The Costs and Benefits of Climate Policy: The Discount rate and Changing Relative Prices

Det Miljökonomiska Råd, Skodsborg Sept 1

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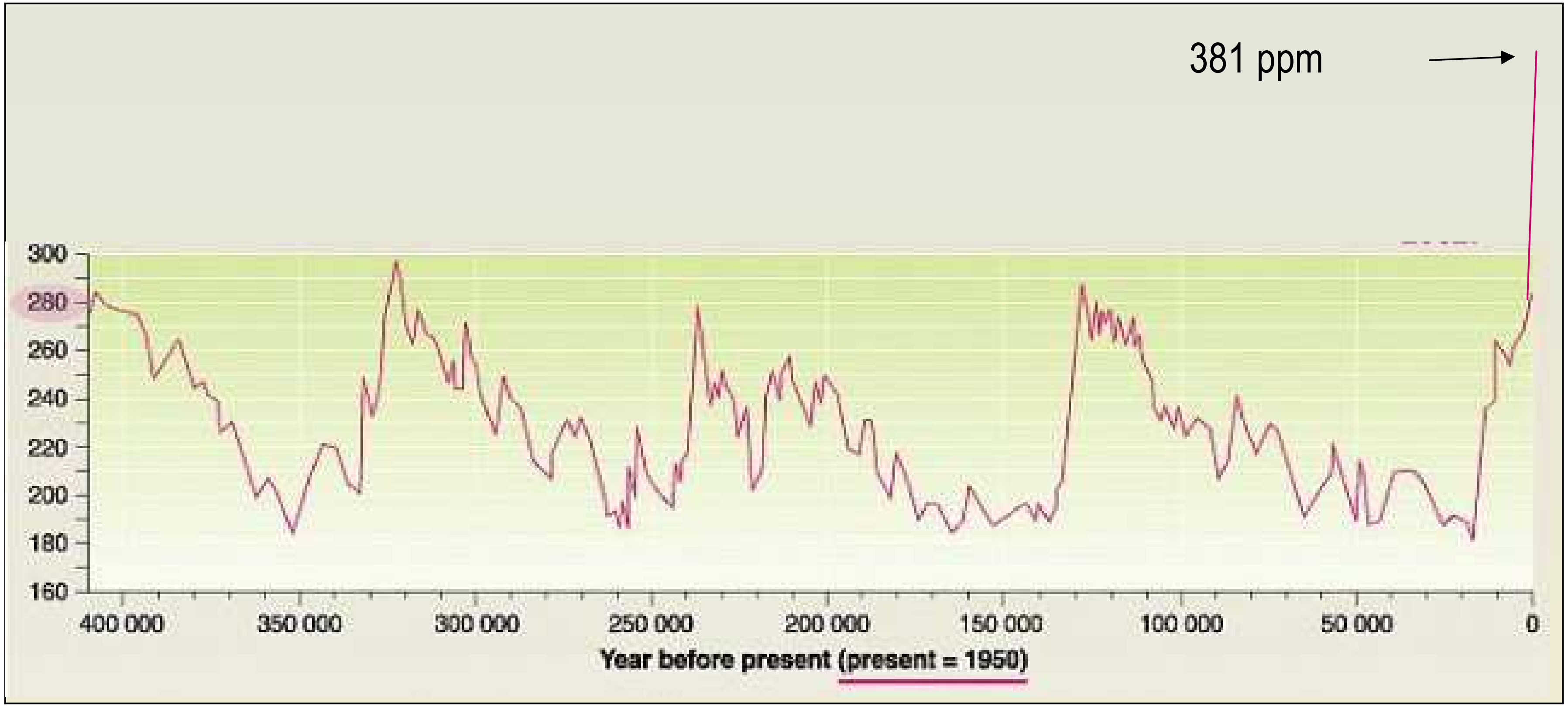
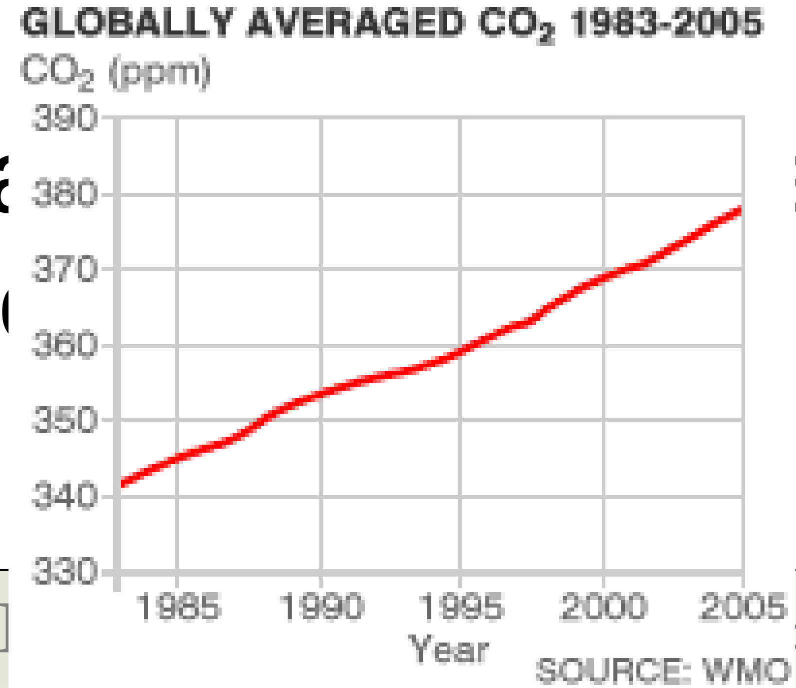
Economics; Gothenburg

President EAERE

Historical variation of atmospheric CO_2-concentration

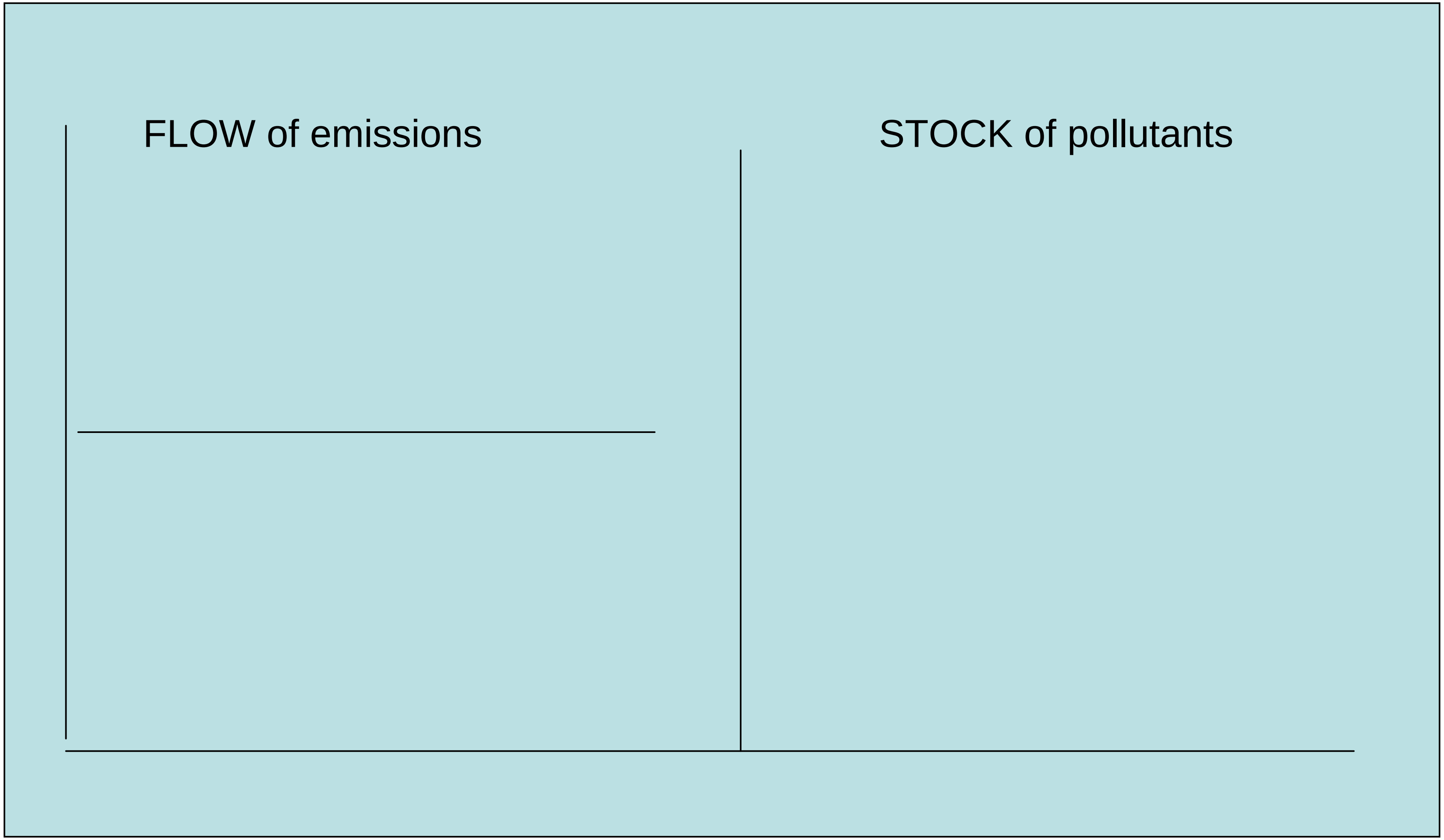


Historical vari… eric
CO_2-c…

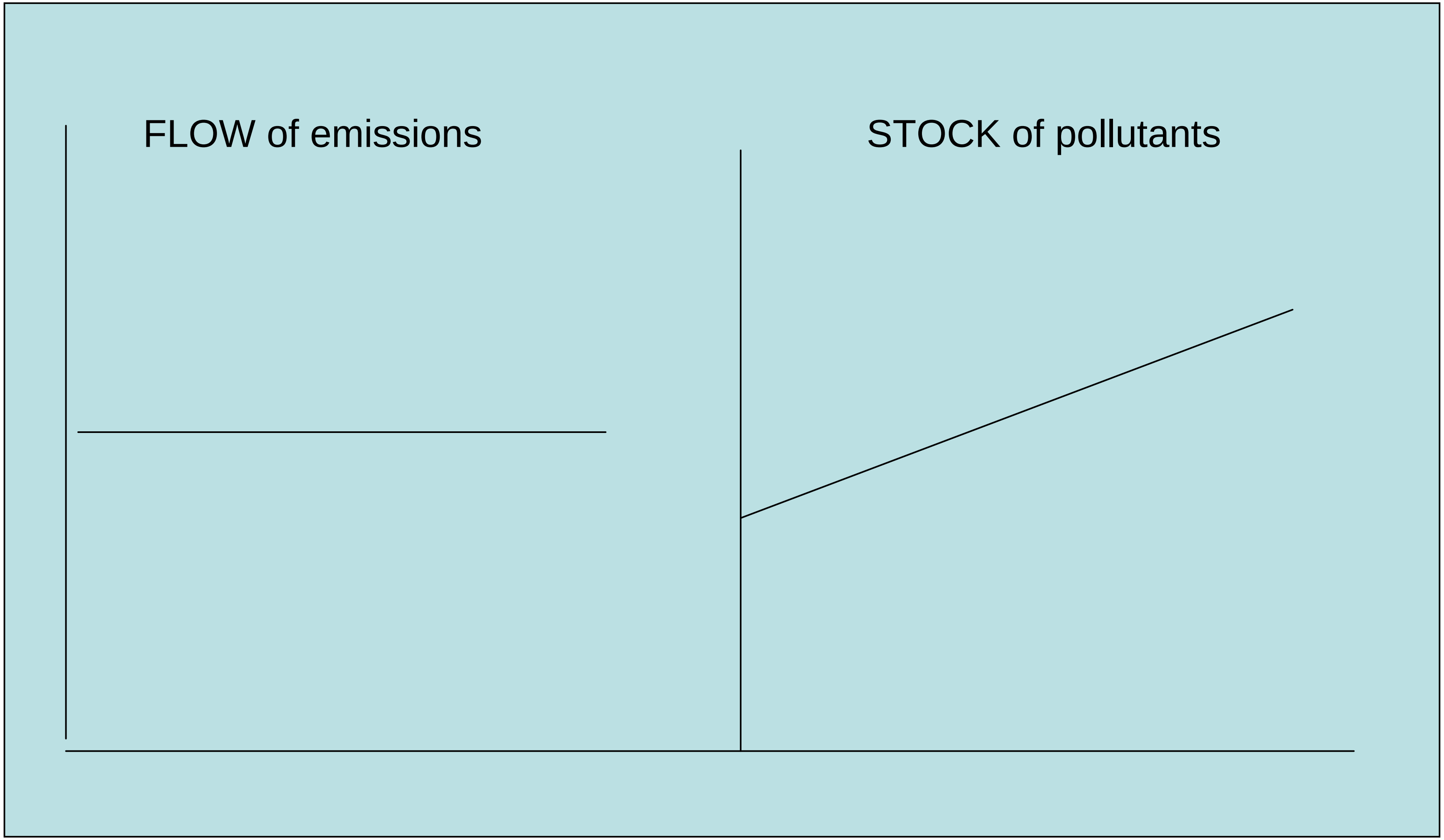


Radical goals for the future ?

Stock goal and flow goal



Stock goal and flow goal



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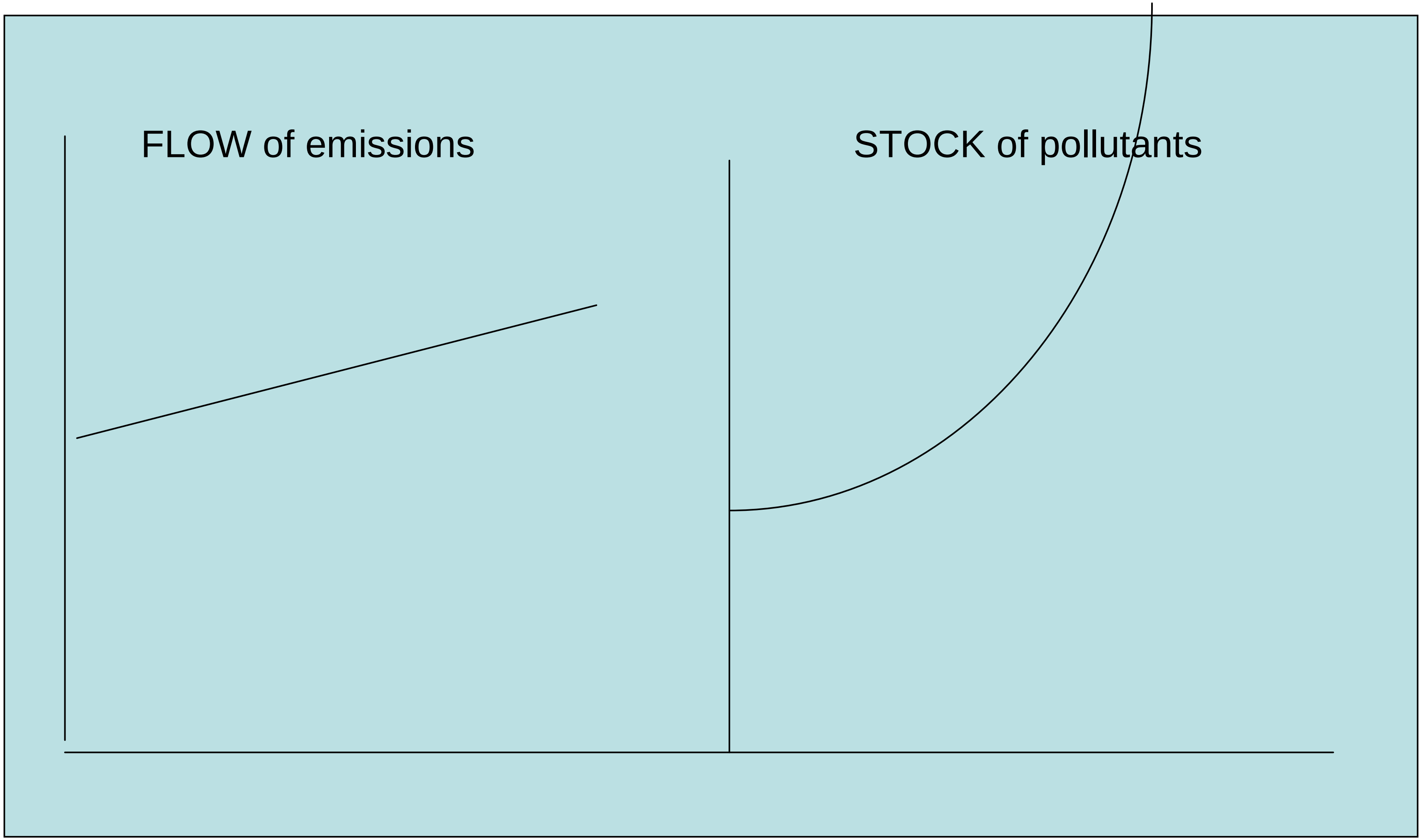

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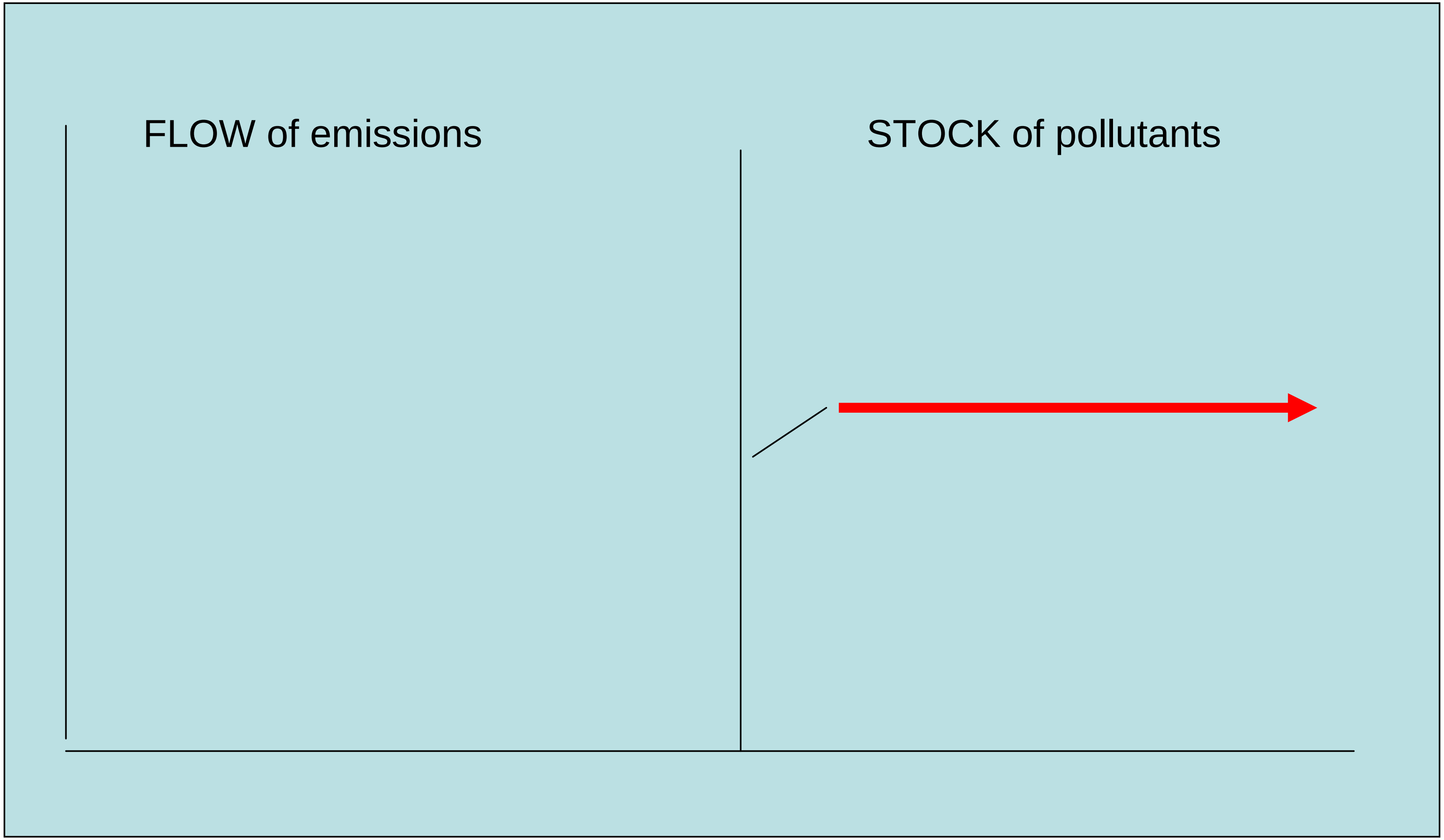

