

Paying More for Less in Energy Efficient Rental Properties

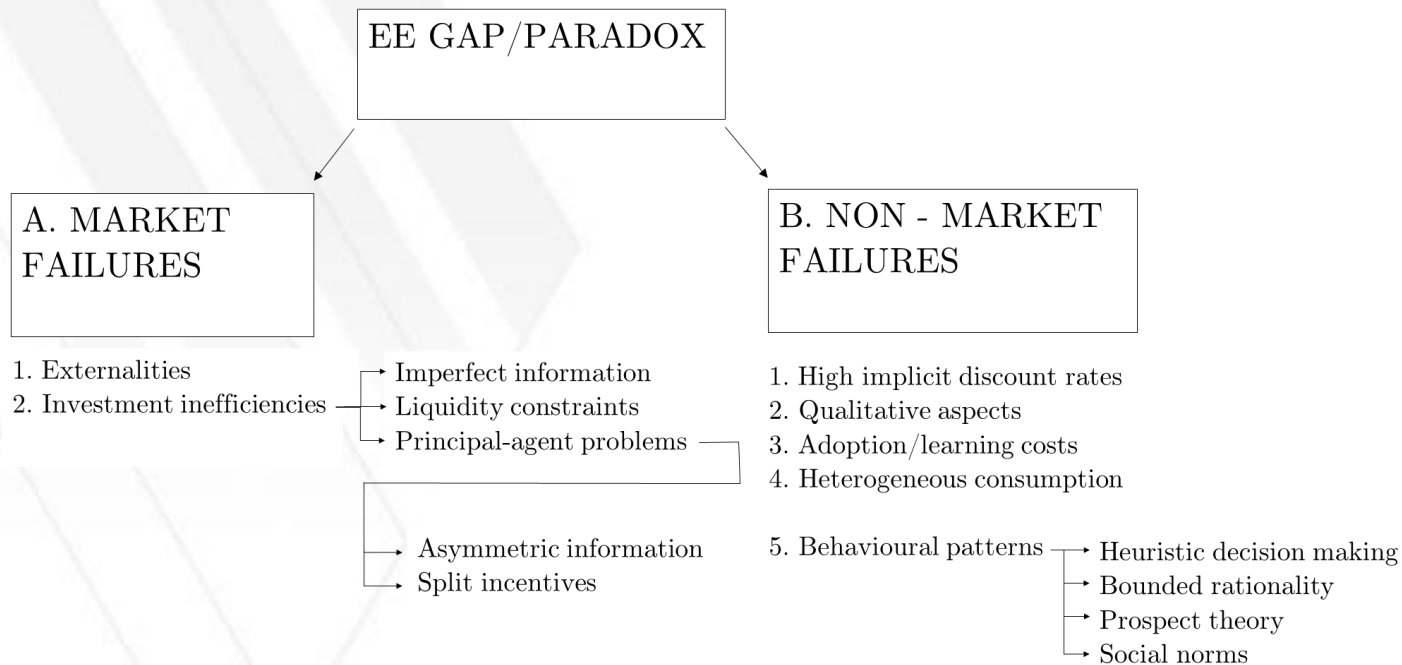
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Energy Efficiency Gap/Paradox

- Not at the cost-minimising level of energy efficiency^{2, 3, 4, 5}
 - Money on the floor.



² Jaffe, A. B., & Stavins, R. N. (1994). The energy-efficiency gap - What does it mean? *Energy Policy*, 22(10), 804–810. [https://doi.org/10.1016/0301-4215\(94\)90138-4](https://doi.org/10.1016/0301-4215(94)90138-4)

³ Gerarden, T. D., Newell, R. G., Stavins, R. N., & Stowe, R. C. (2015). An Assessment of the Energy-Efficiency Gap and its Implications for Climate-Change Policy. In NBER Working Paper Series (No. 20905; Working Paper Series). <https://doi.org/10.3386/w20905>

⁴ Gillingham, K., Newell, R. G., & Palmer, K. (2009). Energy Efficiency Economics and Policy. *Annual Review of Resource Economics*, 1, 597–620. <https://doi.org/10.1146/annurev.resource.102308.124234>

⁵ Allcott, H., & Greenstone, M. (2012). Is There an Energy Efficiency Gap? *Journal of Economic Perspectives*, 26(1), 3–28. <https://doi.org/http://dx.doi.org/10.1016/B978-0-12-397879-0.00005-0>

Landlord – Tenant Problem

- **Principal – Agent problem** – one person/entity acts on behalf of another entity.
- Result of two things: **Split Incentives Problem & Information Asymmetries**^{6, 7, 8}:

1. Split Incentives Problem (goal conflict):

- If utilities bills are paid by tenant – **Efficiency Problem** – landlord underinvests in efficiency (in the absence of premiums to efficiency).
- If utilities bills are included in rental price – **Usage Problem** – tenant overconsumes energy

2. Information Asymmetry

- One party in the principal-agent problem holds more information than the other party

⁶ IEA. (2007). Mind the gap - Quantifying Principal - Agent Problems in Energy Efficiency. https://www.oecd-ilibrary.org/energy/mind-the-gap_9789264038950-en

⁷ Gillingham, K., Harding, M., & Rapson, D. (2012). Split Incentives in Residential Energy Consumption. *The Energy Journal*, 33(2), 37. <https://doi.org/10.5547/01956574.33.2.3>

