ENERGY POVERTY PERSISTENCE: A CROSS-COUNTRY ANALYSIS WITH A FOCUS ON GENDER

ELISENDA JOVÉ-LLOPIS

(CHAIR OF ENERGY SUSTAINABILITY, IEB, UNIVERSITAT DE BARCELONA)

JOINT WORK WITH CARLOTTA MASCIANDARO & MICHAEL MULDER
(UNIVERSITY OF GRONINGEN)

GRUPO DE INVESTIGACIÓN
PRECONSOLIDADO -2017
SGR 739

WHAT IS ENERGY POVERTY?

Energy poverty *occurs when a household cannot afford the most basic levels of energy services such as space heating, space cooling, lighting or cooking.*

First EU-wide definition was not published until as late as 2023 in its Directive (EU) 2023/1791 on energy efficiency.

Developing countries: lack of access to energy services.
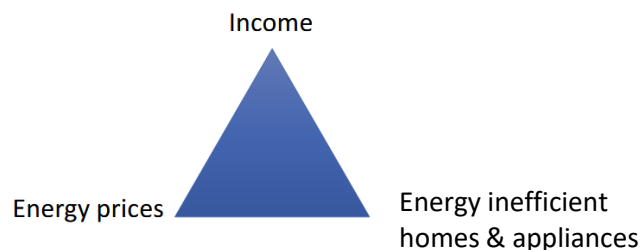Developed countries: energy affordability.
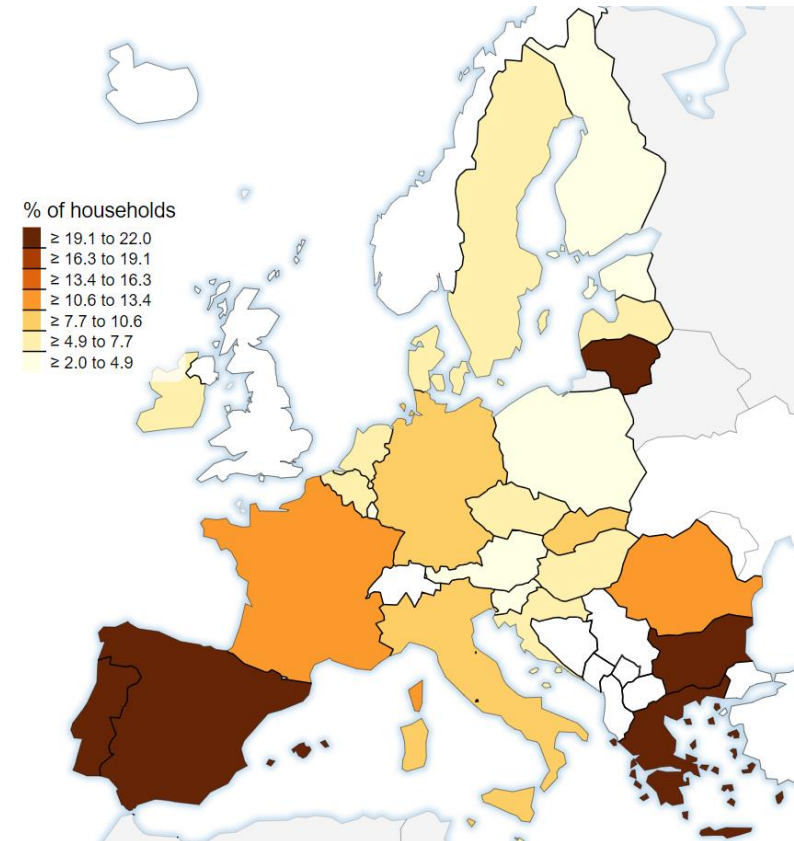
WHAT IS ENERGY POVERTY?

- It is estimated that around **42 million Europeans** are currently experiencing energy poverty (European Commission, 2023):

  - Not being able to heat or cool their homes
  - With arrears in the payment of energy bills
  - Very high energy costs /energy expenditures
  - Living in rooms with problems of humidity and mold.

Energy poverty can pose a social policy problem even in countries with mild climates.

- **Causes & effects** (Boardman, 2010)

Income

Energy prices — Energy inefficient homes & appliances

Inability to keep the home adequately warm. Population share, 2023

% of households
- ≥ 19.1 to 22.0
- ≥ 16.3 to 19.1
- ≥ 13.4 to 16.3
- ≥ 10.6 to 13.4
- ≥ 7.7 to 10.6
- ≥ 4.9 to 7.7
- ≥ 2.0 to 4.9

Negative effects on health and wellbeing (cardiovascular and respiratory problems, depression, isolation or affect the formative process).

