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“Household Behaviour and Environmental Policy”  
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“2008 OECD Survey on Household Environmental  
Behaviour: transport behaviour”

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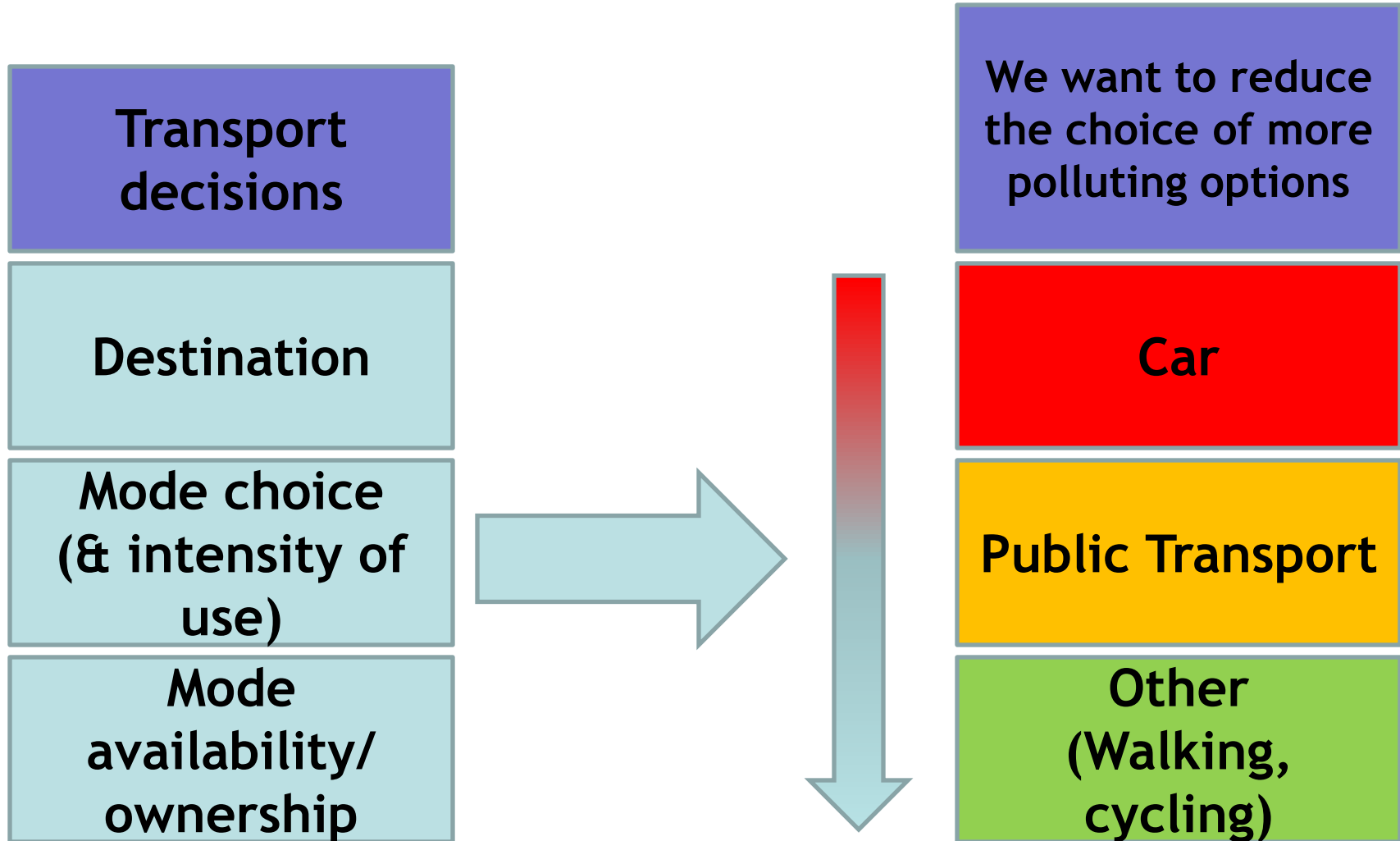
1. Introduction - Rationale
2. Theoretical and empirical background
3. Data
4. Estimation
5. Policy implications and conclusions

# 1. Rationale

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- The transport sector contributes with around 20% of total GG emissions in countries which belong to the UNFCCC.
- “CO<sub>2</sub> emissions from transport are expected to more than double in the period to 2050” (Stern, 2006)
- In order to adopt cleaner transport policies is fundamental to understand how people take their transport decisions.
- An empirical analysis of the determinants of both, transport mode choice decisions and public transport use is presented in this work.

# 1. Rationale: Commuting is a joint decision involving destination, mode and car ownership

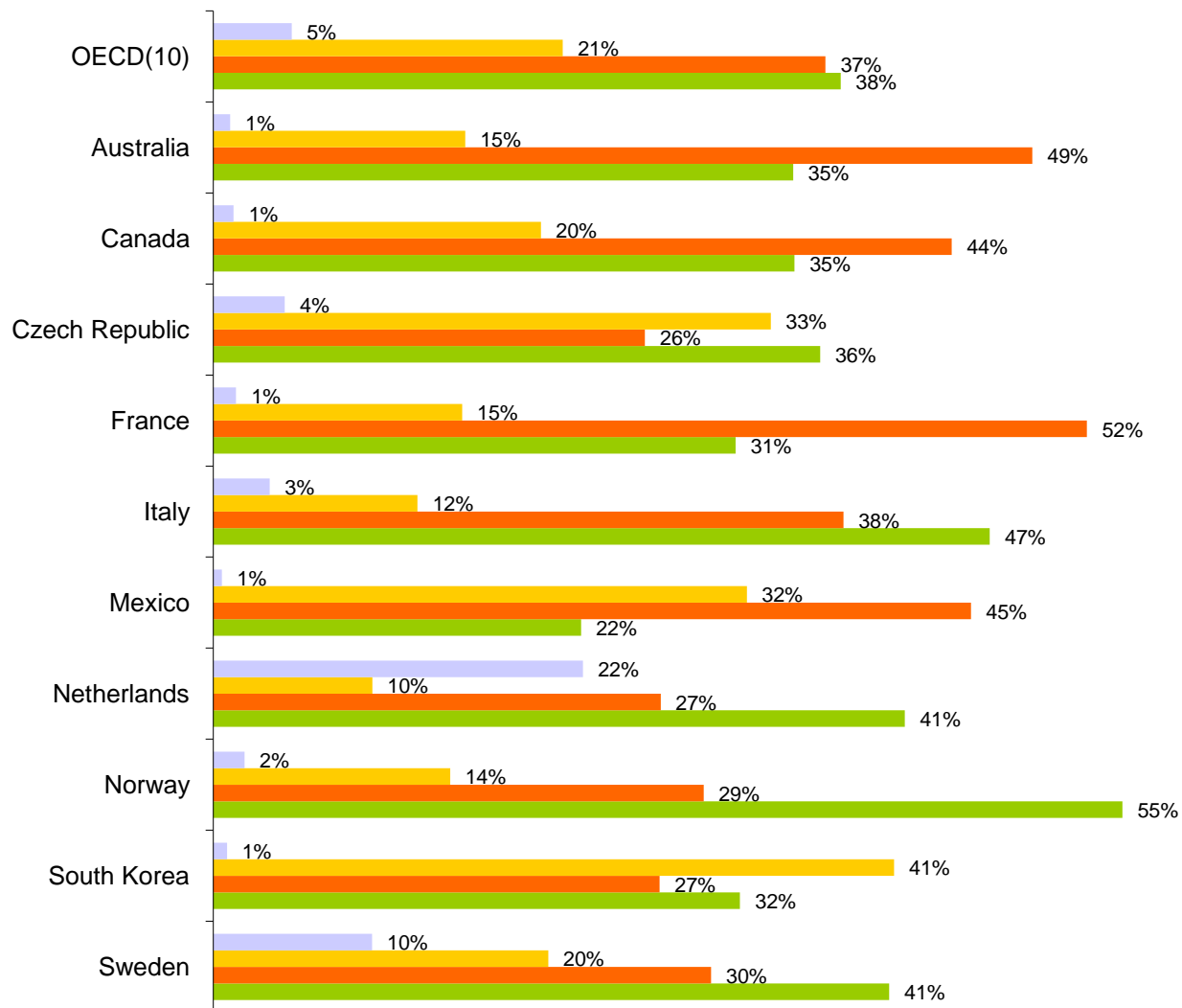


## 2. Theoretical and empirical background

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- Since this is quite a complex task, different authors have approached to the issue in different ways:
  - **Train (1980)** estimates the joint probability of having a certain level of car-ownership and choosing a certain transport mode.
  - **Johansson-Stenman (2002)** use the Heckman's selection model to account for self-selection on driving distance and public transport use decisions.
  - **Bhat and Koppelman (1993)** estimate a simultaneous system of equations that include car ownership, taking income and employment as endogenous variables.
  - **Guliano and Dargay (2005)** specify a recursive system of equations which can be estimated independently to model travel decisions and car ownership.

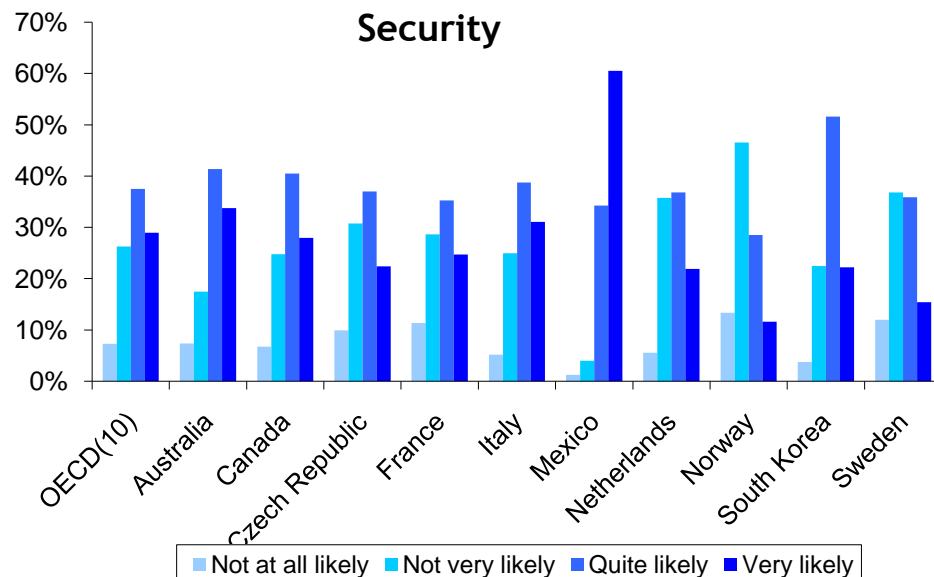
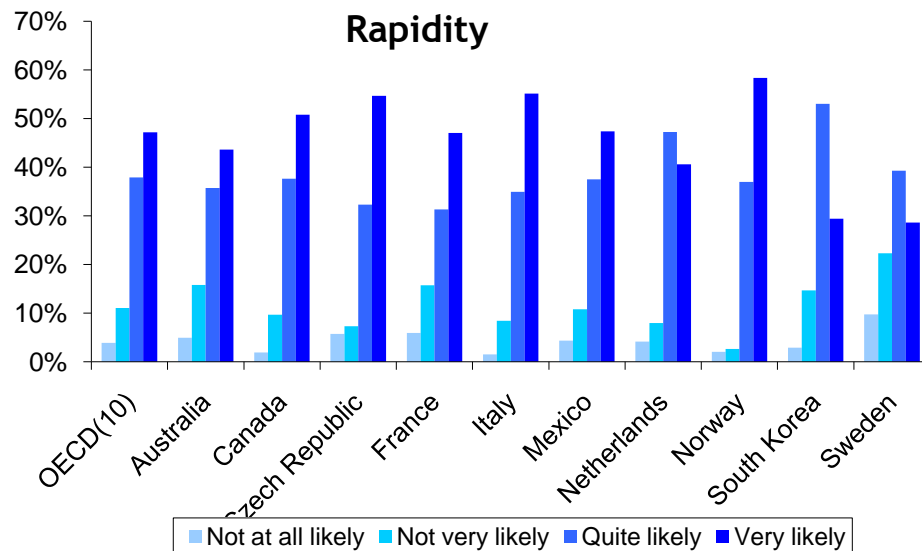
### 3. Data - Commuting mode to and from work



