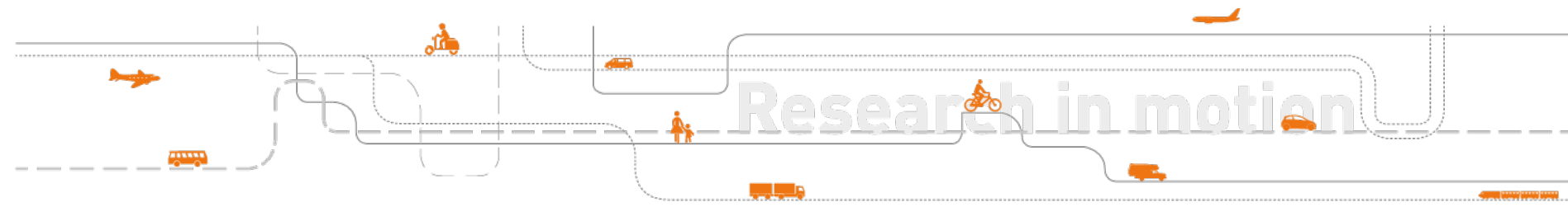


# Effekter på reisevaner i Oslo og Trondheim

Farideh Ramjerdi

BISEK Workshop, Januar 26, 2015

Oslo



- The Oslo scheme
  - A short history of the toll scheme in Oslo
  - Effects on travel behaviour (before and after the introduction of the toll scheme)
  - Equity consequences of the toll scheme
  - Past trends in Oslo
  - A discussion of the impacts of the Oslo scheme on travel behaviour and equity
  - Some conclusions
- The Trondheim Scheme
  - A short history of the toll scheme in Trondheim
  - Effects on travel behaviour (before and after the introduction of the toll scheme)
  - Short summary

# A history of the Norwegian urban schemes

- Toll financing of transport infrastructure dates back to about 80 years
- The introduction of urban tolls was due to limited public funds for financing transport infrastructure
- Nearly all of the toll-financed projects in Norway are supplemented by grants from the central government.
- The toll-financed projects are based on local initiatives.
- However, they require approval by the Norwegian parliament.