RESPONSE TO ENERGY POVERTY

1 **Early 2000's:** energy poverty-relevant challenges acknowledged in European Union's debates.

2 **2009:** first legal recognition in the **Third Energy Package** (protection of vulnerable consumers: financial transfers/disconnection protection).

3 **2016:** addressing EP becomes a policy priority at the EU level with the **Clean Energy for all European Package** (requiring Member States to assess the extent of EP in their National Energy and Climate Plans).

4 **2018:** increased attention with different studies and reports funded by the European Commission: **EU Energy Poverty Observatory.**

5 **2019: European Green Deal** (Supplying clean, affordable and secure energy - Building and renovating in an energy and resource efficient way).

6 **2020: Renovation Wave for Europe** (tacking EP and worst performing buildings). **Energy poverty recommendation** (EU)2020/1563: provide guidance on the indicators for measuring EP, best actions, etc.

7 **2021: Fit for 55 Package** & **EU Energy Poverty Advisory Hub & Energy Prices Toolbox** (eradicate EP & accelerate the just energy transition of European local governments).

8 **2022: REPower EU** & **Commission Energy Poverty and Vulnerable Consumers Coordination Group** (EU 2022/589).

9 **2023: Revised Energy Efficiency Directive** (EU 2023/1791) & **EU Recommendantion and guidance on EP (**EU 2023/ 2407).

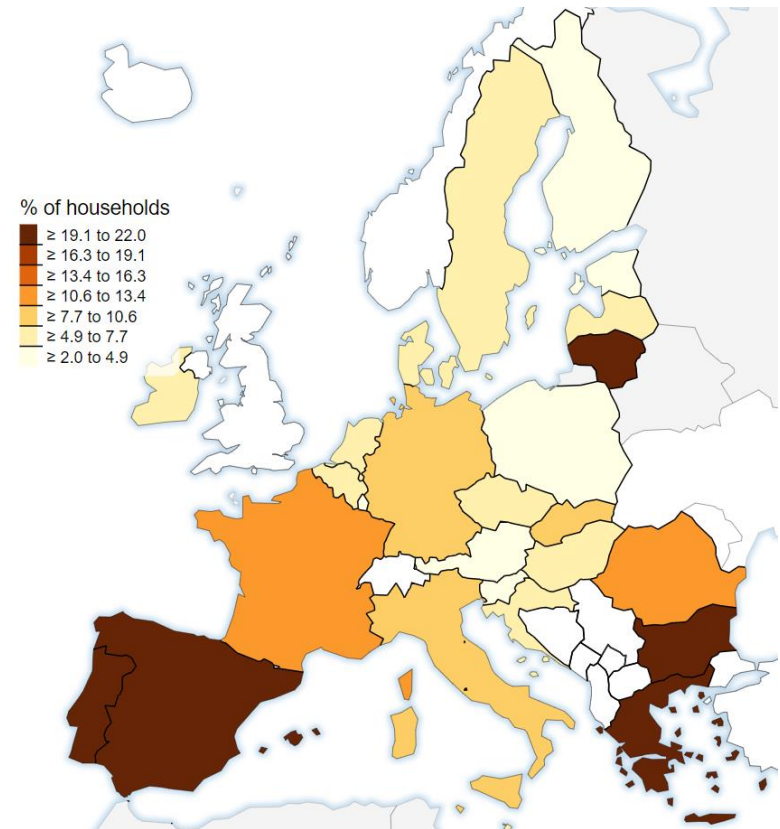## WHY DO THE DYNAMICS OF ENERGY POVERTY MATTER?

- Snapshots of who experiences energy poverty during a particular period (cross-sectional or current energy poverty) provide an incomplete picture of the prevalence of poverty within a population.

- Knowing that 10.6% of the European population is energy poor in a given year (2023) leaves open the question of whether energy poverty for these individuals is a **persistent** or **transitory** phenomenon.

- Therefore, the **persistent or long-term proportion** of energy poverty deserves more attention than the transitory proportion.

- Chronic and transitory energy poverty require **different policy actions** to address them effectively.