### 3. Data - Characteristics of public transport

- Public transport characteristics (Order of preferences):

- Rapidity
- Reliability
- Convenience and comfort.
- Safety (Important for Mexico)



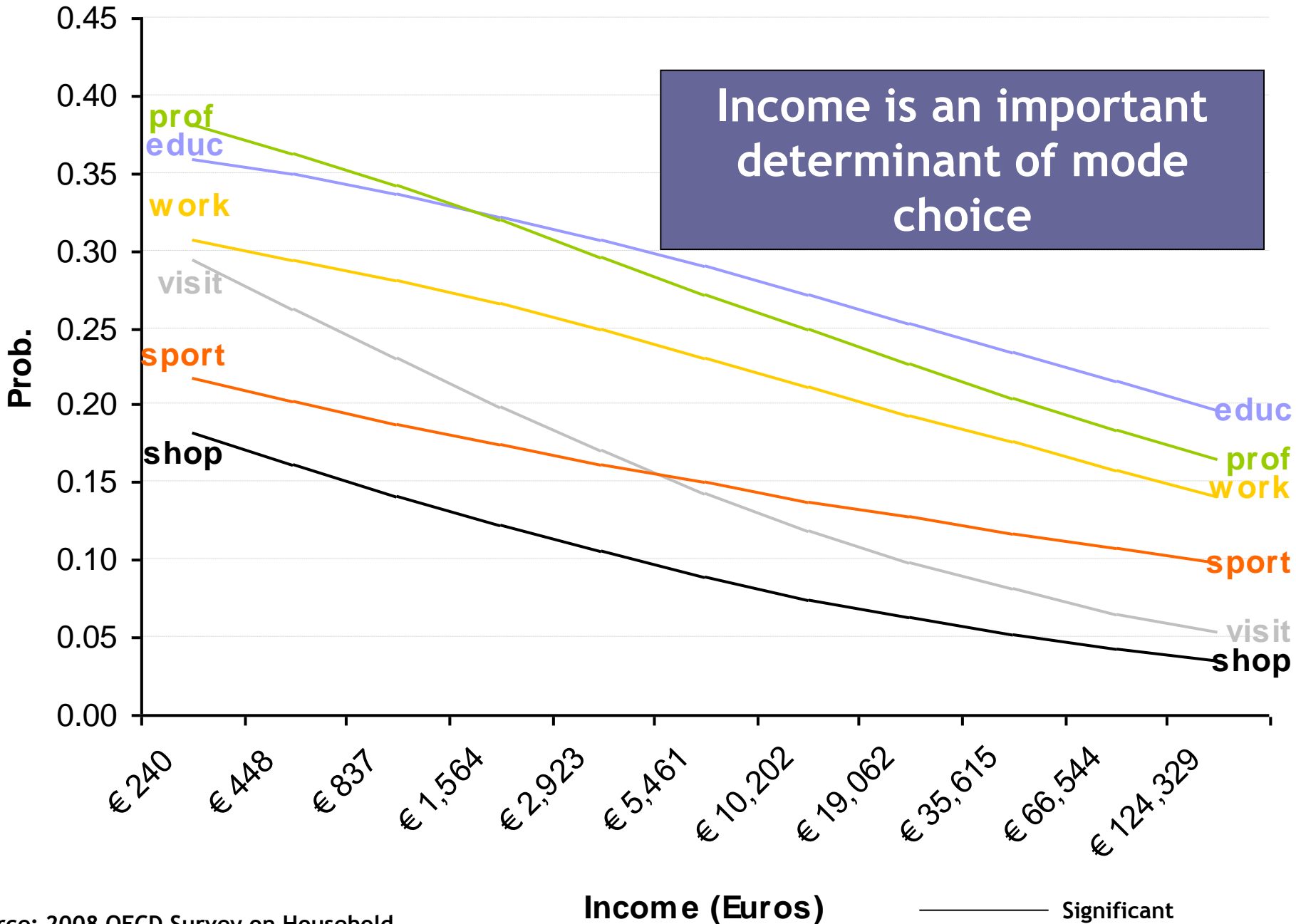
## 4. Estimation

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- The main objective of our work is to model mode choice and public transport use. Respectively, the dependent variables analysed are:
  1. **Mode choice:** a vector indicating whether or not a person chose certain modes of transport to commute to a certain destination.
    - **Modes:** walking, car, public transport, bicycle (non-mutually exclusive).
    - **Destinations:** commuting to and from work, visiting family and friends, shopping, education, sports and cultural activities, and travelling to undertake usual professional activities.
  2. **Public transport use:** measured as monthly expenditures in public transport as a share of income.

