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# From 'Dieselgate' to a Green Tax Reform

## Regulations or economic incentives for a successful environmental policy?

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**Theodoros Zachariadis**

Cyprus University of Technology

tel. 25 002304, e-mail: [t.zachariadis@cut.ac.cy](mailto:t.zachariadis@cut.ac.cy), <http://3ep.weebly.com>

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# Background

- In September 2015 the U.S. Environmental Protection Agency started investigations against Volkswagen for illegally installing software that allowed diesel car models to pass stringent nitrogen oxides (NOx) emission tests
- More allegations were made later about: a) Audi models and b) carbon dioxide CO<sub>2</sub> emissions
- Fact: Vehicle emission tests are conducted with outdated test procedures that do not reflect today's actual driving conditions

# Laboratory testing of vehicle exhaust emissions on a chassis dynamometer



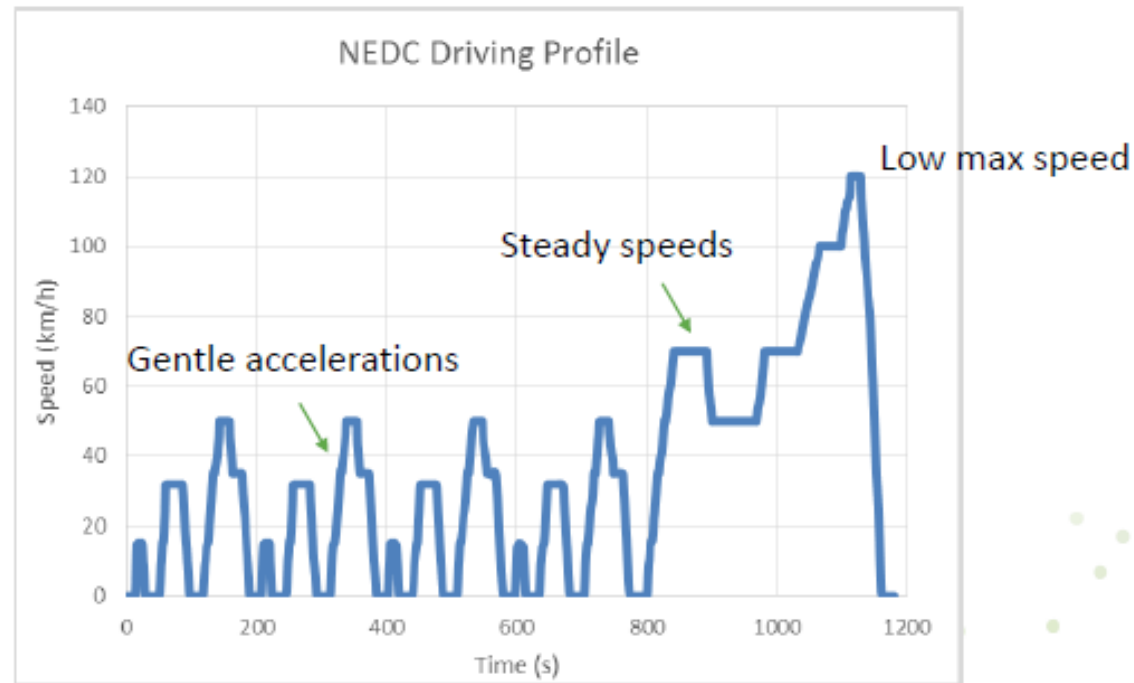
Source: [www.imeche.org](http://www.imeche.org)

A car has to overcome 3 forces when driven:  
Inertia, rolling resistance, wind resistance

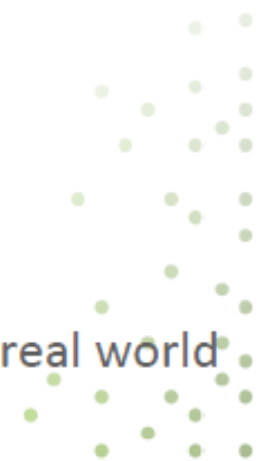
# 'Driving cycle' on a chassis dynamometer

## Europe – New European Driving Cycle (NEDC)

### Type approval driving cycle



- 'Gentle' driving profile accused of causing deviations to real world emissions



# The vehicle has many 'hints' to realise it is being tested on a chassis dynamometer

Non powered axle is stationary

Rollers used to simulate actual road load



No steering

1. Temperature is set to up to 22-28°C
2. Vehicle is pre-conditioned with given profiles and soaked to start with a cold-start

# Proposed solution: Real-World Driving Cycle with Portable Emissions Monitoring System



Plus:

Continuous monitoring of in-use emissions of cars during their lifetime  
(to account for quality of maintenance, retrofits etc.)