Static vs. Dynamic

Inability to keep the home adequately warm. Population share, 2023

% of households
≥ 19.1 to 22.0
≥ 16.3 to 19.1
≥ 13.4 to 16.3
≥ 10.6 to 13.4
≥ 7.7 to 10.6
≥ 4.9 to 7.7
≥ 2.0 to 4.9

Source: Eurostat | EU-SILC survey

AIM OF THE STUDY

Measure the incidence of the energy poverty
1) *Is energy poverty persistent over time, and if so, to what extent?*

2) Are the drivers of transient and chronic energy poverty similar or different?

ORIGINALITY OF THE PAPER

➢ We still have a limited understanding of the determinants of EP and the results are not conclusive (Healy & Clinch, 2004; Legendre & Ricci, 2015; Belaïd, 2018; Burguillo et al., 2024). Earlier studies have been mainly based on cross-sectional samples, not addressing the dynamics of EP.

➢ We use high-quality **panel data (European Union Statistics on Income and Living Conditions)** to provide new evidence on the persistence and dynamics of EP.

- in **two countries (Spain and The Netherlands)** with distinct trajectories. → *Are these dynamics different between the two countries?*
- focus on the role of **gender** → *What is the role of gender in the dynamics of energy poverty and is this role different between the two countries?*
- To account for the multi-dimensional nature of EP, we employ **different energy poverty indicators**

1. CONTEXT & RELEVANCE

Spain

- Country with the highest incidence rate
- 2023: **Spain 20.8% vs EU27 10.6%** (warm indicator)
- Significant experience in addressing energy poverty

1 **2009:** the first **social bonus for electricity** entered into force (energy bill support).

2 **2018**: **social bonus for heating** (energy bill support).

3 **2019: National Strategy against Energy Poverty** 2019-2024.

4 **2020: Housing renovation programme: PREE.** Programa de Rehabilitación Energética de Edificios (for the first time this program introduces special support for vulnerable groups affected by energy poverty).

5 Measures to tackle the **Covid-19** outbreak impact & **high energy prices** (disconnection protections & energy bill support).

Netherlands

- Historically low energy poverty until the recent crisis
- 2023: **Netherlands 7.1% vs EU27 10.6%** (warm)
- Limited policy and academic focus on the issue

1 2022: a 3-year **research program** started with the aim to help municipal and provincial governments tackle energy poverty.

2 2023: the first **monitor of energy poverty** was issued by the national statistics institute (CBS).

3 Most Dutch policy actions against energy poverty have been implemented to counteract the **effects of the energy crisis**, such as direct transfers and a price cap for retail consumers.

- Country with the highest incidence rate (2023)
- Significant experience in addressing energy poverty

- Historically low energy poverty until the recent crisis
- Limited policy and academic focus on the issue

	Spain	The Netherlands
Characteristics		
Macroeconomic		
Real GDP per capita (€, 2023)	25,730	46,240
Total population (1,000 persons, 2023)	48,382	17,877
Unemployment (% of labor force, 2023)	4.30	0.50
Persons at risk of poverty (%, 2023)	26.50	15.80
Energy poverty		
Heating Degree Days (2023)	1,481.64	2,318.86
Cooling Degree Days (2023)	338.23	10.86
Electricity prices for households (€/kWh, 2023)	0.24	0.31
People whose dwelling had energy efficiency improvements in the last 5 years (%, 2023)	14.60	58.50
Inability to keep home adequately warm (% of population, 2023)	20.80	7.10
Gender (In)equality		
Women unemployment (% of labor force, 2023)	5.10	0.50
Men unemployment (% of labor force, 2023)	3.60	0.40
Gender pay gap (% of avg. hourly men's earnings, 2022)	8.70	13.00
Energy poverty policy		
Current situation		
Definition of energy poverty	Yes	No
National strategy against energy poverty	Yes	No
National observatory for energy poverty	No	Yes
Explicit objective for the reduction of energy poverty	Yes	No
Aggregation level of governance	National	Municipal
National Energy and Climate Plans (2021-2030)		
Number of times "energy poverty" appears	102	62
Number of times "vulnerable consumer/household" appears	31	12
Mention of hidden energy poverty	Yes	No
Number of times "gender/women/female" appears	127	4

