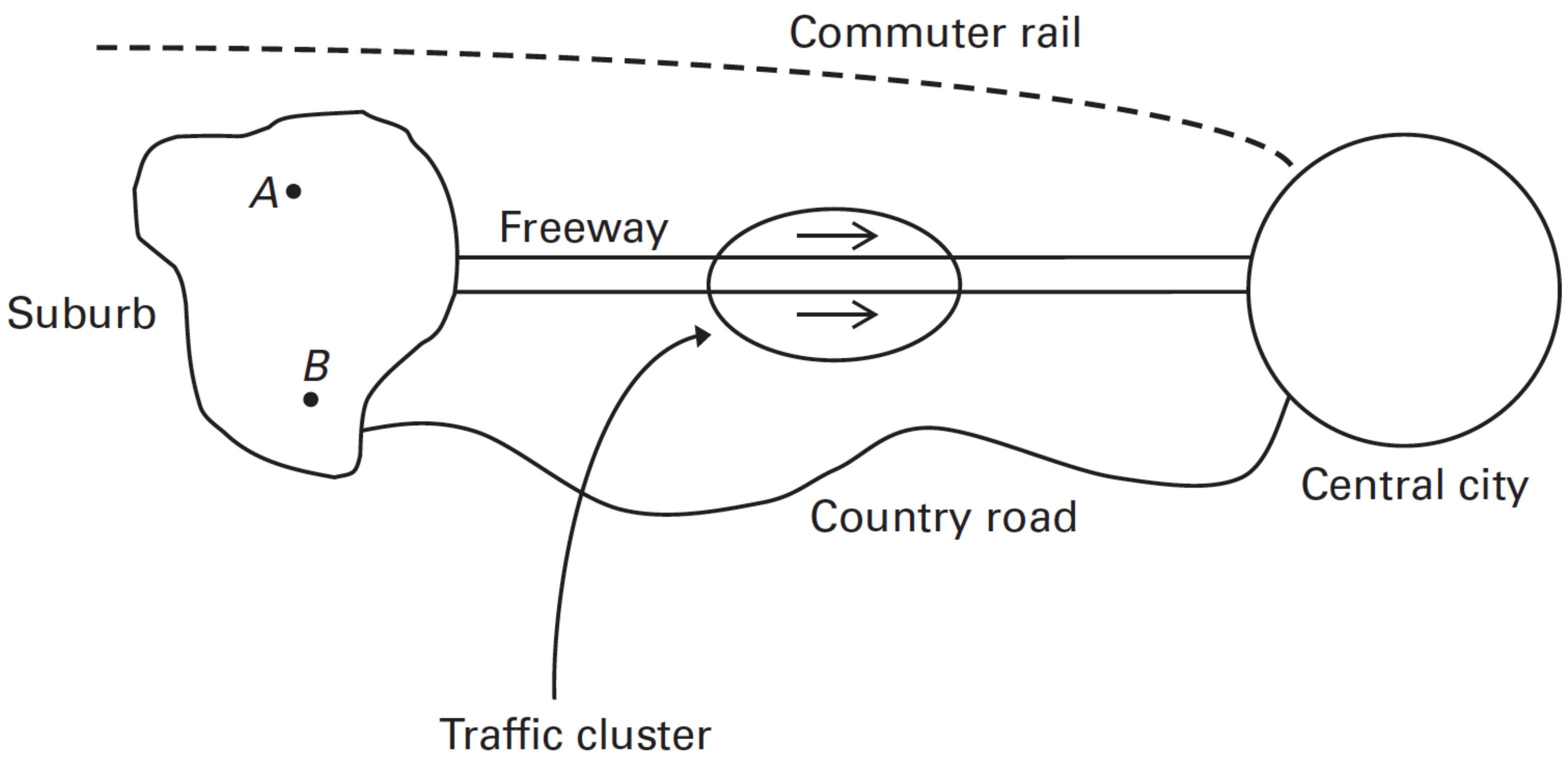
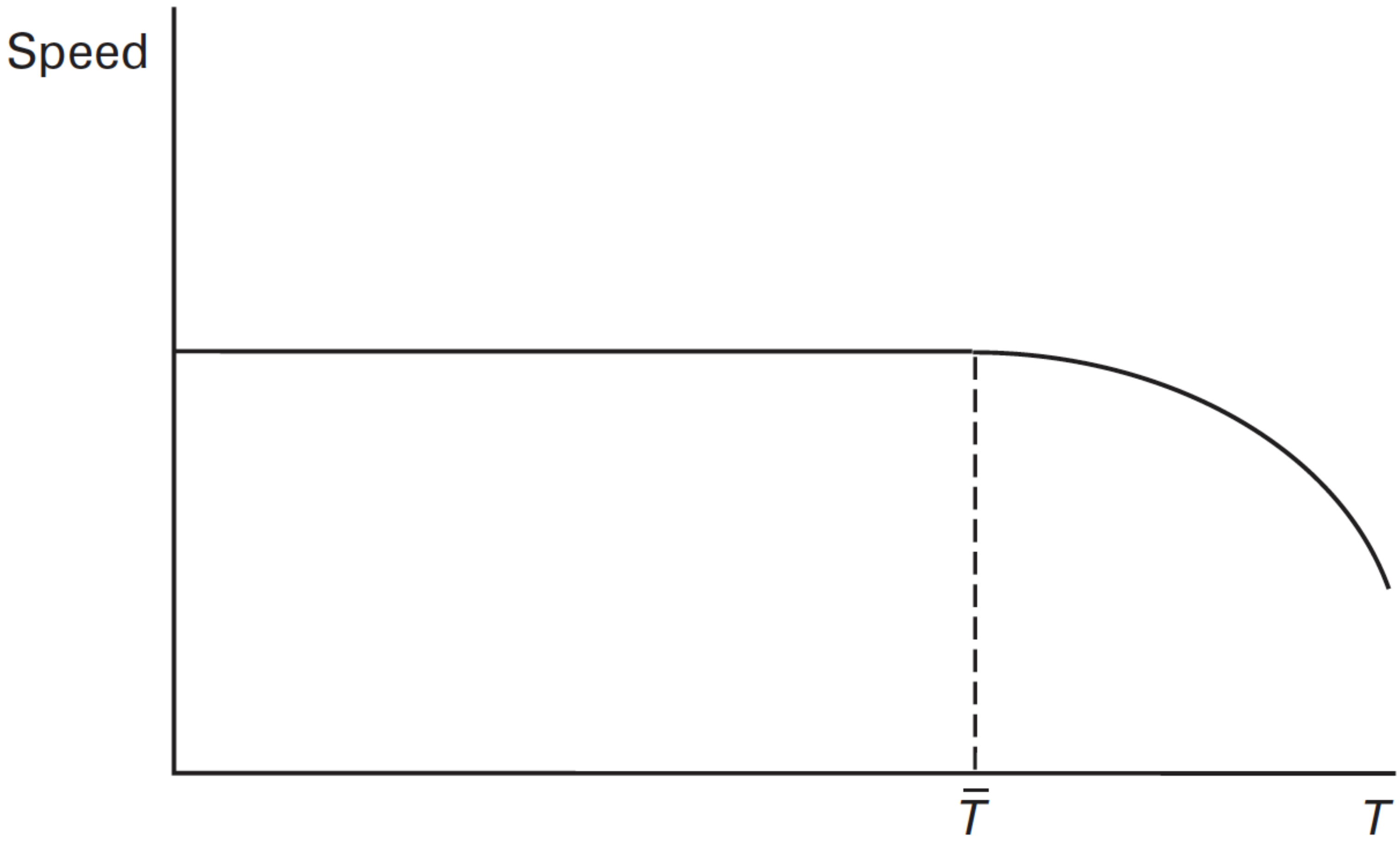
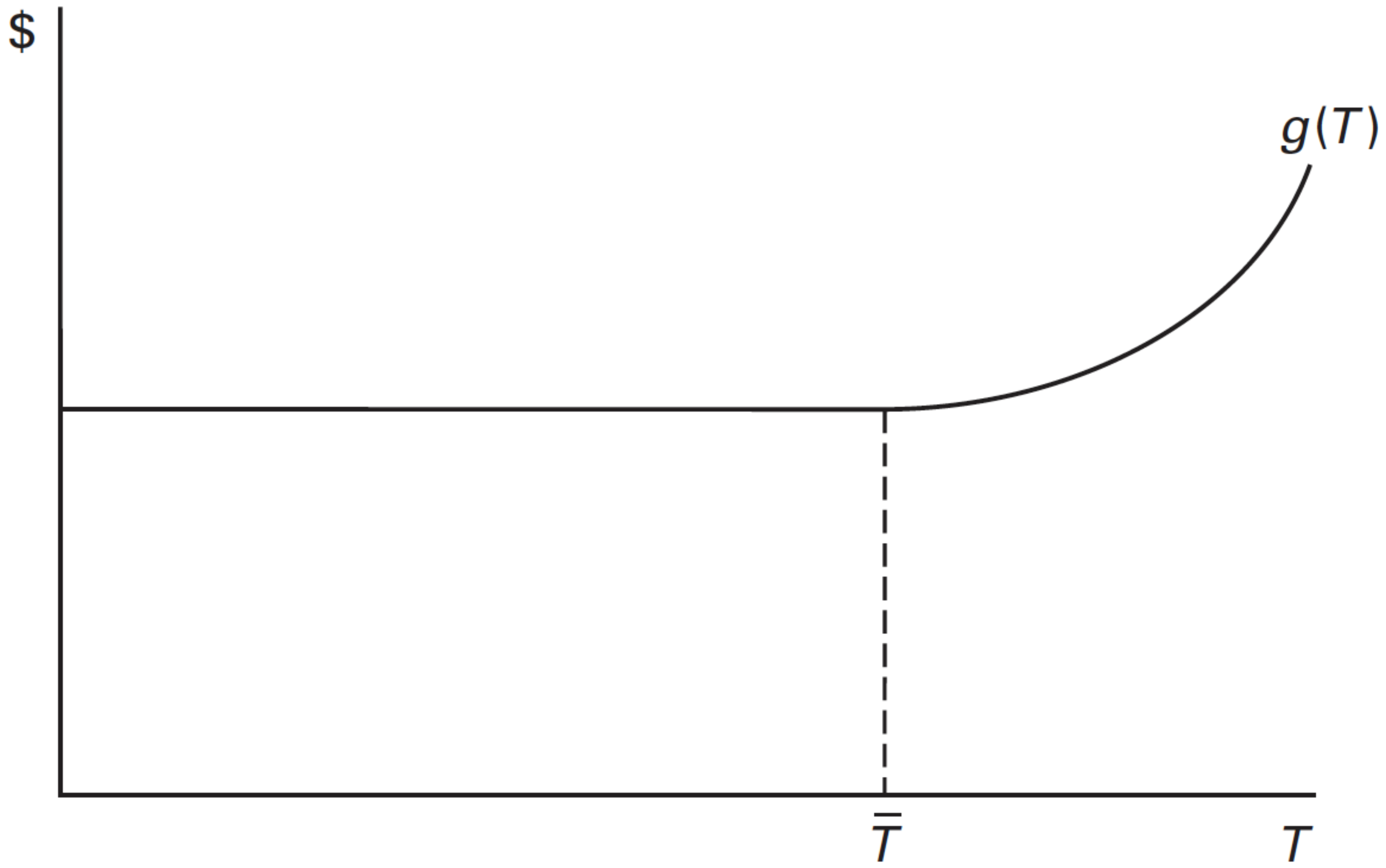


