FUEL POVERTY AND POLICY IN IRELAND AND THE EUROPEAN UNION

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Glossary

Adverse selection	The phenomenon that results from the inability of one trader to assess the quality of another (due to information asymmetries) which makes it likely that poor-quality traders will predominate.
Coase Theorem	A theorem often used in resource and environmental economics that states economic efficiency is achieved when property rights are fully allocated and when free trade of all property rights is possible.
Consensual approach	The Consensual approach to measuring poverty employs indicators of socially perceived necessities. Unlike traditional forms of measuring relative poverty, this approach does not rely on the opinions or scientific postulates of academics or experts.
Cost benefit analysis	The appraisal of an investment project that includes all private and social costs accruing to the project over a pre-identified time period.
DEFRA/DTI	Department of Environment, Food and Rural Affairs (UK)/Department of Trade and Industry (UK)
Endogenous variables	A variable whose values are determined by other variables within a system.
Energy paradox	The slow, gradual diffusion across the housing stock of economically sound energy saving measures.
EU-14	All member states of the European Union during the years 1994 to 1997 including: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom.
Ex ante	Expected or intended beforehand. The terms are often used in economic

	evaluation to denote project appraisal prior to the implementation of the project.
Ex post	The result afterwards. The terms are often used in economic evaluation to denote project appraisal after the project has been implemented.
Excess winter mortality	The increased number of deaths that occur during the winter months over and above the mean mortality rate of the non-winter seasons.
Exogenous variables	Variables whose values are not determined within the set of equations or models established to make predictions or test a hypothesis.
Externalities (external costs/benefits)	The non-market costs (or benefits) of an action borne not by the private individual instigating the action but by society at large.
Free rider problem	The problem arising from an instance when no individual is willing to contribute towards the cost of a public good when it is hoped that someone else will bear the cost instead.
Fuel poverty	The inability to afford adequate home heat in, or the inability to heat, the home adequately for 10 per cent or less of household income.
Home Energy Efficiency Scheme (HEES)	The UK government's chief policy response to the alleviation of fuel poverty over the past decade, which includes means tested grants to low-income and elderly households to improve the energy efficiency characteristics of their homes.
Information asymmetry	A situation in which typically buyers and sellers possess differing levels of information about a good or service which generally results in market failure.

Internal Rate of Return (IRR)	The rate of interest, which would be used in discounting the flow over time of net revenue generated by an investment such that the present value of the net revenue flows is equal to the capital sum invested.
Longitudinal analysis	An empirical analysis of trends in which dynamic effects (over time) are highlighted.
Market failure	An outcome deriving from the self-interested behaviour of individuals in the context of free trade in which economic efficiency does not result and which provides ubiquitous argument for intervention of some kind.
NEA	Neighbourhood Energy Action
Net Social Benefit (NSB)	The monetary benefit (if positive) accruing to society as a result of a proposed project investment usually obtained through economic evaluation techniques such as cost benefit analysis.
OPEC	Organisation for Petroleum Exporting Countries
Payback period	The period over which the cumulative net revenue from an investment project equals the original investment.
Poverty trap	The combination of losing state benefit (social welfare) and paying income tax ensures that poor families keep very little of any extra money they earn.
Probit	This regression model extends the principles of generalised linear models to treat the case of dichotomous and polytomous dependent variables. These methods differ from standard regression in substituting maximum likelihood estimation of a link function of the dependent for regression's use of least squares estimation of the dependent itself. The function used in Probit is the

	inverse of the standard normal cumulative distribution function.
Regression analysis	A mathematical and statistical (econometric) technique commonly employed in applied social science research for estimating the parameters of an equation from sets of data of the independent and dependent variables.
Sensitivity analysis	An investigation into the strength of empirical research findings by altering the various assumptions underpinning the data.
Subsidy	A government grant to suppliers of goods and services.
Tradable permit	A quantity-based economic instrument that facilitates compliance with environmental emissions quotas (such as those set at the Kyoto and Gothenburg Protocols) through the buying and selling of emissions permits in a competitive marketplace.
Transaction costs	The costs associated with the process of buying and selling, sometimes referred to as 'hassle costs'.

