Energy Efficiency Investments in the Context of Split Incentives Among French Households

Dorothée Charlier – Université de Montpellier
UMR ART-DEV
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Context

- Residential sector offers considerable potential to reduce energy uses
- Share of Tenants in Europe: 56.1% in Switzerland, 46.7% in Germany, 36.3% in France (Source: Eurostat 2013)
- Renters are often poorer than homeowners and spend an important share of their income on energy cost ➔ "fuel poverty".
- On average, 75% of households who decide to make energy-savings investments are homeowners.
- 62% of homeowners who report cold problems in their housing units replace their equipment against only 32% of tenants

Tenants

Have to pay a large amount of energy + do not invest in energy efficiency systems

➔ **What factor is responsible for underinvestment: income, occupancy status, energy expenditures?**

Context

- Between 2005 and 2008, 4.2 million principal residences in France received tax credits, equivalent to a total public cost of €7.8 billion.
- The corresponding cost between 2009 and 2010 was €4.2 billion.
- Considering the maintaining of tax credits, evaluating the effect of the tax credit scheme on energy efficiency investment decisions should be a topmost priority.
- Not only have few studies examined the effect of tax credits, but the results that exist diverge (Hasset and Metcalf, 1995; Mauroux, 2012; Nauleau, 2014; Pon and Alberini, 2012).
- Moreover, previous analyses have mainly focused on homeowners and have not considered the split incentive context.

➔ **the effectiveness of tax credits, especially in the context of split incentives?**

Objectives

- Studies on the split incentives problem are in limited number and energy use may be affected by the existence of split incentives (Levinson and Niemann ,2004; Murthishaw and Sathaye, 2006; IEA, 2007)
- Split incentives is also responsible for underinvestment in energy efficiency system (Diaz Rayney and Ashton, 2009; Davis, 2010; Gillingham et al. , 2012)
- Not public policy for the split incentives problem➔ But the existence of split incentives (market failure) justifies government intervention.

What solutions?

2 main objectives:

1/ Analyze expenditures in different type of investments (energy efficiency and reparation) according to occupancy status (owner-occupied vs rented-occupied dwelling)
2/ Provide policy recommendations

Data and descriptive statistics

« *Enquête Logement 2006* » (INSEE) and OPEN data:
- Dwelling ;Household ; Geographical situation;
- Renovation works (repair and energy efficiency)

According to the literature: take into account **potential energy savings** ?

ESTIMATION OF ENERGY EXPENDITURES USING PROMODUL

Theoretical expenditures

1/ The dwelling stock is divided into several categories according to the climate area, the period of contruction, the main fuel used for heating and hot water…

2/ Simulation of energy expenditures before renovation works

3/ Simulation of energy expenditures after renovation works (8 types)

➔ 2160 categories

Possibility to estimate GHG emissions savings with the same method

Data and descriptive statistics

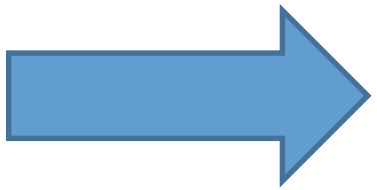
The final sample contains 16,111 households.

Distinction between renovation works and energy efficiency works, why ?

- In 2006, only 4.25% of households undertake energy-saving renovations against 14% for repair works.
- They spent 6232 euros on average for energy saving works and 6228 for repair works.
- 75% of households who decide to make energy-savings investments are homeowners (i.e owner-occupied dwellings).
- Different result for repair works 45% are tenants

Data and descriptive statistics

The annual disposable income of French households in 2010 was
- €43,700 for homeowners,
- €27,000 for tenants living in private housing, and
- €22,000 for tenants living in public housing (Commissariat Géneral du Développement Durable, 2012)



Label distribution (%) according to occupancy status.

