

# DECARBONISING POWER GENERATION - THE EFFECTIVENESS OF RENEWABLE ENERGY POLICY IN EUROPE AND LATIN AMERICA

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# OUTLINE

1. Introduction
2. Determinants of RE investments
3. Methodology and data
4. Main results
5. Final remarks



# INTRODUCTION: motivation and research objectives

- Renewable energy policy is at the heart of decarbonization strategies in both developed and developing countries
- Europe and Latin America are playing central roles in power sector decarbonization
- We evaluate policy effectiveness using a panel dataset covering 50 countries over 1995-2014

## Objectives :

- Evaluate the **effectiveness** of different **policy instruments** to promote RE investments in Europe and LA
- Analyse the influence of **energy-economic determinants**

# The determinants of renewable energy investments (I)

## 1. Support policies

Contrasting results concerning:

**Price-based instruments: FIT, FIP**

**Quantity-based instruments: RPS, tenders**

# The determinants of renewable energy investments (II)

## 2. Structure and dynamic of energy sectors:

- a) Energy mix: competition and complementarity between technologies
- b) Costs of RE and conventional energy sources and electricity prices
- c) Energy dependence
- d) Power sector dynamics: annual rate of growth of consumption rate
- e) Level of CO<sub>2</sub> emissions from fuel combustion

# The determinants of renewable energy investments (III)

## 3. Macroeconomic and institutional determinants :

- a) Income per capita
- b) Access to funding
- c) Openness to international trade ?
- d) Political and institutional determinants (governance quality including the policy framework)



# Methodology and data I: the model

Panel dataset: 1995-2014

20 countries in LA, 30 in Europe

technologies: PV, wind, biomass, geothermal

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 W_{it} + \beta_3 Z_{it} + \varepsilon_{it}$$

Method: PCSE

# Methodology and data II

Dependent variable: newly installed RE capacity per inhabitant (MW/1 million inhabitants) (Popp et al., 2011, Polzin et al., 2015)

$$\frac{(CAP_t^{i,j} - CAP_{t-1}^{i,j})}{POP_{ij}}$$

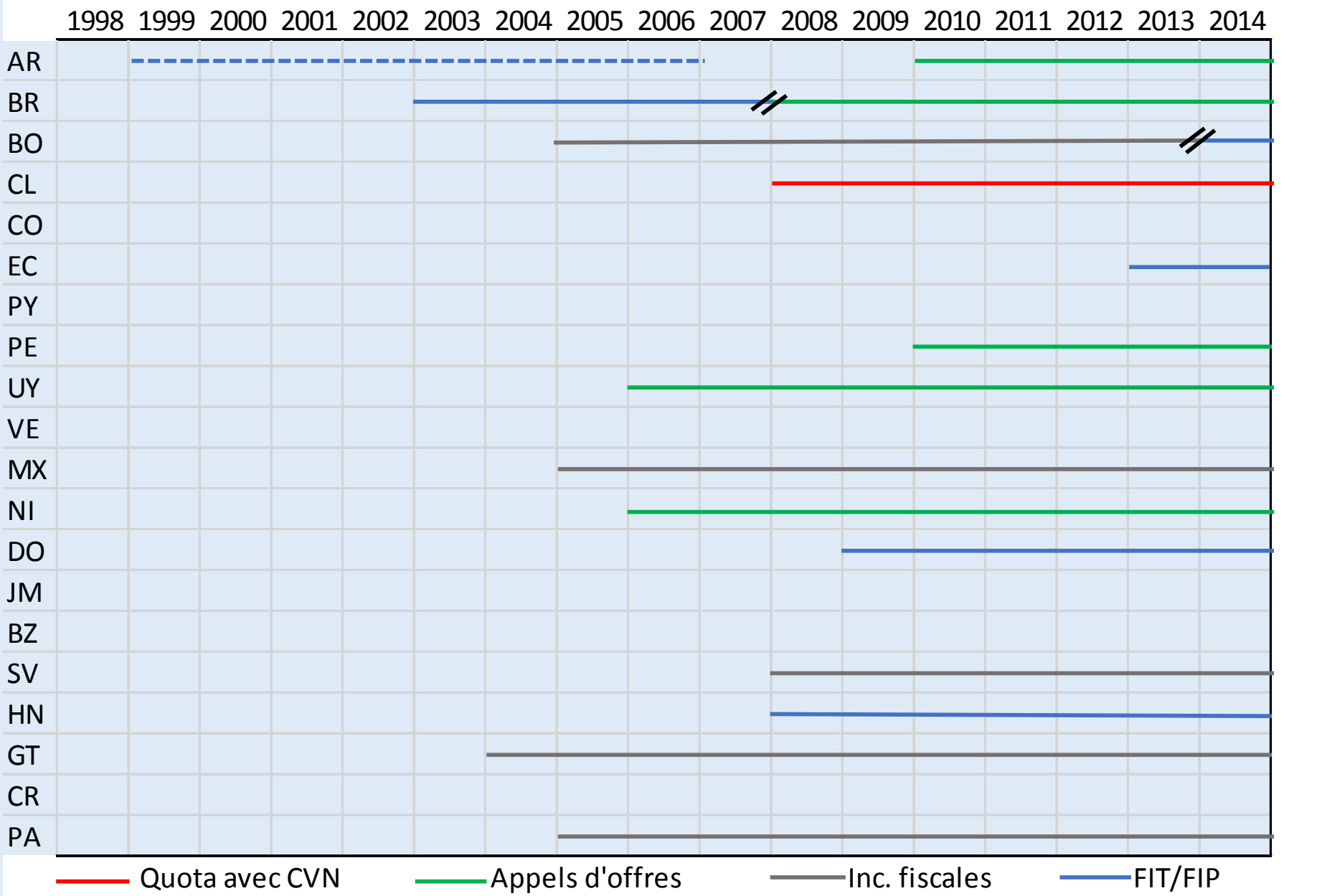
$$\forall i = 1, \dots, 20; j = 1, \dots, 4; t = 1995, \dots, 2014$$