Source: Transport & Environment,  
<http://www.transportenvironment.org>

# But... isn't this monitoring too costly?

- Sophisticated equipment necessary
- Continuous monitoring required
- How are emission standards determined?  
By bureaucrats in governmental agencies?  
How do they know what is technologically feasible by the industry?
- How much can industry lobbying affect the standards?
- What flexibilities are allowed in driving cycles?



# Do 'command-and-control' policies work?

- Yes, they do! Very substantial air/water quality improvement thanks to environmental legislation
- Policymakers and engineers like them – also the industry if they provide clear investment signals
- But... at what cost? Do we really know?
- Can we achieve the same environmental targets more cheaply?
- Economists believe so... through 'market based instruments'!

# 'Market-based policy instruments'

- Give/impose an economic incentive, and let the market adjust
- Economic incentives may be:
  - Taxes/charges/levies on emissions of pollutants or on resource consumption (e.g. Euros/tonne of carbon emitted, Euros/cubic metre of water consumed)
  - Distance-based charges (e.g. road pricing)
  - Emissions-based taxes/subsidies (e.g. tax or subsidy depending on CO<sub>2</sub> emissions of a car, currently applied across Europe and partly in Cyprus)

# Why do economists prefer market-based instruments?

- They are transparent (e.g. a clear price per litre of fuel or per cubic metre of water)
- They provide incentives for continuous improvement – not just ‘meeting’ a standard
- They are cheaper because easier to enforce
- They can influence both:
  - Technology
  - Human behaviour (this is unaffected by legislation)
- You cannot ‘cheat’ (well... almost)

# Shall we remove environmental laws and replace them with economic measures?

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Reality is always more complicated:

- Regulations/laws are often the only politically acceptable policy – people dislike taxes!
- Humans are not perfectly informed or rational  
→ ‘paternalistic’ laws/regulations may be justified
- Taxes/charges are also sometimes prone to cheating or political bargaining
- Cars cause multiple social problems (congestion, accidents, pollution, noise)  
→ there is no single ‘optimal’ price to impose

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Example of a market policy that can  
replace legislated standards:

## **Feebates for new cars**

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# Welfare Effects of Carbon-Based Motor Vehicle Taxes

## Insights from Europe and Policy Implications

[based on article at *Economic Journal* 124: F420–F443]

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**Adamos Adamou<sup>a</sup>, Sofronis Clerides<sup>a</sup> & Theodoros Zachariadis<sup>b</sup>**

<sup>a</sup> *Dept. of Economics, University of Cyprus & Centre for Economic Policy Research, UK*

<sup>b</sup> *Dept. of Environmental Science & Technology, Cyprus University of Technology, Cyprus*



# Feebates – A promising type of vehicle tax?

- Cars emitting CO<sub>2</sub> above a threshold (e.g. 120 g/km) pay a fee; those emitting less than the threshold receive a rebate
- If tax rate is constant (for each g/km) then marginal compliance costs are equalized across all car models
  - But most current systems do not apply constant tax rates
- If threshold decreases over the years, feebates provide a credible long-term price signal that can stimulate innovation – technology-neutrally
  - Makes sense because cost of carbon emissions increases over the years

# Our Modelling Approach – 1

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- Discrete-choice consumer demand model for differentiated products (automobiles)
- Structural estimation of demand by heterogeneous consumers with Nested Multinomial Logit model (Berry S., *Rand Journal of Economics* 25, 242–262)
- NML model relatively simple, allows for linear estimation techniques for multiple policy simulations without large computational burden (compared to random coefficients model of Berry, Levinsohn & Pakes, *Econometrica* 63, 841–889)
- We use two levels of nests to allow for more consumer heterogeneity – and estimate several variants of the NML model to be more confident that policy conclusions are not specification-dependent



# Data

- Automotive data obtained from 'JATO Dynamics'
- Coverage: 9 EU countries (AT, BE, DE, DK, GR, IT, NL, PT, ES), period: 1998–2008
- Dataset includes following variables:

Make	CO <sub>2</sub> emissions
Model	Airbag for driver seat offered as standard
Vehicle length	Airbag for passenger seat offered as standard
Vehicle width	Air conditioning system offered as standard
Engine size	Climate control offered as standard
Max. engine power	Segment type
Max. torque	Retail price
Fuel type	Sales volume
Transmission type	
Body type	
Max. speed	
Acceleration 0-100 km/h	
Fuel consumption	

