Budgetary effects of adaptation in EU Mediterranean countries: A CGE framework applied to Sea Level Rise

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Presentation overview

1. Rationale for the analysis;
2. Framing the topic:
   a. Authonomous vs planned adptation;
   b. Budgetary effect of adaptation
3. Methodology;
4. Results:
   a. Real side effects;
   b. Budgetary effects: government income, savings and expenditures;
5. Knowledge gaps:
6. Conclusions.

Rationale of the analysis:Why assessing the budgetary effects of adaptation?

FROM EUROSTAT

Challenges in the EU Mediterranean Countries:

- **Aging population** (over 65 population: from 11.9% (France) to 14.9% (Italy) in 2013);
- **Financial crisis**;
- **Growing levels of deficit** (from 2.8% of GDP (Italy) to 12.2% of GDP (Greece) in 2013) **and debt** (from 92.1% of GDP (Spain) to 174.9% of GDP (Greece) in 2013) ;
- **High unemployment levels** (unemployment rate: from 12.2 % (France) to 27.3% (Greece) in 2013);

Budgets are under stress in the EU

There are a number of challenges we face in coming years which are likely to put enormous pressures on the public finances of governments virtually everywhere.

Few governments now take account of long-term risks. Even where government policies have given rise to accumulating commitment sphere most budgets give little guidance on future liabilities.

Long- term challenges

1. Demographic changes.
2. Climate changes
3. Economic changes.
4. Security changes
5. Technological changes

Rationale of the analysis: Why SLR?

According to CEPS & ZEW (2010): 98% of adaptation expenditures against SLR is financed by public funds in EU

this is a good example of planned adaptation where fiscal burden falls completely on the government agent. As a consequence this should ensures sufficiently large budgetary effects to report and discuss.

Operatively, to perform this analysis we need two sets of information:

1. Impacts of climate change
2. Direct budgetary costs for adaptation investments

} Both provided by the DIVA model

Framing the topic: autonomous vs planned adaptation

Autonomous adaptation

Autonomous *direct* adaptation: changes that economic agents make when confronted with climate change.

Examples: shifts in the composition of input needed to produce the same output (technological change); shifts in consumers' consumption patterns (shifts in the preference structure)

Autonomous *indirect* adaptation: market response from autonomous direct adaptation.

➔ the supply and demand curve shifts because of climate change, the supply of the affected goods and services will no longer be equal to demand,

➔prices and quantities will therefore be adjusted until a new equilibrium is attained.

➔This means that the relative prices of all goods and services are affected, which gives rise to a range of indirect effects.