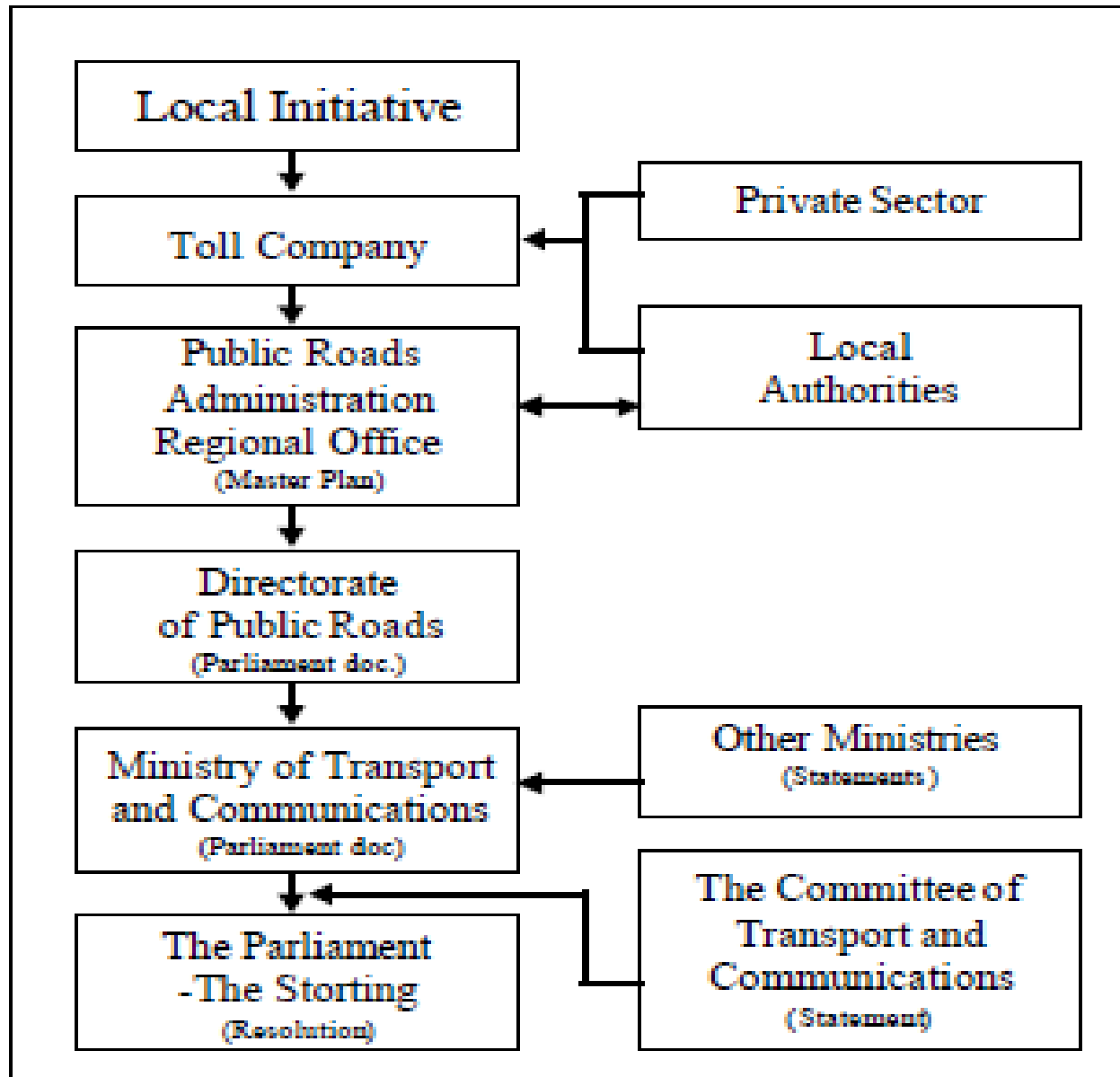
# A history of the Norwegian urban schemes

- Toll collection for financing is limited in period by law
- Approval is usually granted for 10-15 years
- Since the mid 90's amendments to the Road Acts have made it possible to allocate some of the revenues for public transport purposes
- An amendment approved in 2002 sanctions the use of a toll scheme for demand management.

# A history of the Norwegian urban schemes

- According to this amendment there is no time limit on a congestion pricing scheme in an urban area,
- But demands it's revision every 10 years.
- The proceeds from a congestion pricing scheme has to be used for local transport purposes

