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Working Paper No. 219

November 2007

www.esri.ie

Energy-Using Appliances and Energy-Saving Features: Determinants of Ownership in Ireland

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Subsequently published in J. O'Doherty, S. Lyons and R.S.J. Tol, 2008, "Energy-Using Appliances and Energy-Saving Features: Determinants of Ownership in Ireland, Applied Energy, Vol. 85, No. 7, pp. 650-662.

Abstract: Energy usage and energy efficiency are of increasing concern in Ireland. Regression analyses on a large household micro-dataset reveal that those homes that have more energy-saving features are also likely to have a high 'potential energy use'. Statistically significant dwelling features include location, value and dwelling type, while household features such as income, age, period of residency, social status and tenure type are also important.

Key words: Energy use, Ireland, appliance ownership, energy efficiency

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1 Introduction

Domestic energy demand is determined both by the number of households and their characteristics, in particular the extent to which they employ energy-using appliances and avail of energy-saving features. This paper investigates the determinants of domestic ownership of energy-using appliances and energy-saving features in Ireland, a country that has seen rapid economic and demographic change in the last fifteen years, and where the household sector accounts for 23 per cent of total energy consumption (O'Leary *et al.*, 2007).

Household energy use has been a popular topic of study in the literature on energy policy and economics. Energy requirements of household consumption have been studied in The Netherlands (Biesiot and Noorman, 1999; Vringer *et al.*, 2007; Weber and Perrels, 2000), Sweden (Carlsson-Kanyama *et al.*, 2005), the United States (O'Neill and Chen, 2002), Brazil (Cohen *et al.*, 2005). Lenzen *et al*. (2006) present a comparative study of Australia, Brazil, Denmark, India and Japan. Aggregating energy use and demand from the analysis of data on appliance ownership and usage – as is undertaken in this study – has been conducted previously in Malaysia (Saidur *et al.*, 2007), the United Kingdom (Yao and Steemers, 2005; Efstathiou *et al.*, 2004; Mansouri *et al.*, 1996), Austria (Haas *et al.*, 1998), and Australia (Hart and de Dear, 2003).

In Ireland, the study of domestic energy usage has been quite limited. Healy and Clinch (2002, 2004) present the results of two surveys of 1,500 households, with a focus on fuel poverty. Clinch *et al*. (2001) and Clinch and Healy (2003) develop a model of improvements in domestic energy efficiency that incorporates both appliance usage and domestic energy-saving features. In relation to energy-saving features in homes, Scott (1997) provides an overview of literature in this area, as well as conducting a replication study of ownership of these items, highlighting the difficulties that can exist when potential owners seek to install such features in their own homes.

In this study we use a large household micro-dataset to estimate two models. The first examines the characteristics of households that own large numbers of energy-using appliances, and the second investigates the relationship between household characteristics and energy-saving features.

The most comprehensive effort to investigate the relationships between household and dwelling characteristics in Ireland is the National Survey of Housing Quality, 2001-2002 (NSHQ; Watson and Williams, 2003). The survey 'obtained detailed information from a representative sample of over 40,000 householders on characteristics and problems of the dwelling, and on the household members' (ibid, v). As such, it provides a snapshot of a household's appliances and mains connectivity status.[1] However, Watson and Williams (2003) only provide descriptive statistics. Here, we econometrically analyse the data from the NSHQ.

By conducting regression analysis on the data from the NSHQ, it is possible to determine what factors influence the appliance ownership status and prevalence of energy-saving features in Irish households.

We find that similar sets of factors are associated with having larger numbers of energy-saving devices and energy-using appliances. Detached homes that are new and expensive are likely to have more energy-saving features, but are also likely to have more appliances than older, less expensive homes. Similarly, households with higher incomes and who own their home are more likely to have more energy-saving features. Other factors such as the length of time a household has been resident at its current address, respondent age and tenure type were also found to be significant in these models.

The remainder of this paper proceeds as follows. The next section analyses data from the National Survey of Housing Quality 2001-2002 (NSHQ). Section 3 outlines the theoretical model being analysed. Section 4 presents the results from our econometric analysis. Finally, the concluding section draws inferences from each of the preceding sections.

2 Data

The Irish National Survey of Housing Quality (NSHQ) was carried out in 2001-2002. The survey gathered information from a sample of over 40,000 householders on characteristics and problems of the dwelling, and on household members.

[1] The NSHQ has so far been a once-off survey, commissioned by the Department of the Environment, Heritage and Local Government (DEHLG) and conducted by the Economic and Social Research Institute. As such, conducting any time-series analysis on the data was impossible.

The questions asked in the NSHQ are not sufficient to explain total energy usage by households – such a project would require more extensive data on details of appliances, analysis of their efficiency, and the frequency with which they are used – but they do allow us to model the quantity of appliances present in households. The survey asks about the presence of the following items: refrigerator, freezer, microwave oven, dishwasher, clothes washer, clothes dryer or washer/dryer, shower, TV, VCR, telephone and personal computer. We used these data to construct a variable measuring the size of the set of appliance types held by each household. This variable takes a maximum value of eleven (i.e. there are twelve categories, as a home can also have none of the above appliances). It must be noted that the methods of accounting for appliance ownership that are employed in this paper in effect only count the *presence* of certain appliances. We do not know the intensity of usage of these appliances in particular households, and we also do not know when a household has more than one appliance of a given class.

There is likely to be a wide disparity in the amount of energy used by each of these appliance types. Given 'normal' rates of usage and power, a VCR will use more energy than a refrigerator, for example. To allow for this in a stylised way, we apply a weight to each appliance type based on the proportion of overall energy that a representative model regularly consumes. Weights were obtained for this purpose from Fawcett *et al.* (2000). This study indicates the total electricity consumption by appliance type in households in three countries, the UK, Portugal and the Netherlands. Given the broad similarity in the availability of appliances in the UK and Ireland, we chose the UK weights as the best proxy for energy usage of Irish household appliances. The energy-weighted appliance number variable was then re-scaled to a zero-one interval, so that it could be used in the model outlined in the next section.