*CAP* is total installed capacity at the end of each year;

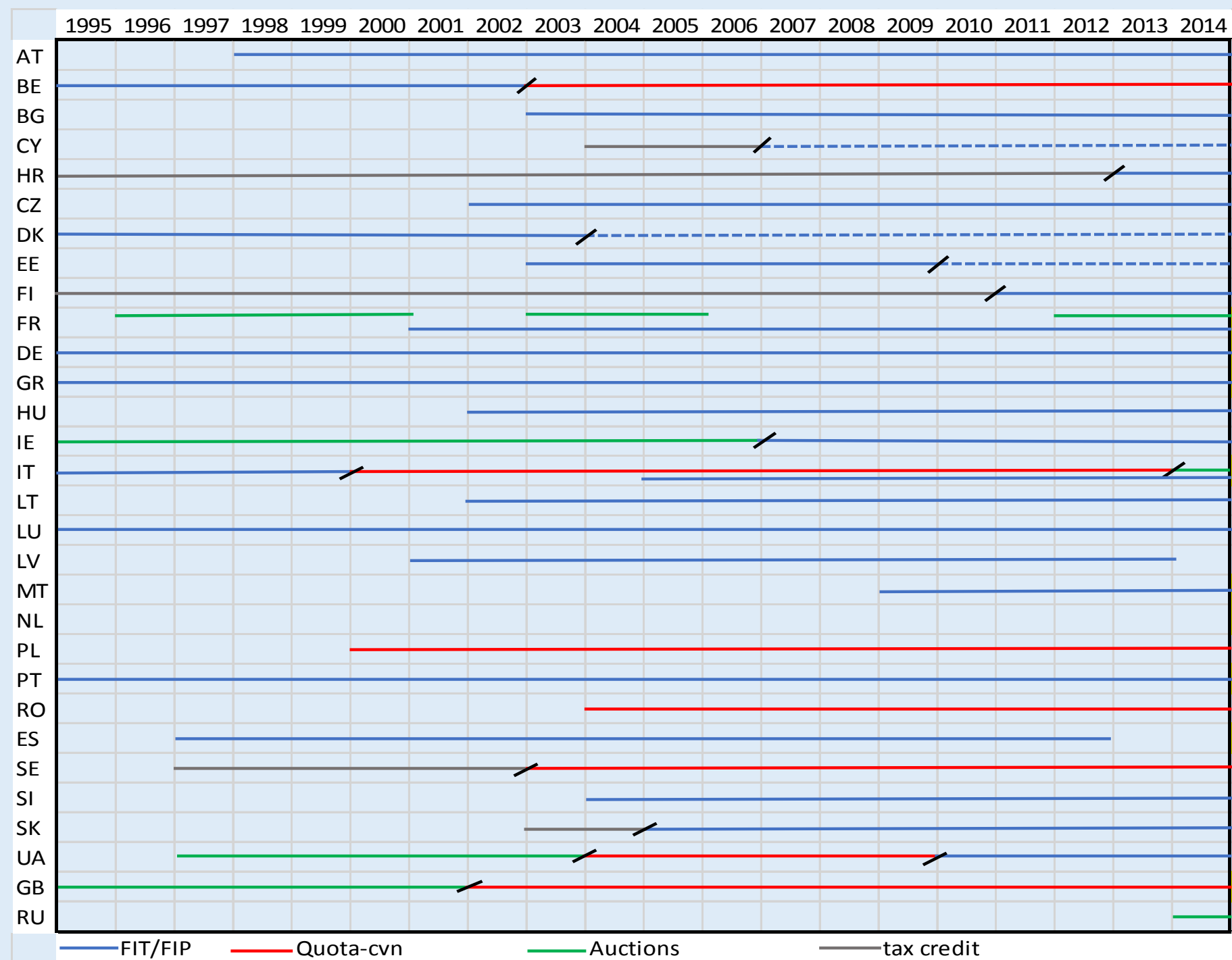
*POP* is the population.



