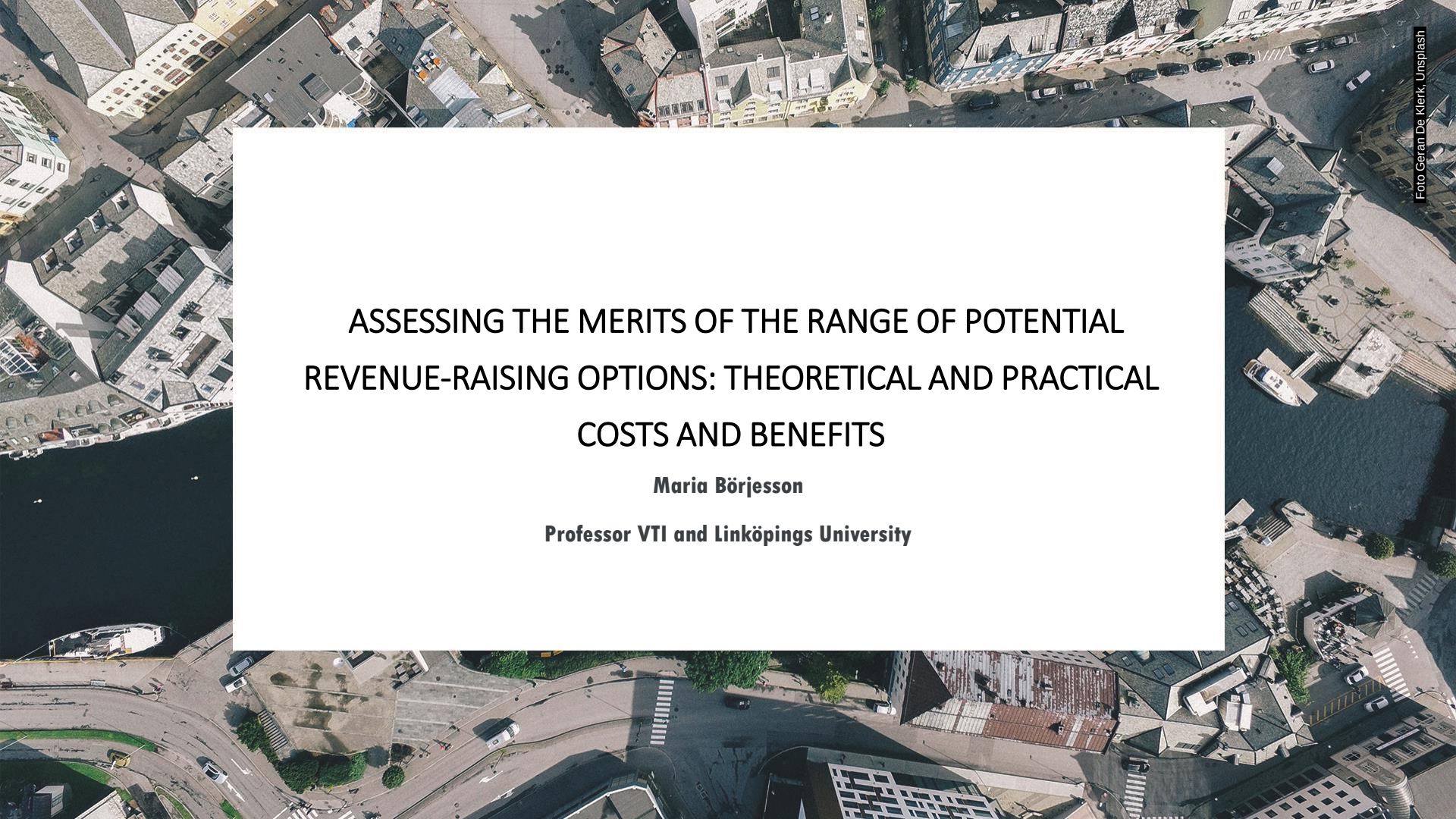


# ASSESSING THE MERITS OF THE RANGE OF POTENTIAL REVENUE-RAISING OPTIONS: THEORETICAL AND PRACTICAL COSTS AND BENEFITS

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# REASONS FOR TAXING ROAD TRANSPORT