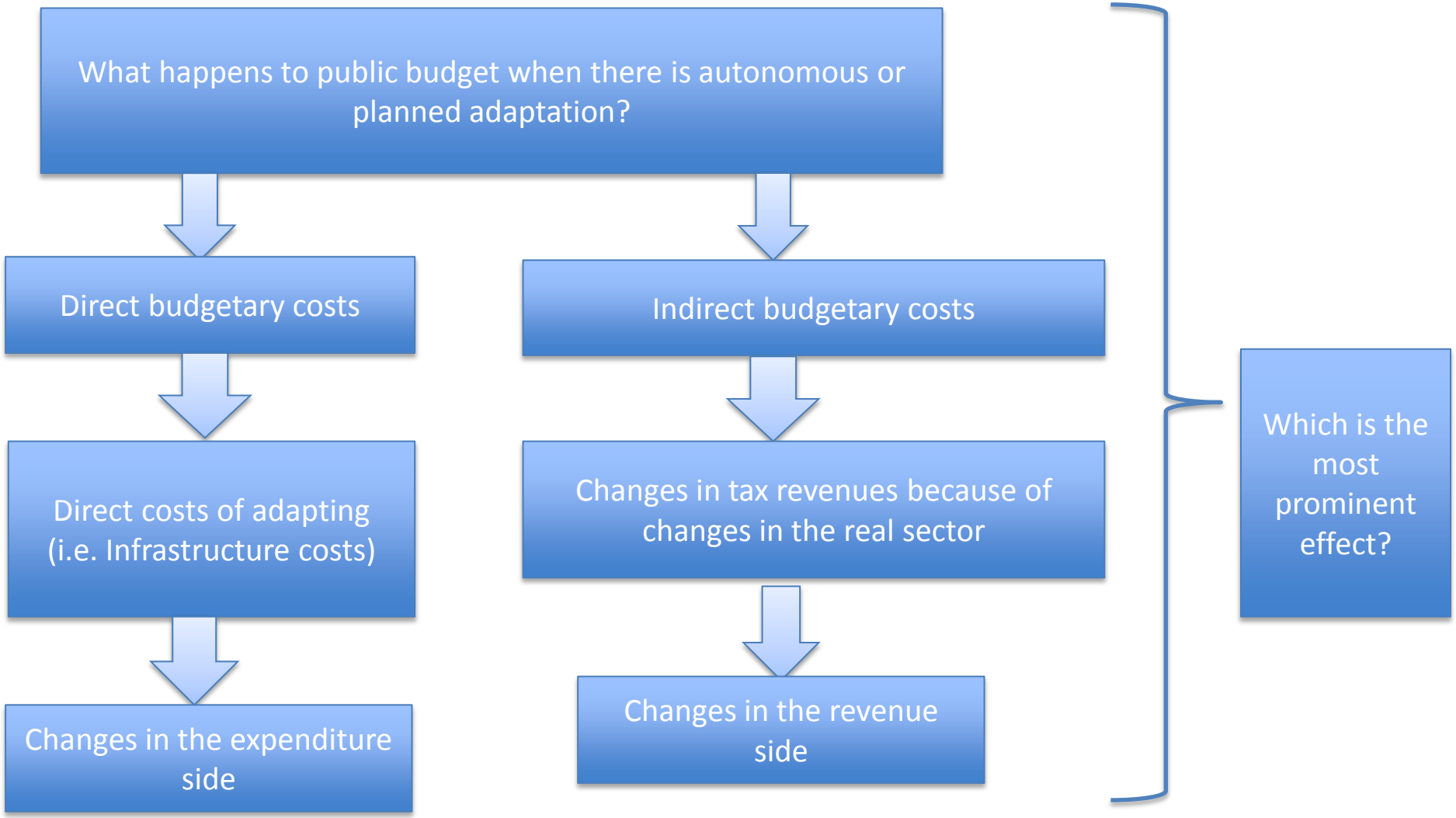
Planned adaptation

Many potential adaptation measures are public goods. These are measures that, if implemented, will benefit more than one economic agent.

Examples: dikes, land-slide entrenchments, road and railway constructions and protection walls against floods

The basic problem with public goods: if adaptation strategies are based solely on autonomous adaptation, the amount of implemented measures wil be lower than the socially beneficial amount. Individuals will therefore lack incentives to invest in a public good. The standard solution to this problem is to make agents cooperate and/or to leave the decision to a public body, which in our case means to make adaptation an issue for the public authorities.

Framing the topic: budgetary effects of adaptation



Methodology: CGE models

Computable General Equilbrium model are well suited to analyse this issue because of their structure. Given their general euqilibirum approach they are able to capture second-round and indirect effects on the economy.

Here we use ICES (Intertemporal Computable Equilibrium System) in a comparative static framework.

Methodology: the ICES model specification of the GOV'T

The government collects taxes, pays transfers to residents and non residents.

$$GOVINC_r = TTAX_r + AIDI_r - AIDO_r - TRNG_r - INTD_r - INTO_r - OTHG_r + OTHI_r$$

The government spends its income in goods and services as a fixed share of real GDP.

$$GOVEXP_r = \alpha_r GDP_r$$

The governemnt allocate the total expenditure according to a Cobb-Douglas function.

$$G_{g,r} = CD\ fx(VGA_{g,r})$$

Finally, Government saving is residually determined as income minus expenditures.

$$GSAVE_r = GOVINC_r - GOVEXP_r$$

Government debt is the summation of benchmark year debt and deficit (it is minus government savings).

$$GDEBT_{r,t} = GDEBT_{r,t0} - GSAVE_{r,t}$$

Methodology:modelling public adaptation expenditures

We consider a priorizing expenditure approach of the government.

➔It diverts expenditures from other sectors to a specific sector (i.e. construction) to adapt to climate change.

$$GOVEXP_r = \Sigma g_{i,r} * (1 - b_r) + g_{cons,r} + \Delta g_{cons,r}$$

Where $g_{i,r}$ represents expenditures in all sectors but construction, $g_{cons,r}$ represents expenditures on contruction and $\Delta g_{cons,r}$

are the additional adaptation expenditures in the construction sector to build sea barriers. Since $\Delta g_{cons,r}$ is the SLR adaptation policy, expenditures on the rest of the sectors $g_{i,r}$ should decrease proportionally to respect the budget constraint. This proportional reduction is represented by the shifting parameter b_r which is equal to:

$$b_r = \Delta g_{cons,r} \overline{\overline{r}} / GOVEXP_r - g_{cons,r}$$

Experiment design

Regional aggregation
France
Greece
Italy
Portugal
Spain
Rest of the EU
Rest of the World

Sectoral aggregation
Primary sector: Agriculture
Energy sectors: Coal, Oil, Gas, Oil products, Electricity from fossil fuels, Electricity from renewables (nuclear, biomass, Hydro, Solar, Wind)
Industry and services: Energy intensive industries, Other industries and services, Construction, Public services