Source: Brueckner (2018)

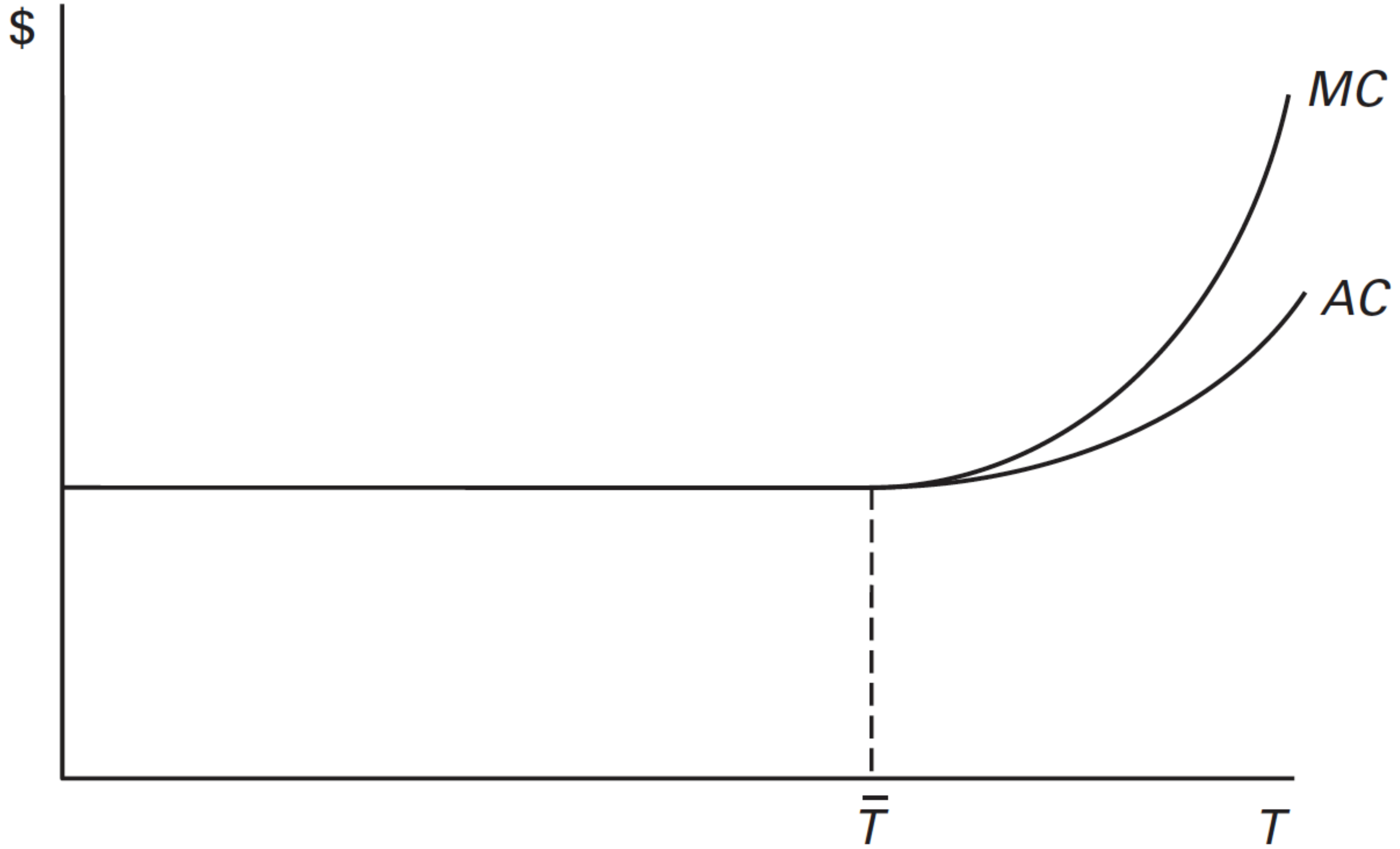
Road use and speed



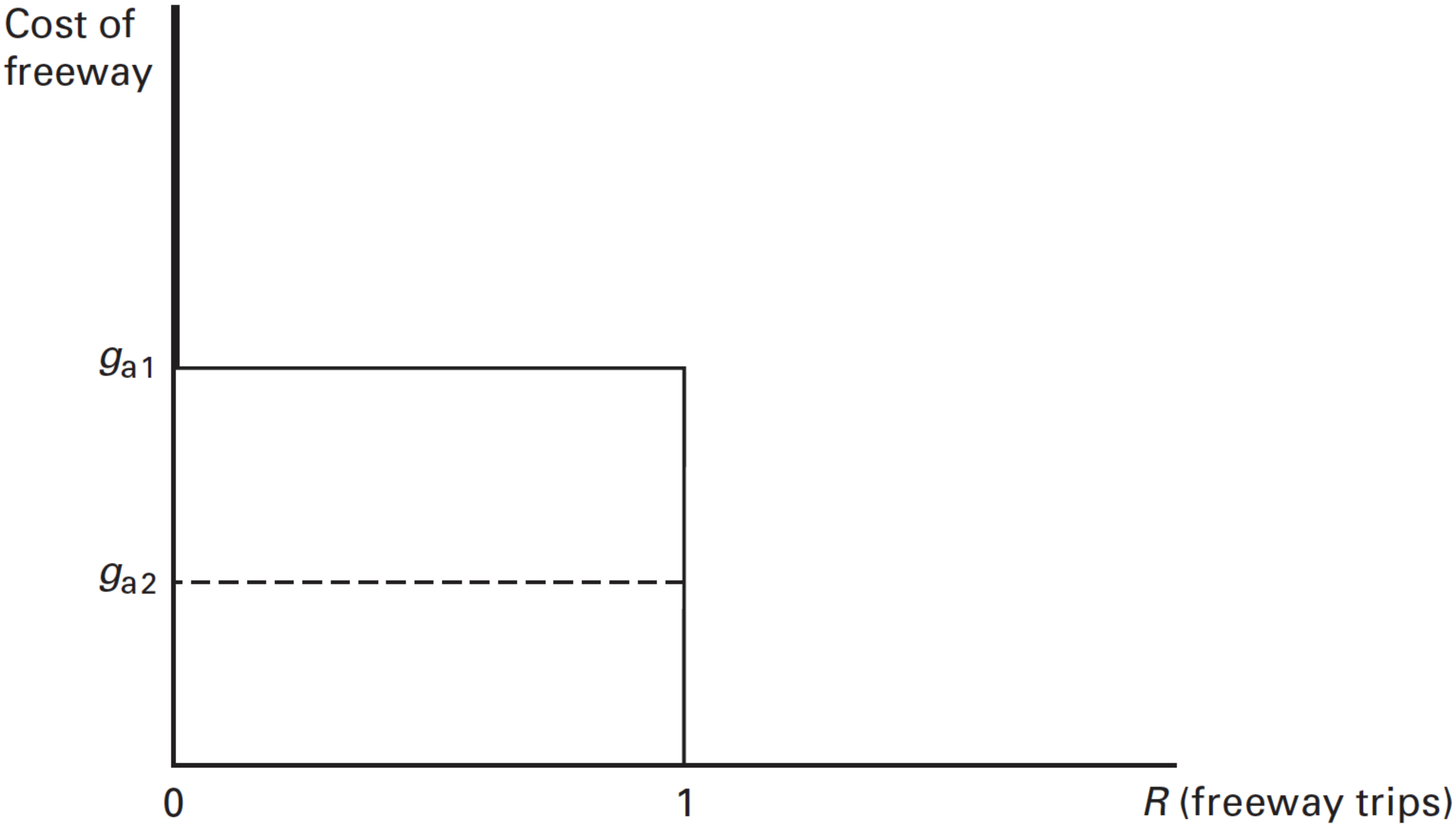