- Marginal cost pricing
- Cost coverage
- Fiscal reasons

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# QUESTIONS

- What is the marginal external cost of road transport ?
- To what extent would marginal cost pricing cover costs?
- How to collect the tax?
  - Kilometre taxes
  - Urban tolls/parking charges
  - Ownership (time based taxes)
- Fiscal reasons

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# EXTERNAL CONGESTION COSTS

- Most studies reports average values (if any)
  - Not so relevant
  - Very much focus on cities but most km are not driven there
- Simulate the spatial and temporal distribution of external congestion cost
- Area representing a small country
- Mälardalen (four million inhabitants),
- Similar “degree of urbanization” as NL and UK (Eurostat)
- 99 inh/km$^2$ (as Spain, Portugal the US)
- We simulate the tax for four time periods, including am- and pm-peak.

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# ADD THE OTHER EXTERNAL COST (OF EVS)

| | | Light vehicles € /km | Truck without trailer €/km | Truck with trailer €/km |
|---|---|---|---|---|
| **Wear and tear on the road infrastructure Source: Nilsson et al. (2020)** | | 0.004 | 0.057 | 0.123 |
| **Accidents Source: Isacsson and Liss (2016) and Transport Analysis (2021)** | Rural | 0.001 | 0.027 | 0.027 |
| | Urban | 0.026 | 0.027 | 0.027 |
| | Weighted average | 0.004 | 0.027 | 0.027 |
| **Emissions from brakes and tyres Source: Transport analysis (Transport Analysis, 2021)** | Rural | 0.000 | 0.001 | 0.001 |
| | Urban | 0.001 | 0.044 | 0.062 |
| | Weighted average | 0.001 | 0.015 | 0.013 |
| **Noise (for trucks the source: Nilsson et al. (2020) for light vehicles Jochem (2016))** | | 0.001 | 0.007 | 0.018 |
| **Sum, average 2019** | | 0.009 | 0.105 | 0.180 |
| **Sum average 2040, assuming that valuation based on WTP increases with GDP by 1.5 % year** | | 0.011 | 0.122 | 0.200 |
| **Congestion** | | To be simulated | To be simulated | To be simulated |

# METHOD

- National transport forecast model : accurate forecast the response to the congestion charges (Stockholm and Gothenburg)
- Optimal toll

$$\tau^*_{h,l} = \frac{\bar{W} t'_{h,k}(D) D_{h,k}}{l_k} + \gamma \approx \frac{\frac{\bar{W} D_{h,k} \Delta t_{h,k}}{\Delta D_{h,k}}}{l_k} + \gamma$$

h time period

k link

$\tau^*_{h,l}$ optimal toll, $\bar{W}$ value of time, $D$ traffic volume, $t_{h,k}$ travel time $l_k$ link length, $\gamma$ other external cost