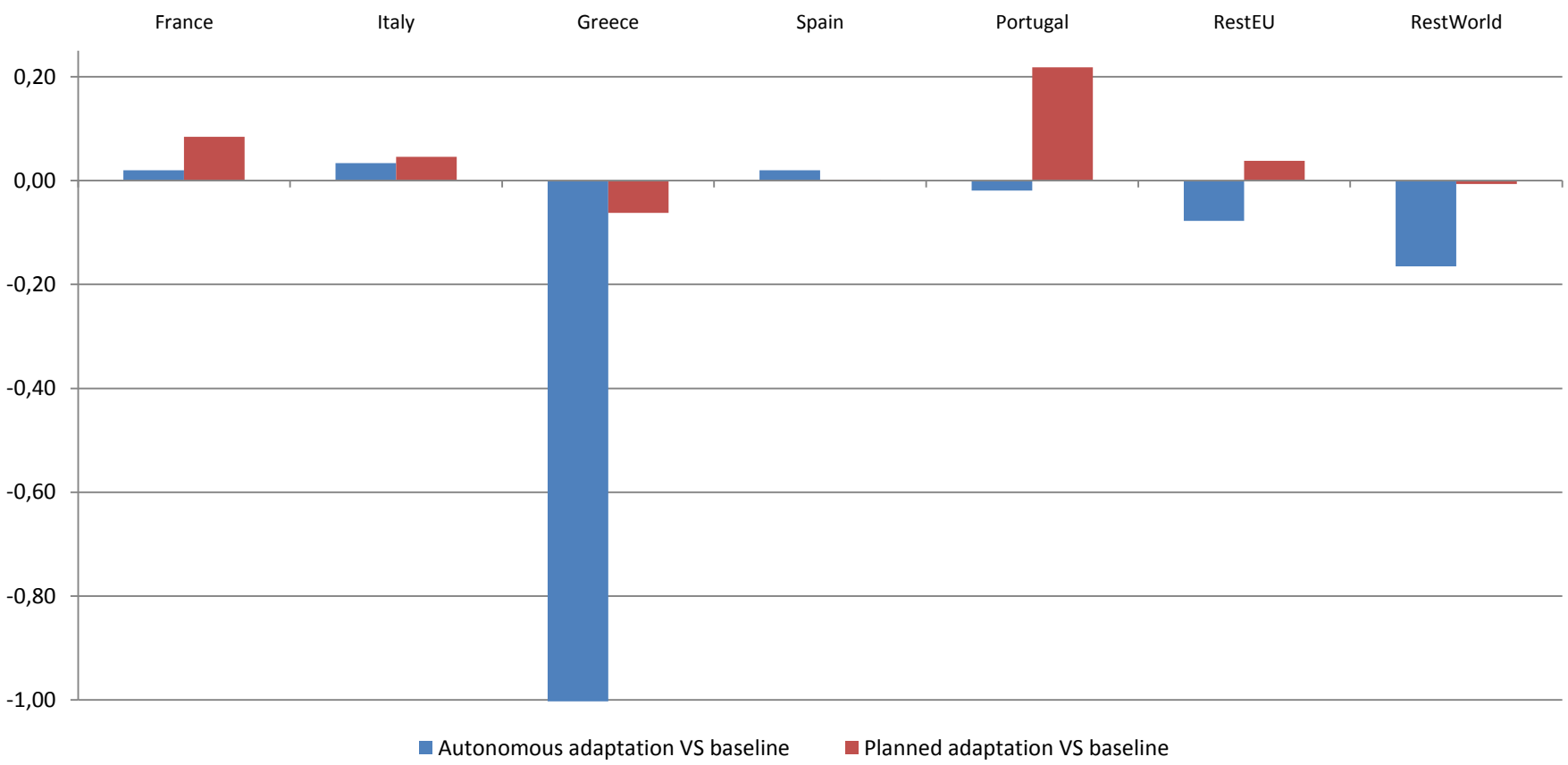
Scenarios
Baseline: no Sea Level Rise (SLR) and no adaptation
«autonomous adaptation» scenario: only SLR impacts
«planned adaptation» scenario: publicly financed adptation

Input data: SLR impacts and direct adaptation costs

- Data refer to a A2 scenario where impacts and costs for adaptation are higher;
- Impacts of SLR: Coastal zones + river floods;
- Adaptation expenditures comprehend: dikes, sea walls, full nourishment (tidal basin, beaches, wetlands);