3. LITERATURE REVIEW

ENERGY POVERTY

Discussions on the **concept and metrics** of the energy poverty (Boardman, 1991, Moore 2012; Romero, Linares, and López 2018; Tirado Herrero 2017).
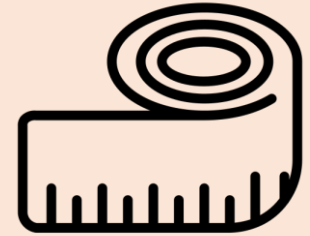
Identification of the **drivers** behind the energy poverty (Legendre and Ricci, 2015; Burguillo et al., 2024; Buzar, 2016; Costa-Campi, M.T. et al., 2020).
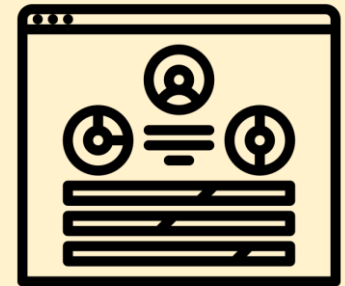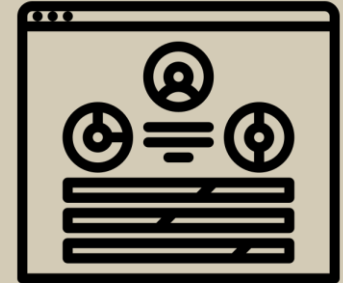
Evaluation the scope of **public policies** aimed at reducing energy poverty. Single policy approach (García and Tol, 2021; Barrella, R. et al., 2021; McCoy and Kotsch, 2021; Jové-Llopis and Trujillo-Baute, 2024).

ENERGY POVERTY

Identification of the **drivers** behind the energy poverty (Legendre and Ricci, 2015; Buzar, 2016; Costa-Campi, M.T. et al., 2020; Burguillo et al., 2024).

Socio-economic characteristics of the household
-Household composition
-Labour status
-Education level, etc.

Dwelling characteristics
-House type
-Number of rooms
-Age of the property, etc.

Climate factors
-Heating or cooling degree days

ENERGY POVERTY

What is currently known about the persistence of energy poverty?

- *Is energy poverty a persistent or transient issue?*

GLOBAL

- Alem & Demeke (2020). Ethiopia (2009 -09)→ strong state dependence in EP

- Vera- Toscano (2022). Australia (2001- 2017) → most individuals in Australia never experience EP, and those who do, experience it only temporarily

EUROPEAN UNION

Dresden & Janzens (2021). **Germany** (2013 -19) → strong evidence of state dependence effects in EP. EP persistence ranges between 3.3% and 7.5%

Karpinska & Smiech (2021). **Poland** (2014 -17) →The probability of remaining in EP is 37%

Halkos & Kostakis (2023). **Greece** (2017 -20) → energy-poor household today is up to 10–12% more likely to face EP tomorrow, confirming poverty persistence

The analysis is based on:

✓ **European Union Statistics on Income and Living Conditions (EU-SILC): data on a wide variety of socioeconomic variables and housing conditions.**

✓ **Energy poverty:**

- **Warmth**, which is a dummy variable that is one if the household is unable to keep the home adequately warm
- **Arrears** is a dummy variable that is one if the household has arrears on utility bills
- **Damp** is a dummy variable that is one if the household lives in a dwelling with leaks, damp, or rot