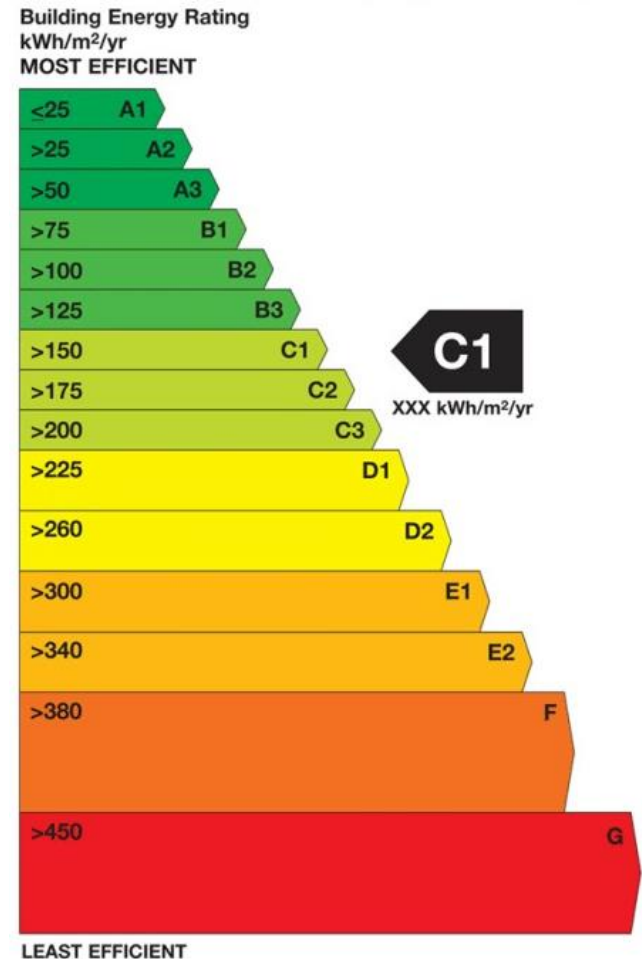
⁸ Hyland, M., Lyons, R. C., & Lyons, S. (2013). The value of domestic building energy efficiency - evidence from Ireland. *Energy Economics*, 40, 943–952. <https://doi.org/10.1016/j.eneco.2013.07.020>

Energy Performance Certificates (EPC) – Correcting the Information Asymmetry

- In Ireland – this known as the Building Energy Rating (BER)
- Allow landlords to communicate the efficiency of the property to prospective tenants
- Compulsory from 2009 to display BER cert at point of sale or lease.
- 2013 – Legislation extended to advertising of rental properties.

Research Question

- Do buildings with better energy performance command a higher rental premium?



Previous Literature

- Majority of studies focus on sales premium^{9, 10, 11, 12}
- Rental premium
 - Mostly in commercial properties¹³
 - Private rental properties^{14, 15}
 - Advertisement data
 - Relatively small sample size
 - How does the observed premium compare to expected premium?

⁹ Cespedes-Lopez, M. F., Mora-Garcia, R. T., Perez-Sanchez, V. R., & Perez-Sanchez, J. C. (2019). Meta-analysis of price premiums in housing with energy performance certificates (EPC). *Sustainability*, 11(22). <https://doi.org/10.3390/sul1226303>

¹⁰ Stanley, S., Lyons, R., & Lyons, S. (2016). The price effect of building energy ratings in the Dublin residential market. *Energy Efficiency*, 9(4), 875–885. <https://doi.org/10.1007/s12053-015-9396-5>

¹¹ Brounen, D., & Kok, N. (2011). On the economics of energy labels in the housing market. *Journal of Environmental Economics and Management*, 62(2), 166–179. <https://doi.org/10.1016/j.jeem.2010.11.006>

¹² Zheng, S., Wu, J., Kahn, M. E., & Deng, Y. (2012). The nascent market for “green” real estate in Beijing. *European Economic Review*, 56(5), 974–984. <https://doi.org/10.1016/j.euroecorev.2012.02.012>

¹³ Leskinen, N., Vimpari, J., & Junnila, S. (2020). A review of the impact of green building certification on the cash flows and values of commercial properties. *Sustainability*, 12(7). <https://doi.org/10.3390/sul2072729>

¹⁴ Cajias, M., & Piazzolo, D. (2013). Green performs better: energy efficiency and financial return on buildings. *Journal of Corporate Real Estate*, 15(1), 53–72. <https://doi.org/10.1108/JCRE-12-2012-0031>

¹⁵ Hyland, M., Lyons, R. C., & Lyons, S. (2013). The value of domestic building energy efficiency - evidence from Ireland. *Energy Economics*, 40, 943–952. <https://doi.org/10.1016/j.eneco.2013.07.020>