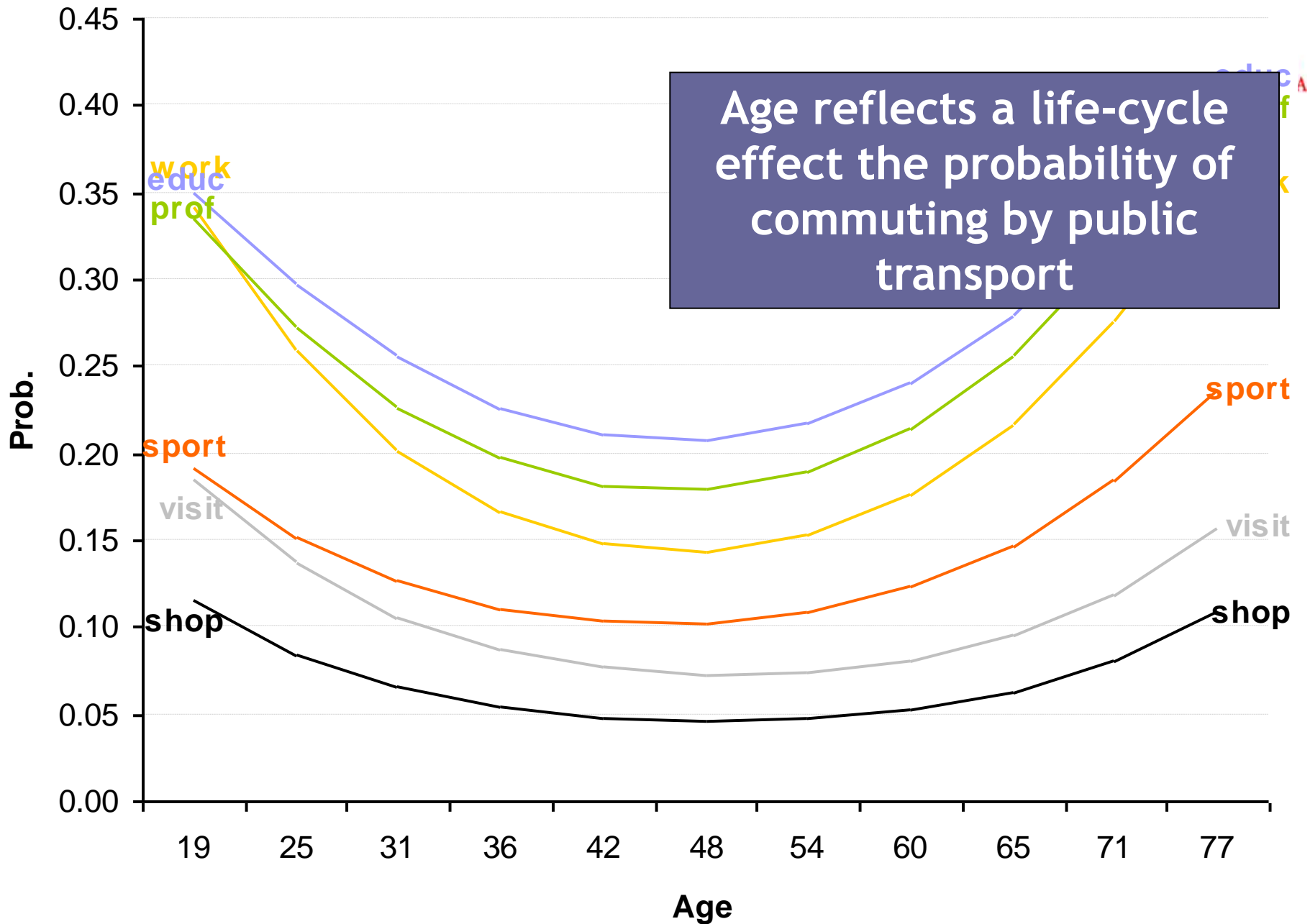
**Empirical results (1):**

**Continuous variables**



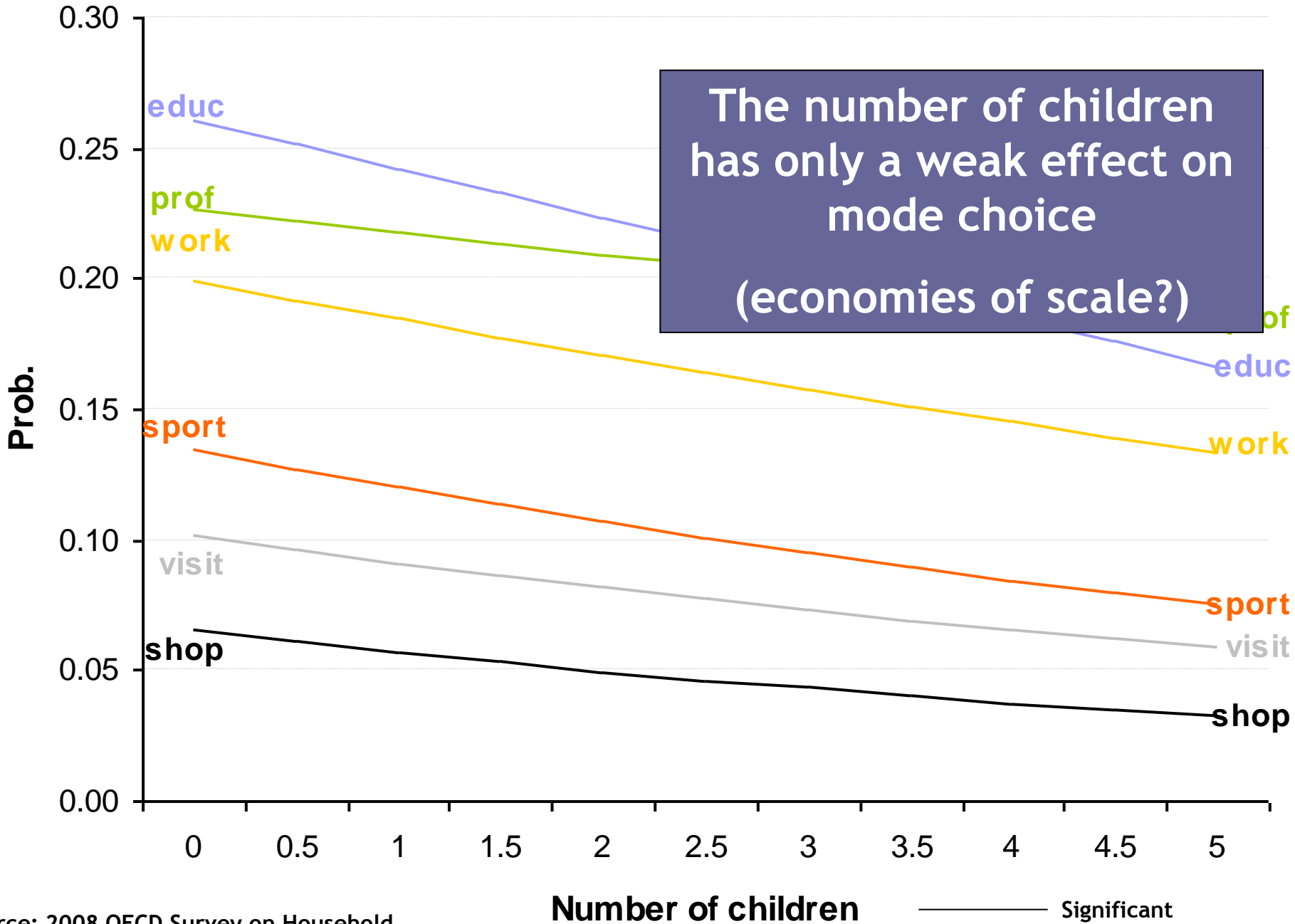
Source: 2008 OECD Survey on Household Environmental Behaviour

— Significant  
 - - - Not significant



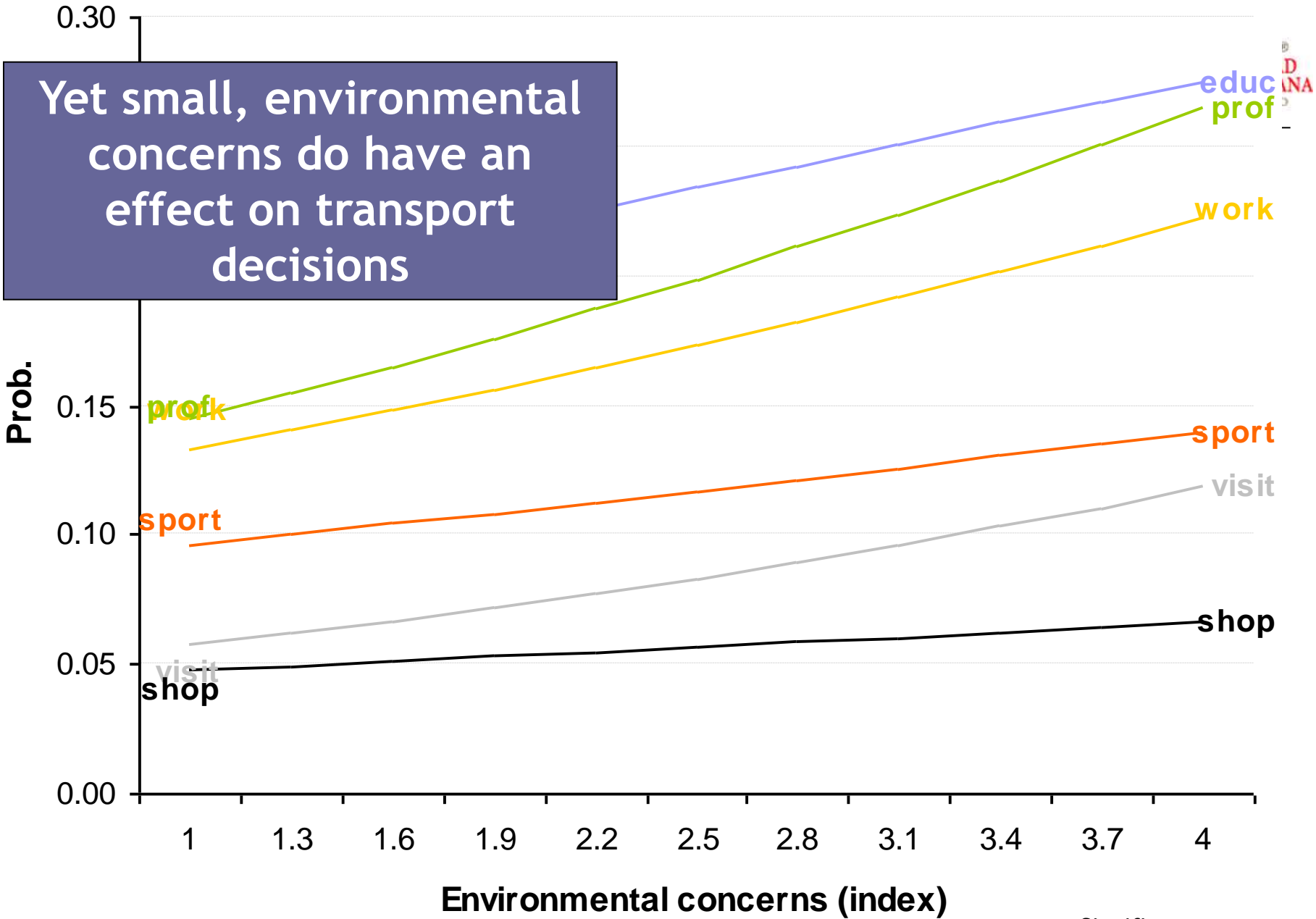
Source: 2008 OECD Survey on Household Environmental Behaviour

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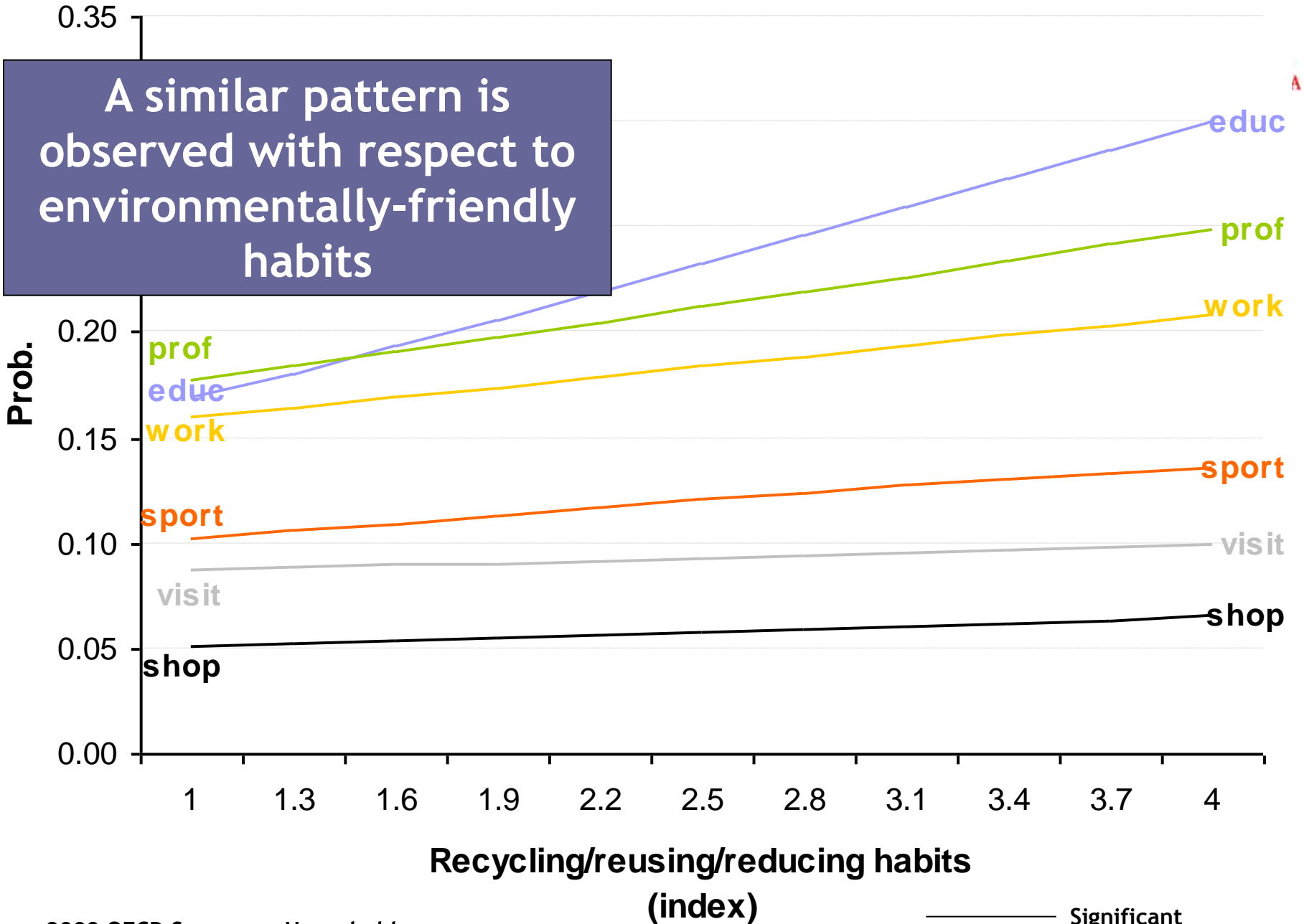
Source: 2008 OECD Survey on Household Environmental Behaviour

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Source: 2008 OECD Survey on Household Environmental Behaviour