Spanish and Dutch households

2005-2023

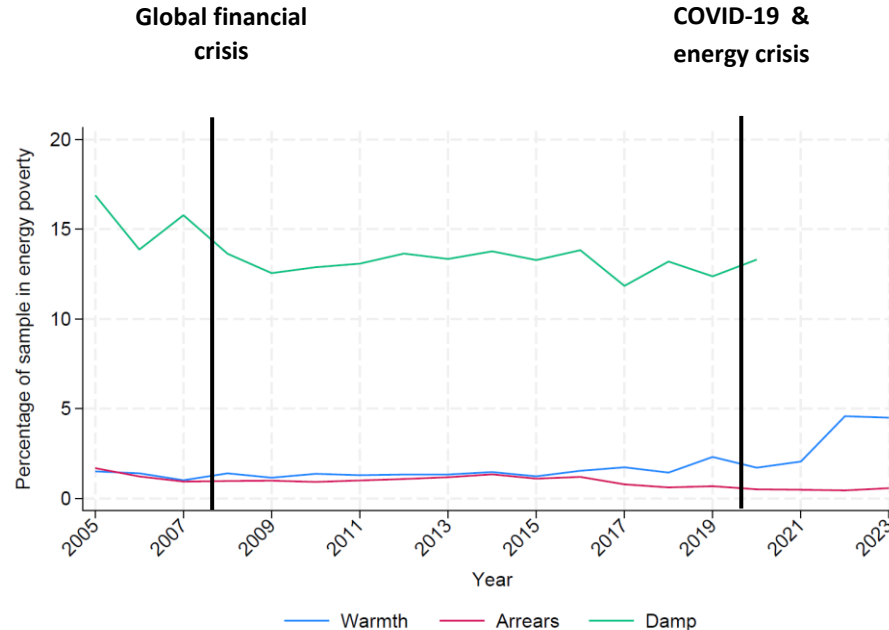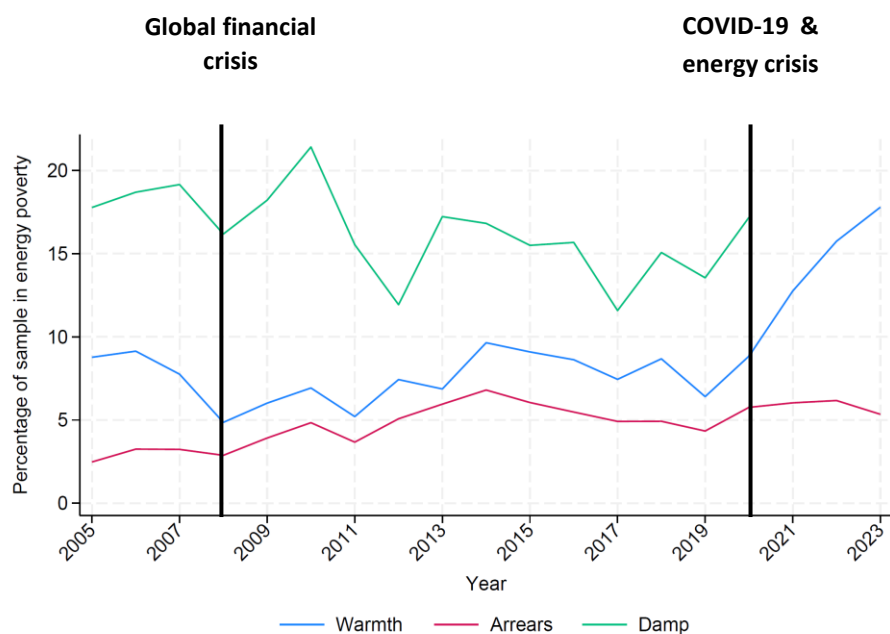**A total of 204,576 Spanish and Dutch households are analyzed**

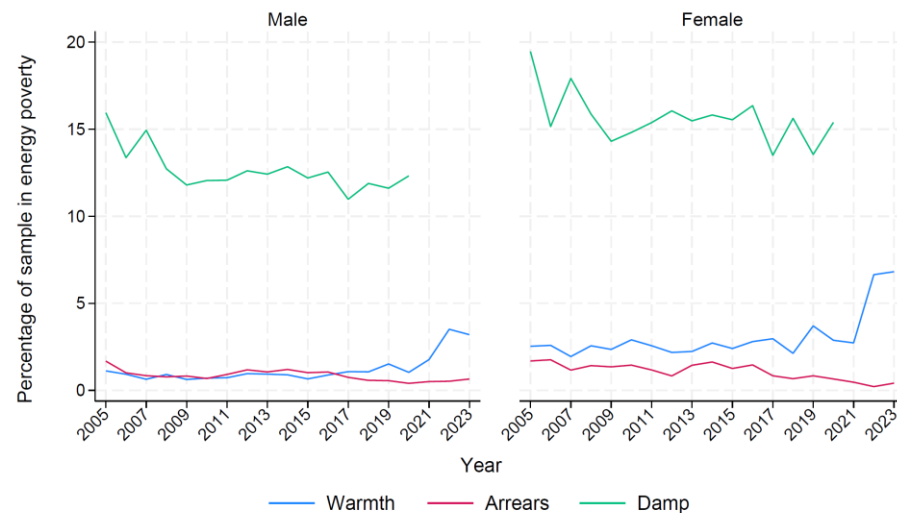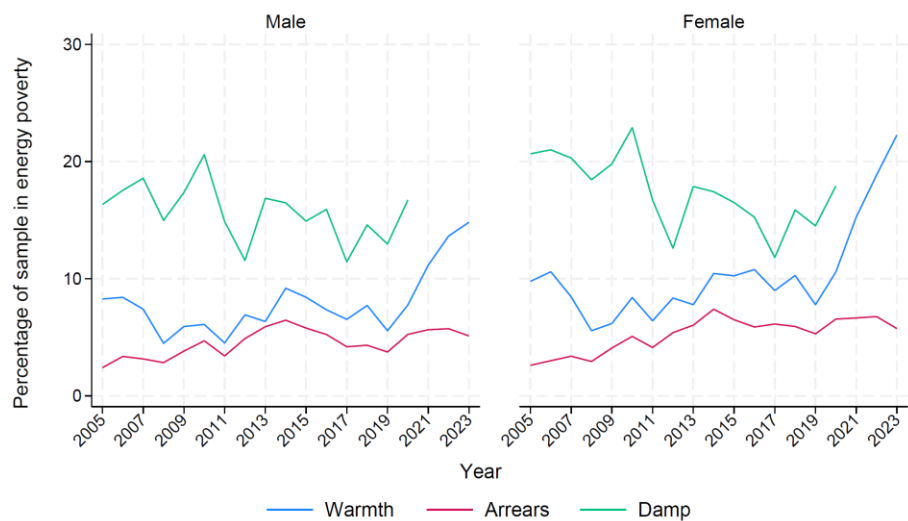**Figure. Average trend in energy poverty intensity by country**