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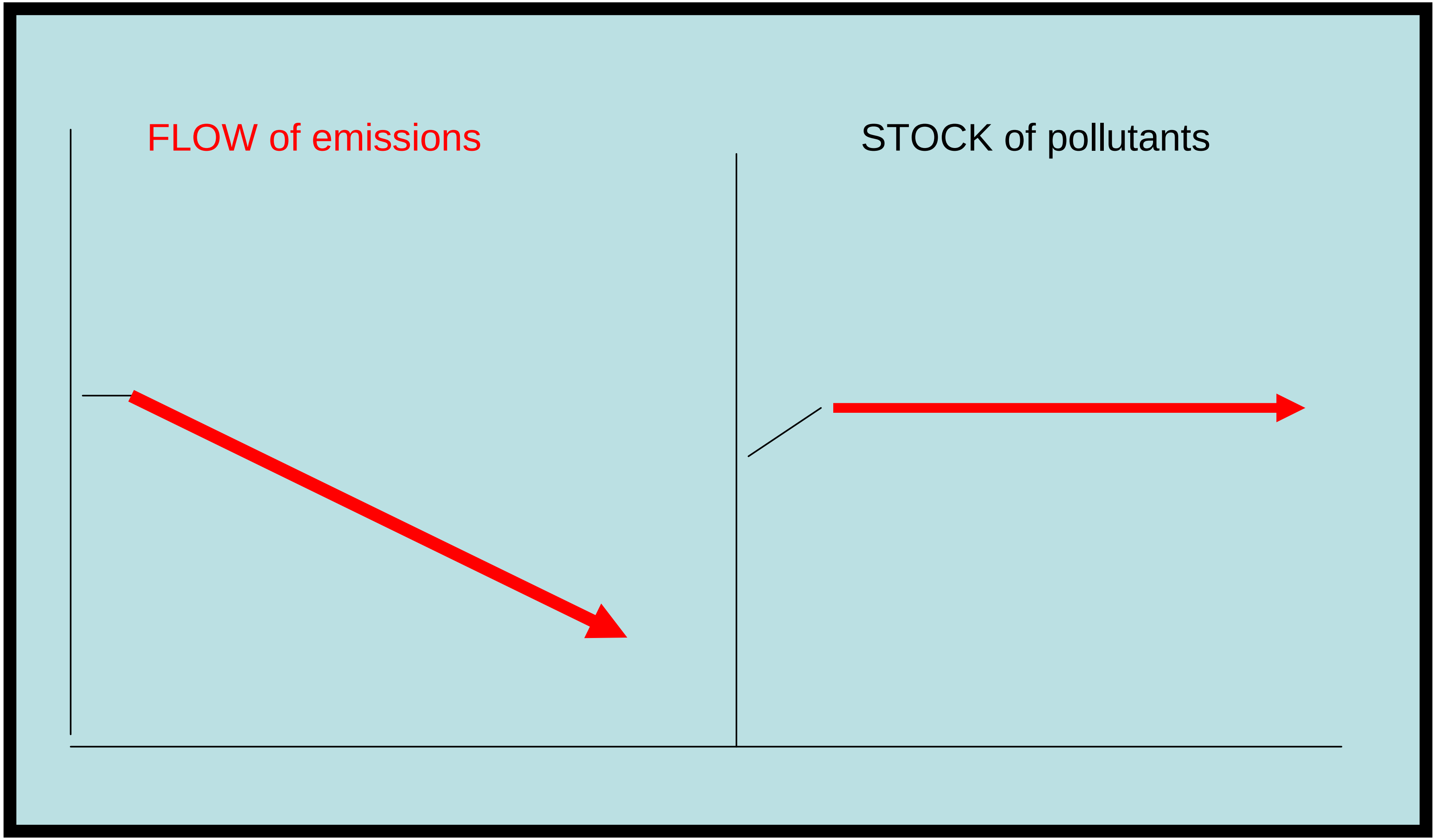
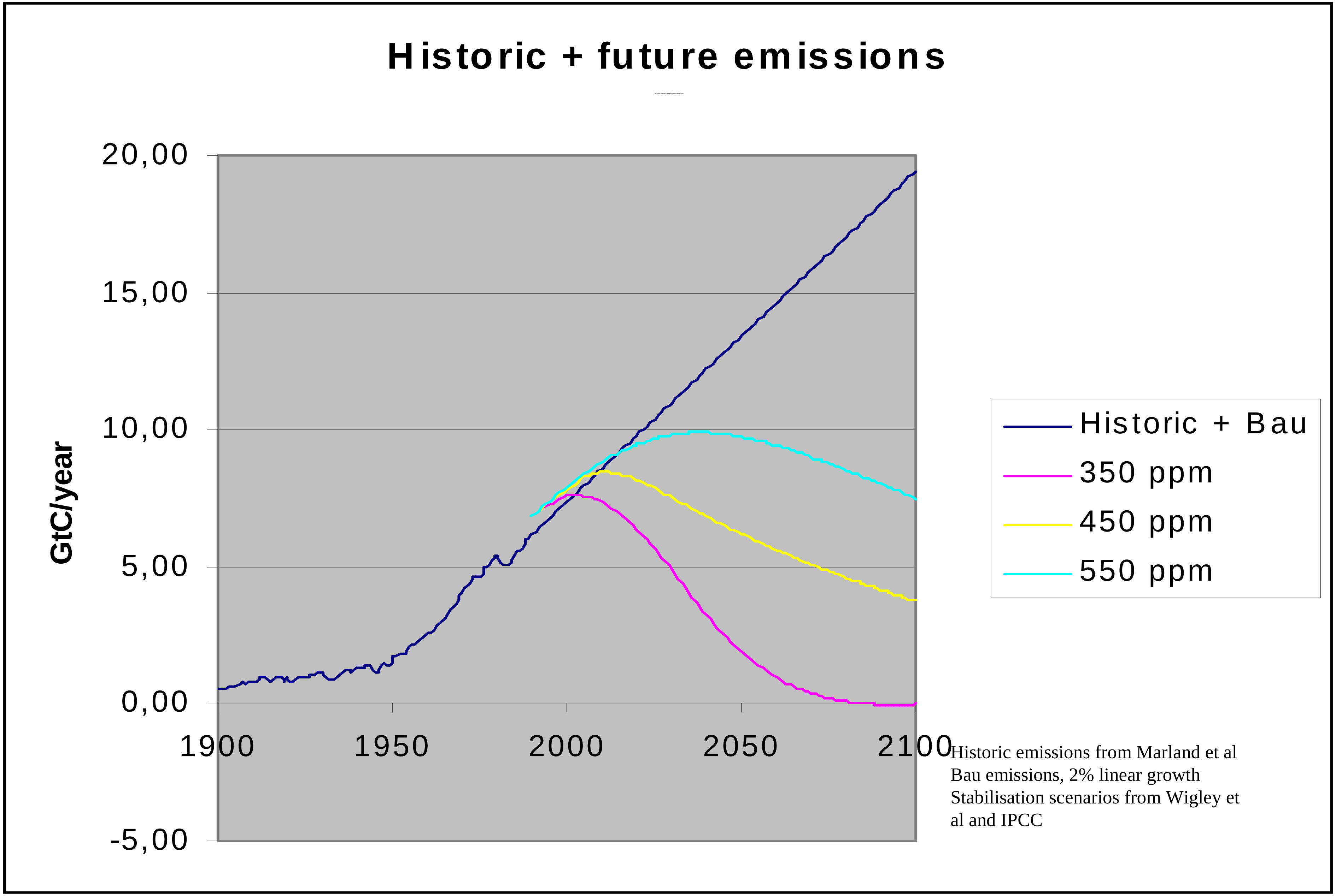
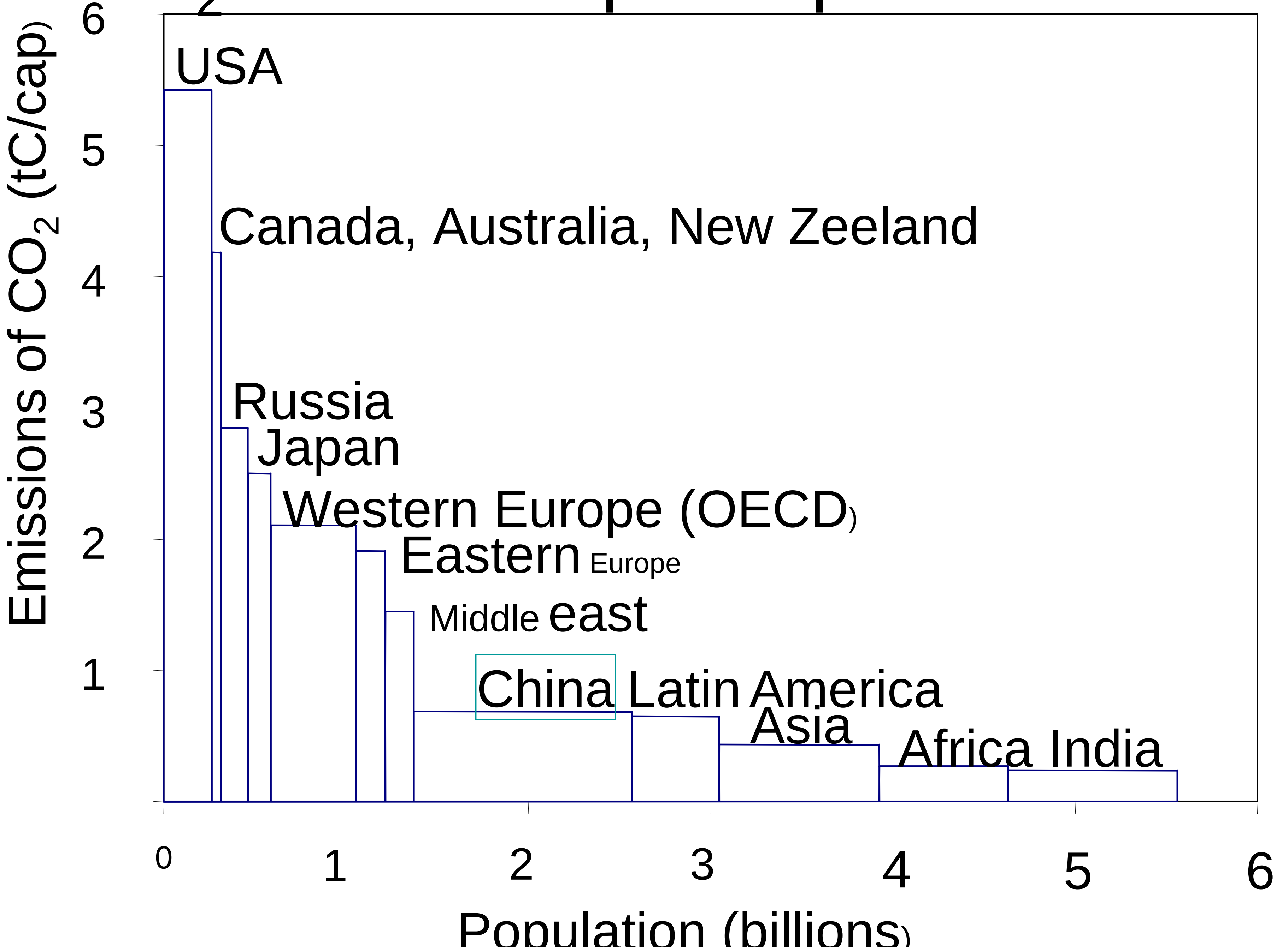


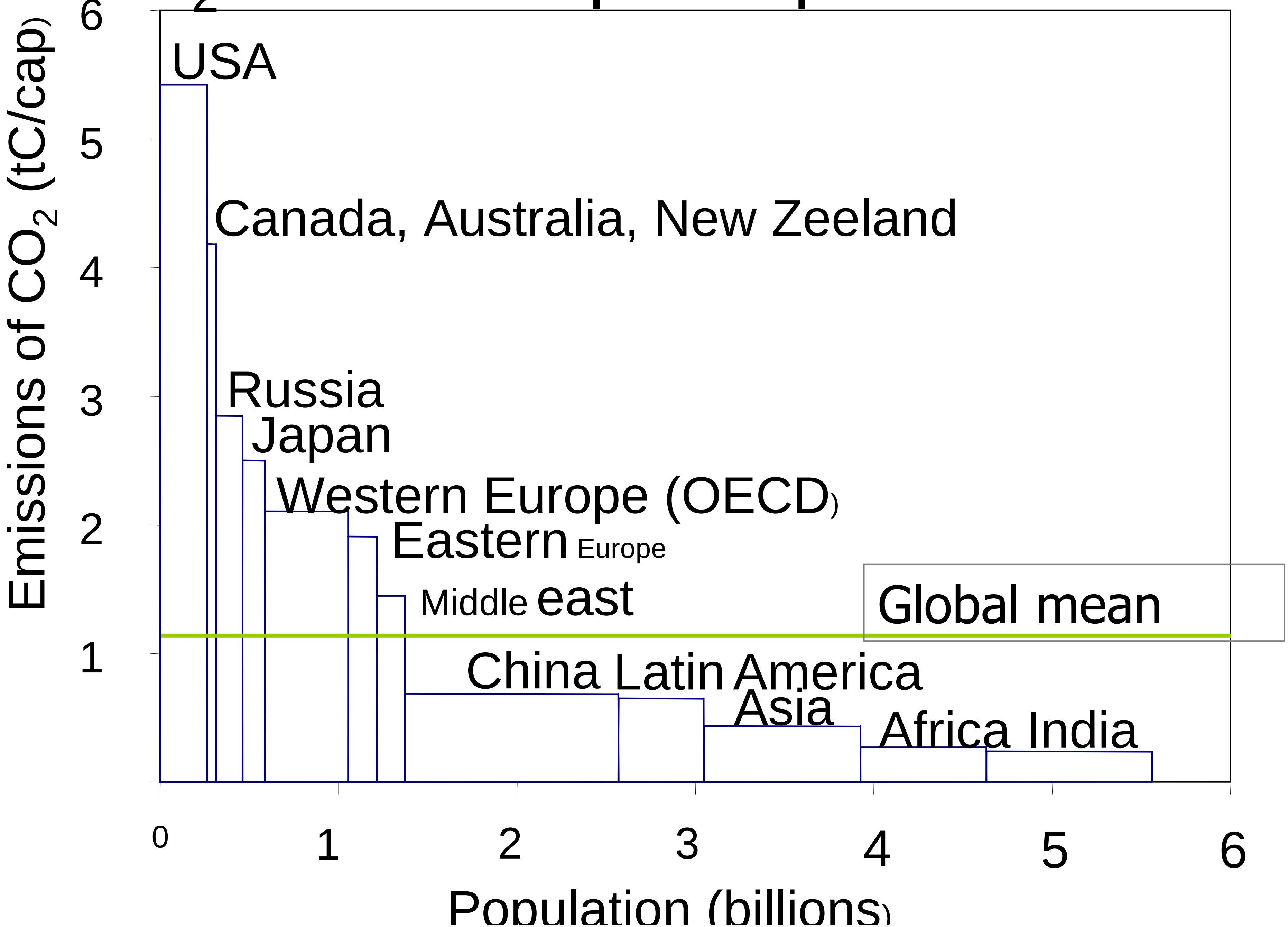


Historic emissions from Marland et al
Bau emissions, 2% linear growth
Stabilisation scenarios from Wigley et al and IPCC

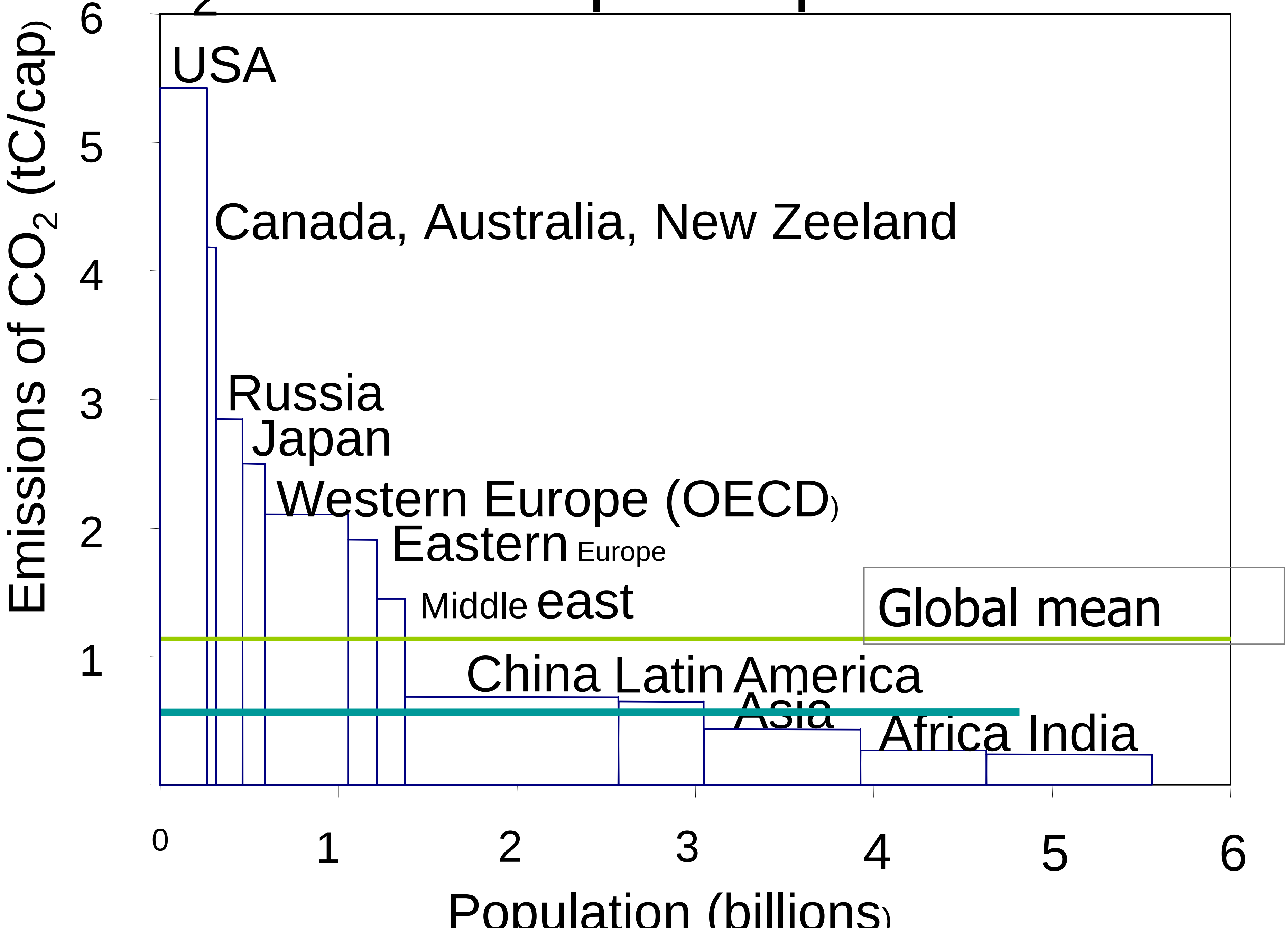
CO_2 emissions per capita in 1998



CO_2 emissions per capita in 1998



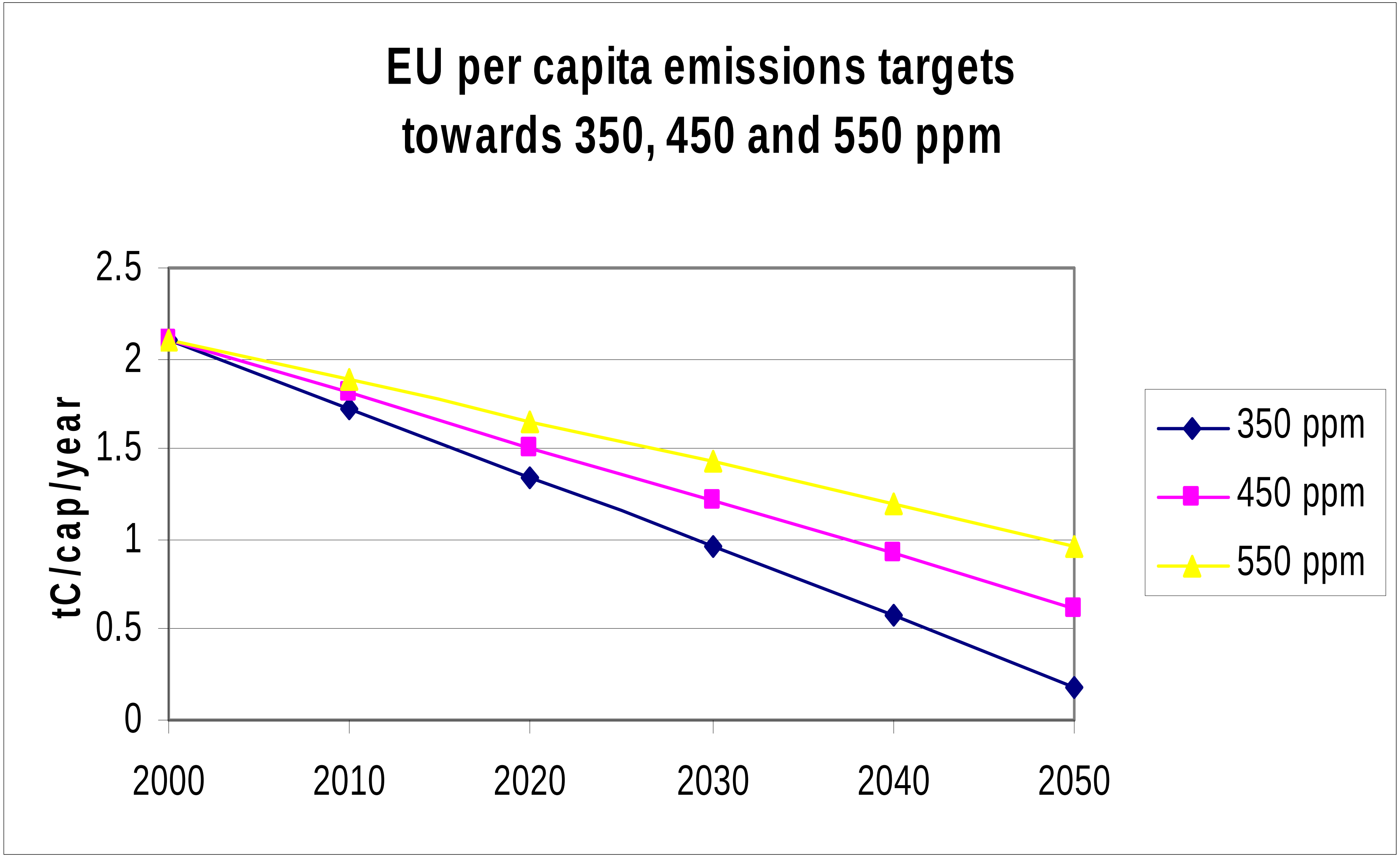
CO_2 emissions per capita in 1998



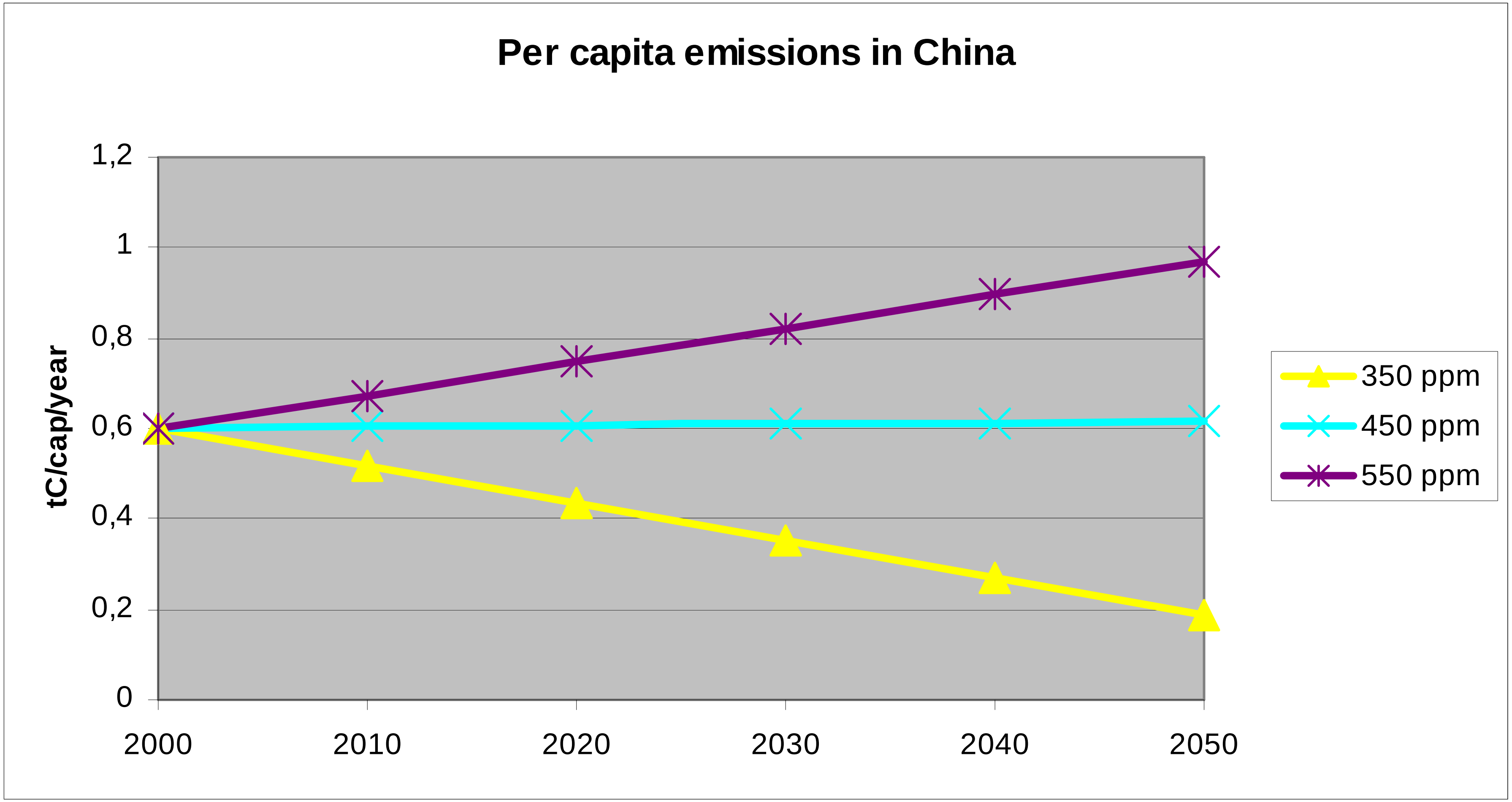
Breakdown by country

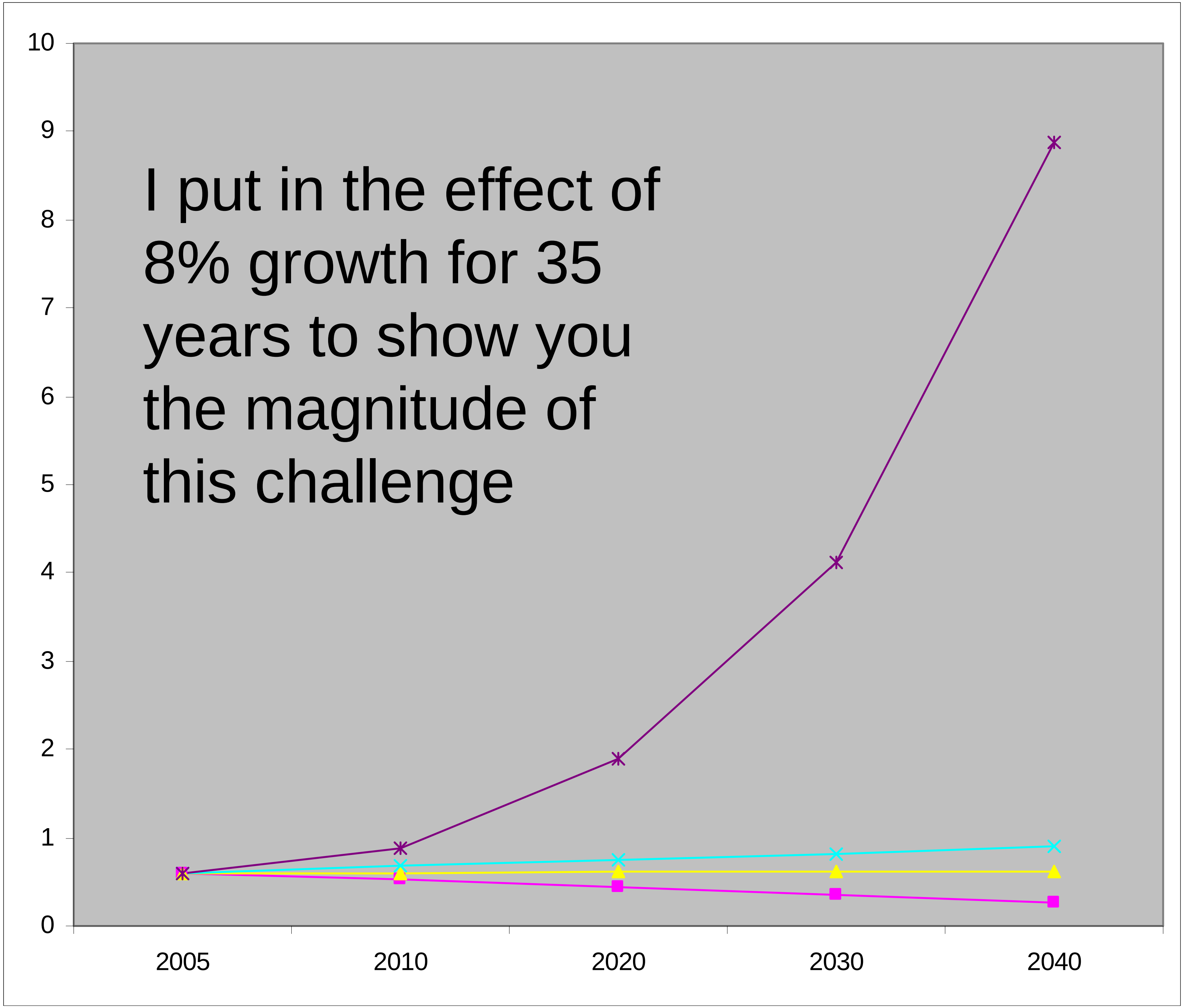
- Overall World reduction by 30-75% 2050
- Or 50-100% by 2100
- Emissions 6 Gtons to 3
- Pop increase from 6 - 10 G Capita
- Per capita decrease from 1 ton to 300 Kg
- For EU this could be 2 tons to 300Kg
- Official goals now hovering 20-40% 2020
- (80% by 2050 = 55% by 2025)

