

On modeling the impact of fuel prices and income on service and energy demand in individual transport in Austria – Evidence from the period 1970-2006

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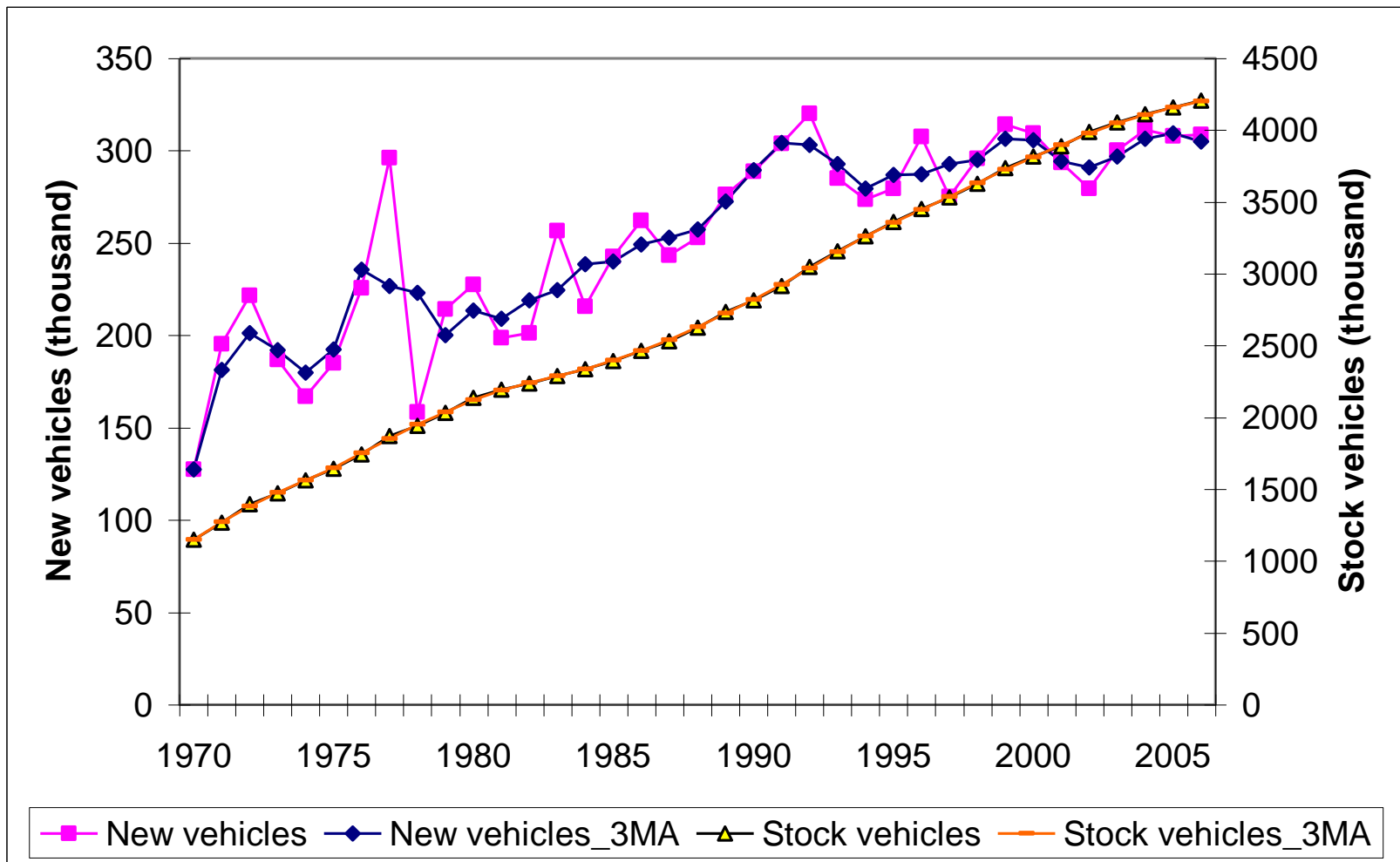
1. Introduction
2. Some background
3. Method of approach
4. Results of the econometric analyses
5. Conclusions