# The organizational framework of toll initiatives



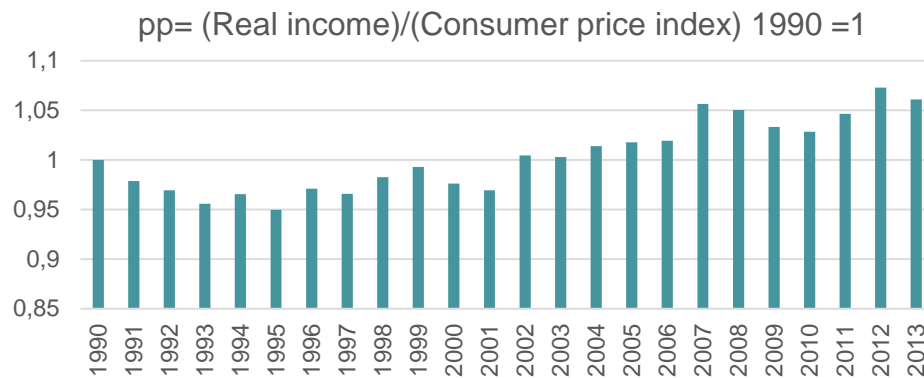
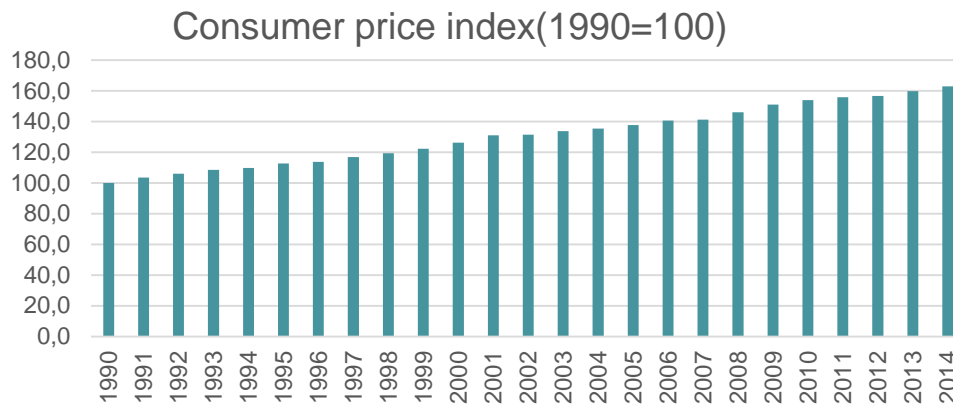
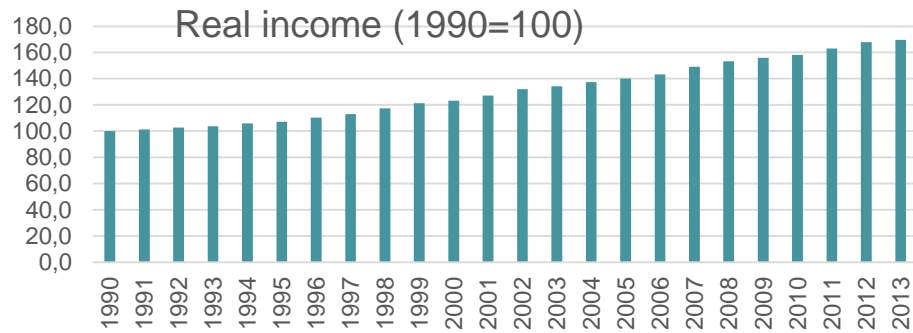
# The Oslo scheme 1990-2014

- **1990** The Oslo scheme was introduced in February, toll fee 10 NOK (**Oslo Package 1**). Originally 17 toll stations, increased to 19 toll stations. Inbound traffic all day, every day of the year.
- **2000** The Parliament approved “**Oslo Package 2**”: with an increase in the toll fee for financing investments in public transport projects, toll fee 15 NOK
- **2008 Oslo Package 3** to finance for road and public transport infrastructure, as well as operating subsidies to public transport in the period 2008–27, toll fee 25 NOK. The toll ring was expanded with a new collection point on the city limit between Oslo and Bærum in the West.
- **2012** Toll fee 27 NOK
- **2014** Toll fee 31 NOK

# Changes in the Oslo region 1990 -2014

- Population & employment
- Land use
- Economy (income, consumer price index and Gini coefficient)
- Car ownership
- Road infrastructure
- Public transport infrastructure and services
- Toll fee and public transport ticket prices
- Generalized cost of car and public transport
- Change in parking policies in Oslo