For the other part of this analysis – specifically, the presence of energy-saving items in homes – the NSHQ again proved to be a valuable source of data. The survey asked respondents about the presence of the following items in their homes: Wall insulation, enclosed porch, roof insulation, double glazing, draft stripping, low-energy light bulbs, insulated hot water cylinder, central heating controls, separate timer for water heating. For two reasons, we decided not to apply weights to each of these features to allow for the energy-saving benefits each allows. First, performance standards for the listed features vary widely. For example, roof insulation and double-glazing technologies have improved significantly, and the NSHQ did not ask respondents to specify the form that each feature took. Second, the NSHQ asked respondents to indicate the presence of at least one of these features, but does not ask about the prevalence of each feature within the home; a home may have just a few energy-saving light bulbs or only some of its windows double-glazed, for example. The dependent variable in this instance is thus a simple count of the number of energy-saving features present in a home.

Both of the dependent variables described above were employed in regressions against explanatory variables that are detailed in Table 1 and Table 2.[2]
The next section will detail the models employed in this analysis.

3 Models

In order to model the determinants of energy usage in Ireland we employ a Papke-Wooldridge generalised linear modelling (GLM) estimator. This method was first employed by Papke and Wooldridge (1996) to investigate employee participation in pension plans, and a thorough description of this modelling procedure is contained in that paper. Essentially, this is a fractional logit model that involves the use of a dependent variable that is constrained to minimum and maximum values of zero and one. The model estimates the marginal effects of a GLM modelling procedure on this variable. The dependent variable was detailed in the previous section.

In the decade since this modelling technique was first employed, it has been used in a variety of policy areas, including sport, energy, finance and health, and is particularly useful in for this paper, where observations are distributed between a defined minimum and maximum that can be rescaled to zero and one.

In order to analyse those factors that affect the total number of energy-saving features present in a household, a Poisson count model was employed. For an overview of Poisson models, see Wooldridge (2002) or El Sayyad (1973). Poisson models have been used to analyse a very wide variety of dependent variables, from the number of goals scored in football matches (see Karlis and Ntzoufras, 2003) to the frequency of bombs landing on parts of London in World War 2 (see Feller, 1957). In general, they can be employed in situations where one wishes to interpret a count of events or items as a dependent variable. As it is employed here, outcomes were

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[2] Unfortunately, there were only a limited number of observations for the total floor space of the dwelling and for the length of ownership by the household currently living in the dwelling, so these were omitted from this analysis.

limited to whole numbers between zero and nine, inclusive, indicating the total number of energy-saving items in each household.

4 Results

This section presents the results of the two regressions run on the NSHQ data, a Papke-Wooldridge fractional logit model for the weighted number of energy-using items in a residence, and a Poisson count model for analysing the determinants of the number of energy-saving devices in a dwelling.[3]

Weighted number of energy-using appliances – potential energy use

Twelve energy-using appliances[4] were accorded a weight based on the proportion of total electricity consumption that can be apportioned to its usage (weights adapted from Fawcett et al, 2000). This variable was rescaled such that the maximum value was one and, accordingly, each household was ranked on a 0-1 scale. We refer to this as potential energy use. The results of this regression are shown in Table 3. For a given variable, a coefficient of 0.2 means that a unit change in that variable would result in a change of 0.2 along the 0-1 interval, holding all other variables at their respective means. Accordingly, some of the results are presented here as percentage changes, indicating the effect on the dependent variable of a unit change in an independent variable.

As shown in Table 3, nearly all of the tested variables have a high level of significance in this regression. The results shown in Table 3 indicate that the following factors have a positive influence on owning more appliances:

Off-peak mains electricity: Having off-peak mains electricity increases a household's potential energy use by 1.3%.

House value: For every £100,000 increase in the value of a house, potential energy use increases by 4.4%.

Household income: For every £100 increase in household income potential energy use increases by 0.6%.

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[3] A Poisson model was chosen over a negative binomial count model after it was tested for overdispersion and no evidence was found to suggest that this was present.

[4] The twelve appliances are Refrigerator, Freezer, Microwave Oven, Dishwasher, Clothes Washer, Clothes Dryer, Washer/dryer, shower, TV, VCR, Telephone and PC. Note that clothes dryer and washer/dryer are mutually exclusive, and as such the maximum number that any household can have is eleven.

House age: Compared to the omitted variable, ‘before 1900’, all but one of the other variables in this group are likely to use more energy (living in a house built in the period ‘1900-1940’ is likely to reduce energy use, but this result is not statistically significant). However, this does not follow a chronological trend, as is demonstrated in Figure 1.

[Figure 1 about here]

Household type: Compared to the omitted variable, ‘1 adult under 65’, other household types have a higher potential use of energy, except for households composed of ‘1 adult over 65’, which have 3% less energy use potential. ‘Couples with children’ have 11.8% higher potential energy use than the base category, while other types of households (‘Other families with children’, ‘parents with grown-up children’, ‘all adults under 65’ and ‘all adults over 65’) have 6.9%-9.4% higher potential energy use. These results are illustrated in Figure 2.

[Figure 2 about here]

The following factors have a negative influence on potential energy use:
Years at this address: For every additional ten years a household has been resident at an address it’s potential energy use falls by 0.8%.
Tenure type: Compared to the omitted variable, ‘own outright’, households with all other forms of tenure are likely to have lower potential energy use (although ‘purchasing’ is not statistically significant at the 10% level), particularly local authority renters and private renters, membership of which decreases a household’s potential energy use by 8% and 11%, respectively.
Social status: Compared to the omitted variable, ‘high professional’, each of the other classes is likely to have lower potential energy use. This is illustrated in Figure 3. Note that ‘low professional’ is not statistically significant.

[Figure 3 about here]

Dwelling type: Compared to the omitted variable, ‘detached’, each of the other variables is likely to lower potential use. There is substantial variation among the dwelling type effects. Living in a semi-detached house reduces a household's potential energy use by 1.8% compared to the detached house baseline, and living in a terraced house or a purpose-built apartment confers a similar reduction of 2.5%. In contrast, living in an apartment in a converted house reduces a household's potential energy use by 7.4% and living in a caravan is associated with a reduction of 14%.

