

## CASE STUDY:

Fezzi, C., Bateman, I. J., and Ferrini, S. (2014). Using revealed preferences to estimate the value of travel time to recreation sites. *Journal of environmental economics and management*, 67, 58-70.

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EE465/EE463 Project Evaluation

Semester 2/2014

# Summary of the Paper

- This paper uses **revealed preference** approach to **estimate the value of travel time (VTT) for recreation trips based on traveling choices between alternative routes** (free access road vs. toll roads).
- VTT is estimated from **the toll costs per hour of time saved (€/h)**.
- Case-study sites: three beaches located on the Italian Riviera Romagnola.
- The estimated VTT is between €8.4/h and €9.4/h.
- A Monte Carlo simulation shows that  $\frac{3}{4}$  of the wage rate is a reasonable approximation of the average VTT for recreation trips.

# Models of Value of Travel Time (VTT)

- **Becker (1965)**
  - Use a combination of revealed preference and stated preference data to estimate a value of time.
  - It assumes fixed time and monetary prices for each good.
  - The **value of time (or the shadow price) is uniform in all activities.**
- **DeSerpa (1971)**
  - Relaxes Becker's assumption by fixing only the monetary costs while allowing the amount of time spent on each activity to vary depending on individuals' preferences.
  - The shadow value of time is replaced by a **value of saving time specific to each activity.**
  - This is possible by assuming inequality in time consumption constraints.

# Empirical Setting and Data (1)

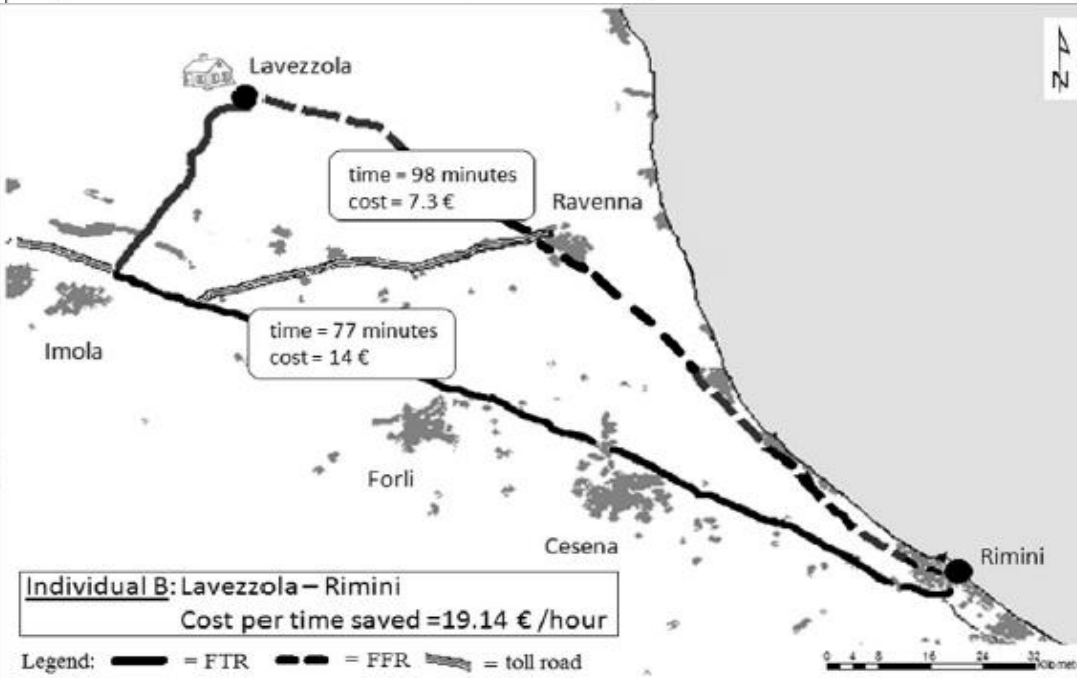
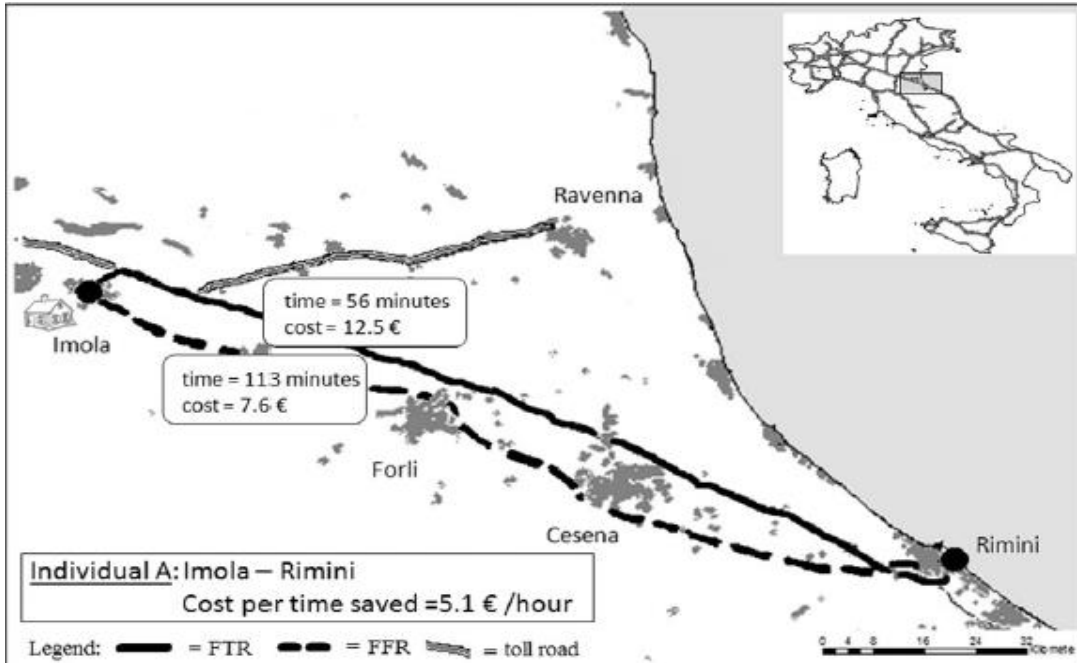
- This study uses DeSerpa's framework to estimate a VTT for recreation sites.
- It requires observations on individuals facing trade-offs between travel costs and driving time to recreation sites.
  - Need information from more than one site to see variation in travel time and travel costs of a particular person.
  - Need information from more than one person to have variation for the same recreation site.
- Key question: **how individuals choose between different routes to travel to a given site, with each route option characterized by different travel time and monetary costs.**