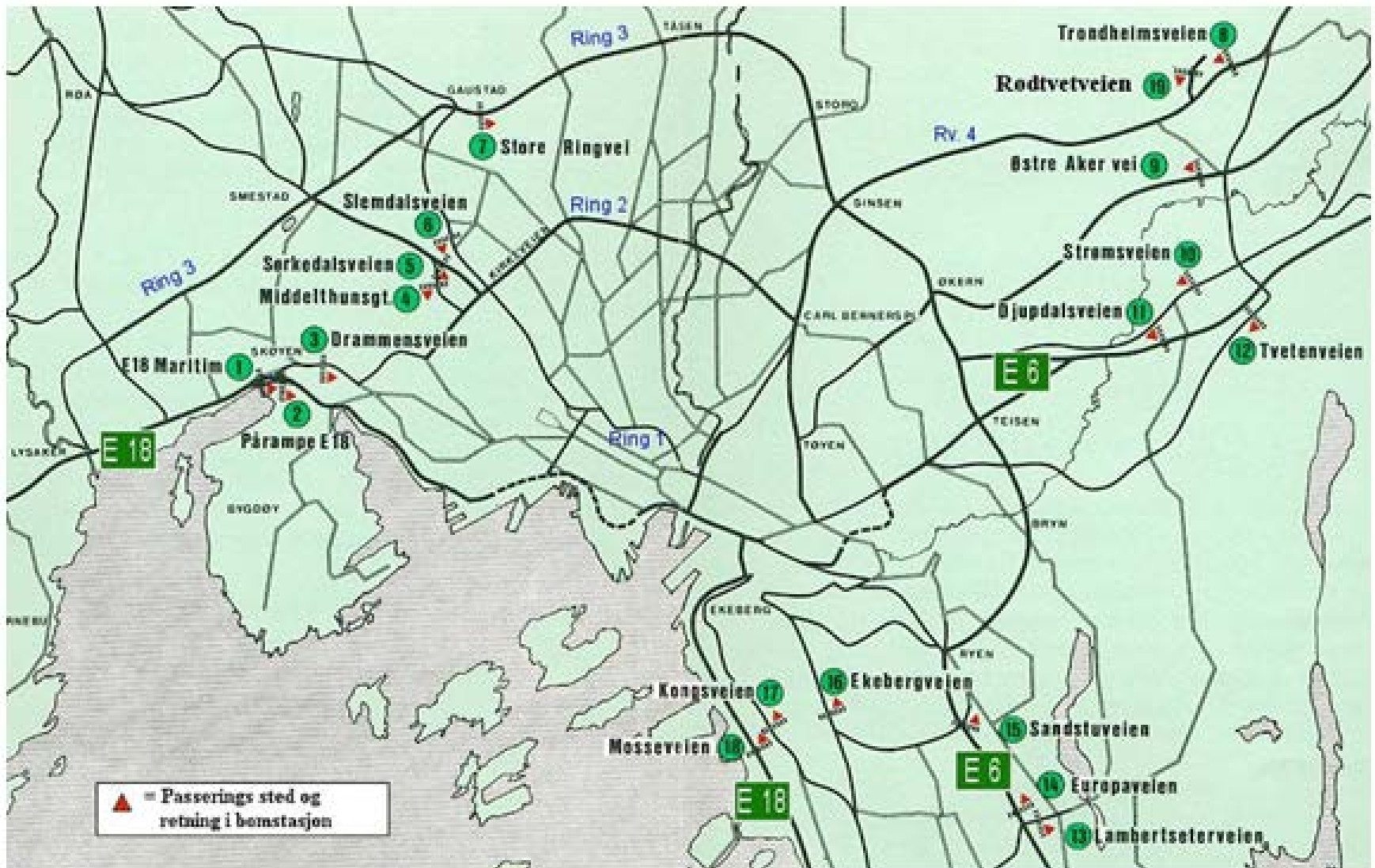




# The Oslo scheme: Toll fee

Year	Toll fee, NOK	Toll fee, NOK (2014 price)
1990	10	16.5
2000	15	19,5
2008	25	28
2012	27	28
2014	31	31

