

On modeling energy demand vs service demand for individual motorized mobility in Austria

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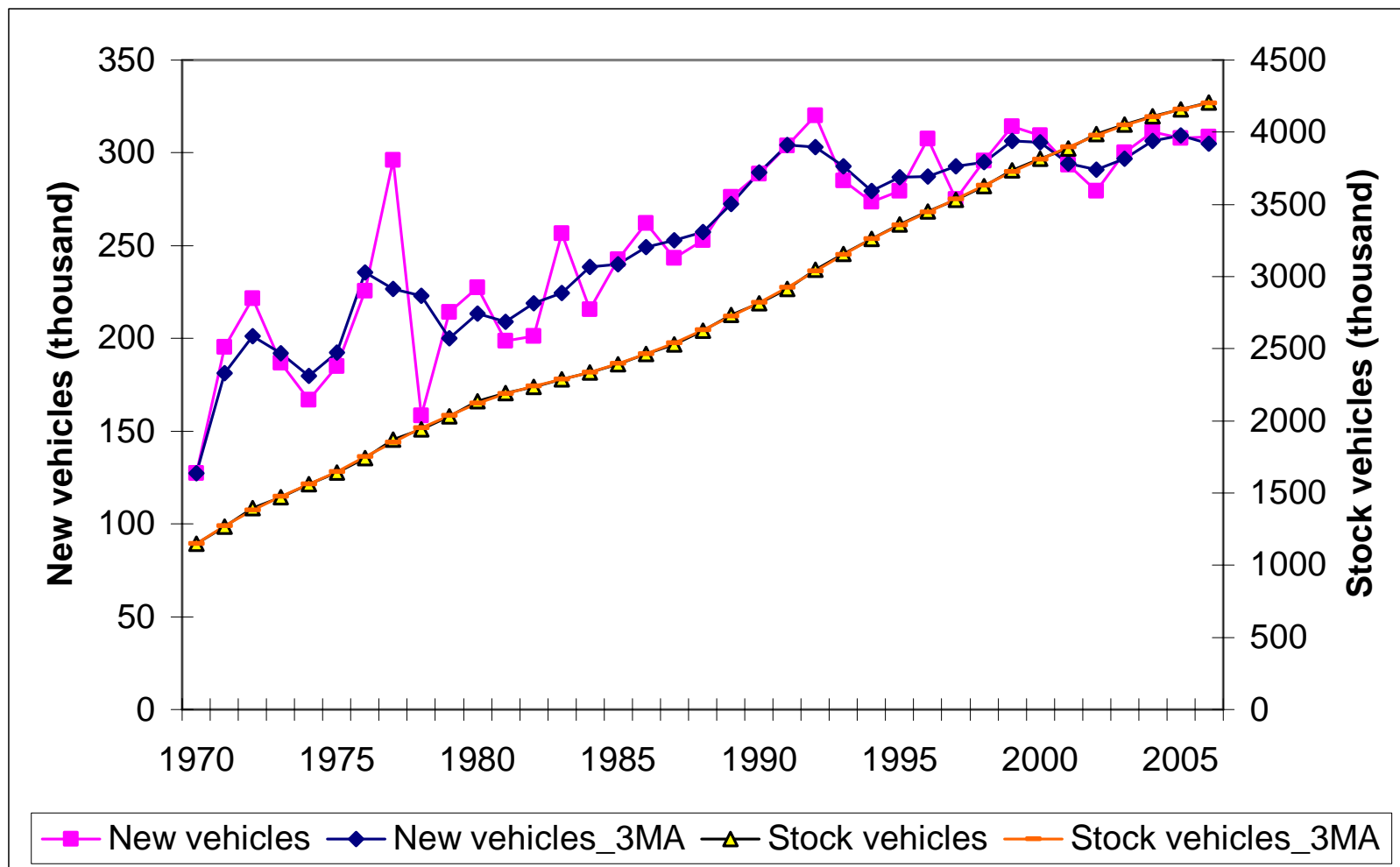
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2. Some background
3. Method of approach and results of the econometric analyses
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1. Introduction