Per capita targets (EU)



Per capita targets (China)




I put in the effect of 8% growth for 35 years to show you the magnitude of this challenge
10
9
8
7
6
5
4
3
2
1
0
2005
2010
2020
2030
2040

IPPC 4 and Stern

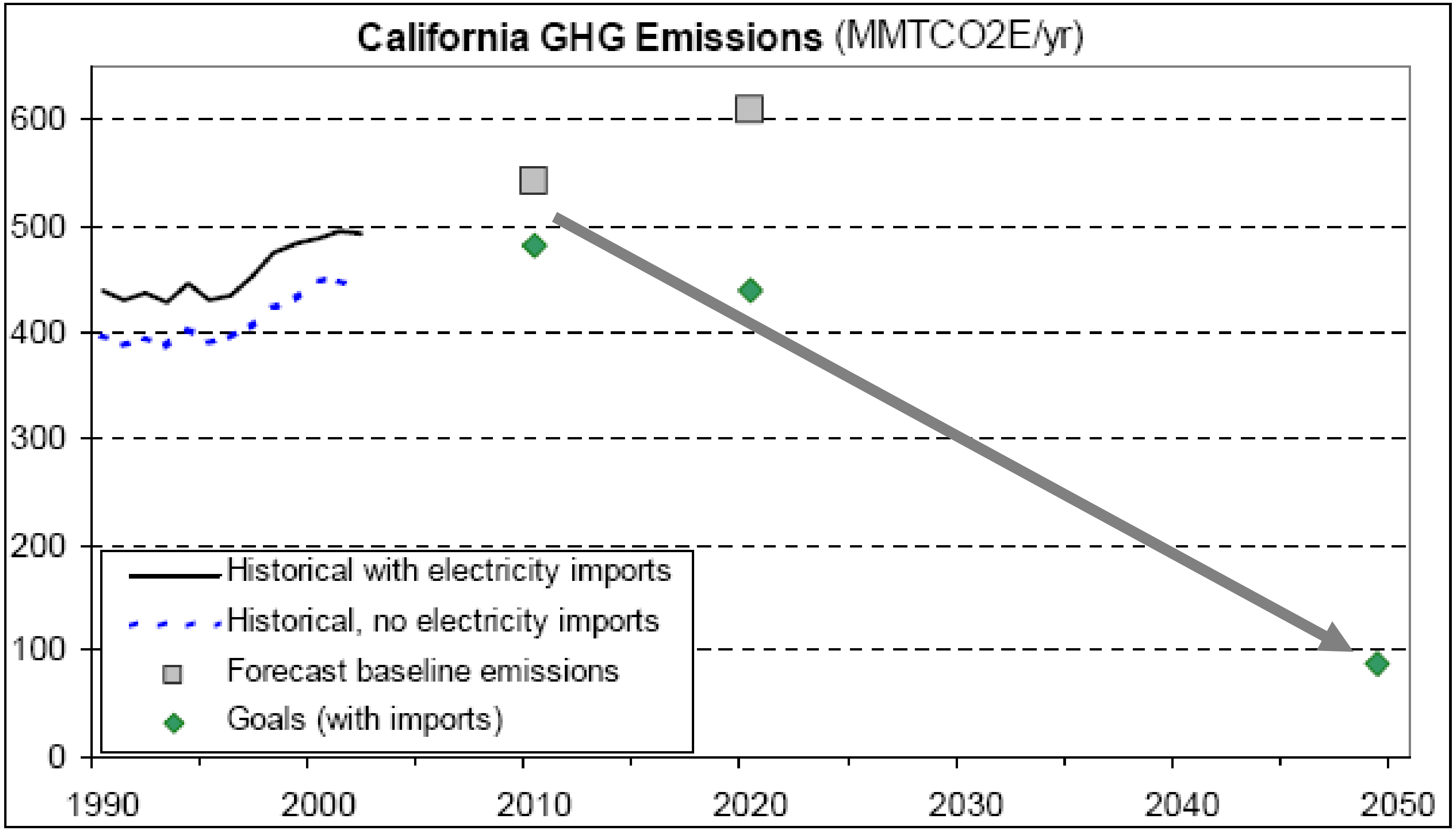
- Climate change anthropogenic
- Costs of doing nothing considerable
- Climate change → costs ~[5-20%] of GDP

- Costs of action smaller ~ 1%

- Stern Review has had PROFOUND Effect

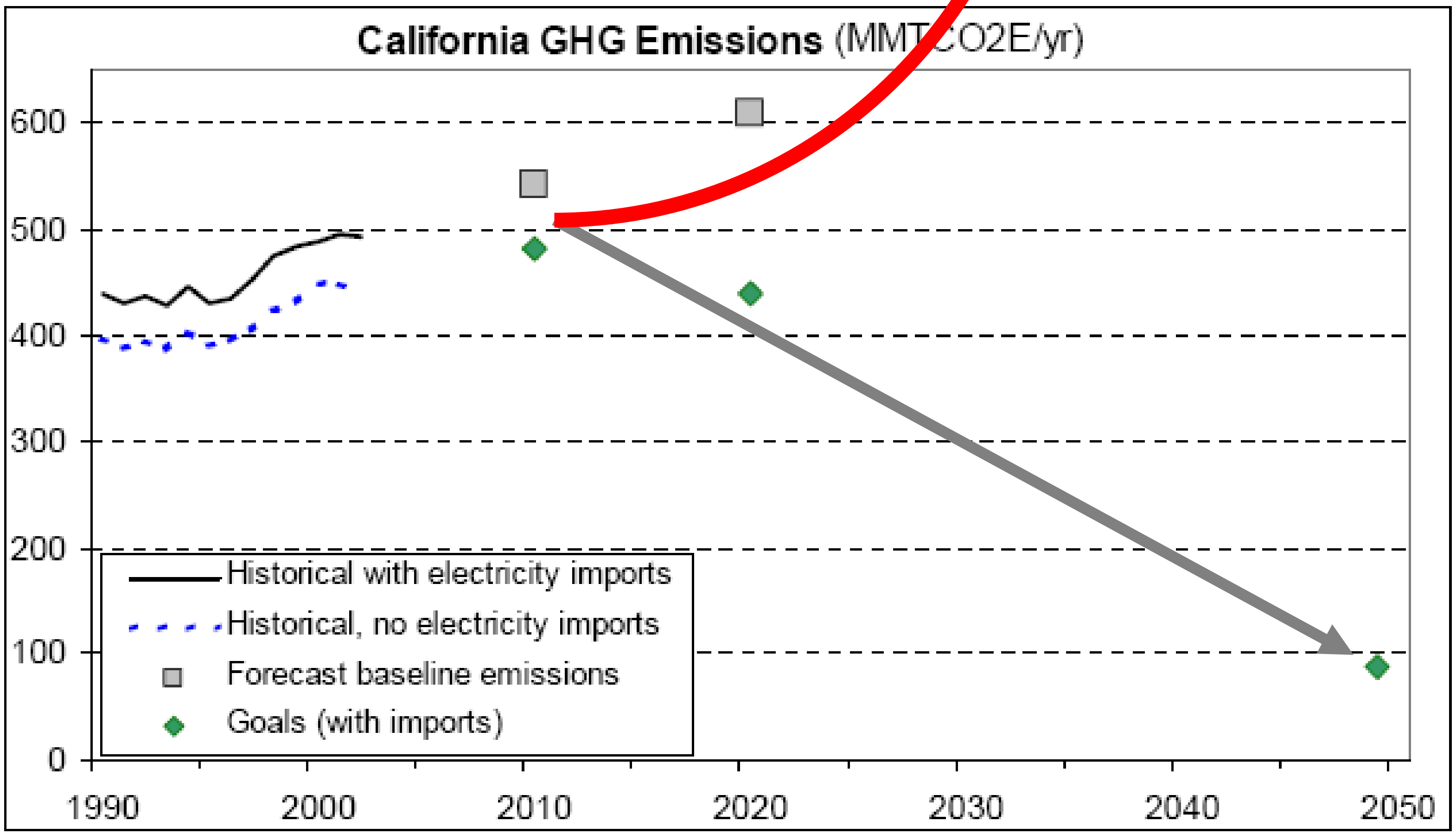
Even Schwarzenegger

Figure 3-1: Recent GHG emissions[1] in California and Governor Schwarzenegger's goals.

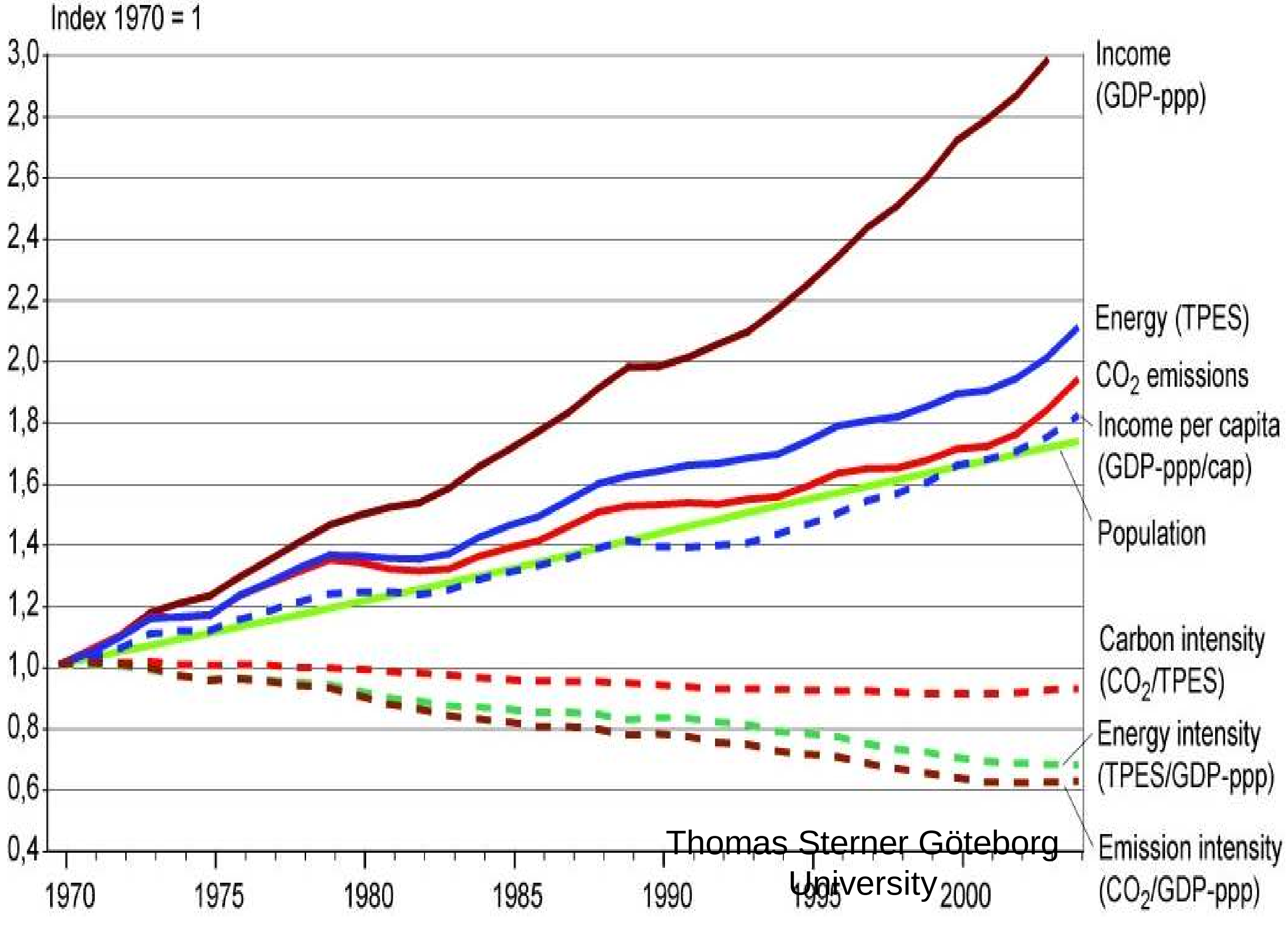


Even Schwarzenegger

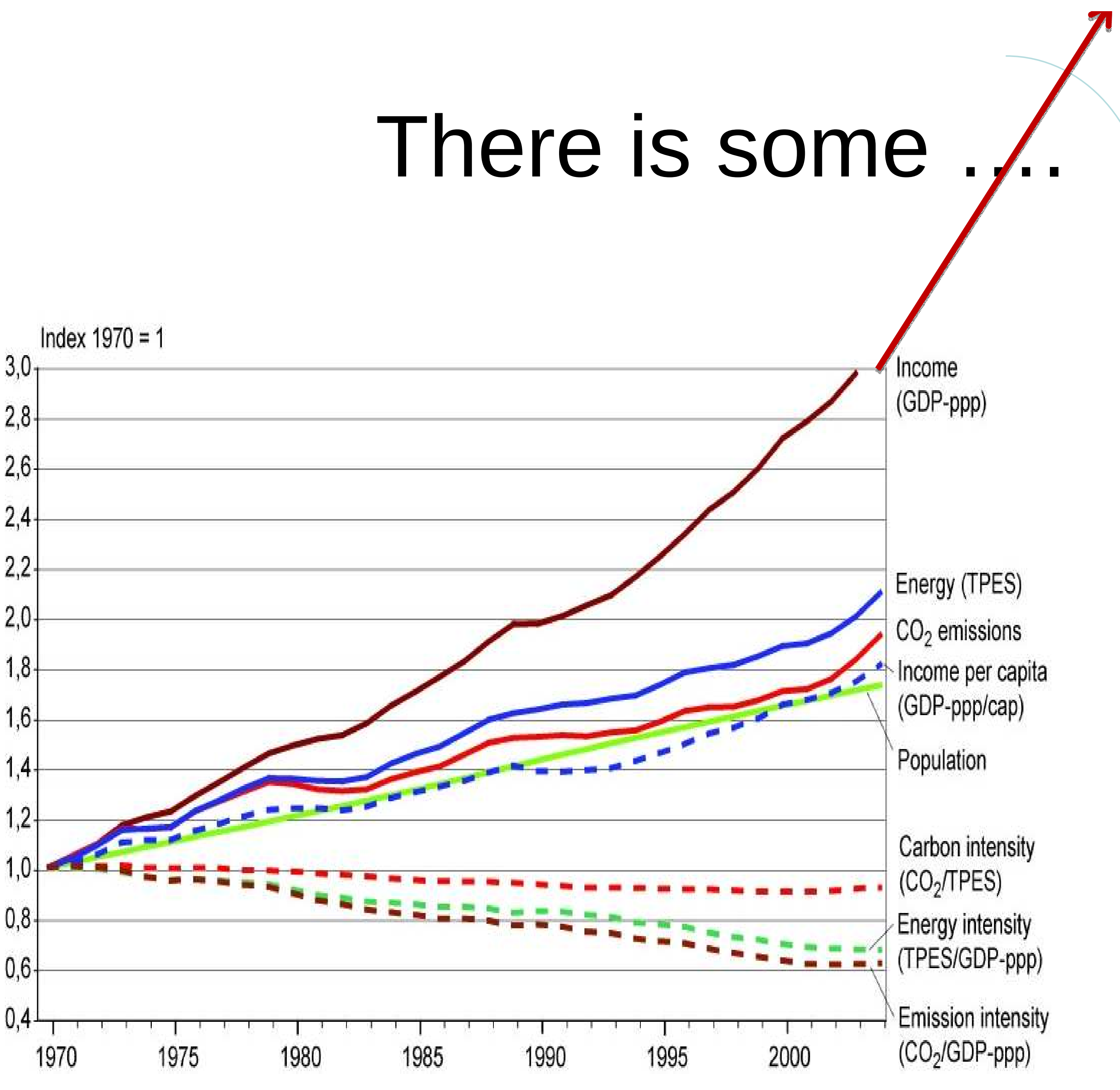
Figure 3-1: Recent GHG emissions[1] in California and Governor Schwarzenegger's goals.



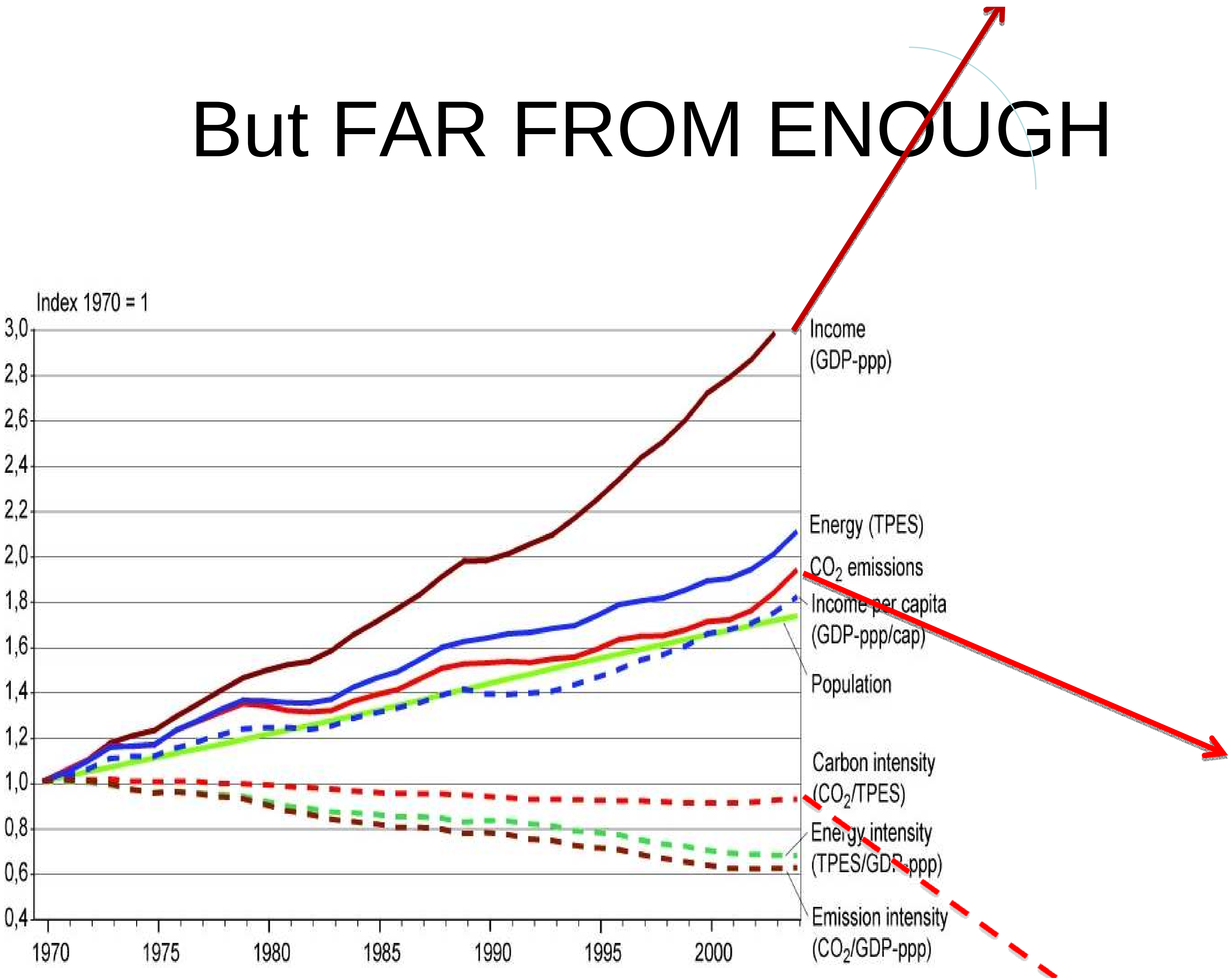
World decoupling



There is some ….



But FAR FROM ENOUGH

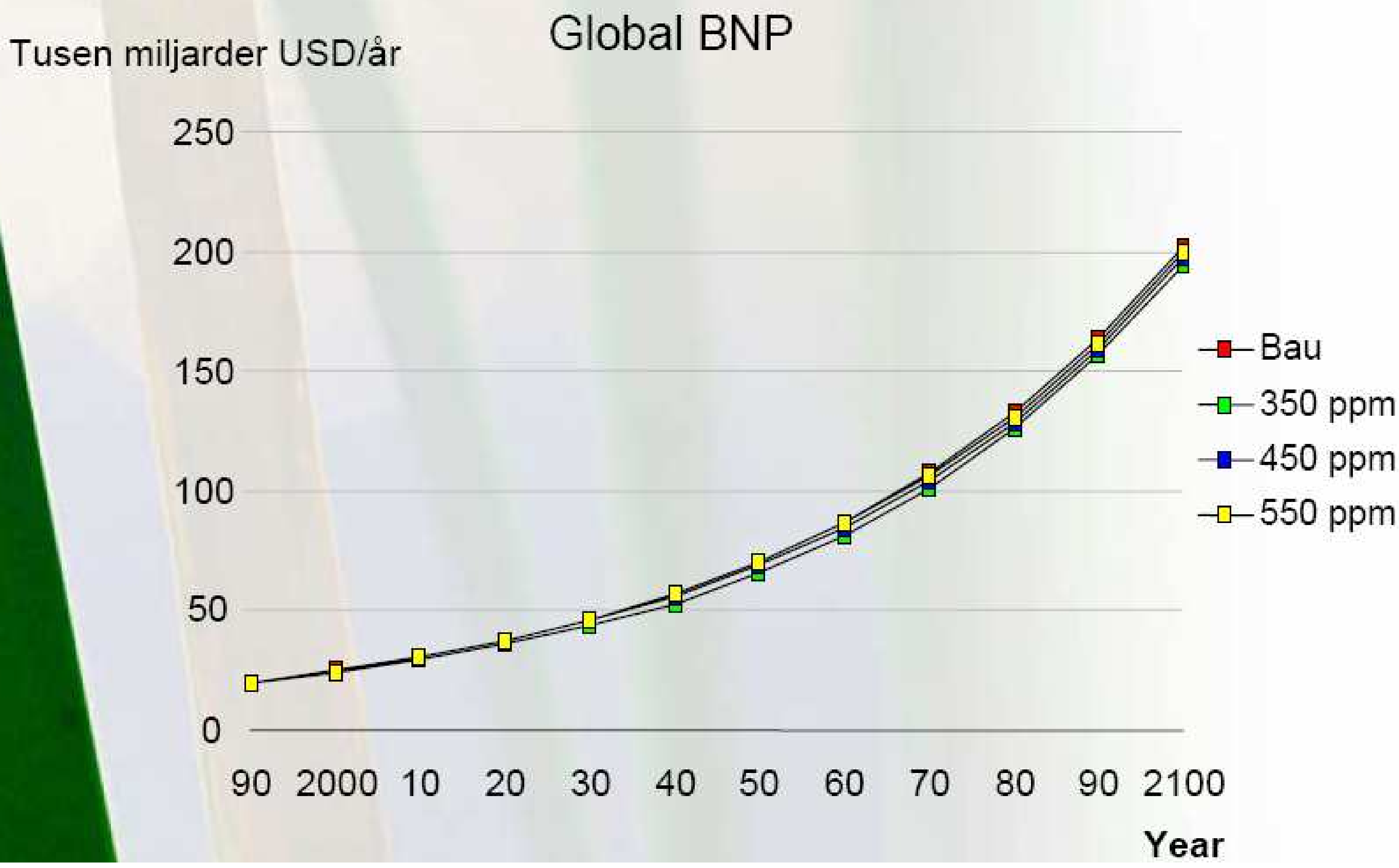


But what about the costs?

- What do economists mean by costs anyway?