# The Oslo Scheme

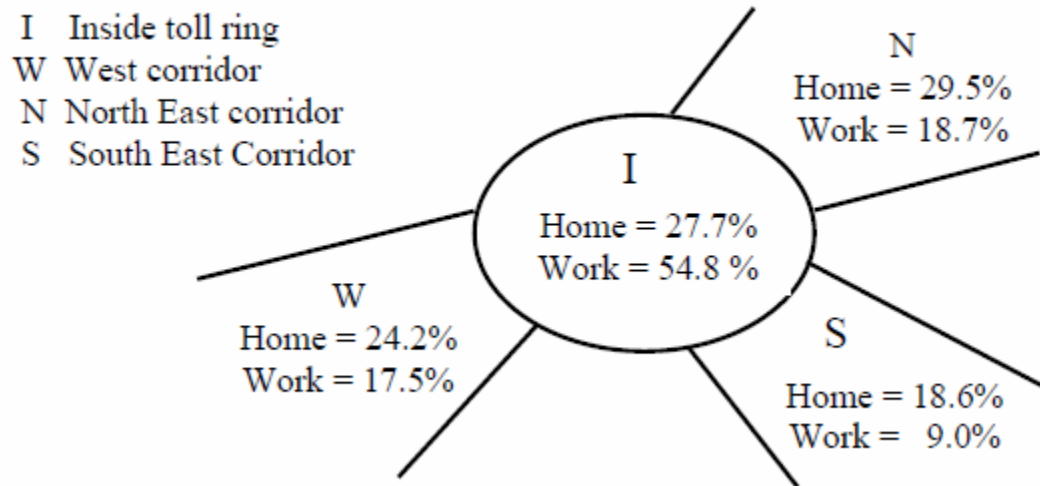


# Impact on Travel Behaviour 1989-1990

Based on:

- Panel survey of 1989-1990
- Registration of cars crossing the cordon toll (March 89-June 90)
- Public Transport ticket sale (1985-1990)
- Manual registration of car occupancy at cordon toll (before and after)

# Distribution of home & work locations in the Oslo region 1989-1990



# Impact on Travel Behaviour 1989-1990

Based on:

- Trip scheduling and route choice
- Tour frequency and trip chaining
- Mode Choice
- destination Choice

# Trip scheduling and route choice

- Some peak shifting seems to have occurred from 1989 to 1990. Note that toll is not differentiated by the time of day.
- Shifts in trip timing could have occurred due to the suppressed demand during the peak periods.
- The resulting effect seems to have been a reduction of the length of the peak periods (the reverse of peak spreading), however small.

# Tour frequency

- A linear regression model could best capture the impact of the toll
- Decrease in the car traffic due to toll fee alone is about 3.6 percent.
- The toll fee elasticity is -0.026.
- Socioeconomic variables: Income, Children 0-6 & Female
- Importance of access to a "free parking place at work" in the generation of car tours. The parking fee in the inner city of Oslo in 1990 was about 40 NOK/day and 15 NOK/hr. A free parking place at work should be much more highly valued by the employees than the market price of a parking space since it reduces search and walking time along with offering comfort, reliability and convenience.



# Trip chaining (1)

- Trips can be categorised as
  - compulsory trips (such as those for work and education) and
  - discretionary trips (such as those for shopping and recreation).

There is a larger degree of flexibility in the frequency, timing and destinations associated with discretionary trips.

we expect to observe changes at the following levels:

- A larger reduction of discretionary tours compared with compulsory tours.
  - An increase in the number of trips that are linked together to make a tour.
- The impact of the toll fee on trip generation and trip chaining is evaluated by a recursive structure which is used to describe the trip generation of work and discretionary trips (shopping, personal business, social visit and recreation) and the number of trip chains (tours).

# Trip chaining (2)

## Results of the estimation

1. Toll did not have much impact on the work trip at the level of trip generation (Socioeconomic variables: Female, Children 0-6)
2. Corresponding to each work trip there is on average 1.2 discretionary trips (Socioeconomic variable: only income)
3. Toll had some impact at the level of trip generation for discretionary trips, however small.
4. The toll fee elasticity (of tour frequency) based on average the number of work and discretionary trips, tours and the average number of toll crossings reported by respondents is around -0.038.

# Mode choice (1)

Switches in mode of transport, 1989-1990.

Mode	Car Driver, 90	Car Pass., 90	Public Trans., 90	Walk & Bike, 90
Car Driver, 89	1083	27	55	51
Car Passenger, 89	54	105	24	35
Public Transport, 89	70	31	634	35
Walk & Bike, 89	64	24	27	331

Mode choice models based on 1989,1990 and pooled data.

