Three-me

Multisector Macroeconomic Model for the Evaluation of Environmental and Energy policy

Simulating the macro-economic effects of the energy transition in France

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There are two ways for analysing the economic effects of an ecological measure:

- *the static equilibrium models,*
- *the models in general and dynamic equilibrium.*

1. The static equilibrium analysis

- it assumes that markets are perfectly self managed:
  - *Perfect flexibility of prices and wages*
  - *savings finance investments.*
- Consequences : optimal equilibrium
  - *all incomes are consumed.*
  - *firms don’t have any problem of outlets.*
  - *Production is maximal, only limited by the quantities of factors avalaible*
  - *Unemployment is inexistant or volontary*
- There is no fluctuation of economic activity, except those generated by
  - *technical progress,*
  - *demographic changes,*
  - *climatic catastrophes*
  - *unintended interventions of the Government.*

Generate a “double dividend”

The static equilibrium analysis

- a tax on fuels increases the production costs and prices.
  - *diminution of demand*
  - *therefore a fall in production and trade.*
- the redistribution of tax revenues by reducing charges, can offset the decline.
- In a closed economy,
  - *the amount of energy available at low cost is reduced,*
  - *There is a “deadweight” or “welfare losses’.*
  - *despite the redistribution of incomes, tax conducts to higher prices and declining demand.*
- it would be impossible to compensate this loss by an expansive fiscal policy, besause of an eviction effect

Generate a "double dividend"

a non cooperative game

2. Static equilibrium analysis : a non-cooperative game

- In an opened economy, energy tax does not have recessive effect if:
  - *Energy imports decrease*
  - *Exports increase thanks to the reduction of labour costs,*
- the GDP increases by an amount equal to the trade-balance surplus, less the deadweight.
- In parallel, the GDP of the rest of the world collapses of an amount equivalent to its trade deficit.
- Hence the global balance will remains negative.
- Nevertheless the costs of inaction in the future is much higher than the costs of an earlier intervention.
- policy makers are faced with the cruel choice of an immediate cure of austerity, with recessive effects, or an apocalyptic crisis in an undetermined future.
- In short, a static equilibrium analysis systematically follows a sacrificial logic.

II The effects of an "Green new deal"

- 1 The macroeconomic analysis in dynamic general equilibrium

- In a world where there is imperfect competition or imperfect information :

  - *prices don't adjust instantly the supply to the demand.*
  - *oligopolistic firm would prefer adjust the quantities produced and its employment, rather than the prices.*
  - *unemployment can be involuntary.*

- In a world where money is not neutral

  - *investments is not financed by savings, but by bank credit, that is to say, by money creation.*
  - *In other words, the stock of capital is not determined by an exogenous amount of savings.*
  - *it depends on the anticipation of corporate profits, which is function of the anticipated demand.*
  - *An increase in the credit supply provokes a fall of interest rates, which raises investment.*
  - *its evolution influences the growth rate.*

- Investment and production depend on anticipated demand.

II The effects of an "Green new deal"

1 The macroeconomics analysis in dynamic general equilibrium

- firms have to deal with the probability of a lack of outlets.
  - *In dynamic equilibrium, interest rates don't balance investment and savings any more (but the supply and demand for money).*
  - *a growth of savings leads to a decrease in consumption and an increase in unwanted inventories.*
  - *The lower profits discourage credit supply and investment.*
- production is not determined by the quantity of available factors, but by anticipated demand.
- The reduction of prices can't offset the negative effects on demand caused by the diminution of wages and employment
- there is no more economic balance between the potential production and the demand
- A growth in public spending (demand) can have a positive effect on the GDP, even in the long term.
- *There is no total eviction between public private investments since they are financed by money creation*

II The effects of an "Green new deal"

2 The multiplier effect of decreased energy

- a growth in investments:
  - *Financed with crédit :*

    the GDP should increase by an amount at least equal to those spending in the short term.

  - *financed through tax increases:*

    overall effect less expansive but still positive because the multiplier (positive) of the variation of spendings is higher, in absolute value, than the multiplier (negative) of the tax.

- Decrease of charges financed by a carbon tax

  it may have a positive effect if it leads to a transfer of activity from an énergivore sector to another

  which is labour intensive

  which doesn't import a lot of inputs from the rest of the world.

