

# ***On-Street vs. Off-Street Parking - an Urban Economic Analysis***

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# Why should we take a closer look at parking?

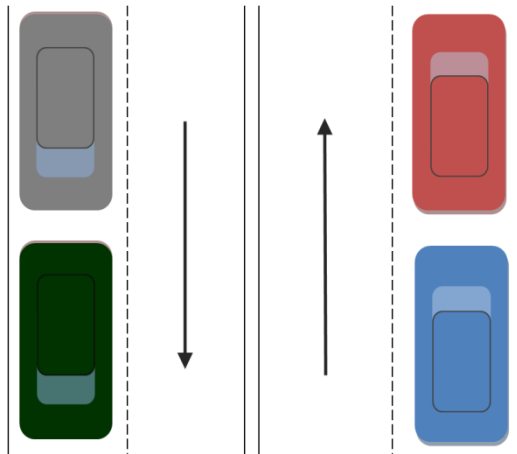
- >> **An average car is parked 23 hours per day**
- >> **On-street parking often is cheap and scarce**
  - > Cheaper than marginal costs
  - > Induces cruising for free or cheap parking
  
- >> **There are several distortions on the parking market**
  - > Price distortions
  - > Subsidies
  - > Spatial competition
  - > Cruising for parking



- 1. On-Street vs- Off-Street Parking**
- 2. The Urban Spatial CGE Model**
  1. Model Basics
  2. Integrating Cruising for Parking
- 3. Results**
  1. Expected Results
  2. Model Results
- 4. Conclusion and Discussion**

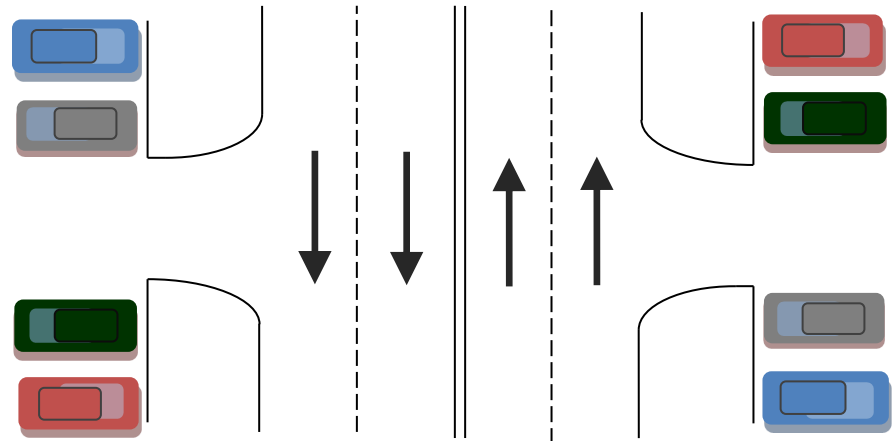
## >> Benchmark Scenario:

- > Major parts of the road are blocked by parking vehicles



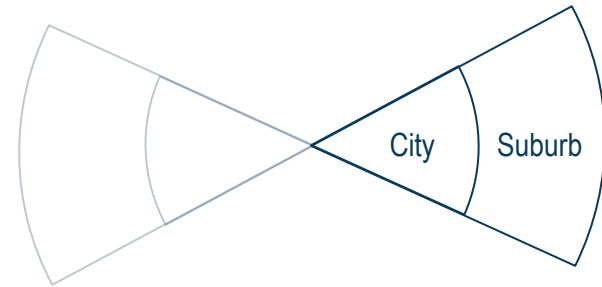
## >> Policy:

- > Curbside parking is prohibited
- > All cars are parked in parking lots beside the roads



**>> Computable General Equilibrium Model, based on Anas & Xu (1999)**

- > circular city
- > Polycentric, due to companies and household choosing their place of residence