Socioeconomic variables did not turn significant

# Mode choice (2)

Mode choice elasticity values with respect to toll, travel purpose work

Elasticity of demand w.r to toll costs:	All Tours	Tours crossing cordon toll
Car/Driver	-0.04	-0.14
Car/Passenger	0.04	0.09
Public Transport	0.03	0.04
Walk/Bike	0.01	0.06

Mode choice elasticity values with respect to toll, other travel purposes

Elasticity of demand w.r to toll costs:	All Tours	Tours crossing cordon toll
Car/Driver	-0.014	-0.06
Car/Passenger	0.015	0.05
Public Transport	0.018	0.05
Walk/Bike	0.013	0.06

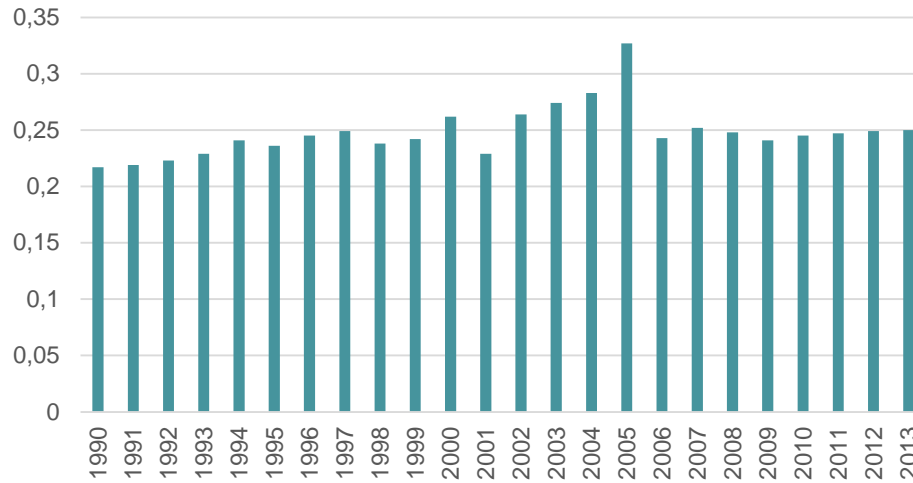
# Destination choice

- The impacts of the toll scheme on destination choices for compulsory travel were traced through changes in home and/or work locations from 1989 to 1990.
- The changes in home or work locations do not seem to be related to the toll scheme. Rather, it detects the ongoing trends in the changes of the land use pattern in the Oslo region
- The impacts of the toll scheme on destination choices for discretionary travel were analysed from two perspectives:
  - *First perspective:* The impact of the Oslo toll scheme on destination choices in relation to the distance of destinations (locations of businesses and services) from the toll ring.
  - *Second perspective:* The impacts of the Oslo toll scheme on the travel behaviour of households
- After the introduction of the scheme, households have chosen alternative destinations that did not require toll crossings. The shifts are more marked for households that were located in the inner city and close to the toll ring. The shifts are very small for households located 5 to 11 kilometres outside the toll ring.

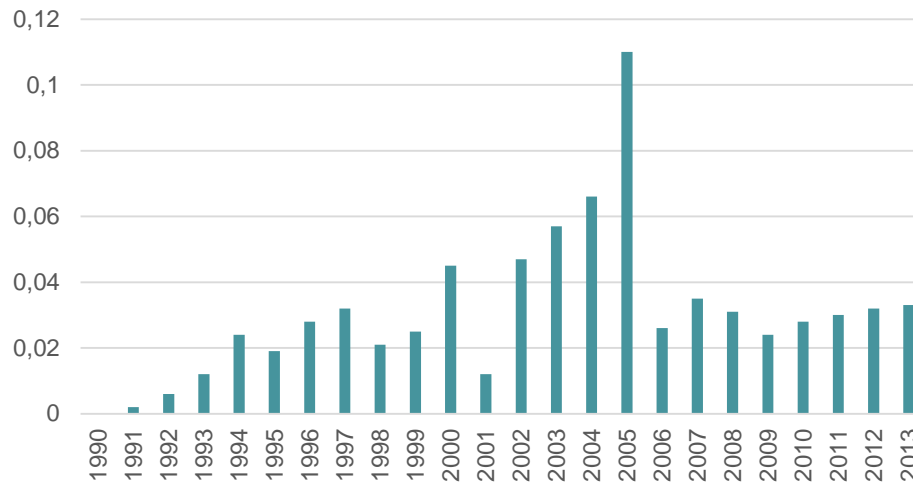
# Equity (and accessibility)