- Less welfare – or simly less consumption
- than we would have had otherwise

Kostnaden för att stabilisera atmosfärens koldioxidhalt

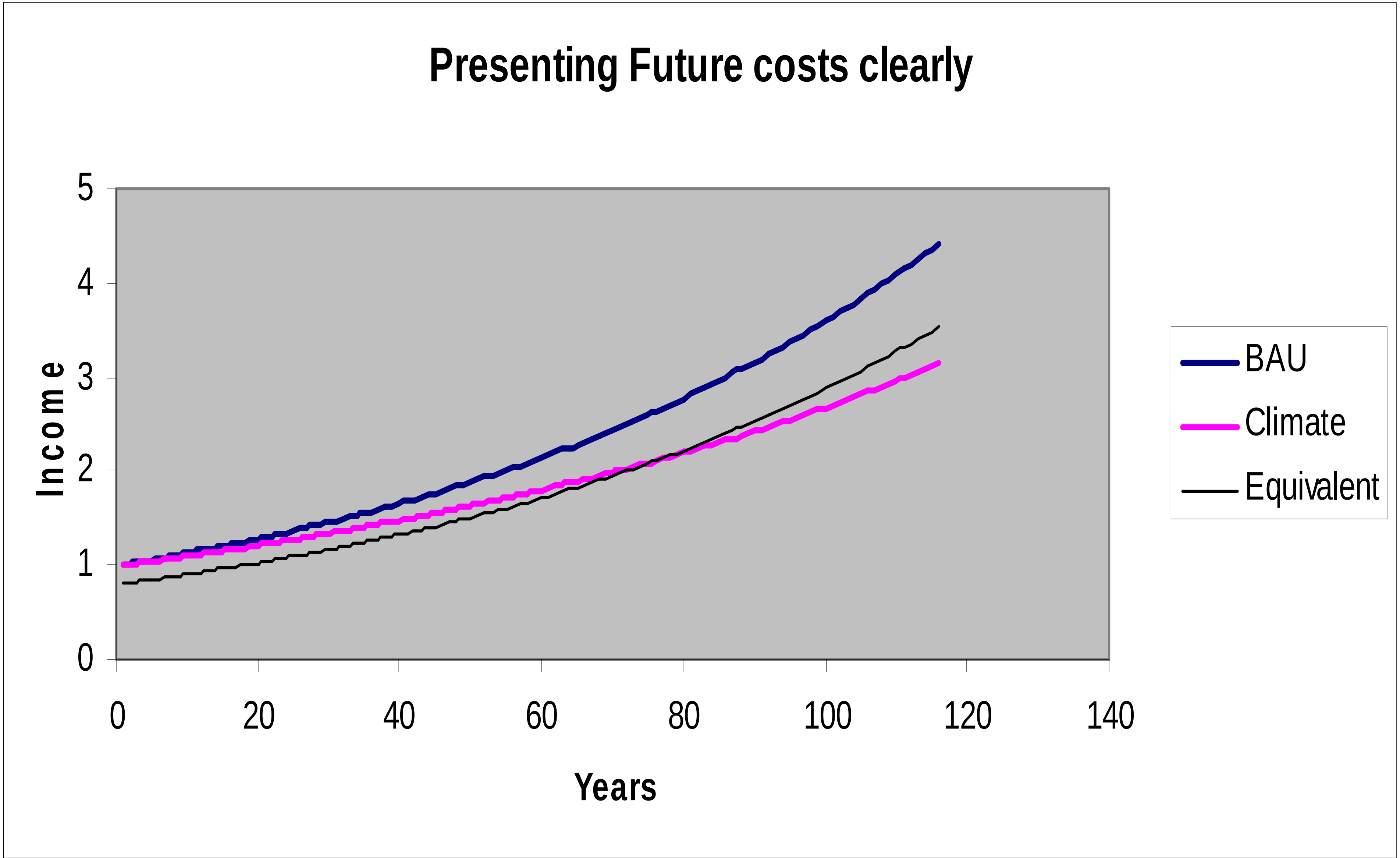


Kostnaden för att stabilisera atmosfärens koldioxidhalt

2,2% growth → 8* in 100 Years.

Discounted Sum of costs = 14 T$

5-20% For now and forever…



Also much critique of Stern
Stern points to uncertainty

- Ecosystem damage:
- Albedo
- Cloud formation
- Methane hydrates
- Human response, deforestation
- Asian population

Also much critique of Stern
Stern points to uncertainty

- Ecosystem damage:
- Albedo
- Cloud formation
- Methane hydrates
- Human response, deforestation
- Asian population
- Which is most important ?

In the calculations by Stern the largest source of uncertainty was:

- Albedo
- Cloud formation
- Methane hydrates
- Human response, deforestation
- Chinese population
- **The Rate of Discount!**

Welfare, Discounting, Relative Prices and Risk

- What is the **COST?** →

- Discounting in multisector growth models
- Valueing ecosystem damage → Changing relative prices
- Ethical issues, Welfare Weights
- Treating risks, distributions have fat tails

Ramsey

$$r = \rho + \alpha g$$

Value of a future cost

- $V_t = V_o / (1+r)^t$

Value of a future cost

- $V_t = V_o / (1+r)^t$
- $V_t = V_o (1+p)^t / (1+r)^t$
- Effect of relative prices can be = discounting!
- Iff p big enough!

Labour

- 100 years ago 5% of the population in Copenhagen had a maid.
- Incomes have grown 3-4%/year

Labour

- 100 years ago 5% of the population in Berlin had a maid.
- Incomes are growing 4%/year

- How many people have a maid today?

Why can’t we all have maids?

Why can’t we all have maids?

- $P_{maid} = f(\text{Income})$

FOOD

- World Agriculture is 24% GDP

- What is cost of a 1% loss ?

FOOD

- World Agriculture is 24% GDP
- What is cost of a 1% loss ?
- ~ 0.01*24% = 0. 24 % GDP

FOOD

- World Agriculture is 24% GDP

- What is cost of a 95% loss ?

- ~ 0.95*24 = 23 % GDP

FOOD

- **23%!**
- **Doesn't seem right**

- **What is wrong ?**

Relative Prices of food…

Relative Prices of food…

- will change so fast
- The 5% left which today accounts for 1% of GDP will become ALL of GDP.

Future Ecosystem Scarcities

- Water
- Soil
- Wild (non-cultivated) fish
- Biodiversity
- Glaciers and snow
- Wildlife, protected areas
- Fuelwood, pasture, silence (?)

OK: lets talk Economics

- Why do we discount?

OK: Economics

- Why do we discount?
- We will be richer
- We are impatient
- Rich people dont know the value of money

Assume an intertemporal welfare function

$$W = \int_0^T e^{-\rho t} U(C(t))dt$$

The tradeoffs between consumption at different points of time are given partly by the “utility discount rate” ρ

partly by the utility function *U*.

The discount rate is the rate of change in the marginal value of more consumption = sum of two factors

$$r = \rho - \frac{\frac{d}{dt} U'(C(t))}{U'(C(t))}$$

With Constant elasticity of utility function → classical Ramsey Rule

$$U(C) = \frac{1}{1-\alpha} C^{1-\alpha}$$

$$r(t) = \rho + \alpha g_C(t)$$

Ramsey and growth

- If $\rho = 0.01$, $\alpha = 1.5$ and $g = 2.5\%$ $r = 4.75\%$.
- Constant over time iff growth is constant.
- Increases with growth
- If growth falls, future discount rates will fall over time. Azar & Sterner (1996): limits to growth → falling discount rates and higher damage from carbon emissions.

ECOLOGICAL ECONOMICS

ELSEVIER

Ecological Economics 19 (1996) 169–184

ANALYSIS

Discounting and distributional considerations in the context of global warming

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Received 21 May 1995; accepted 6 May 1996

Compare Nordhaus 5 $/ton

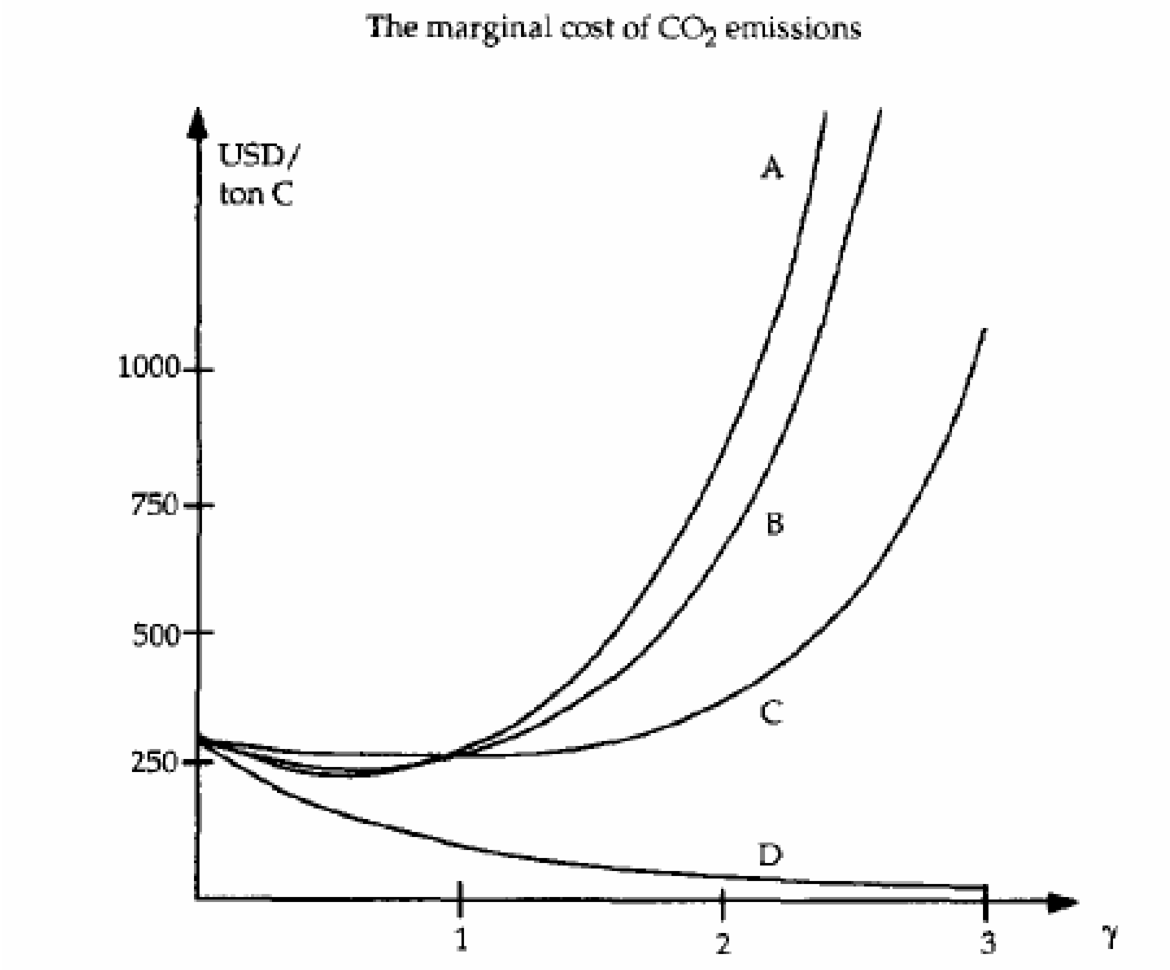


Fig. 3. The *generalized* cost of a unit emission of CO_2 is plotted as a function of γ in four cases. In plot A, B and C, the inequality situation is worsened, unchanged, and improved, respectively. In plot D, income distribution is not considered. The higher the value for γ, the higher is the discount rate, but also the inequality

Are there Limits to Growth?

- Clearly YES:
- A finite planet
- The amount of cement, carbon, steel and water that we can use is limited!

Are there Limits to Growth?

- Clearly YES:
- A finite planet
- The amount of cement, carbon, steel and water that we can use is limited!
- Clearly NO:
- Human imagination is limitless
- The quality of concerts and computer games knows no bounds!

Our best image of the future

- Continued growth…
- Rich get even richer.
- Poor will eventually also get richer but gap not eliminated.
- Much of growth in manufactured goods that use little resources. More mobiles, culture, computation, communication…
- Less transport, corals, clean water?

Consequences of this

- Rapidly rising real price of carbon intense goods (and this may apply to other env problems too).
- Allocation of rights will be sensitive!
- Discounting needs to be suplemented by relative price change.

We need two sectors:
C which grows; E (which does not)

$$W = \int_0^\infty e^{-\rho t} U(C,E)\,dt$$

The appropriate discount rate *r* is then

$$r = \rho + \frac{-\frac{d}{dt} U_C(C,E)}{U_C(C,E)}$$

Relative price of ”environment”

Value of environmental good is given by

$$U_E / U_C$$

The relative change in this price, *p*, is

$$p = \frac{\frac{d}{dt}\left(\frac{U_E}{U_C}\right)}{\left(\frac{U_E}{U_C}\right)}$$

To simplify: select utility function that combines contant elasticity of utility above with constant elasticity of substitution between E and C

$$U(C,E)=\frac{1}{1-\alpha}\left[(1-\gamma)C^{1-\frac{1}{\sigma}}+\gamma E^{1-\frac{1}{\sigma}}\right]^{\frac{(1-\alpha)\sigma}{\sigma-1}}$$

The relative price effect

$$p = \frac{\frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{U_E}{U_C}\right)}{\left(\frac{U_E}{U_C}\right)} = \frac{1}{\sigma}(g_C - g_E).$$

Formula for discounting

- not only is there a relative price effect
- but the discounting formula itself changes

Discounting in 2 sector model

$$r = \rho + \left[(1-\gamma^*)\alpha + \gamma^* \frac{1}{\sigma} \right] g_C + \left[\gamma^* \left(\alpha - \frac{1}{\sigma} \right) \right] g_E$$

Where γ* is ”utility share” of the environment

$$\gamma^* = \frac{\gamma E^{1-\frac{1}{\sigma}}}{(1-\gamma) C^{1-\frac{1}{\sigma}} + \gamma E^{1-\frac{1}{\sigma}}} = \frac{U_E E}{U_E E + U_C C} = \frac{\frac{U_E}{U_C} E}{\left(\frac{U_E}{U_C} E \right) + C}$$

Comparing discount formulae

$$r = \rho + \alpha g$$

$$r = \rho + \left[(1-\gamma^*)\alpha + \gamma^* \frac{1}{\sigma} \right] g_C + \left[\gamma^* \left(\alpha - \frac{1}{\sigma} \right) \right] g_E$$

$$P = \frac{1}{\sigma}(g_C - g_E)$$

Discount rates will be the same if

- $\gamma^* = 0$ (Sector E plays no role for U)
- $g_C = g_E$ (Sectors E and C identical)
- $\alpha\,\sigma = 1$

2 sector discount will be lower if

- $g_C > g_E$ (Sector E grows slowly)

and

- $\alpha \sigma > 1$ (ie if substitutability is good and utility curvature very high).

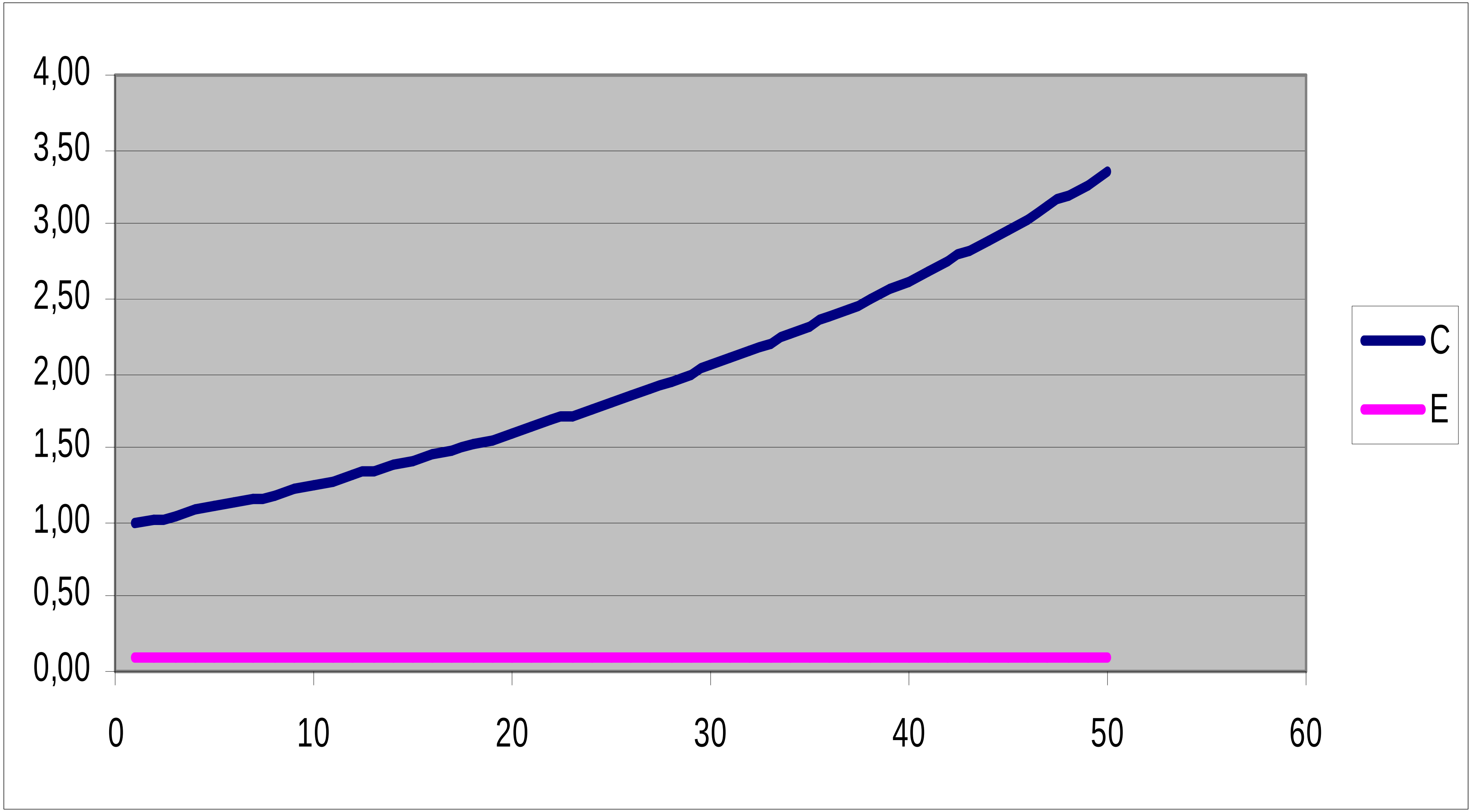
- NB that normally if $\sigma \neq 1$ and $\alpha\sigma \neq 1$ then r in the 2 sector model will change over time

The TOTAL discount factor

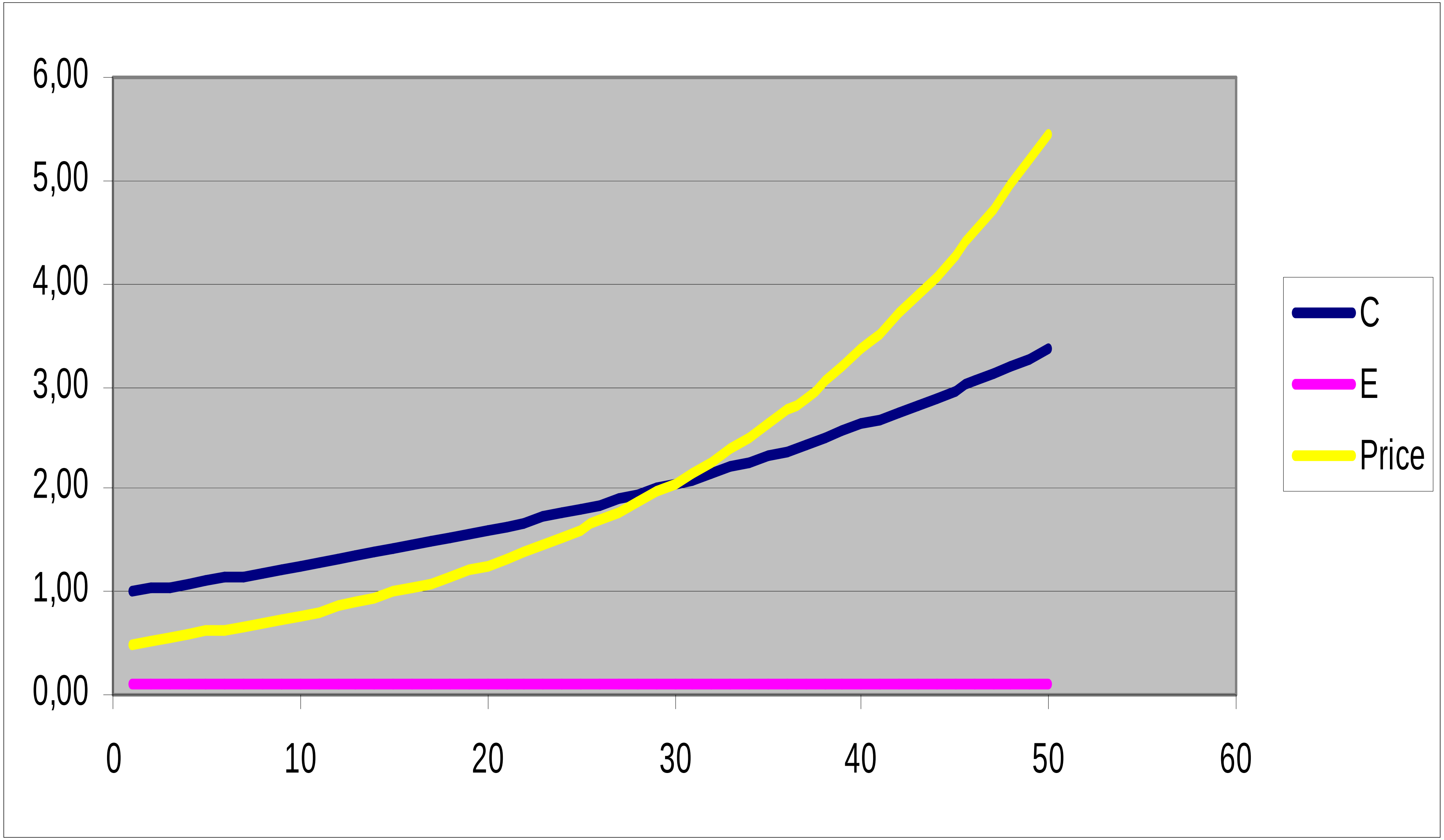
Using *R* to denote the combined effect of discounting and relative price increase of environmental goods,
i.e. *R*=*r*-*p*,

$$R = \rho + \left[(1-\gamma^*)\left(\alpha - \frac{1}{\sigma}\right) \right] g_C + \left[\gamma^*\alpha + (1-\gamma^*)\frac{1}{\sigma} \right] g_E$$

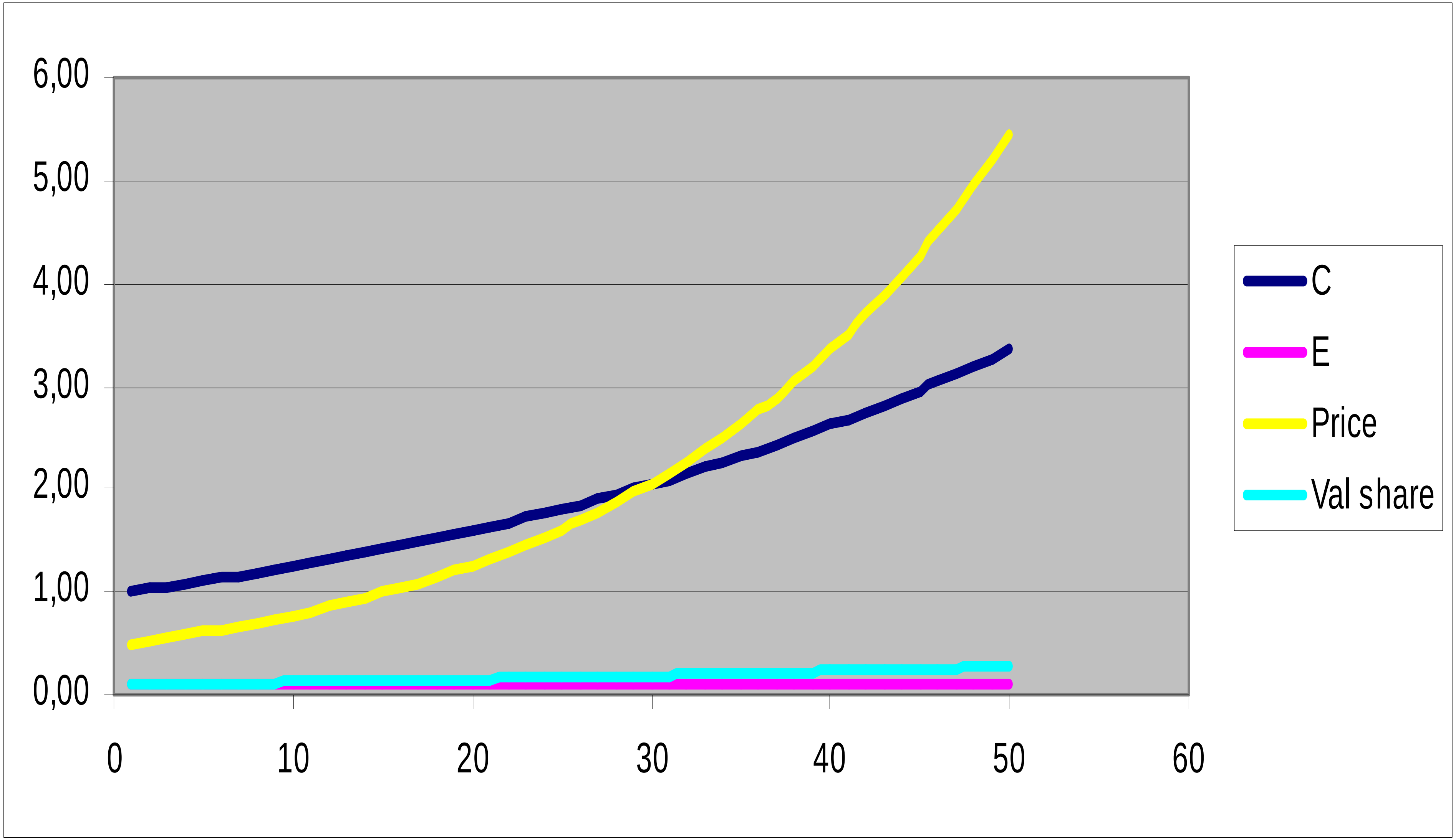
2 sectors, C&E with different rates $\sigma=0,5$