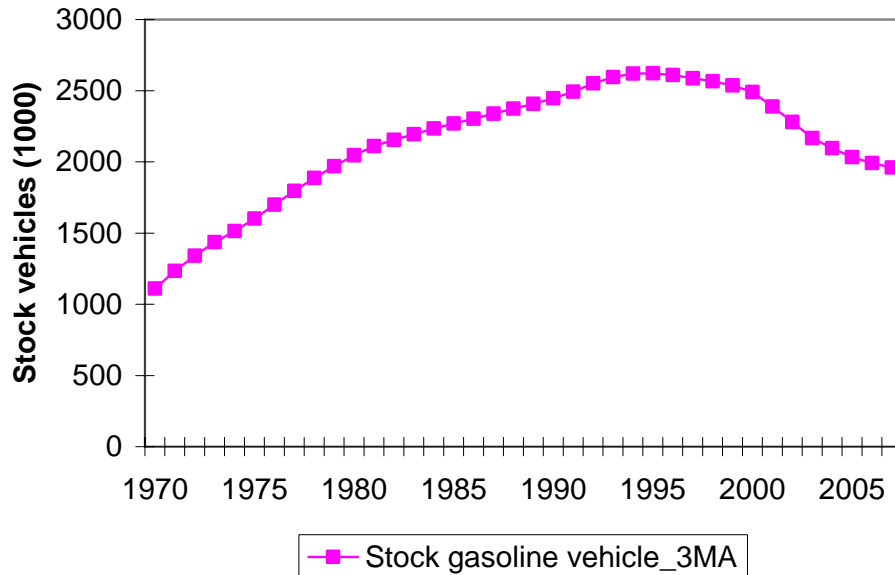
This work focuses on the development of the key indicators responsible for growth in energy consumption in individual transportation in Austria.

The **core objective** is to identify the impact of major economic parameters – changing fuel prices, households income, investment costs of cars – on the overall demand for vehicles (and the changes in their size), mobility (km driven) and the corresponding demand for gasoline and diesel in Austria.