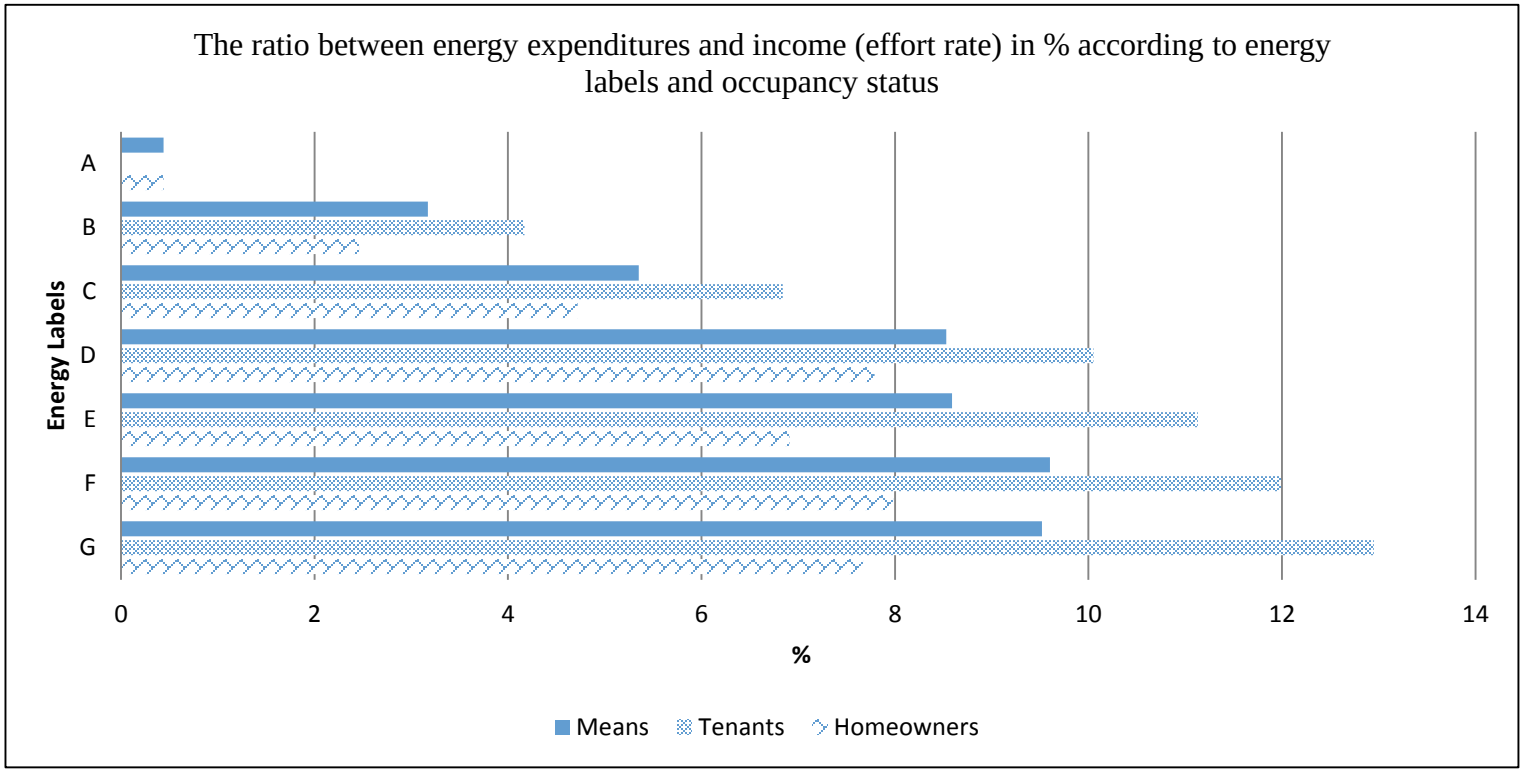
	Energy Label			Climate Label		
Label	Total	Homeowner	Tenant	Total	Homeowner	Tenant
A	0.01	0.01	0	0.70	0.96	0.40
B	8.06	8.75	7.25	6.37	7.31	5.28
C	27.52	29.23	25.53	21.52	22.51	20.37
D	25.33	23.83	27.08	30.82	30.8	30.86
E	20.07	12	20.17	19.11	19.17	19.04
F	12.04	11.54	12.62	14.41	12.93	16.13
G	6.97	6.65	7.35	7.06	6.33	7.92
Total	100.00	100.00	100.00	100.00	100.00	100.00