1. Introduction

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

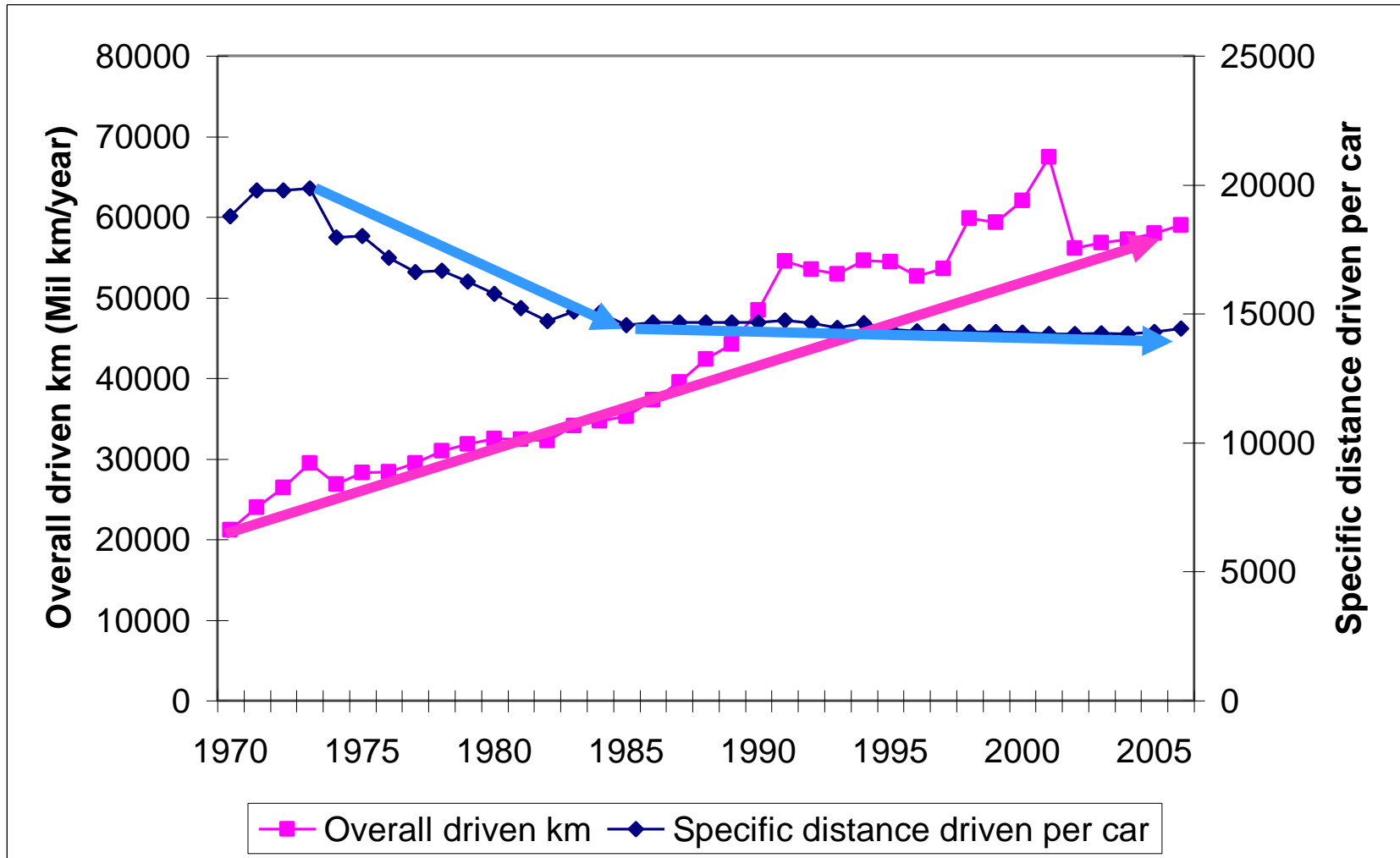
The **core objective** is to identify the impact of major economic parameters – changing fuel prices, households income, investment costs of cars – on the overall demand for vehicles (and the changes in their size), mobility (km driven) and the corresponding demand for gasoline and diesel in Austria.

