



Domestic and international drivers of urban dynamics

Urbanization and low-carbon growth pathways Modeling the interactions between energy and real estate prices

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20 years of a surprising absence in energy-economy modeling

- ❑ *What was “obvious” in the early nineties*
 - Large competitive advantage of oil-based motor and fuels over substitutes (biofuels, electricity, hydrogen)
 - Apparent low price elasticity of mobility and energy demand for transportation
 - Mobility and transportation are driven by other “signals” than energy prices

- ❑ *What should have been done*

A strong collaboration between energy, transportation and urban economists
(Hourcade ,1993)

- ❑ *What happened :*

A methodological lock-in due to three converging intellectual dynamics:

 - The ‘Elephant and rabbit stew metaphor’ legitimates to treat the energy sector independently from the rest of the economy (Hogan & Manne 1977)
 - The TD/BU controversy about the energy efficiency gap focused the debate on technological efficiency
 - Extrapolating electricity optimization models to the entire energy system

- ➔ ***The overwhelming majority of energy-economy models adopt carbon price as the only driver of decarbonizing economies.***

The Impasse of the « carbon price only » frameworks

- ❑ A carbon price at 50\$/tCO₂
 - doubles the cost of cement in India and hurts segments of the steel industry in the EU
 - ...but hardly affects mobility demand (low price-elasticity)

- ❑ Consequences for cost assessment of climate policies
 - **Underestimated** : an often ignored caveat of energy-economy modeling
 - « Most models use a global **least cost** approach to mitigation portfolios with **universal emissions trading**, assuming **transparent** markets, **no transaction cost**, and thus **perfect implementation** of mitigation measures throughout the 21st century. » (IPCC, AR4, WGIII)

 - **Overestimated** : in absence of complementary policies in the transport sector
 - very high carbon prices are needed to curve down transport emissions
(low elasticity of mobility demand to energy prices)
 - other determinants : non-energy prices and non price signals
(real estate prices, risk-adjusted capital cost, infrastructure policies)

- Economic rationale behind the difficulties in making a deal around policy architectures built around a “pure” pricing of carbon

Intertwined methodological issues to be solved

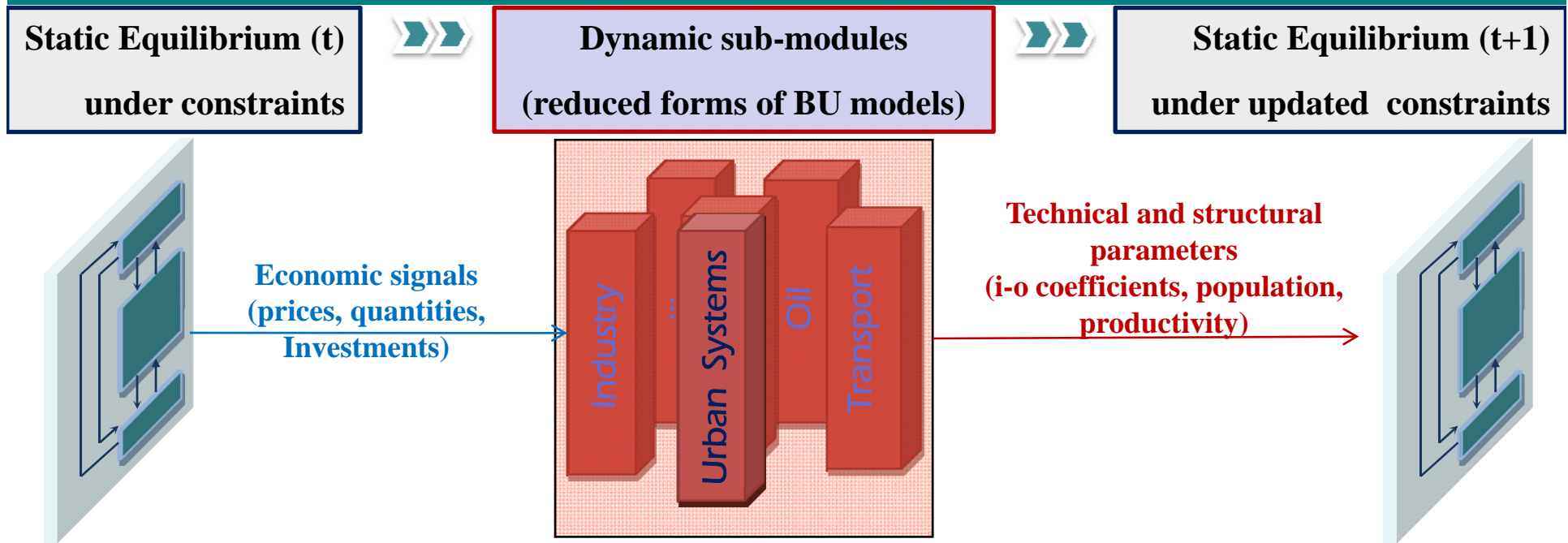
- ❑ Modeling second- best economies with
 - Imperfect foresight
 - Inertia of capital stocks
 - Market imperfections (underutilization of production factors)