Finally for this regression, there is mixed evidence with regard to **age** and **location**. Compared to the omitted variable, 'under 40', householders in the '40-64' age category are likely to have more appliances, increasing their potential energy use by 1.4%. On the other hand, those in the 'over 65' age category have potential use 2% lower than the base category. Geographical location does not seem to be associated with significant variations in potential use of energy.

Number of energy-saving features:

We estimated a Poisson model to explain the total number of energy-saving features in each household. Table 4 shows the results from this regression, and the results are summarised below.

The results are presented as 'Incident Rate Ratios' (IRR), rather than coefficients.[5]

As can be seen from Table 4, nearly all of the tested variables have a high level of significance in the Poisson model. The results shown in Table 4 indicate that the following factors have a positive influence on having more energy-saving features:

Off-peak mains electricity: Having off-peak mains electricity increases the expected number of energy-saving features in the dwelling by 4.5%.

House value: For every £100,000 increase in the value of a house the expected number of energy-saving features in the dwelling increases by 3.4%.

Household income: For every £100 increase in household income the expected number of energy-saving features in the dwelling increases by 1.1%.

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[5] The relationship between the coefficient and the IRR for any variable is $IRR = e^{\beta}$, where β is the coefficient as it might normally be interpreted. As coefficients are defined as the difference between the log of expected counts, where formally, this can be written as $\beta = \log(\mu_{X+1}) - \log(\mu_X) = \log\left(\frac{\mu_{X+1}}{\mu_X}\right)$, where β is the regression coefficient, μ is the expected count and the subscripts represent where the predictor variable, say *X*, is evaluated at *x* and *x+1* (implying a one unit change in the predictor variable X). Therefore e^{β} is the ratio of two consecutive count estimates, and is more easily interpreted.

House age: Compared to the omitted variable, 'before 1900', each of the other variables is likely to have more appliances. This follows a chronological trend, with more recently-built homes having more energy-saving features. This is demonstrated in Figure 4.

[Figure 4 about here]

Household type: Compared to the omitted variable, '1 adult under 65', all other household types have more energy-saving features, except for households composed of one adult over 65. This is shown in Figure 5.

[Figure 5 about here]

The following factors have a negative effect on the number of energy-saving features:

Years at this address: For every additional ten years a household has been resident at an address the expected number of energy-saving features in the dwelling decreases by 0.3%.

Location: When compared with households in Dublin, households in all other areas have fewer energy-saving features. In rural areas, the expected number of such features is lower by between 5.9% and 9.6%, while in urban areas it is lower by 2.6-2.8% compared to Dublin.

Tenure type: Compared to the omitted variable, 'own outright', households with all other forms of tenure are likely to have fewer appliances (though 'purchasing', 'renting from a voluntary organisation and 'rent free' are not statistically significant at even the 10% level). Being a local authority renter or private renter is likely to reduce the number of appliances one has by 9.9% and 19.1%, respectively.

Social status: Compared to the omitted variable, 'high professional', each of the other classes has fewer energy-saving features. This is illustrated in Figure 6. Note that "low professional" is not significant.

[Figure 6 about here]

Dwelling type: Only one variable is statistically significant in this group: ‘terraced houses’. Compared to the omitted variable (‘detached houses’), living in a terraced house decreases the expected number of energy-saving features in a dwelling by 8%.

Again, the evidence for **age** is mixed. Compared to the omitted variable, ‘under 40’, householders in the ’40-64’ age category have more energy-saving features (by 1.7%), whereas those in the ‘over 65’ age category have fewer appliances (by 2.5%).

From the above results it is evident that the two models have quite similar results. That is, the factors that determine whether a home has a lot of energy-saving devices in general also determine whether the home has a lot of energy-using appliances. Without data on net energy usage, it is unclear from this analysis whether certain homes and households consume more energy.

5 Conclusions

In this paper we investigate the determinants of domestic ownership of energy-using appliances and energy-saving features in Ireland. Using regression methods that allow for a limited response dependent variable (a Poisson model and a Papke-Wooldridge fractional logit model), independent variables related to both household and dwelling characteristics are included.

Qualitatively, our results are not surprising. Quantitatively, these effects were not known before. We find that similar sets of factors are associated with having larger numbers of energy-saving devices and energy-using appliances. Newer and more expensive homes are more likely to have more energy-saving features, but are also more likely to have more appliances. Indeed, an increase of £100,000 in the value of a home is likely to increase the number of energy-saving features by 3.4%, but is also likely to increase the number of energy-using appliances such that its potential energy use goes up by 4.4%. A house built in the period since 1997 is likely to have 23% more energy-saving features than a house built before 1900, but is also has the potential to use 3% more energy. Similarly, households that have higher incomes and are owner-occupiers tend to have more energy-saving features. An increase in weekly household income of £100 is associated with 0.6% higher potential energy use and 1.1% more energy-saving features. Other factors such as the length of time a household has been resident at its current address, respondent age and tenure type were also found to be significant.

Given the limited nature of the data available, basing policy recommendations on these analyses alone might be imprudent. However, in addition to the findings outlined above, the results of this study highlight two important points.

First, there is relatively little data in relation to energy use and trends in Ireland. The NSHQ has proved to be a useful tool in relation to conducting this analysis, but without time series and/or panel data, conducting a thorough analysis of the effect of changes in household and housing characteristics is probably impossible.

Second, Ireland is a country experiencing a rapid increase in population, changing living patterns, and unprecedented economic prosperity. The effects that these changes may have on energy use are difficult to determine based on this analysis alone, but further research into the interaction of energy use and changing household trends may prove fruitful in relation to policy formation and forecasting Ireland's future demands in this area.

