Evaluation of the effect of the Power of One campaign on natural gas consumption

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Abstract: In this paper we study an advertising campaign launched by the Irish government to induce more energy-efficient behaviour and we assess its effect on residential natural gas consumption. We first analyse changes in the daily consumption of natural gas and find that advertising leaflets had a significant, but short-lived, effect on natural gas consumption. We find no persistent effect of the campaign. We then study three surveys administered to 1000 consumers prior to and during the campaign. This repeated cross-section allows us to determine that the efficiency campaign has increased awareness of behaviours that curb natural gas consumption. However we do not find any significant effect of the campaign on self-reported natural gas-saving behaviour.

Key words: energy efficiency policy, advertising, natural gas

1. Introduction

In September 2006 the Irish Department of Communications, Energy and Natural Resources started a campaign to change energy consumption. The campaign was aimed at increasing awareness of energy efficiency issues and encouraging more efficient behaviour. The campaign targeted use of natural gas, electricity and transport fuel (petrol and diesel) both at home and at work.

In this paper we analyse the impact of the campaign on residential natural gas consumption, the bulk of which is used for heating. We are interested in assessing whether a broad advertising and awareness campaign can be an effective tool in reaching measurable energy savings.

We have access to aggregate daily consumption of natural gas for the residential and small commercial sectors between 2004 and 2008 and information gathered from

three household surveys conducted between September 2006 (prior to the beginning of the campaign) and November 2007. We find that the campaign enhances awareness of behaviours that lead to lower heating bills. This, however, does not translate into persistent changes in behaviour within the time frame of our study. We find a short-run effect, but no long-run effect, on daily natural gas consumption from one of the modules of the campaign.

Section 2 surveys existing literature. Section 3 gives details of the advertising campaign. Section 4 introduces the data. Section 5 describes the estimation strategy and the regression results for daily natural gas demand, whereas section 6 concentrates on the estimation strategy and the results of the survey analysis. Section 7 offers concluding comments.

2. Literature

The effect of advertising on consumers has been analysed from a marketing, economic, social and psychological point of view (for a useful overview see Vakratsas and Ambler, 1999). Economists typically focus on how advertising affects consumers' incentives. Bagwell (2001) reviews previous studies and suggests that advertising can be persuasive, informative or complementary. In the persuasive view, advertising is assumed to change preferences (shifting out demand for the advertised product), potentially making customers more loyal and decreasing the price elasticity of demand. The informative view assumes that advertising provides information on the product either directly or by signalling its high quality through the firm's willingness to spend money on its promotion. Finally, the complementary view assumes that preferences are fixed, but the act of acquiring advertised goods increases utility (for example because of their effect on perceived social status). In this paper we are interested in assessing if advertising affects consumers' choices through any of these

channels, but most likely either because consumers learn of ways to decrease their expenditure on energy (informative view) or because being 'green' improves their utility indirectly (complementary view).

Bertrand *et al.* (2010) analyse a direct-mail campaign in South Africa that advertises relatively small loans and find that some types of advertising can have large effects on demand for loans. The authors are especially interested in ads that have little or no informational content. For example, they find that ads that do not suggest a specific use for the loan increase loan uptake as much as a 25 per cent reduction in the interest rate.

Gillingham, Newell and Palmer (2006) review Demand Side Management (DSM) programs in the United States and conclude that the most effective policies are the ones that offer monetary incentives to buy energy-efficient durable goods, for example refrigerators. The authors state that advertising campaigns promoting energy efficient behaviours account for a very small part of the overall expenditure on demand-side management and are therefore likely to be responsible for small savings. Typically DSM programs have been run by the utilities themselves. The utilities have access to very detailed data, allowing them to obtain precise estimates. On the other hand Loughran and Kulick (2004) have questioned their methodology and the implied energy savings. Wirl (2000) has suggested that overall these programs do not have much of an impact and this is at least partly because utilities have an incentive to keep demand high and therefore run campaigns that are not effective. Auffhammer *et al.* (2008) review DSM programs enacted in the 1990s and find that they cannot statistically reject the level of savings cited by the utilities, on average 1.8 per cent. The average cost of reducing consumption, which the utilities declare to be between $0.02 and $0.03 per kilowatt-hour.

Reiss and White (2008) show that households in San Diego reduced their electricity consumption by 7 per cent over a six month period in response to public appeals. Whereas no monetary incentive was offered, the appeals came on the heels of the California electricity crisis in 2000, in the midst of limited rolling blackouts and with the threat of much larger ones. This occurred during the summer, suggesting that changes in air conditioning use were a major factor in the reduction.

Nolan *et al.* (2008) undertake a field experiment with California households and find that the most effective campaigns exploit peer pressure. In their study the authors show that electricity consumption decreases more when consumers are told that their neighbours are also saving electricity (for example households are told that neighbours use fans more often than air conditioning, or that they turn off unnecessary lights) than when they are informed that saving energy will save them money and be good for the environment. In light of this growing research, some utilities have adopted 'comparative billing', where customers are told how much energy they consume with respect to their peers in an effort to increase energy efficiency. Ayres *et al.* (2009) study an experiment where consumers are provided comparative billing for both electricity and natural gas consumption. They compare changes in natural gas consumption between a treatment and a control group and find that the treatment group decreases consumption by about 1.2 per cent with respect to the control group. The decrease occurs quickly, suggesting that it is likely driven by changes in behaviour.

Most studies of persuasion campaigns find that their effects decrease over time. This includes Nolan *et al.* (2008), mentioned above, who state that reductions in consumption started eroding as soon as one month after its end. Reberte *et al.* (1996) report that a second wave of the 'drink milk' campaign in New York had a smaller

effect than the first one. Studies cited in Vakratsas and Ambler (1999) find that the effect of advertising tends to decrease as the campaign becomes longer. Ayres *et al.* (2009), on the other hand, find that the effect persists for the first year, the length of their study.

For Ireland, Dulleck and Kaufmann (2004) study a previous energy-efficiency campaign run by the main electricity utility in 1990. They find that households responded to the campaign by decreasing consumption in the medium run by 7 per cent but there was no short-run effect. The authors conclude that the effect is most likely driven by the adoption of energy efficient appliances. Their data set runs from 1976 to 1993 and is based on households' bimonthly bills. Their campaign variable increases gradually from 0 in January 1990 to 1 in December 1990 and stays at 1 thereafter. It is difficult to separate the effect of the campaign from other time-varying influences.

Natural gas use in Ireland has been growing rapidly, although from low levels. Conniffe (2000) analyses the Household Budget Survey (HBS) of 1994-1995 and finds that only 26.3 of urban and 17.9 per cent of all houses were connected to a gas line. In the same survey, the 'higher' social groups were more likely to have a natural gas connection. Income elasticity of natural gas was high by international standards at 0.75. The author explains that this is likely due to the fact that many households relied historically on peat and coal for heating, but aspired to cleaner heating systems. In fact Conniffe also finds that income elasticity of less convenient fuels (peat, LPG and coal) is negative. Scott *et al.* (2008) use the 2004-2005 HBS for Ireland and report that gas line connections reach 31 per cent of all houses by then. The difference in gas-line connections between income groups persists. Only 19 per cent of households in the poorest decile use piped natural gas, as opposed to 46 per cent of the wealthiest

decile. Income elasticity of natural gas declined to 0.39 but is still the highest income elasticity across all fuels.