- ❑ Representing structural change driving the decoupling between growth and energy
 - Beyond pure energy efficiency, the fundamentals of the material content of the economy C-T-L (Hourcade 1993):
 - Consumption styles (preferences)
 - Technical potentials (resource and technology availability, asymptotes)
 - Location patterns

- ❑ Capturing the interplay between energy prices, land prices and the growth engine (productivity, demography, savings) in an opened economy

- ❑ Endogenizing the urbanization process and location decisions in urban/rural areas

IMACLIM, a tool to investigate the interplay between Systems of Cities in Interaction and growth patterns



❑ Long term growth drivers vs. transitory disequilibrium

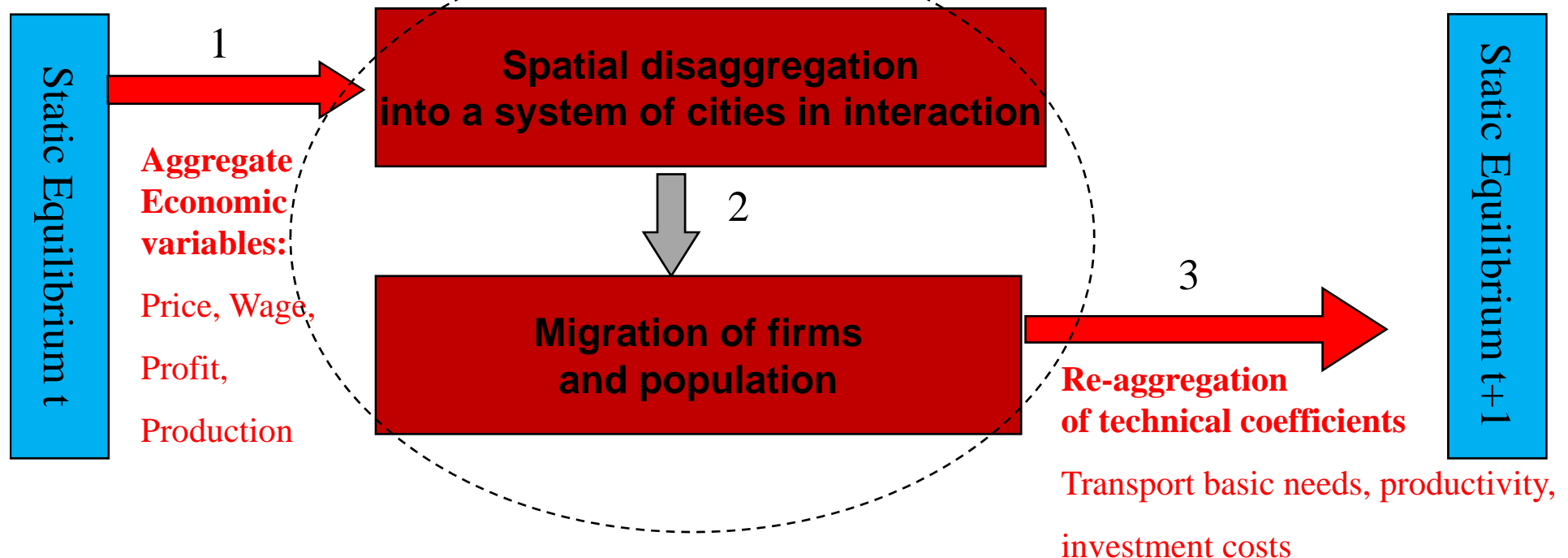
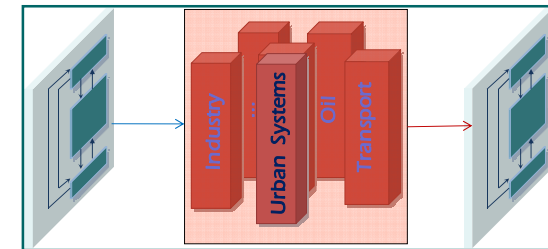
- Demography + Labor productivity growth
- Imperfect markets & Partial use of production factors (unemployment, idle capacities)
- Investments under imperfect foresight
- Trade and capital flows under exogenous assumption about debts