Basic City Setup

**>> Equilibrium through market clearance on the markets for housing, goods and labours**

**>> Transport sector is endogenous and can therefore model congestion**

## >> Households

- > Try to maximise their utilities by choosing their work place and place of residence
- > Utility is derived from the consumption of goods housing and leisure time

$$U_{ij} = \alpha \ln \left( \sum_{k=1}^K z_{ijk}^{\eta} \right)^{1/\eta} + \beta \ln q_{ij} + \gamma \ln l_{ij} + e_{ij}$$

- > While it is constrained by the time budget

$$D_{ij}L + l_{ij} + \sum_{k=1}^I 2t_{ik}Z_{ijk} + 2t_{ij}D_{ij} = E$$

- > and the monetary budget

$$\sum_{k=1}^I p_{ijk} Z_{ijk} + r_i q_{ij} + \tau^{ls} + c_{ij} D_{ij} \\ = (1 - \tau^w) w_j L D_{ij} + R$$

## >> Companies

- > Try to maximise their profits by choosing their location
- > Produce with the inputs land and labour
- > Different production functions: service companies → more labour force; producing companies → more land

## >> Public household

- > Has to be balanced
- > Pays for infrastructure
- > Receives money from taxes

## >> Cruising for parking in the baseline scenario

- > Up to 30% of city traffic is due to cruising for parking, an average search takes up 8.1 minutes
- > Based on Arnott and Inci (2006): traffic flow is the sum of vehicle in transit (T) and the vehicles cruising (C)
- > Our model only has two zones → no transit, all trips originate or terminate in the considered zone

$$T(i) = \sum_j Flow(i, j)$$

- > All vehicles have to cruise, yet in contrast to Arnott and Inci's approach there is sufficient parking
- > Still available on-street parking is scarce and commuters have to cruise
- > Assuming that not all of the zone's infrastructure is required for cruising, the number of vehicles cruising in i is

$$C(i) = 0,5 \cdot \sum_j Flow(j, i)$$

## >> Cruising for parking in the baseline scenario

- > As the cruising vehicle drive slower during their search for parking and block parts of the road during the parking process they contribute 1.5 times as much to traffic volume as the transit vehicles do

$$V(i) = T + 1.5(C)$$

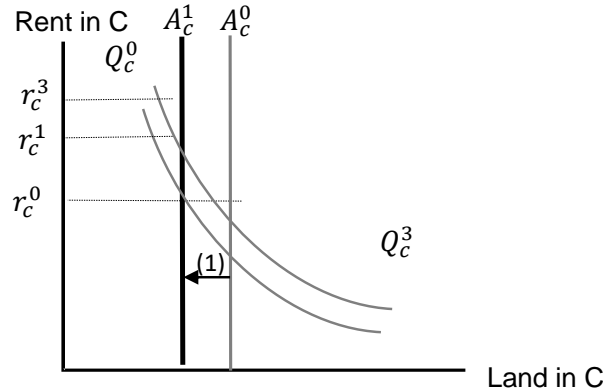
- > Cruising is only considered for commuters but every commuter cruises

## >> Off-street parking in the policy case

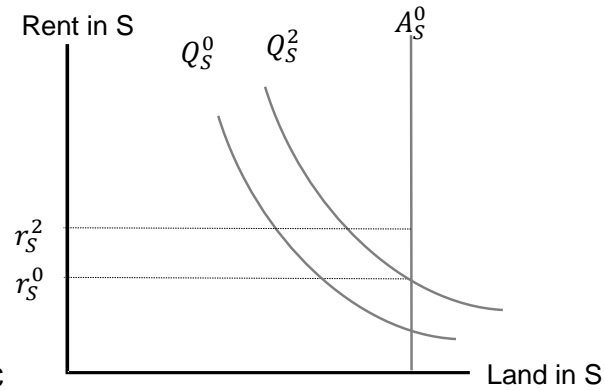
- > No cruising for parking on the roads due to well-working car-park routing systems
- > Additional land requirement for parking infrastructure has to be refinanced
  - > Lump-sum tax
  - > Congestion toll
  - > Parking fee