Development of vehicle stock and new vehicles in Austria

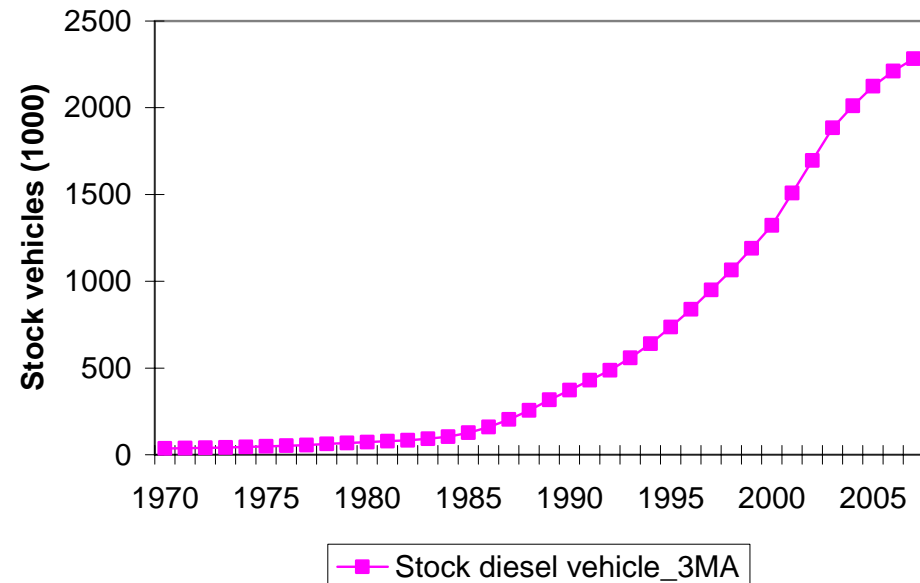


2. Some background



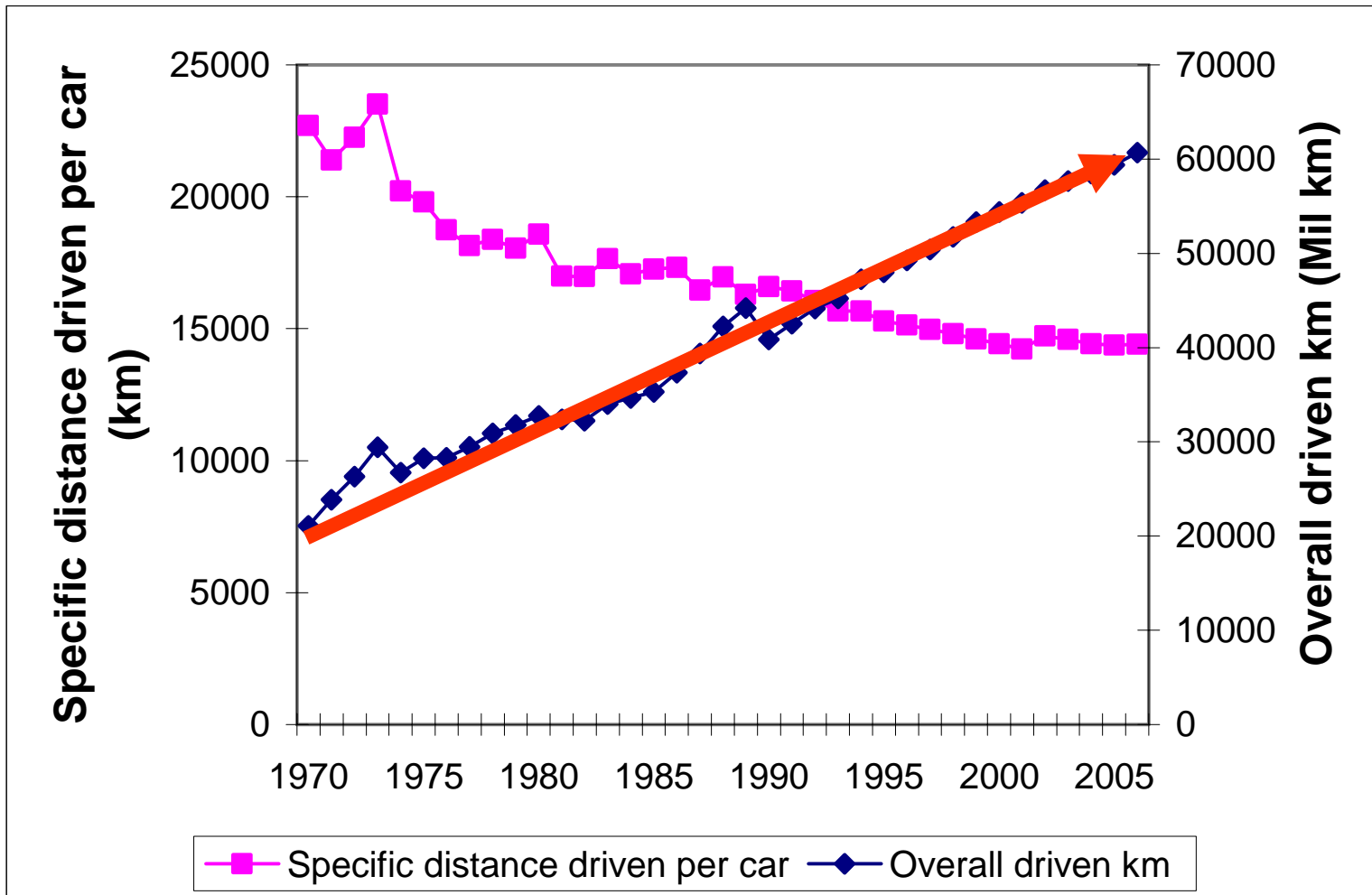
*** Development of gasoline vehicle stock in Austria**