❑ A dialogue between engineering-based and economic analyses

- Hybrid matrixes in values, energy and « physical » content (Mtoe, pkm)
- Explicit accounting of inertias on equipments, technical asymptotes and basic needs

IMACLIM, a tool to investigate the interplay between Systems of Cities in Interaction and growth patterns

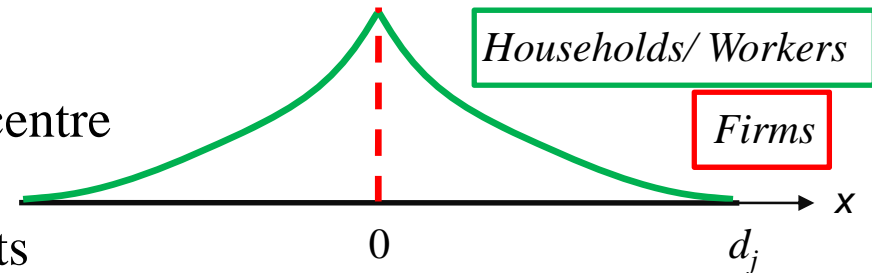
1. Disaggregate the national economy into a System of Cities in Interaction
2. Represent the spatial dynamics among a number of urban agglomerations
3. Capture the feedbacks on growth patterns



The system of cities in interaction

□ *Spatial structure of cities*

- Monocentric and axisymmetrical
- Firms clustered into the adimensionnal centre
- Spatial distribution of households
 - tradeoff on housing/commuting costs



- Calibration in 2001: 74 OECD agglomerations
 - « Empirical data » : Population, Density, Production, Wage

□ *Multi-level interactions*

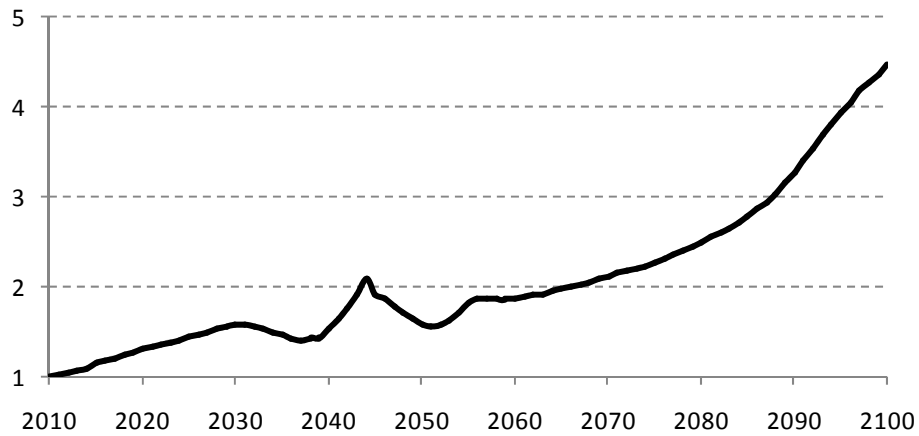
- Inter-city trade (iceberg structure)
- Monopolistic competition & imperfect substitution among varieties
- Agglomeration effect on production