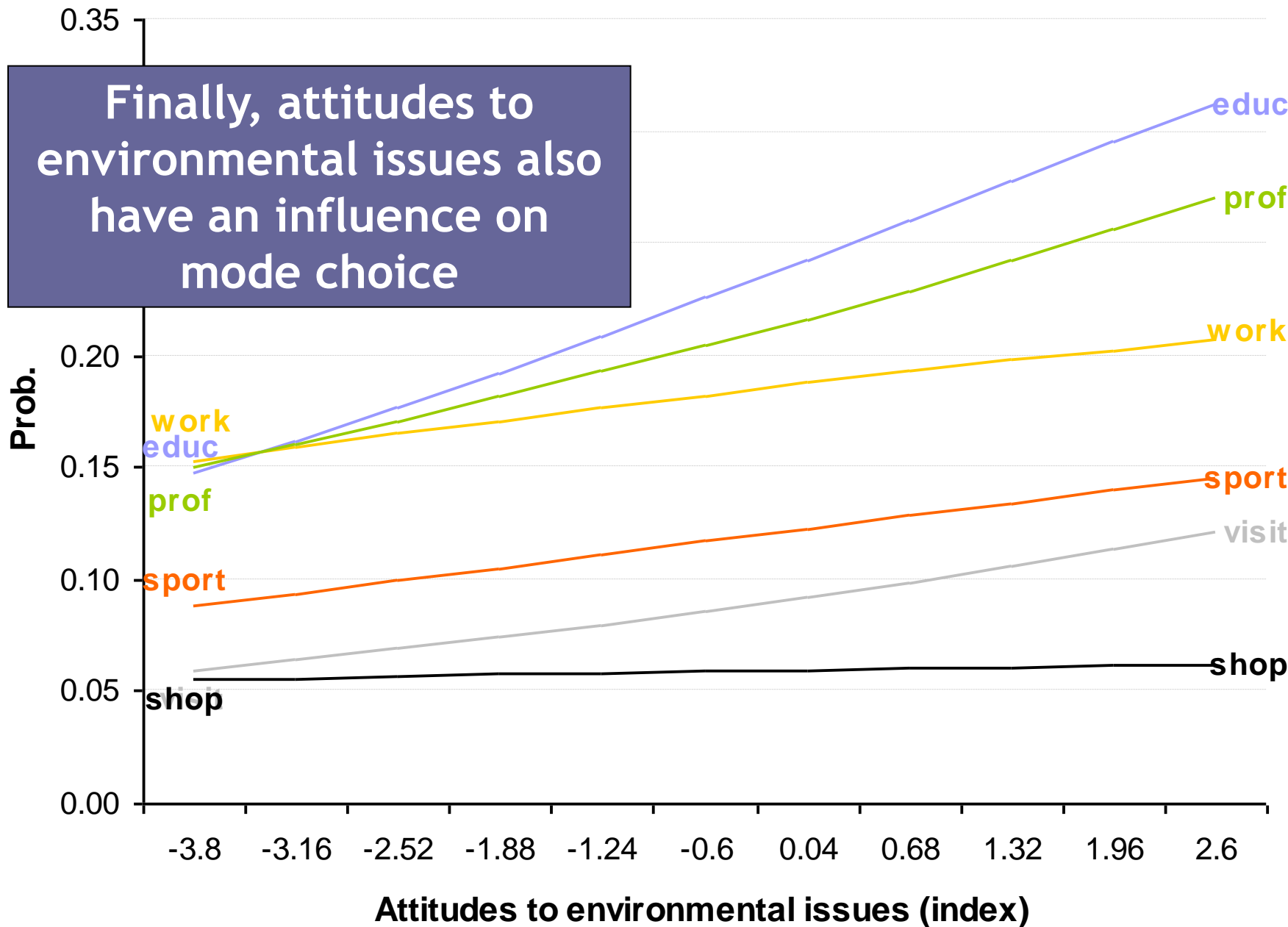
—— Significant  
 - - - - - Not significant



Source: 2008 OECD Survey on Household Environmental Behaviour

— Significant  
 - - - Not significant

Finally, attitudes to environmental issues also have an influence on mode choice



Source: 2008 OECD Survey on Household Environmental Behaviour

— Significant  
- - - Not significant

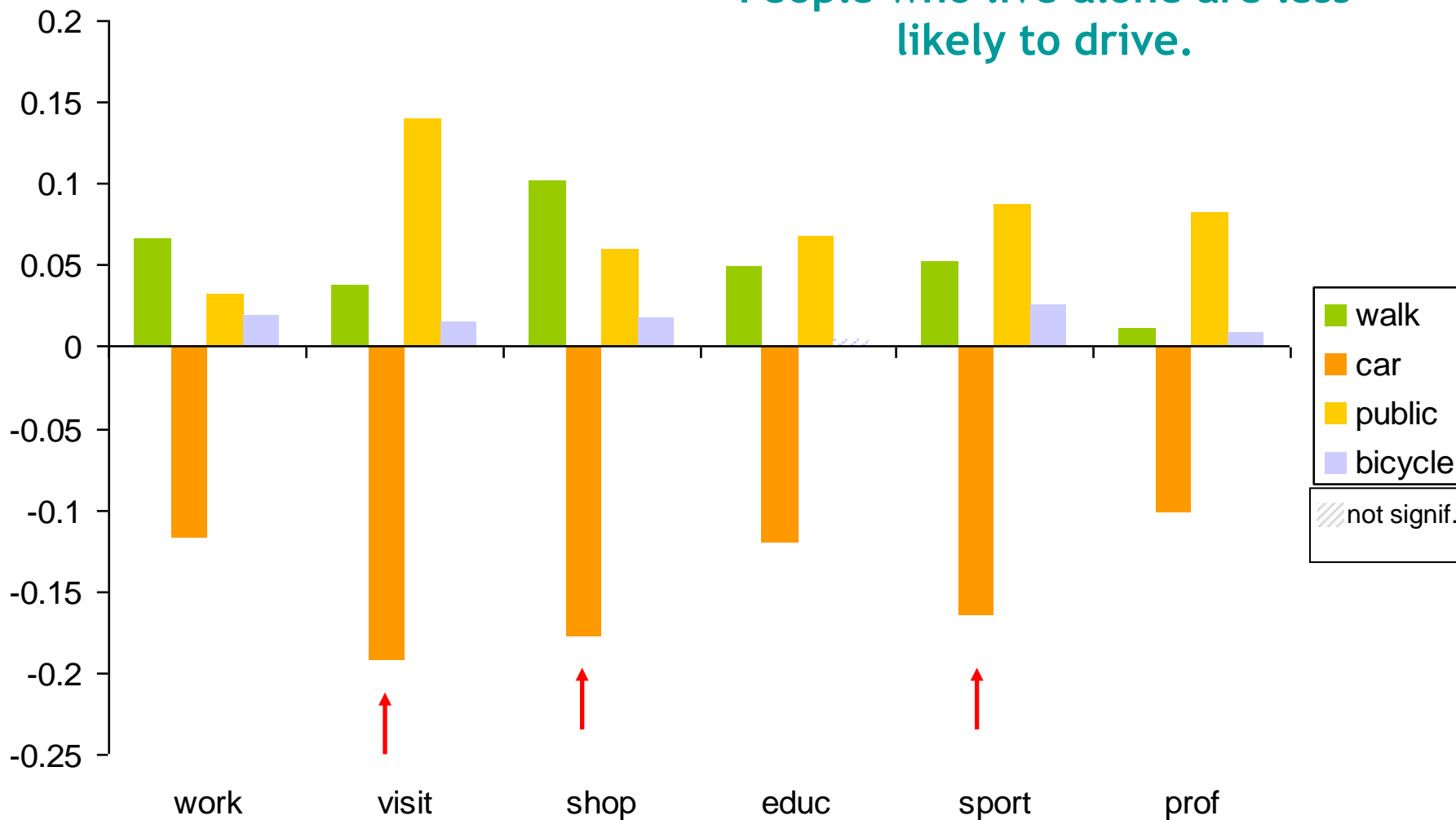
Empirical results (2):

Discrete variables

# Living alone

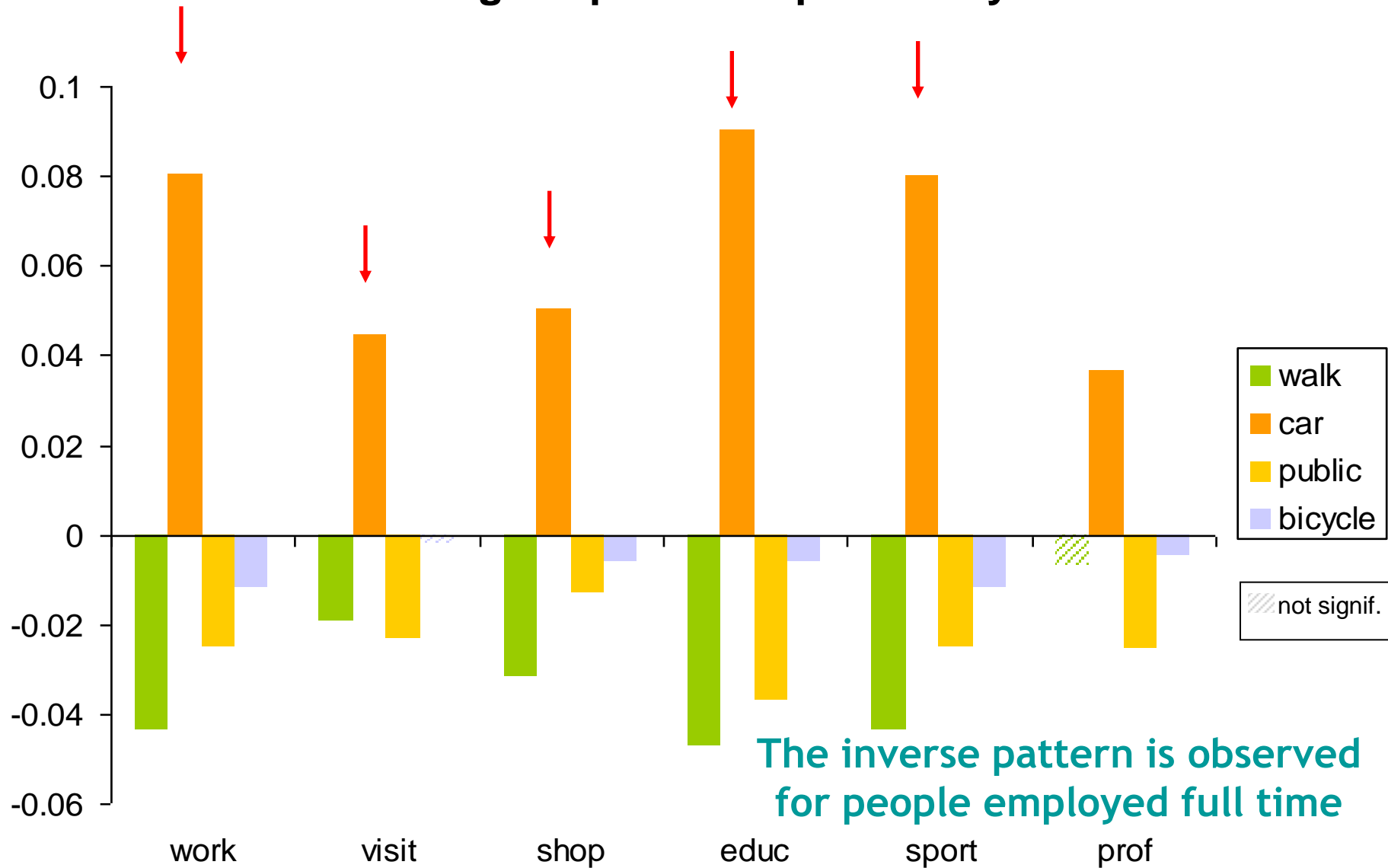
## Change in predicted probability (base=married)

People who live alone are less likely to drive.