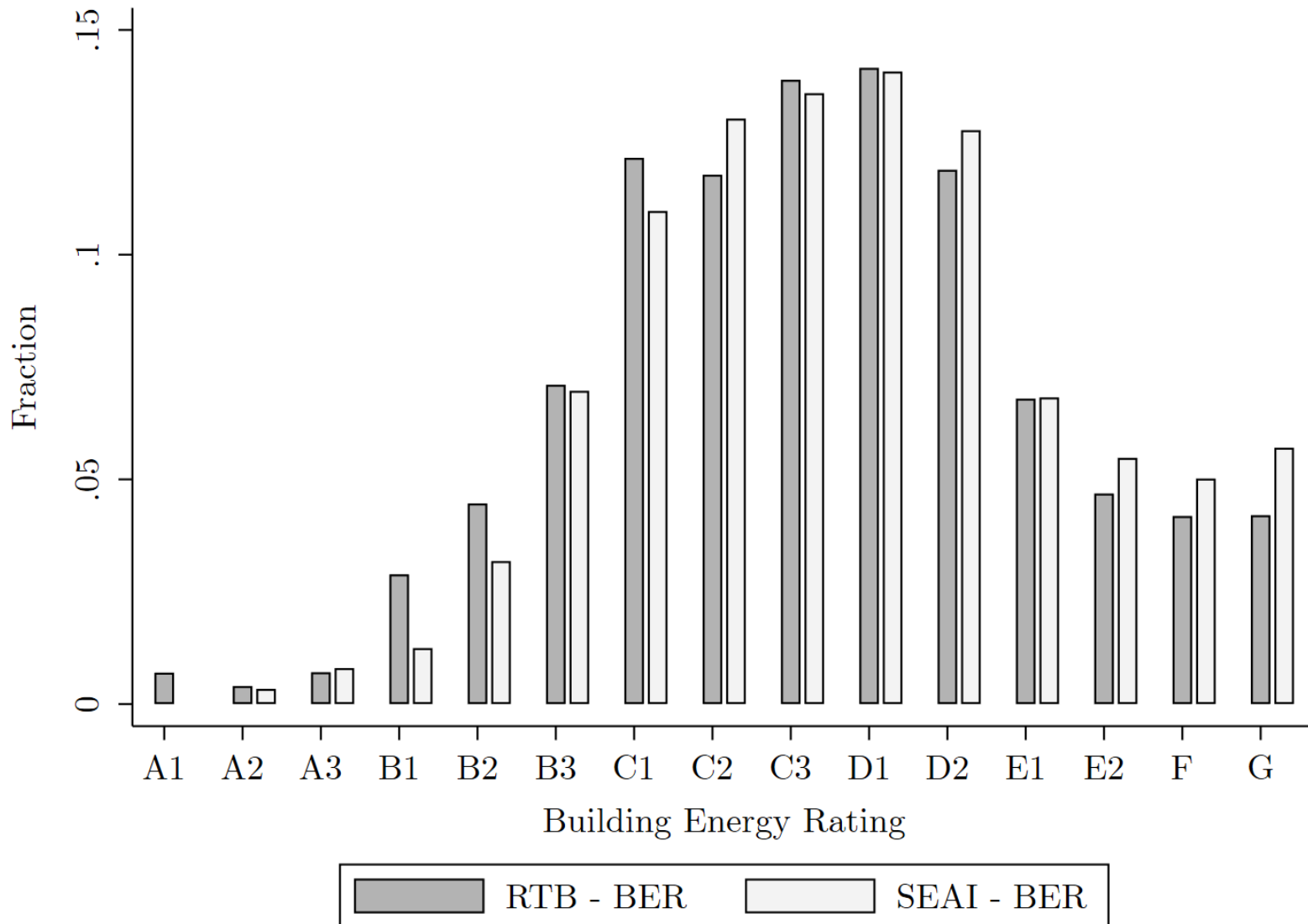
Data: RTB – Period: 2007 - 2017

Table 1: Summary Statistics - Full Sample

	(1) Full Sample		(2) Have BER		(3) No BER		Difference in Means	
	mean	sd	mean	sd	mean	sd	(2) - (3)	t
Monthly rent	877.21	422.11	943.95	462.51	864.48	412.73	-79.47***	(-66.51)
Property type								
Detached house	0.10	0.30	0.12	0.33	0.10	0.30	-0.02***	(-28.39)
Semi-detached house	0.26	0.44	0.26	0.44	0.26	0.44	-0.01***	(-5.90)
Terraced house	0.14	0.35	0.17	0.37	0.14	0.35	-0.03***	(-31.72)
Apartment	0.44	0.50	0.42	0.49	0.44	0.50	0.02***	(17.79)
Flat	0.05	0.21	0.02	0.15	0.05	0.22	0.03***	(62.35)
Bedsit	0.01	0.12	0.00	0.07	0.02	0.13	0.01***	(54.78)
Rent frequency								
Weekly	0.13	0.33	0.09	0.29	0.13	0.34	0.04***	(54.20)
Fortnightly	0.00	0.06	0.00	0.06	0.00	0.06	-0.00	(-0.55)
Monthly	0.86	0.35	0.89	0.31	0.85	0.36	-0.04***	(-50.53)
Yearly	0.01	0.12	0.01	0.11	0.01	0.12	0.00	(1.85)
Quarterly	0.00	0.03	0.00	0.03	0.00	0.03	-0.00***	(-4.29)
Number of bedrooms	2.52	1.47	2.63	1.27	2.50	1.51	-0.13***	(-36.94)
Number of bed spaces	3.68	2.13	3.59	2.00	3.69	2.15	0.10***	(18.55)
Number of occupants	2.07	1.63	2.36	1.23	2.02	1.69	-0.34***	(-98.92)
Substantial refurbishment	0.00	0.03	0.00	0.04	0.00	0.02	-0.00***	(-14.41)
Observations	1,077,213		172,597		904,616			