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Figures

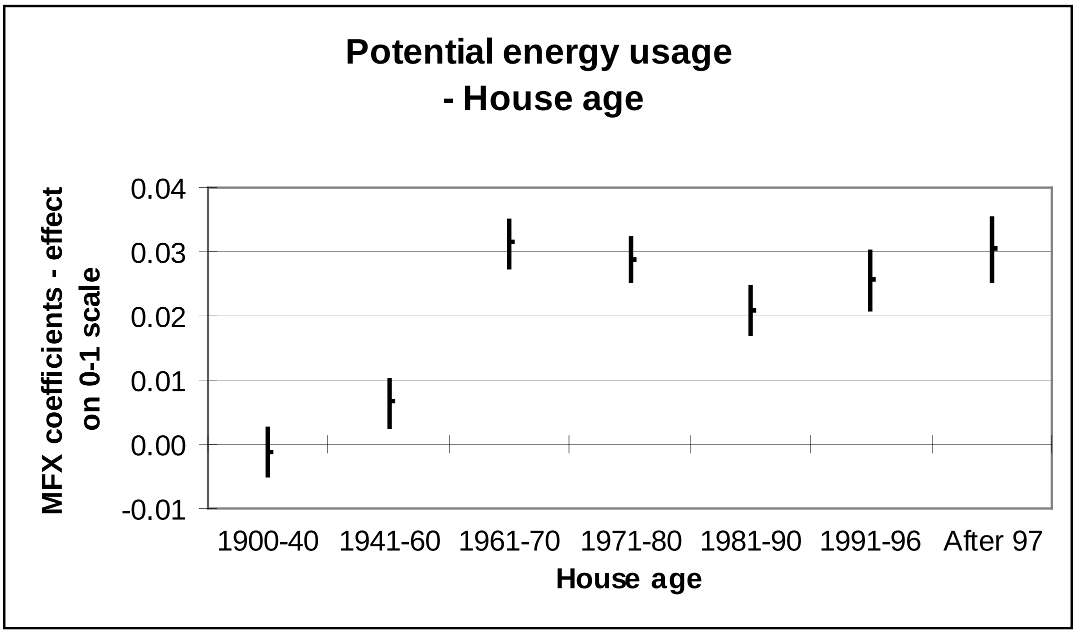

Figure 1 - Marginal effects of house age on potential energy usage in Papke-Wooldridge regression. Omitted variable is 'before 1900'. Vertical lines indicate standard errors.

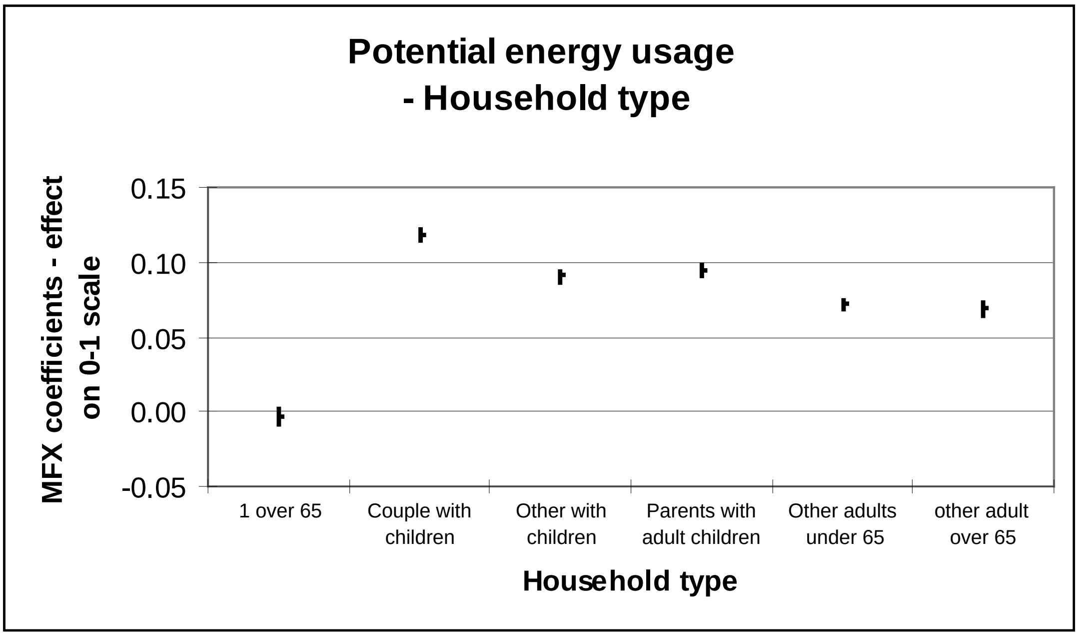

Figure 2 - Marginal effects of household type on potential energy usage in Papke-Wooldridge regression. Omitted variable is 'one person under 65'. Vertical lines indicate standard errors.