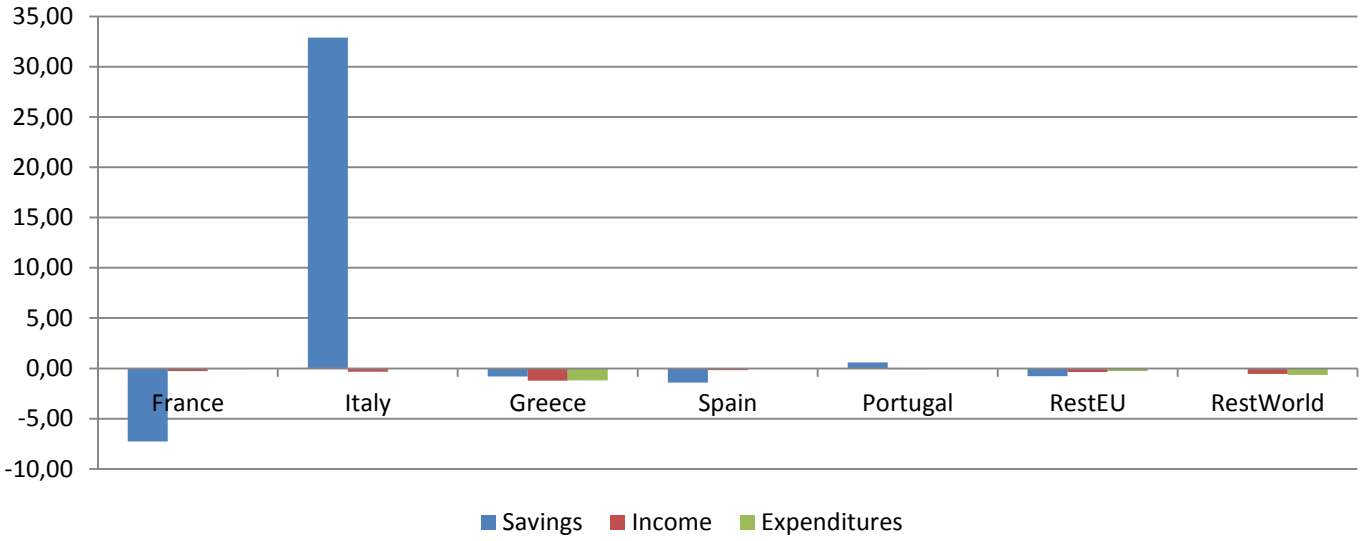
	SLR impacts (% changes in 2050 with respect to 2007)	Adaptation expenditure (2007 US dollar)
France	-0.0197	22132
Greece	-1.9627	6588
Italy	-0.0159	9297
Portugal	-0.2606	5261
Spain	-0.0001	6483
Rest of Eu	-0.2522	417872
Rest of World	-0.4372	2613212