*** Statistically different from rental mean at $p < 0.01$

Distribution of Ratings



Methodology (a) – Estimating Rental Premium

Following Hyland, Lyons and Lyons (2013):¹⁶

1. Hedonic regression (Rosen 1974)¹⁷

- Price is a function of the observable characteristics of the property.

$$price = y = f(x, n, c) + \epsilon$$

Where

- x = observable characteristics such as property type, size, number of beds etc.
- n = location
- c = energy efficiency

2. Heckman selection model (Heckman 1979)^{18, 19}

- Selection problem is treated as an omitted variable bias problem.
 - Need an exclusion restriction which makes selection into treatment more likely.

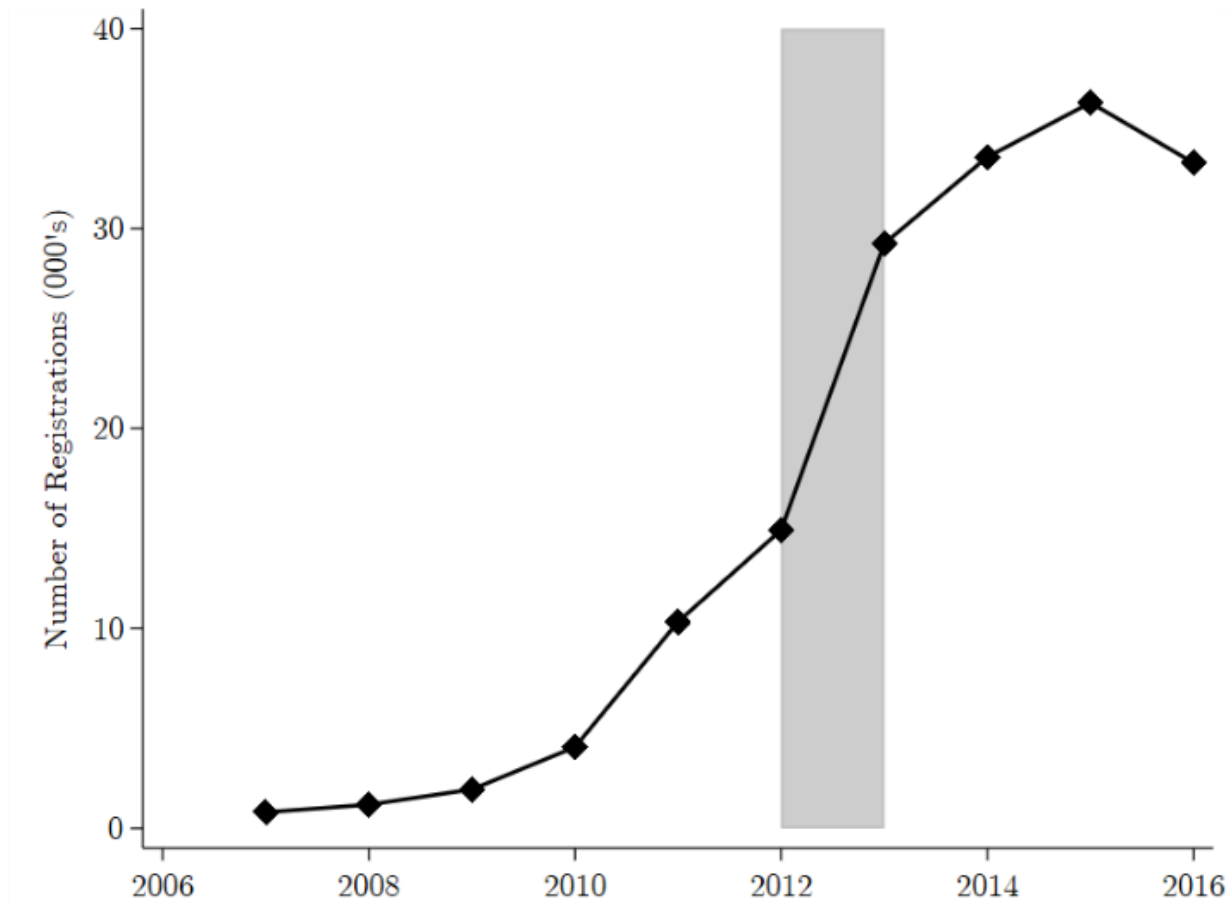
¹⁶ Hyland, M., Lyons, R., & Lyons, S. (2013). The value of domestic building energy efficiency - evidence from Ireland. *Energy Economics*, 40, 943–952. <https://doi.org/10.1016/j.eneco.2013.07.020>

¹⁷ Rosen, S. (1974). Hedonic Prices and Implicit Markets : Product Differentiation in Pure Competition. *Journal of Political Economy*, 82(1), 34–55. <https://doi.org/10.1086/260169>

¹⁸ Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica*, 47(1), 153–161. <http://www.jstor.org/stable/1912352>