Development of vehicle stock and new vehicles in Austria between 1970 and 2006



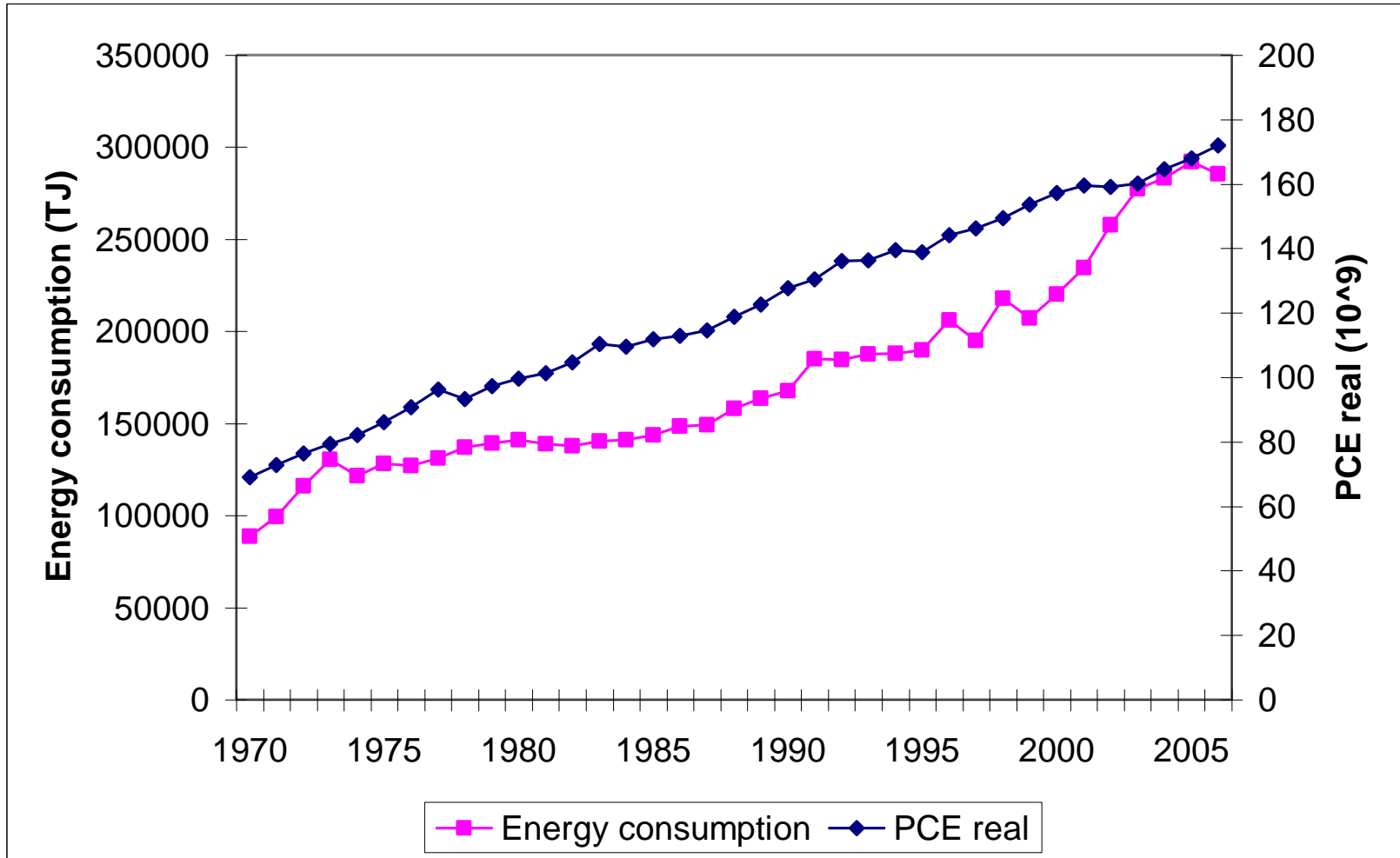
2. Some background

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