# Employed full time

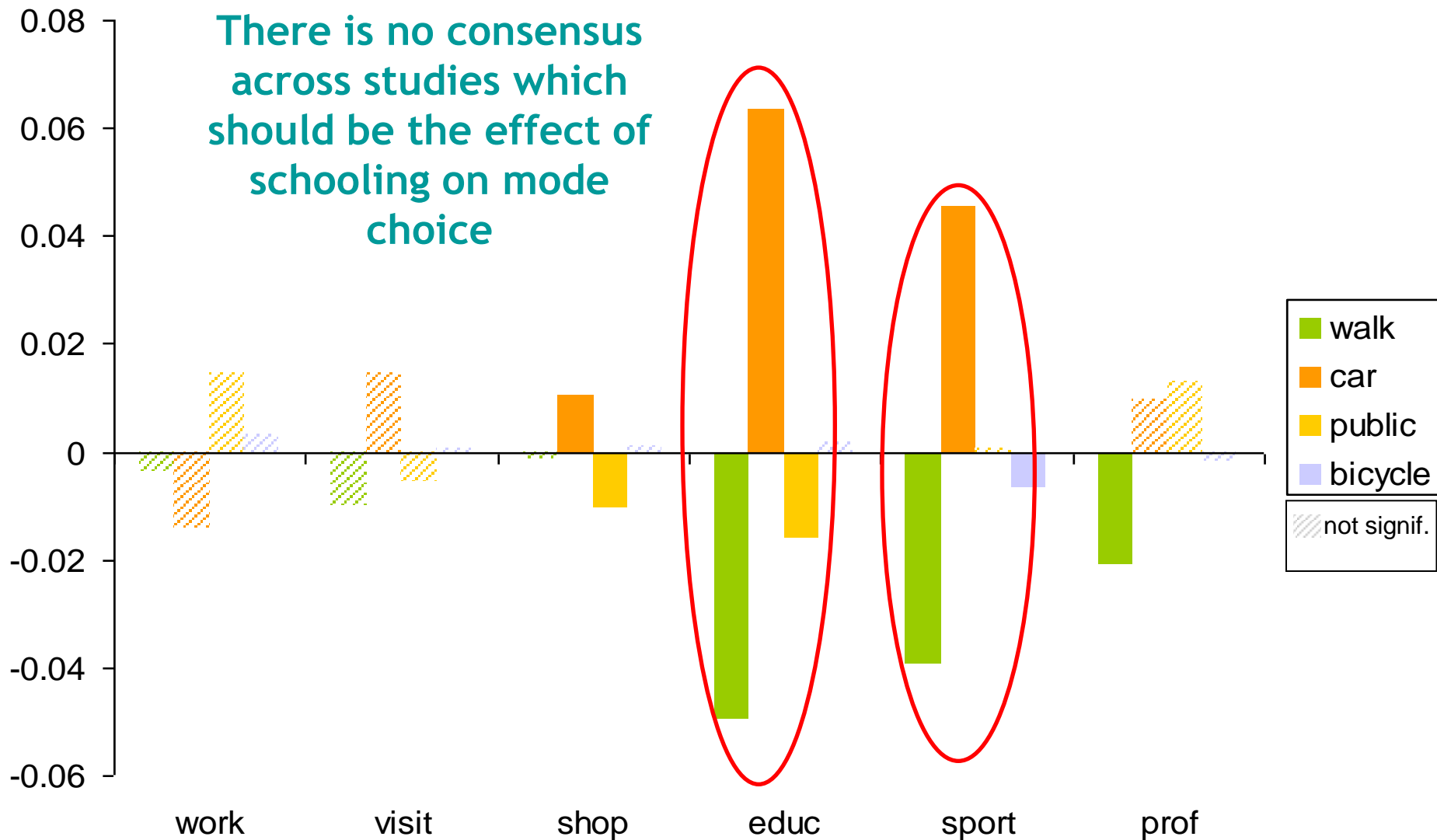
## Change in predicted probability



# Post-secondary education or highest

## Change in predicted probability

There is no consensus across studies which should be the effect of schooling on mode choice



# Male that earns most in household

## Change in predicted probability

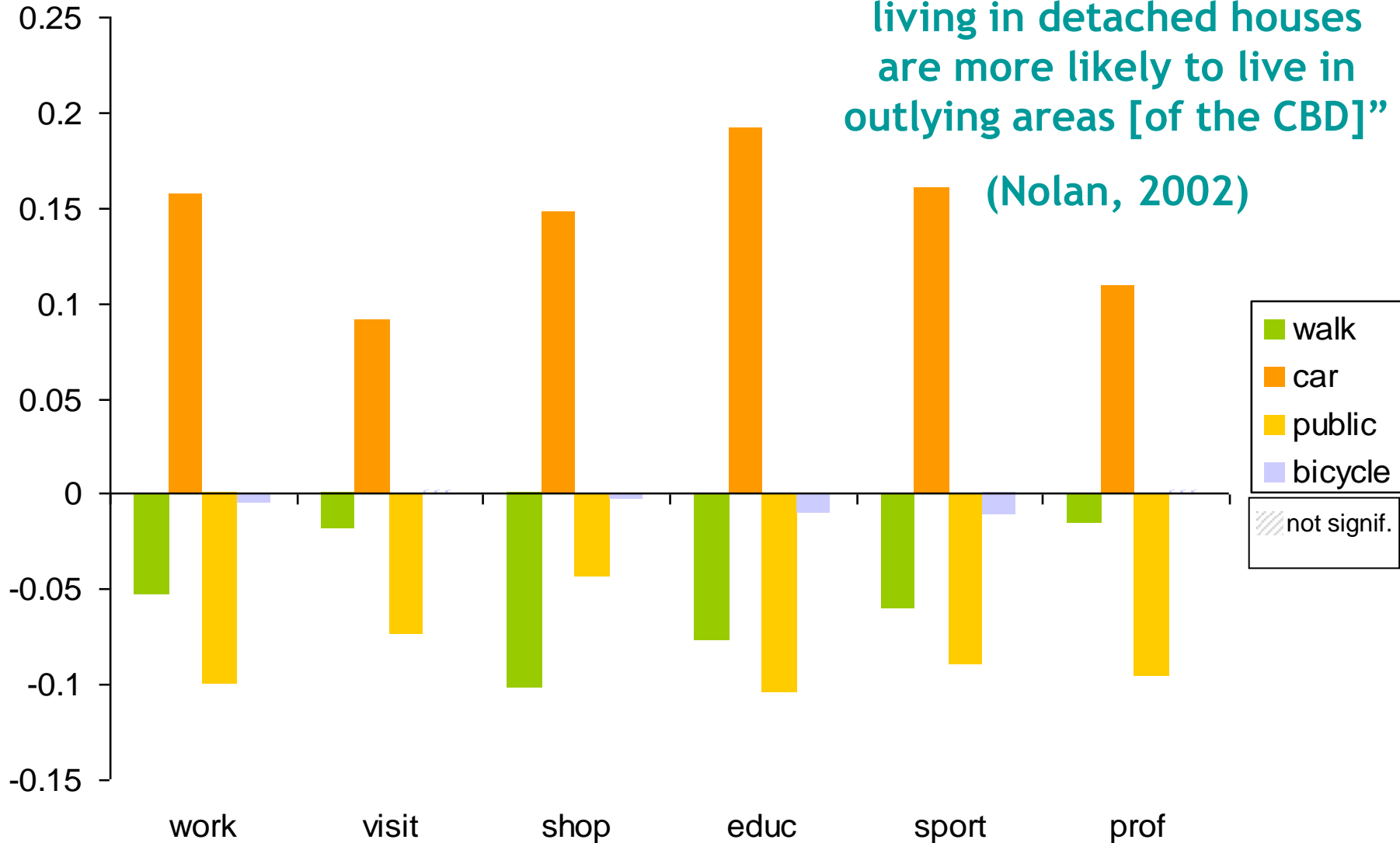
Gender does not determine mode choice; however there are differences for someone who is a male AND earns the most in household.



# Residence is a detached house

## Change in predicted probability

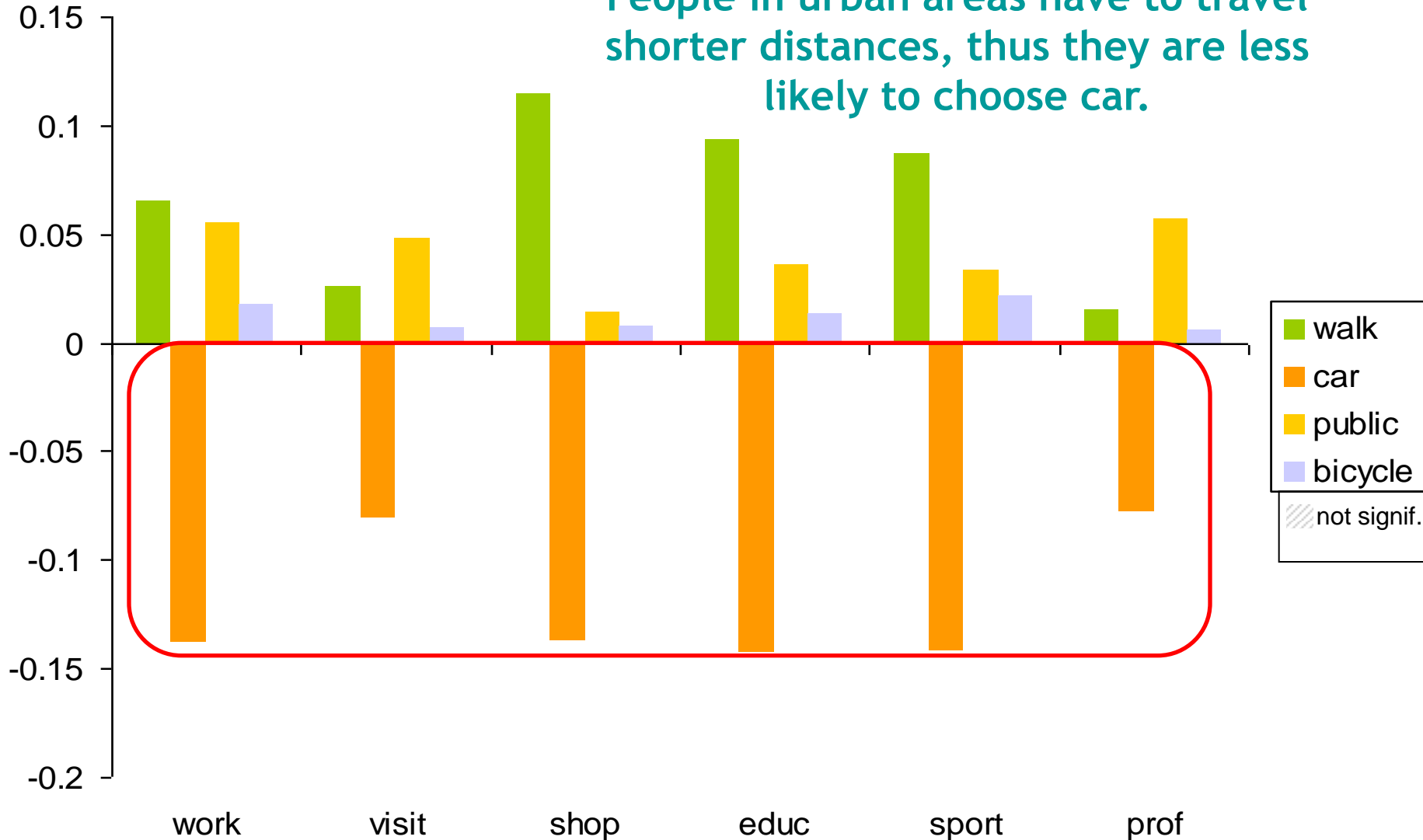
“It is assumed that those living in detached houses are more likely to live in outlying areas [of the CBD]”  
(Nolan, 2002)