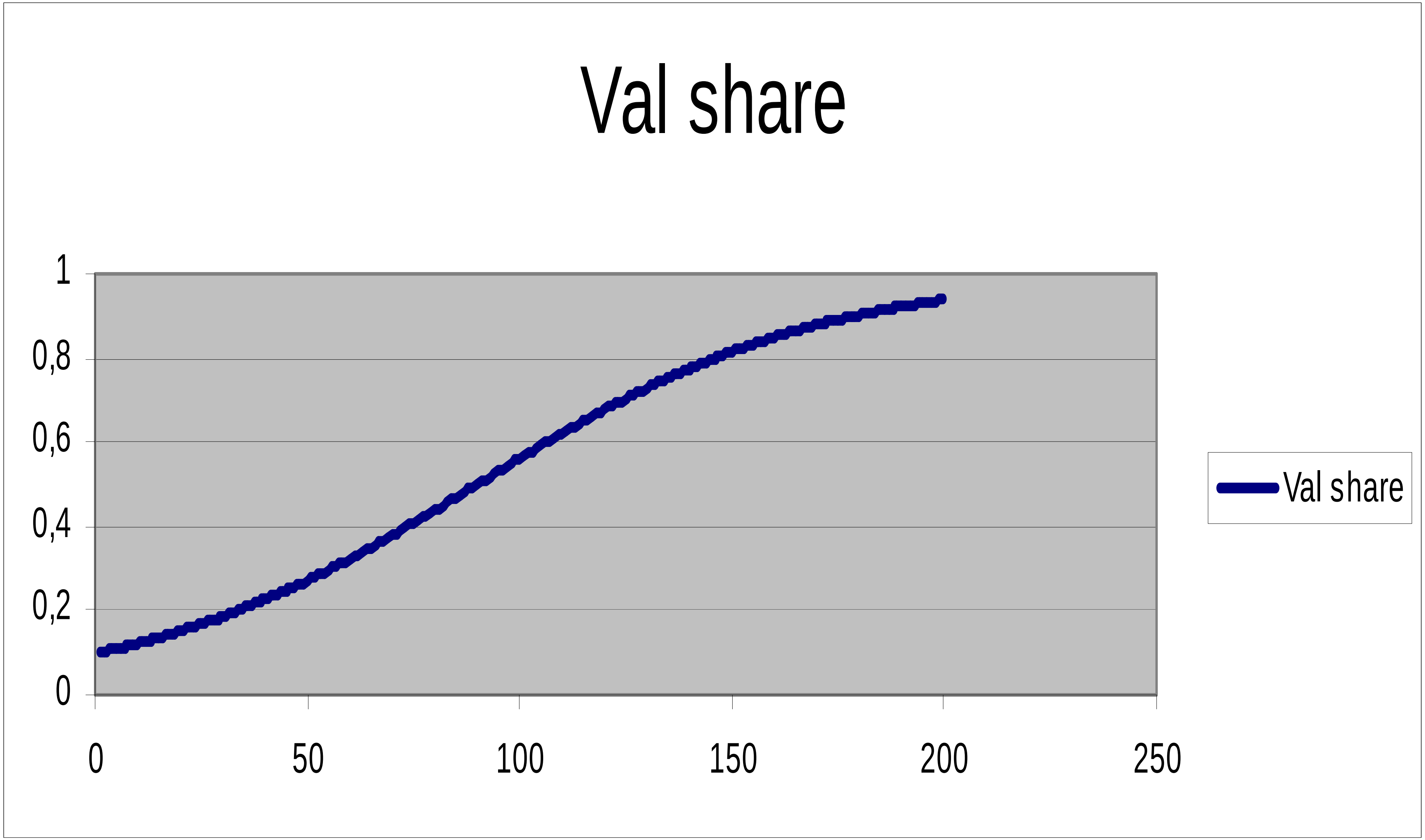
C gets bigger but the price of E goes up FASTER



So the value share of E rises

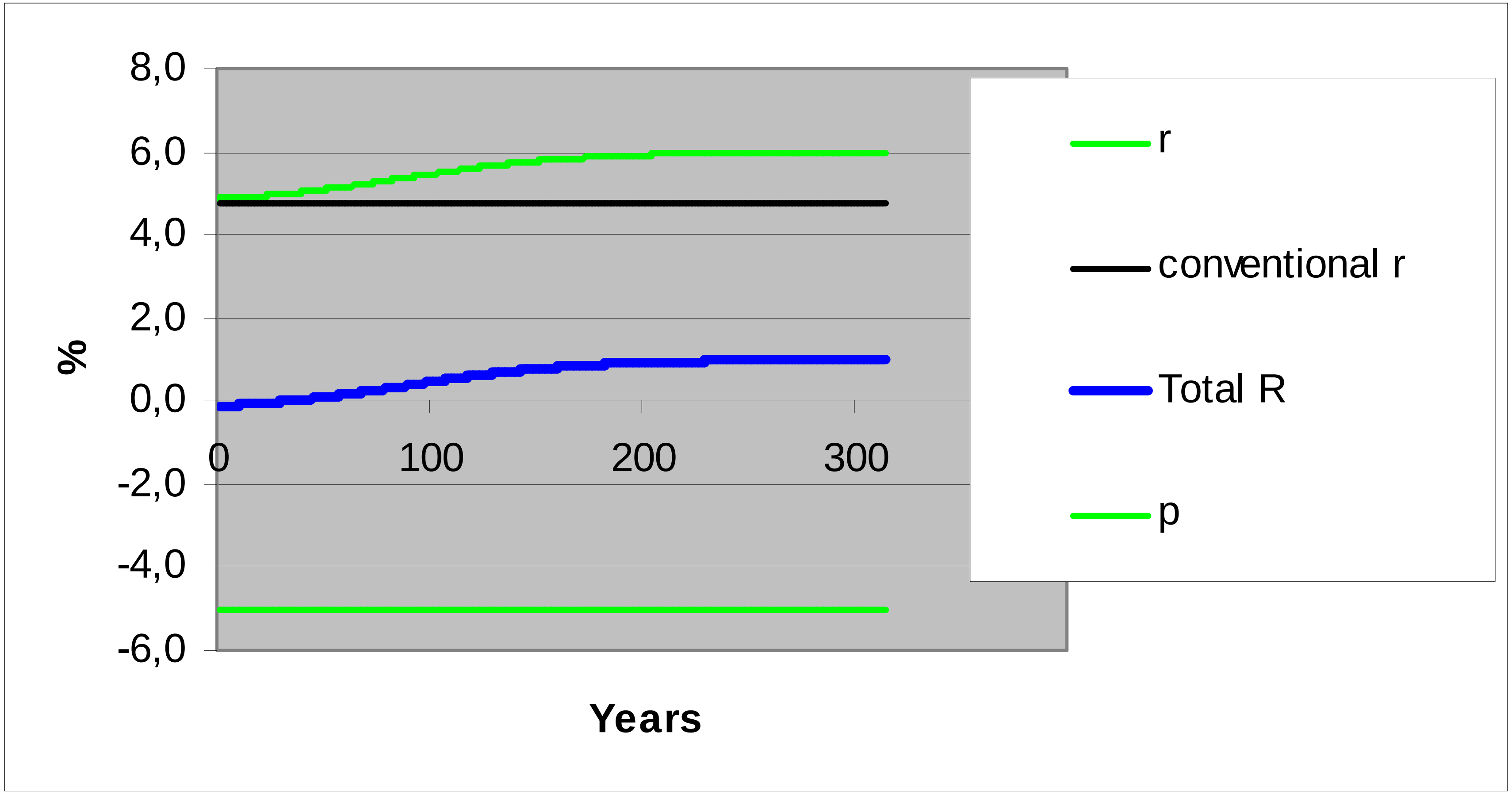


After some time E dominates



Therefore variation in discount rate

$\rho=0.01,\ \sigma=0.5,\ \alpha=1.5,\ \gamma^*_0=0{,}1\ g_C=2.5\%$



Comparison of discountrates

g_c = 2,5%, rho = 1%, g_E = 0%,

α	σ	Convent *r*	***2sector R***		
0.5	0.5	2.25	**3.35**		
0.5	1	2.25	**2.37**		
0.5	1.5	2.25	**2.28**		
1	0.5	3.5	**4.24**		
1	1	3.5	**3.50**		
1	1.5	3.5	**3.44**		
1.5	0.5	4.75	**5.12**		
1.5	1	4.75	**4.62**		
1.5	1.5	4.75	**4.60**		

Comparison of discountrates

g_c = 2,5%, rho = 1%, g_E = 0%,

α	σ	Convent *r*	***2sector R***	*Price p*	TOT *R*
0.5	0.5	2.25	**3.35**	-5.00	-1.65
0.5	1	2.25	**2.37**	-2.50	-0.12
0.5	1.5	2.25	**2.28**	-1.67	0.61
1	0.5	3.5	**4.24**	-5.00	-0.76
1	1	3.5	**3.50**	-2.50	1.00
1	1.5	3.5	**3.44**	-1.67	1.77
1.5	0.5	4.75	**5.12**	-5.00	0.12
1.5	1	4.75	**4.62**	-2.50	2.13
1.5	1.5	4.75	**4.60**	-1.67	2.94

Conclusions

- Relative prices CRUCIAL in long run CBA
- Complement discounting by price correction
- Discounting itself is complex in 2 sector model
- Important policy conclusions for Climate
- Next step: integrated GE Climate model

Introducing relative prices into DICE

- Stern has been criticised for low r. $\delta=0,1$ $\eta=1$ and per capita g =1,3. Total 1.4
- Nordhaus reproduced Stern-type results with DICE and low r
- We reproduce Stern (or intermediate) results with Nordhaus values (high r)
- By including a small part of non-market sector and changing relative prices.

An even Sterner Review

Thomas Sterner & Martin Persson

1. Comment on r, η and δ
2. And on non market damages
3. Introduce Relative Prices into Debate

2 Changes to DICE

- The original model maximizes total discounted utility using a CRRA function
- $U(C) = C^{1-\alpha} / (1-\alpha)$
- To include the effect of changing relative prices we use a constant elasticity of substitution function of two goods:
- $U(C)= [(1-\gamma)C^{1-1/\sigma} + \gamma E^{1-1/\sigma}]^{(1-\alpha)\sigma/(\sigma-1)}/(1-\alpha)$

Environmental Damages

- First we assume a share of environmental services in current consumption of 10%.
- We assume damage to environmental amenities will be quadratic in temperature
- At 2,5 ℃ damage ~ 2% current GDP
- $E(t) = E_0 / [1 + aT(t)^2]$
- *So E is actually falling due to climate ch.*
- *We assume elasticity of Substitution is .5*

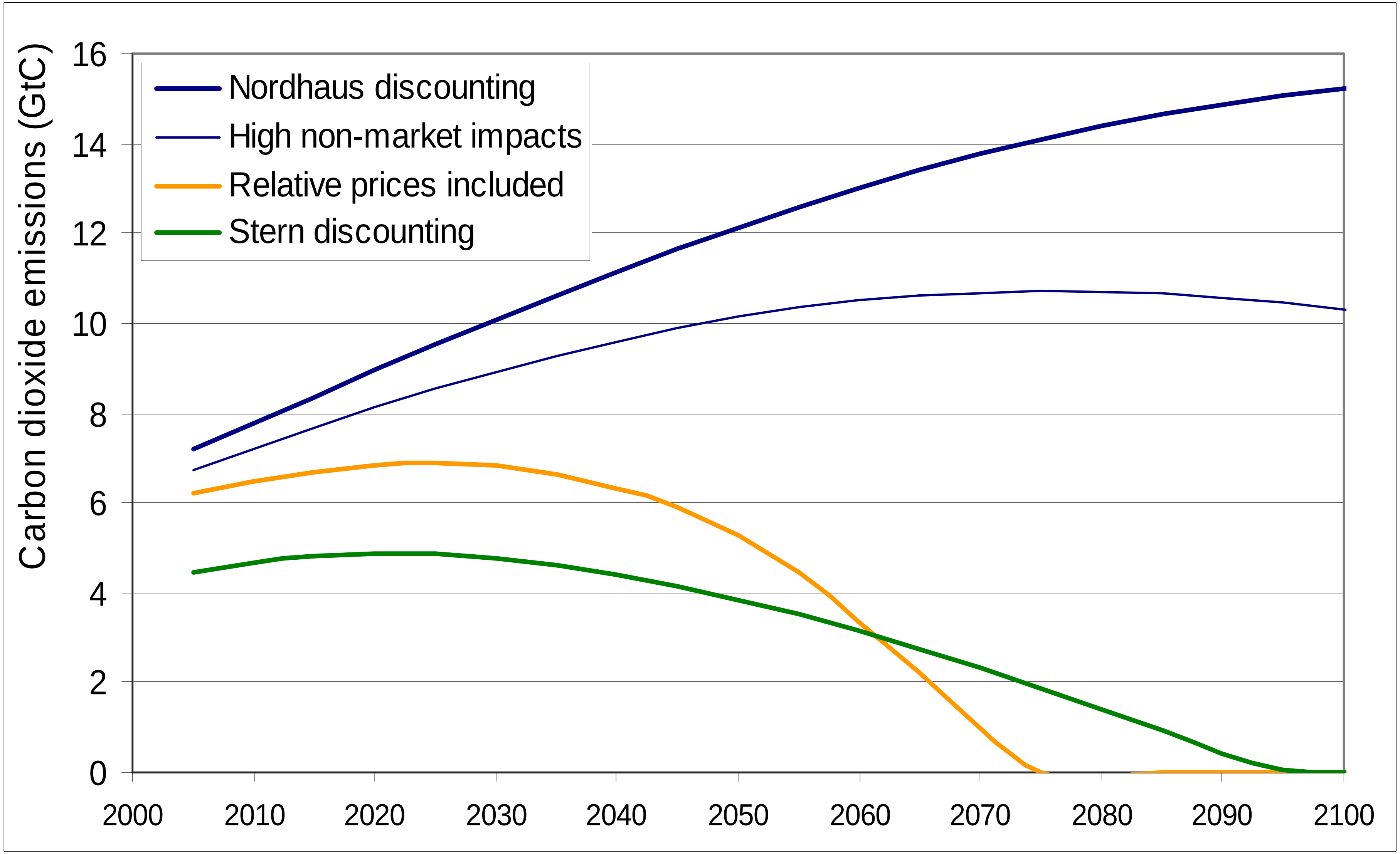


Figure 2: *Optimal carbon dioxide emission paths in the DICE model for four different cases: the original model (Nordhaus discounting), the original model with high non-market impacts(High non-market impacts), the original model with low discount rate (Stern discounting) and a run where the changes in relative prices between market and non-market (environmental) goods is taken into account (Relative prices included). See text for explanation.*

Conclusion

- Stern has been accused by Nordhaus et al
- High damage because of low r
- (This in turn because of low δ and/or η)
- We do not necessarily disagree with these
- We show that even with high δ & η carbon abatement is optimal if relative prices for damaged ecosystems are considered
- Another approach is risk & Uncertainty

Thanks

- More:
- More on Stern and Sterner…
- Tansport sector
- Change in various sectors
- Bargaining and allocation efficiency
- Political economy of gas taxes
- Distributional issues, regressivity

Other Applications

- CBA for a road past Sthlm …
- Same gasoline price in 25 yrs as today
- No congestion fees…

- Thing of WTP for water, recreation, space, maids …….

Relative prices very different

Costa & Kahn, The Rising Price of Nonmarket goods, AEA Papers &P

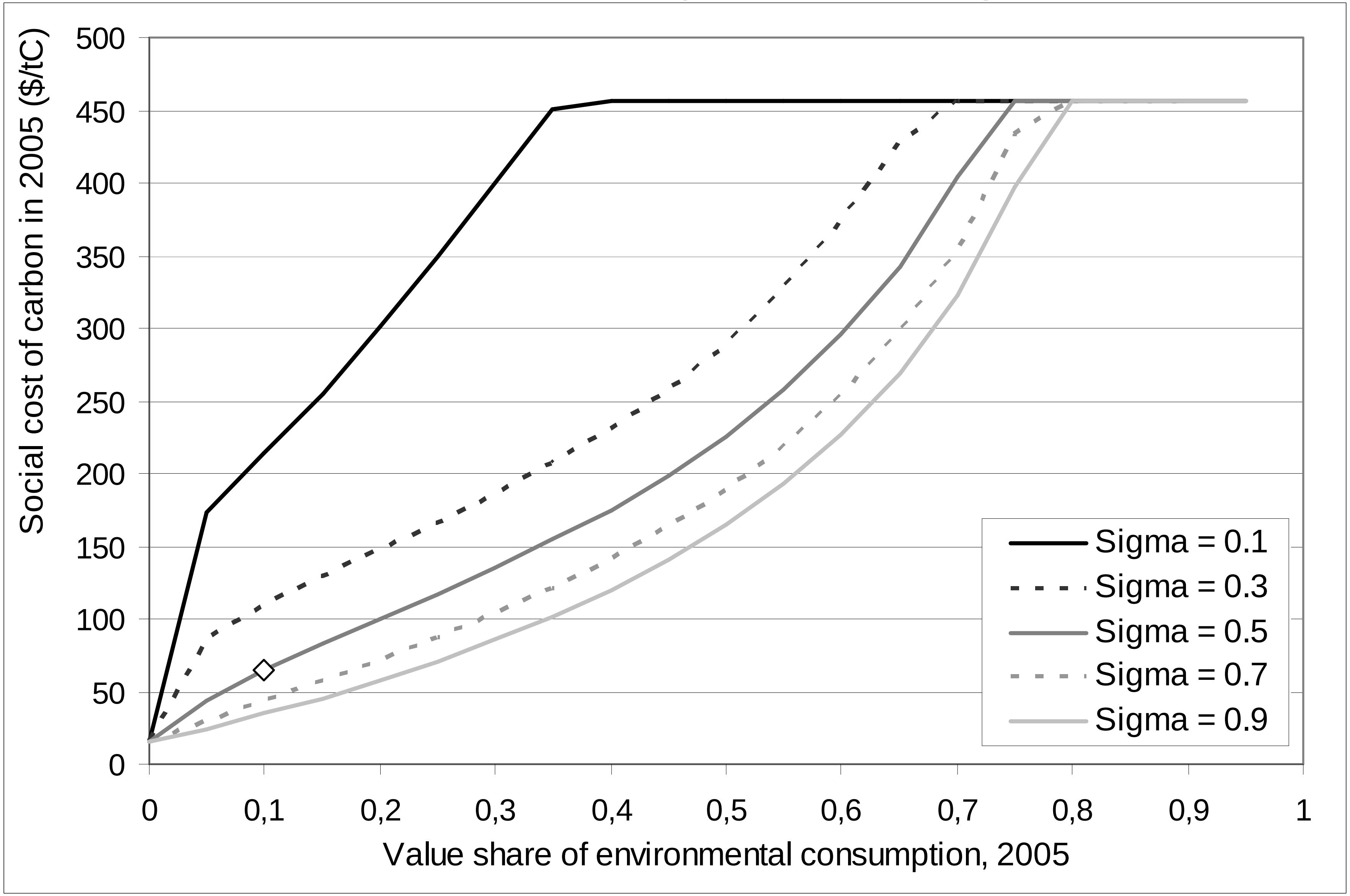
TABLE 1—THE VALUE OF LIFE IN 2002 DOLLARS, 1900–2000

Year	Value of life
1900	$427,000 (predicted)
1920	895,000 (predicted)
1940	1,377,000
1950	2,426,000
1960	2,884,000
1970	5,176,000
1980	7,393,000
2000	12,053,000 (predicted)

Analyze data on *evolution* of

- The value of ecosystem services?
- The WTP for fair treatment
- For silence
- Darkness
- Coral reefs
- Water of different quality?

Sensitivity testing



More opinions on Stern & Nordhaus

- Not reasonable to base r, in this case, on short term markets for equity or bonds
- Reasonable to use low delta
- Eta = 1 is already quite high
- Stern discount rate quite reasonable for climate issues.
- On top of this more non-market damages and changing relative prices!

More opinions on Stern & Nordhaus

- Not reasonable to base r, in this case, on short term markets for equity or bonds
- LONG run should be used. Other phenomena such as lack of aid and lack of progressive taxes
- In 1970s ”everyone” recomended welfare weighting (Dasgupta, Marglin, Sen, Little & Mirrlees (1974) Drèze and Stern. Eta = 1 is already quite high. Sometimes 2 was recommended but
- In practical CBA it is **not** used ie **η=0** !
- It would be strange to use **η=0 for all current issues and η=2 only for decisions about the future.**

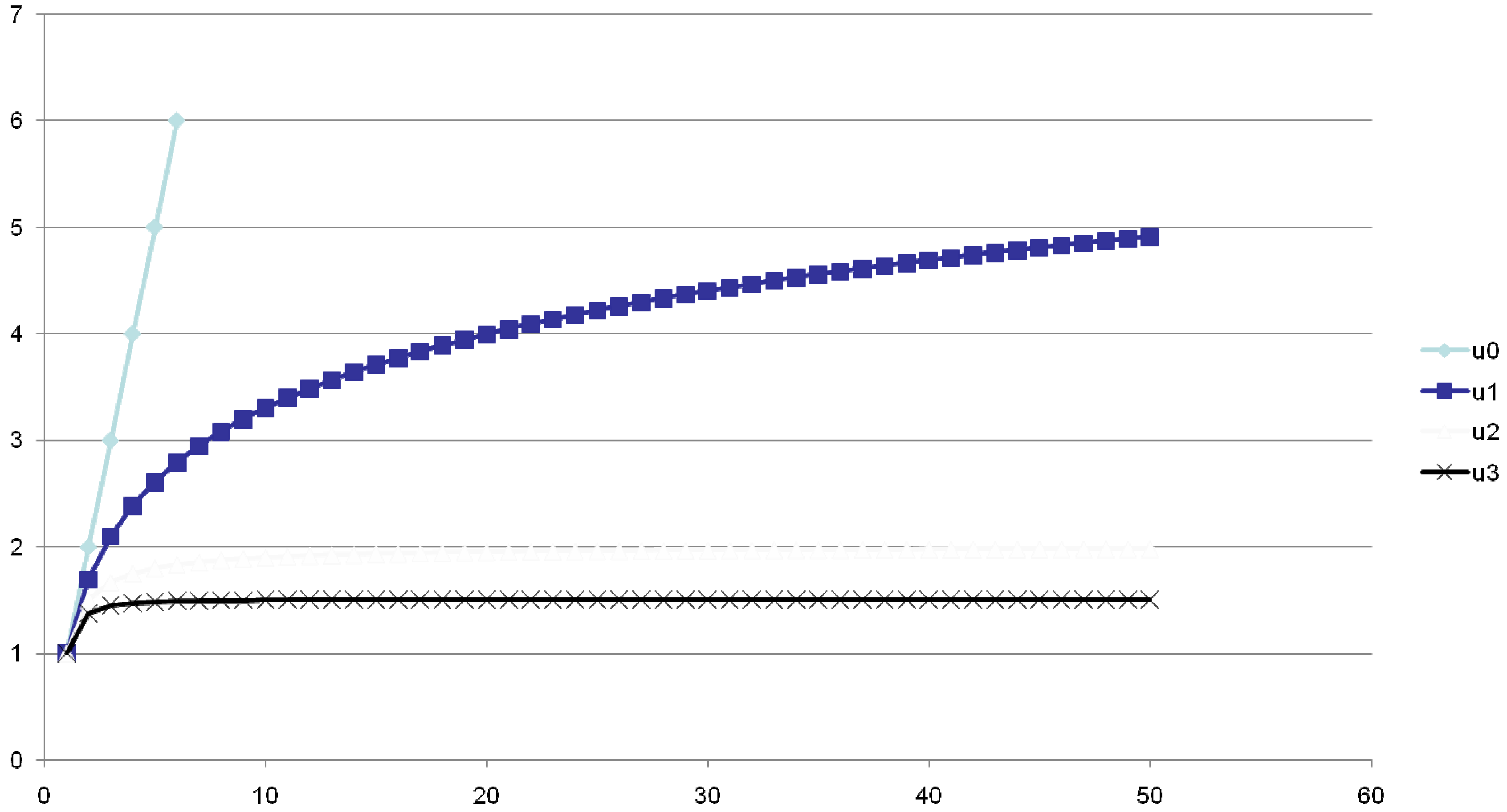
Sign of Derivatives of *r*, *p*, and *R*

	R	p	$R = r - p$
g_C	+	+	$-$ if $\alpha\sigma < 1$ $+$ if $\alpha\sigma > 1$
g_E	$-$ if $\alpha\sigma < 1$ $+$ if $\alpha\sigma > 1$	$-$	+
α	Depends on γ^*, g_C and g_E (+ if $g_C > 0$ and $g_E \geq 0$)	0	Depends on γ^*, g_C and g_E (+ if $g_C > 0$ and $g_E \geq 0$)
σ	$-$ (if $g_C > g_E$)	$-$ (if $g_C > g_E$)	+ (if $g_C > g_E$)

Double counting ?