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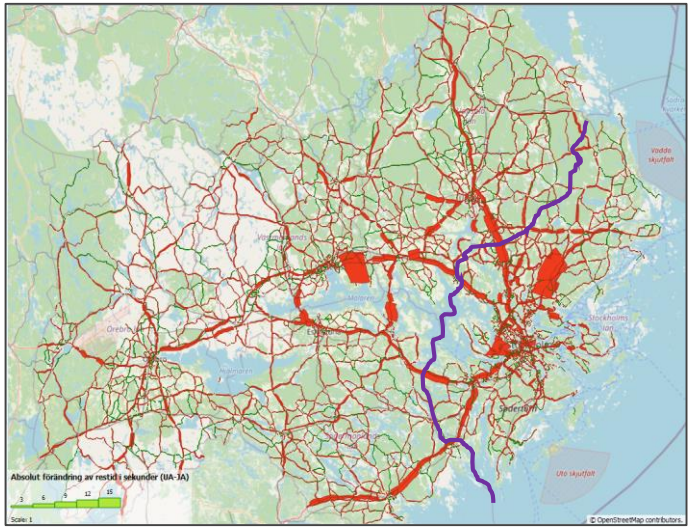
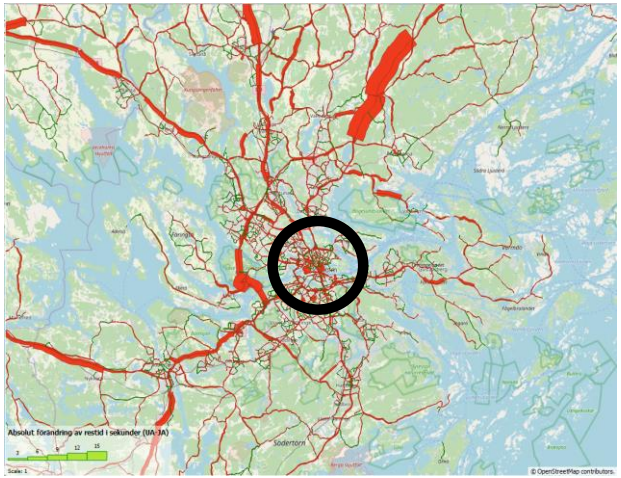
# SCENARIO

- The Swedish Transport Administration’s baseline scenario:
  - 60 percent EVs by 2040, driving cost 0.18 €/km
- Vary cost 0.14 - 0.18 €/km
- Population and economic growth: 30% higher traffic 2040 (rel 2017)

# RESULT

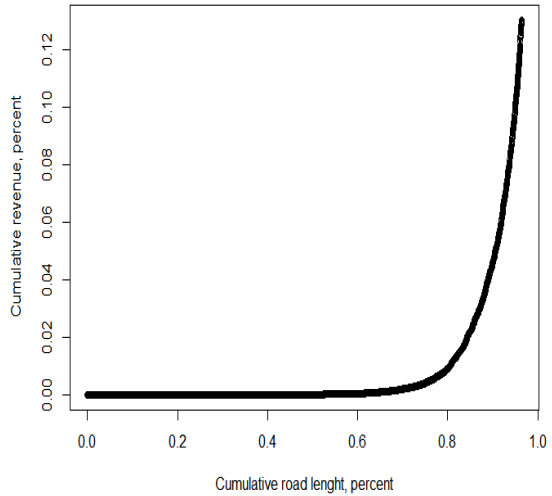
- vkt median optimal kilometre tax 0.04 €/km (2019 fuel tax 0.06 €/km)
- vkt average tax 0.09 €/km

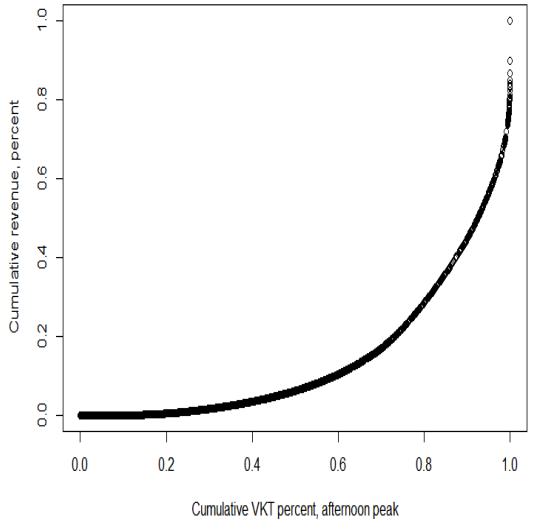


# HUGE VARIATION

- 90 percent of the revenue collected on 10 percent of the road network.
- 50 percent of the revenue collected from 15 percent of the vkt
- Ekström et al. (2014): 96% of the welfare gain achieved by 70 toll stations