# Residence is in an urban municipality

## Change in predicted probability

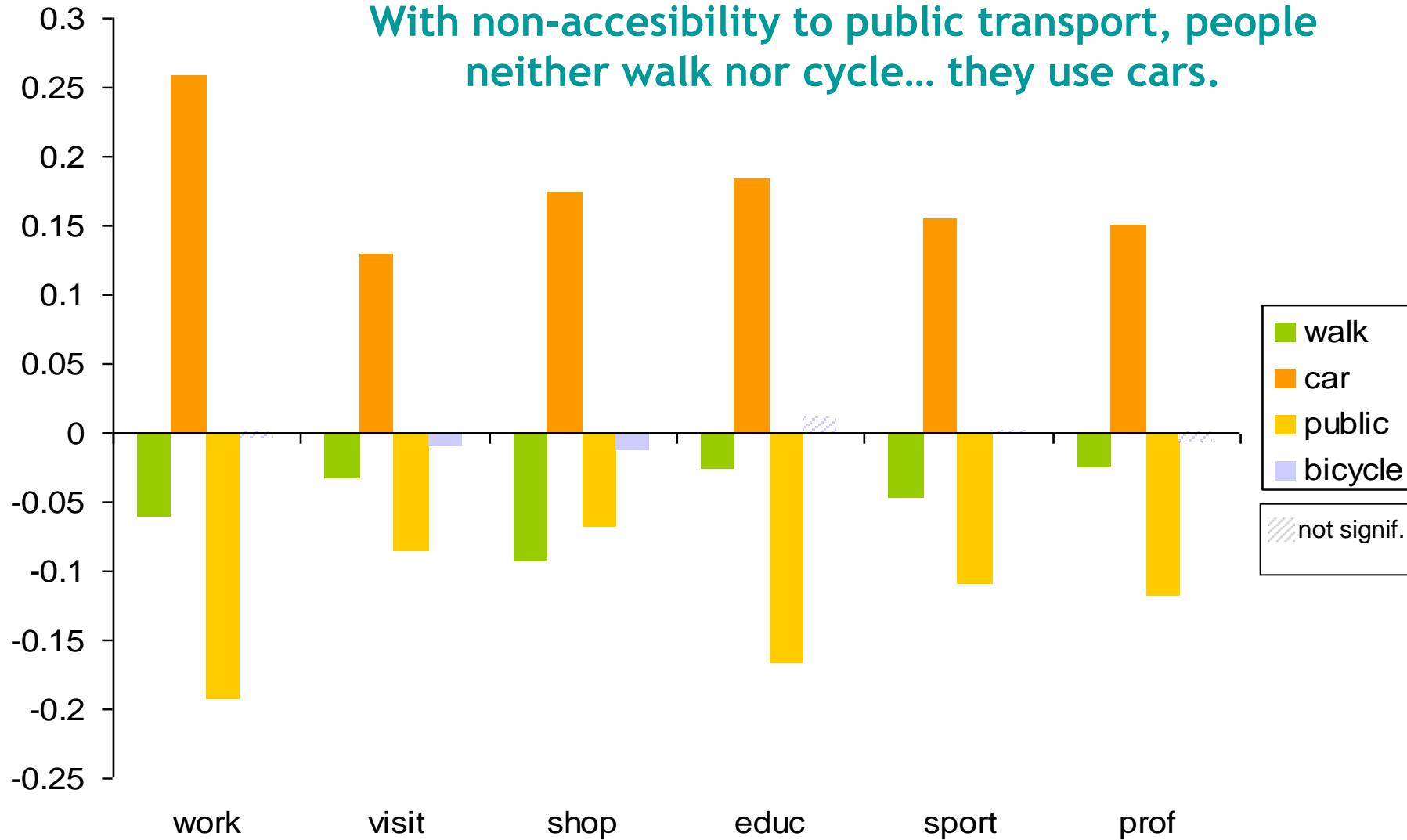
People in urban areas have to travel shorter distances, thus they are less likely to choose car.



# There is no public transport station near residence

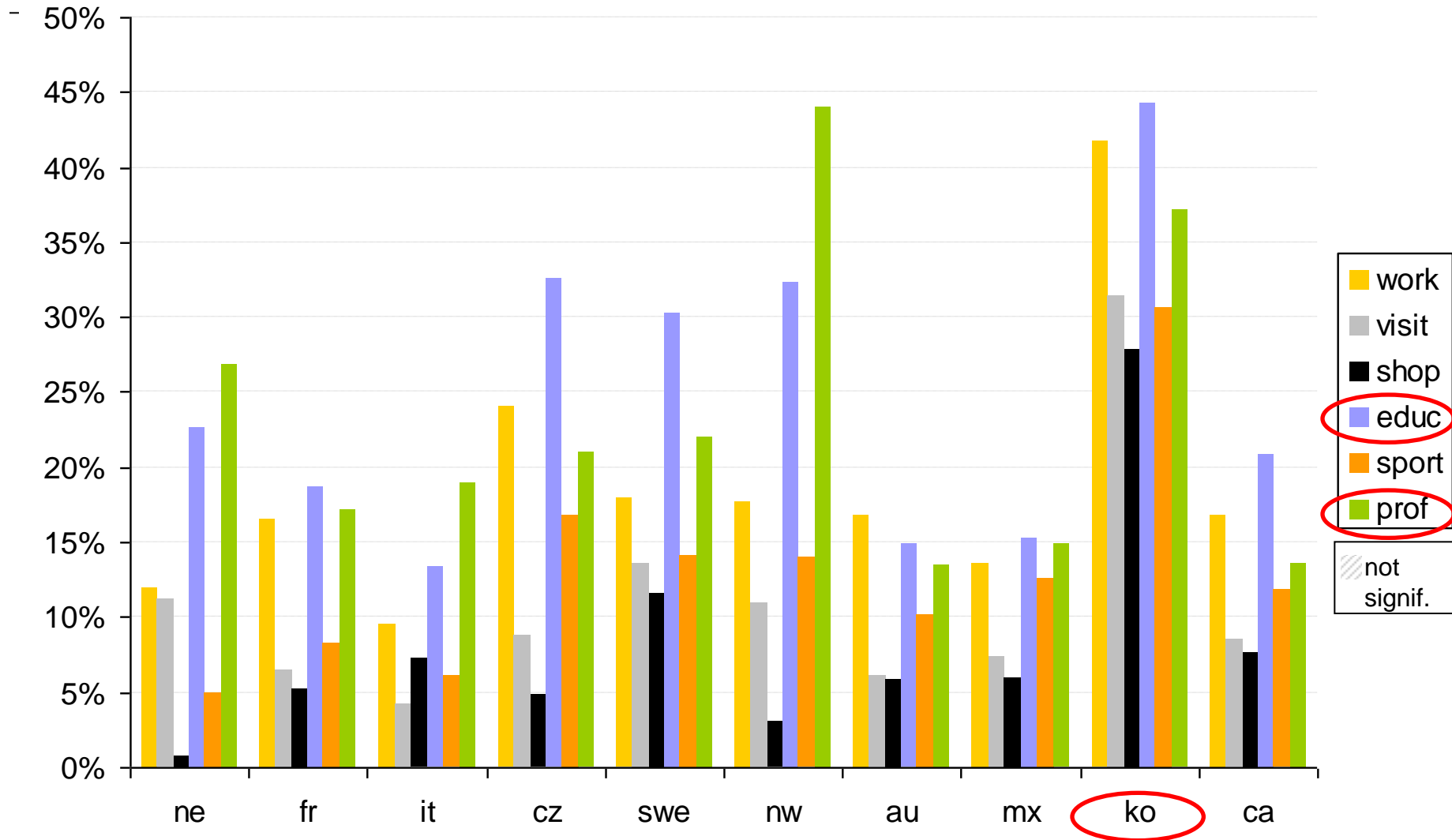
## Change in predicted probability

With non-accesibility to public transport, people neither walk nor cycle... they use cars.



# Fixed effect by country

## Predicted probability of commute by public transport



Source: 2008 OECD Survey on Household Environmental Behaviour

People in Korea are the most likely to choose public transport.

## 4. Estimation - Public transport use

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### Public transport use

- Public transport was analysed specifying a Heckman selection model.
- First, the probability of choosing public transport is estimated.
- Then, the intensity of public transport use is estimated. (Measured in terms of public transport monthly expenditures as a share of income).
- Results from estimations are:

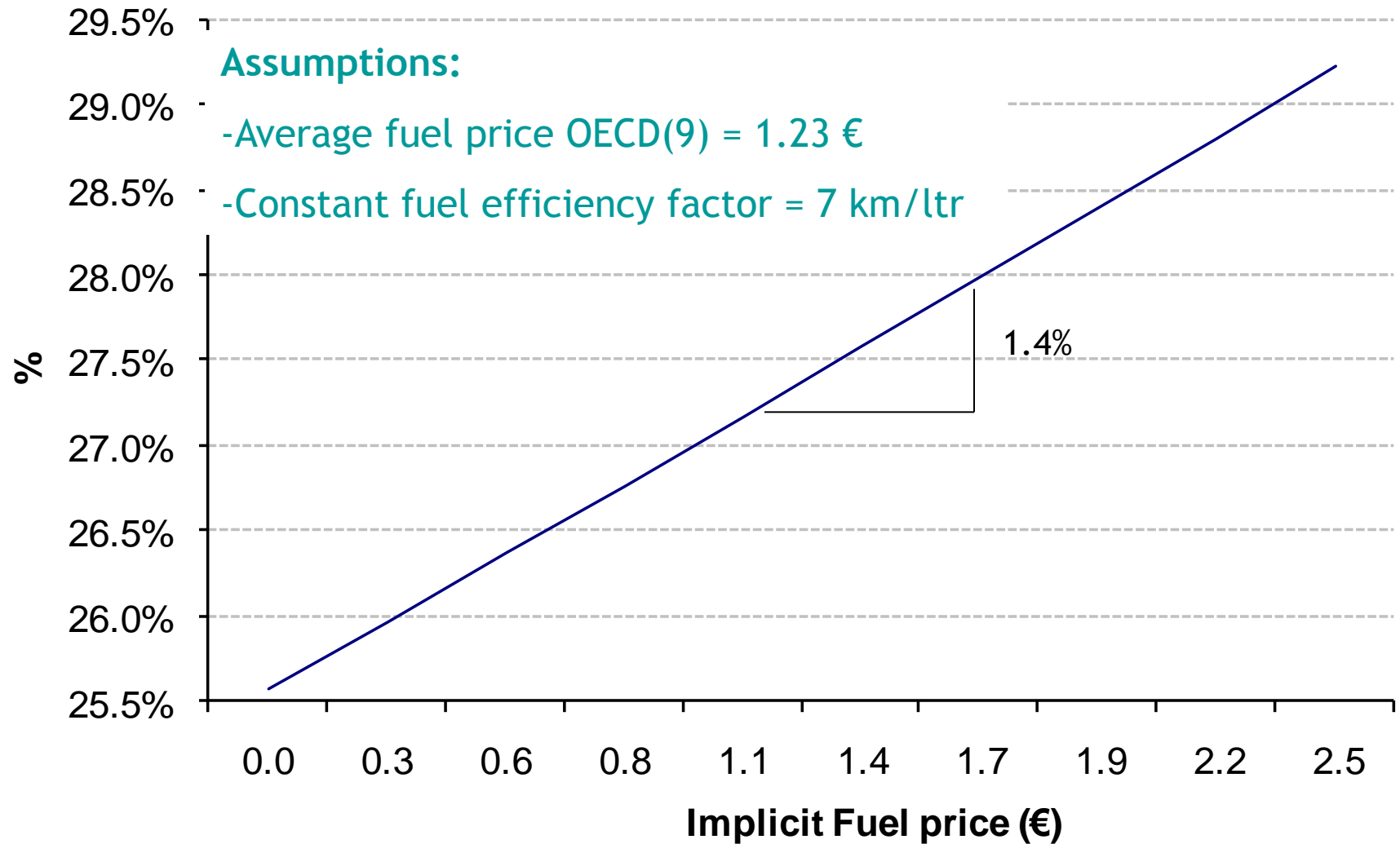
Variable	Intensity of use	Probability of selection
lincome	-0.026 ***	0.035
aprice	0.004	0.306 ***
retired	-0.007 ***	
female	0.001	
educated	0.001	0.265 ***
envpurch_index	0.002	0.116 ***
envattid_index	-0.002 **	0.143 ***
encncrn_index	0.000	0.072 **
Urban	-0.006 **	0.457 ***
suburban	-0.006 **	0.406 ***
children		-0.062 ***
age		-0.039 ***
age2		0.000 ***
car		-0.666 ***
comnopub		-1.146 ***
can	0.000	-0.924 ***
nld	0.001	-1.027 ***
fra	-0.001	-0.827 ***
ita	-0.005 **	-0.517
czr	-0.023 ***	-0.087
swe	0.006 *	-1.032 *
nor	0.014 ***	-0.497 **
aus	-0.002	-0.879 ***
constant	0.282 ***	0.228

/athrho	-0.023
/lnsigma	-3.448 ***
rho	-0.023
sigma	0.032
lambda	-0.001

LR test of indep. eqns. (rho = 0):  $\chi^2(1) = 0.05$

Number of obs	9,242
Censores obs	6,368
Uncensored obs	2,874
Log Likelihood	936.63
Prob > $\chi^2$ (Wald)	0
Prob > $\chi^2$ =	0.816

# Probability of commuting by public transport vs. fuel price



## 5. Policy implications and conclusions

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- The way in which people make their commuting decisions is dependent on a number of socio demographic features such as age and income, but also on the way any given trip occurs in terms of rapidity, comfort, personal safety, etc., and on more permanent choices, such as the level of car ownership.
- Given these facts, changing the way in which people commute is not easy.
- *48 years old is related to the least prob. of commuting by public transport*
- *Prob of commuting by public transport is reduced by 2% when annual income increase by 1,000 euros*
- *An increase of 1 euro of price of fuel increase prob. Of commuting by public transport in 1.4%*

## 5. Policy implications and conclusions

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- While useful, it is claimed that traditional pricing measures have a limited scope mainly because of the rebound effect (Dargay, 2008). In this context, our results show that the probability of commuting by public transport is inelastic to fuel prices.
- However, there are other policies that can increase the use of public transport:
  - Invest in accesibility, comfort and rapidity.
    - Adopt an origin-destination approach to identify travel patterns
  - Targeting younger and older people.
    - Differentiated fees.
  - Implementing “soft policies”
    - Public campaigns, educational programs.

Thank You

<i>Independent variable</i> Reference	Income	Age	Male	Education	Children (# no.)	Acces- sibility to public transport	City size	Attitude to env.	Country
<b><i>Car (Commuting mode)</i></b>									
Simma and Axhausen (2004)			+		—				Austria
Golob and Hensher (1998)	?	+	+/-	—			0	—	Australia
Dargay (2005)	+		0		+		—		GB
Guevara and Lara (2008)	+	-/+	0	—	+	+	—	—	10 OECD countries
<b><i>Public transport use</i></b>									
Abreu e Silva <i>et al.</i> (2006)*	—	+	—						Portugal
Johansson-Stenman (2002)*	—	-/+	—	+	—		+	0	Sweden
Guevara and Lara (2008)	+		0	—			—	-(+)	10 OECD countries
<b><i>Public transport use (Commuting mode)</i></b>									
Golob and Hensher (1998)	+	-/+	—	-/+			+	+	Australia
Dieleman <i>et al.</i> (2002)	—			—	—		+		NL
Guevara and Lara (2008)	0	-/+	0	+	—	—	+	+	10 OECD countries

\* Measured as kilometres travelled.

## 4. Estimation - Mode choice

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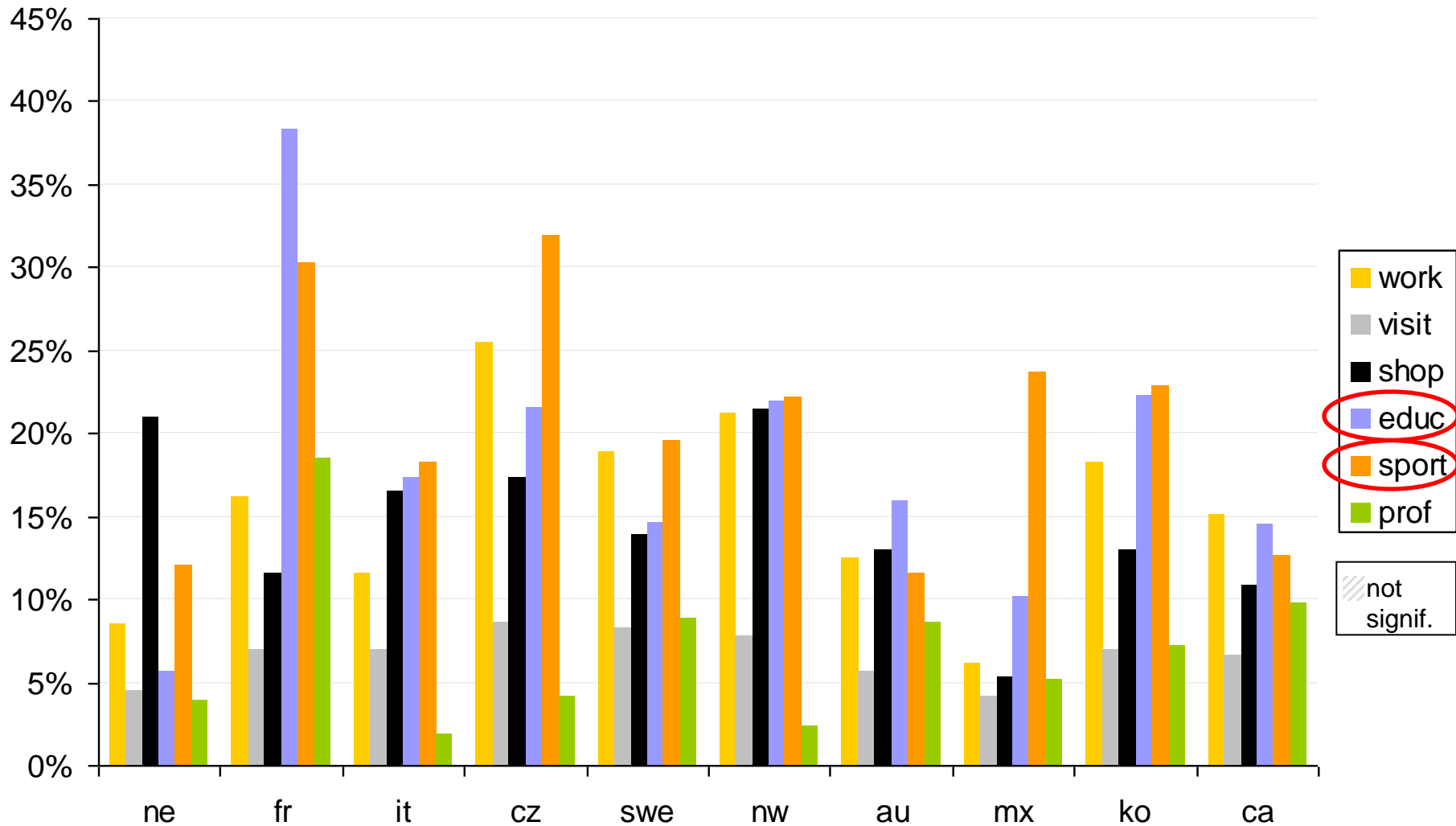
- For each destination a conditional logit is specified. This model estimates the probability of choosing a specific mode of transport.