*** Development of diesel vehicle stock in Austria**

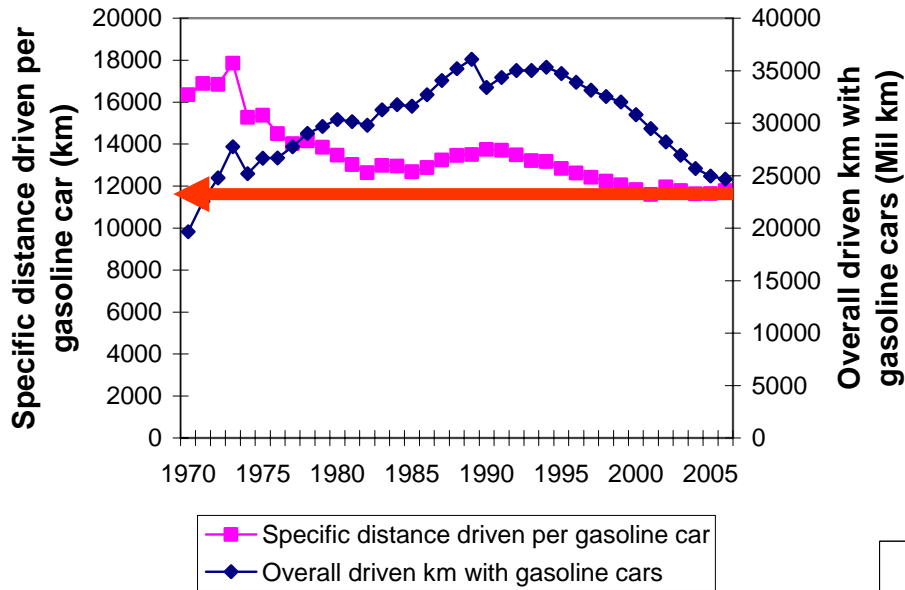


2. Some background

Number of overall driven person-km and specific distance driven per car and year from 1970 to 2006 in Austria