  Which export more products into the rest of the world

II The effects of an “Green new deal”

2 The multiplier effect of decreased energy

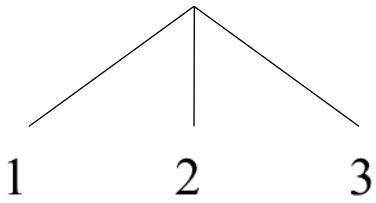
- In all cases, improving energy efficiency leads to:
  - *a decrease in fuel imports that improves the trade balance and the GDP.*
  - *a growth in money supply*
  - *a revenue transfer from energy distributors and road transporters to the sectors of building and railways.*
  - *a growth in employment since these sectors are very labor intensive.*
  - *Higher consumption and anticipated demand.*
  - *further investment and credit supply, and a new increase in the GDP.*
- The limits :
  - *Inflation which may erode the competitiveness of enterprises (in a fixed exchange rate system).*
  - *If the NPV of the investments are negativ, and if the directs and indirects training effects do not cover the cost of the debt reimbursment : decrease of GDP in a long term.*

- Macroeconomic multisectorial Model for the evaluation of environmental and energy policy

  - *Prices are not perfectly flexible (Mark up theory)*
  - *Wages are not perfectly flexible (Philipps curve)*
  - *Interest rate is fixed by the Central Bank (Taylor rule)*
  - *Supply and demand interact together.*
  - *Increase in energy efficiency and sobriety with the fuel prices*
  - *Investment choices between energivor and sober equipments*
  - *Substitution between energy sources and transportation modes*

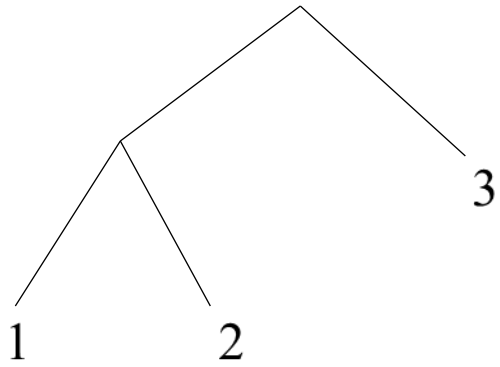
Standard models & Elasticity of substitution

- Often a **restrictive** framework
- **CES** function imposes a common ES between factors
  - Problematic when the number of production factors > 2



ES12 = ES13 = ES23

- **Nested CES** (Sato, 1967) provides an imperfect solution



ES12 ≠ ES13 = ES23

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Energy not directly related to revenue

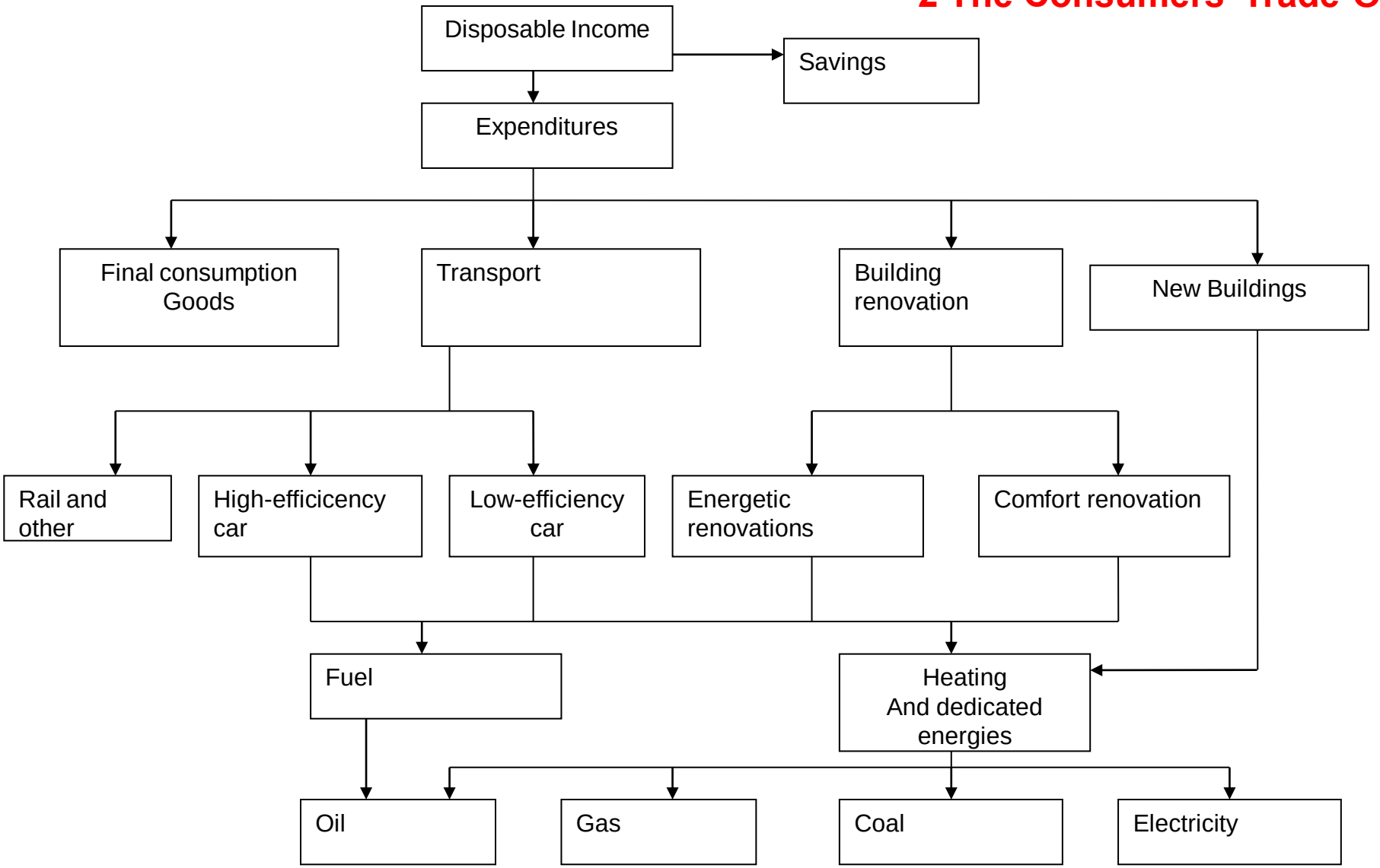
- Energy related to the number of buildings and cars
- Avoids unrealistic rebound or wealth effects
  Ex : Heating at 35 ºC ! Having 5 cars per person !
- Different energy classes for buildings and cars
- Investment in each type made according to their user cost: sell price + energy cost (Endogeneous energy efficiency)
- There is also a sobriety effect