3. Power of One campaign – description

The Power of One campaign is an energy efficiency information campaign funded by the Irish Department of Communications, Energy and Natural Resources. It started in September 2006 and lasted until March 2008 in the advertising-intensive mode described in this paper. It was followed by another – significantly smaller – campaign focussing on climate change, where many of the original messages continued to be addressed. The campaign aimed to provide information on energy-saving behaviours. It used television ads, radio ads, billboards, internet ads, ads in movie theatres, ads in the press and also partnered with utilities to include leaflets in bills. Typically the television campaign targeted a specific topic each month. After the launch at the end of September 2006, ads in November explained the advantages of not consuming electricity during peak time (5-7 p.m.). In early December the ads suggested investing in energy-efficient Christmas lights. The late December and January campaign focused on home heating. In February there were tips about how to decrease electricity used for lighting, March targeted appliance use, April was dedicated to suggestions for efficient appliance purchases, and May concentrated on how to improve automobile mileage. During July and August a 'reminder' campaign was aired. At the end of September 2007 the campaign entered its second year with a month dedicated to reducing energy use in the office, followed by a focus on lighting use in November and heating habits again around Christmas. Radio ads reinforced the television message, although they typically ran for two weeks while the television campaign ran for four weeks at a time. The total cost of the TV component of the Power of One campaign over the two years was about €3 million. Total costs for the

campaign ran to about €10 million for the two years. In this study we do not address the module of the campaign that targeted the use of energy at work, since it started in September 2008, after the period we focus on here.

This study sets out to determine if any changes in natural gas consumption during this period were driven by the advertising campaign. The main use of residential natural gas is for heating. We therefore limit our attention to the elements of the campaign that targeted heating habits. One module addressed heating specifically and ran on both radio and TV around Christmas in 2006 and again in 2007. This module cost about €109 thousand in the first year, including the cost of about 1,220 television spots, and €257 thousand in the second year when about 1,700 television and 280 radio ads were aired. It was complemented by leaflets enclosed in consumers' February or March natural gas bills (consumers are billed every other month) in both 2007 and 2008. Nearly 90 per cent of all natural gas and electricity consumers received the leaflets. The percentage of the population reached by the TV and radio ads varied by week, but by the end of each module was about 80 per cent, as measured by the advertising company.

4. Data description

The advertising data variable includes weekly information of the reach of advertising, i.e. the percentage of the population reached by the campaign, provided by Cawley Nea/TBWA, the advertising agency that undertook the campaign. The data also specifies the average number of times each person was exposed to the campaign each week. From these flow data we constructed an advertising variable equal to the share of the population that was reached at least three times by the television campaign

during the weeks the campaign on heating was active.[1] The summary statistics for the flow measure are reported in Table 1 and are used to build a stock variable, as explained in Section 5.

Table 1. Summary statistics of daily data

	Obs	Mean	Std. Dev.	Min	Max
Gas Demand (MWh)	1425	32443	18702	5727	74138
Personal consumption (million €)[a]	1425	20966	1299	18504	22575
Customers	1425	553,479	41,082	474,364	613,697
Population, thousands	1425	4268	109	4090	4443
Degree days	1424	5.70	3.85	0	15.6
Rain (0.1 mm)	1425	20.4	46.3	0	560
TV advert flow, %	1425	0.11	0.87	0	9.29
Leaflet advert flow, %	1425	0.14	2.65	0	50
CPI (no energy) (2006=100)	1425	99.17	4.54	93.4	106.8
Vacancy rate	1425	14.88	1.66	12.03	16.67
Natural gas Price (Index, 1995=100)	1425	157.48	26.68	114.1	204.7
Electricity Price (Index, 1995=100)	1425	163.77	11.78	138.9	180.5

[a] constant 2006 prices

In addition to the broadcast ads, consumers received Power of One information leaflets in their February or March natural gas bills. We take this into account by building a dummy variable that is equal to 0.5 for February and March of 2007 and measures the proportion of households reached by the leaflets. The stock for this advertising also depreciates over time. A separate variable is built for the 2008 campaign. The total effect of the advertising campaign is measured by the combined television and leaflet variables, the two modes with the highest overall consumer reach. We do not take into account other forms of advertising: internet, movie theatres, radio or billboard.[2] Ads in movie theatres and on billboards are likely to have

[1] This is based on the established result that the response to advertising levels off after the third exposure (see studies cited in Vakratsas and Ambler, 1999).

[2] The data provide reach for each radio campaign, but not its disaggregation by week. This makes it difficult to build an indicator that is consistent with the television one. The radio ads ran at the same time as the television ads, with a very similar total reach, so we assume it has the same penetration

had limited additional effect. Internet hits grew over the course of the campaign, but the largest number of unique visits to the Power of One website through internet ads was about 12,000 in November 2006, far fewer than those reached by television, radio and leaflets in bills. The results are also presented assuming a 0 per cent depreciation rate. This variant is equivalent to standard event analyses in the economic literature where the treatment is assumed to be equal to 0 before the campaign and 1 after the campaign.

Daily natural gas consumption data for the aggregate 'Non-daily metered' (NDM) sector comes from Bord Gáis, as does the monthly data on the total number of natural gas meters. The data runs from October 2004 to the 24th of August 2008, yielding 1,425 daily observations. The NDM sector comprises all consumers who are not metered individually on a daily basis. The main group of consumers in the NDM sector is households, but there are also a few small commercial and industrial businesses.[3] In 2008 residential customers represented 97 per cent of all customers, and residential consumption accounted for 72 per cent of natural gas consumed (CER, 2010). As shown in Table 1, the total number of customers varies between 474,000 at the beginning of our sample to 614,000 at the end, a 30 per cent increase. In order to maintain consistency throughout the analysis, the analysis focuses on consumption per customer. Ireland experienced a large increase in housing completions in the period we are studying. This was accompanied by an increase in vacancies. Since this implies that part of the 30 per cent increase in customers could be vacant housing, we also include the average vacancy rate, calculated on a quarterly basis. The weather variables come from the European Climate Assessment and Dataset (Klein Tank *et al.*, 2002). We use the daily temperature and rainfall measurements for Dublin and

pattern and its effect is captured by the television ad variable. Ads in movie theatres and on billboards are likely to have had limited effect as they aired mostly in the 6 week introductory period.

[3] Any customer consuming more than 5.3 GWh of natural gas per year is metered daily in Ireland.

build a time series of heating degree days designed to measure the need for heating on any given day. There is one heating degree day if the average temperature is one degree below 15.5 ºC. Colder days are characterised by a larger number of degree days. Since there is a missing observation for the daily temperature this provides 1,424 observations. We then calculate the difference between current degree days and their 50-year average and also allow for non-linear effects of weather variables. A detailed description of the weather variables can be found in Appendix A.

Indices of residential quarterly energy prices for electricity and natural gas come from the International Energy Agency's *Energy prices and taxes*. We convert them into real relative energy price indices, dividing them by the monthly Consumer Price Index (CPI) excluding energy goods from the Central Statistics Office (CSO). These deflated indices allow us to take account of changes in the relative price of energy goods with respect to other goods in households' consumption baskets.