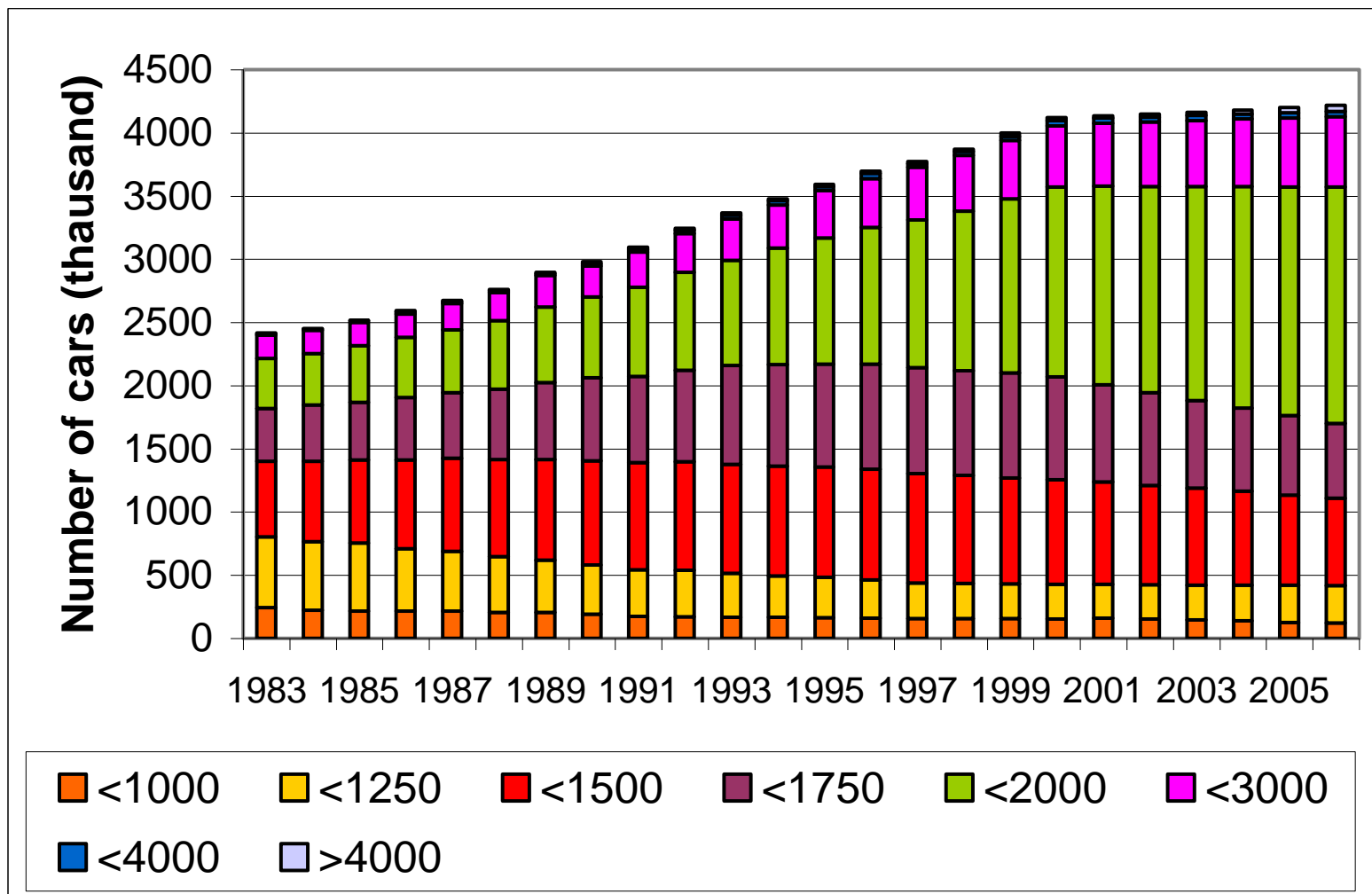
2. Some background

Development of energy consumption in individual transport and private final consumption expenditures in Austria between 1970 and 2006