Cost of using the road



The marginal cost of commuting



The demand for freeway commuting



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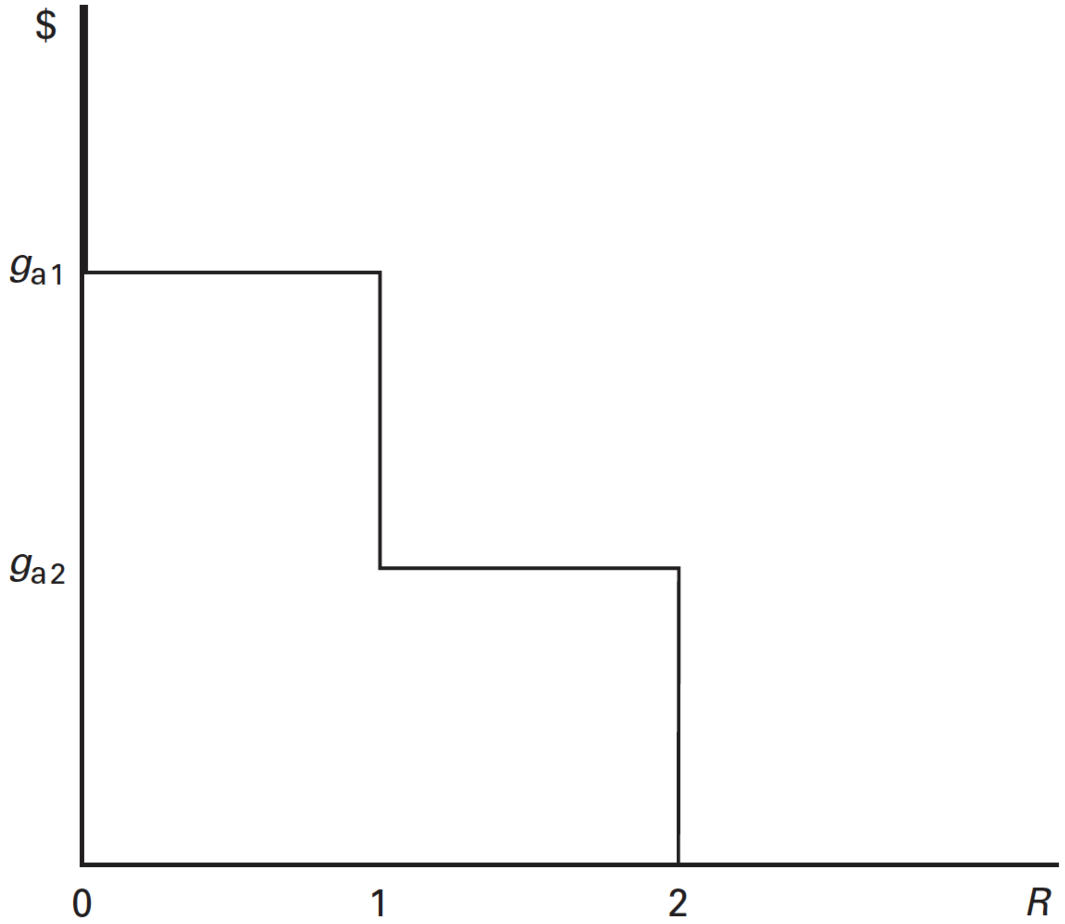
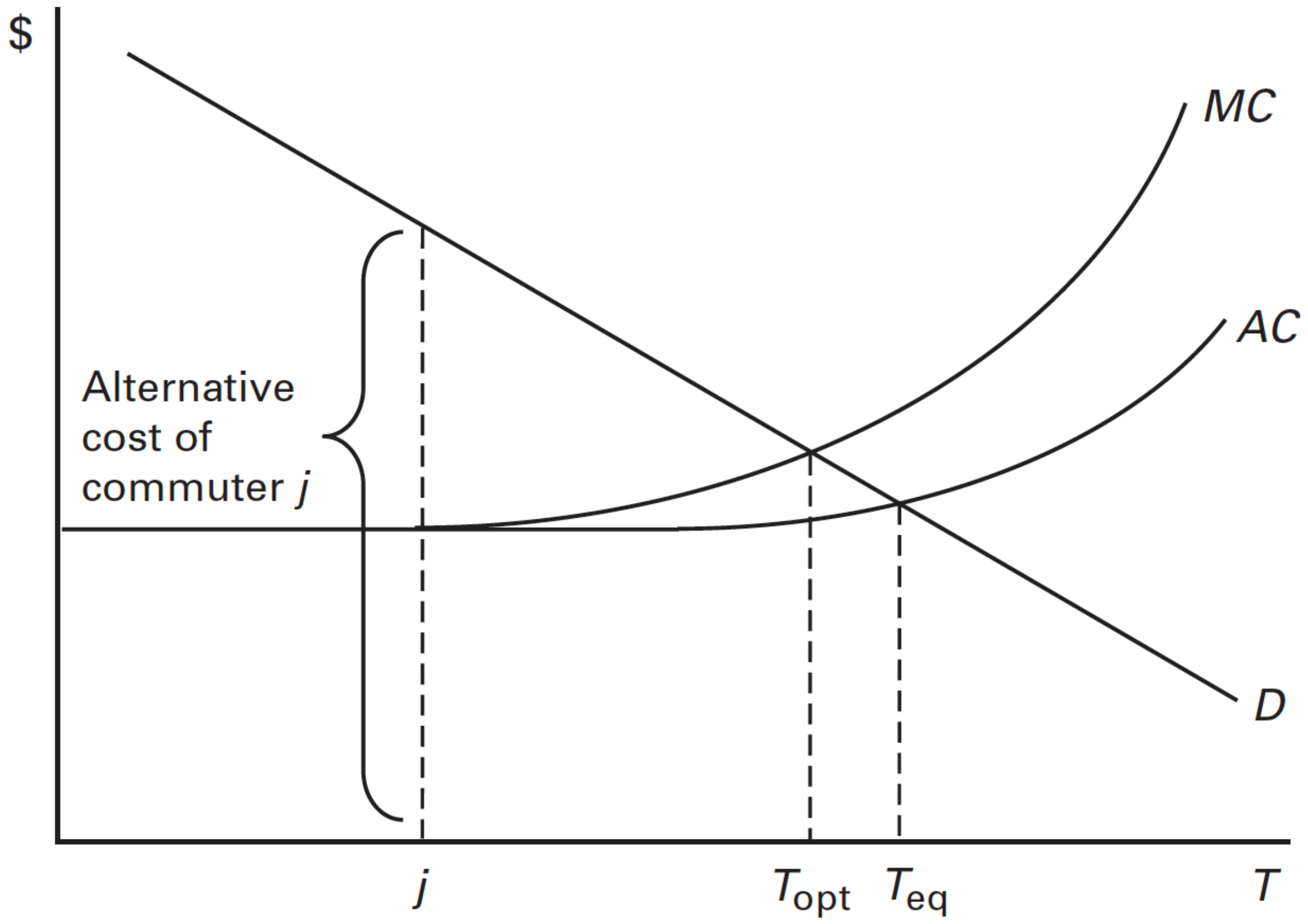
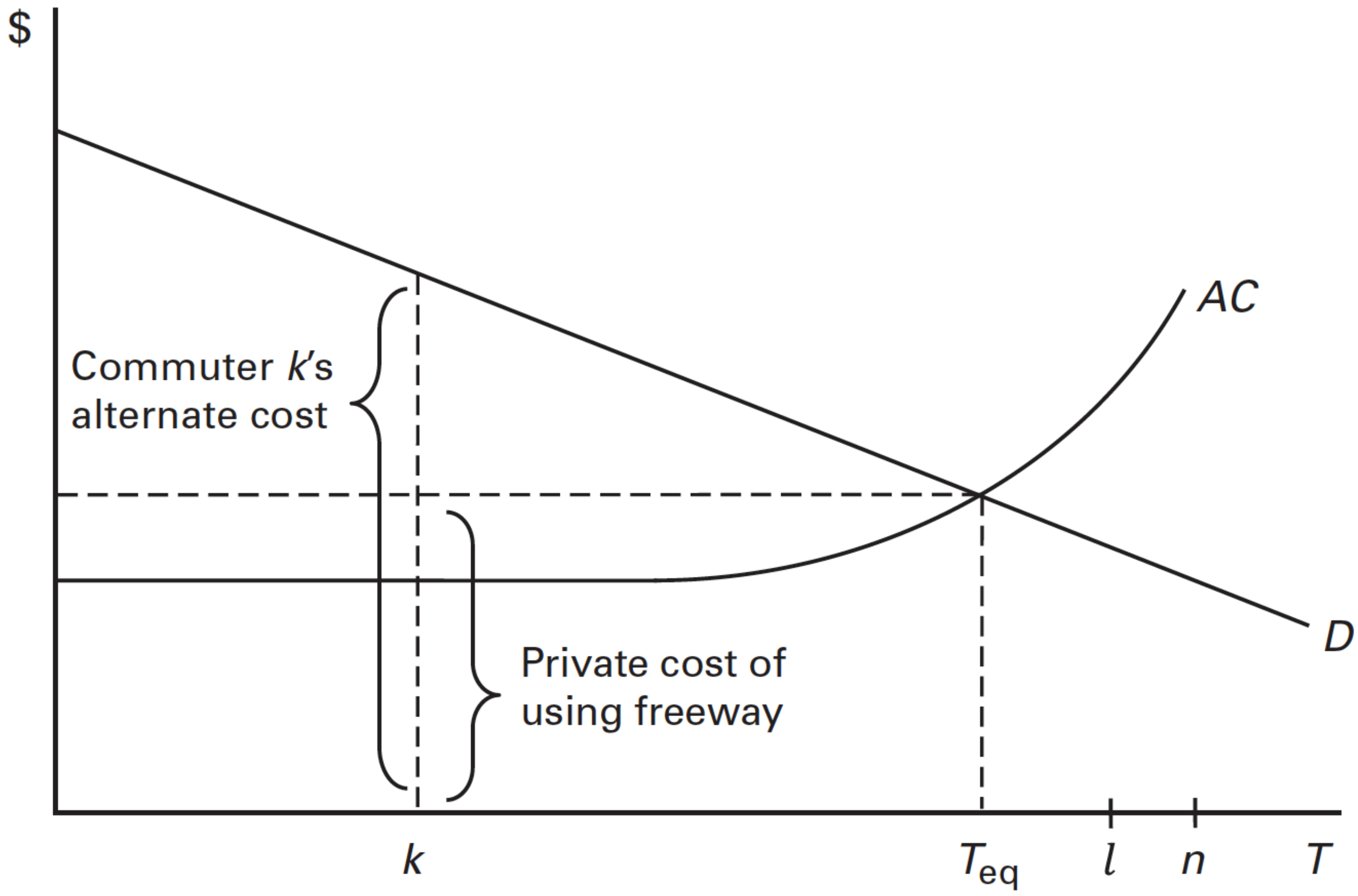