Figure. Average trend in energy poverty intensity by country and gender

DYNAMIC PROBIT MODEL

$$\text{energy poverty}_{it}^* = \beta \ \text{energy poverty}_{it-1} + \delta \ X_{it} + \alpha_i + \varepsilon_{it}$$

$$\text{energy poverty}_{it} = 1 \ if \ \text{energy poverty}_{it}^* > 0, \qquad 0 \ otherwise$$

$$\alpha_i = \delta_0 + \delta_1 pobreza \ energética_{i0} + \ \delta_2 \ \bar{X}_i + \ \delta_3 \ X_{i0} + \mu_i$$

Eq [1]

Eq [2]

Eq [3]

- Treatment of unobserved individual effects: random effects specification
- Initial conditions problem: unobserved individual effects are correlated only with the initial values of dependent variable.

  (Wooldridge, 2005; Ryamond et al., 2010)

DEPENDENT VARIABLES

Energy poverty: 3 indicators

- **Warmth:** dummy variable that is 1 if the household is unable to keep the home adequately warm
- **Arrears**: dummy variable that is 1 if the household has arrears on utility bills
- **Damp**: dummy variable that is 1 if the household lives in a dwelling with leaks, damp, or rot

INDEPENDENT VARIABLES

Sociodemographic characteristics of the household: household size, gender (female), marital status (married)

Economic characteristics of the household: income, employment status, education level (highly educated)

Dwelling characteristics: Apartment building, Number of rooms, housing tenure (tenant)

5. RESULTS

Table. Drivers of energy poverty: average marginal effects (whole sample)

	Warmth		Arrears		Damp	
	Exogenous initial conditions	Correlated with initial conditions	Exogenous initial conditions	Correlated with initial conditions	Exogenous initial conditions	Correlated with initial conditions
Energy poverty $t-1$	0.115***	0.032***	0.201***	0.028***	0.352***	0.107***
	(0.007)	(0.003)	(0.012)	(0.003)	(0.008)	(0.005)
Initial conditions		0.0834***		0.122***		0.200***
Energy poverty		(0.004)		(0.007)		(0.005)
Sociodemographic characteristics of the household						
Size	0.004***	0.004***	0.006***	0.006***	0.007***	0.007***
	(0.0005)	(0.0005)	(0.0003)	(0.0004)	(0.0008)	(0.001)
Female	0.004***	0.004***	0.002***	0.002**	0.007***	0.007***
	(0.001)	(0.001)	(0.0009)	(0.001)	(0.001)	(0.002)
Married	0.016***	0.015***	0.011***	0.0113***	0.027***	0.028***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Economic characteristics of the household						
Income (logs)	-0.004***	-0.004***	-0.003***	-0.002***	-0.007***	-0.006***
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0007)	(0.0008)
Highly educated	-0.016***	-0.016***	-0.012***	-0.012***	0.002	0.003
	(0.001)	(0.001)	(0.0008)	(0.0008)	(0.001)	(0.002)
Employed	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Unemployed	0.045***	0.0422***	0.0272***	0.0236***	0.0267***	0.0265***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Retired	0.012***	0.012***	-0.010***	-0.010***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.0009)	(0.001)	(0.002)	(0.002)
Disabled	0.049***	0.044***	0.018***	0.015***	0.039***	0.039***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.005)	(0.005)
Student	0.001	0.001	-0.003	-0.002	0.009	0.011
	(0.004)	(0.004)	(0.003)	(0.003)	(0.008)	(0.009)
Domestic Tasks	0.020***	0.019***	-0.0059***	-0.005***	-0.002	-0.003
	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.004)
Other activities	0.040***	0.038***	0.003	0.003	-0.0008	0.002
	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)
Dwelling characteristics						
Rooms	-0.005***	-0.005***	-0.005***	-0.004***	-0.006***	-0.006***
	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.0009)	(0.0009)
Tenant	0.030***	0.029***	0.016***	0.0162***	0.044***	0.045***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Flat	-0.012***	-0.012***	-0.0001	-0.0003	-0.066***	-0.066***
	(0.001)	(0.001)	(0.0008)	(0.0009)	(0.002)	(0.002)
Country: NL	-0.054***	-0.054***	-0.024***	-0.025***	-0.044***	-0.046***
	(0.001)	(0.001)	(0.0009)	(0.0009)	(0.0021)	(0.002)
Observations			153432			