$$P_j = \frac{e^{x_j\beta_j}}{\sum_{i=1}^J e^{x_i\beta_i}}$$

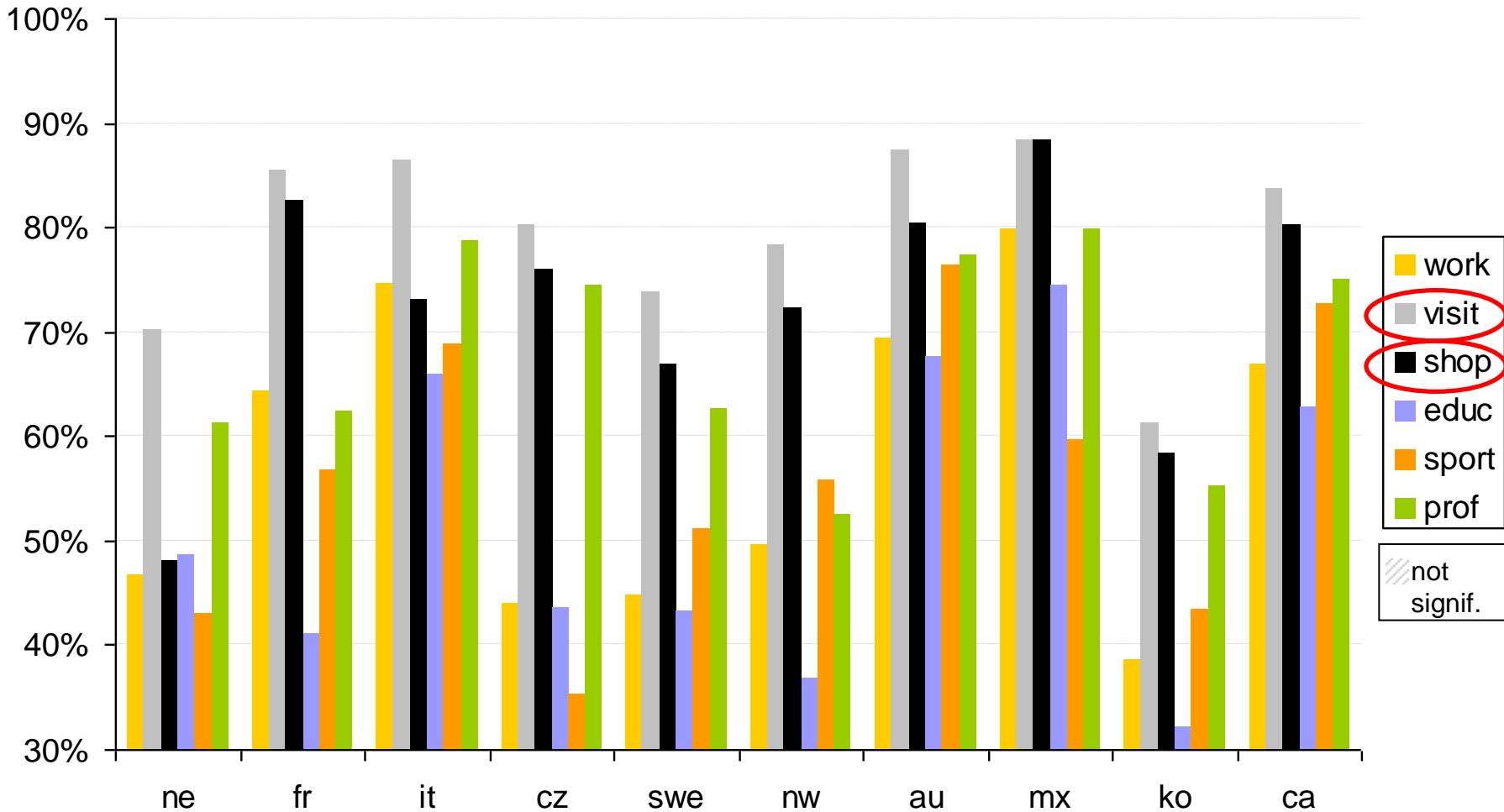
- Estimation of the  $\beta$  is carried out by maximum likelihood.
- The set  $X$  includes socio-demographic characteristics, attitudes toward environment issues, characteristics of the trips and attitudes to public transport.
- Main results are presented next:

# Fixed effect by country

## Predicted probability of walking

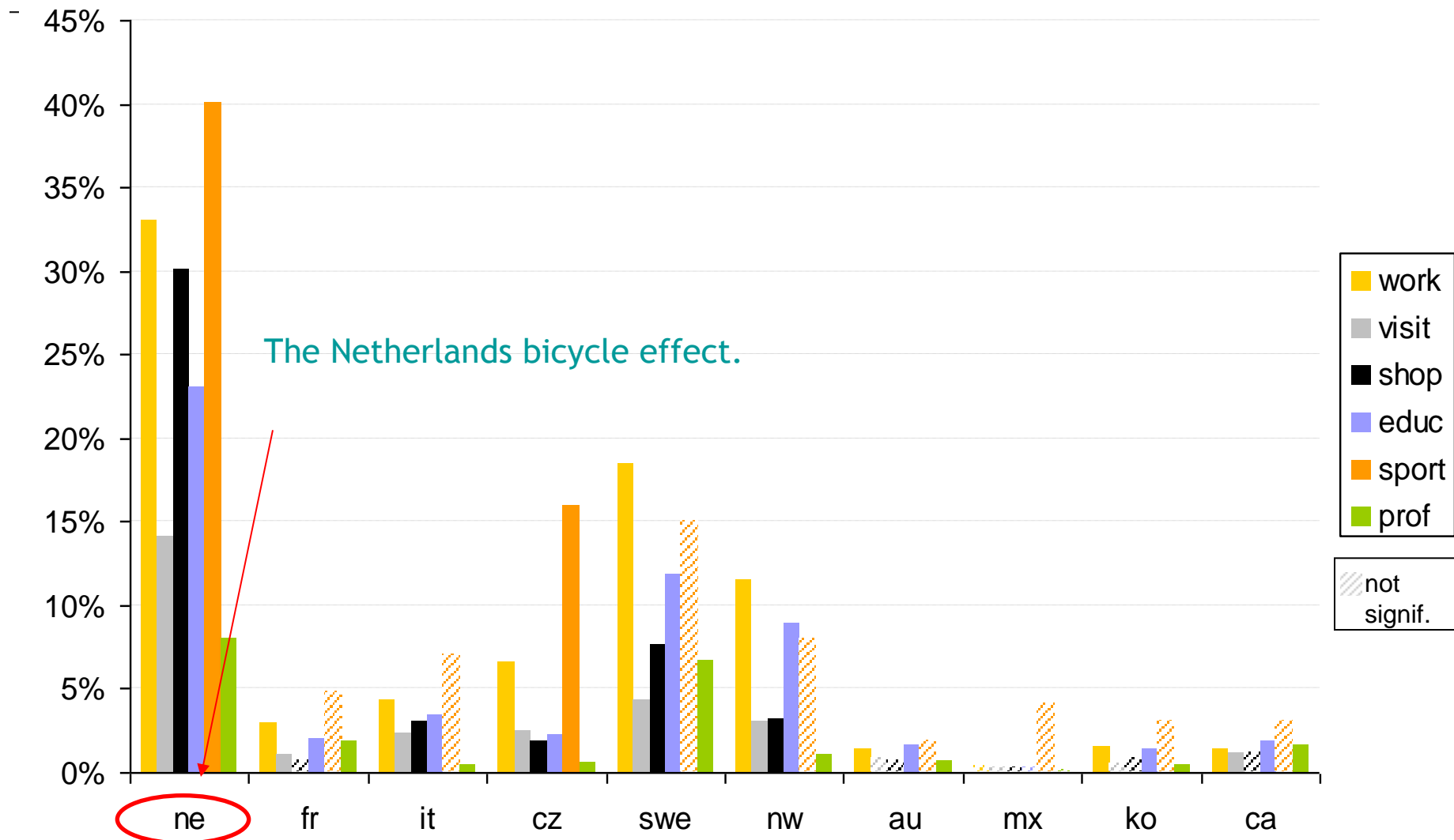


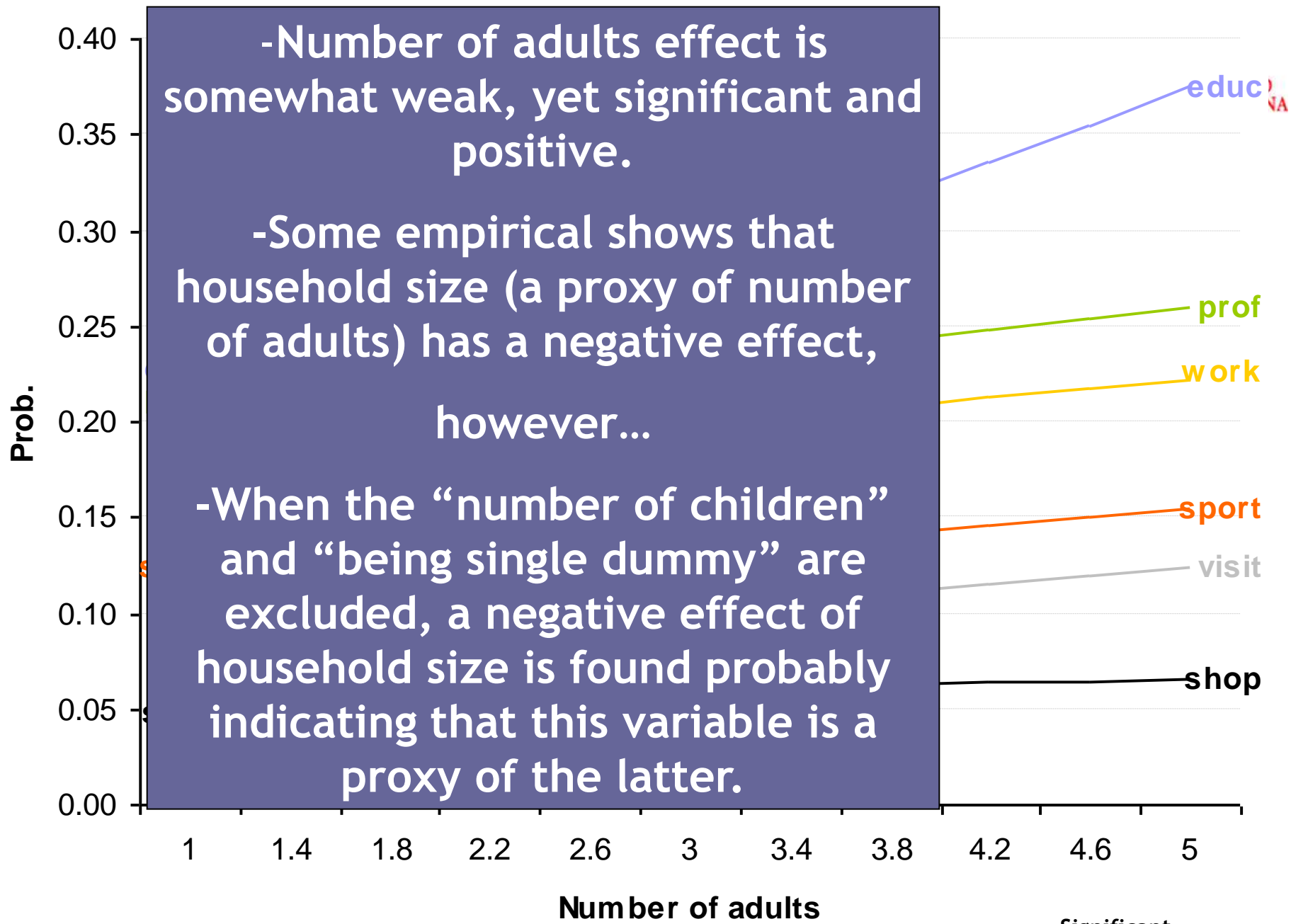
## Fixed effect by country Predicted probability of commute by car



# Fixed effect by country

## Predicted probability of cicyling





-Number of adults effect is somewhat weak, yet significant and positive.

-Some empirical shows that household size (a proxy of number of adults) has a negative effect, however...

-When the “number of children” and “being single dummy” are excluded, a negative effect of household size is found probably indicating that this variable is a proxy of the latter.