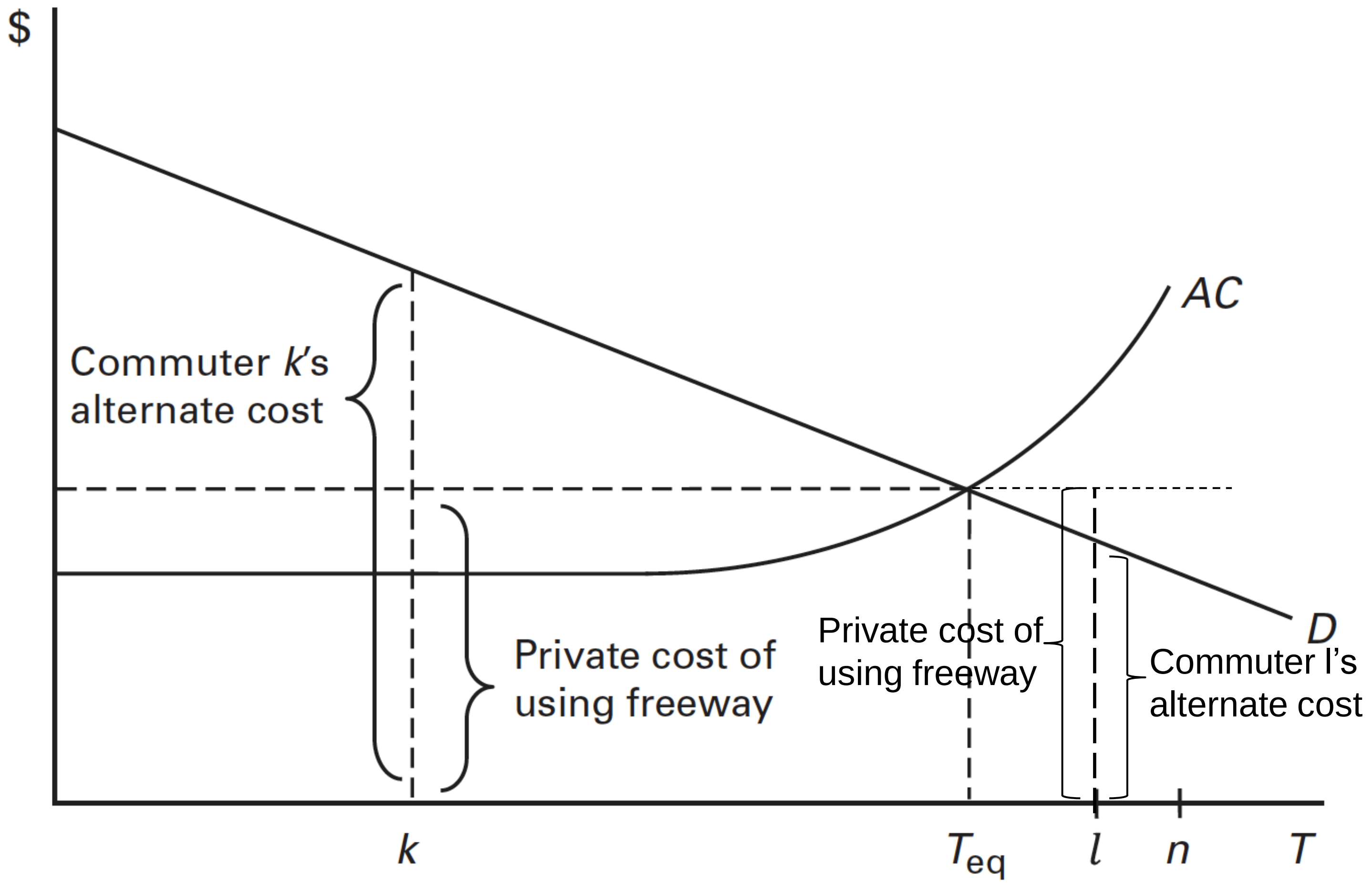
Aggregate Demand for Freeway Commuting



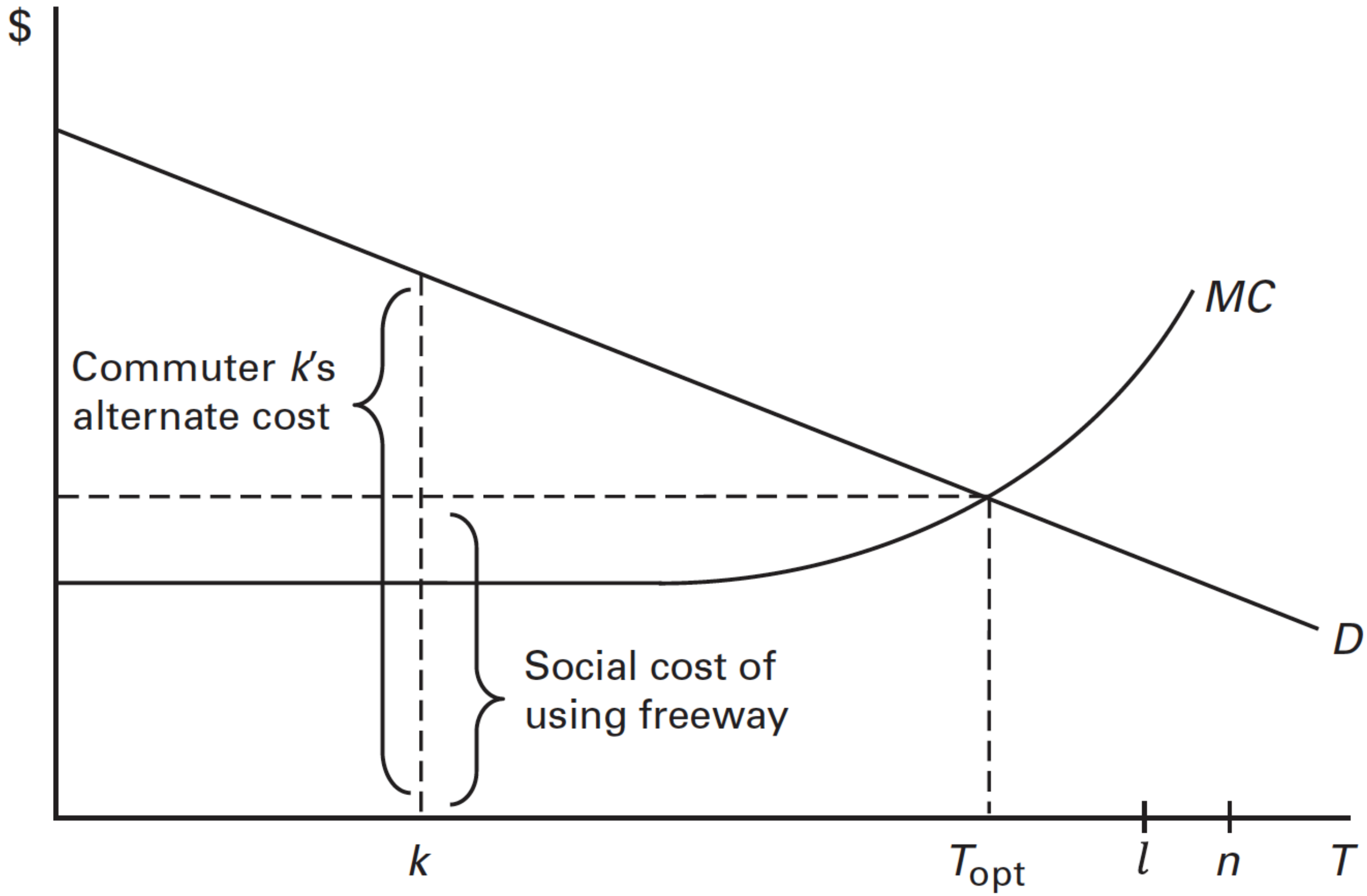
Traffic Allocation Equilibrium



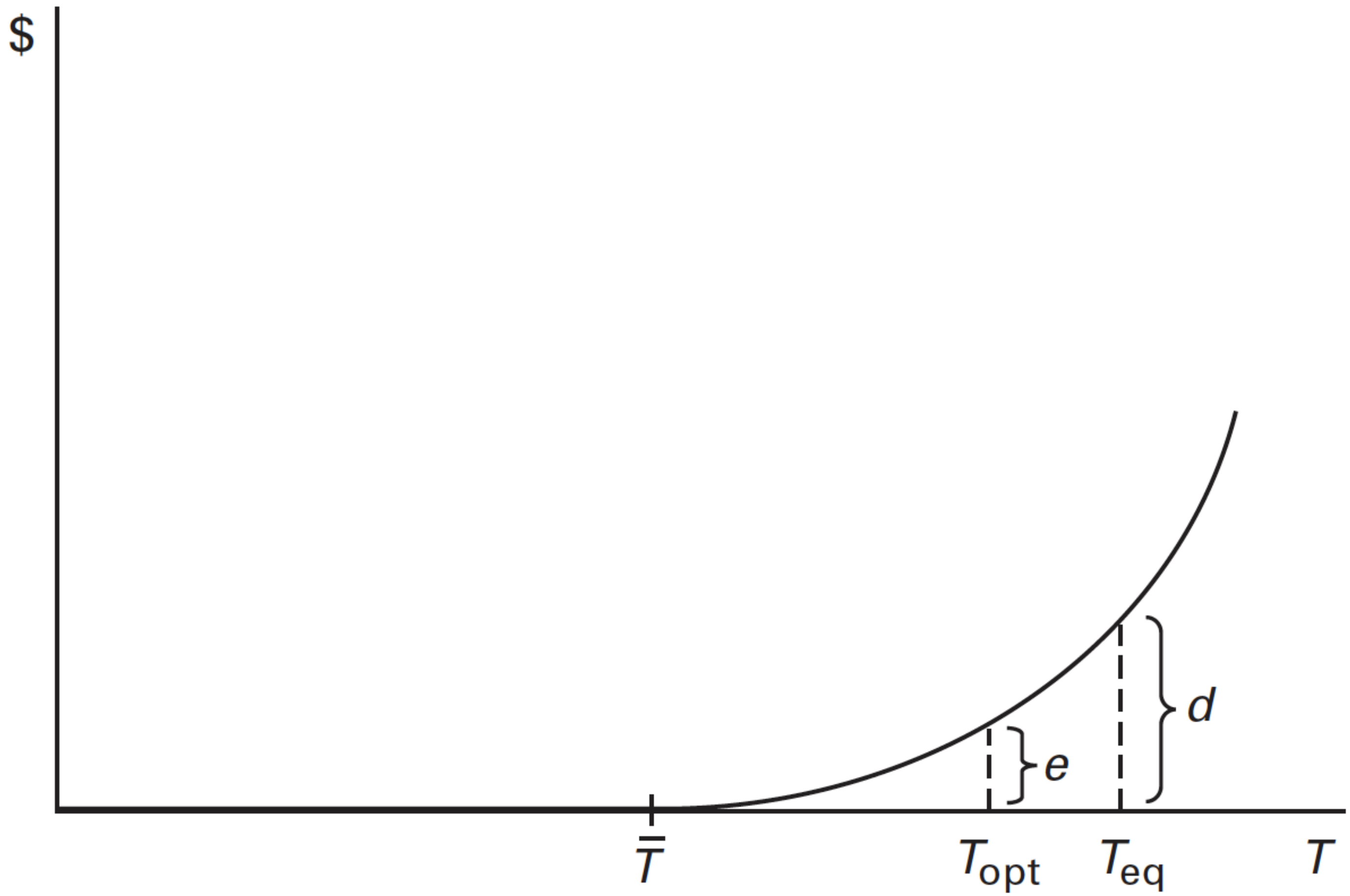
Traffic Allocation Equilibrium



Traffic Allocation in the Social Optimum



Congestion Toll Schedule



Market Prices are Wrong

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“[I]n no other major area are pricing practices so irrational, so out of date, and so conducive to waste as in urban transportation. Two aspects are particularly deficient: the absence of adequate peak-off differentials and the gross underpricing of some models relative to others”

