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 available
     - Unemployment is inexistant or voluntary

   - There is no fluctuation of economic activity, except those generated by

     - technical progress,
     - demographic changes,
     - climatic catastrophes
     - unintended interventions of the Government.
• 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, because of an eviction effect
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
- Often a **restrictive** framework

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

  \[
  ES_{12} = ES_{13} = ES_{23}
  \]

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

  \[
  ES_{12} \neq ES_{13} = ES_{23}
  \]
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 °C! 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
Disposable Income

<table>
<thead>
<tr>
<th>Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
</tr>
</tbody>
</table>

- Final consumption Goods
- Transport
- Building renovation
- New Buildings

- Rail and other
- High-efficiency car
- Low-efficiency car
- Energetic renovations
- Comfort renovation

- Fuel
  - Oil
  - Gas
- Heating and dedicated energies
- Coal
- Electricity

III The ThreeME Model
2 The Consumers’ Trade-Off
• without redistribution, the carbon tax has a negative 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 positive 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 positive (the reduction in the energy bill is higher than the debt reimbursement)
  • The expansive effect of the tax redistribution is more important than the recessive effect of the tax increase.
### III The ThreeME Model

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

<table>
<thead>
<tr>
<th>Source</th>
<th>2010</th>
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<td>0.6</td>
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<tr>
<td>coal</td>
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<td>4.8</td>
<td>4.5</td>
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<td>236.4</td>
<td>185.0</td>
<td>159.1</td>
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Evolution du mix énergétique en Mtep énergie primaire (source ThreeME)
### III The macroeconomic effects of energetical transition

#### 1 Preliminary results

<table>
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<tr>
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<th>2010</th>
<th>2020</th>
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<td>Consumption</td>
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<td>5.8</td>
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<tr>
<td>employment</td>
<td>(a)</td>
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<td>0.5</td>
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<tr>
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<td>(d)</td>
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<td>CO2 emissions</td>
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<tr>
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<td>(f)</td>
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<td>15</td>
<td>26</td>
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</table>

Légende: difference between the "business as usual" scenario unless for (d); relativ difference for (a) (b) in %; (c) in % of GDP; (d) indice = in 2006; (e) in constant Euros per ton of CO2;
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)*
• 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.