The transportation sector as a lever for reducing long-term mitigation costs in China

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1. Context/Motivation

➢Chinese economic development :
(i) Growth of the production
→ increase of the FREIGHT transport
(ii) Enriched population and fast-growing urbanization
→ increasing demand for passenger transport

➢The Transportation sector is crucial for China
- High reliance on oil products
- Increasing energy demand
- Increasing CO_2 emissions

→Particularly regarding Energy Security and Climate Change issues

2. Quantifying the impact of urban voluntary policies

➢ Complementarily to carbon pricing to reach a 3.4W/m2 in 2100 ...
… we consider infrastructure policies that aim at controlling the structural determinants of transport emissions (not only technical, but also behavioral):

(i) Urban reorganization lowering the constrained mobility (i.e. mobility for commuting and shopping)

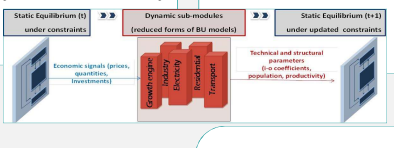
(ii) Reallocation of infrastructure investments in favor of public transportation modes

(iii) Adjustments of the logistics organization to decrease the transport intensity of production/distribution processes.

3. Methodology and Modeling approach

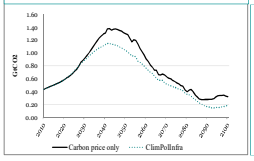
IMACLIM-R
- Global Energy-Economy-Environment (E3) model
- Explicit representation of the interplay between: Transportation , Energy and Growth patterns
- Hybrid CGE, Dynamic and Recursive
- Relies on hybrid matrices ensuring consistency between money flows and physical quantities (Mtoe, pkm, tkm)

- IMACLIM-R accounts for
  - The rebound effect of energy efficiency improvements on mobility
  - Endogenous mode choices in relation with infrastructure availability
  - The impact of investments in infrastructure capacity on the amount of travel
  - The constraints imposed on mobility needs by firms' and households' location (urban form)



4. Effects of Infrastructure policies

CO_2 emissions from transportation sector

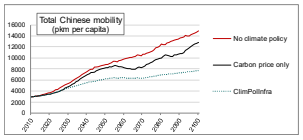


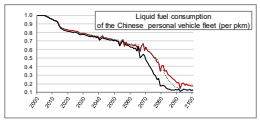
→Appreciable reduction

➢Mechanisms at play ?
- The evolution of the total passenger mobility per capita
- Modal structure evolution
- Efficiency improvements and/or electrification of the vehicle fleet

5. Determinants of emissions reductions

Very different according to the implemented policies!





Modal Breakdown	2010	2050			2100		
		No climate policy	CarbonPriceOnly	ClimInfraPol	No climate policy	CarbonPriceOnly	ClimInfraPol
Pesonal vehicles	28%	78%	74%	60%	92%	88%	67%
Low carbon modes	72%	22%	25%	39%	7%	11%	31%
Air transport	0.2%	0.3%	0.4%	0.6%	0.6%	0.7%	1.5%

➢ If the carbon price is the only instrument , the major effect comes from the diffusion of energy efficiency in vehicles

➢ When complementary policies are implemented, modal shifts towards low-carbon modes coupled with mobility reduction measures play a dominant role

6. Mitigation efforts in the Chinese economy

		2010-2050	2050-2100
Transports	CarbonPriceOnly	2.2%	-2.8%
	ClimInfraPol	1.8%	-3.4%
Electricity	CarbonPriceOnly	-2.7%	-3.0%
	ClimInfraPol	-2.3%	-2.3%
Industry	CarbonPriceOnly	-0.3%	-6.5%
	ClimInfraPol	-0.1%	-6.2%

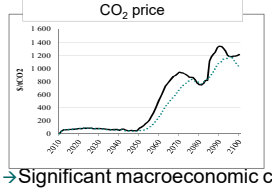
Mean annual emissions variations
By period – Three main emitting sectors

➢ Without specific measures aimed at reducing mobility, decarbonization efforts are mainly based on electricity and industry

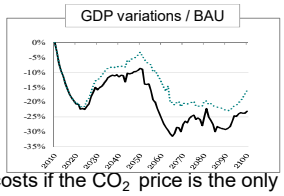
➢The "transportation policies"
✓increase the contribution of the transportation sector to mitigation efforts
✓allow the other main emitting sectors to slow their decarbonization efforts

7. Macroeconomic effects

CO_2 price



GDP variations / BAU



→Very weak sensitivity of the transportation sector to price signals
→Need for very high CO_2 prices

→Significant macroeconomic costs if the CO_2 price is the only instrument
→The implementation of mobility growth control measures offers mitigation potentials independent of carbon prices
→These measures allow for important reductions in the level of carbon prices
→Significant reductions of the macroeconomic mitigation costs

8. Conclusion

➢ This study allows to highlight the role of transportation in the mitigation process
➢ Given a climate objective, …
… the implementation of measures fostering a modal shift towards low-carbon modes + a decoupling of mobility needs from economic activity prove to:
→Modify the sectoral distribution of mitigation efforts
→Contribute to avoid the risk of 'lock-ins' in carbon-intensive pathways
→Significantly reduce the mitigation macro-economic costs relatively to a "carbon price only" policy

→**Early** and **voluntary infrastructure policies** have a key role to play…
… as a **hedge against the risk of very high costs** of the climate stabilization that China seems to undertake

Reference
Hamdi-Chérif, 2016. Aligning development and energy policies under climate constraints in China Lessons from a second-best general equilibrium framework, phd thesis, EHESS