Data and descriptive statistics

	Energy Label			Climate Label		
Label	Total	Landlord	Tenant	Total	Landlord	Tenant
A	35655	38018	26127	30694	32018	27034
B	34964	26083	32788	30043	33560	24368
C	31547	34662	26930	28295	32178	23293
D	28198	31786	24357	28263	32110	23785
E	25207	28420	22581	28043	31665	22696
F	16105	19017	14416	26336	30231	25463
G	20148	25645	15497	29292	33400	15497
Mean	28153	31984	23687	28153	31984	23687

➔ the wealthiest households lived in the most energy-efficient and climate-efficient homes

Data and descriptive statistics



Effort rate ➔ a measure of fuel poverty (Boardman, 2010)
Effort rate = (income/ energy expenditures)x 100

9.51% of households in a situation of fuel poverty are tenants against 6.15% that are landlords.

Data and descriptive statistics

	Energy efficiency works		Repair works	
	Expenditures	Number of observations	Expenditures	Number of observations
Owner-occupied	6237	***517***	5886	*1281*
Rented-occupied	5185	***168***	6658	*1020*
Total	6232	*685*	6228	*2301*

•75% of households that decided to make energy-savings investments were homeowners, whereas only 56% of repair works were undertaken in owner-occupied dwellings.

Data and descriptive statistics

Energy Label	Homeowners	Tenants	Mean
Average energy expenditures for households who invested in energy-efficiency systems (in Euros)			
A	0	0	0
B	544	391	526
C	823	925	849
D	1230	1412	1282
E	1237	1362	1271
F	1473	2002	1570
G	1348	1052	1274

Data and descriptive statistics

Energy Label	Homeowners	Tenants	Mean
Theoretical energy savings in euros according to occupancy status (in Euros)			
A	0	0	0
B	38,4	29,5	37,4
C	41,9	39,8	41,4
D	36,7	30,8	35
E	32	37,7	33,6
F	61,4	61,9	61,5
G	50,7	53,8	51,5
Theoretical GHG emissions savings in kg.CO_2 according to occupancy status			
A	0	0	0
B	20,8	10,1	19,5
C	19,29	14,45	18,1
D	25,58	13,03	22
E	21,86	19,75	21,3
F	21,53	23,14	21,8
G	19,02	9,72	16,7

Data and descriptive statistics

And about public policies ?

- In 2006, 3 measures existed: the income tax deduction, the zero rate bank loan and the subsidies
- The policy measures are mainly dedicated to landlords and to homeowners.
- 78.8% of households who undertake energy-saving renovation do not benefit from public policy
- 13.43% benefit from a tax credit, 4% from a subsidy and 3.8% from the zero rate bank loan.
- 7.7% of tenants who invest in energy saving system benefit from the income tax deduction against 15.8% for homeowners
- Generally, very few tenants benefit from a public policy.

Variables

Socio-economic characteristics of households
- Income (quintile)
- Tenure
- Age
- Effort Rate (separate estimations)

Dwelling characteristics
- Period of construction
- Climate area
- Type of heating
- Surface
- Main fuel (gaz, oil, electricity)

Renovation works characteristics
Potential Energy Savings
Number of works

Public policy
Tax credit

Renovation works expenditures

Energy efficiency works

Repair works

Model

The decision to invest in energy efficiency system

Main objective: to identify the determinants of energy-saving investments

- **Censoring ?**

Significant proportion of households with zero expenditures

- **Interdependance ?**

Possible interdependence across two expenditures types: repair works and energy-saving works

Censoring + interdependence → Multivariate Tobit (Amemiya, 1974 ; Maddala, 1983)

Results: decision to invest with energy savings

Energy efficiency expenditures	Repair works expenditures
Socio-economic characteristics of households	
Homeowner (+) Age (+) Age*Homeowner (-)	•Income quintile 1 and 2 (-) •Homeowner (+) •Age*Homeowner (-)
Dwelling characteristics	
Cold climate area (+) Surface (+) (non linear effect ↘) Gas (+) Oil (+)	•Period of construction (all periods before 2001) (-) •Individual housing units (+) •Surface (+) (non linear effect -)
Renovation works characteristics	
Potential Energy Savings (+) Number of works (+) (non linear effect ↘)	Number of works (+) (non linear effect ↘)
Public policy	
Tax credit ➔no effect	