24 production sectors

16 energy sub-sectors and 5 transports sub-sectors

III The ThreeME Model

2 The Consumers' Trade-Off



- without redistribution, the carbon tax has a negativ effect on GDP
  - *Simulation of the Quinet scenario : -0,3% in GDP in long term*
  - *Impact on employment near zero, thanks to a growth in investment (energy efficiency)*
- With a redistribution, the tax has a positiv effect on GDP and employment in the long term
  - *Decrease in labor cost*
  - *Growth of the sectors which do not consume a lot of energy*
  - *Increase in labor intensity and reduction in imports*
  - *In a long term, the net present value of investments is positiv (the reduction in the energy bill is higher than the debt reimbursment)*
  - *The expansiv effect of the tax redistribution is more important than the recessiv effect of the tax increase.*

III The ThreeME Model

3 The energy transition :The new energy mix in primary Mtep

		2010	2020	2030	2040	2050
Liquid Fuel	TOTAL	91.5	71.6	54.9	39.4	23.1
	fuel	89.0	69.0	52.0	33.4	12.9
	biofuel and biogaz	2.6	2.6	2.9	6.0	10.2
Electricity	TOTAL	118.4	109.8	77.1	67.9	76.58
	nuclear power	100.2	95.6	53.4	46.8	52.5
	fuel power	1.1	0.1	0.0	0.0	0.0
	gaz power	3.9	3.6	3.2	2.9	3.3
	coal power	4.9	0.1	0.0	0.0	0.0
	wind power	0.9	2.2	8.4	7.5	8.6
	solar power	0.1	0.5	3.2	2.9	3.3
	hydrolic	5.7	5.6	5.6	5.0	5.7
	other	1.6	2.1	3.2	2.8	3.1
Natural gaz ar	TOTAL	49.1	50.1	48.6	47.2	38.5
	natural gaz	34.2	32.0	21.4	18.8	12.5
	wood and biomass	9.5	12.0	15.9	15.2	12.3
	biogaz	0.6	1.6	6.0	6.2	5.4
	waste	3.0	1.7	0.8	0.3	0.1
	gorthermal	1.6	2.1	3.0	4.7	6.0
	other	0.4	0.6	1.4	1.9	2.3
coal	coal	7.5	4.8	4.5	4.5	4.1
TOTAL		266.6	236.4	185.0	159.1	142.4

