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Is there an Urban Environmental Kuznets Curve due to daily mobility ?

5th Urban Research Symposium
*Cities and Climate Change : Responding to an
urgent agenda*
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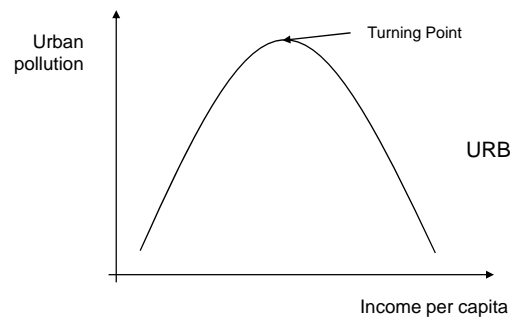
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Introduction

« *The relationship between the level of urban pollution and the real income per capita is, broadly speaking, bell-shaped* » (Polese and Shearmur, 2005)

→ **The Urban Environmental Kuznets Curve (UEKC)**



Polynomial Form :
$$\text{URBPOLL} = a + b \cdot \text{INC}^2 + c \cdot \text{INC}$$

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The UEKC applied to daily mobility

- The key role of cities in achieving sustainable development (Camagni *et al.*, 1998)
- Daily mobility : a unique source of pollution

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EKC in a general sense

A bell-shaped curve between GDP per capita and polluting emissions

1. *Scale effect* : the growing part of the curve
2. *Composition effect* : sectoral transformations (from industry to services)
3. *Technological effect* : « green » products and processes

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Urban EKC : past research is scarce

- *Kahn (2006)* :
 - UEKC for hydrocarbon emissions (United States)
 - Emissions are predicted, not measured
- *Peters and Murray (2004)* :
 - L-shaped curve
 - 5 pollutants and 17 asian cities
- *Hank Hilton and Levinson (1998)* :
 - UEKC for lead emissions (48 countries)
 - Pollution intensity overcomes pollution activity.

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Urban EKC : mechanisms

*What is the influence of income on daily mobility ?
Which mechanisms could explain a bell-shaped curve ?*

- Behavioural effect
 - Direct (« *people buy more mobility* »)
 - Indirect (« *people buy more space* »)
(Newman, Kenworthy, Vintila, 1995)
- Technical effect : « green » vehicles or high-power ones ?
- Political effect :
 - Transport system initiatives (on-site transit)
 - Urban form : from compact cities (Jenks et al, 1996) to coherent cities (Pouyanne, 2005)

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Data and Method

- Millenium Cities Database : 88 cities in the world (IATP, Murdoch Univ., 1995)
- Test of the UEKC for 5 polluting emissions
- A more general model to explain environmental performance of urban transport systems

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(1) The « pure » UEKC

- VHC and SO₂ : UEKC is invalidated
- CO and Nox : UEKC is validated (but a very low R²)
- Density of pollutants : UEKC is relevant

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	<i>CO</i>	<i>NOx</i>	<i>VHC</i>	<i>SO2</i>	<i>DensPoll</i>
<i>Constant</i>	62,234 (-4.22)***	8,369 (-2.60)**	12,203 (-4.86)**	1,240 (-4.80)***	11,858 (-6.92)***
<i>gdpc</i>	4.398 (2.90)***	0.797 (-2.83)***	0.348 (-1.63)	0.008 (-0.25)	-0.411 (-3.20)***
<i>gdpc2</i>	-9.26e-05 (-3.12)***	-1.45e-50 (-2.66)***	-8.13e-06 (-1.95)*	-6.86e-06 (-0.09)	5.08e-06 (-2.35)**
<i>R² adjusted</i>	0.05	0.05	0.01	0.02	0.25
<i>Turning point</i>	23,739	27,433	--	--	40,436

(2) A comprehensive approach of the UEKC

- *Behavioural model* :
 - The influence of income is lowered
 - An inverse UEKC ?
- *Regional model* :
 - A decisive continental influence
 - A growing trend
- *Transport supply model* :
 - The influence of urban form (concentration and centralisation)
 - The impact of transport infrastructures

overall energy consumption per capita	"pure" UEKC	Regional model	Transport supply model	Behavioural model	Costs model	Collinearity Tolerance
Constant	404 (0.24)	7,139 (-4.99)***	11,106 (2.45)	-1,488 (-0.16)	400 (0.30)	
GDPG (USD per capita)	1,946 (6.12)***	0,669 (5.61)***	0,657 (3.04)***	-0,466 (-1.77)*	0,815 (3.45)***	
GDPG2	-3.20e-05 (-5.33)***	-6.45e-06 (-3.39)***	-9.62e-06 (-2.43)**	8.16e-06 (1.87)*	-1.33e-05 (-2.89)***	
Asie		-5,885 (-3.47)***				0.90
USA		26,551 (6.49)***				0.73
Europe		-4,199 (-1.99)**				0.25
Human Density (persons/ha)			-25,99 (-3.10)***			0.65
Proportion of jobs in CDB (jobs/ha)			-216 (-2.93)***			0.86
Public transport capacity (seat km/person)			-1,521 (-3.22)***			0.79
Relative average time in public transport (public vs private; minutes)			32,44 (1.81)*			0.79
Length of freeway per 1000 people (m/1000 persons)			130 (3.40)***			0.64
Proportion of non motorised modes (% over all trips)				-431 (-6.54)***		0.61
Proportion of motorised public modes (% over all trips)				-336 (-3.82)***		0.64
Overall average trip distance (km)				2,208 (4.94)***		0.74
Total daily trips per capita (trips/person)				9,214 (3.42)***		0.48
Relative public transport operating cost (public vs private; USD/passenger km)					217 (6.83)***	0.66
Public transport investment per capita (USD/person)					-45,75 (-4.41)***	0.68
R ² adjusted	0.30	0.71	0.58	0.79	0.70	
Turning point	30,415	51,880	34,174	28,538	30,569	



Conclusion

- EKC applied to urban mobility has to be considered with caution
- The key role of public regulation



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