As a proxy for income we use information on personal expenditure of goods and services at constant 2006 market prices, available on a quarterly basis from the quarterly national accounts. This allows us to account for changes in the economic environment rather than strictly measuring changes in income, given that we are dealing with average measures across households. To measure personal expenditure per capita, we divide aggregate personal expenditure by the yearly population size, available from the CSO, and interpolate to obtain quarterly values.

In addition to the daily natural gas consumption, we have access to data from three face-to-face surveys that were conducted prior to and during the campaign. The first survey dates to September 2006 and the other two were carried out in May 2007 and in November 2007. This allows us to assess the first year of the campaign more

thoroughly and measure self-reported changes in awareness and behaviour. These data are described in more detail in section 6.

5. Methodology and results

We are interested in measuring the effect of the campaign on average national gas consumption. Ideally, we would have access to a control group that was not subject to the advertising campaign, but was otherwise identical to the group we are interested in studying. Because the Power of One was a national campaign, it is impossible to identify such a control group. We therefore use a different strategy and measure the effect of the campaign by observing consumers in two different states: one prior to the advertising campaign and one during and after the advertising campaign. We identify the effects of the campaign by comparing consumption patterns in the period before and the period after the launch of the campaign. In order for the analysis to be meaningful, we must control for any other aspects affecting natural gas consumption that have varied over time. Chief among these are changes in weather, which are the main determinant of natural gas consumption, explaining more than 90 per cent of natural gas use variation.

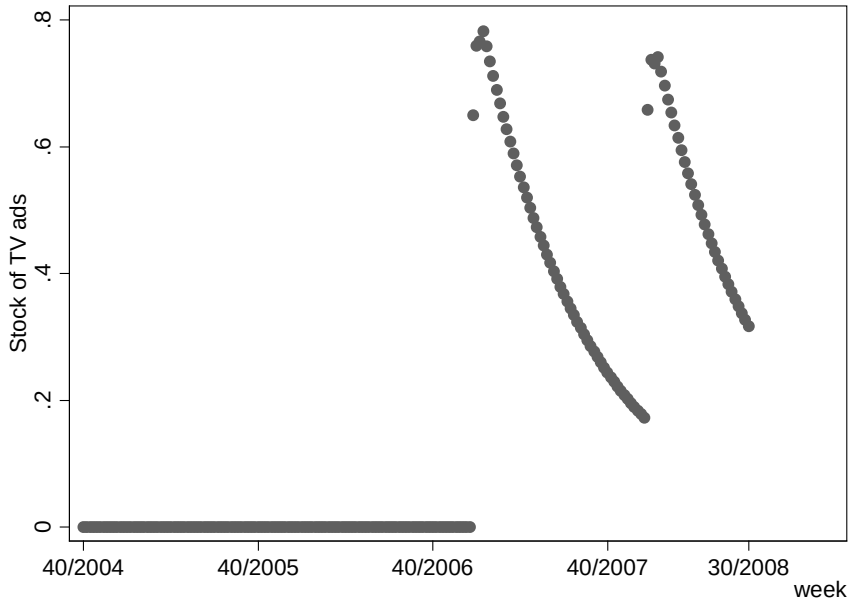
We measure the advertising variable in several alternative ways. In regular event analysis, the change in policy is measured by a dummy variable that is zero prior to the event (in this case the advertising campaign) and one after that. We use the same approach here, except that the post-event variable is weighted by the per cent of the population reached by the campaign in each period, so instead of being a dummy variable that is either 0 or 1, the variable is 0 before the beginning of the campaign, ramps up to about 0.8 for the TV variable and 1 for the leaflet variable and then stays at that level. This is equivalent to saying that we expect no depreciation of the campaign message over time. The literature suggests that the effect of advertising

vanishes between six months and a little over a year (Schmalensee, 1972; studies cited in Vakratsas and Ambler, 1999). To take this into account we alternatively assume that the effect of advertising depreciates over time at a constant rate $\delta > 0$. In this case the stock of advertising at time *t* is calculated as the stock of advertising at time *(t-1)*, appropriately depreciated, plus any new advertising that takes place at time *t*. More formally:

$$A_t = A_{t-1}(1-\delta) + AF_t \qquad (1)$$

where *A* represents the advertising stock, δ is the depreciation rate and *AF* is the advertising flow. Figure 1 illustrates the weekly television advertising stock when the stock depreciates by 80 per cent after one year.

Figure 1. Weekly stock of TV advertising campaign on heating



The heating campaign encourages households to lower their thermostat setting, a behaviour that cannot be repeated indefinitely (Woods, 2008). We therefore allow each year of advertising to have a separate effect on natural gas use.

We assume that the per capita demand for gas depends on several variables. We use a log-log specification as is common in the literature analysing energy demand. Equation (2) defines the specification.

$$\ln GD_t = \alpha + \sum_n \rho_n \ln GD_{t-n} + \beta_i W_{it} + \gamma \ln I_t + \nu V_t + \vartheta_j \ln P_{jt} + \pi_s A_{st} + \zeta Z_t + \varepsilon_t \quad (2)$$

GD represents natural gas demand per customer, *W* represents weather variables, such as heating degree days, which measure how cold it is in each period, the amount of rain, etc. The lagged dependent variable accounts for possible inertia in heating behaviour (it includes both a one period and seven period lag), to reflect the fact that if the heating was on yesterday it is more likely to be on today (all other things being equal). *I* represents personal expenditure per capita on goods and services, V_t is the housing vacancy rate for Ireland as a whole, $P_j = \{P_{NG}, P_E\}$ is an index of the price of natural gas and electricity for households and *t* indexes time. A_s represents the stock of advertisement, $s = \{TV, L\}$ represents either television or direct mail advertising. Finally *Z* includes dummies that pick up the effects of months, holidays and days of the week. The detailed specification of the dummy variables can be found in Appendix A.

At low income levels we expect that natural gas use will grow when disposable income increases. This reflects the fact that as personal consumption per capita (used as a proxy for income) increases, there is a tendency to warm homes more and also accounts for the longer term effect of the increase in housing sizes.[4] At higher income the effect might be muted. Since we can only measure the average effect of income on average consumption, we are agnostic about the value of γ. We expect the coefficient

[4] We only have information on the average disposable income per capita for the whole population. We know from the 2004-2005 Household Budget Survey that households with a gas connection have an average disposable income that is 15 per cent higher than the general population. We implicitly assume that the ratio of personal disposable income per capita of those with a natural gas connection with respect to general personal disposable income per capita is constant over the time of this study.

on the price of natural gas, ϑ_{NG}, to be negative and the coefficient on the price of electricity, ϑ_E, to be positive. In many households heating can be increased by using small electric portable units in addition to gas heating, so limited switching of heating sources is fairly easy. There is however evidence that heating behaviour is fairly inelastic to the price of energy (van den Berg, 2008). If the campaign is effective, the coefficient on advertising, π_s, will be negative denoting a reduction in consumption in line with the increase in energy efficiency advertising. If the two coefficients (for TV ads and leaflets) are negative and jointly significant, we conclude that the campaign had an effect.