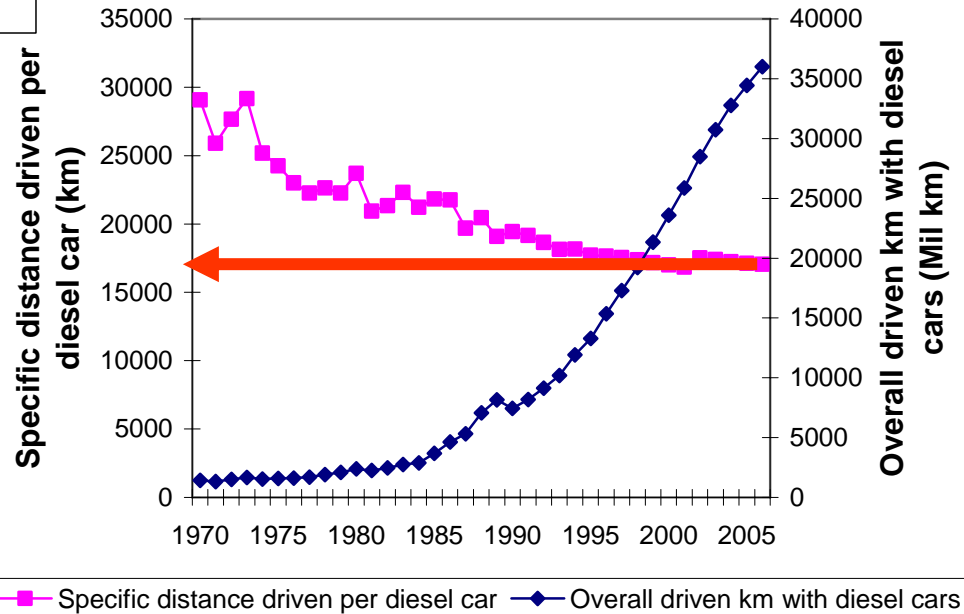


2. Some background



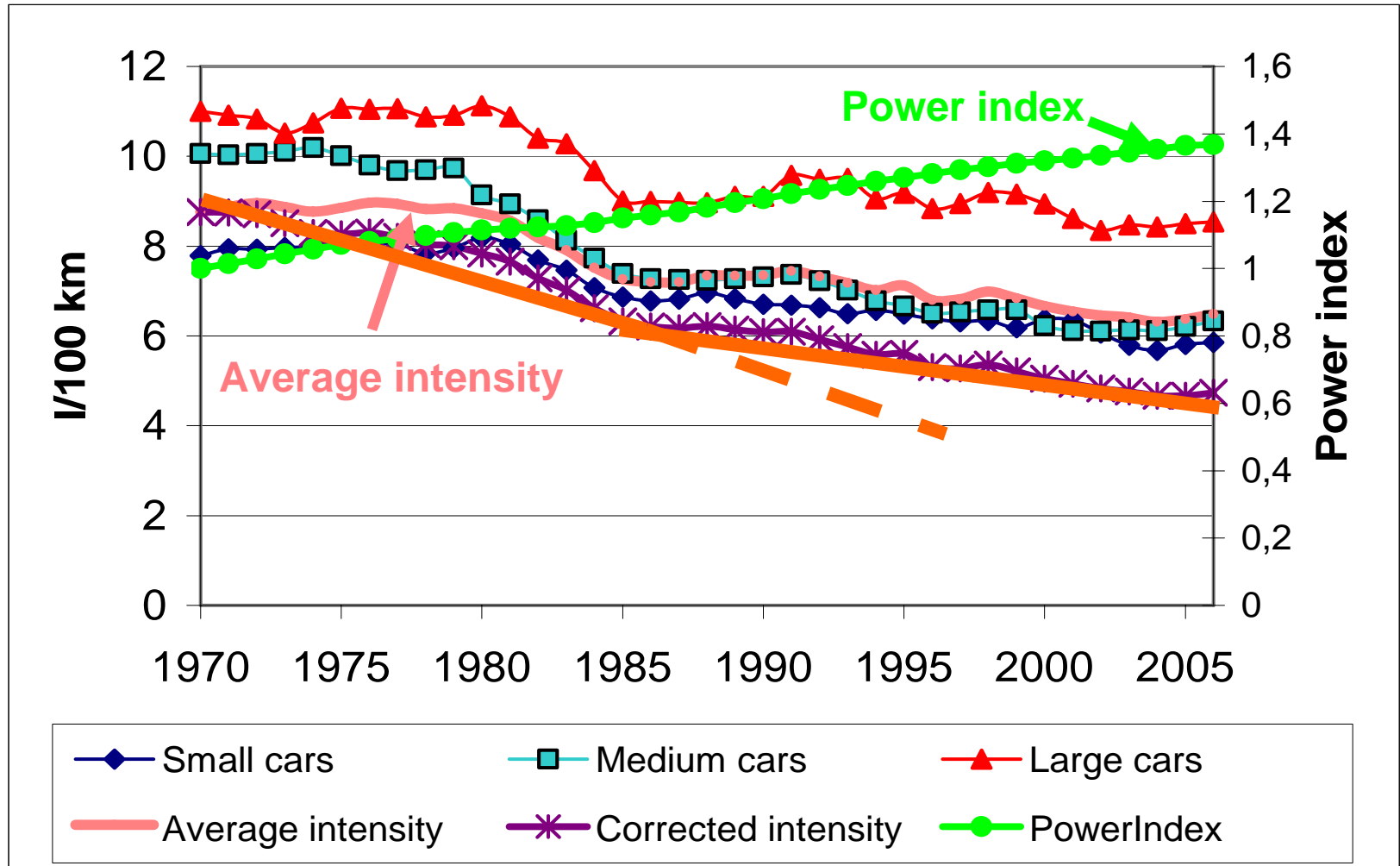
* Number of overall driven person-km and specific distance driven per gasoline car and year in Austria