William Vickrey, 1963

Negative Externalities from Cars

- Congestion
  - Time cost for car users
  - Time cost for bus users
- Environment
  - CO_2e emissions (global)
  - $PM_{2,5}$ emissions (local)
- Traffic Fatalities and Hospitalization

Congestion costs

1. Compare time spent in traveling with the time it would take in “free flow”.
2. Estimate the time lost per individual
3. Use an estimation of cost/minute per individual to monetize time costs.
4. Do 1 to 3 for Bus Users

Time Lost in São Paulo

Index	Cars	Buses
Total Time Lost (minutes)	59.922.650	69.092.757
Total Cost of Time (R$)	6.612.132	3.925.119
Time Lost (sec/km)	206,84	91,24
Cost of Time (R$/1000km)	350,80	212,31

The Car

- Last Century: the rise of the automobile has been the most impacting factor of urban form
- European Model: public transit is highly subsidized; gas is heavily taxed; cities are in general more subsidized
- Latin American Cities appears to be heading in the same direction as U.S.: ‘The Car Cities’

The Opportunity…

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- In most large cities in Latin America 40% or more of the trips are by public transit.
  - It was 50% before Covid-19
- But this is not connected to the tax structure that is usually similar to the US.
  - It is connected to the low car ownership that is correlated to low income.
- A change in transport's taxes and subsidies may keep people out of cars.

Loosing my religion

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- Long-run declining trend in the use of public transit services (Mallett 2018; Rabay et al. 2021).
- Decline has been further accentuated by Covid-19 (Mallett 2022; Loh and Rowlands 2023)
  - Full recovery to pre-pandemic patterns very much unlikely absent further intervention (Dai, Liu, and Li 2021; Tsavdari et al. 2022).
- High fixed costs of operating a public transit system (solved temperately with government subsidies) threaten the long-run financial viability of these services (Welle and Avelleda 2020; Aguilar et al. 2021; Tsavdari et al. 2022).

Disruption in Mobility

- Uber start its service hiring car that were performing “especial” services for hotels, conventions, etc.
- In a market economy, there was nothing wrong with that. The service was already there, and it seems not to affect the status quo.
- Solution to Information problem (1):
  - Matching demand and supply increased sales considerably. High return for first drivers.

Disruption in Mobility

- Service is generalized to the large public: Uber X introduced.
  - Pricing trips instead of miles in public transit make Uber competitive with it.
- Solution to Information problem (2) and (3):
  - Adverse selection: the user does not know if the driver is trustable or not.
  - Moral hazard: the driver is insecure about the payment.
- The system of evaluation plays a key role in keeping the level of the service.

Local government regulation

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- There are currently two significant branches of regulation:
  - Quantity Control (including total prohibition)
  - Excise tax
- São Paulo decided to implement a totally different framework, charging the TNC a tariff per kilometer for using the municipal road system = public land.

Road pricing revisited

- The (served) land dedicated to roads is paid by all tax payers.
  - Everybody pays the investment in infrastructure.
  - Everybody pays maintenance.
- Distortion in price: user share in total cost do not depend on the usage.
- Charging per kilometer this distortion is mitigated.

Charging the road per use

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- This is a very simple solution and yet very refined:
  - It is a benefit charge.
  - Private benefits from its commercial use cannot be paid publically.
  - Why charging for residential land and not charging land dedicated to transport?
    - Auto users do not pay for the cost they impose on the society.

Vickrey Taxation

- Every road should receive at least the proportional maintenance cost from its users (benefit tax).
- Congested hours/sites should pay for the negative externality using the road generates on all other users (Pigou’s corrective tax).
- It is possible to separate the two components (space and time) to create a “perfect” taxation.

Mobility as a Service (MaaS)

- The sharing economy does not pay the cost of (carrying) the stock exchanging capital per service.
- The gain comes from solving information asymmetries AND reducing hidden resources.
- Can we use this concept in Public Transit?
  – Integration as the Public Transit MaaS

Changing Paradigm

- The “last mile” can be by “on demand” system (e-hailing, bike share, etc.)
- Medium and high capacity will be more relevant
  - Split CAPEX and OPEX?
- Combining modes can have financial and environmental impacts
  - The best way to transport 3 people from point A to B is by car...

Steps to Change Paradigm

- Take over the ticketing system from bus operators and make it open to any payment system.
- Increase capacity for monitoring, operating and planning.
- Experiments on integrated (discounted) trips.
- If feasible, integrate tariffs and physical infrastructures.

Experiment Results

- 50% discount leads to a large contemporaneous increase in integrated rides, (60%); 20% discount leads to a 25% discount but not very precisely estimated,
- We observe a sizeable and persistent decrease in the mean and dispersion in the demand for door-to-door rides, lasting for over four months after the end of the experiment.
- Around half of the contemporaneous increase can be attributed to “learning”.

Zero Tariff: What not to do!

- Subsidy to public transit distort prices
  - It can reduce walking and biking.
- All investments will go to operational costs instead of investments in medium and high capacity
  - Users are more sensitive to quality than price.
- The market is unionized and there is an information asymmetry: operators know (much) more about costs than the government.
- As a distributive policy it lacks focus.
- Fly paper effect.

What problem is zero Tariff solving?

- Congestion? No
- Emissions? No
- Quality of service? No
- Equality of opportunities? Partially at most
  - The main social cost is time

Want to distribute Money? Distribute Money.