As noted in the last section, small industrial and commercial entities are responsible for about a quarter of the daily natural gas consumption measured in the data. Most of their consumption is for heating and therefore driven by the same weather variables. We do not explicitly take into account the possible effect of other ongoing programs, such as Sustainable Energy Authority of Ireland's (SEAI) 'Lower Income Housing' program or additional efforts to improve insulation in local authority housing. These programs are unlikely to have a large effect on natural gas consumption for two reasons. First, as noted in section 2, lower-income households are less likely to have a natural gas connection. Second, between 2004 and 2007 the SEAI program involved 2000 to 3000 dwellings a year (Dáil Éireann, 2007), a number too small to have a measurable effect on aggregate natural gas consumption (the total number of dwellings in the Republic of Ireland is about 2 million).

The 2004-2005 Household Budget Survey (HBS) shows that households spend on average €30.65 per week on energy, or 4 per cent of their total weekly expenditure. Natural gas expenditure is on average 13 per cent of households' energy expenditure,

with the wealthiest decile spending a higher percentage (19 per cent) and the lowest decile spending a lower percentage (9 per cent).

In Table 2 we present the results for select variables when the dependent variable is the log of daily natural gas consumption per customer for different levels of depreciation of the advertising variables.[5] We estimate the regression with OLS, using the Huber-White correction for heteroscedasticity. We find no residual autocorrelation of the first order.[6] To ensure that we are not estimating a spurious relation between natural gas consumption per capita and explanatory variables due to the presence of a unit root, we test for stationarity of the log of natural gas demand per capita and find that we can reject the hypothesis of a unit root at the 95 per cent confidence level.[7] The first column of Table 2 shows the results when there is no depreciation of the advertising effect (i.e. $\delta = 0$). The second column shows the results when advertising is assumed to depreciate by 80 per cent after 12 months; the third column shows the results for a steeper depreciation rate, when all the advertising effect is extinguished within 6 months. Analysing daily consumption allows us to account for the weather patterns and for special days (holidays, days of week) very precisely. The disadvantage is that the television advertising variable is available weekly. In order to obtain daily information we need to make additional assumptions on how it varies within each week. In the following analysis we have assumed that the advertising variables grow linearly within each week.

[5] Complete results can be found in Table B.1 in Appendix B.

[6] OLS estimators in the presence of lagged dependent variables are consistent as long as there is no residual serial correlation. In this case we tested for autocorrelation of the first order using the alternative Durbin test and cannot reject the hypothesis of no autocorrelation, as reported in the tables. The lack of residual autocorrelation also suggests that we can discount the risk that the coefficient on the lagged dependent variable is overestimated and coefficients on other variables of interest are underestimated, as shown for example in Keele and Kelly (2006).

[7] We use the augmented Dickey-Fuller test with constant, which tests the null hypothesis of the existence of a unit root. The reported approximate MacKinnon p-value for the test is 0.013.

Table 2. Dependent variable: log daily natural gas consumption per customer

	Depreciation of advertising over 1 year		
	0%	**80%**	**100% in 6 months**
Log Gas demand (t-1)	0.736***	0.733***	0.735***
	(0.021)	(0.021)	(0.021)
Log Gas demand (t-7)	0.0603***	0.0592***	0.0590***
	(0.014)	(0.014)	(0.014)
Log consumption per capita	0.323	0.156	-0.169
	(0.351)	(0.364)	(0.435)
Bank holiday dummy	-0.0640***	-0.0642***	-0.0642***
	(0.0132)	(0.0133)	(0.0132)
Christmas dummy	-0.0078	-0.0074	-0.0074
	(0.0141)	(0.0142)	(0.0144)
Power of One TV – year 1	0.0059	-0.0059	0.0008
	(0.0202)	(0.0219)	(0.0307)
Power of One leaflet, year 1	-0.0175	-0.0368**	-0.0779***
	(0.0161)	(0.0182)	(0.0276)
Power of One TV – year 2	0.0343	0.0366	0.0327
	(0.0251)	(0.0267)	(0.0367)
Power of One leaflet, year 2	-0.0046	-0.00255	0.00315
	(0.0172)	(0.0194)	(0.0266)
Log natural gas price	0.0091	0.0125	0.0110
	(0.0485)	(0.039)	(0.0352)
Log electricity price	0.0958	0.237	0.206
	(0.188)	(0.201)	(0.208)
Vacancy rate	-0.0176*	-0.0149*	-0.0080
	(0.0094)	(0.009)	(0.0094)
Weather variables	Yes***	Yes***	Yes***
Month dummies	Yes***	Yes***	Yes***
Day of week dummies	Yes***	Yes***	Yes***
Constant	-1.315**	-1.833***	-1.234**
	(0.643)	(0.654)	(0.560)
Observations	1417	1417	1417
R-squared	0.984	0.984	0.984
Durbin alternative test	$\chi^2 = 0.197$	$\chi^2 = 0.201$	$\chi^2 = 0.223$
1st order autocorrelation	(p = 0.657)	(p = 0.654)	(p = 0.637)

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

We find a large inertia effect measured by the lagged dependent variable across all specifications. This suggests that people do not adjust instantly to changes in outdoor temperature. Personal consumption of goods and services per capita does not have a significant effect on the demand for natural gas. There are several explanations for this. It might be difficult to measure the effect of personal expenditure because it varied little during the period or because the national average might not be representative of natural gas customers. It could also be that urban consumers have higher income (and expenditure) on average but consume less in heating since they

live in smaller dwellings such as apartments, thereby causing the average effect to be close to zero.

We do not have access to the disaggregation of natural gas customers by region, but we know that they are not randomly distributed around the country. The majority of the customers are in the Dublin and Cork area and typically have a higher income than national average. Recently connections have expanded in Western counties, where average income tends to be lower.

The coefficients on the prices of natural gas and electricity are not significantly different from zero. This is probably due to the fact that residential prices change only about once to twice a year during the time horizon of this study. It is also consistent with the general finding that natural gas demand is inelastic to price (see e.g. Baker and Blundell, 2001; Asche *et al.*, 2008; van der Berg, 2008).

The coefficient on bank holidays is negative. This is possibly due to households going on vacation during long weekends that include bank holidays. Alternatively, the effect could be due to the influence of (non-retail) small commercial businesses. Retail businesses are typically open on bank holidays, so they would not be affected.

When we assume a 0 depreciation rate, there is no measurable effect of the advertising campaign. Across all specifications of the advertising variable, the only advertising variable that has a statistically significant effect is the first year of leaflet advertising when advertising depreciation is positive. For the 80 per cent depreciation rate, Table 2 reports that for every 10 per cent increase in the proportion of people reached by the leaflet ads there is a 0.368 per cent reduction in natural gas consumption, increasing to a 0.779 per cent reduction for the 100 per cent depreciation column.

These results imply that there is a short run effect of the campaign, but no measurable long-run effect. This is in line with other studies (e.g. Nolan *et al.*, 2008) that find that

the effect of a persuasion campaign starts decreasing fairly quickly, but is not in line with the findings in Asche *et al.* (2009) that suggest that the effect persists at least for the first year.