# Empirical Setting and Data (2)

- The probability of person  $n$  choosing to visit site  $s$  and using route  $j$  is:

$$P_n(s, j) = P_n(S)P_n(j|s)$$

- Case study - 3 beaches on the Italian Riviera Romagnola:
  1. Rimini
  2. Cesenatico
  3. Igea-Marina.
- Possible routes: free-access roads and toll roads.
- Use google map to calculate a proxy for expected travel time.
- Assume average gas consumption of 1 L/18 km & use average gas price.



Possible routes and costs per time saved for two individuals living in different cities:

1. Imola

→ save >1h at a cost €5/h

2. Lavezzola

→ save 20 min at a cost €20/h.

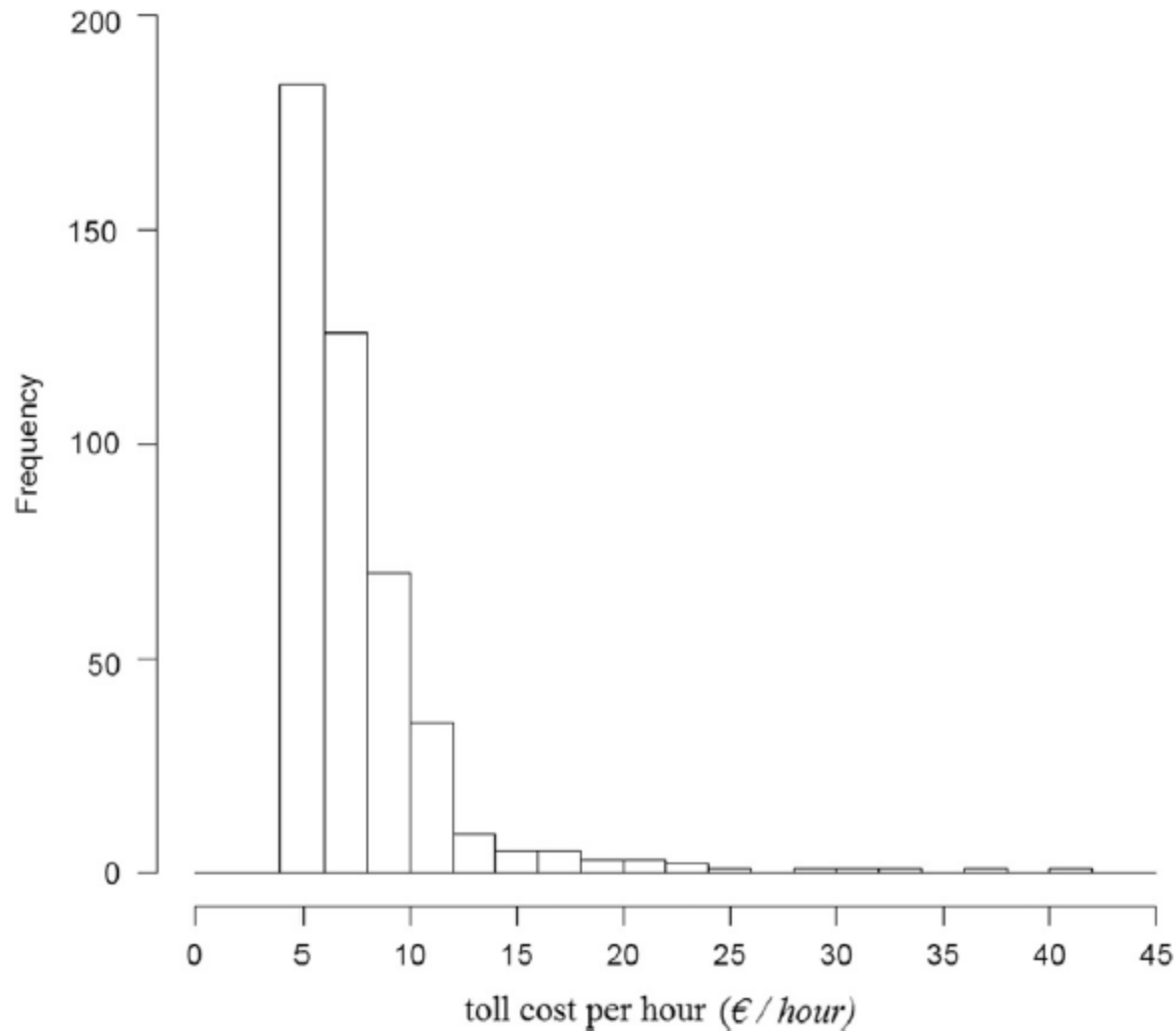
# Routes' Descriptive Statistics

Route	Time (min)			Fuel cost (€)	Toll cost (€)	Include bypass	Include mountain road	Include scenic road	% Chosen
	Mean	Min	Max	Mean	Mean	Mean	Mean	Mean	
<i>FTR</i>	137.8	28.0	495.0	16.22	11.26	0.09	0.02	0.00	56
<i>FFR</i>	233.9	35.0	763.0	15.49	0.00	0.16	0.09	0.07	15
<i>FT1A</i>	148.7	37.0	498.0	16.35	10.29	0.17	0.02	0.00	14
<i>FT1B</i>	144.7	35.0	502.0	16.32	10.76	0.09	0.02	0.00	4