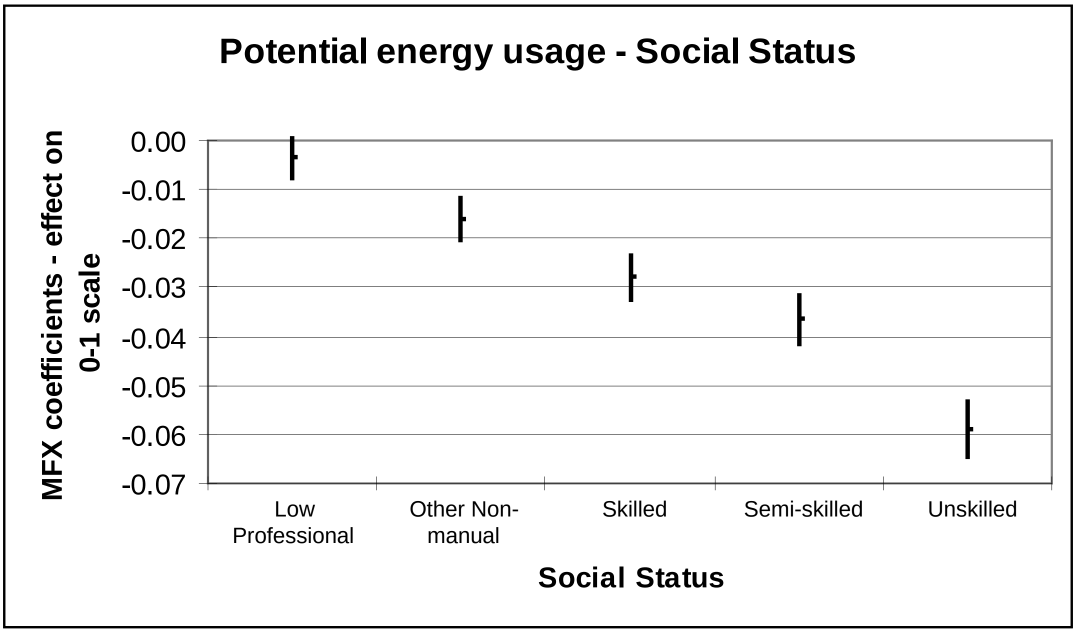

Figure 3 - Marginal effects of social status on potential energy usage in Papke-Wooldridge regression. Omitted variable is 'high professional'. Vertical lines indicate standard errors.

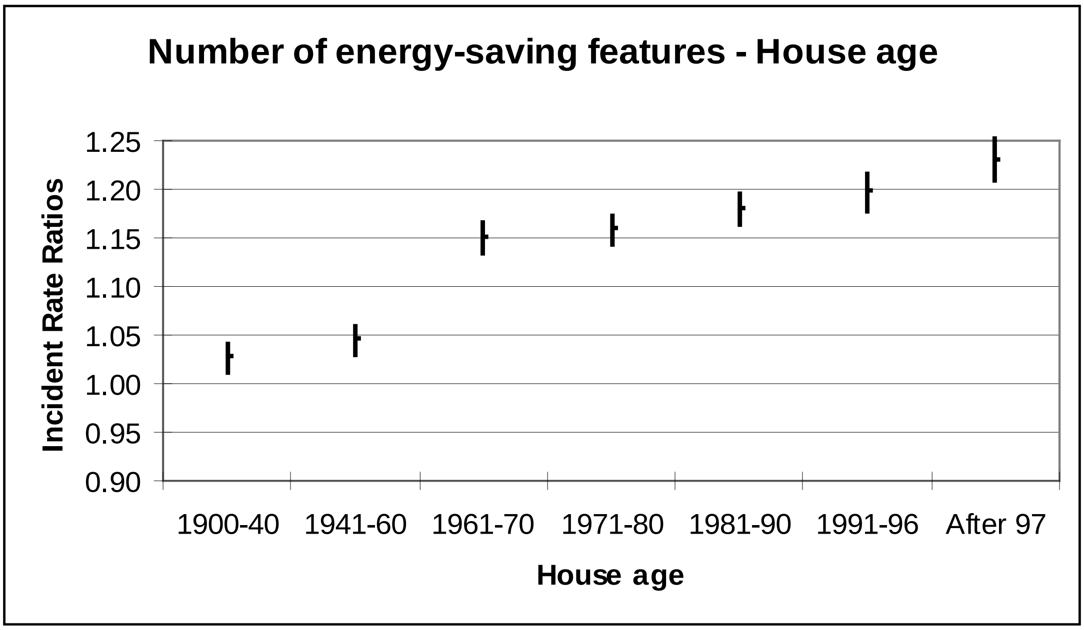

Figure 4 - Incident rate ratios for house age in a Poisson regression explaining the number of energy-saving features. Omitted variable is 'before 1900'. Vertical lines indicate standard errors.

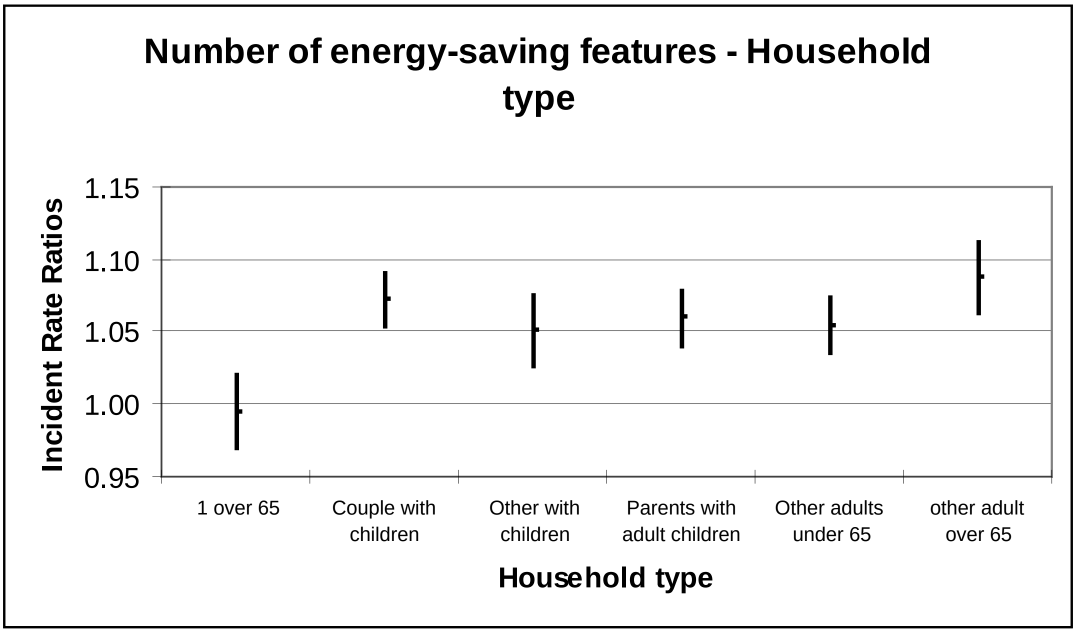

Figure 5 - Incident rate ratios for household type in a Poisson regression explaining the number of energy-saving features. Omitted variable is ‘one person under 65’. Vertical lines indicate standard errors.