Bord Gáis, the natural gas utility, has reported an ongoing decrease in per-capita natural gas consumption, possibly due to the increase in vacancy rates and the uptake of gas connections in smaller homes, such as apartments. To account for the vacancy rate effect, we introduce a national level vacancy rate which is only significant at the 10 per cent level when advertising is assumed to depreciate by 80 per cent in a year or not at all. The estimated coefficient is negative, showing that average consumption decreases as the vacancy rate increases, as expected. The fact that this relation is not statistically stronger might be due again to differences between the makeup of the population of natural gas customers and the wider population. In particular we expect a lower uptake of natural gas in second homes, since the cost of dual fuel connection will be larger than the (likely small) additional cost of electricity heating.

One concern is that unobserved characteristics might be driving the effect of the first year of advertising in leaflets. For this to be the case, there should be a variable that decreases the use of natural gas during February and March of 2007 and the months that directly follow. One possibility is that the previously discussed large influx of new customers might be affecting the results. If new customers are systematically consuming less and an exceptional numbers of new connections were established in February and March of 2007, the coefficients on the first year of the Power of One campaign leaflets might be biased. This is not the case, however. The number of new connections does indeed vary over time, but most new connections are established between October and January in each year. Moreover, the number of new connections in February and March of 2007 is not particularly different from the new connections

in February and March of the previous year (a total of 5748 versus 6084 in 2006). We therefore conclude that the influx of new customers is unlikely to be affecting the coefficient of the leaflet advertising variables.

As stated earlier, many studies show that the effect of persuasion campaigns depreciates quickly. There is however the possibility that campaigns aimed to change people's lifestyles take decades rather than years to have an impact on behaviour. An example is the 'participACTION' campaign in Canada that ran from 1971 to 2001 and aimed to increase the population's participation in physical activity (Bauman *et al.*, 2004). Since the natural gas consumption data in this study spans less than four years, we are not able to assess the campaign's long-term impact although the results presented in Table 2 suggest a rapidly decreasing effect over time.

In the next section we use individual level data to identify only self-reported changes in behaviour and awareness of energy efficient changes in heating.

6. Survey description and results

In addition to the data on daily consumption of natural gas we have access to data from three face-to-face surveys that were conducted prior to and during the campaign. The first survey dates to September 2006 and the other two were carried out in May 2007 and in November 2007. This allows us to assess the first year of the campaign. Each survey had about 1000 respondents, chosen to be representative of Ireland's households with respect to area of residence, gender and age distribution. The surveys asked about general interest in energy efficiency, awareness of the effects of specific behaviours and actual behaviour.

Since we are interested in the effect of the campaign on natural gas use, we limit our attention to the elements of the campaign that targeted heating habits. Specifically there was one question in the survey that asked respondents if they were aware that

decreasing the thermostat setting by one degree Celsius could lead to savings of up to 10 per cent. The response to this question forms the awareness variable we analyse below. Another question asked people if they actually turned down the thermostat in order to save on the heating bill. This forms the behaviour variable.

Similarly to the time series analysis, we identify the effect of the Power of One campaign by measuring how our variable of interest changes between survey waves, after controlling for other observed characteristics. If there are omitted variables that have also changed during the period of analysis and affect either awareness of how thermostat settings affect bills or behaviour, this might lead to biased estimates. However, we believe that this is not likely in this dataset, mostly because factors such as changes in energy prices or general awareness of climate change are unlikely to strongly influence the very specific measure that we study in this section: change in bills following the adjustment of the thermostat.

Table 4 presents summary statistics for the sample, disaggregated by survey wave. In the raw data we observe that awareness of the energy-saving behaviour slightly increased over time and that high interest in energy efficiency stayed fairly flat. Changes in behaviour (reports of an actual decrease in the thermostat setting) are more difficult to evaluate since in the first survey this question is asked only of the customers who report awareness of the issue. We address this in more detail later.

About 25 per cent of the sample uses natural gas for home-heating.[8] The share is slightly higher in the survey taken in November 2007. The ages of the respondents and the areas where they reside are roughly in line with Census 2006 figures (CSO, 2007), although rural areas are somewhat overrepresented, as are residents of the southern region of Munster. The sample slightly underrepresents the higher social

[8] This is a slight underestimation since only those uniquely or jointly responsible for paying natural gas bills are classified as natural gas users in the survey.

classes (managerial and professional) with respect to the 2006 Census. Apartment dwellers are also underrepresented, as is usually the case in face-to-face interviews in Ireland, due to the difficulty in gaining access to apartment buildings. There are 32 unclassified observations for the type of housing and we drop those observations from the analysis.

Table 4. Survey, summary statistics by survey date

	First survey Sep. 2006		Second survey May 2007		Third survey Nov. 2007	
	Obs	Mean	Obs	Mean	Obs	Mean
Awareness	1077	.61	937	.68	989	.72
Change behaviour	653	.60	1050	.44	1003	.50
Efficiency interest-high	1070	.27	1041	.26	1003	.30
Natural gas payer	1095	.25	1050	.25	1003	.30
Age 15-17	1095	.10	1050	.07	1003	.05
Age 18-24	1095	.11	1050	.11	1003	.10
Age 25-34	1095	.20	1050	.20	1003	.21
Age 35-44	1095	.19	1050	.19	1003	.23
Age 45-54	1095	.14	1050	.13	1003	.17
Age 55-64	1095	.12	1050	.14	1003	.13
Age 65 +	1095	.13	1050	.17	1003	.12
Class – AB (Professional & Managerial)	1095	.07	1050	.08	1003	.07
Class - C1 (White collar)	1095	.31	1050	.32	1003	.34
Class – C2 (Skilled manual)	1095	.25	1050	.23	1003	.27
Class – DE (unskilled manual & other)	1095	.27	1050	.28	1003	.23
Class - Farmer	1095	.10	1050	.09	1003	.09
Male	1095	.48	1050	.50	1003	.49
Female	1095	.52	1050	.50	1003	.51
Dublin	1095	.28	1050	.29	1003	.28
urban Leinster	1095	.11	1050	.10	1003	.14
Rural Leinster	1095	.15	1050	.12	1003	.12
Munster - Cork	1095	.09	1050	.10	1003	.06
Urban Munster	1095	.06	1050	.07	1003	.10
Rural Munster	1095	.13	1050	.13	1003	.12
Urban other	1095	.05	1050	.05	1003	.06
Rural other	1095	.14	1050	.13	1003	.13
Total rural	1095	.41	1050	.38	1003	.36
Apartment	1086	.02	1045	.04	981	.03
Detached	1086	.41	1045	.32	981	.38
Semidetached	1086	.38	1045	.43	981	.36
Terrace	1086	.19	1045	.21	981	.23
Other house	1086	.01	1045	.01	981	.00

We start by evaluating the general attitude towards energy efficiency and find that having a high interest in energy efficiency is not affected by the campaign.[9] We therefore use the 'high interest in energy efficiency' variable as a proxy for environmental concern, which might make a respondent more likely to be influenced by the campaign.