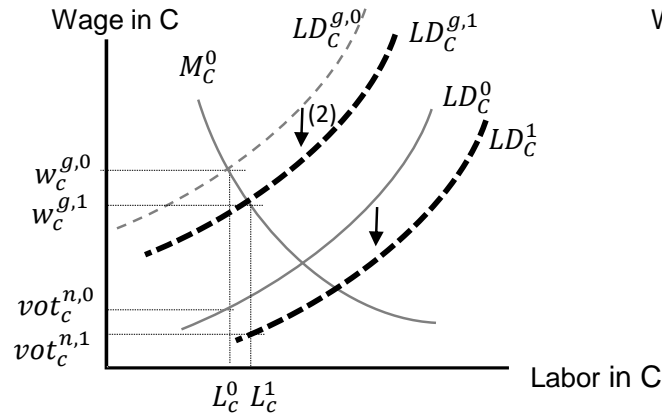
# Expected Results – Policy Effects on the Land Market



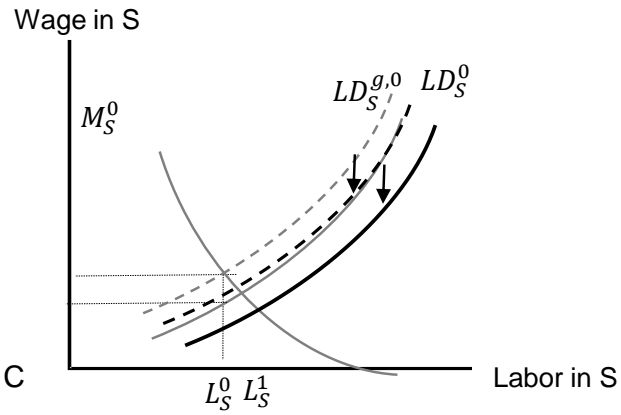
**a) Land market center**



**b) Land market suburbs**



**c) Labor market center**



**d) Labor market suburbs**

	Benchmark	Lump-Sum	Toll	Parking fee
Percentage of housing in center	37.0 %	-0.3 %	-0.5 %	-0.6 %
Percentage of jobs in center	57.5 %	+0.1 %	+0.2 %	±0 %
Rent center [€/m <sup>2</sup> ]	7.52	+5.7 %	+3.9 %	+4.9 %
Wage center [€/hour]	21.95	-0.6 %	-0.4 %	-0.4 %
Annual disposable income [€]	47,376	+0.8 %	-2.6 %	+1.4 %
Lump-sum transfer [€]	3,720	-27.2 %	-38.2 %	-8.0 %
Price for goods in suburb [€]	67.39	+1.6 %	+0.4 %	+1.4 %
Income absentee landlords [m. €]	10,495	+4.3 %	+2.4 %	+3.9 %
Marginal congestion costs [€/km]	0.34	-61.8 %	-91.2 %	-70.6 %
Annual travel distance [km]	22,388	+0.2 %	-0.3 %	-0.3 %
Emissions per HH [kg CO <sub>2</sub> ]	2,238	+0.3 %	-27.6 %	-7.2 %
Modal split (car/ PT/ walking)	0.63 /0.35 /0.02	0.67 /0.31 /0.02	0.53 /0.44 /0.02	0.62 /0.36 /0.02
Modal split commuting	0.56 /0.41 /0.03	0.68 /0.30 /0.03	0.32 /0.65/0.03	0.58 /0.39 /0.03
Modal split shopping	0.67 /0.31 /0.02	0.67 /0.31 /0.02	0.67 /0.31 /0.02	0.64 /0.34 /0.02
Road infrastructure costs [Mio.€]	4,306	+4.8 %	+2.9 %	+4.2 %

## >> Lump-Sum Tax

- > No price distortion
- > Rent increase stronger near CBD → relocation towards the suburb; overall decreasing land demand
- > Car use increases drastically, still congestion decreases
- > Higher emissions

## >> Congestion toll

- > Internalization of externalities
- > Spatial effects similar to those with lump-sum taxation
- > Drastic reduction of car usage for commuting
- > Additional load through less lump-sum payment