# Results: Impacts on emissions, public revenues & consumer welfare

Scheme		Change in:				
<i>t</i>	PP	Total sales	Consumer surplus	Producer surplus	Emissions cost	Total welfare
<i>Revenue-neutral symmetric schemes</i>						
10	135.2	-23.8 (-0.8)	-96 (-1.7)	-30 (-0.8)	-60 (-4.2)	-66 (-0.3)
20	132.7	-47.6 (-1.6)	-191 (-3.3)	-58 (-1.5)	-110 (-7.7)	-139 (-0.7)
30	130.2	-71.9 (-2.5)	-288 (-4.9)	-84 (-2.1)	-155 (-10.7)	-217 (-1.0)
40	127.7	-97.3 (-3.3)	-388 (-6.7)	-109 (-2.8)	-196 (-13.4)	-300 (-1.4)
30.7	130	-73.7 (-2.5)	-295 (-5.1)	-86 (-2.2)	-158 (-10.9)	-223 (-1.1)
71.6	120	-186.7 (-6.4)	-732 (-12.6)	-175 (-4.4)	-315 (-20.8)	-593 (-2.8)
<i>Revenue-neutral asymmetric schemes</i>						
-10/+20	130.6	-26.3 (-0.9)	-106 (-1.8)	-34 (-0.8)	-66 (-4.6)	-74 (-0.3)
-20/+10	136.7	-43.5 (-1.5)	-175 (-3.0)	-52 (-1.3)	-101 (-7.0)	-127 (-0.6)
-5/+20	127.2	-14.4 (-0.5)	-58 (-1.0)	-19 (-0.5)	-38 (-2.7)	-39 (-0.2)
-20/+5	139.4	-41.0 (-1.4)	-165 (-2.8)	-49 (-1.2)	-95 (-6.6)	-119 (-0.6)
-10/+30	127.3	-28.2 (-1.0)	-114 (-2.0)	-36 (-0.9)	-70 (-4.9)	-80 (-0.4)
-30/+10	136.6	-61.8 (-2.1)	-248 (-4.3)	-72 (-1.8)	-134 (-9.3)	-185 (-0.9)
-5/+30	123.8	-15.4 (-0.5)	-62 (-1.1)	-21 (-0.5)	-41 (-2.9)	-43 (-0.2)
-30/+5	138.8	-58.8 (-2.0)	-236 (-4.1)	-67 (-1.7)	-127 (-8.8)	-176 (-0.8)
<i>Welfare-improving schemes</i>						
10	130	-29.1 (-1.0)	-118 (-2.0)	-37 (-0.9)	-62 (-4.4)	61 (0.3)
20	120	-73.2 (-2.5)	-293 (-5.0)	-92 (-2.3)	-122 (-8.4)	473 (2.2)
-2/+3	130.6	-6.0 (-0.2)	-24 (-0.4)	-8 (-0.2)	-14 (-1.0)	13 (0.06)
-10/+20	123.8	-34.2 (-1.2)	-138 (-2.4)	-44 (-1.1)	-68 (-4.7)	141 (0.7)
<i>Sales-increasing schemes</i>						
0/+10	120	0.6 (0.02)	3 (0.04)	0.3 (0.01)	-1.5 (-0.1)	-31 (-0.15)
0/+10	140	3.8 (0.1)	15 (0.3)	4 (0.1)	-6 (-0.4)	-167 (-0.8)
0/+10	160	12.7 (0.4)	52 (0.9)	15 (0.4)	-13 (-0.9)	-508 (-2.4)

# Conclusions

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- It is possible to design a feebate program for new automobiles that curbs carbon emissions without reducing total welfare
- But needs careful design in order to account for trade-offs between environmental effectiveness, public finances and consumer/producer surplus
- Revenue-neutral tax schemes (politically most attractive) may not be welfare-improving *in the short run*; more stringent policies increasing public revenues can improve welfare
- But purpose of feebates is to provide long-term price signal, not work miracles in 1-2 years

# What role for feebates after the 'Volkswagen scandal'?

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- Discrepancy between test and on-road fuel economy & emissions has been well known and increasing in recent years
- Any regulatory or economic instrument based on reported emission levels is problematic
- To decarbonize transport, a carbon/fuel tax is preferable. Political acceptance can be improved through a **Green Tax Reform** (increase fuel taxes, decrease labour/income taxes, provide targeted compensation to low-income households)

# “Green Tax/Fiscal Reform”

Reduce taxes that discourage / distort economic activity, e.g.