AWARENESS

We consider how the measure of awareness has changed with the Power of One campaign by estimating the following probit equation:

$$A_i = \alpha + \beta H_i + \gamma Y_i + \varphi S_i + \kappa G_i + \rho A_i + \tau T_i + EE_i^{H} + \varepsilon \qquad (5)$$

Awareness of the fact that lower thermostat settings lead to lower heating costs depends on the type of housing *H*, the age of the respondent *Y*, social class *S*, area of residence *A* and time of the survey *T*. We expect that larger houses will induce a higher awareness. We do not have a prior on how age, social class or area of residence will affect awareness of this specific issue. We expect that people with a high level of interest in energy efficiency (EE^H) will be more aware of energy reduction strategies throughout the period of analysis and that the Power of One campaign will increase awareness. The subscript *i* indexes the respondent.

Unfortunately the wording of the question we use for awareness changed over time. In the first survey, awareness of the issue was couched in a general context, while subsequent surveys linked the question to the ongoing advertising campaign.[10]

If not everyone who was initially aware of the potential savings is exposed to the campaign, the awareness results might be somewhat underestimated.

[9] Results shown in Table B.2 in Appendix B.

[10] Exact wording is reported in Appendix C, together with the information on how answers were classified.

The results are presented in the first two columns of Table 5 using the 2942 available observations. Awareness of the effect of controlling the thermostat on heating bills increased by about 8 per cent in May 2007 with respect to the pre-survey level and remained more or less stable at this level in November 2007.

Higher social classes tend to display greater awareness, whereas the younger segment of the population is less aware. Those who pay natural gas bills are not significantly different from the rest of the population, as shown in the second column of Table 5. As expected, those with high interest in energy efficiency tend to be more aware than the rest of the population. Households living in larger (detached) houses are more aware of the information. This is consistent with the idea that larger houses will consume more natural gas, as found for the Netherlands in Berkhout *et al*. (2004). The reported pseudo R-squared statistic is fairly low, although typical of cross-section analyses. To confirm that the model has explanatory power, we also perform the Hosmer-Lemeshow test, which cannot reject the hypothesis that the model fits the data well.[11]

The results are generally consistent with existing literature. Kotchen and Moore (2007) report that US households with increased environmental concern and higher incomes are more likely to participate in voluntary (and costly) programs that provide 'green' electricity. In general households in larger houses consume more and are more likely to be interested in information on how to improve heating efficiency. This is true in other studies, for example Berkhout *et al*. (2004).

BEHAVIOUR

[11] The Hosmer-Lemeshow test (Hosmer and Lemeshow, 1989) measures the fit of the model by decile. We report the χ-square statistic and its associated p-value.

We also study the effect of the first year of the Power of One campaign on self-reported behaviour. As in the analysis of awareness, the wording of the question changed over time (specific wording is reported in Appendix C).

The behaviour variable is set to 0 if the respondent answers that they do not turn down the heat by 1 degree Celsius in order to save up to 10 per cent off heating bill (September 2006) or if they answer that they have done nothing about turning down the heat (May and November 2007). For all other answers it takes the value of 1.

In order to provide a meaningful analysis, we have to limit the number of observations. In the first survey the behaviour question was asked only of those who declared to be aware of the issue, whereas in subsequent surveys it was asked of all respondents. If people who are aware are for some reason different from the general population, for example because they are more tuned in to environmental issues, this means that the subsection of the population in the first survey is more likely to report decreases in the use of heating. We therefore only use observations for people who declared to be aware across the three surveys. This reduces the sample size from 2942 observations to 1965.

$$B_i = \alpha + \beta H_i + \gamma Y_i + \varphi S_i + \kappa G_i + \rho A_i + \tau T_i + EE_i^{H} + \varepsilon \qquad (6)$$

B_i is the change in behaviour variable. It is 1 if the respondent answers that they have turned down the thermostat and 0 otherwise. Energy-saving behaviours tend to decrease with income since their opportunity cost is lower and increase with the size of homes as shown in Reiss and White (2008). As mentioned previously, having a high interest in energy efficiency is not affected by the Power of One campaign. We again use the high interest in energy efficiency variable as an independent measure of pre-survey attitudes towards environmental issues.

Table 5. Effects of campaign on self-reported awareness and behaviour

	Awareness	Awareness	Behaviour	Behaviour
Wave 1 - reference				
Wave 2 – May 2007	0.084***	0.085***	-0.042	-0.041
	(0.021)	(0.021)	(0.028)	(0.029)
Wave 3 – Nov. 2007	0.098***	0.098***	0.005	0.003
	(0.021)	(0.020)	(0.028)	(0.028)
Gas bill payer		0.013		0.060*
		(0.026)		(0.033)
Apartment - reference				
Detached	0.118**	0.119**	-0.082	-0.085
	(0.052)	(0.052)	(0.078)	(0.078)
Semidetached	0.074	0.074	-0.068	-0.075
	(0.051)	(0.051)	(0.076)	(0.076)
Terrace	0.043	0.042	-0.098	-0.108
	(0.052)	(0.052)	(0.079)	(0.079)
Other house	-0.032	-0.032	-0.042	-0.050
	(0.131)	(0.131)	(0.202)	(0.202)
Age > 65 - reference				
Age 15-17	-0.157***	-0.154***	-0.337***	-0.327***
	(0.044)	(0.044)	(0.056)	(0.058)
Age 18-24	-0.098**	-0.097**	-0.114**	-0.106**
	(0.039)	(0.039)	(0.052)	(0.052)
Age 25-34	0.084***	0.084***	-0.028	-0.028
	(0.029)	(0.029)	(0.041)	(0.041)
Age 35-44	0.100***	0.099***	0.035	0.033
	(0.029)	(0.029)	(0.040)	(0.040)
Age 45-54	0.120***	0.120***	0.070*	0.071*
	(0.029)	(0.029)	(0.041)	(0.041)
Age 55-64	0.083***	0.083***	-0.009	-0.008
	(0.031)	(0.031)	(0.044)	(0.044)
Low skill & unempl. - reference				
Class – AB (Professional & Managerial)	0.090***	0.090*	0.067	0.067
	(0.034)	(0.034	(0.045)	(0.045)
Class - C1 (White collar)	0.085***	0.085**	0.036	0.034
	(0.023)	(0.023	(0.031)	(0.031)
Class – C2 (Skilled manual)	0.076***	0.076**	0.068**	0.069**
	(0.024)	(0.024)	(0.032)	(0.032)
Class – Farmer	0.016	0.015	-0.023	-0.023
	(0.036)	(0.036	(0.048)	(0.048)
Male - reference				
Female	0.007	0.007	-0.000	-0.001
	(0.018)	(0.018)	(0.023)	(0.023)
High interest in energy efficiency	0.151***	0.151***	0.134***	0.133***
	(0.019)	(0.019)	(0.024)	(0.024)
Area dummies	Yes***	Yes***	Yes***	Yes**
Observations	2942	2942	1965	1965
Pseudo R-squared	0.081	0.081	0.051	0.052
Hosmer-Lemeshow test (χ-sq)	5.70	6.05	20.18	5.45
Hosmer-Lemeshow test p-value	p = 0.68	p = 0.64	p = 0.01	p = 0.71

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Coefficients measure marginal effects

Table 5 displays the results for the behaviour regression in columns 3 and 4. In this case the Power of One variables (proxied again by the time of the survey) exhibit no positive effect. Natural gas paying consumers appear much more likely to lower their thermostat setting and in fact the specification without this variable fails to fit the data well, according to the reported Hosmer-Lemeshow test.