# MEAN VALUES NOT SO INFORMATIVE

| | | Mean tax | 0% | 25% | 50% | 75% | 100% |
|---|---|---|---|---|---|---|---|
| **Time period** | Total road length 10^3 km | Distribution of the congestion tax per link k, weighted by link length $l_k$: $\frac{\tau_{kt} l_k}{\sum_k l_k}$ | | | | | |
| | | Mean | 0% | 25% | 50% | 75% | 100% |
| **h=1 am peak 7-9** | 36.9 | 0.016 | 0.000 | 0.000 | 0.001 | 0.009 | 99 |
| **h=2 pm peak 15-18** | 36.9 | 0.020 | 0.000 | 0.000 | 0.002 | 0.012 | 246 |
| **h=3 midday 9-15** | 36.9 | 0.012 | 0.000 | 0.000 | 0.001 | 0.008 | 38 |
| **h=4 night 18-7** | 36.9 | 0.003 | 0.000 | 0.000 | 0.000 | 0.002 | 0.37 |
| **Average tax over all periods h={1,2,3,4}** | 36.9 | 0.013 | 0.000 | 0.000 | 0.001 | 0.007 | 246 |
| **Time period** | Total VKT 10^6 | Distribution of the congestion tax per link k, weighted by link VKT $l_k$: $\frac{\tau_{kt} D_{kt} l_k}{\sum_{kt} D_{kt} l_k}$ | | | | | |
| | | Mean | 0% | 25% | 50% | 75% | 100% |
| **h=1 am peak 7-9** | 9.4 | 0.118 | 0.000 | 0.015 | 0.043 | 0.159 | 99 |
| **h=2 pm peak 15-18** | 14.9 | 0.146 | 0.000 | 0.017 | 0.050 | 0.175 | 246 |
| **h=3 midday 9-15** | 26.4 | 0.081 | 0.000 | 0.014 | 0.039 | 0.101 | 38 |
| **h=4 night 18-7** | 20.7 | 0.023 | 0.000 | 0.006 | 0.014 | 0.031 | 0 |
| **Average tax over all periods h={1,2,3,4}** | 71.39 | 0.083 | 0.000 | 0.009 | 0.030 | 0.084 | 246 |

# ADMIN COST OF ROAD TAX

- Fuel
- Vignette/ownership  tax
- Roadside equipment: ANPR and/or DSRC
  - Admin cost 15% Sweden, 9% Norway, 35% London
  - (Parking charges in Stockholm 18%)
- GPS
  - Enforcement drives cost

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# PREFERRED TAX DESIGN?

- 90 percent of the revenue collected on 10 percent of the road network.
- Ekström et al. (2014) dynamically simulating optimal km pricing in County
  - 96% of the welfare gain achieved by 70 toll stations
- ANPR based congestion toll in cities in combination with time-based (car ownership/ vignette) probably internalizes most of the external cost
- Trade-off: exact targeting the externality vs administration cost

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# COST COVERAGE

- The optimal tax covers the public cost for road system
- But very large redistribution effects
    - large city to small city and rural
- The large city population may reject

# FISCAL TAX

- Ramsey (1927)
  - Optimal commodity tax is inversely proportional to its price elasticity
- Challenged by Atkinson and Stiglitz (1976): added distributional aspects
  - Uniform tax on all final consumption goods (except Pigouvian) , if optimal income tax
  - Income tax is enough for desired redistribution effect.
  - All consumption is also much larger tax base
- Fiscal taxes on commuting introduce deadweight losses
- Horizontal equity
  - Families, rural, neighbours
- Diamond and Mirrlees (1971) advice against fiscal tax of freight transport

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# CONCLUSION

- Median 0.04 €/km (fuel tax 0.06 €/km). Mean at 0.09 €/km
- Enforcement of GPS systems drives admin cost.
- 90 percent of the revenue is collected on 10 percent of the road network.
- ANPR city toll combined with time-based tax preferred?
  - Heavy vehicles (non-congestion costs much larger, distance varies less)
- Trade-off between targeting the externality precisely and admin cost
- Revenue of Pigouvian tax covers public costs for road transport
  - City population may reject
- A&S advice against fiscal taxes on a single commodity, road transport a thin tax base, fiscal tax on commuting induces deadweight loss, horizontal equity

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