Results: GDP effects

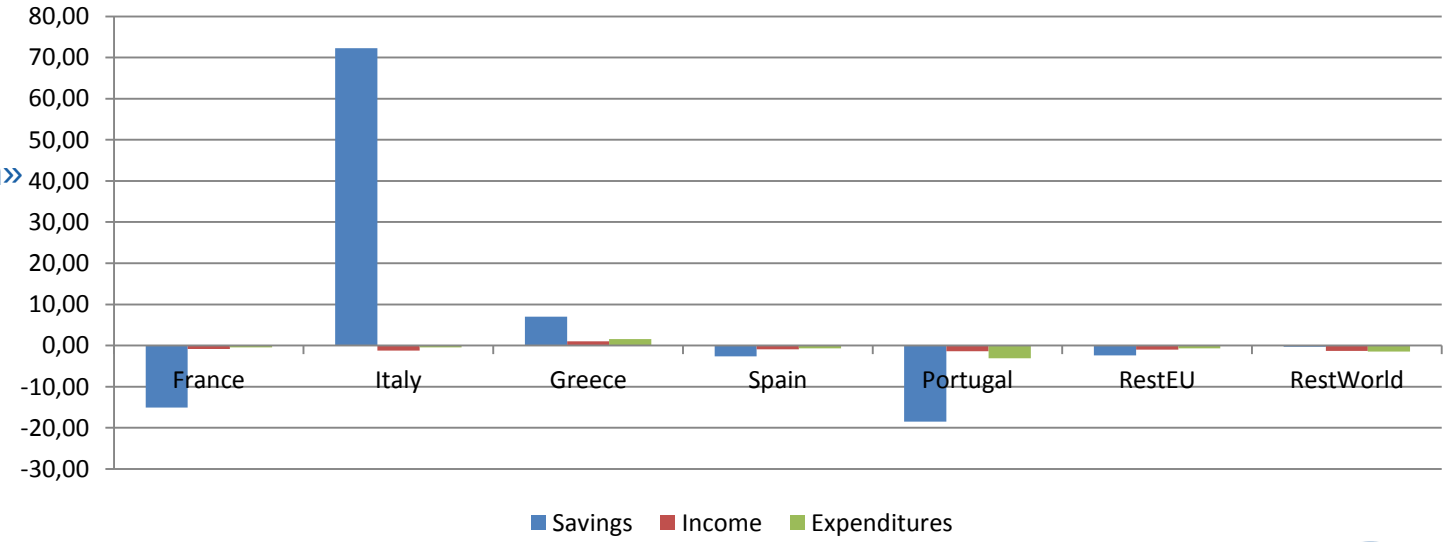


Results: public sector results

- «**autonomous adaptation**» scenario

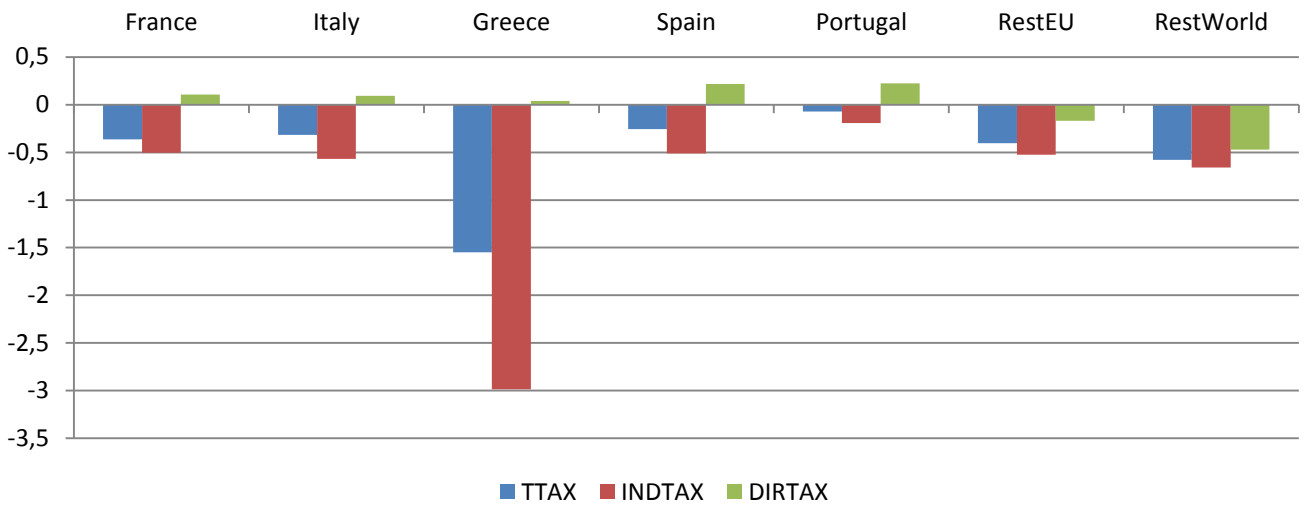


- «**planned adaptation**» scenario

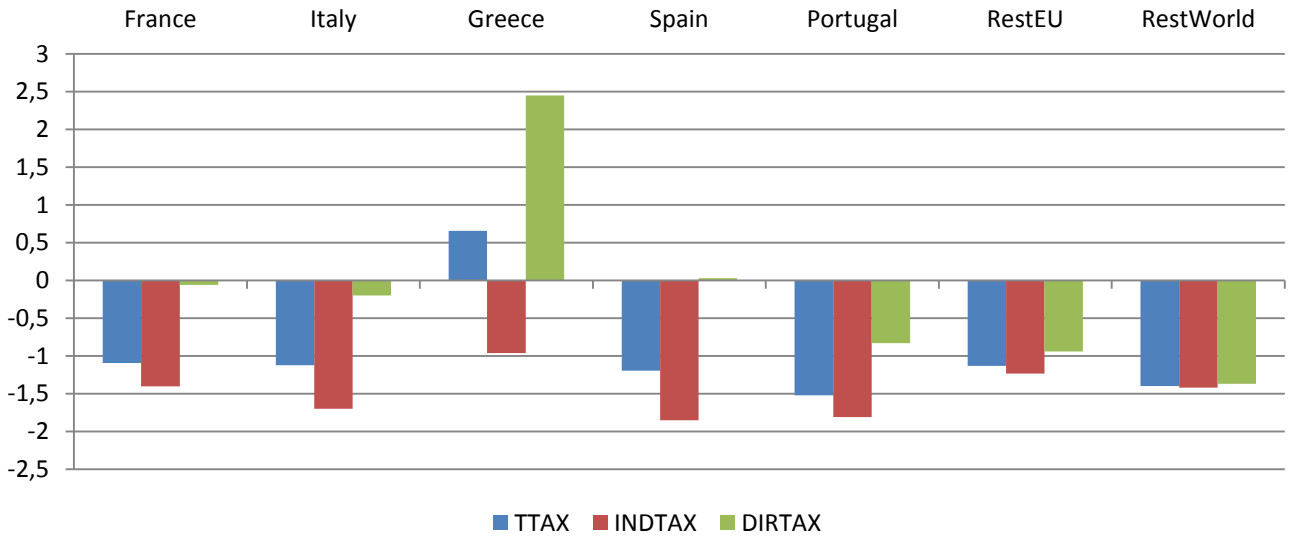


Results: direct and indirect budgetary effects