This strong effect of having gas heating on willingness to lower the thermostat setting may be due to natural gas consumers' greater likelihood of having central heating operated by a thermostat in the first place. More than 90 per cent of Irish households have central heating according to the 2004-2005 Household Budget Survey, but some of the older systems based on solid fuels or oil may not provide an easily accessible central thermostat (e.g. they may be controlled with a timer rather than a room thermostat). The effect on awareness shows us that some households were more aware of the savings after the beginning of the campaign than before.

One interpretation of the results on behaviour is to think that households were optimising their heating settings and the additional information did not change their optimal behaviour. Another possibility is that the lack of central heating or appropriate controls might have limited the change in behaviour. Finally, the change in the wording of the survey over time might have brought more people to report that they were saving in the first survey rather than in subsequent surveys, where the savings were directly linked to the advertising campaign, thereby obscuring any effect of the campaign on behaviour. However, the results are consistent with the lack of a persistent change in heating behaviour found in the first part of this paper. We do not think that contemporaneous changes in energy prices affect the results, since the prices during this time period generally increased, presumably encouraging people to be aware of their thermostat setting.

We have also run the results limiting the observations to those who pay natural gas bills and results are qualitatively similar (results not reported). On average gas bill payers are more likely to have decreased their thermostat setting. However this self-reported behaviour did not increase after the campaign. Self-reported awareness on the other hand increased, in line with the rest of the population.

Summarising, we find a strong suggestion that the Power of One campaign affected awareness of how changing thermostat settings affects bills. There is weaker evidence that this did not however change actual behaviour.

7. Conclusion

This paper analysed the effects of the Power of One campaign on natural gas consumption. We first studied daily consumption of natural gas in the aggregated Non-Daily Metered sector in Ireland, before and during a national energy efficiency campaign. Our results show no persistent effect of the campaign. In the first year, however, Power of One leaflets included in customers' bills helped reduce consumption in the short run. We control for changes in weather and state-wide economic variables, such as the average level of housing vacancy rates and average personal disposable income. There are no further effects in the second year. In addition the results do not show any significant effect for the TV campaign, either in its first or second year.

We also examine a series of three surveys administered to 1,000 people each before and during the campaign. We find that awareness of the savings associated with decreasing the thermostat setting has significantly increased after the campaign. On the other hand, self-reported heating behaviour has not changed after the first year of the campaign, the time frame of the analysis. One possible interpretation is that whereas households now have more information, it does not affect their optimal

decision, but we have also highlighted that changes in the wording of the surveys might have led to an underestimation of its effects on self-reported behaviour.

We conclude that the campaign influenced awareness of the savings associated with a reduction of the thermostat setting and the short-run heating behaviour, but not longer-term behaviour. We suggest that in order to be an effective tool in reducing energy consumption, such campaigns may have to be backed up by additional measures, for example comparative billing and monetary incentives to switch to more efficient boilers.

There are some limitations to our data. First, questions in the surveys vary over time, which might lead to underestimation of the effect of the campaign on awareness of the information on heating costs. Second, the length of the data means that we can only look at short to medium run effects. While the results we find suggest that the impact of the campaign decreases relatively quickly over time, there could be further long-run effects. Although most of the literature finds decreasing effects over time (see for example Reberte *et al.*, 1996 and Nolan *et al.*, 2008), some studies report findings that are consistent with a persistent and possibly increasing effect over time (Ayres *et al.*, 2009 and Bauman *et al.*, 2004).

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Appendix A

This appendix provides details on which weather variables and dummy variables are used in the time series analysis of natural gas consumption. Because of the importance of weather on heating behaviour, we allow for non-linear effects of weather, in line with Conniffe (1996). There are a number of weather variables considered in the regressions:

$$W_{it} = [DD_t; DD^2{}_t; DDif_t; (DD_t - \sum_{k=1}^{13} (1/2)^k \cdot DD_{t-1}); R_t; L_t] \qquad (1A)$$

DD represents degree days, DDif is the difference between the current degree days and their 50 year average (LRDD) and R is the amount of daily rainfall. A more thorough explanation of the variables follows.

Degree Days (DD)

Degree Days provide a measure of the impact of temperature on heating or cooling requirements. One heating degree occurs when the average daily temperature is one degree below the base temperature (15.5 ºC). The average daily temperature is defined as the daily average between the minimum and maximum temperature as recorded for Dublin. The temperature information comes from the European Climate Assessment and Dataset (Klein Tank *et al.* 2002). To account for non-linearity the regression includes degree days and the square of degree days.

Lagged Degree Days Measure

An additional non-linear effect of the weather on natural gas consumption is captured using a lagged degree day measure:

Lagged Temperature Measure = ½ DD_{t-1} + ¼ DD_{t-2}+ 1/8 DD_{t-3} + …+ (1/8192) DD_{t-13}

Where DD_{t-n} refers to the number of degree days at time (t-n). Thus the impact of a days' temperature on gas demand declines as time passes.

Rain (R)

The rain variable is defined as the amount of rain fallen in Dublin (measured in 0.1 mm) if the day is cold enough to have non-zero degree days. Rain is likely to increase heating needs both because it is associated with lack of sunshine and because it increases humidity.

Day length (L)

Independent of the temperature, as the days get longer there is likely to be more sunshine, so heating needs are likely to fall.

Dummy variables in regression for daily consumption of natural gas

$$Z_t = \left[WD_{it}; M_{jt}; C_t; B_t\right] \qquad (2A)$$

WD represents the day of the week (where 1 = Monday, and Friday is the reference day), *M* represents the month of the year (July is the reference month), *C* is equal to one for the two weeks of Christmas and is zero otherwise, *B* is one if a day is a bank holiday an 0 otherwise.

Appendix B

Table B.1. (complete version of Table 2 in text).
Dependent variable: log natural gas consumption per capita;