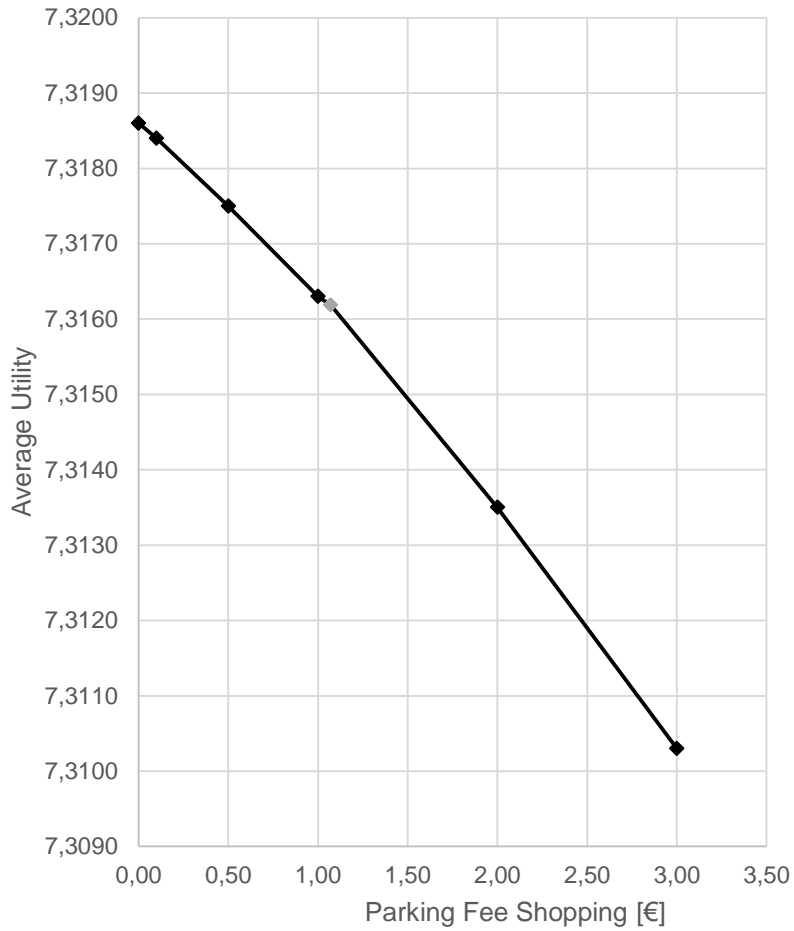
## >> Parking fee

- > Parking fees for a work day are four times that of fees for shopping and in total have to equal the additional costs stemming from parking infrastructure
- > Spatial effects similar to those with lump-sum taxation
- > Increasing car use for commuting
- > Decreasing car use for shopping

	Lump-Sum	Toll	Fee
Change in GDP (m €)	+600	-200	+300
EV per household [€]	-515	-1,076	-747
EV all households [m €]	-258	-538	-374
EV absentee landlords [m €]	+374	+222	+322
Emission costs (policy – benchmark) [m €]	-0.5	44.5	11.5
Total impact [m €]	+115.5	-271.5	-40.5
Total welfare change in % of GDP	0.46%	-1.1%	-0.16%
Change in GDP in %	2.41%	-0.8%	1.2%

- >> **Lump-sum tax refinancing is the only funding scheme in which overall welfare increases**
- >> **Landlords are the major beneficiaries**
- >> **Inhabitants' welfare losses are massively influenced by increasing land rents**
- >> **User financed funding schemes massively decrease emissions**

# In Search of an Optimal Parking Fee?



**>> Near linear relationship between utility and parking fee level**

**>> Welfare neutral fees:**

**> Shopping: 0.82€**

**> Commuting: 3.28€**

- >> *The distorting effects of user financed funding schemes deteriorate overall welfare***
- >> *Lump-sum funding, yet, is ineffective regarding congestion and emissions***
- >> *Congestion toll revenues do not fully cover additional infrastructure costs and by that have to be supplemented by lump-sum taxes***
- >> *Besides that, congestion tolls favour shopping trips over commuting trips as shopping trips – according to our assumptions – do not face congestion***

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