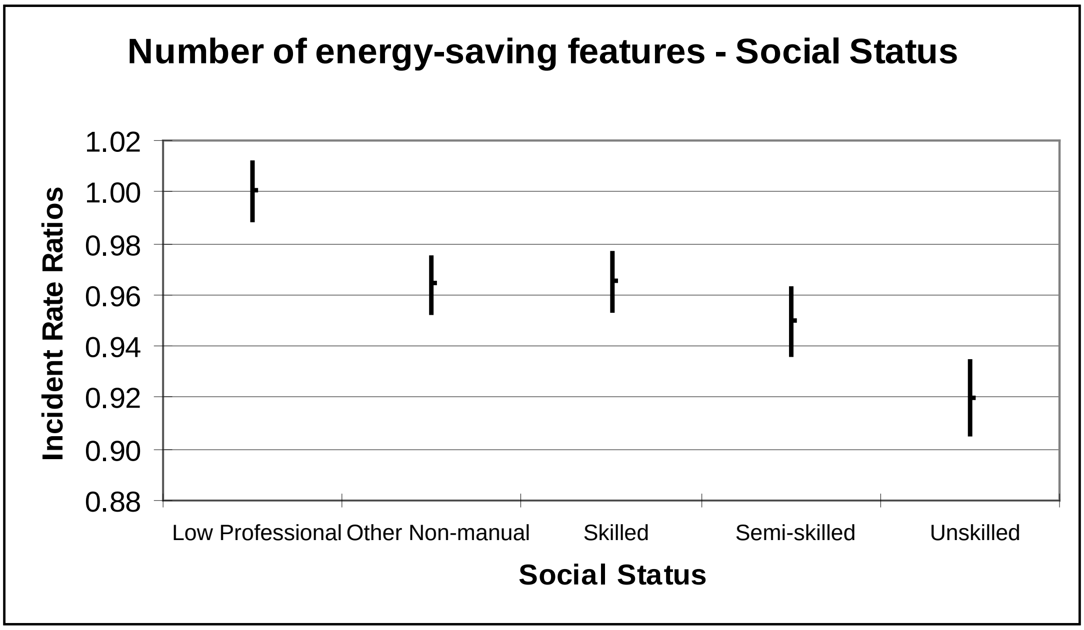

Figure 6 - Incident rate ratios for social status in a Poisson regression explaining the number of energy-saving features. Omitted variable is ‘high professional’. Vertical lines indicate standard errors.

Tables

PWclasspower	Weighted number of appliances owned, rescaled to 0-1 interval
totalEnSav	Number of energy-saving features present in the dwelling
yrshere	The number of years a household has been resident at the dwelling

hvalue	Estimate of the dwelling's value
HHincome	Declared income of the respondent
age40_64	Dummy: householder is between 40 and 64 years old, inclusive (omitted category is 'less than 40')
age65plus	Dummy: householder is over 65 years old, inclusive (omitted category is 'less than 40')
locBMWurban	Dummy: location is in an urban part of the border-midlands-west region (omitted category is 'Dublin')
locothurban	Dummy: location is urban but not in Dublin or BMW (omitted category is 'Dublin')
locruralBMW	Dummy: location is rural and in BMW (omitted category is 'Dublin')
locothrural	Dummy: location is rural but not in Dublin or BMW (omitted category is 'Dublin')
tenurePurch	Dummy: home is being purchased (i.e. mortgage) (omitted category is 'own outright')
tenureLocalA	Dummy: home is rented from a local authority (omitted category is 'own outright')
tenurePrRent	Dummy: home is rented from a private landlord (omitted category is 'own outright')
tenureVolOrg	Dummy: home is rented from a voluntary organisation (omitted category is 'own outright')
tenureRentFr	Dummy: home is lived in rent-free (omitted category is 'own outright')
socLowProf	Dummy: social status is 'low professional' (omitted category is 'professional')
socOthNonMan	Dummy: social status is 'other non-manual' (omitted category is 'professional')
socSkill	Dummy: social status is 'skilled' (omitted category is 'professional')
socSemiSkill	Dummy: social status is 'semi-skilled' (omitted category is 'professional')
socUnskill	Dummy: social status is 'unskilled' (omitted category is 'professional')
socUnknown	Dummy: social status is 'unknown' (omitted category is 'professional')
DwellSemiD	Dummy: dwelling is semi-detached (omitted category is 'detached')
DwellTerrace	Dummy: dwelling is terraced (omitted category is 'detached')
DwellPurpApt	Dummy: dwelling is a purpose-built apartment (omitted category is 'detached')
DwellHousApt	Dummy: dwelling is an apartment in a converted house (omitted category is 'detached')
DwellCaravan	Dummy: dwelling is a caravan (omitted category is 'detached')
HAge1900_40	Dummy: dwelling was originally built between 1900 and 1940 (omitted category is 'pre-1900')
HAge1941_60	Dummy: dwelling was originally built between 1941 and 1960 (omitted category is 'pre-1900')
HAge1961_70	Dummy: dwelling was originally built between 1961 and 1970 (omitted category is 'pre-1900')
HAge1971_80	Dummy: dwelling was originally built between 1971 and 1980 (omitted category is 'pre-1900')
HAge1981_90	Dummy: dwelling was originally built between 1981 and 1990 (omitted category is 'pre-1900')
HAge1991_96	Dummy: dwelling was originally built between 1991 and 1996 (omitted category is 'pre-1900')
HAgeAfter97	Dummy: dwelling was originally built between after 1997 (omitted category is 'pre-1900')
HH1over65	Dummy: Household consists of 1 person, aged 65 or older (omitted category is '1 person under 65')
HHCoupleKids	Dummy: Household consists of a couple with child(ren) (omitted category is '1 person under 65')
HHOthKids	Dummy: Household consists of adult(s) (not a couple) with child(ren) (omitted category is '1 person under 65')
HHParAduKids	Dummy: Household consists of parents living with adult child(ren) (omitted category is '1 person under 65')
HHOthAdUn65	Dummy: Household consists of all-adults, under 65 (omitted category is '1 person under 65')
HHOthAdOv65	Dummy: Household consists of all-adults, over 65 (omitted category is '1 person under 65')