	Depreciation rates of advertising			
	80%	**95%**	**100%**	**0%**
Log Gas demand (t-1)	0.733***	0.732***	0.735***	0.736***
	(0.021)	(0.021)	(0.021)	(0.021)
Log Gas demand (t-7)	0.0592***	0.0584***	0.0590***	0.0603***
	(0.014)	(0.014)	(0.014)	(0.014)
Log consumption per capita	0.156	-0.019	-0.169	0.323
	(0.364)	(0.388)	(0.435)	(0.351)
Degree days	0.0499***	0.050***	0.0494***	0.0494***
	(0.0038)	(0.004)	(0.0038)	(0.0038)
(Degree days)^2	-0.0012***	-0.0012***	-0.0011***	-0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
14day lag degree days	-0.0189***	-0.0189***	-0.0192***	-0.0190***
	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Day length	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	(8.75e-05)	(8.77e-05)	(8.93e-05)	(8.78e-05)
Rainfall (0.1 mm)	0.0005***	0.0005***	0.0005***	0.0005***
	(8.57e-05)	(8.56e-05)	(8.55e-05)	(8.59e-05)
Bank holiday dummy	-0.0642***	-0.0642***	-0.0642***	-0.0640***
	(0.0133)	(0.0133)	(0.0132)	(0.0132)
Christmas dummy	-0.0074	-0.0073	-0.0074	-0.0078
	(0.0142)	(0.0142)	(0.0144)	(0.0141)
January	0.0365	0.0352	0.0360	0.0390
	(0.0424)	(0.0423)	(0.0424)	(0.0427)
February	0.0726**	0.0743**	0.0773**	0.0715**
	(0.0357)	(0.0356)	(0.0357)	(0.0359)
March	0.102***	0.106***	0.108***	0.0982***
	(0.0296)	(0.0298)	(0.0298)	(0.0295)
April	0.0942***	0.0967***	0.0952***	0.0914***
	(0.0229)	(0.0229)	(0.0229)	(0.0229)
May	0.0631***	0.0647***	0.0641***	0.0614***
	(0.0195)	(0.0196)	(0.0195)	(0.0194)
June	0.0227	0.0233	0.0242	0.0225
	(0.0163)	(0.0163)	(0.0162)	(0.0162)
August	-0.0152	-0.0164	-0.0161	-0.0135
	(0.0151)	(0.0151)	(0.0152)	(0.0151)
September	-0.0005	-0.0033	-0.0030	0.0037
	(0.0241)	(0.0242)	(0.0244)	(0.0242)
October	0.0407	0.0383	0.0348	0.0407
	(0.0318)	(0.0317)	(0.0318)	(0.0323)
November	0.0502	0.0478	0.0432	0.0501
	(0.0406)	(0.0405)	(0.0407)	(0.0411)
December	0.0304	0.0279	0.0232	0.0306
	(0.0448)	(0.0447)	(0.0450)	(0.0452)
Power of One TV – year 1	-0.0059	-0.0079	0.0008	0.0059
	(0.0219)	(0.0237)	(0.0307)	(0.0202)
Power of One leaflet, year 1	-0.0368**	-0.0541***	-0.0779***	-0.0175
	(0.0182)	(0.0200)	(0.0276)	(0.0161)
Power of One TV – year 2	0.0366	0.0362	0.0327	0.0343
	(0.0267)	(0.0284)	(0.0367)	(0.0251)
Power of One leaflet, year 2	-0.00255	-0.0023	0.00315	-0.0046
	(0.0194)	(0.0213)	(0.0266)	(0.0172)
Log natural gas price	0.0125	0.0201	0.0110	0.0091

	(0.039)	(0.0360)	(0.0352)	(0.0485)
Log electricity price	0.237	0.278	0.206	0.0958
	(0.201)	(0.207)	(0.208)	(0.188)
Saturday	-0.0761***	-0.0762***	-0.0762***	-0.0760***
	(0.0090)	(0.0090)	(0.0090)	(0.0090)
Sunday	-0.059***	-0.0594***	-0.0590***	-0.0588***
	(0.0092)	(0.0092)	(0.0093)	(0.0093)
Monday	0.0890***	0.0889***	0.0894***	0.0895***
	(0.0095)	(0.0095)	(0.0095)	(0.0096)
Tuesday	0.0094	0.0094	0.0094	0.0095
	(0.0086)	(0.0086)	(0.0086)	(0.0086)
Wednesday	-0.0035	-0.0036	-0.0037	-0.0035
	(0.0089)	(0.0089)	(0.0089)	(0.0090)
Thursday	0.0031	0.0031	0.0031	0.0031
	(0.0090)	(0.0090)	(0.0090)	(0.0090)
Vacancy rate	-0.0149*	-0.0123	-0.0080	-0.0176*
	(0.009)	(0.0089)	(0.0094)	(0.0094)
Constant	-1.833***	-1.839***	-1.234**	-1.315**
	(0.654)	(0.638)	(0.560)	(0.643)
Observations	1417	1417	1417	1417
R-squared	0.984	0.984	0.984	0.984

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B.2. Interest in energy efficiency

	High interest	**High interest**
Wave 2 – May 2007	-0.0199	-0.0197
	(0.0195)	(0.0195)
Wave 3 – Nov. 2007	0.0093	0.0091
	(0.0199)	(0.0199)
Wave 1 - reference		
Gas bill payer		0.0085
		(0.0236)
Detached	0.0445	0.0447
	(0.0536)	(0.0536)
Semidetached	0.0288	0.0281
	(0.0513)	(0.0513)
Terrace	-0.0049	-0.0057
	(0.0520)	(0.0520)
Other house	-0.0962	-0.0960
	(0.1122)	(0.1122)
Apartment - reference		
Age 15-17	-0.2316***	-0.2309***
	(0.0182)	(0.0185)
Age 18-24	-0.1781***	-0.1775***
	(0.0221)	(0.0222)
Age 25-34	-0.0786***	-0.0787***
	(0.0256)	(0.0256)
Age 35-44	-0.0072	-0.0077
	(0.0278)	(0.0278)
Age 45-54	-0.0188	-0.0188
	(0.0287)	(0.0287)
Age 55-64	-0.0209	-0.0208
	(0.0295)	(0.0295)
Age > 65 - reference		
Class – AB	0.1669***	0.1667***
(Professional&Managerial)	(0.0390)	(0.0390)

Class - C1 (White collar)	0.1238***	0.1233***
	(0.0239)	(0.0239)
Class – C2 (Skilled manual)	0.0919***	0.0917***
	(0.0255)	(0.0255)
Class - Farmer	0.0359	0.0355
	(0.0365)	(0.0365)
Low skill & unempl. - ref		
Female	0.0353**	0.0352**
	(0.0161)	(0.0161)
Male - reference		
Area dummies	Yes***	Yes***
Pseudo R-sq	0.0539	0.0539
Observations	3080	3080

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Coefficients measure marginal effects

Appendix C

For the awareness campaign, the first survey suggested the following question:

I am going to read out some other energy saving tips. Please tell me which, if any, you are aware of already:
Turn the heat down by 1˚C to save up to 10% off heating bill

Respondents were allowed to answer either "Yes" or "No" to this question.

Subsequent surveys linked the question the ongoing advertising campaign:

Which of the following suggestions do you remember from the Power of One campaign?
Turn the heat down by 1˚C to save up to 10% off heating bill

In this case respondents could choose amongst more answers: "I remember that suggestion very clearly"; "I vaguely remember that suggestion"; "I don't remember that suggestion at all". For the second and third surveys we classify a respondent as being 'not aware' if he or she answers "I don't remember that suggestion at all" and 'aware' otherwise.

The question that addressed behaviour was the following in September 2006:

September 2006 *(Ask for each aware)*
Which, if any, do you tend do to?
Turn the heat down by 1˚C to save up to 10% off heating bill

The answer could be either "Yes" or "No". In May and November 2007 the question

specifically referred to the advertising campaign:

May & November 2007 *(Ask all)*
This advertising campaign has been running since September 2006. It has featured a number of specific recommendations. I am going to read out these to you and for each one I would like you to tell me which of the phrases on this card best summarises how you feel about each of those suggestions?
Turn the heat down by 1˚C to save up to 10% off heating bill

Respondents could answer "I was doing that regularly before the campaign started"; "I have been doing that much more often since the campaign started"; "I have been doing that a little more often since the campaign started"; "I have done nothing about that".