A €1 increase in potential energy savings led to a 5.54% increase in energy efficiency expenditures

Results: decision to invest with effort rate

Energy efficiency expenditures	Repair works expenditures
Socio-economic characteristics of households	
Effort rate (+) (non linear effect ↘) Homeowner (+) Age (+) Age*Homeowner (-)	•Income quintile 1 and 2 (-) •Homeowner (+) •Age*Homeowner (-)
Dwelling characteristics	
	•Period of construction (all periods before 2001) (-)
Public policy	
Tax credit ➔no effect	

Summary of main results

- Energy efficiency expenditures higher in owner-occupied dwelling
- Tenants are poorer than homeowners and have to pay a large amount of energy expenditures ➔ fuel poverty
- Underinvestment in collective building with collective heating system
- Income effect only in owner-occupied dwelling ➔ problem of occupancy status in rented occupied-dwelling
- No effect of the tax credit ➔ efficiency ?
- Positive effect on potential energy savings ➔ information campaign
- Positive effect of the effort rate but at a decreasing rate ➔ problem for low income households

What solutions ?

Conclusion and policy recommandations

Proposals	Benefits	Limitations
Mandatory measures to retrofit buildings and to improve energy efficiency	• Bonus on the housing market value • Bonus on the housing rental value • Energy savings • Less dependence on rising energy prices	• Direct or indirect rebound effect (rising energy consumption) • Expenditures and maintenance cost • Indirect costs or disturbance costs • Possible rent increase
Third-party investment with Energy Performance contract and "warm rents"	• Bonus on the housing market value • Bonus on the housing rental value • Energy savings • Less dependence on rising energy prices • Relief landlords/tenants of the burden of debt • Avoid a rent increase in a short term	• Direct or indirect rebound effect (rising energy consumption) • Negotiation between the tenant and the landlord • Indirect costs or disturbance costs
Individualization of heating systems and direct metering in collective buildings with collective heating systems	• Provide information on the energy cost • Easier for EE decision making	• Expenditures cost • Indirect costs or disturbance costs

Thank you for your attention

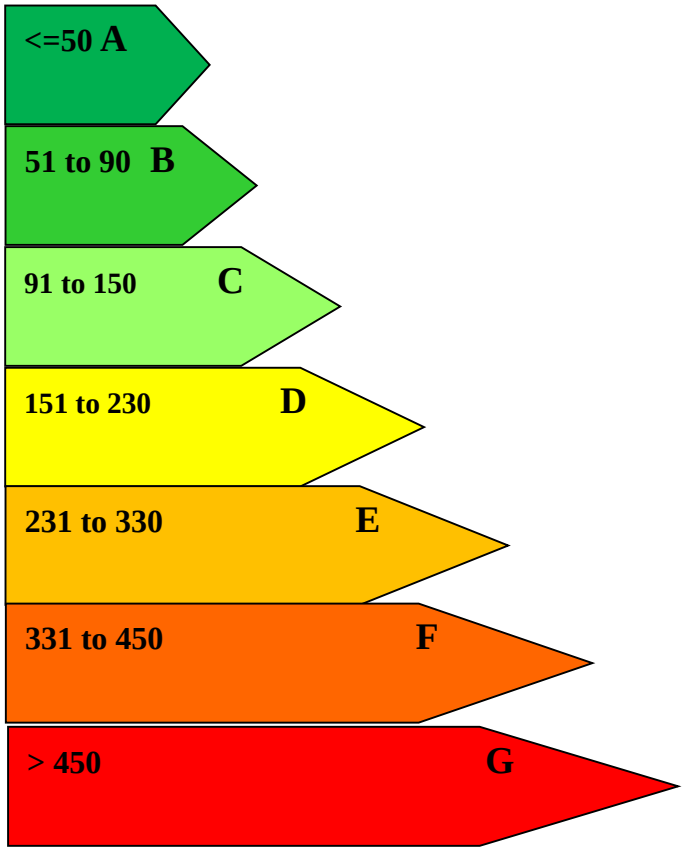
Data

	Energy in Kwh/m²/year	GHG emissions in kg.$_{CO2}$	Expenditures by m² and by year in euros
Without renovation	747	48	33.8
EE renovation works			
Isolation			
Double glazing	703*	45	32.3
Wall insulation	661	42	30.7
Roof insulation	622	38	29.1
Floor insulation	667	42	30.9
Replacement			
Mechanical ventilation	645	41	30.9
New heating system	713	46	32.6
New hot water system,	740	47	33.6
Chimney	686	37	31.2