□ *Spatial dynamics*

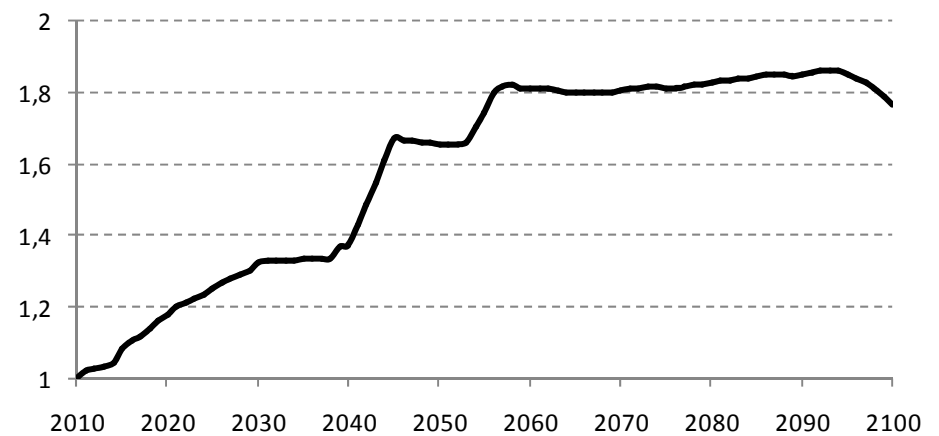
- Differentiated attractiveness of cities (investment profitability)
- Migration of investments towards the most attractive cities
- Migration of firms and associated labor force