- **«Autonomous adaptation»** scenario



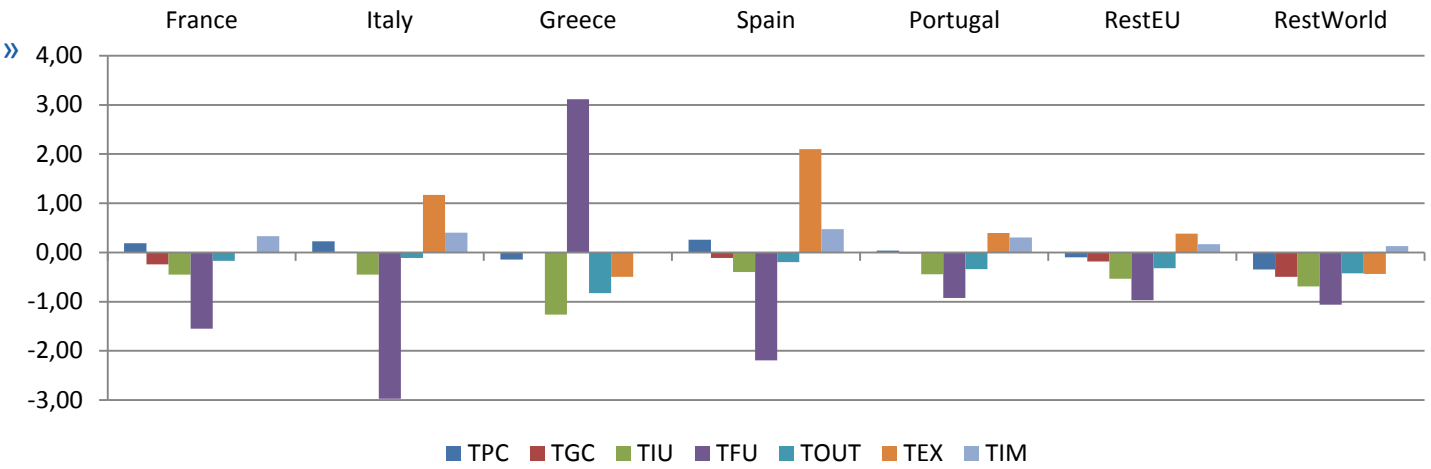
- **«Planned adaptation»** scenario



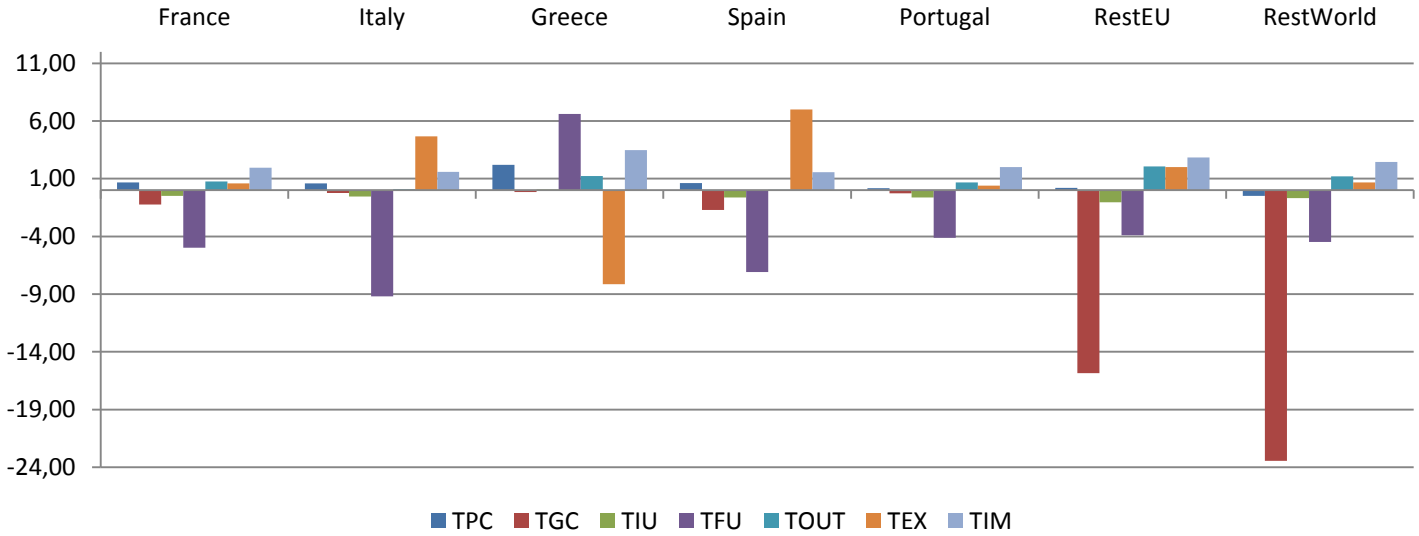
Where: TTAX= total tax revenues; INDTAX= total indirect tax reveneus; DIRTAX= total direct tax revenues