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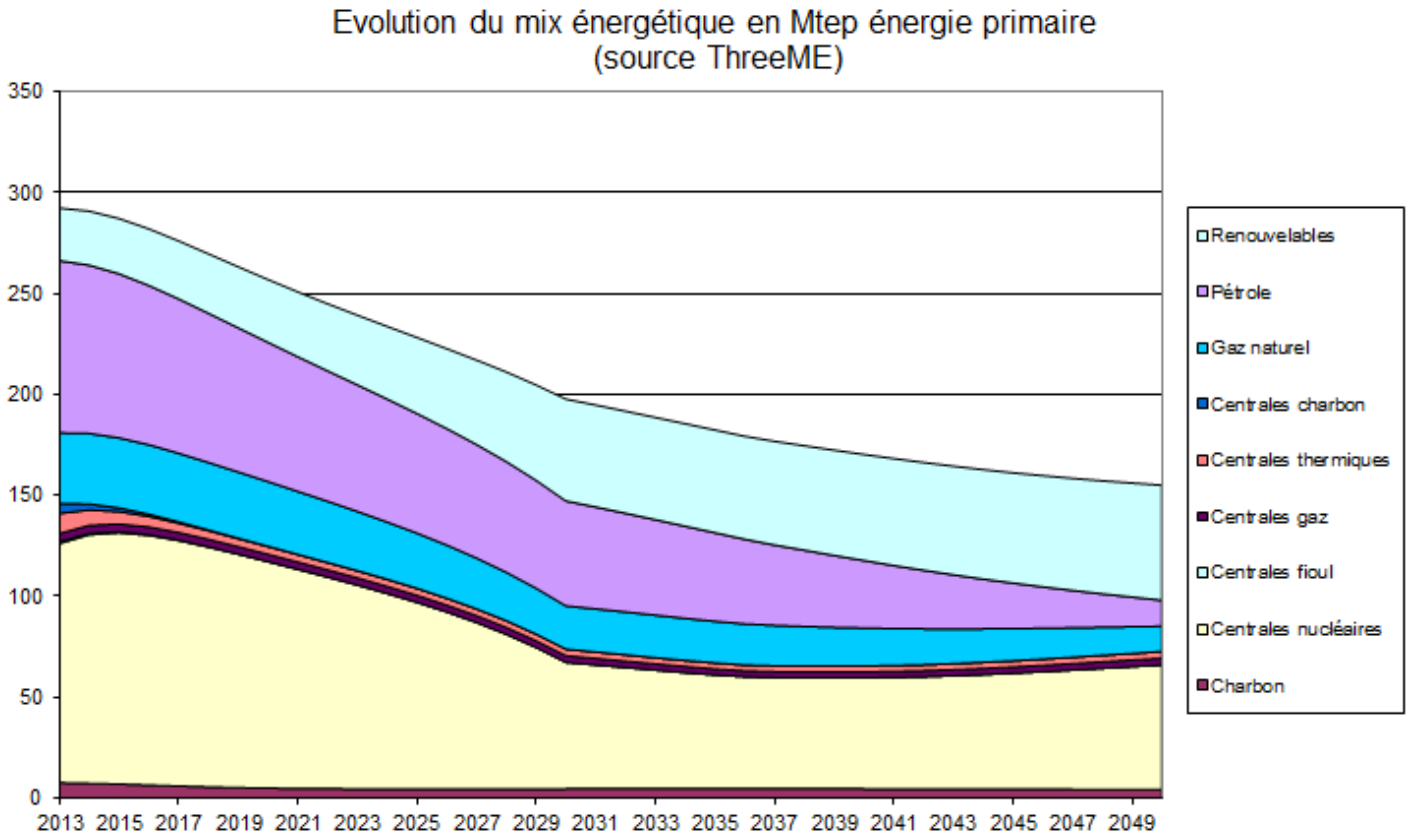
One of the ADEME scenarios



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III The macroeconomic effects of energetical transition

1 Preliminary results

		2010	2020	2030	2040	2050
GDP	(a)	0.00	0.9	2.0	1.5	1.8
Consumption	(a)	0.00	0.8	1.3	1.8	2.4
Investment	(a)	0.00	1.9	5.8	1.8	2.0
employment	(a)	0.00	0.5	0.9	1.1	1.5
public deficit	(c)	0.00	-0.2	-0.6	-1.0	-1.3
public debt	(c)	0.00	-1.2	-5.1	-10.9	-18.1
trade deficit	(c)	0.00	-0.2	-0.4	-0.9	-1.1
GDP	(d)	107.64	132	160	190	226
CO2 emissions	(d)	99.13	76	63	52	34.9
sectors	(d)	102.10	77	66	64	49.5
housholds	(d)	94.03	76	57	32	9.9
carbon tax rate	(e)	0.00	55	115	238	486
carbon tax receipts	(f)	0.00	15	26	42	53

Légende: difference between the"business as usual" scenario unless for (d); relativ difference for (a

(a) (b) in %; (c) in % of GDP; (d) indice = in 2006; (e) in constant Euros per ton of CO2;

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III The macroeconomic effects of energetical transition
2 A double dividend

- Increase in jobs and economic activity, decrease in GHG
  - *GDP growth by 1,8% in 2050*
  - *In level, GDP X2 between 2012 and 2050*
  - *Decrease in unemployment rate by 1,5 pt in 2050. +600 000 jobs*
  - *CO2 emissions divided by 4 since 1990, reduction by 50% in energy demand*
  - *Carbon tax rate near 500€/tCO2 in 2050 (3 times the actual level)*

Conclusion

- In general equilibrium, the fight against global warming is not costly if the government
  - *reinvests its tax incomes*
  - *or diminishes the labour cost.*
- The government can conciliate ecological prosperity and economic efficiency.
- The green growth may be the main drivers of a new Kondratief Cycle.