A consistent view of macroeconomic and urban dynamics

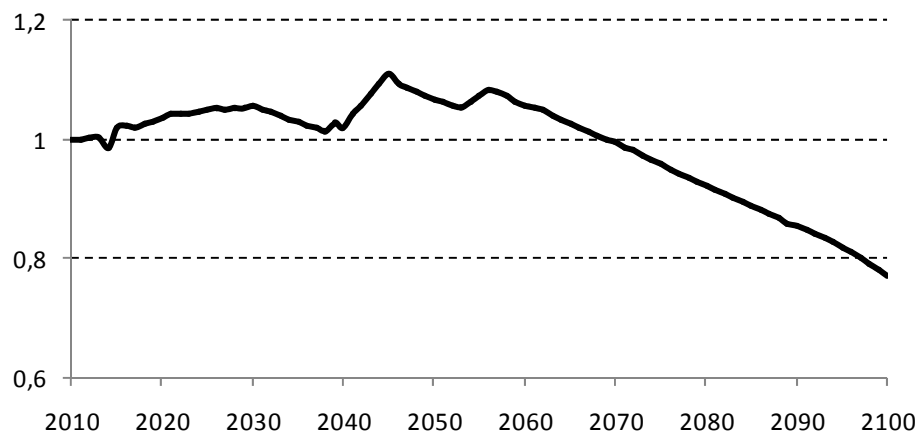
**World oil price
(index 1= 2010)**



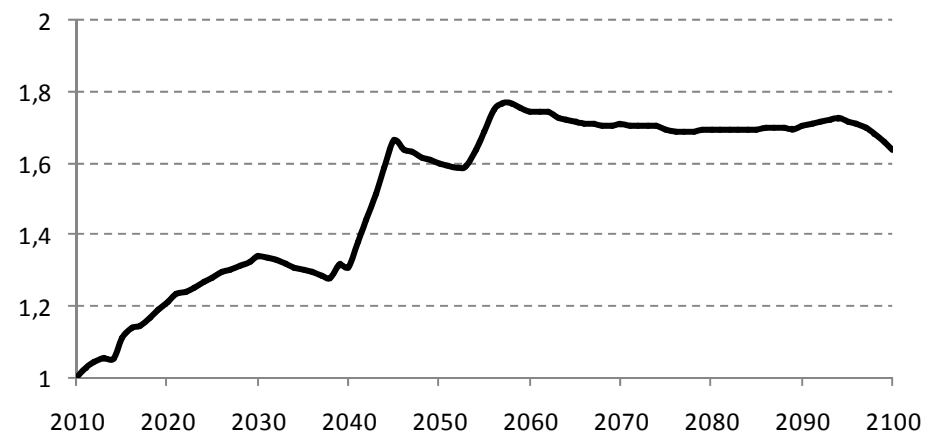
**Unitary urban commuting cost
(index 1=2010)**