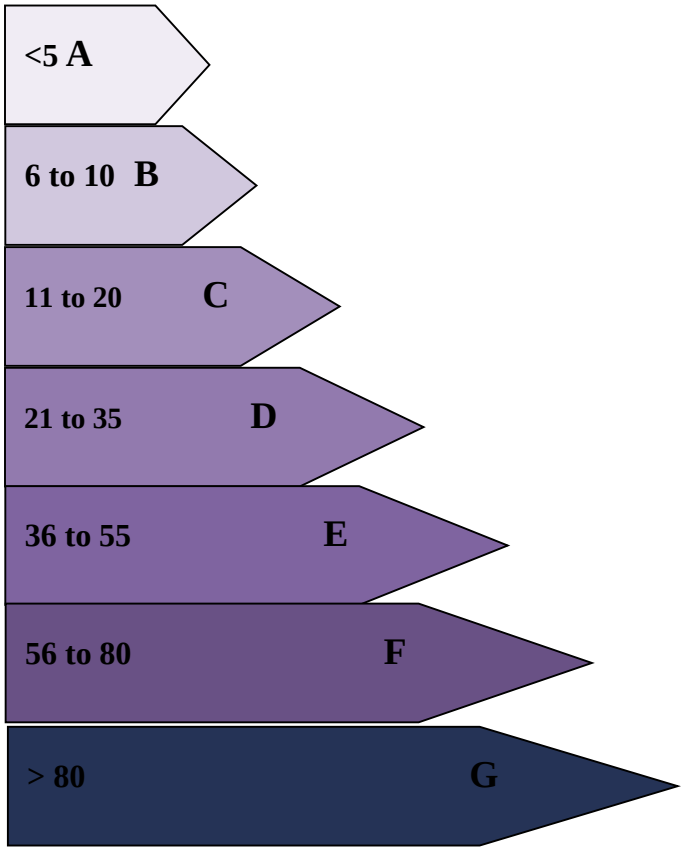
Table : Average household income according to occupancy status and energy label

Labels	Total	Homeowners	Tenant
A	35673.	38235.76	25838.369
B	34793.146	35854.655	32577.057
C	31615.609	34892.	27011.672
D	28392.	32141.48	24342.73
E	25237.152	28401.248	22783.932
F	16189.	19145.097	14604.604
G	20031.391	25925.347	15370.157
Means	28196.51	32197.29	23755.01

Dwelling energy label in kWhef/m²/year



Climate label in kg.CO_2.



	No incentives received	Tax credit	Subsidy	Zero-rate bank loan
All households				
Number of households	539	92	28	26
Average energy-efficiency expenditures in euros	5286	5375	5670	13883
Number of energy-efficiency renovations	0.7	1.8	0.2	7.7
Theoretical GHG emissions savings in kg.CO2	19.1	22.5	27.6	25.2
Theoretical energy savings in euros	40.9	45.8	41.6	20.5
Owner-occupied dwellings				
Number of households	392	79	21	25
Average energy-efficiency expenditures in euros	5761	5400	6306	13629
Number of energy-efficiency renovations	0.9	2.1	0.1	8
Theoretical GHG emissions savings in kg.CO2	20.7	25.3	27.0	25.4
Theoretical energy savings in euros	41.9	44.7	45.3	19.7
Renter-occupied dwellings				
Number of households	147	13	1	7
Average energy-efficiency expenditures in euros	3960	5227	3943	19730
Number of energy-efficiency renovations	0.5	1.8	0.2	7.7
Theoretical GHG emissions savings in kg.CO2	14.6	16.1	29.4	21.7
Theoretical energy savings in euros	38.2	52.9	30.4	41