Intergenerational effects of financing private investments for low-carbon energy transitions -an application to France

Laura Atarody[1] Mourad Ayouz[2] Frédéric Gonand[3]

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[1]University of Paris Dauphine-PSL (LEDa-CGEMP)

[2]Électricité de France

[3]University of Paris Dauphine-PSL (LEDa-CGEMP)

Motivation and Literature

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The literature does not jointly deal with the macroeconomic and intergenerational redistributive effects of different paths of investments in the power sector

1. **The need for significant investments to decarbonize the economy** (Acemoglu and al (2012); Dao and Dávila (2014))
    - **Contribution:** give a precise order of magnitude on the amounts of investments and study its intergenerational redistributive effects.
2. **The effects of carbon taxes and energy prices** (Goulder(1995); Chiroleu-Assouline and Fodha(2006); Rausch and Yonezawa(2018); Argentiero and al(2018))
    - **Contribution:** in a detailed OLG-EG empirical setting, we develop three scenarios of low-carbon investments in the power sector that differ on only one element: the financing method.

Question and Key Results

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What are the macroeconomic and intergenerational effects of financing private investments for low-carbon energy transitions in the power sector?

Using an empirical general equilibrium model with fifteen overlapping generations and five economic sectors with different technical progress, on French data, we find that:

1. **The intergenerational redistributive effects differ significantly depending on the financing methods :** In Scenarios 1 and 2, the middle aged and older generations are more sensitive to the intergenerational redistributive effects while in Scenario 3, the young and future generations are more sensitive to the intergenerational redistributive effects

2. **The economy suffers from a drop in production in the three scenarios, mainly due to:**
    - the increase in wholesale prices associated with the investment chronicle
    - the crowding out effect of energy transition investments
    - the increase in the tax to finance the policy, paid by private agents

Model

Dynamic Model

Supply: Nested CES production functions for the five branches (agriculture, energy, manufacturing, construction, services) of the economy with the demand for added value, capital, labor, energy that are determined by the first order conditions.

$$y_{b,t} = A_b \left[\alpha z_b (z_{b,t})^{\frac{\sigma_{KLEV}-1}{\sigma_{KLEV}}} + \alpha ic_b (ic_{b,t})^{\frac{\sigma_{KLEV}-1}{\sigma_{KLEV}}} \right]^{\frac{\sigma_{KLEV}}{\sigma_{KLEV}-1}}$$

Five functions for the investment, determined by the classic capital accumulation function.

$$k_{b,t+1} = k_{b,t}(1 - \delta_{0,b} - \gamma_{rate} - n) + inv_{b,t}$$

Dynamic Model

The representative agent by cohort maximizes its expected utility function :

$$\text{Max u}(c_{g,t}h_{g,t}) = \left[\kappa^{\frac{1}{\xi}}\left(c_{g,t}\right)^{\frac{\xi-1}{\xi}} + (1-\kappa)^{\frac{1}{\xi}}\left(\bar{h} - h_{g,t}\right)^{\frac{\xi-1}{\xi}}\right]^{\frac{\xi}{\xi-1}}$$

$$\text{s.t. Net wealth}_{t+1} = \text{Net wealth}_t\,(1+r) + \text{labor income}_t + \text{transfers}_t - \text{consumption}_t - \text{taxes}_t$$

Some households are Keynesians, i.e., they consume all their income and do not save. The aggregate consumption is then:

$$c_{t,g} + c^*_{t,g} = \lambda w_{t,g} r_{t,g} + (1-\lambda) w^*_{t,g}(y_{t,g} - t_{t,g})$$

Public finances: The government faces a public debt that accumulates with the annual primary deficit such as:

$$\text{Bond}_{t+1} = \text{Bond}_t(1+r_t) + \text{Primd}_t$$

Open economy

Data and policy scenarios

Intersectoral links and redistributive effects for each cohort

- **The model performs a sectoral breakdown** allowing to see in detail the impact on production, added value, energy, capital and investment of each sector (agriculture, energy, industry excluding energy, construction, services)
- **Calibration with a generational breakdown (every five years):** modeling of the redistributive effects for the 15 generations of our model

Data used:

- Insee, national accounts, base 2017
- 2018 SRCV (Statistics on Resources and Living Conditions) data (most recent)
- Eurostat (energy tax data)
- In the power sector, investment modelling (as related wholesale price) is exogenous (IHS Markit)