Results: focus on indirect tax revenues

- **«Autonomous adaptation»** scenario



- **«Planned adaptation»** scenario

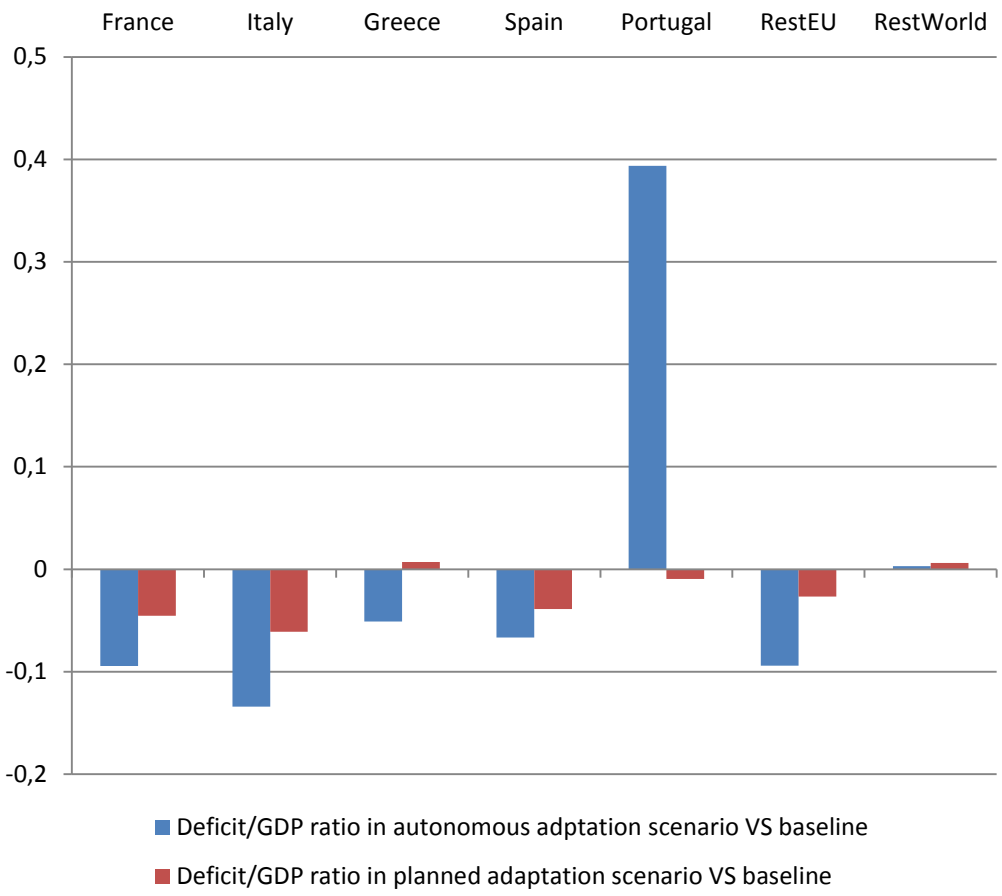


Where: TPC= total tax revenues on private consumption; TGC= total tax revenues on gov't consumption; TIU= total tax revenues on intermediates; TFU= total tax revenues on factor use; TOUT= total tax revenues on production; TEX = total tax revenues on exports;TIM= = total tax revenues on imports

The effects on the Deficit/GDP ratio

Why the Deficit/GDP ratio?