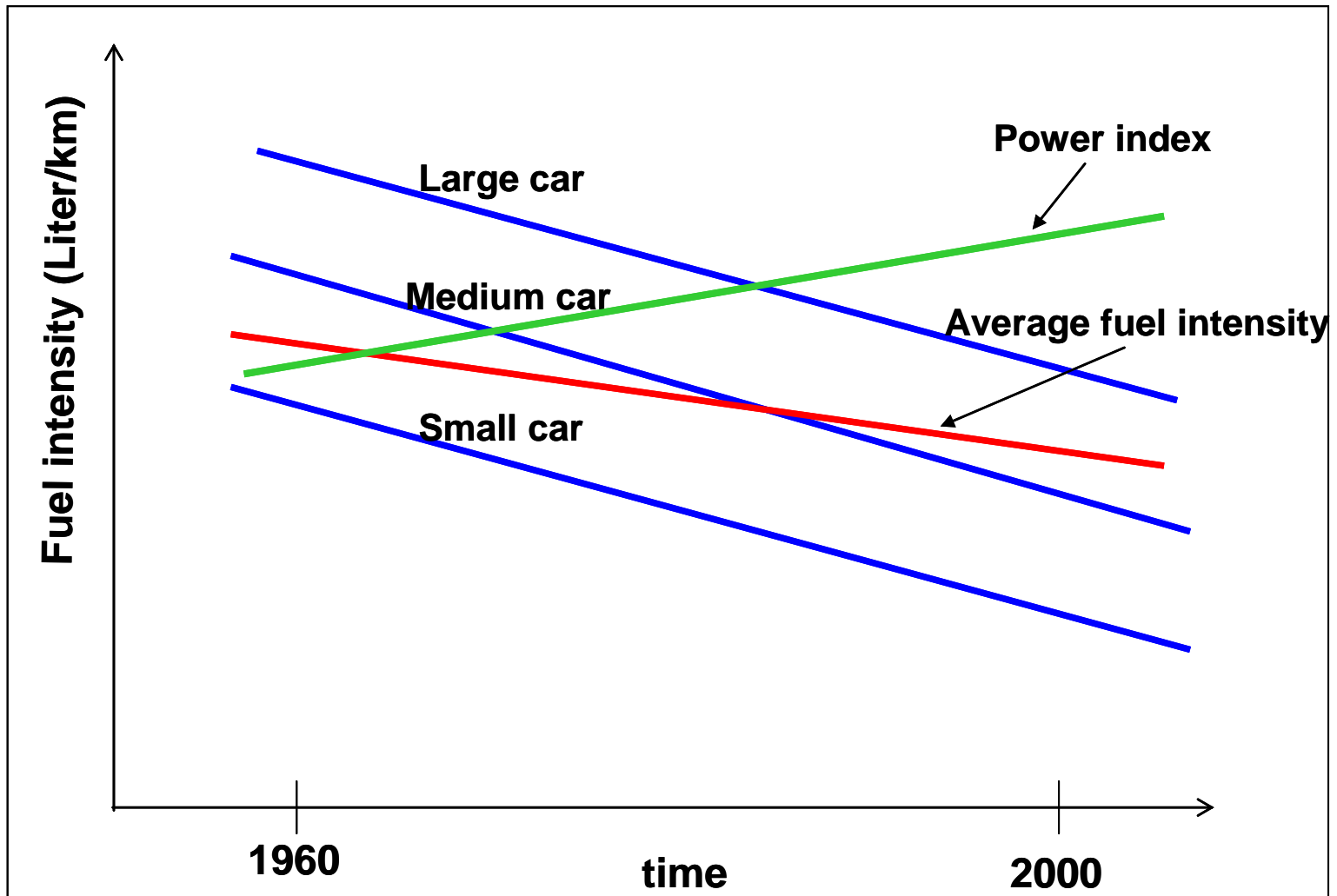
2. Some background

Development of the size of cars showing the cylinder categories of the vehicle stock in Austria (2002-2006 interpolated)