- Is someone lost:
- Are we double counting when we first work out special discount formula that builds on the marginal utility of *quantities* of E and C and then also add in a relative price change?
- No: Our discount rate for the two sector model is specifically formulated in terms of rate of change of U_C !

Curvature of utility



Some argue for high discount rate

- Because of high α.

- If future is rich it can take care of itself

- Then we should value damages that hit the poor even higher!
- The loss of one family's harvest in Bangladesh
- Maybe = $1000 but welfare weighted value >

Breakdown by sector

- How much reduction for transport?
- 25-30%
- Fast Growing;

The most efficient pol Instrument?

- Kyoto
- ETS
- Agricultural policy
- Subsidies
- R&D – fusion, solar, wind….energy saving
- Chinese ”One Child” policy

The most efficient pol Instrument?

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- Chinese ”One Child” policy
- **Gasoline Taxes!**

Growth and Environment 2020

- Can we increase income 50% **&** reduce fossil emissions 50% ?
- Take the transport sector: A simple modell for fuel demand is $Q = Y^a P^b$
- Elasticities 1 for income Y, – 0.8 for price P

Simple-minded economist solves major problem:

- All you need is to raise price of fuel by 300% !

- Because $P = (0.5/1.5)^{-1/0.8} = 3.95$

300% !

- Is that **realistic**??
- What happens to Welfare?
-
- Isn't there some **other way** ?

Is it **possible**?

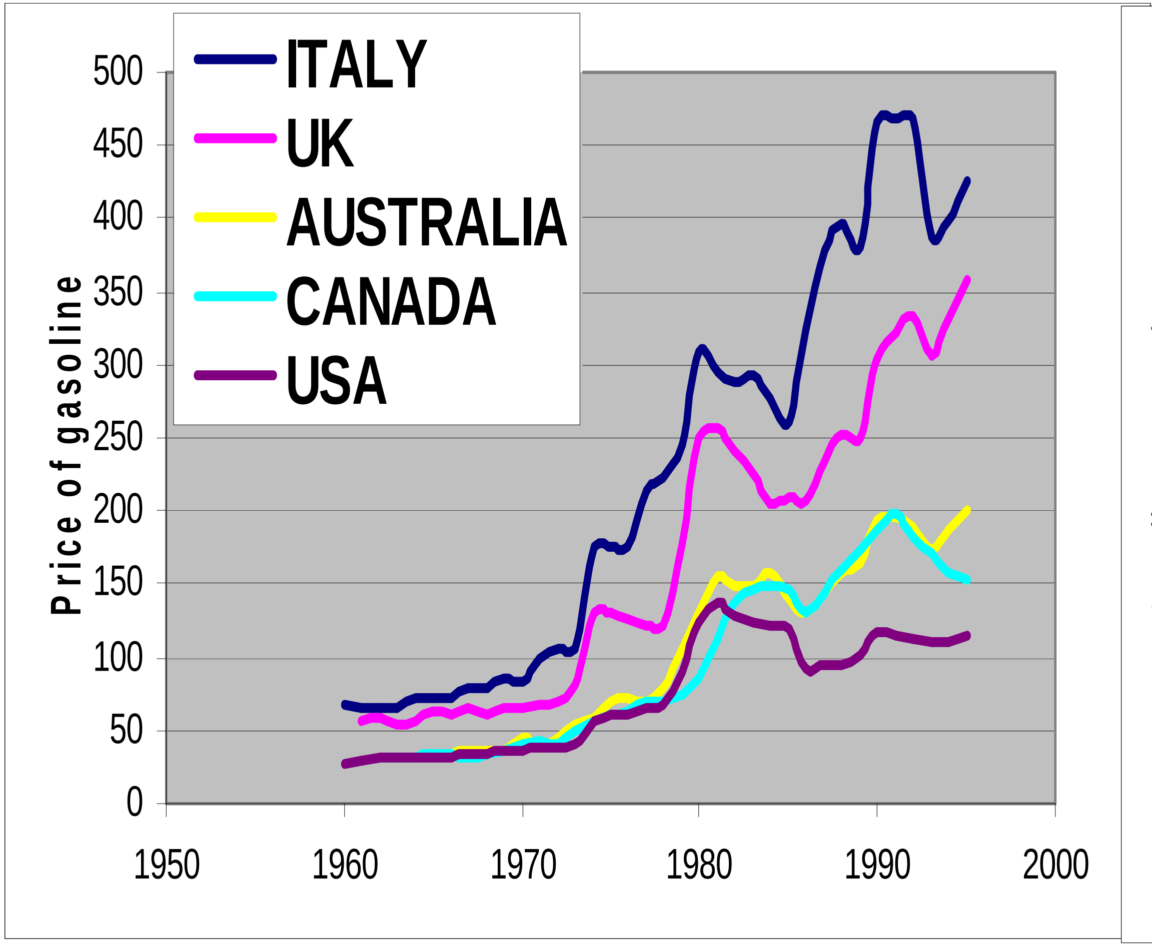
Is that POSSIBLE?

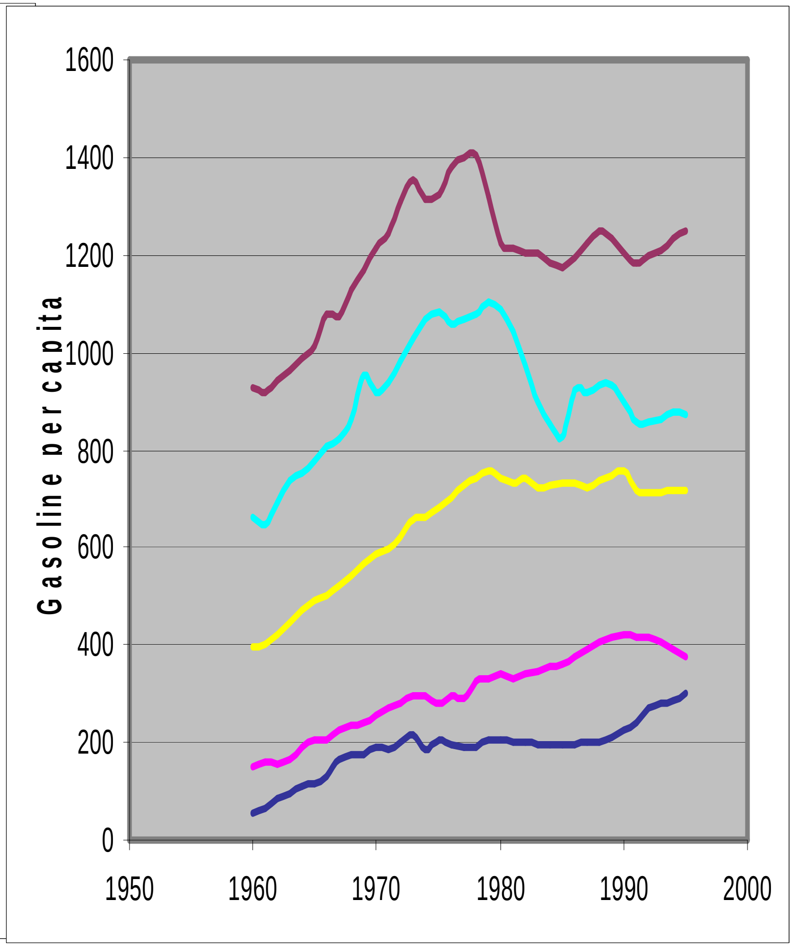
- Yes : Europe has already done it! International price of fuel is 0,3 $/l.
- If the Whole World had prices like UK or Italy a large share of the problem would be solved.
- Though only for transport. We haven’t done much concerning industry and electricity yet…

Petrol

prices

Consumption/cap





Effect of higher fuel price in OECD

country	price	Fuel use	Hypothetical fuel use	Reduction in %
AUSTRAL	0,54	13306	7664	**42**
CANADA	0,51	28167	15535	**45**
FRANCE	0,95	14216	12968	**9**
GERM	0,85	30025	25061	**17**
ITALY	1,12	17565	18230	**-4**
JAPAN	0,61	41828	26742	**36**
MEXICO	0,69	21343	15025	**30**
NETH	1,07	4139	4147	**0**
SPAIN	0,92	8928	7919	**11**
UK	1,07	21513	21504	**0**
USA	0,31	356981	131819	**63**
OECD	0,53	605873	346844	**44**

Transport Fuel Use in OECD
Gtons fuel (and ~C*(12/14))

	Real	UK prices	US prices
Fuel use	**1,13**	0,72	1,47
		-36%	+30%

Subsidies for ”environmental” cars

- Annual tax: Renew.360; gasoline 2046; Diesel 4011 (- 6000 kr >1July)
- Difference several hundred €/yr
- Parking 1000 – 6000 kr/yr
- Env car subsidy10000 = 2000/yr
- Tax benefit: 50% of ~15000 Kr
- Total 14-20 000 kr/yr or 0,5-1 kr/km
- Reasonable?

CO2 storage under ground

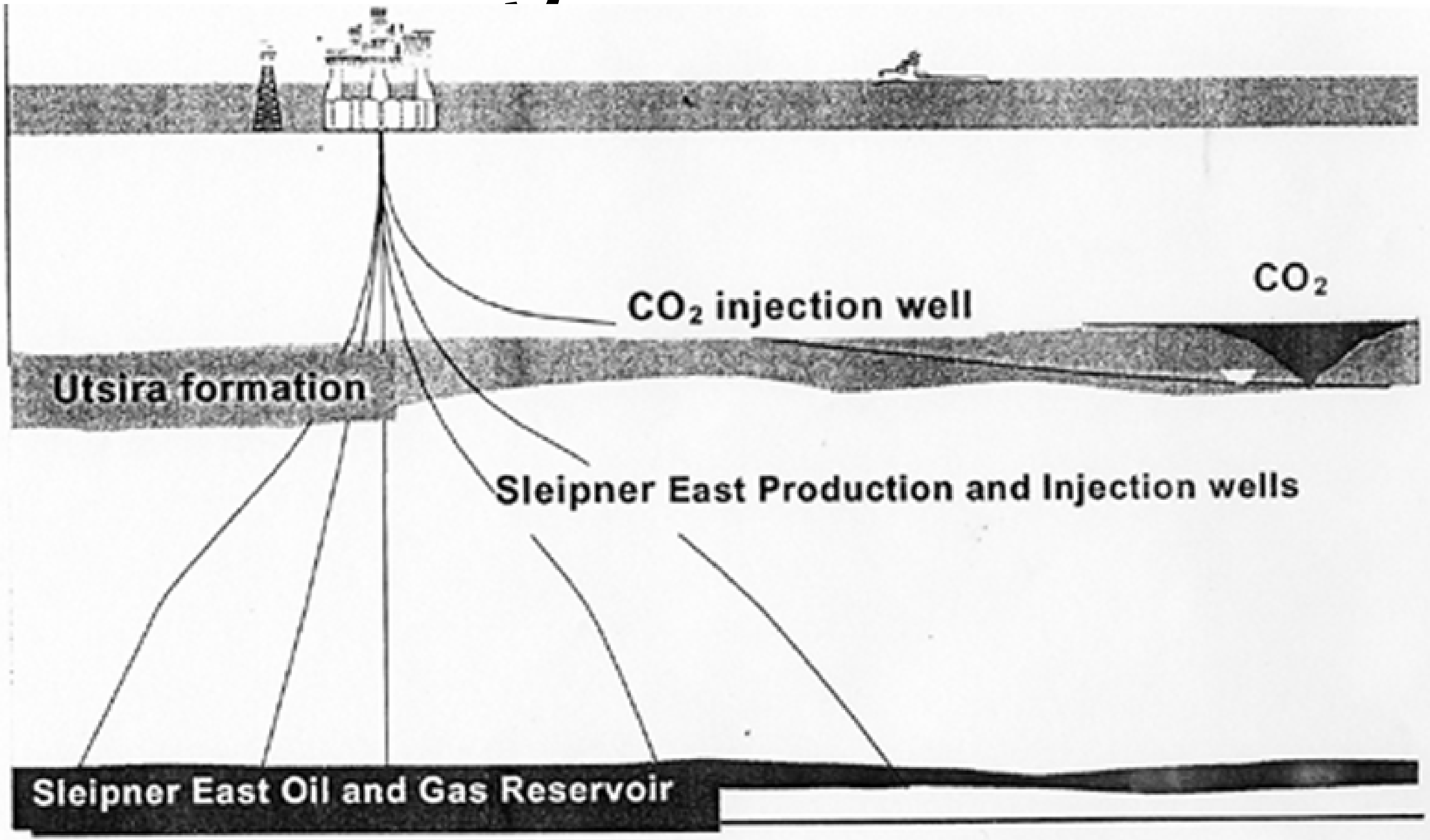
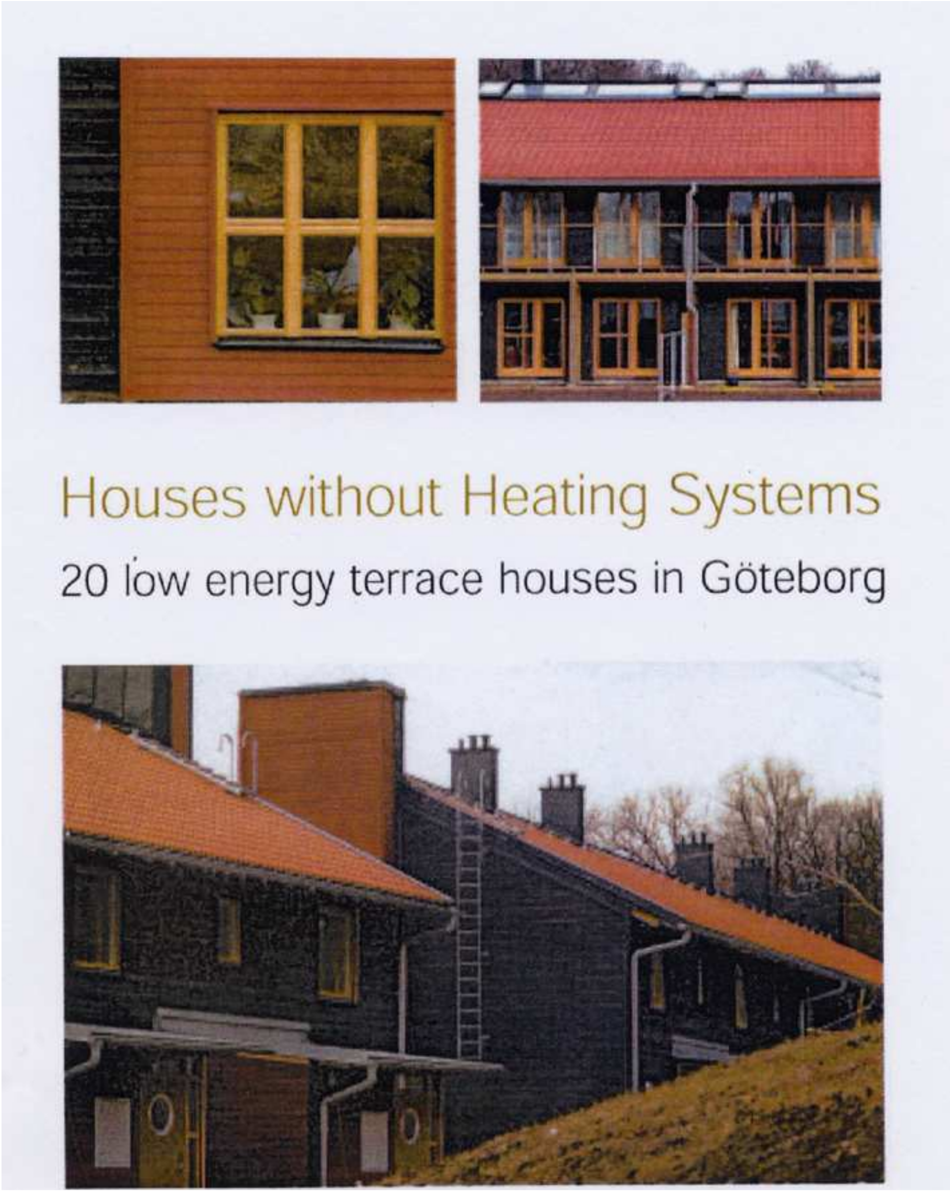


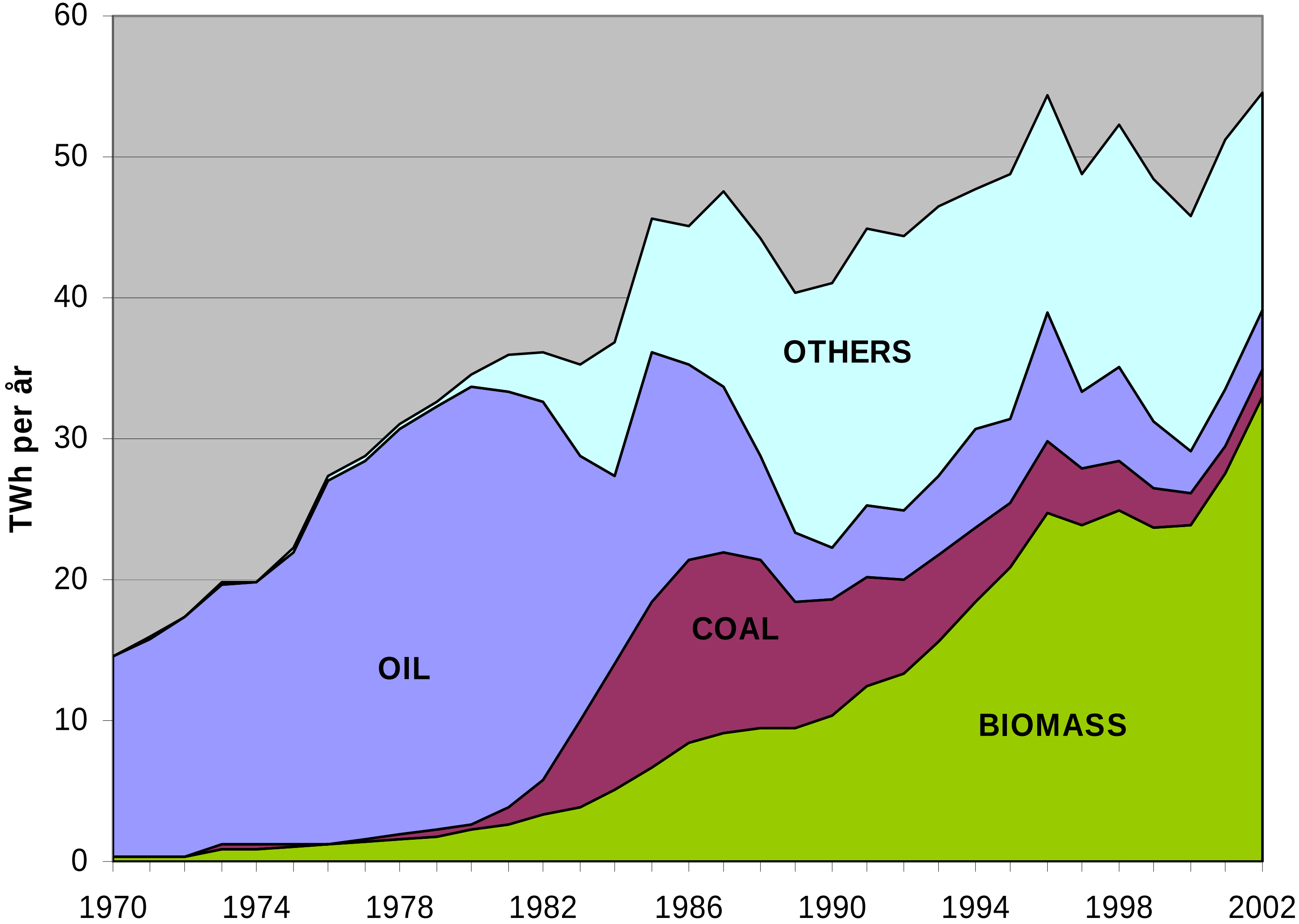
Figure 6.1 *The Sleipner CO_2 injection project in the North Sea. Approximately 1 million tonne CO_2 per year is being disposed into a saline aquifer*

Houses without Heating…

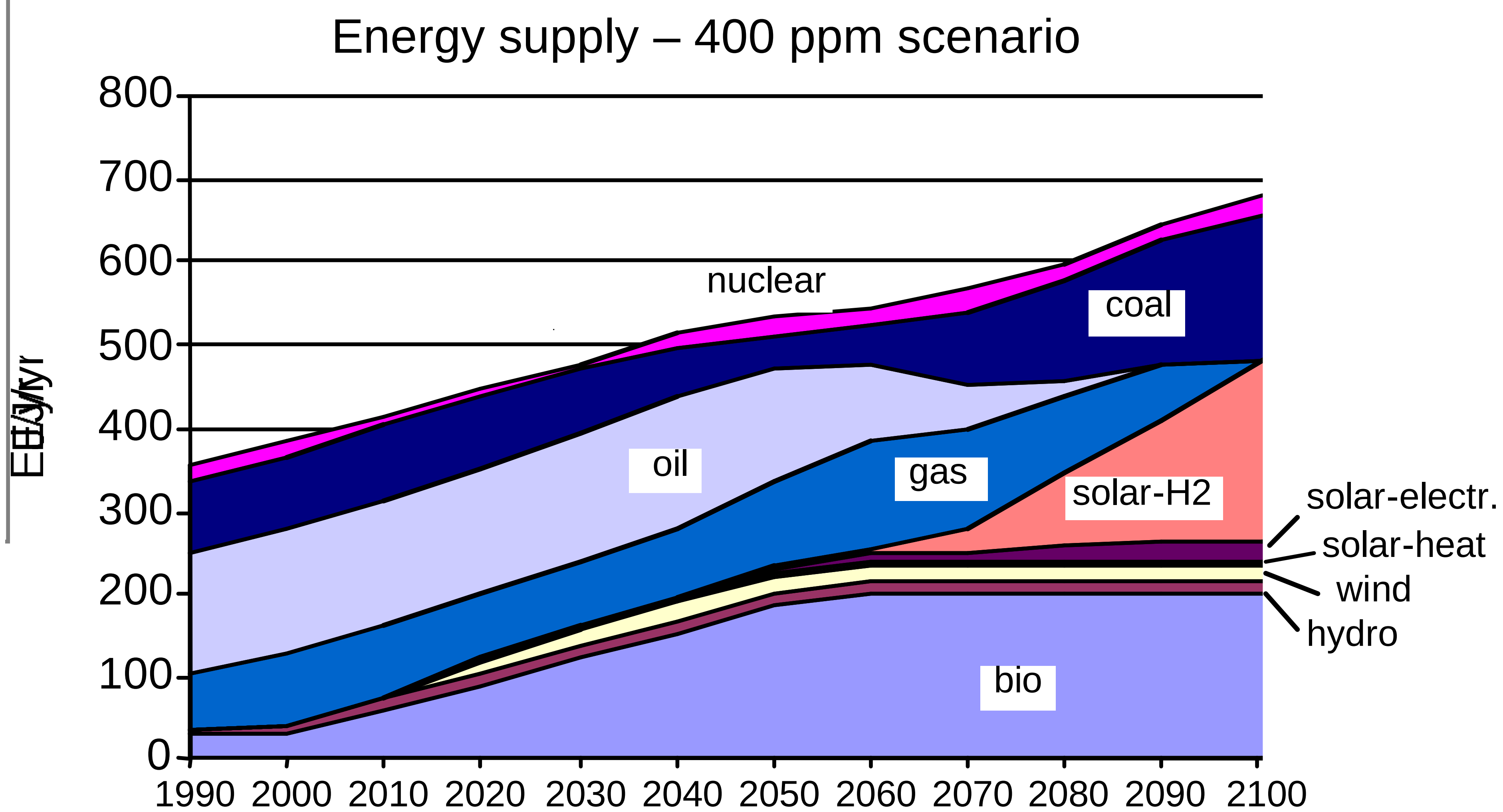


In Sweden !?