- Definition of equity (e.g., justice, rights, opportunity, income, welfare,..)
- The variable used to assess equity (e.g., welfare, wealth, quality of life, ...)
- Unit of analysis (e.g., woman, household, a region,...)
- Inequality measures are often classified as statistical, welfare or axiomatic
  - *Statistical measures* examine the distribution of any variable in a given population such as income. Examples of these are; range, variance, measure of variation, log variance, Gini measure and Theil's entropy measure.
  - *Welfare measures* rely on welfare economics and incorporate equity concerns into a welfare function.
  - *Axiomatic measures* are derived by addressing the properties that a satisfactory measure ought to have.
- These measures can be applied to the evaluation of inequality of any vector or distribution of observations, even to non-economic data such as the distribution of the ambient level of pollutants or accessibility over an area.

## Gini Coefficient



## Change in Gini coefficient (1990 = 0,217)



# Is it simple to evaluate equity consequences of a transport policy?

- Equity concerns of transport policies
  - Accessibility to ....
  - Welfare
  - ....
- Unit of analysis
  - Income groups
  - Vulnerable groups (single parents with young children)
  - ....

## How to calculate equity

- Travel surveys
- Transport models Integrated transport and land use models
- General equilibrium models (impact on the labour market)
- Spatial general equilibrium models



# Changes in the Oslo region 1990 -2014

- Population & employment
- Land use
- Changes in relative real state prices inside and outside the cordon toll
- Economy (income, consumer price index and Gini coefficient)
- Car ownership (inside and outside the cordon toll)
- Road infrastructure
- Public transport infrastructure and services
- Toll fee and public transport ticket prices
- Generalized cost of car and public transport
- Change in parking policies in Oslo

# Some speculation on the impacts of the Olso scheme in 2014

The impact of the scheme in 2014 is most likely quite small

- Relative generalized costs of public transport and car use
- Increase in purchasing power
- .....

**Changes in parking costs and restrictions on public parking most likely have had a significant impact, specially related to equity consideration**