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010. Estimations control for time dummies.

Table. Drivers of energy poverty: average marginal effects (whole sample)

| | Warmth | | Arrears | | Damp | |
	Exogenous initial conditions	Correlated with initial conditions	Exogenous initial conditions	Correlated with initial conditions	Exogenous initial conditions	Correlated with initial conditions
Energy poverty t-1	0.115***	0.032***	0.201***	0.028***	0.352***	0.107***
	(0.007)	(0.003)	(0.012)	(0.003)	(0.008)	(0.005)
Initial conditions Energy poverty		0.0834***		0.122***		0.200***
		(0.004)		(0.007)		(0.005)
Sociodemographic characteristics of the household						
Size	0.004***	0.004***	0.006***	0.006***	0.007***	0.007***
	(0.0005)	(0.0005)	(0.0003)	(0.0004)	(0.0008)	(0.001)
Female	0.004***	0.004***	0.002***	0.002**	0.007***	0.007***
	(0.001)	(0.001)	(0.0009)	(0.001)	(0.001)	(0.002)
Married	0.016***	0.015***	0.011***	0.0113***	0.027***	0.028***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Economic characteristics of the household						
Income (logs)						
Highly educat…						
Employed						
Unemployed						
Retired						
Disabled						
Student						
Domestic Tas…						
Other activiti…						
Dwelling char…						
Rooms						
Tenant						
Flat						
Country: NL	-0.054***	-0.054***	-0.024***	-0.025***	-0.044***	-0.046***
	(0.001)	(0.001)	(0.0009)	(0.0009)	(0.0021)	(0.002)
Observations			153432			

**Is energy poverty persistent at household level?
Is this true for all types of energy poverty?**

✓ We find **genuine state dependence** effects in energy poverty.

✓ Facing energy poverty in one period **significantly increases** the probability of being energy poor in the subsequent period.

✓ The probability of being energy poor increase by **3.2%, 2.8%, and 10.7%**, depending on the EP indicator, if the household was energy poor in the previous period.

**Energy poverty persistence:
A cross-country analysis with a focus on gender
(average marginal effects)**
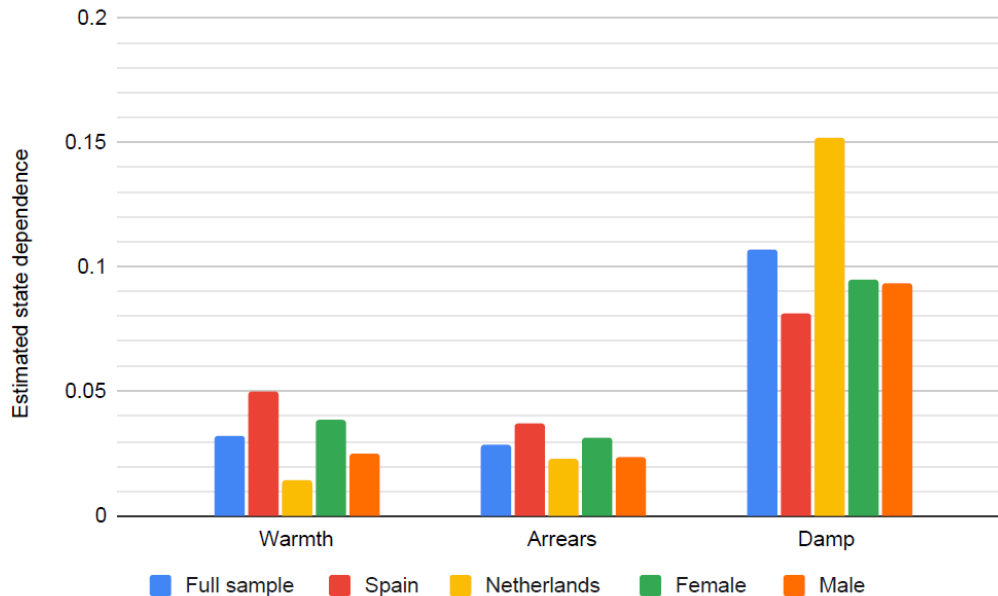
Does the degree of persistence remain the same or differ between different types of countries and by gender?