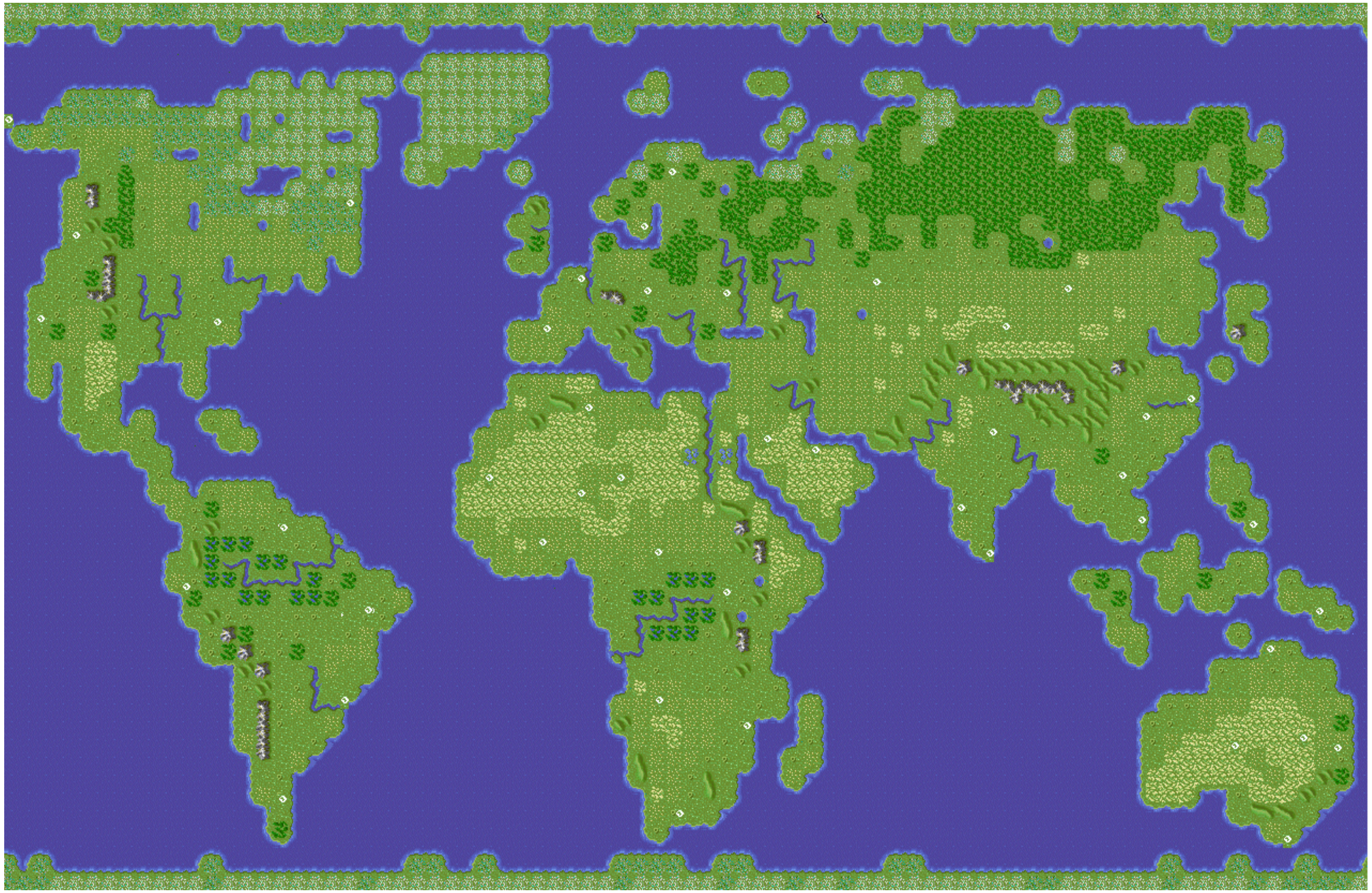
Fuel use in Swedish district heating



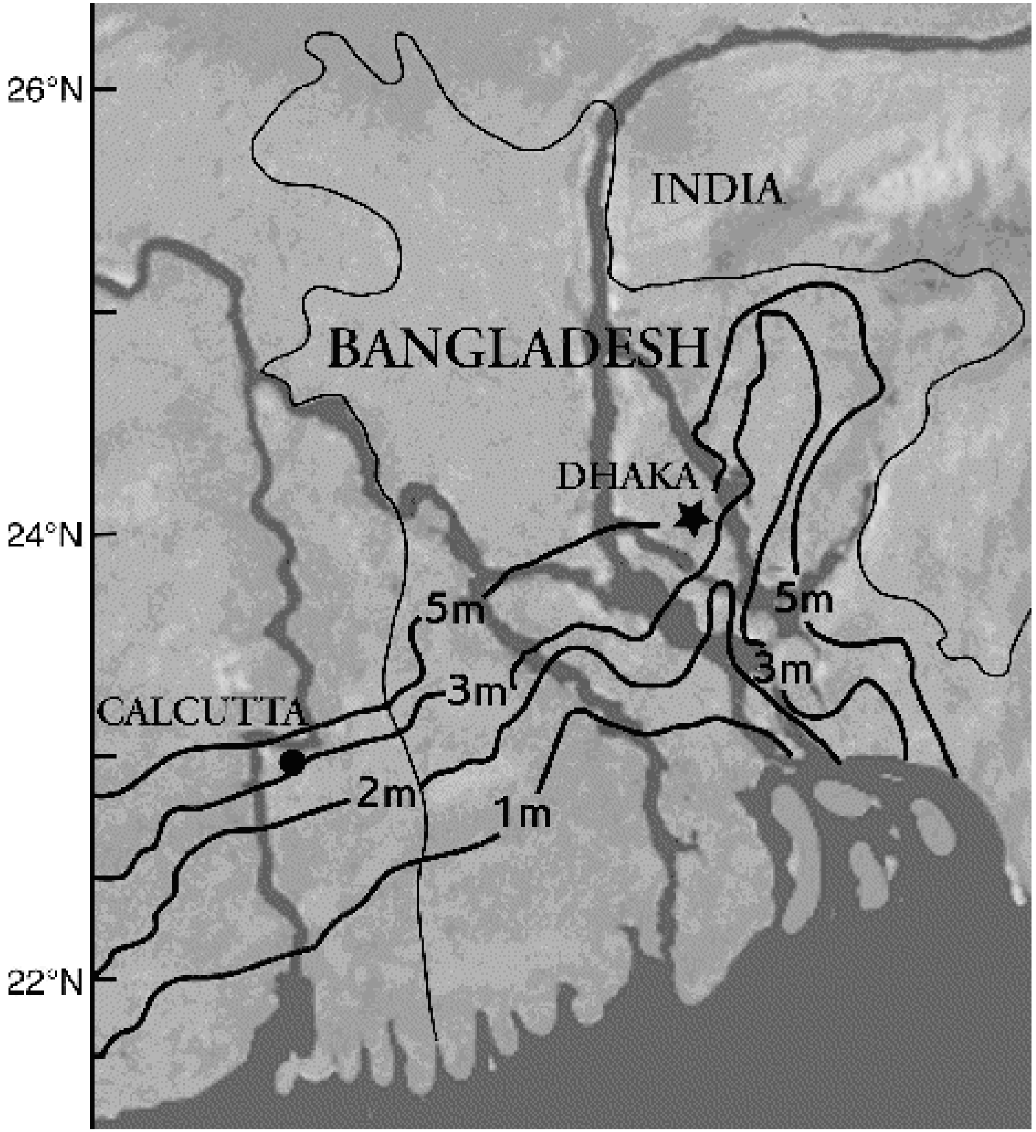
More Energy - less Carbon



There ***is*** enough energy



Sea Level Rise

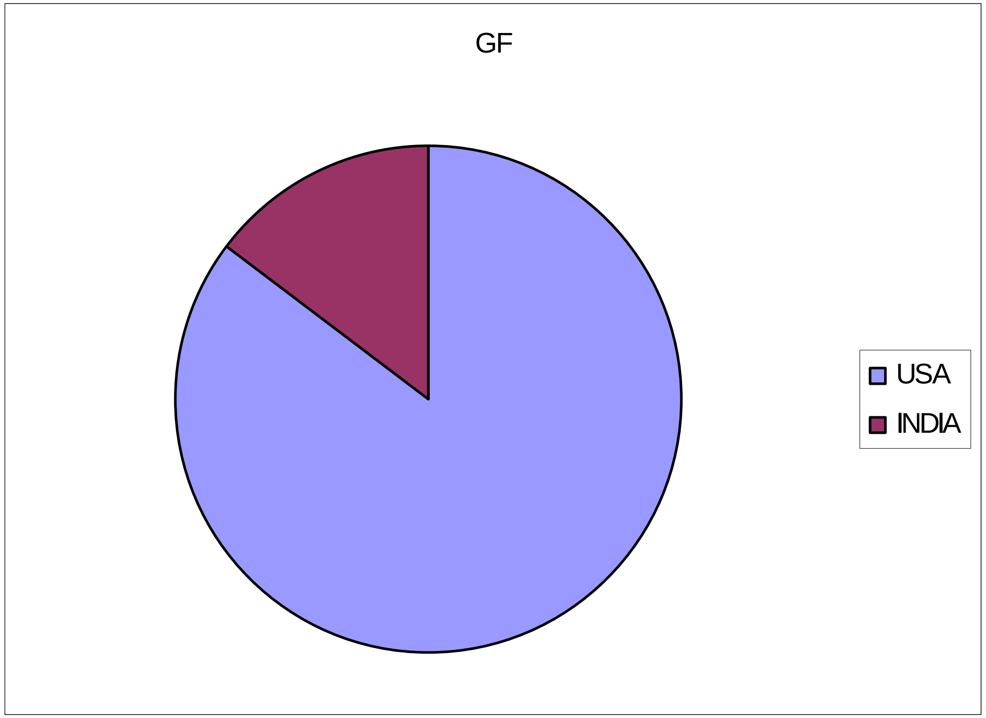


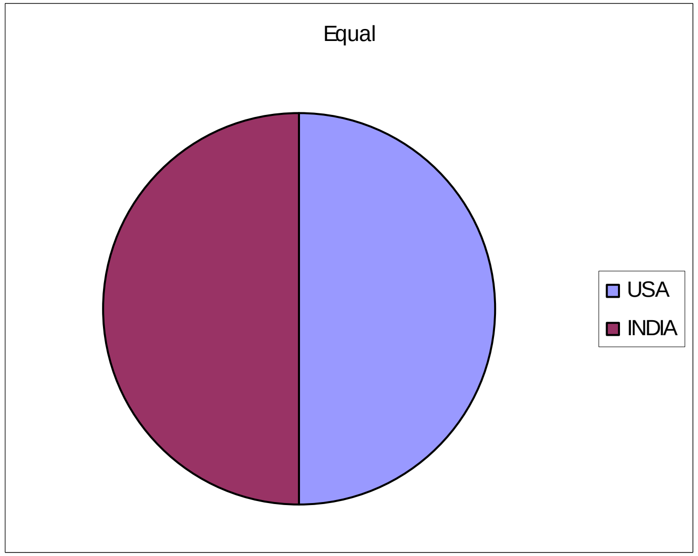
Climate Bargaining

Different burden allocations

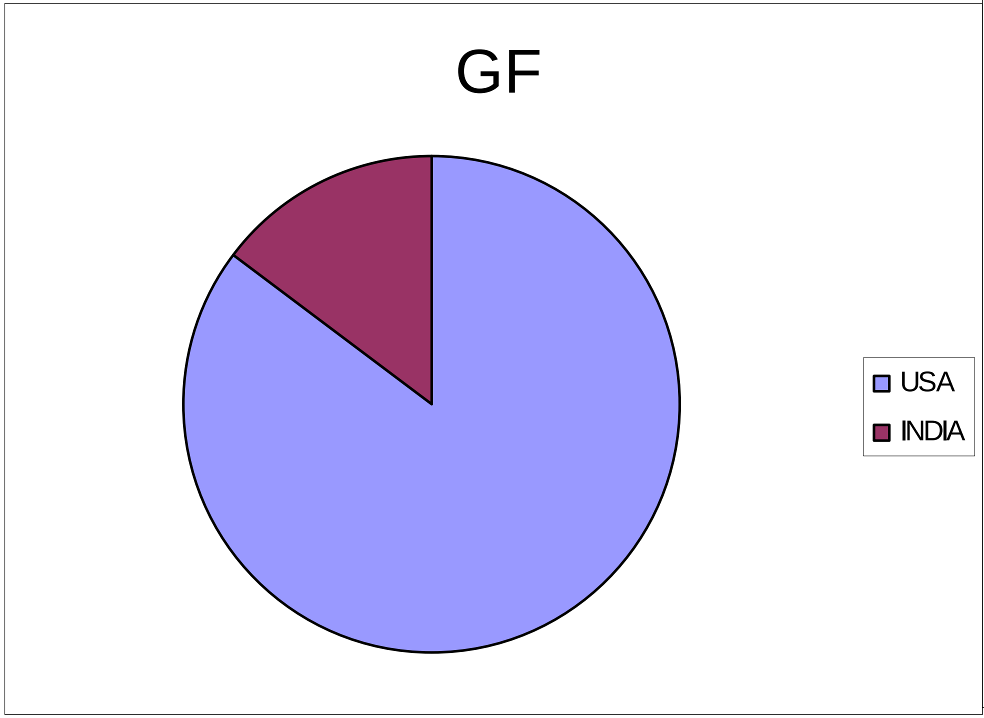
	Current	GF	Equal	Per Capita
USA	1750	875	512,5	170
INDIA	300	150	512,5	855
Total	2050	1025	1025	1025

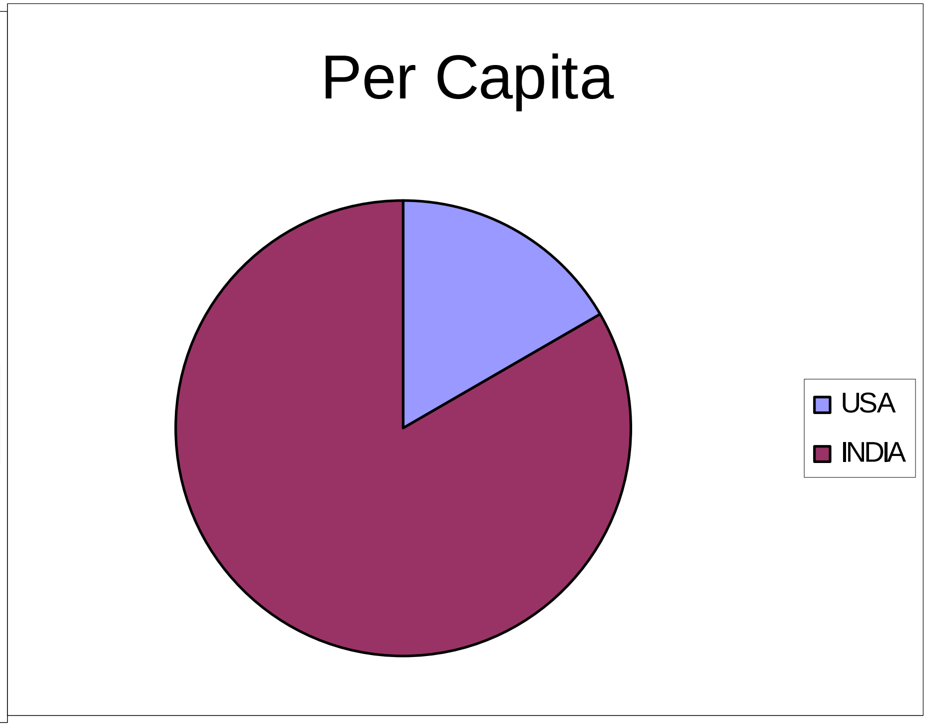
The allocation between US and India





The allocation between US and India





Bargaining strategies

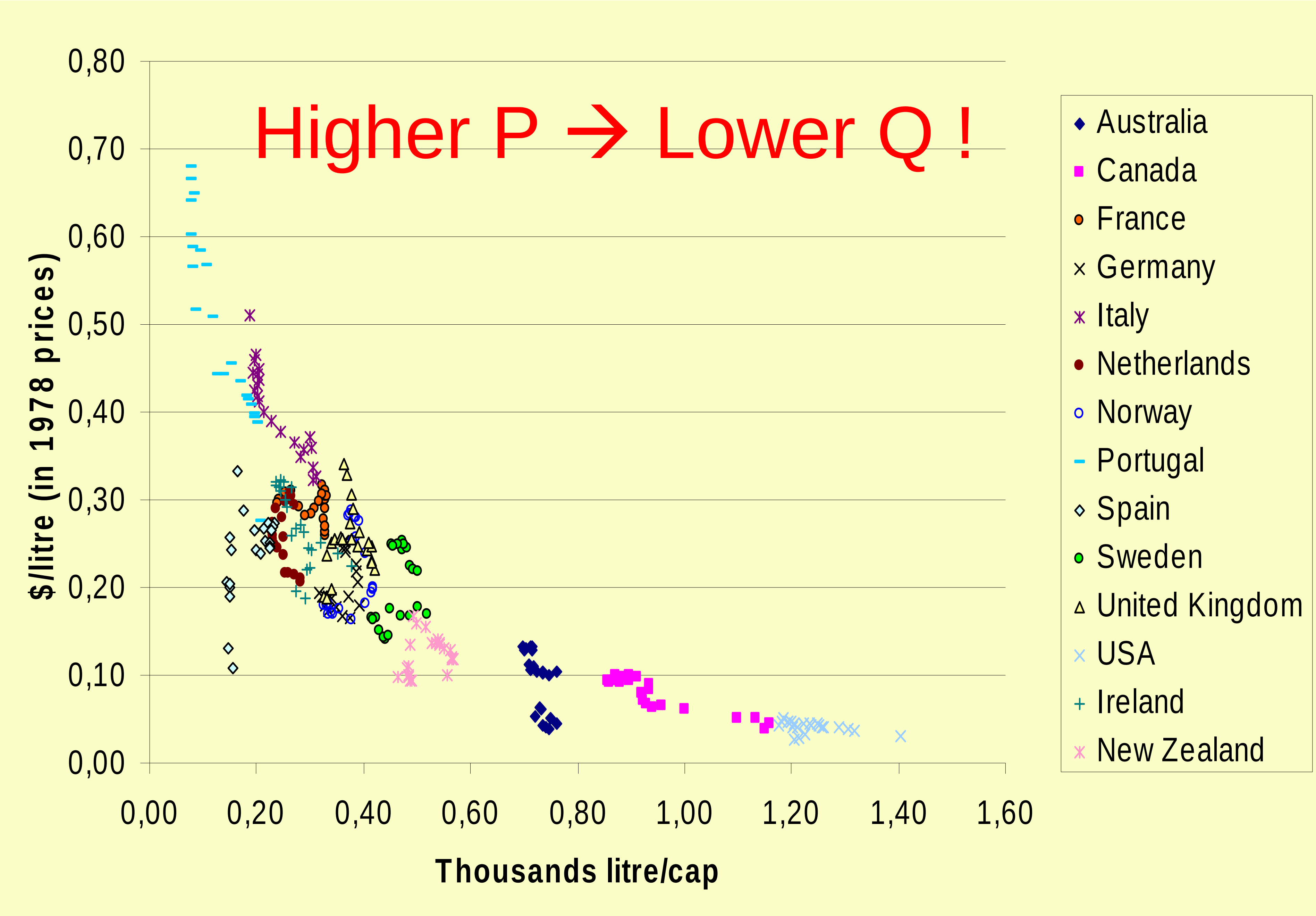
- What do you do when you are in a shop where you have to bargain and you really want something but it is much too expensive?

Political Economy of Fuel Taxation

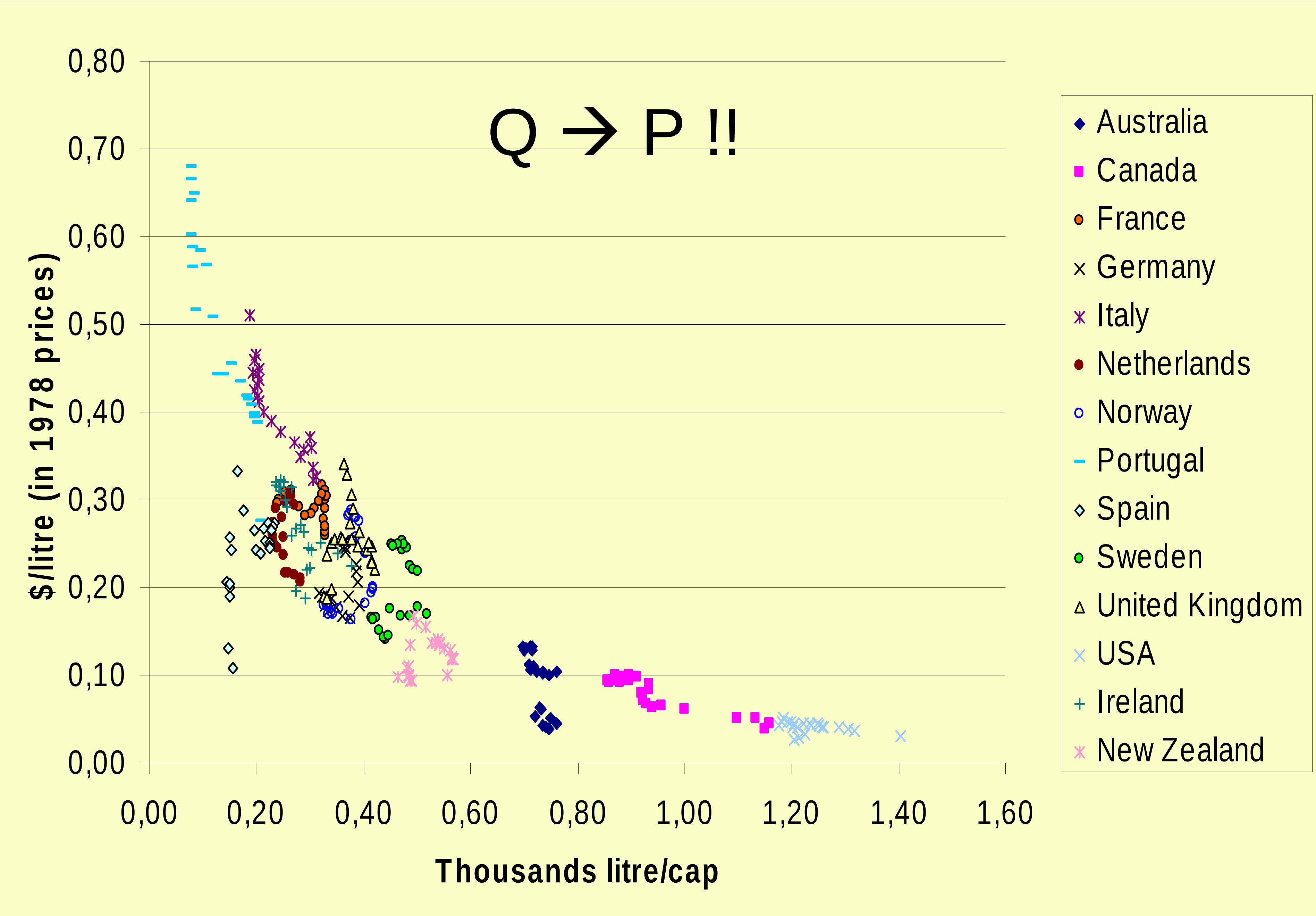
- Henrik Hammar
- Åsa Löfgren
- Thomas Sterner

Determinants of Fuel demand

- Hundreds of studies...
- Q=f(Y,P)
- Dahl – Sterner surveys
- Stylized facts: Income elasticity = 1
- Price Elasticity = -0,8
- See figures ....→



Higher P → Lower Q !
$/litre (in 1978 prices)
0,80
0,70
0,60
0,50
0,40
0,30
0,20
0,10
0,00
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
Thousands litre/cap
Australia
Canada
France
Germany
Italy
Netherlands
Norway
Portugal
Spain
Sweden
United Kingdom
USA
Ireland
New Zealand



Q → P !!
$/litre (in 1978 prices)
0,00
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
Thousands litre/cap
Australia
Canada
France
Germany
Italy
Netherlands
Norway
Portugal
Spain
Sweden
United Kingdom
USA
Ireland
New Zealand

Causality

- *Q as dependent variable:*
- (1a) $Q_t = \alpha + \beta Q_{t-1} + \beta Q_{t-2}$
- (1b) $Q_t = \alpha + \beta Q_{t-1} + \beta Q_{t-2} + \beta P_{t-1}$
-
- *P as dependent variable:*
- (2a) $P_t = \alpha + \beta P_{t-1} + \beta P_{t-2}$
- (2b) $P_t = \alpha + \beta P_{t-1} + \beta P_{t-2} + \beta Q_{t-1}$

Early work (Goel&Nelson 1998)

- *Presence of oil indust. →lower gas taxes*
- *Higher highway tolls →lower gas taxes*
- *High pop density →high/low taxes <>1981*
- *Compliance with env. standards →high tax*
- *Nominal taxes tend to be adjust. to inflation*
- *Higher real (pre-tax) gasprices →low taxes*

$$T_{it} = f(G_{it}, Y_{it}, NP_{it}, Tax_{it}, Debt_{it}, Year, D_i) \qquad (1)$$

$$T_{it} = f((G/V)_{it}, V_{it,} Y_{it}, NP_{it}, V_{it}, Tax_{it}, Debt_{it}, Year, D_i) \qquad (2)$$