<i>Other routes</i>	174.2	84	418.0	17.25	9.35	0.25	0.01	0.00	11

## Possible routes:

1. Fastest Free Route (FFR)
2. Fastest Toll Route (FTR)
3. FT1A: Fastest route access the toll road one station after that used in the FTR.
4. FT1B: Fastest route exiting the toll road one station before that used in the FTR.

# Histogram of Toll Cost Per Hour of Travel Time Saved



# Respondents' Descriptive Statistics

	$\bar{x}$	$\hat{s}(x)$	Min	Max	$\bar{x}$ (y=FTR)	$\bar{x}$ (y=FFR)	$\bar{x}$ (y=other)
<i>Personal income (€1000/month)</i>	2.11	1.33	0.25	11.20	2.15	2.33	1.92
<i>Age (years)</i>	40.70	12.17	18.00	76.00	40.00	43.38	40.51
<i>Gender</i>	0.29	0.45	0	1	0.30	0.29	0.26
<i>People in the car</i>	2.85	1.13	1	7	2.89	2.54	2.92
<i>&gt; 16 Years old</i>	2.27	0.86	1	7	2.32	2.07	2.27
<i>&lt; 16 Years old</i>	0.59	0.84	0	4	0.57	0.47	0.65

# Empirical Specification

- The (dis-)utility that person  $n$  receives from choosing route  $j$  is:

$$U_n(j) = U_{n,j} = \lambda_n c_{n,j} + \theta_n t_{n,j} + q_j + \varepsilon_{n,j}$$