**Average urban density
(index 1= 2010)**

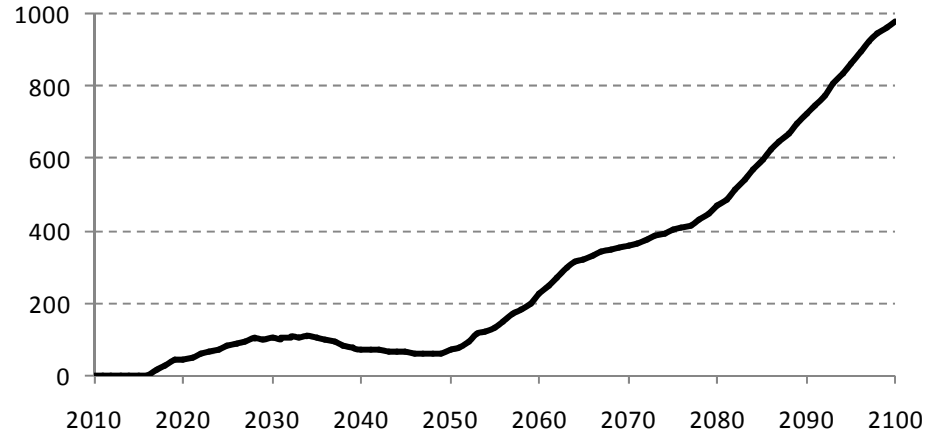


**Urban land price
(index 1=2010)**

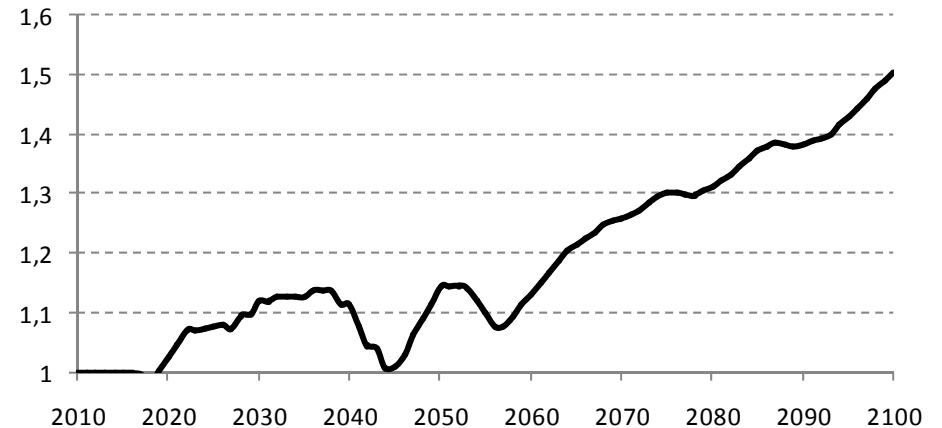


Climate policy (450ppm-CO₂) and urban dynamics

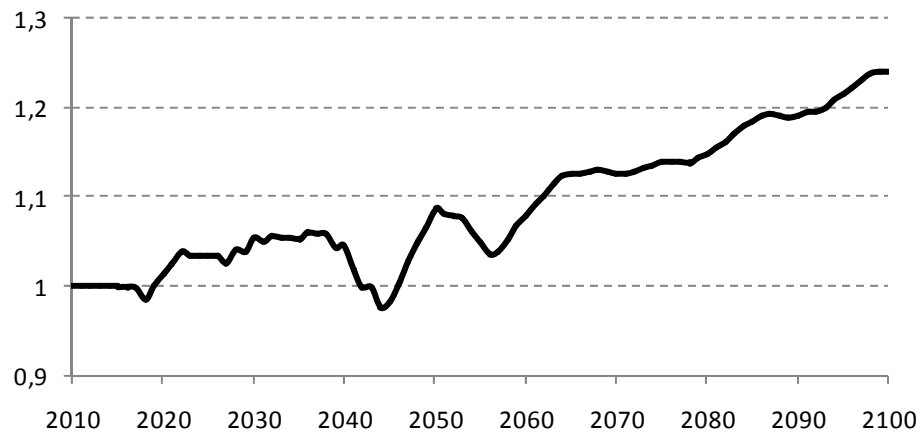
**Carbon price
(\$/tCO₂)**



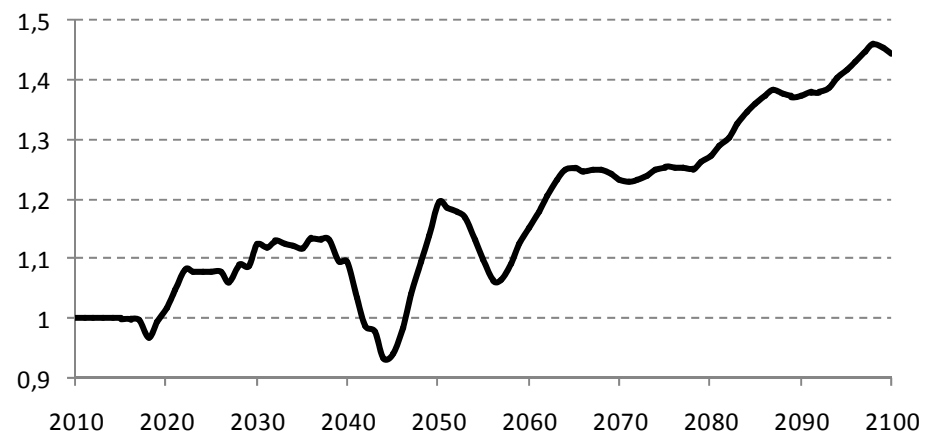
**Relative variation of unitary commuting cost
under climate policy (index 1= baseline)**