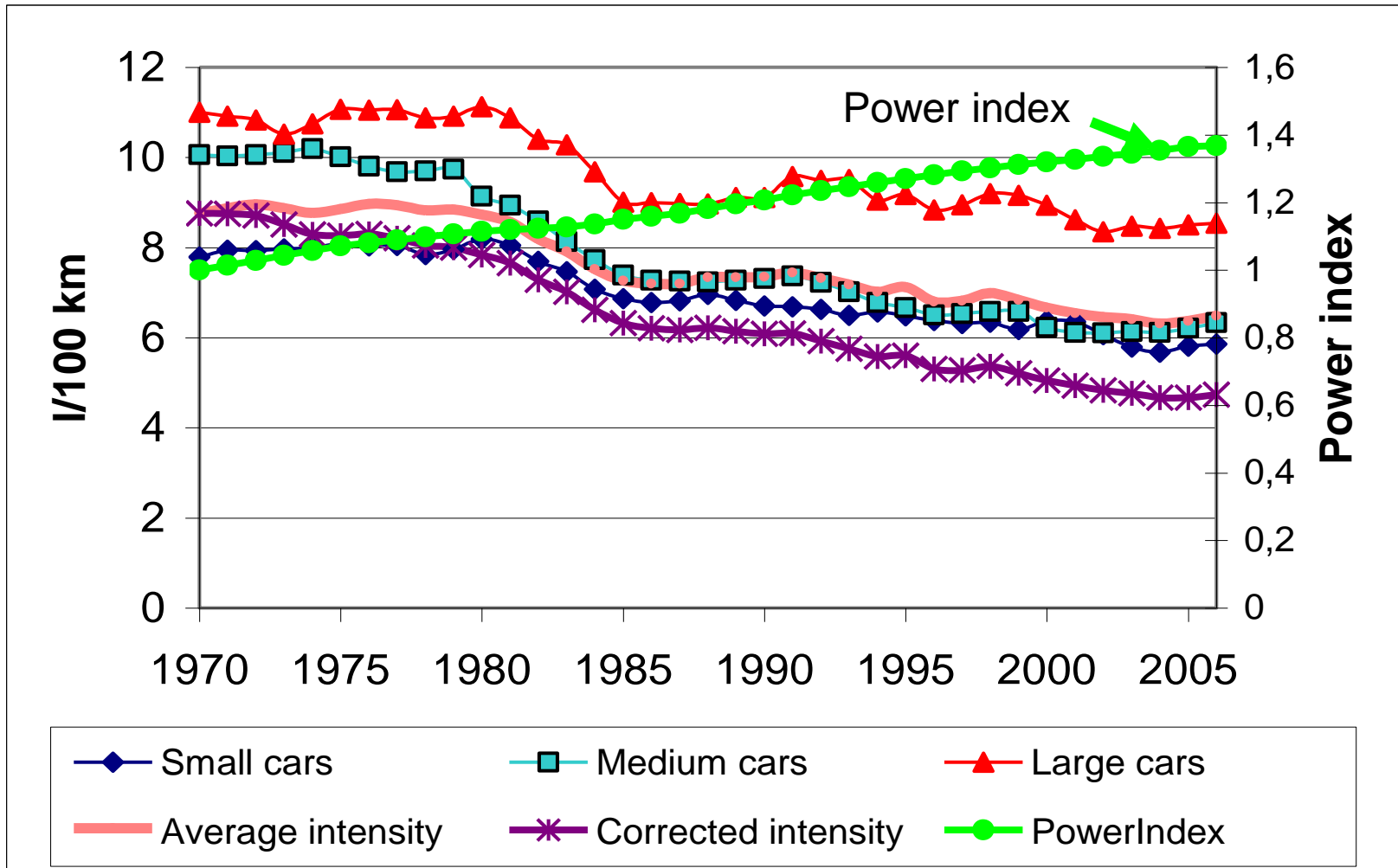
2. Some background

Index of power increase of cars and average fuel intensities vs specific fuel intensity for small, medium and large cars in individual automotive transport