* Number of overall driven person-km and specific distance driven per diesel car and year from in Austria



2. Some background

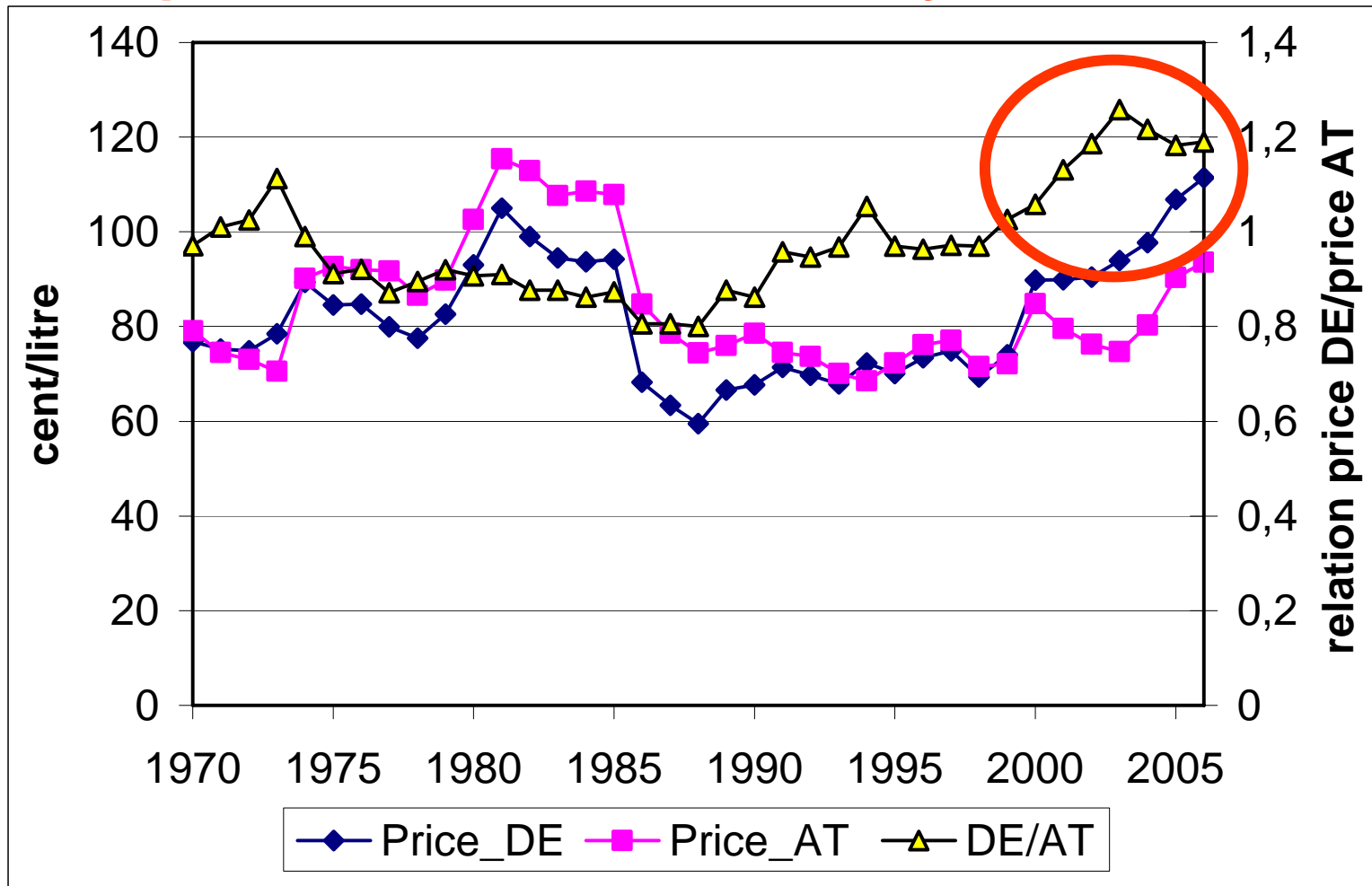
Different fuel intensities in Austria (1970-2006)