**Relative variation of urban density
under climate policy (index 1= baseline)**

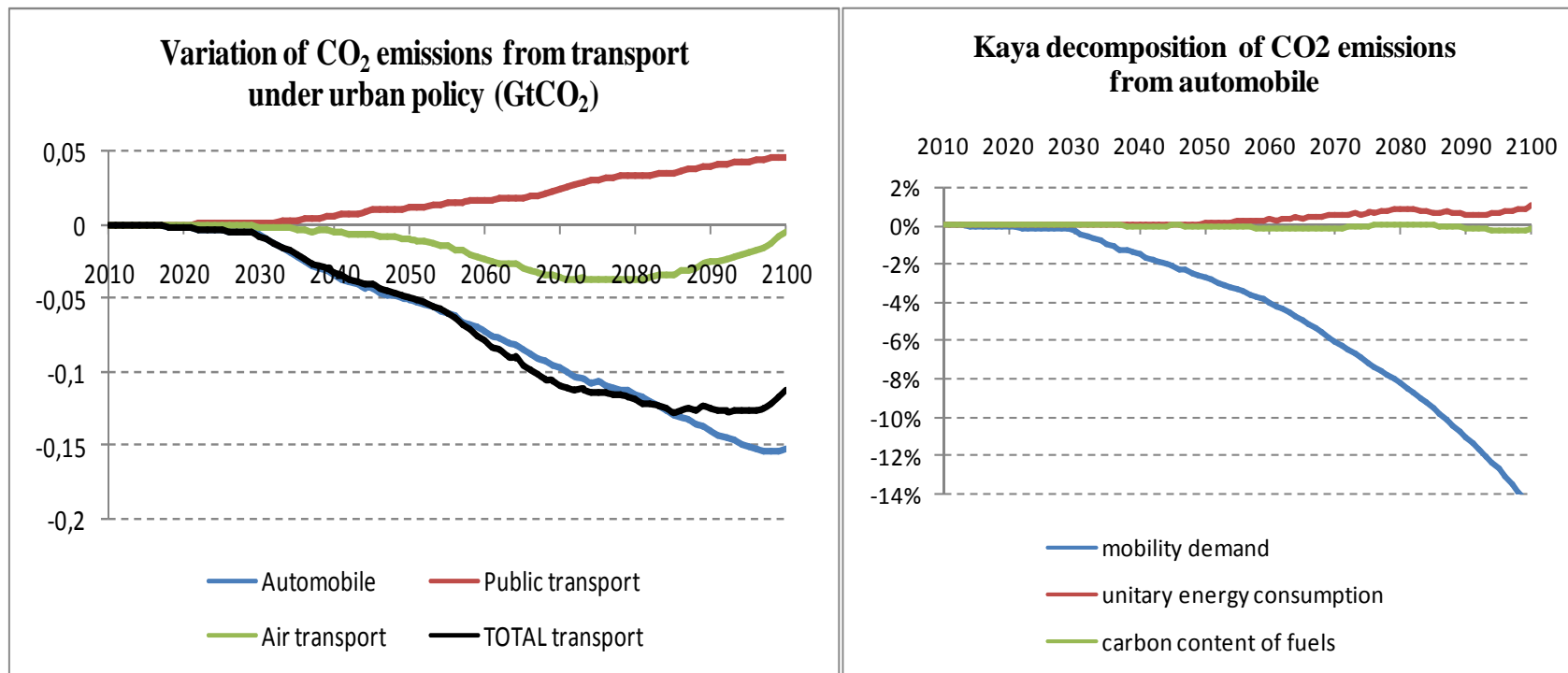


**Relative variation of urban land price
under climate policy (index 1= baseline)**



Urban policy and CO₂ emissions

Spatial policy at the city level to limit urban sprawl and constrained mobility
= 0.1% of OECD GDP



Urban densification policy and costs of climate policies

| | discount rate = 7% | | discount rate = 1% | |
|--|--------------------|-----------------------------|--------------------|-----------------------------|
| | carbon price only | carbon price & urban policy | carbon price only | carbon price & urban policy |
| Carbon price (\$/tCO ₂) | 56.2 | 55.8 | 225.0 | 219.8 |
| Oil price (\$/Barrel) | 69.4 | 69.2 | 61.2 | 60.0 |
| Land price (index 1 =baseline) | 1.31 | 1.37 | 1.70 | 1.93 |
| Total surplus variations (Billion \$) | -4.30 | -4.27 | -4.08 | -3.46 |

Conclusion

IMACLIM, a methodological tool for consistency checks between expertises

- material content of economic growth
- transport, infrastructure policies and mitigation
- endogenizing urban systems in a global energy-economy model

Quantification of the impact of urban policies on carbon and real estate prices

- important complement to carbon pricing for ambitious mitigation objectives
- not only for carbon mitigation : political implementation, social dimensions (welfare effects, distributional issues)

On-going research:

- real estate markets and scarcity rents
- interplay between transport infrastructure, modal choice and the dynamics of real estate at the local level
- linkages between labor productivity and agglomeration effects