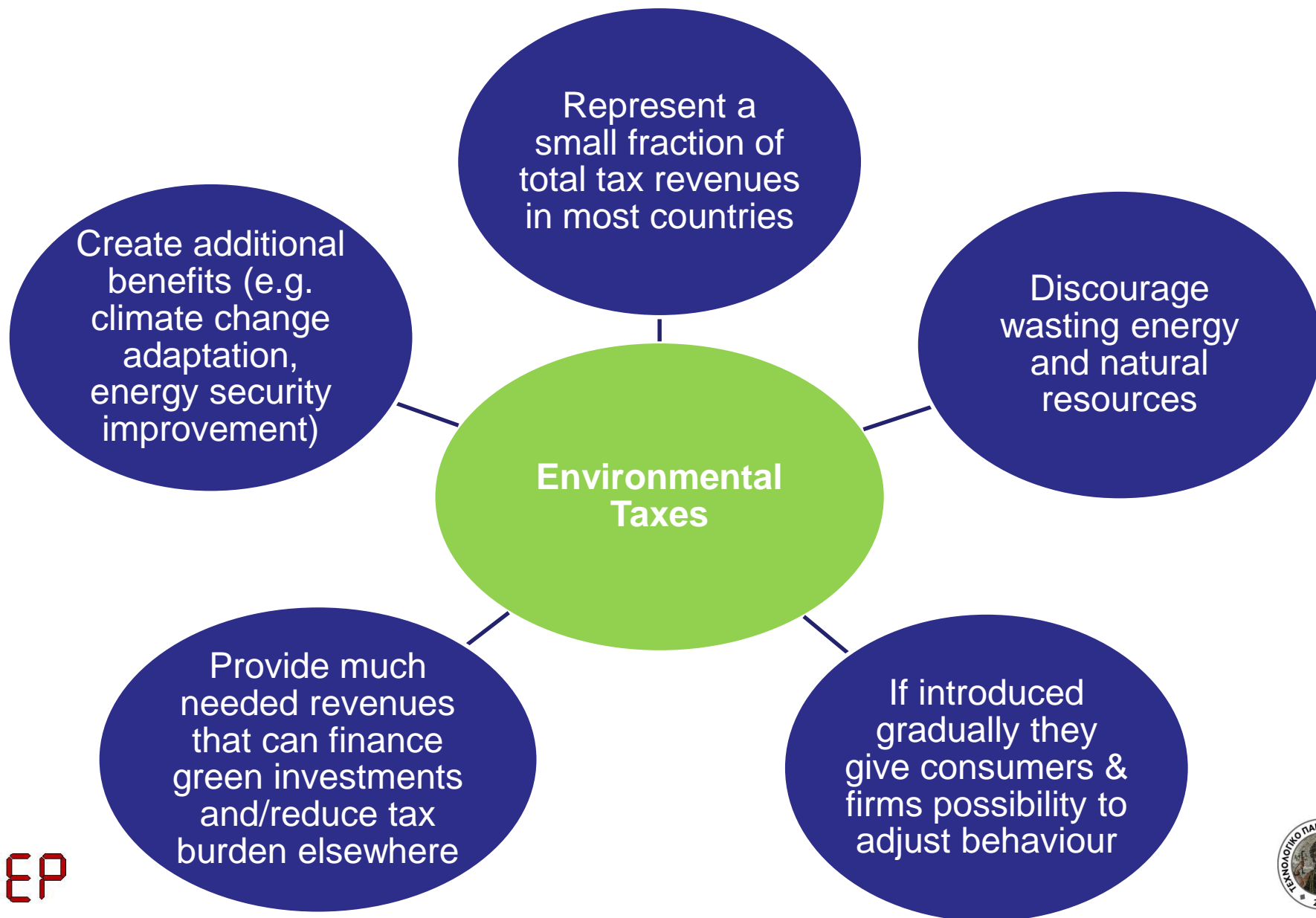
- Labour taxes (social security contributions)
- Income tax
- VAT

Increase taxation in activities causing environmental degradation and/or resource depletion, e.g.

- Fuel use in residential, industrial, transport sectors
- Water use, waste production, packaging
- Fertilizers – pesticides

➤ **At times of high unemployment, priority to be given to reducing labour taxation!**

# Why “Green/Environmental Tax Reform”?



# How to fix our environmental problems – With the Law or with Money?

Every scientific discipline has its 'idée-fixe':

- Engineers → Technology
  - Economists → Price
  - Political scientists → Institutions
  - Organization theorists → Decision processes
  - Teachers → Education
- More emphasis should be given in the future to economic incentives for phasing out high-carbon and highly polluting fuels and technologies
- But: In a complex and imperfect world, we need a mix of regulatory and economic measures to solve our environmental problems



# Epilogue:

## We need polycentric approaches

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“... Waiting for effective policies to be established at the global level is unreasonable. Rather than only a global effort, it would be better to self-consciously adopt a polycentric approach to the problem of climate change in order to gain the benefits at multiple scales as well as to encourage experimentation and learning from diverse policies adopted at multiple scales”.

*Elinor Ostrom, Economics Nobel Laureate 2009*

Ostrom E., A Polycentric Approach for Coping with Climate Change. Background Paper to the 2010 World Development Report, Policy Research Working Paper 5095, The World Bank, Washington, DC, 2009, pp. 31–32