✓ When it comes to the magnitude of such true state dependency, Spanish households show a higher degree of persistence than Dutch households, except for the Damp EP indicator

✓ If the main earner is a woman, the level of persistence is higher

5. RESULTS

Table. Drivers of energy poverty: average marginal effects (whole sample). Correlated with initial conditions

	Warmth	Arrears	Damp
Energy poverty *t-1*	0.032***	0.028***	0.107***
	(0.003)	(0.003)	(0.005)
Initial conditions	0.0834***	0.122***	0.200***
Energy poverty	(0.004)	(0.007)	(0.005)
Sociodemographic characteristics of the household			
Size	0.004***	0.006***	0.007***
	(0.0005)	(0.0004)	(0.001)
Female	0.004***	0.002**	0.007***
	(0.001)	(0.001)	(0.002)
Married	0.015***	0.0113***	0.028***
	(0.001)	(0.001)	(0.002)
Economic characteristics of the household			
Income (logs)	-0.004***	-0.002***	-0.006***
	(0.0003)	(0.0002)	(0.0008)
Highly educated	-0.016***	-0.012***	0.003
	(0.001)	(0.0008)	(0.002)
Employed	Ref.	Ref.	Ref.
Unemployed	0.0422***	0.0236***	0.0265***
	(0.002)	(0.002)	(0.004)
Retired	0.012***	-0.010***	-0.007***
	(0.001)	(0.001)	(0.002)
Disabled	0.044***	0.015***	0.039***
	(0.003)	(0.002)	(0.005)
Student	0.001	-0.002	0.011
	(0.004)	(0.003)	(0.009)
Domestic Tasks	0.019***	-0.005***	-0.003
	(0.002)	(0.001)	(0.004)
Other activities	0.038***	0.003	0.002
	(0.004)	(0.002)	(0.005)
Dwelling characteristics			
Rooms	-0.005***	-0.004***	-0.006***
	(0.0005)	(0.0004)	(0.0009)
Tenant	0.029***	0.0162***	0.045***
	(0.001)	(0.001)	(0.002)
Flat	-0.012***	-0.0003	-0.066***
	(0.001)	(0.0009)	(0.002)
Country: NL	-0.054***	-0.025***	-0.046***
	(0.001)	(0.0009)	(0.002)

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010. Estimations control for time dummies.

Socioeconomic, demographic and dwelling characteristics are significant predictors of energy poverty:

➢ **Higher income** status is negatively related to energy poverty

➢ The likelihood of facing energy poverty is decreasing with higher levels of **education**.

➢ Being **non-working** increases the probability of energy poverty.

➢ Regarding dwelling characteristics, living in **blocks of flats** experience a lower probability of facing energy poverty.

PRELIMINARY RESULTS!

1 Experience of energy poverty per se raises the chances of facing energy poverty in the future → there is evidence of **state dependence**. In general, energy poverty is m**ore persistent among Spanish households** than Dutch households, and among **women** compared to men.
- ✓ Household-level characteristics and dwelling that are associated with the experience of energy poverty.
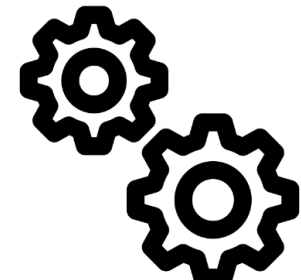
2 Policies must be **tailored** to address the distinct needs of **chronic vs. transient** energy-poor households (break the energy poverty trap):
- ✓ **Short-term measures**, such as energy vouchers, can provide immediate relief to reduce energy poverty, but they are not sufficient for lasting impact.
- ✓ **Long-term measures**, like promoting energy-efficient housing, are essential to permanently lift households out of energy poverty and ensure sustainable energy access.

WORK IN PROGRESS....

- ✓ Continue with characterization & driver analysis ….
- ✓ Are the drivers of transient and chronic energy poverty similar or different?

Many thanks for your attention!