Where  $t_{n,j}$  = the route time

$c_{n,j}$  = the route costs (toll and fuel)

$\theta_n$  = marginal disutility of spending time driving

$\lambda_n$  = marginal utility of money

$q_j$  = observed characteristics of route

- The value of travel time is the ratio of the marginal disutility of time spent driving to the marginal utility of money:

$$VTT = \frac{\theta_n}{\lambda_n}$$

# Model Estimates and Corresponding VTT

	Preference space		VTT space			
	Model A1 base model	Model A2 base model	Model B route characteristics	Model C route and respondent characteristics	Model D unobserved heterogeneity (Gaussian)	Model E unobserved heterogeneity (Triangular)
Time	-3.031*** (0.361)	0.858*** (0.072)	0.835*** (0.107)	0.700*** (0.136)	0.777*** (0.121)	0.712*** (0.122)
s.e. (Time)					0.218*** (0.051)	
Cost	-3.533*** (0.543)	-3.533*** (0.543)	-2.996*** (0.549)	-3.116*** (0.562)	-6.626*** (1.461)	-6.166*** (1.263)
s.e. (Cost)					3.396*** (0.888)	
FTR			-0.425*** (0.089)	-0.394*** (0.083)	-0.166*** (0.047)	-0.175*** (0.047)
FFR			-0.416*** (0.110)	-0.440*** (0.113)	-0.263*** (0.073)	-0.262*** (0.073)
Bypass			-0.243* (0.144)	-0.234** (0.112)	-0.151*** (0.063)	-0.153*** (0.065)
Scenery			0.218 (0.266)	0.225 (0.211)	0.153 (0.171)	0.232 (0.171)
Mountain			0.612*** (0.233)	0.629*** (0.221)	0.549*** (0.187)	0.537*** (0.188)
Time * gender				0.039 (0.108)	0.016 (0.093)	0.052 (0.088)
Time * d_age ≥ 60				-0.305*** (0.119)	-0.321*** (0.107)	-0.302*** (0.119)
Time * p_inc				0.091* (0.053)	0.085* (0.048)	0.092** (0.036)
Time * one_day				0.138 (0.141)	-0.003 (0.106)	0.054 (0.107)
Log-likelihood	-580.06	-580.06	-500.31	-492.83	-483.33	-485.98
Pseudo R <sup>2</sup>	0.13	0.13	0.25	0.26	0.28	0.27
Mean WTP (€/h)	8.58	8.58	8.35	9.26	9.35	9.16

Notes: travel cost expressed in €10 (e.g. €100=10), travel time in hours, and gross income in €1000/year (e.g. €20,000/year=20).

# Empirical Results

- Model A: use only route time and costs as choice attributes
  - Estimated VTT is  $\sim$  €8.6/h
- Model B: include route characteristics:
  - FTR and FFR are more likely to be chosen than other routes
  - Estimated VTT is  $\sim$  €8.35/h
- Model C: include both route and respondent characteristics
  - Income has a positive effect, and older respondents have lower VTT.
  - Estimated VTT is  $\sim$  €9.26/h
- Model D & E: include unobserved tastes heterogeneity
  - Estimated VTT is  $\sim$  €9.16/h - €9.35/h

# Monte Carlo Simulation: Welfare Estimates Using Different VTT

	Mean WTP (€)	5% Quantile of WTP (€)	95% Quantile of WTP (€)
True $VTT_n$	9.29 (8.61, 10.10)	0.57 (0.47, 0.71)	11.47 (10.26, 12.83)
$VTT_n=0$	2.88 (2.67, 3.13)	0.18 (0.14, 0.22)	3.56 (3.18, 3.99)
$VTT_n=1/3w_n$	7.21 (6.68, 7.85)	0.44 (0.36, 0.54)	8.91 (7.9, 9.98)
$VTT_n=w_n$	11.99 (11.11, 13.05)	0.74 (0.60, 0.92)	14.81 (13.25, 16.59)
$VTT_n=3/4w_n$	10.03 (9.28, 10.04)	0.61 (0.50, 0.76)	12.39 (11.07, 13.89)
$VTT_n=3/4\bar{w}$	9.78 (9.06, 10.64)	0.60 (0.45, 0.74)	12.06 (10.82, 13.52)

Notes: results generated with 5000 Monte Carlo repetition,  $w_n$  indicates the person specific wage rate and  $\bar{w}$  indicates the sample mean wage rate. In brackets is the 95% confidence intervals.

# Average WTP Estimates