# Methodology and data III: RE policies in LA



# Methodology and data IV: RE policies in Europe



# Methodology and data V: explanatory variables

NAME/CODE	DEFINITION/INDICATOR
Evolution of electricity demand (crois_con)*	Growth rate of electricity consumption over the last 5 years.
Share (%) of nuclear in the electricity mix (part_nuc)*	Percentage of nuclear energy, in toe, in the gross total electricity production
Share (%) of hydropower in the power mix (part_hyd)*	Percentage of hydropower, in toe, in the gross total electricity production
Energy independence rate (inde_en)*	The coverage of primary energy consumption by total domestic primary production. It measures the ability of a country to cover its energy needs and its dependence on energy imports.
CO <sub>2</sub> emissions (em_co2)*	CO <sub>2</sub> emission per inhabitant (CO <sub>2</sub> from fuel combustion) (tCO <sub>2</sub> /inhab.)
Coal production per inhabitant (charbon)*	Gross annual coal production per inhabitant (Mt/inhab)
Gas production per inhabitant (gaz)*	Gross annual gas production per inhabitant (Mm <sup>3</sup> /inhab)
Income per inhabitant (pibh)*	GDP US\$ at constant price and exchange rate (2005) per capita
Domestic credit to the private sector (as % of GDP) (credit)**	Financial resources provided to the private sector by the banking sector and other financial corporations, through loans, purchases of non-assimilated securities and commercial credits (% du PIB)

# Main results I

## Summary - global model I

Dependent variable: cap_ad						
Variables	PCSE(1)		FE(2)		RE(3)	
FIT	(+)S	**	(+)S	**	(+)S	***
CVN	(+)S	**	(+)S	***	(+)S	***
SEC	(+)NS		(+)S	**	(+)S	**
FISC	(+)NS		(+)NS		(+)NS	
Crois-con	(-)S	**	(-)S	**	(-)S	***
Part_nuc	(-)S	***	(-)S	**	(-)S	**
Part_hyd	(+)NS		(-)NS		(-)S	*
Inde_en	(+)NS	***	(+)S	*	(+)NS	
Em_co2	(-)NS		(-)S	***	(-)S	***
Charbon	(+)S	***	(+)NS		(+)S	***
Gaz	(-)S	**	(-)S	*	(-)NS	
PIBh	(+)S	***	(+)S	***	(+)S	***
Credit	(+)NS		(+)NS		(+)S	**
Observations	1000		10000		1000	

# Main results II

## Summary - Europe/LA model

	Dependent variable: cap_ad					
	Europe			Latin America		
Variables	PCSE(1)		PCSE(2)		PCSE(1)	PCSE(2)
FIT	(+)S	***	(+)S	***	(+)NS	(+)NS
CVN	(+)S	***	(+)S	***	(+)NS	(+)S *
SEC	(+)NS		(+)S	**	(+)NS	(+)S **
FISC	(+)NS		(+)NS		(-)NS	(-)NS
Crois-con	(-)S	***	(-)S	***	(-)NS	(-)NS
Part_nuc	(-)S	***	(-)S	***	(-)NS	(+)S *
Part_hyd	(-)NS	**	(-)S	***	(+)S **	(+)NS
Inde_en	(+)NS		(+)S	**	(+)S *	(+)NS
Em_co2	(-)NS		(-)S	***	(-)NS	(-)NS
Charbon	(+)S	**	(+)S	***	(-)S *	(-)NS
Gaz	(-)S	**	(-)S	***	(+)NS	(+)NS
PIBh	(+)S	**	(+)S	***	(+)S ***	(+)S ***
Credit	(+)NS		(+)NS		(+)NS	(-)NS
		600				

# Main results III

Latin America:

- Support policies: the main drivers of RE diffusion in LA (factor 5)
- Policy effect delay (3 years-lag)
- Positive impact of GDP per capita
- Positive and significant impact of auction and quota system
- Positive but not significant impact of other policy instruments
- Influence credit market development?

# Main results IV

Europe:

- Support policies: the main drivers of RE diffusion in Europe
- Policy effect delay (3 years-lag)
- Positive impact of GDP per capita
- Positive and significant impact of FIP/FIT and quota system
- Positive but not significant impact of auctions
- Negative correlation with power demand growth



# Final remarks

1. The results converge for the influence of promotion policies in general: policies have a positive and statistically significant effect on investment in RE in both Europe and LA
2. Auctions scheme appears to be the main instrument in LA but it need to be adapted to the new phases of RE deployment in each country
3. Main challenges for LA:
  - Funding
  - Grid balance
  - Cooperation and energy integration in the region

**Thank you for your attention!**

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