$$INT_{Corr} = INT_{Average} / \pi$$

2. Some background

Fuel prices in Austria vs Germany 1970 to 2006



$$p_{DE/AT} = p_{DE} / p_{AT}$$

3. Method of approach

Total energy consumption is estimated using the conventional approach:

$$E_t = C p_t^A PCE_t^B E_{t-1}^\lambda$$

Tank tourism is considered by means of including a variable p_{DEATt} representing the relationship between German und Austrian fuel prices:

$$E_t = C p_t^A p_{DEATt}^D PCE_t^B E_{t-1}^\lambda$$

Estimates for over-all energy consumption 1970 – 2006

Model:	A	B	C	D	E
α (long-term price elasticity)	-0.08 (0.78)			-0.13*	-
β (long -term income elasticity)	1.07 (17.2)	1.08 (18.3)	0.94 (24.3)	0.84*	0.90*
δ (long-term price relation to Germany elasticity)			0.68 (8.66)	0.8*	0.84*
λ (Lag)			-	0.55 (4.70)	0.49 (4.55)
A (short -term price elasticity)				-0.06 (1.24)	
B (short -term income elasticity)				0.38 (3.11)	0.44 (4.00)
D (short short-term price relation Germany elasticity)				0.36 (3.99)	0.41 (5.01)
R ² korr	0.90	0.91	0.97	0.98	0.98
DW	0.35	0.37	1.12	2.47	2.34
Durb. H					-1.35

Estimates for over-all energy consumption 1970–1985 and 1985–2003

Model:	Energy consumption (1970-1985)			Energy consumption (1985-2003)		
	A	B	C	A	B	C 2006
α (long-term price elasticity)	-0.79	-0.23 (1.12)	-0.62	0.03 (0.23)		
β (long-term income elasticity)	1.07	1.28 (6.38)	1.18	1.45 (12.1)	1.44 (13.51)	0.94 (4.14)
δ (price relation Germany elasticity)		0.74 (1.99)	0.22 (1.0)			0.67 (3.09)
λ (Lag)	0.58 (5.07)		0.55 (4.6)			
A (short-term price elasticity)	-0.33 (2.99)		-0.28 (2.4)			
B (short-term income elasticity)	0.45 (3.09)		0.53 (3.19)			
R ² korr	0.92	0.84	0.92	0.9	0.91	0.945
DW	2.54	0.82	2.85	0.99	0,96	1.18

3. Method of approach

$$S = E \eta(T)$$

E.....energy input

$\eta(T)$ technical efficiency

$$S = S_{LR} S_{SR}$$

S_{SR} short-term service demand

S_{LR} long-term service demand

$$S_{LR} = Z \pi$$

Z... number of vehicles (long-term quantitative service demand)

π ...specific power/quality index e.g. size, capacity of vehicles

$$S_{SR} = d$$

d ... short-term service demand e.g distance driven per car

Estimates for total vehicle stock and purchase of new vehicles

	Total vehicle stock (1970-2006) – moving average over 3 years			New vehicles (1970-2006) – moving average over 3 years		
	A	B PCE(-1)	C	A	B (ICPI)	C
α (short-term price elasticity)	-			-0.15 (1.62)	-0.19 (1.26)	
β (long-term income elasticity)	1.40 (84.4)	1.35 (101.1)	1.2*)	0.63 (3.53)	0.61 (2.16)	0.67 (17.3)
δ (short-term investment cost elasticity)	-			-0.24 (0.52)	-0.30 (0.41)	
λ (Lag)	-		0.75 (16.7)			
B (long-term income elasticity)			0.30 (4.49)			
R ² korr	0.995	0.997	0.999	0.88	0.75	0.90
DW	0.99	1.40				
Durb. H			4.19			

