

# Welfare implications of EU effort sharing decision and possible impact of a hard Brexit

Frédéric Babonneau, Alain Haurie and [Marc Vielle](#)

[marc.vielle@epfl.ch](mailto:marc.vielle@epfl.ch)

IAEE Annual Congress 2017  
Singapore – June 2017

## Last developments in EU climate policy

- In December 2015 at COP21, the EU is committed to a binding target of an at least 40% domestic reduction in GHG emissions by 2030 compared to 1990
- In June 2016, the UK voted to leave the European Union
- In July 2016, the EC presented its proposal for a regulation to reduce GHG emissions in sectors not covered by the emissions trading system (ETS) with regards to post-2020 binding targets called *Effort Sharing Decision* (ESD)

## Questions:

- 1 What are resulting cost by Member States of this EU Effort Sharing Decision ?
- 2 What are the impact of the Brexit on the UK and European climate policies ?

# A noncooperative dynamic game

## Assumptions:

- 1 **A safety emissions budget**  $Bud$  is distributed among the Member States. Let  $\theta_j \in (0, 1)$  be the share of Member State  $j$ , with  $\sum_{j=1}^m \theta_j = 1$ .
- 2 **A competitive market for emissions permits**, which clears at each period. Let  $\omega_j^t$  be the vector of permits for Member State  $j$  at period  $t$ .

**Model:** Then we consider the game where each Member State  $j$  controls the permit allocations schedule  $(\omega_j^t : t = 0, \dots, T - 1)$  with  $\Omega^t = \sum_{j=1}^m \omega_j^t$  and tries to achieve

$$\min_{\omega_j} \left\{ \sum_{t=0}^{T-1} \beta_j^t (\Phi_j^t(e_j^t(\Omega^t)) + p^t(\Omega^t)(e_j^t(\Omega^t) - \omega_j^t)) \right\},$$

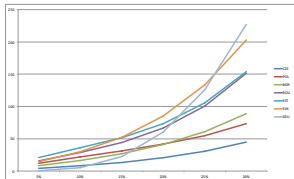
subject to actions chosen by the other Member States and under the budget sharing constraint

$$\sum_{t=0}^{T-1} \omega_j^t \leq \theta_j Bud. \quad (1)$$

Here  $\Phi_j^t(e_j^t)$  represents the cost of abatement with respect to emissions by Member State  $j$ , at time  $t$  and  $\beta_j^t$  a discount factor

# Numerical implementation and further assumptions

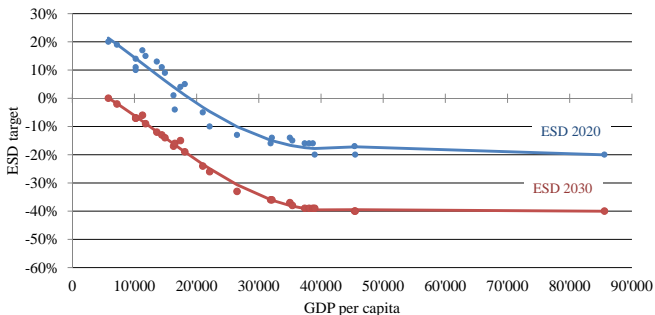
- Time horizon 2011-2050, 4 decades 2011-2020, 2020-2030, 2030-2040, 2040-2050
- $Bud=99$  Gt CO<sub>2</sub>; Reference scenario = 173 Gt CO<sub>2</sub>
- $\Phi_j^t(e_j^t)$  are estimated from 200 runs of the CGE GEMINI-E3



- We assume full flexibility between ETS and non ETS (**one-off flexibility option**)
- We assume trading between non ETS sectors (**inter-Member State flexibility**)
- We assume **inter-temporal flexibility** between decades

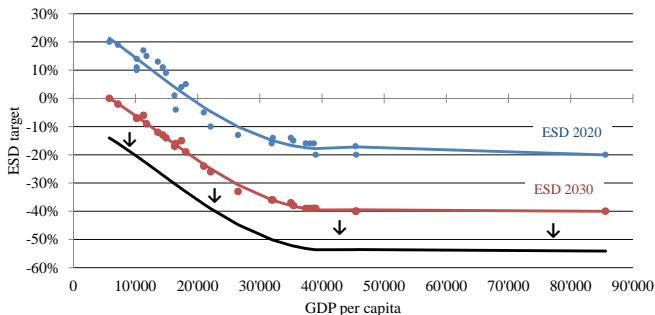
# Effort Sharing Decision rule

- EC already defined ESD per Member State for years 2020 and 2030
- We have to define ESD for the whole period (2011-2050)
- CO<sub>2</sub> emissions targets: 2020 = -20%, 2030=-40%, 2050=-80%



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Computing the share of budget allowed to MS  $j$ :  $\theta_j$