Methodology (a) – Estimating Rental Premium

- Exclusion restriction – number of registrations with a BER



Methodology (b) – Perfectly Informed Tenant

3. What should a perfectly informed tenant pay for a more efficient property?

3.1. Estimate an average bill based on BER grade g and heating type h

$$b_{gh} = \underbrace{s \times e_g \times p_h}_{\text{Space/water heating}} + \underbrace{(1 - s) \times e_g \times p_{elec}}_{\text{Appliance/lighting}} \quad (1)$$

Where

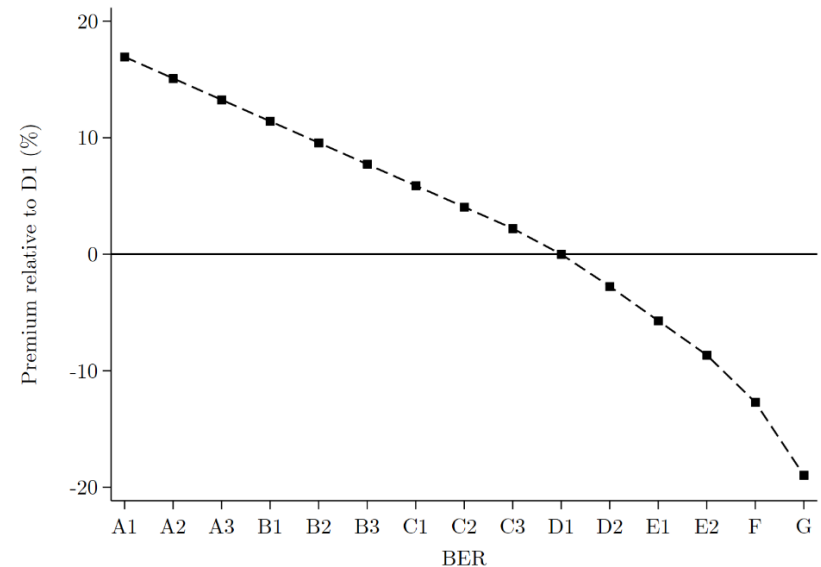
- s = share of energy devoted to space/water heating
- e_g = energy use in kWh/month for an average sized rental property
- p_h = price of heating type h per kWh

3.2. Weight b_{gh} by the proportion of rental properties with heating type h (w_h) to get a measure of expected bill per grade:

$$E(b_g) = \sum_{h=1}^H b_{hg} \times w_h \quad (2)$$

3.3. Obtain premium relative to a D1 rated property based on average rent ($\bar{R}$) of properties with a BER

$$E(\text{premium}_g) = 1 - \frac{E(b_g) + \bar{R}}{E(b_{g=D1}) + \bar{R}} \quad (3)$$