2. Some background

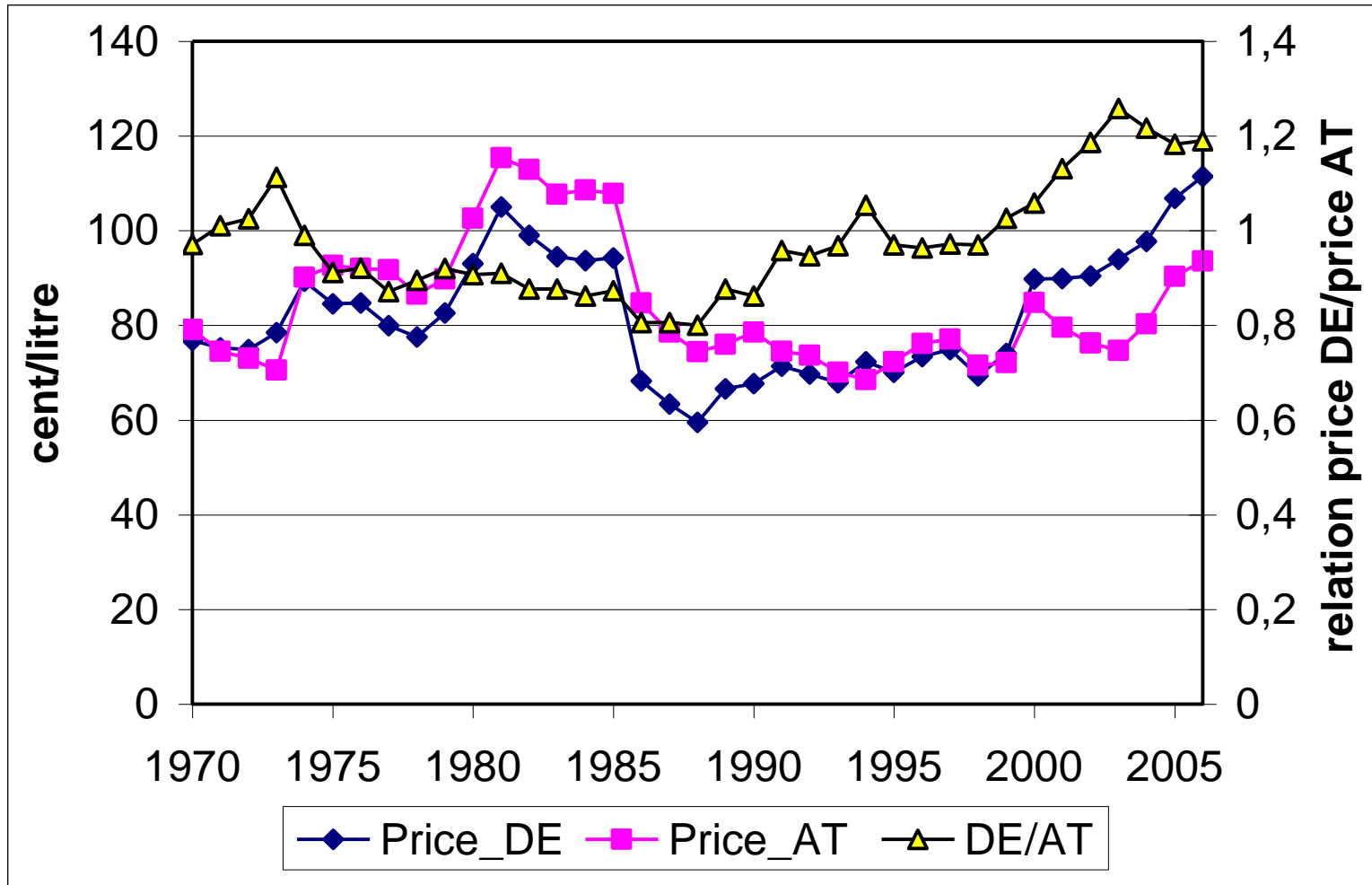
Different fuel intensities in Austria (1970-2006)



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

2. Some background

Fuel prices in Austria vs Germany 1970 to 2006



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

3. Method of approach

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

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 of capacity of vehicles

$$S_{SR} = d$$

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

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

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		
Model:	$\frac{S}{E} = \frac{S}{PCE(-1)}$	$\frac{S_{LR}}{S_{SR}}$	$\frac{Z\pi d}{c}$	$\frac{A}{INT}$	$\frac{B}{(ICPI)}$	$\frac{C}{Corr}$
α (short-term price elasticity)	η	$-\eta$	η	-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

	Power/quality index of stock		
Model:	A	B	C
α (Long-term energy price elasticity)		-0.05 (4.4)	-0.05 (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)

	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

Estimates for weighted fuel intensity and efficiency (fuel intensity corrected) 1970-2002

Model:	Fuel intensity weighted (l/100 km per vehicle per year) (1970-2002)			Efficiency (fuel intensity corrected by power index) (1970-2002)		
	A	B	C	A	B	C
α_{rise} (long-term price elasticity due to rising prices)	$INT_{Average} = p_{rise}^{\alpha_{rise}(-x)} \pi^{\varphi} e^{\Theta}$			$INT_{Corr} = p_{rise}^{\alpha_{rise}(-x)} e^{\Theta}$		
$\alpha_{rise}(-3)$	-0.16 (1.85)	-	-	-0.22 (3.76)		
$\alpha_{rise}(-4)$		-0.20 (-2.73)	-		-0.22 (4.12)	
$\alpha_{rise}(-5)$		-	-0.16 (2.34)			-0.20 (3.33)
φ (power index)	2.61 (2.13)	2.42 (2.34)	2.9 (2.89)			
Θ (Trend)	-0.03 (2.6)	-0.03 (2.81)	-0.03 (3.41)	-0.0155 (10.43)	-0.0150 (10.2)	-0.016 (9.4)
R ² korr	0.942	0.950	0.946	0.978	0.98	0.976

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!