	Potential energy use Papke-Wooldridge regression *observations = 33,017*		**Number of energy-saving features – Poisson regression** *observations = 23,526*	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
PWclasspower	**0.783**	**0.201**	**0.783**	**0.201**
totalEnSav	**4.658**	**1.653**	**4.658**	**1.653**

Table 1 – Summary of variables used in regression analysis

electype	0.068	0.252	0.068	0.252
yrshere	22.795	17.570	22.795	17.570
hvalue100k	1.452	1.225	1.452	1.225
HHincome100	5.348	3.394	5.348	3.394
age40_64	0.547	0.498	0.547	0.498
age65plus	0.286	0.452	0.286	0.452
locBMWurban	0.096	0.295	0.096	0.295
locothurban	0.191	0.393	0.191	0.393
locruralBMW	0.297	0.457	0.297	0.457
locothrural	0.241	0.428	0.241	0.428
tenurePurch	0.332	0.471	0.332	0.471
tenureLocalA	0.072	0.259	0.072	0.259
tenurePrRent	0.043	0.202	0.043	0.202
tenureVolOrg	0.002	0.045	0.002	0.045
tenureRentFr	0.008	0.087	0.008	0.087
socLowProf	0.162	0.369	0.162	0.369
socOthNonMan	0.170	0.375	0.170	0.375
socSkill	0.163	0.370	0.163	0.370
socSemiSkill	0.109	0.312	0.109	0.312
socUnskill	0.089	0.285	0.089	0.285
socUnknown	0.207	0.405	0.207	0.405
DwellSemiD	0.233	0.423	0.233	0.423
DwellTerrace	0.201	0.401	0.201	0.401
DwellPurpApt	0.011	0.104	0.011	0.104
DwellHousApt	0.006	0.076	0.006	0.076
DwellCaravan	0.003	0.055	0.003	0.055
HAge1900_40	0.121	0.326	0.121	0.326
HAge1941_60	0.129	0.335	0.129	0.335
HAge1961_70	0.115	0.319	0.115	0.319
HAge1971_80	0.232	0.422	0.232	0.422
HAge1981_90	0.149	0.356	0.149	0.356
HAge1991_96	0.076	0.264	0.076	0.264
HAgeAfter97	0.061	0.240	0.061	0.240
HH1over65	0.063	0.243	0.063	0.243
HHCoupleKids	0.352	0.478	0.352	0.478
HHOthKids	0.047	0.211	0.047	0.211
HHParAduKids	0.263	0.440	0.263	0.440
HHOthAdUn65	0.134	0.341	0.134	0.341
HHOthAdOv65	0.092	0.288	0.092	0.288

Table 2 - Descriptive statistics for variables used in regressions. The dependent variable for each regression is shown in bold

variable	dy/dx	Std. Err.	z	P>|z|		Mean
electype	0.013	0.004	3.53	0.000	***	0.066
yrshere	-0.001	0.000	-11.18	0.000	***	23.255
hvalue100k	0.044	0.003	16.34	0.000	***	1.452
HHincome100	0.006	0.000	16.41	0.000	***	5.492
age40_64	0.014	0.003	4.54	0.000	***	0.560
age65plus	-0.020	0.004	-4.46	0.000	***	0.283
locBMWurban	-0.009	0.004	-2.15	0.031	**	0.091
locothurban	0.015	0.003	4.34	0.000	***	0.196
locruralBMW	-0.007	0.005	-1.50	0.133		0.304
locothrural	0.002	0.004	0.46	0.642		0.247
tenurePurch	-0.002	0.002	-1.04	0.301		0.354
tenureLocalA	-0.081	0.005	-15.27	0.000	***	0.050
tenurePrRent	-0.107	0.008	-14.07	0.000	***	0.029
tenureVolOrg	-0.064	0.027	-2.39	0.017	**	0.001
tenureRentFr	-0.036	0.014	-2.63	0.008	***	0.006
socLowProf	-0.004	0.004	-0.90	0.366		0.168
socOthNonMan	-0.016	0.004	-3.77	0.000	***	0.171
socSkill	-0.028	0.004	-6.28	0.000	***	0.170
socSemiSkill	-0.036	0.005	-7.34	0.000	***	0.108
socUnskill	-0.059	0.005	-10.75	0.000	***	0.086
socUnknown	-0.037	0.005	-8.13	0.000	***	0.193
DwellSemiD	-0.018	0.003	-6.24	0.000	***	0.239
DwellTerrace	-0.025	0.003	-7.28	0.000	***	0.185
DwellPurpApt	-0.025	0.012	-2.17	0.030	**	0.007
DwellHousApt	-0.074	0.019	-3.93	0.000	***	0.003
DwellCaravan	-0.140	0.031	-4.46	0.000	***	0.002
HAge1900_40	-0.001	0.004	-0.34	0.733		0.120
HAge1941_60	0.006	0.004	1.80	0.072	*	0.125
HAge1961_70	0.031	0.004	8.90	0.000	***	0.116
HAge1971_80	0.029	0.003	8.74	0.000	***	0.238
HAge1981_90	0.021	0.004	5.62	0.000	***	0.151
HAge1991_96	0.025	0.004	5.72	0.000	***	0.075
HAgeAfter97	0.030	0.005	6.37	0.000	***	0.060
HH1over65	-0.003	0.006	-0.58	0.565		0.059
HHCoupleKids	0.118	0.004	31.35	0.000	***	0.363
HHOthKids	0.090	0.004	24.85	0.000	***	0.039
HHParAduKids	0.094	0.004	25.39	0.000	***	0.267
HHOthAdUn65	0.071	0.004	20.01	0.000	***	0.132
HHOthAdOv65	0.069	0.004	16.15	0.000	***	0.094