Results – First Stage

Table 1: First Stage Probit Results

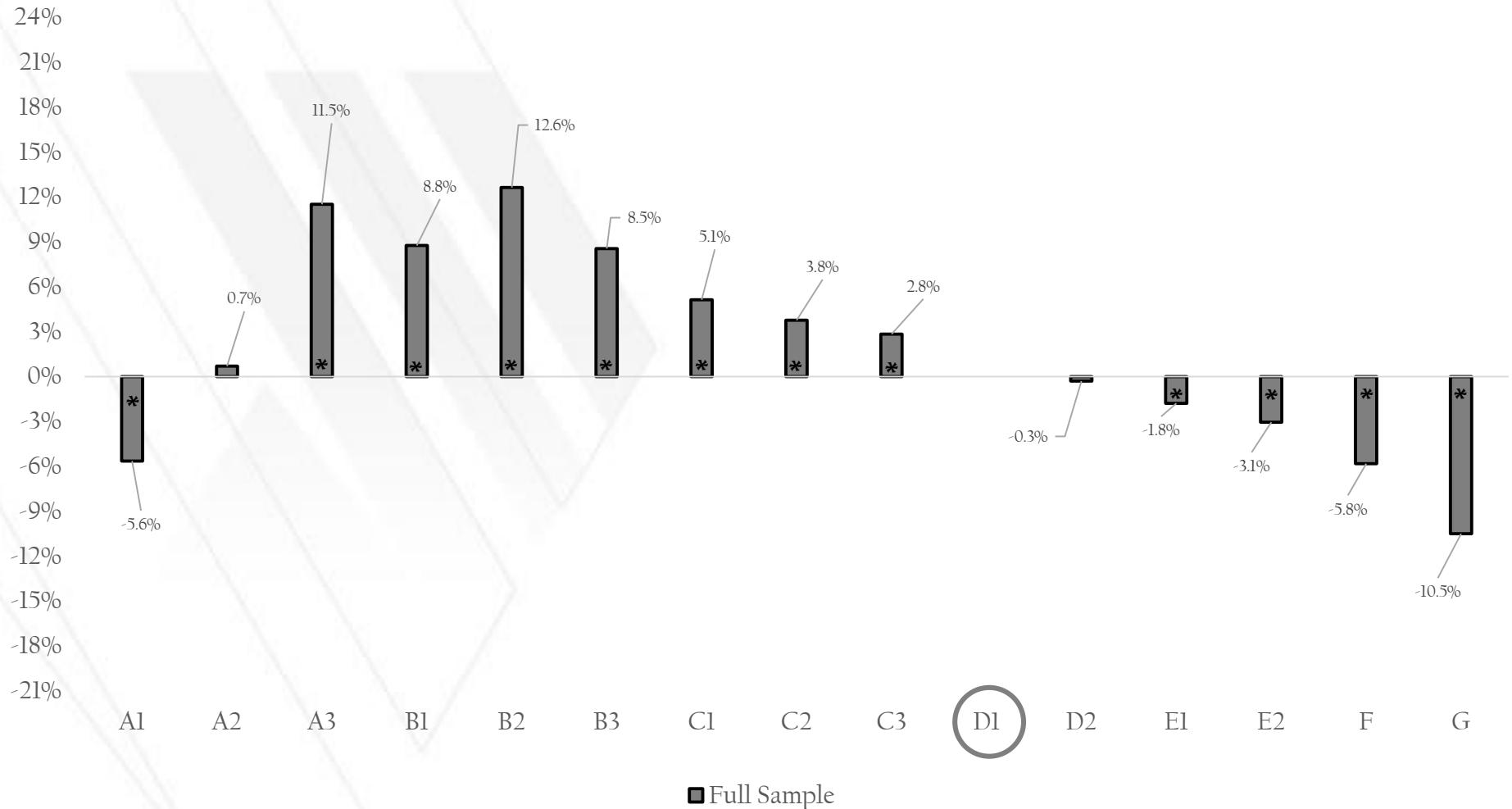
	Full	Cities	Outside Cities
BER legislation (2013)	0.157*** (0.036)	0.265*** (0.067)	0.111* (0.044)
Property type			
Detached house	0 (omitted)	0 (omitted)	0 (omitted)
Semi-detached house	-0.051*** (0.006)	0.028 (0.016)	-0.051*** (0.006)
Terraced house	-0.009 (0.006)	0.128*** (0.016)	-0.016* (0.008)
Apartment	-0.147*** (0.006)	-0.036* (0.015)	-0.110*** (0.007)
Flat	-0.588*** (0.011)	-0.593*** (0.019)	-0.330*** (0.016)
Bedsit	-0.757***	-0.671***	-0.666***
Rent frequency			
Weekly	-0.116*** (0.006)	-0.097*** (0.011)	-0.118*** (0.007)
Fortnightly	0.154*** (0.030)	0.279*** (0.049)	0.078* (0.038)
Monthly	0 (omitted)	0 (omitted)	0 (omitted)
Yearly	0.104*** (0.015)	0.467*** (0.019)	-0.613*** (0.029)
Quarterly	-0.033 (0.050)	0.182* (0.083)	-0.181** (0.064)
Number of bedrooms	-0.018*** (0.002)	-0.012*** (0.003)	0.005* (0.002)
Number of bed spaces	-0.034*** (0.001)	-0.038*** (0.002)	-0.028*** (0.001)
Number of occupants	0.070*** (0.001)	0.053*** (0.003)	0.097*** (0.002)
Number of tenants	0.020*** (0.001)	0.031*** (0.001)	-0.009*** (0.002)
Substantial refurbishment	0.721*** (0.049)	0.734*** (0.067)	0.672*** (0.072)
Time fixed effects	Quarterly	Quarterly	Quarterly
Location fixed effects	Local authority	Local authority	Local authority
N	1,070,842	403,778	667,064
N selected	172,046	60,105	111,941
N non-selected	898,796	343,673	555,123