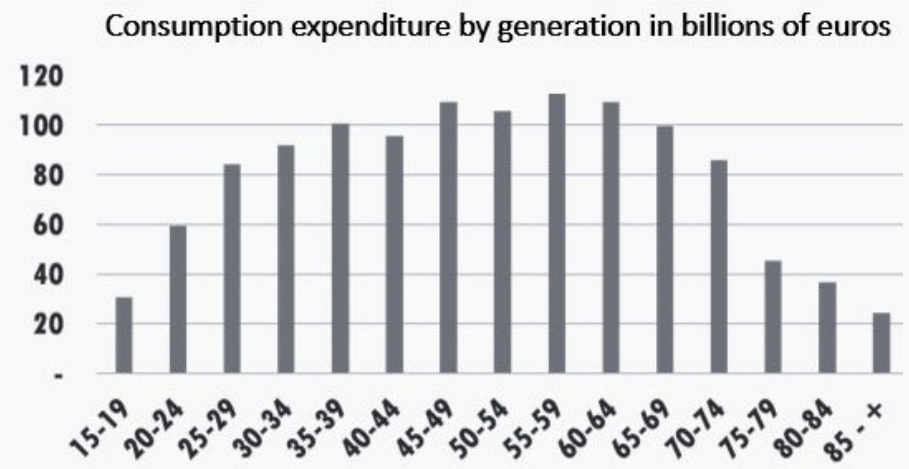
Table 1. Investments in the power sector (in billions of euros)

Year	5	10	15	20	25	30
Amounts of electricity investments	2.9	5.1	7.8	10.2	11.9	11.2

Policy scenarios

- Scenario 1. Rise in low carbon electricity investments financed by public debt. The associated rise in public debt is reimbursed in the medium run by taxes on labor income paid by households and firms.
- Scenario 2. Rise in low carbon electricity investments financed through a signal price or a tax on electricity consumption for firms only. The IMF analyses such a scenario in Chen et al, 2020.
- Scenario 3. Rise in low carbon electricity investments financed through a higher energy price for firms (carbon price or tax on electricity consumption) and households (carbon tax or the tax on electricity consumption).

- Consumption by generation in the base scenario:



Results

Results : Macroeconomic effects

- Substitution effect due to the increase of the wholesale and retail prices of energy
- Crowding out effect due to the rise of low carbon energy investments
- The aggregate impact is less detrimental in scenario 1 as financial burden on private agents is postponed through public debt and some households are Keynesians
- The aggregate impact is slightly more detrimental in scenario 3 in which households contribute to financing the investments in low carbon transition

	Year		
Deviation from the baseline scenario (%)	5	10	30
Scenario 1			
Production	-0.46	-0.57	-0.53
Consumption	-0.09	-0.33	-0.36
Scenario 2			
Production	-1.18	-1.26	-1.33
Consumption	-0.96	-0.67	-0.87
Scenario 3			
Production	-1.38	-1.59	-1.55
Consumption	-0.54	-1.09	-1.12

Results : Intergenerational redistributive effects

- The overall decrease in consumption (in all scenarios) hides disparities from one generation to the next.

The most penalized generations (age in year 0)	Current welfare	Intergenerational welfare
Scenario 1	30-64	30-39
Scenario 2	55-74	55-64
Scenario 3	20-29	20-29

- **Scenario 1 and 2:** The negative effect of the investment shock on wages and capital stock weights relatively more on middle and older generations as they have the highest levels of capital and labor incomes.
- **Scenario 3:** The shock weighs relatively more on young cohorts than on middle-aged cohorts.

Conclusion

Conclusion

1. **The aggregate detrimental effects on growth, as well as the intergenerational redistributive effects, are more contained when low-carbon investments are financed by public debt** as financial burden on private agents is postponed and some households are Keynesians.
2. **In Scenarios 1 and 2, the intergenerational redistributive effects weigh relatively more on the middle aged and older generations,** while in scenario 3, the young and future generations are relatively more detrimentally affected.
3. **The magnitude of the signal price and tax increase for firms and households should be subdued** if some government seeks to limit the negative macroeconomic effect, and to improve pro-youth redistributive properties.
4. **These results on French data feed into the current debate ignited by Blanchard (2019) about the intergenerational limited implications of public debt.**

Questions?