T_{it} = taxes in country i year t

G_{it} = gasoline use per capita

$(G/V)_{it}$= gas consumption per vehicle

V_{it} = Vehicles per capita

Y_{it} = Income (GDP) per capita

NP_{it}= Net price of gasoline

Tax_{it} = Total taxes as share of GDP

$Debt_{it}$ = Total public debt as share of GDP

Year= Time trend, D_i = Country dummies

Determinants of the gasoline tax rate

	1a	2b	5
Estimator:	OLS	Fix-eff AR(1)	OLS
Gas/capita	-0.91	-0.83	
Gas/car			-0.92
Cars/capita			-0.89
GDP/capita	-0.05	0.00	-0.06
Net price	-0.29	-0.14	-0.30
total tax share	0.68	0.14	0.68
Govern. debt	0.00	0.10	0.00
Year	0.01		0.01

Interpretation

- Income → tax levels - (very weak)
- Time dimension weak + (Fig 2)
- High consumption → lower gasoline tax

  Gas/car clearest correl (Fig 3&4)
- Pre-tax price: - Governments appease protests lower taxes when net prices rise
- Taxation+ betw count (not over time fig 5)
- Goverm. debt (Fig 6) (+) only when country effects included

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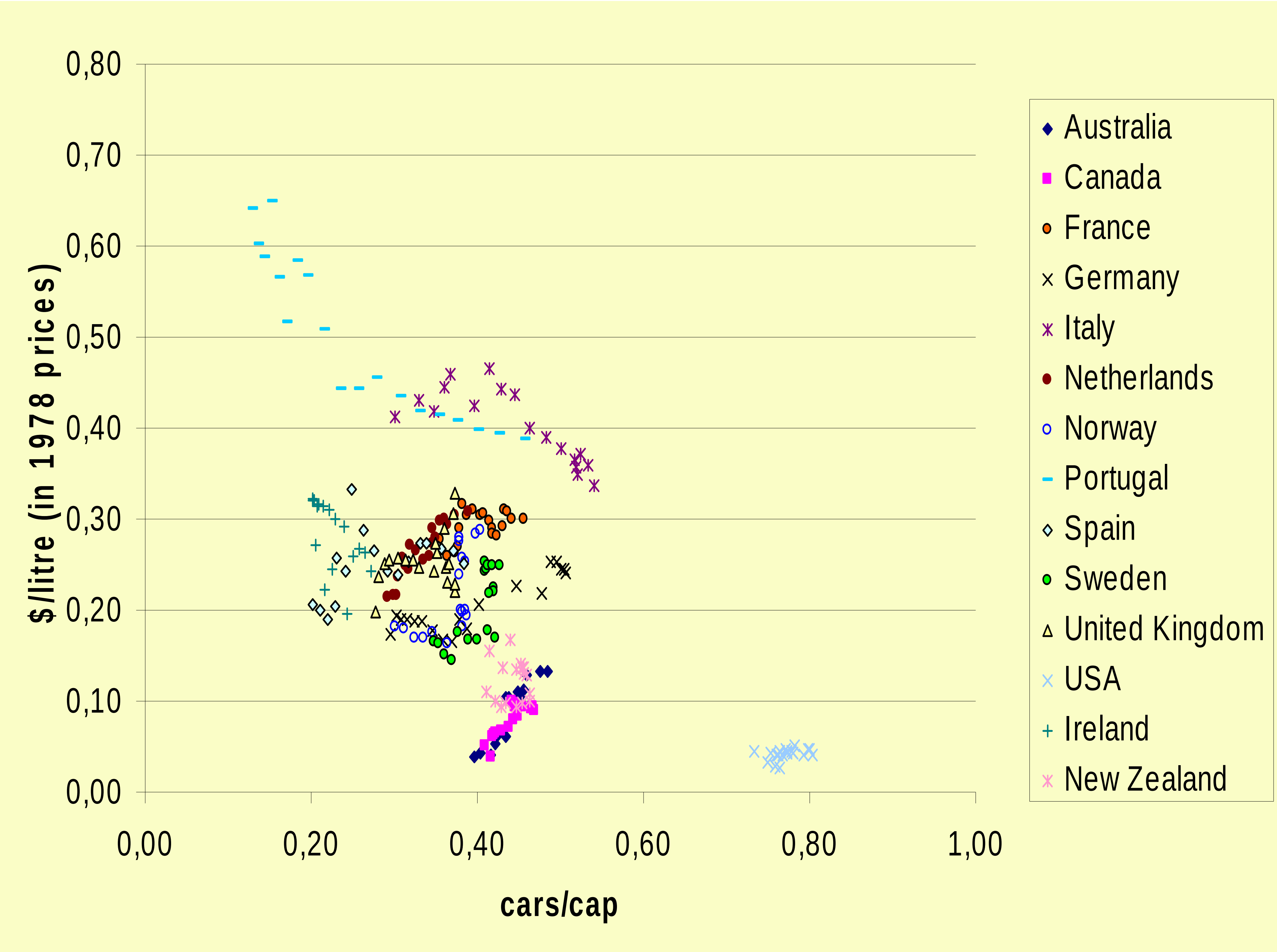

$/litre (in 1978 prices)
0,80
0,70
0,60
0,50
0,40
0,30
0,20
0,10
0,00
0,00
0,20
0,40
0,60
0,80
1,00
cars/cap
Australia
Canada
France
Germany
Italy
Netherlands
Norway
Portugal
Spain
Sweden
United Kingdom
USA
Ireland
New Zealand

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Conclusions

- Variation in prices mainly due to taxes
- Reverse Causality: high cons → low tax
- Tendency to incr. tax over time
- Counter-cyclical adaptation of taxes
- Relationship with tot tax/ public debt
- Small tax rises have 2 pos effects: 1) some demand red. 2) weaken resistance to future tax by changed lobby structure & by

Transport Fuel Use in OECD
Gtons fuel (and ~C*(12/14))

	Real	UK prices	US prices
Fuel use	**1,13**	0,72	1,47
		-36%	+30%

Gasoline taxes Regressive??

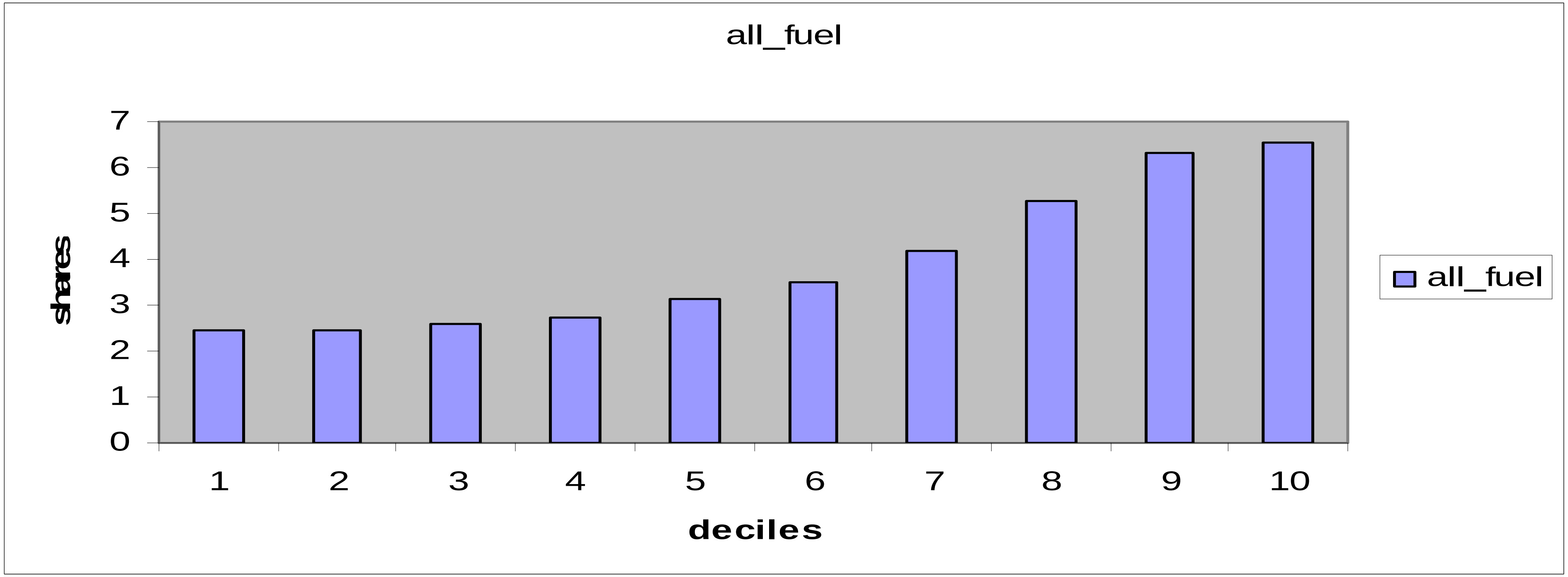
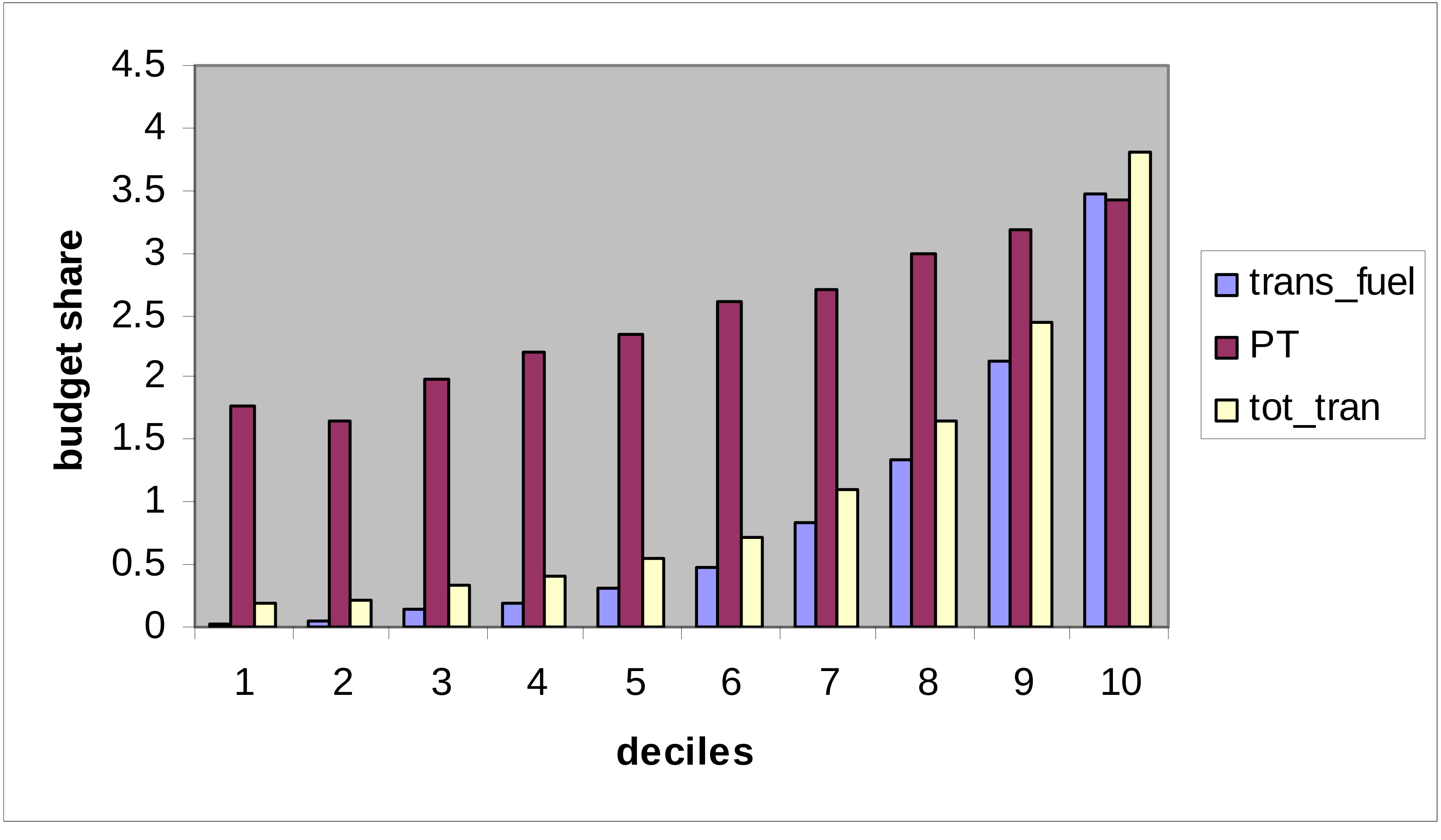


Table1: Budget shares of fuels (Transport + Cooking and Lighting Fuels)

India contd.


4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
budget share
1
2
3
4
5
6
7
8
9
10
deciles
trans_fuel
PT
tot_tran

S Africa

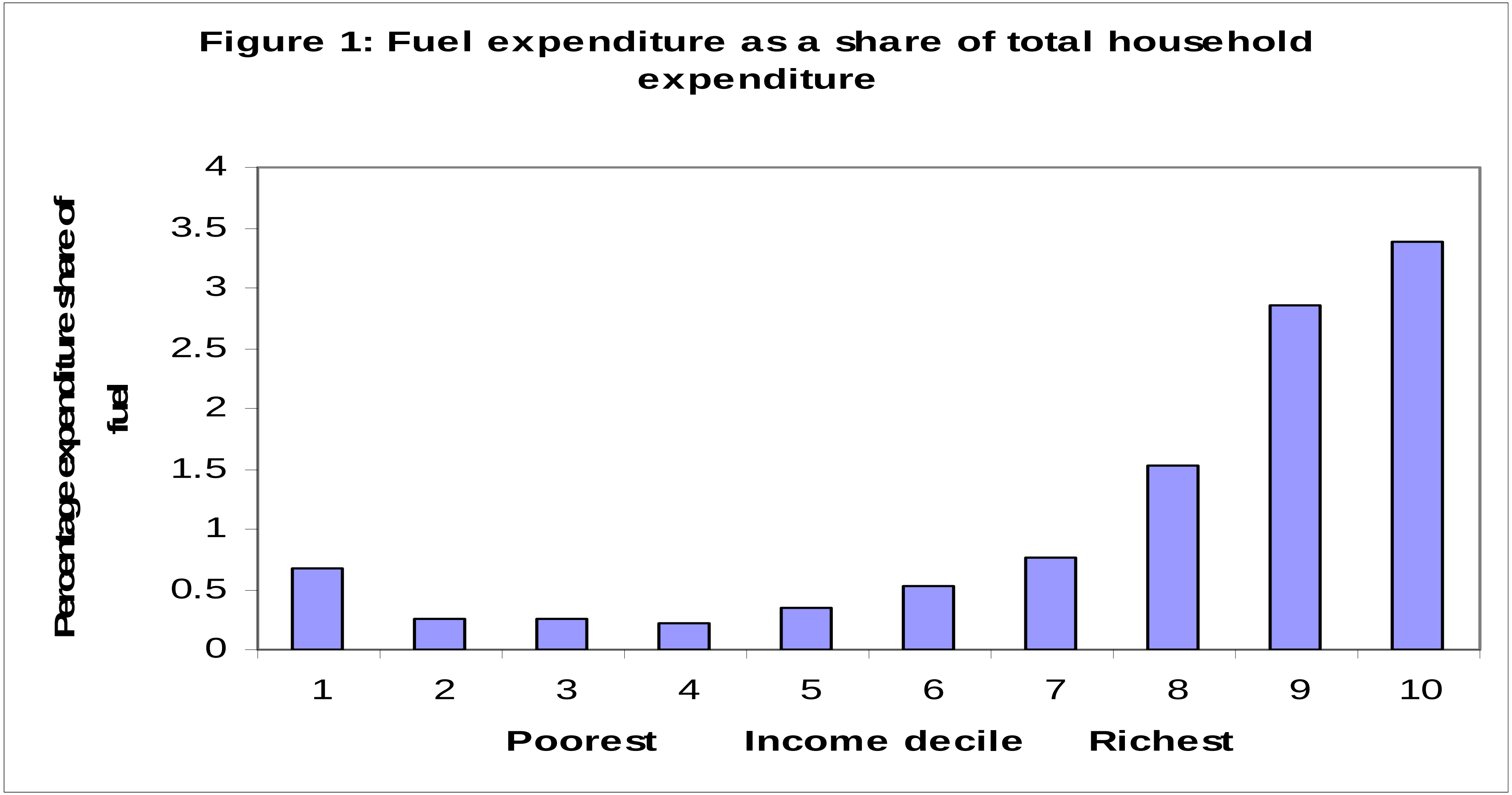
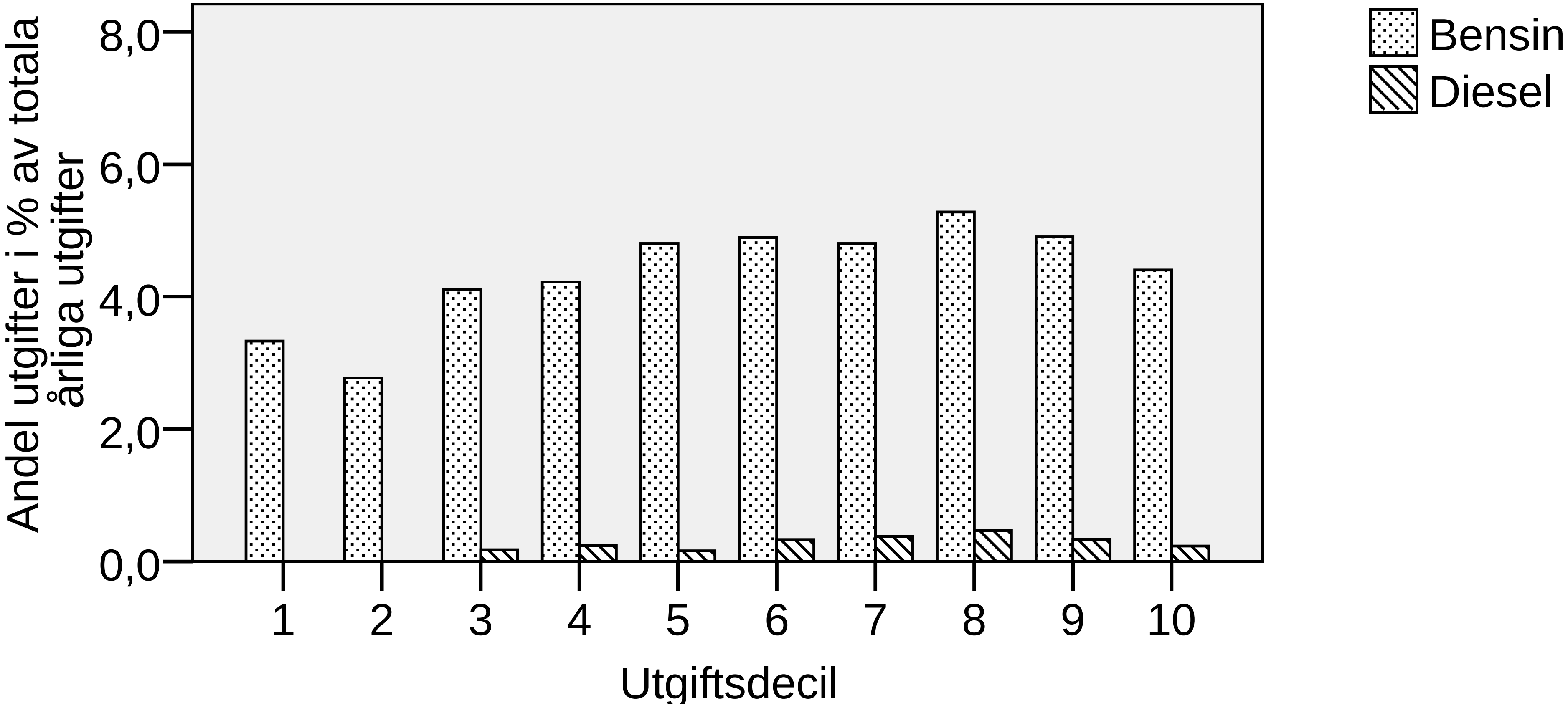
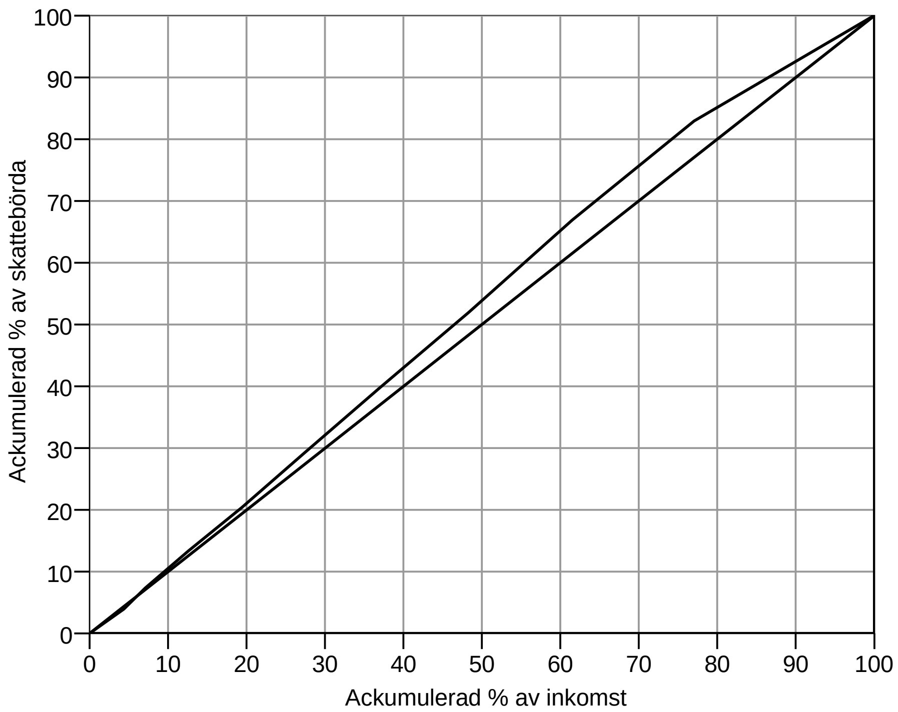


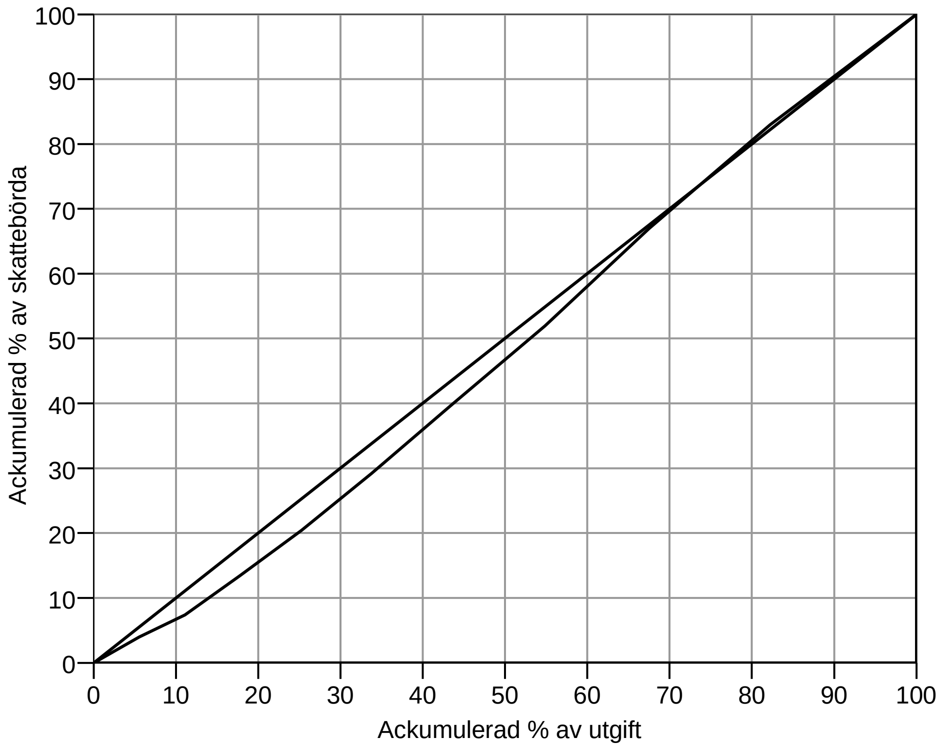
Figure 1: Fuel expenditure as a share of total household expenditure
Percentage expenditure share of fuel
4
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
6
7
8
9
10
Poorest
Income decile
Richest

Sweden


8,0
6,0
4,0
2,0
0,0
Andel utgifter i % av totala årliga utgifter
1
2
3
4
5
6
7
8
9
10
Utgiftsdecil
Bensin
Diesel

Suits Index: (weakly)regr in Y and progressive in expenditures





Balanced budget tax reforms