***Statistically significant at $p < 0.01$

**Statistically significant at $p < 0.05$

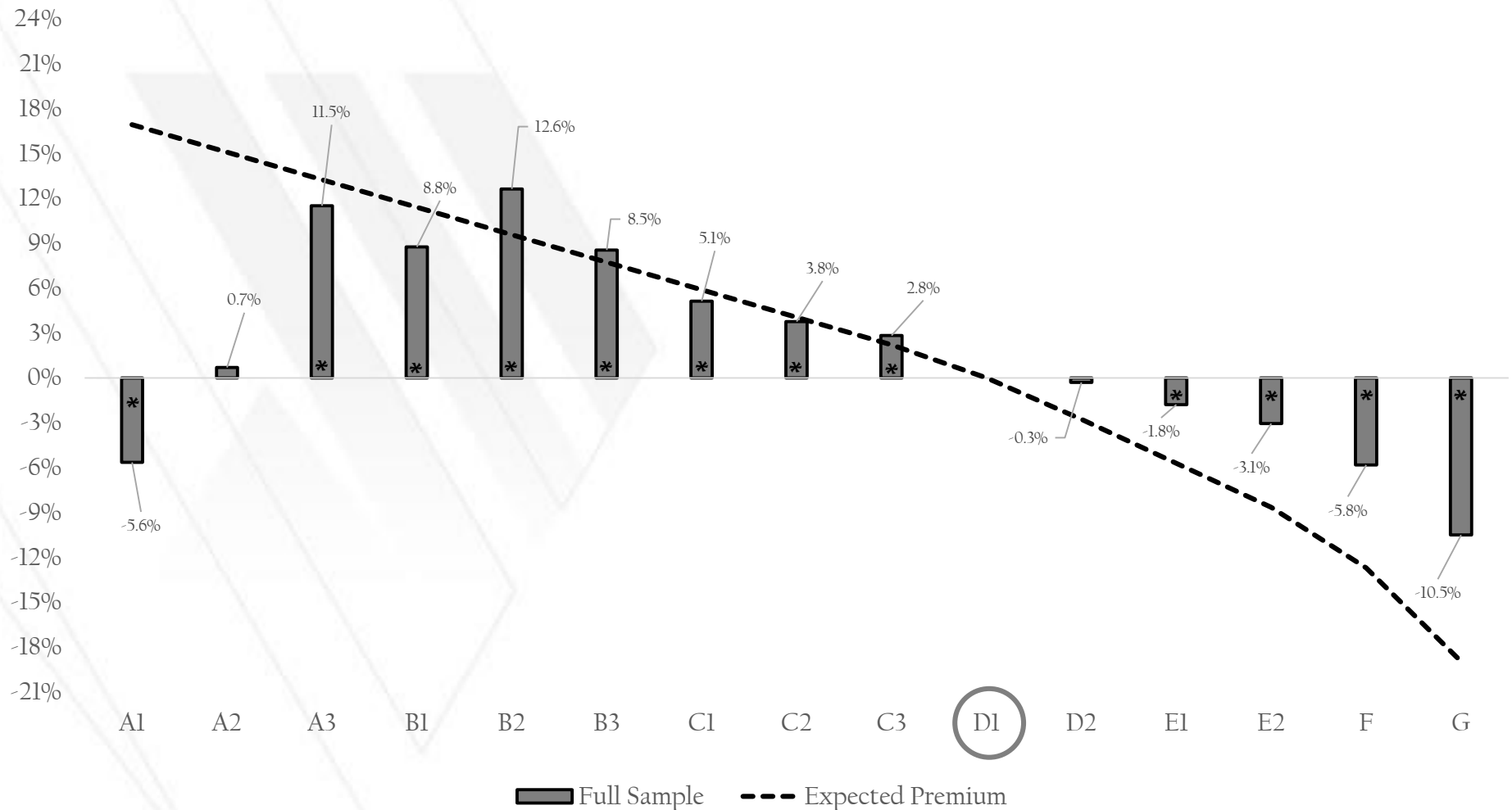
*Statistically significant at $p < 0.1$

Second Stage Results



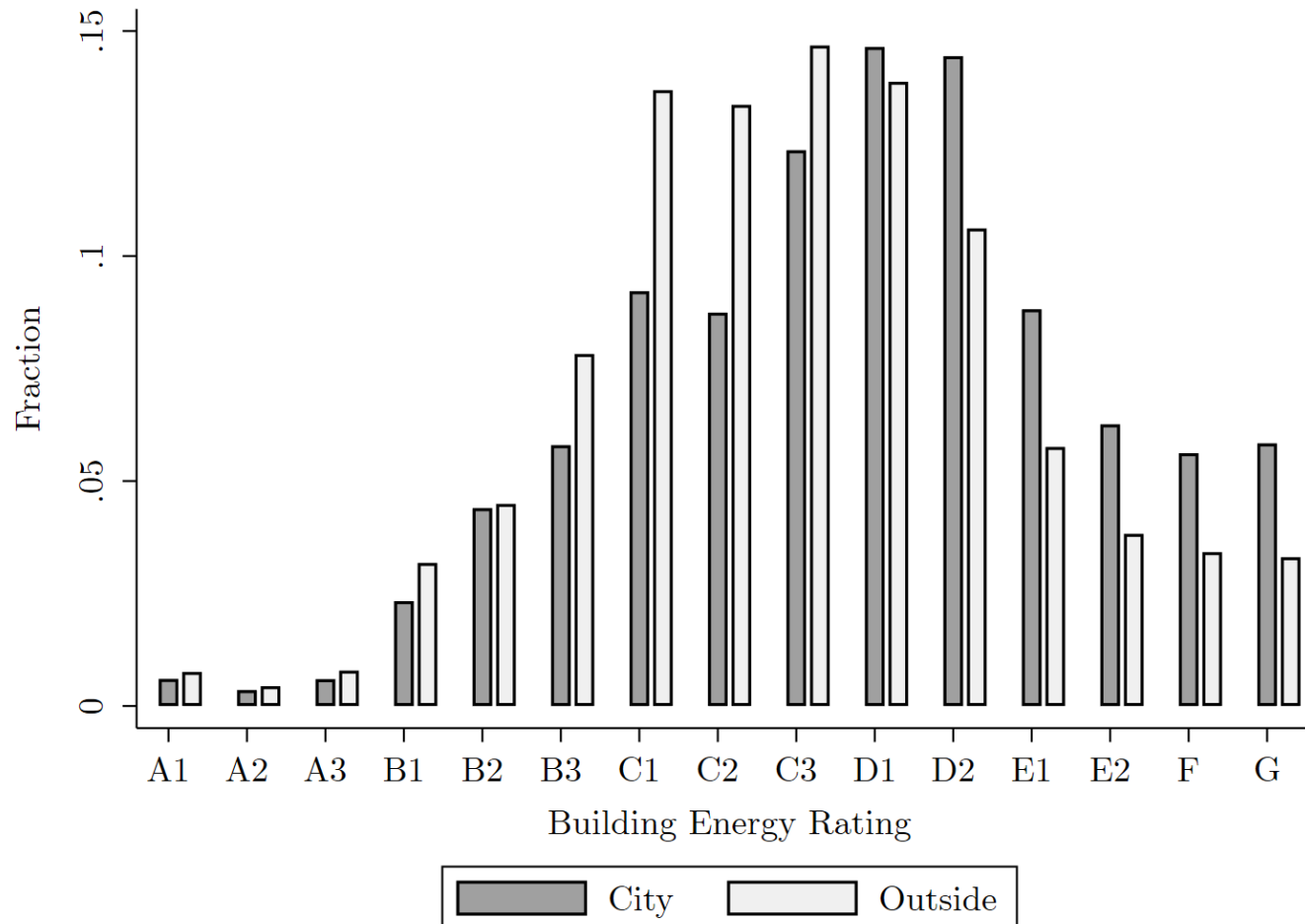
* indicates statistical significance at $p < 0.01$