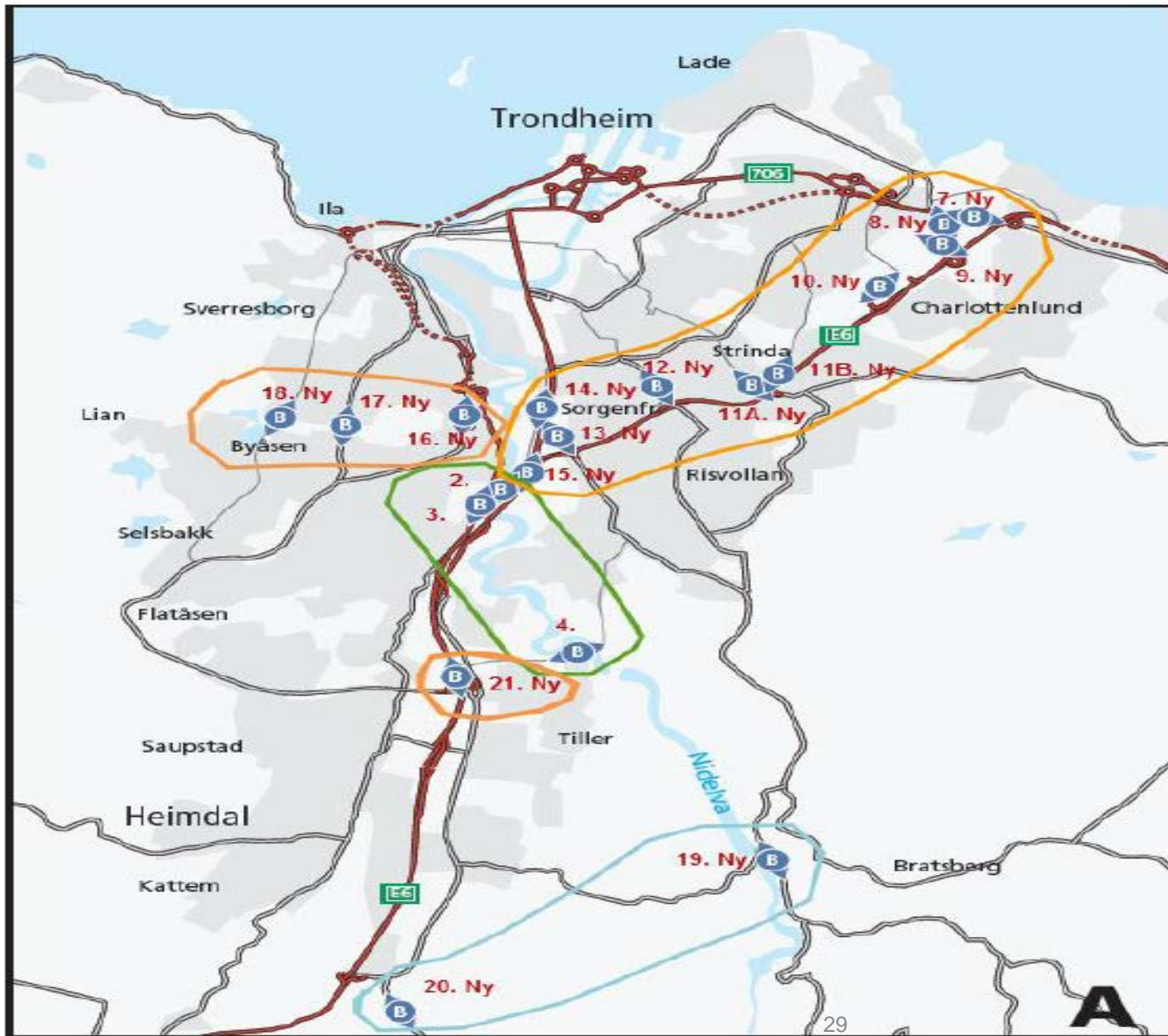
# The Trondheim scheme (1991-2006)

- **1991** Trondheim Scheme was introduced. 12 toll plazas. Payment only during rush hours between the hours of 06 and 17. Charge 10 NOK
- **1998** Fee Zones and 12 new stations. Payment only in rush hour, but now defined from the clock 6 to 18
- **2003** The center zone with 5 new tolls
- **2005** The scheme was abandoned
- **2010** toll was reintroduced introduced as an environmental package. 8 toll stations. Payment whole day, every day, toll fee 10 NOK. It is also put in a rush-hour item: The price is double during the periods 07-09 and 15-17 Monday to Friday. One exception: Kroppanbrua E6, 5 NOK all day
- **2014** Trondheim scheme was introduced with 14 new toll stations, totaling 22 stations in «Trondheimsapakken." In addition, 2 new tolls on roads into neighboring municipalities. They are not part of the environmental package and the income from them to finance new county to Klæbu
- It is expected to decrease traffic by 15%

# The Trondheim scheme



# The Trondheim environmental scheme





# Objectives of the scheme:

1. Reduce CO<sub>2</sub> emissions from transport by at least 20% by 2018
2. Reduce share of private car from 58% to 50%
3. To build comprehensive pedestrian and cycle networks
4. Improve public transport accessibility
5. Safeguard all national regulations for local urban environment
6. Reduce number of people who are bothered by traffic noise by 15%
7. Build 80% of new homes within the existing urban structure, and built 60% of new labor-intensive jobs in the central city areas
8. Reduce CHG emission from transport in municipal operations by 40%
9. The municipality should work for other private and public actors implementing similar measures
10. Reduce number of traffic accidents by at least 20%

# The Trondheim scheme (2014)

- Different studies suggest that the impact of the toll scheme in 1991 on travel behaviour was not significant
- The scheme in 2014 was calculated to decrease traffic by 15%
- The effect on work trip is through mode shift and departure time
- The effect on discretionary trips is through departure time, mode shift and frequency (trips foregone)