Table 3 - Papke-Wooldridge regression results for potential energy use; *=significant at the 10% level; **=significant at the 5% level; *=significant at the 1% level; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.**

totalEnSav	Coef.	Std. Err.	IRR	Std. Err.	z	P>|z|	
electype	0.044	0.012	1.045	0.012	3.69	0.000	***
yrshere	-0.003	0.000	0.997	0.000	-9.21	0.000	***
hvalue100k	0.034	0.002	1.034	0.003	13.59	0.000	***
HHincome100	0.010	0.001	1.011	0.001	10.11	0.000	***
age40_64	0.016	0.009	1.017	0.010	1.74	0.081	*
age65plus	-0.025	0.015	0.975	0.014	-1.74	0.081	*
locBMWurban	-0.026	0.013	0.974	0.013	-1.99	0.046	**
locothurban	-0.029	0.011	0.972	0.010	-2.71	0.007	***
locruralBMW	-0.101	0.012	0.904	0.011	-8.47	0.000	***
locothrural	-0.061	0.012	0.941	0.011	-5.16	0.000	***
tenurePurch	-0.007	0.008	0.994	0.008	-0.86	0.389	
tenureLocalA	-0.104	0.022	0.901	0.019	-4.83	0.000	***
tenurePrRent	-0.212	0.025	0.809	0.020	-8.64	0.000	***
tenureVolOrg	-0.084	0.092	0.919	0.084	-0.92	0.358	
tenureRentFr	-0.051	0.047	0.951	0.045	-1.07	0.287	
socLowProf	0.000	0.011	1.000	0.011	0.02	0.984	
socOthNonMan	-0.037	0.011	0.964	0.011	-3.24	0.001	***
socSkill	-0.036	0.012	0.965	0.011	-3.11	0.002	***
socSemiSkill	-0.052	0.013	0.950	0.013	-3.86	0.000	***
socUnskill	-0.084	0.015	0.920	0.014	-5.48	0.000	***
socUnknown	-0.043	0.012	0.958	0.012	-3.53	0.000	***
DwellSemiD	-0.004	0.009	0.996	0.009	-0.46	0.648	
DwellTerrace	-0.083	0.011	0.920	0.010	-7.35	0.000	***
DwellCaravan	0.028	0.109	1.029	0.112	0.26	0.795	
HAge1900_40	0.026	0.014	1.027	0.015	1.82	0.068	*
HAge1941_60	0.044	0.015	1.045	0.015	3.02	0.003	***
HAge1961_70	0.139	0.014	1.150	0.016	9.71	0.000	***
HAge1971_80	0.147	0.013	1.158	0.015	11.53	0.000	***
HAge1981_90	0.166	0.014	1.180	0.016	12.15	0.000	***
HAge1991_96	0.180	0.016	1.197	0.019	11.37	0.000	***
HAgeAfter97	0.208	0.017	1.231	0.021	12.34	0.000	***
HH1over65	-0.005	0.025	0.995	0.025	-0.21	0.835	
HHCoupleKids	0.070	0.017	1.072	0.018	4.06	0.000	***
HHOthKids	0.050	0.024	1.051	0.025	2.09	0.037	**
HHParAduKids	0.058	0.018	1.060	0.019	3.23	0.001	***
HHOthAdUn65	0.053	0.018	1.055	0.019	2.89	0.004	***
HHOthAdOv65	0.084	0.022	1.087	0.024	3.76	0.000	***
Constant	1.401	0.028			50.79	0.000	***
Observations	23,526						
LR chi2(37)	2,910.41						
Prob > chi2	0.0000						
Log likelihood	-45,438						

Table 4 - Poisson regression results for number of energy-saving features; *=significant at the 10% level; **=significant at the 5% level; *=significant at the 1% level.**

Year	Number	Title/Author(s) ESRI Authors/Co-authors Italicised
2007	218	The Public/Private Mix in Irish Acute Public Hospitals: Trends and Implications *Jacqueline O'Reilly* and *Miriam M. Wiley*
	217	Regret About the Timing of First Sexual Intercourse: The Role of Age and Context *Richard Layte*, Hannah McGee
	216	Determinants of Water Connection Type and Ownership of Water-Using Appliances in Ireland *Joe O'Doherty, Seán Lyons* and *Richard S.J. Tol*
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	213	Adolescents' Educational Attainment and School Experiences in Contemporary Ireland *Merike Darmody, Selina McCoy, Emer Smyth*
	212	Acting Up or Opting Out? Truancy in Irish Secondary Schools *Merike Darmody, Emer Smyth* and *Selina McCoy*
	211	Where do MNEs Expand Production: Location Choices of the Pharmaceutical Industry in Europe after 1992 *Frances P. Ruane*, Xiaoheng Zhang
	210	Holiday Destinations: Understanding the Travel Choices of Irish Tourists *Seán Lyons, Karen Mayor* and *Richard S.J. Tol*
	209	The Effectiveness of Competition Policy and the Price-Cost Margin: Evidence from Panel Data Patrick McCloughan, *Seán Lyons* and William Batt
	208	Tax Structure and Female Labour Market Participation: Evidence from Ireland *Tim Callan,* A. Van Soest, *J.R. Walsh*
	207	Distributional Effects of Public Education Transfers in Seven European Countries *Tim Callan,* Tim Smeeding and Panos Tsakloglou

206	The Earnings of Immigrants in Ireland: Results from the 2005 EU Survey of Income and Living Conditions *Alan Barrett* and *Yvonne McCarthy*
205	Convergence of Consumption Patterns During Macroeconomic Transition: A Model of Demand in Ireland and the OECD *Seán Lyons, Karen Mayor* and *Richard S.J. Tol*
204	The Adoption of ICT: Firm-Level Evidence from Irish Manufacturing Industries *Stefanie Haller* and *Iulia Traistaru-Siedschlag*
203	EU Enlargement and Migration: Assessing the Macroeconomic Impacts Ray Barrell, *John Fitz Gerald* and Rebecca Riley
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200	The 'Europeanisation' of Reference Groups: A Reconsideration Using EU-SILC *Christopher T. Whelan* and *Bertrand Maître*
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198	"Man Enough To Do It"? Girls and Non-Traditional Subjects in Lower Secondary Education *Emer Smyth* and *Merike Darmody*
197	Analysing the Effects of Tax-benefit Reforms on Income Distribution: A Decomposition Approach Olivier Bargain and *Tim Callan*
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