Second Stage Results

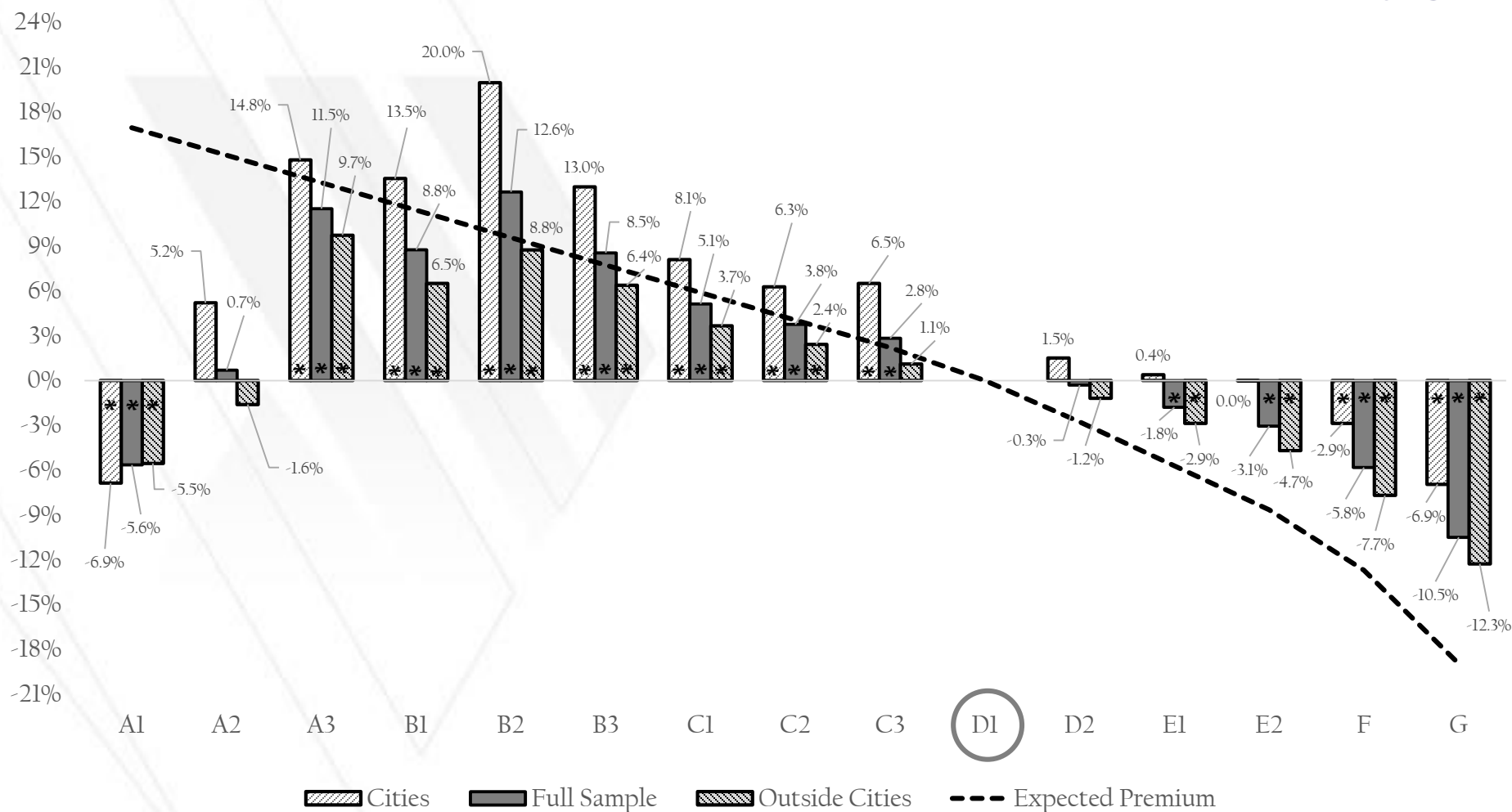


* indicates statistical significance at $p < 0.01$

Distribution of Ratings – Cities vs Rest



Second Stage Results



* indicates statistical significance at $p < 0.01$

Conclusion

- There is a significant rental premium to more efficient rental properties.
 - The BER seems to be correcting the information asymmetry between landlords and tenants.
- In cities there is a large premium to more efficient categories, and a lesser discount to less efficient properties.
 - Interplay between supply of location characteristics and energy efficiency.
 - Information asymmetry is likely not the only problem.

Limitations

- Costs – Need more research into how premiums compare with costs of upgrades.
- Need to ensure landlords have a valid BER.
- Need to make sure landlords are advertising correct ratings.

Thank You