- In Brazil there is a system for formal workers that cap expenditure in public transit at 6% of total income.
- It is very focused and direct the aid to people instead of companies.
- The City may give a similar aid to people in the informal market.
  - To receive the benefit, the user may enter in a general cadaster for social programs.
- Problem: incentives to job informality

GHG Emissions per Mode

Mode	Division	g/km	US$/mil km	R$/mil km
Cars	72,30%	127,43	11,64	64,94
Motobikes	3,10%	45,65	4,17	23,26
Bus	23,70%	20,66	1,89	10,53
Other	0,90%	-	-	-

Urban GHG Emissions

- GHG emissions in urban áreas represent 30% to 35% of total emissions.
- Urban transport contributes to 40% (extreme clime regions) to 80% (São Paulo).
- Reducing emissions from urban transport may reduce 6% to 10% of GHG emissions in 10 years.
- This is a rare opportunity

What not to do: Eletromobility

- The production of 440kgs of batery (A Nissan Leaf's) generates 7,06 tons of GHG equals to 44,1gCO_2e/Km or 33,9gCO_2e/Km per pax*km.
- A hybrid ethanol vehicle (non-plug-in) produces 42,3gCO_2e/Km or 30,2gCO_2e/Km per pax*km.
- A 2010 study shows that if all cars in Berlin were converted to EV, it would be necessary all energy consumed in Berlin to run the cars.
- The best energy matrix in LAC, Brazil, use 5% to 15% of termoeletrics **now**, but this is the only source to increase energy production.

Other critical points

- We do not no where the technology is going: short or long charging; hydrogen; metano; plugin or not; etc.
- We have no idea what to do with those bateries when they “die”.
- Lythium production is very “dirty” and the stock is limited.

$PM_{2,5}$ Emissions

Negative Externality	Car	Motorbike	Bus
Hospitalizations resulting from the emission of PM2.5 per million km	0,0005	0,0051	0,0023
Deaths resulting from the emission of PM2.5 per million km	0,0018	0,0201	0,0092
Hospitalizations resulting from the emission of PM2.5 (R$/thousand km)	0,0013	0,0139	0,0064
Deaths resulting from the emission of PM2.5 (R$/thousand km)	1,55	17,26	7,89

Electric buses?

- Pro
  - Bus emissions of $PM_{2,5}$ in areas with very high concentration of particules.
  - Biofuell for buses is still very undeveloped.
- Against
  - EURO6 may do the job with $PM_{2,5}$
  - EV Buses cost 3 times Diesel Buses but EURO6 costs 30% more than EURO5
- Main gain: spliting CAPEX from OPEX

Summing up Negative Externalities (R$/Thousand km)

Cost of negative externality	Car	Motorbike	Bus	Bike
CO_2e emissions	64.94	23.26	10.53	
Congestion time per car	350.80			
Congestion time per bus	212.31			
Non-fatal casualties resulting from crashes	34.13	72.31	1.79	12.22
Fatal casualties resulting from crashes	20.81	88.35	3.24	38.23
Hospitalizations resulting from the emission of PM2.5	0.0013	0.0139	0.0064	
Deaths resulting from the emission of PM2.5	1.55	17.26	7.89	
Total	472.23	201.20	23.46	50.45

Space Distribution in São Pau

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Street component by type of use			Distribution by Component		Disaggregated Distribution	
			Area	%	Area	%
Sidewalks	Service lane		6,211	32.1%	2,109	10.9%
	Without minimum conditions for pedestrian circulation				797	4.1%
	With minimum conditions for pedestrian circulation				3,305	17.1%
Bus lanes (exclusive use of CPT)			562	2.9%	562	2.9%
Mixed traffic	Streets with bus lines	CPT use	5,094	26.3%	688	3.6%
		IMT use			4,406	22.8%
	Roads without bus lines (exclusive use of IMT)		7,349	38.0%	7,349	38.0%
Cycle lanes and tracks (exclusive use of bicycles)			129	0.7%	129	0.7%
Total			19,343	100%	19,343	100%

Travel Demand and Space Distribution

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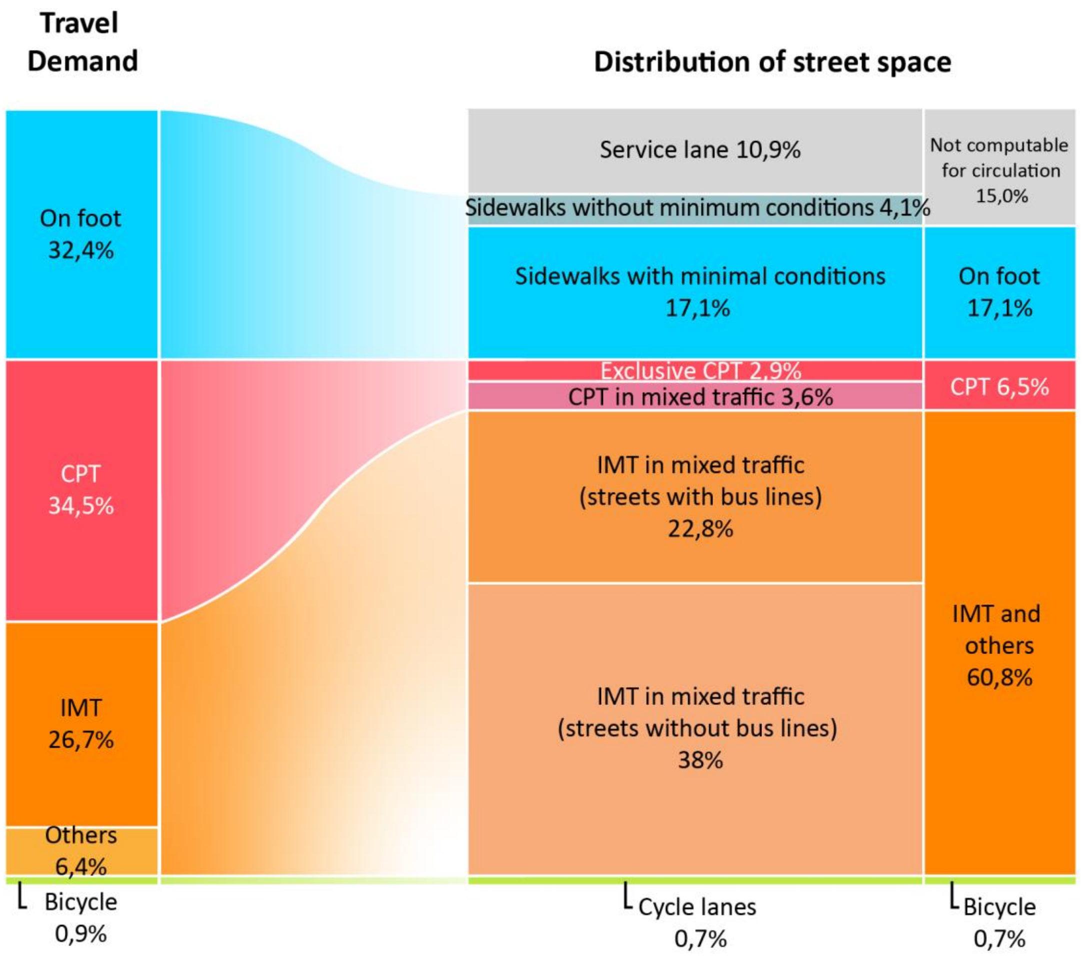

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Space distribution in space

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- Best sidewalks are in districts where people walk less.
- The problem is sidewalk wideness.
- The need for space is high; this is the main distributive conflict by mode.