Estimates for overall power/quality index

$$\pi = C p_t^\alpha PCE_t^\beta IC_t^\zeta e^\Theta$$

	Power/quality index of stock		
Model:	A	B	C
α (Long-term energy price elasticity)		-0.05 (4.4)	-0.03 (3.75)
β (Long-term income elasticity)	0.31 (13.2)	0.29 (13.2)	0.12 (4.13)
ζ (Long-term investment cost elasticity)	-0.15 (-2.25)	-0.17 (-2.98)	-0.11 (-2.53)
Θ (Trend)			0.004 (5.82)
R ² korr	0.987	0.994	0.996

Estimates for vehicle-specific and total km driven per year (1970-2006)

$$d = C p_t^\alpha PCE_t^\beta VS_t^\zeta \quad Td = C p_t^\alpha PCE_t^\beta$$

	Average km per vehicle per year	Total km driven per year
Model:	A	A
α (long-term energy price elasticity)	-0.15 (3.25)	-0.38 (6.55)
β (long-term income elasticity)	0.61 (1.57)	1.16 (34.85)
ζ (long-term vehicle stock elasticity)	-0.72 (2.58)	
R ² korr	0.85	0.978

The share of diesel cars - new vehicle (1970-2006)

The idea is that estimating the share of diesel cars by means of using service related parameters (service price, total km driven...) leads to better results than using the variable energy price and intensity separate. In the following we show estimates for share of new registered diesel cars.

$$SH_{diesel} = C PR_{GD} INTR_{GD} TDR_{GD}$$

$$PR_{GD} = \frac{P_{gasoline}}{P_{diesel}} \quad INTR_{GD} = \frac{INT_{gasoline}}{INT_{diesel}} \quad TDR_{GD} = \frac{TD_{gasoline}}{TD_{diesel}}$$

SH_{diesel} The share of new diesel cars

PR_{GD}Ratio of fuels price

$INTR_{GD}$Ratio of intensity

TDR_{GD} Ratio of total kilometer driven per year

PSR_{GD}Ratio of service price

$$PSR_{GD} = PR_{GD} INTR_{GD}$$

The share of diesel cars - new vehicle (1970-2006)

	The share of diesel cars - new vehicles (1970-2006)				
Model:	1	2	3	4	5
The ratio of energy price (gasoline to diesel price)	0,98 (1,09)		-0,15 (-0,33)		
The ratio of energy intensity (gasoline to diesel car intensity)		7,57 (10,71)	7,62 (10,34)		
The ratio of service price-mobility (gasoline to diesel service price)				2,31 (3,95)	
The lagged ratio of service price (gasoline to diesel service price) (-1)					1,93 (2,41)
The ratio of total km driven (gasoline to diesel cars)	-1,06 (-20,95)	-0,50 (-8,75)	-0,50 (-8,21)	-0,90 (-15,87)	
The lagged ratio of total km driven (gasoline to diesel cars) (-1)					-0,93 (-11,30)
R ² korr	0,92	0,98	0,98	0,95	0,91
DW	0,12	0,22	0,23	0,23	0,15

5. Conclusions

➤ In general, the chosen parameters provide very good estimates for explaining the demand for vehicles, mobility and energy consumption in Austria.

➤ The analyses of underlying service demand parameters and efficiency provides additional and deeper insight on the impact of different econometric parameters.

Actually, all components of short-term and long-term service demand depend significantly on income. The long-term components – number of new vehicles and the power index – also depend on fuel prices and investment costs.

➤ Finally, it has to be stated that fuel price increases lead to significant efficiency improvements and straightforward energy savings. However, these effects are – if prices drop – outweighed by increases especially in short-term km driven.

5. Conclusions

- With respect to the future development of the Austrian individual mobility system the perception is that only a broad portfolio of policy instruments – consisting mainly of tax policies for fuels as well as car investment and standards – will bring about major changes.

Thank you!