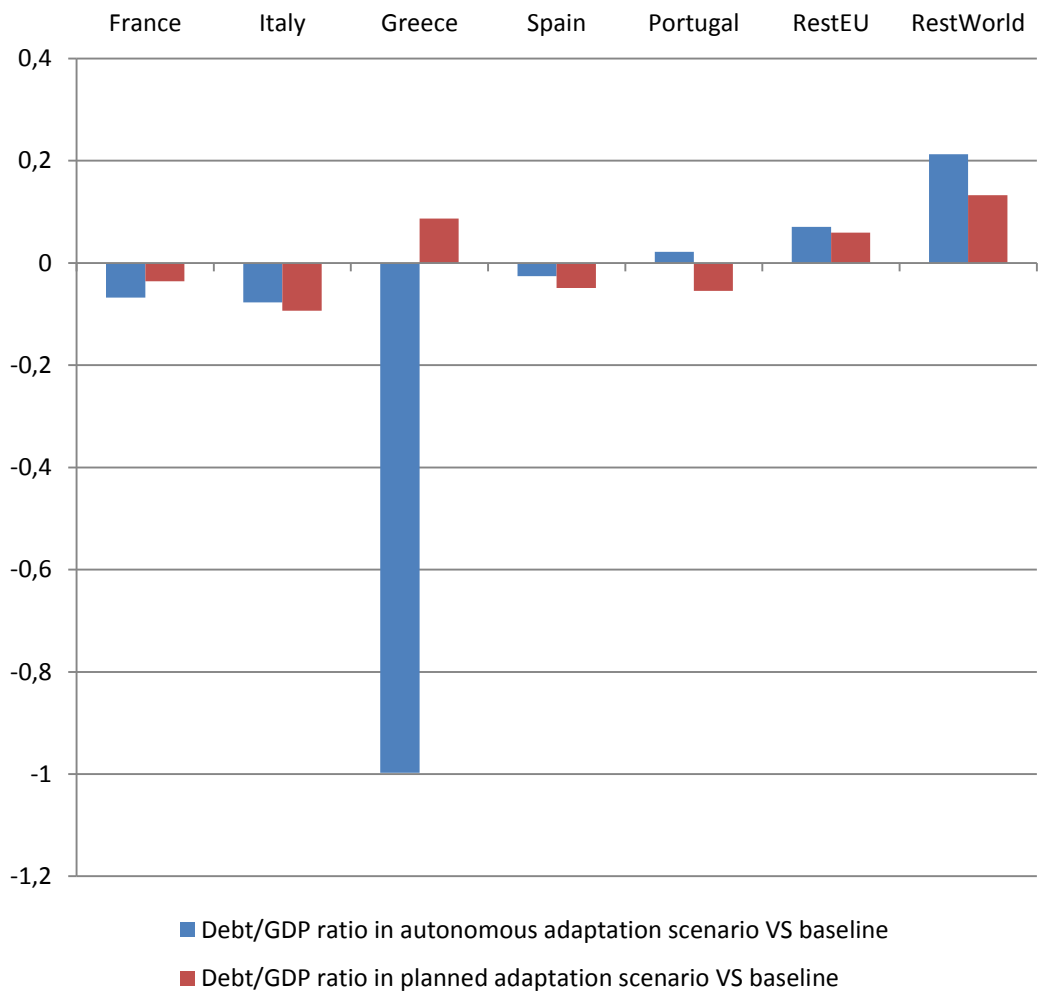
- ➔ It combines both the real side effects and the budgetary effects;
- ➔ It gives a measure of the fiscal space of the country and of the availability of resources for growth;
- ➔ It is a common measure in the EU statistics;



The effects on the Debt/GDP ratio

Why the debt/GDP ratio?

- ➔ It gives the measure of the fiscal sustainbility of long term fiscal policies because of the link between debt level and interest to be paid;
- ➔ Commonly adopted in the EU statistics



Addressing knowledge gaps

1. **Addressed knowledge gaps**:
   a. Introduce an explicit government institution to analyze budgetary effects of adaptation in a general equilibrium framework; as far as we know CGE models are used only to assess market-driven adaptation.
   b. Set up of a framework to analyze indirect budgetary effects of adaptation;

2. **Residual knowledge gaps or works in progress:**
   a. Introduce recursive dynamics;
   b. Extend the analysis of budgetary effects of adaptation to other Climate Change impacts;
   c. Model different adaptation funding schemes (deficit-financed, ricycling in adaptation, foreign financed etc.).

Conclusions

1. In a general equilibrium framework, we detect the indirect budgetary effects of climate change impacts (specifically to SLR) and adaptation expenditures.
2. Adaptation expenditures have effects on both the real side and the budgetary situation of the government;
3. From this analysis we infer that a full adaptation strategy is a winning strategy in terms of GDP and production, and it could have positive effects on the deficit/GDP ratio in most cases.
4. Final results are mainly driven by:

   a. initial impacts;

   b. Structure of the tax system in each country;

   c. Modelling of how to finance adaptation.

Thank you for your attention

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