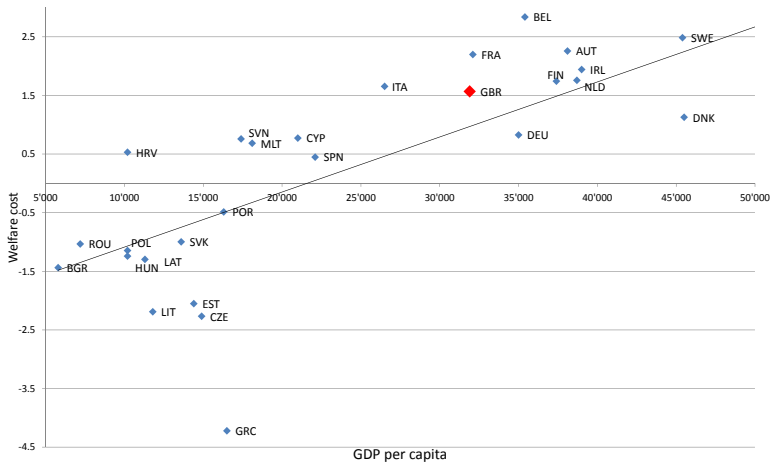
- We already defined  $\theta_j^{ESD}$  the burden sharing for non ETS emissions
- We compute the  $\theta_j$  with the following equation:

$$\theta_j = \frac{\frac{\gamma_j \theta_j^{ESD} \text{Bud} + (1 - \gamma_j) \sum_t e_j^t \text{ TAX}}{\psi}}{\text{Bud}}, \quad (2)$$

where

- $e_j^t \text{ TAX}$ , the emissions in an *uniform tax* scenario
- $\gamma_j$  is the share of emissions in non-ETS sectors
- $\psi$  a normalization factor (equal to 1.04)

# Welfare cost in relation to GDP per capita



Welfare cost: discounted welfare cost in % of discounted household consumption



# UK and climate change policy

- UK was the second-largest European GHG emitter, with 518 Mt CO<sub>2</sub>-eq emitted, representing 13.1% of EU28 emissions
- UK was the first G20 country to adopt legislation on GHG emissions
- According to the UK government about 1,000 power stations and industrial plants in the UK participate in the EU ETS
- UK Climate Change Act established a mandate of an 80% cut in GHG emissions by 2050
- As pointed out by Lord Nicholas Stern: *“The UKs commitment on climate change is longstanding and based on a understanding that it is global issue and should not be altered by its future departure from the European Union”*

# EU climate change policy and Brexit options

We consider two options:

- Hard Brexit: no access to EU emissions trading
- Third access status: UK participates to the EU emissions trading but without ESD (i.e. UK budget = UK domestic commitment)

	EU28	Hard Brexit	Third access status
UK budget (Mt CO <sub>2</sub> )	13'807		
UK discounted welfare cost <sup>†</sup>	1.57		
<i>Abatement cost</i>	1.55		
<i>Permit trading</i>	0.18		
<i>Gains from terms of trade</i>	-0.16		
Change in welfare cost (billion US \$)	-		
EU discounted welfare cost <sup>†</sup>	1.17		

<sup>†</sup> in % of discounted household consumption

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	EU28	Hard Brexit	Third access status
UK budget (Mt CO <sub>2</sub> )	13'807	13'693	
UK discounted welfare cost <sup>†</sup>	1.57	1.65	
<i>Abatement cost</i>	1.55	1.81	
<i>Permit trading</i>	0.18	–	
<i>Gains from terms of trade</i>	-0.16	-0.16	
Change in welfare cost (billion US \$)	–	-43	
EU discounted welfare cost <sup>†</sup>	1.17	1.06	

<sup>†</sup> in % of discounted household consumption

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	EU28	Hard Brexit	Third access status
UK budget (Mt CO <sub>2</sub> )	13'807	13'693	13'693
UK discounted welfare cost <sup>†</sup>	1.57	1.65	1.63
<i>Abatement cost</i>	1.55	1.81	1.55
<i>Permit trading</i>	0.18	–	0.24
<i>Gains from terms of trade</i>	-0.16	-0.16	-0.16
Change in welfare cost (billion US \$)	–	-43	-34
EU discounted welfare cost <sup>†</sup>	1.17	1.06	1.17

<sup>†</sup> in % of discounted household consumption

- Using a meta-game approach it is possible to analyse the ESD
- With the ESD, high-income European countries pay for low-income European countries
- A hard Brexit would induce a welfare cost of UK climate policy ( $\approx$  43 billion US \$)
- A soft brexit (i.e. a “third access status”) would moderate UK cost ( $\approx$  34 billion US \$)
- Within the Brexit scenarios MSs that are net sellers of permits (new Ms) suffer from less revenue and, in contrast, net buyers experience some benefits
- Brexit will divert EC from climate policy in short and mid term
  - EC will look after the Brexit during several years
  - Brexit reinforces the leadership of Germany that accounts now for 1/4 of CO<sub>2</sub> European emissions
  - But also other countries that are less sensitive to climate policy (Eastern countries)