Executive summary

Research aims

The core objective of this paper is to analyse key policy issues regarding fuel poverty in Ireland and across the European Union. More specifically, the paper aims to answer the following research questions:

a) What are the policy blockages that lead to fuel poverty (and represent the causes of market failure), and why do they exist?
b) What are the policy implications arising therefrom?
c) What policy instruments are available to alleviate fuel poverty and rectify market failure?
d) What is the international experience regarding fuel poverty policy making, and what lessons can be learned from these approaches?
e) What are the policy strategies available to reduce fuel poverty and improve domestic thermal standards?

The study employs longitudinal data from the European Community Household Panel to calculate fuel poverty in 14 EU states. Multivariate regression models are developed for the Irish data to examine in detail, those factors that influence the probability of being fuel poor. Recent data from a UCD-commissioned survey of Irish households are analysed to assess the key reasons for market failure in this area.

Research findings

Fuel poverty

Despite government spending in excess of €63m per annum on measures to mitigate fuel poverty, almost one in ten Irish households suffer from persistent fuel poverty. The incidence of fuel poverty is highest among low-income groups, such as single parents, the unemployed and those separated from their spouse. Southern Europe suffers from the highest national incidences of fuel poverty; however the national estimate of fuel poverty in Ireland is among the highest in northern Europe.

Reasons for market failure
Lack of income and information are found to be the main reasons for households failing to invest in energy efficiency, with 94 per cent of energy inefficient households reporting these barriers to household thermal efficiency; property rights' failures and transaction costs appear to be far less significant explanations of this market failure.

Policy implications
The policy implications of fuel poverty are strong in scope and scale. Fuel poverty results in excess environmental emissions of harmful air pollutants such as carbon dioxide, sulphur dioxide and nitrogen oxide. A strong policy arena has been developed for these emissions, and unless these are curbed significantly, Ireland and other EU member states are facing punitive fines from the EU under the Kyoto and Gothenburg Protocols respectively.

There are also strong implications for housing policy. Poor housing conditions are widespread in southern European countries, with damp and overcrowding affecting large portions of the housing stocks in these countries; the latter is also a problem in Ireland, the UK, Belgium and France. Thermal efficiency varies dramatically across housing in the EU, with standards declining from northern to southern Europe. Households living in multi-family dwellings are found to suffer disproportionately from fuel poverty across much of the EU, particularly in Ireland. Conditions in social housing in Ireland appear to be especially poor relative to the rest of northern Europe.

Fuel poverty is found to be heavily concentrated among certain social groups in Ireland, to a far greater extent than in other European countries. The persistently poor performance demonstrated by Ireland in the socio-economic analysis indicates a level of government failure in implementing some form of 'safety net' for low-income households in an attempt to combat fuel poverty. It is clear that the fuel allowance in Ireland (currently €9 per week for 29 weeks) is not a sufficient measure to combat fuel poverty. There is some evidence to suggest, however, that the fuel allowance does reduce the severity of experience of fuel poverty suffering among certain low-income household groups. As children are particularly vulnerable to the adverse health effects of cold, damp homes, it is disturbing to note the relatively high incidences

of fuel poverty among households with children. Such findings are of obvious concern for those involved in community and public health and children's health.

The public health implications of fuel poverty are far-reaching, with the potential for premature mortality among the very young and also among older people. Excess morbidity associated with domestic energy inefficiency and fuel poverty amounts to an excess exchequer expenditure of at least €58m in Ireland per annum. As many as 2,000 excess winter deaths in Ireland are associated with fuel poverty and domestic energy inefficiency. The majority of this excess mortality occurs in the over 65-age group in Ireland.

Policy measures

Ireland has traditionally based its fuel poverty policy measures around income subsidisation of low-income homes, *ad hoc* grant schemes and, more recently, building regulations governing thermal efficiency in housing. In Scandinavia, stringent building regulations have existed since the early 1960s. Tax breaks for owner-occupiers and subsidisation of tenants have been the main policy instruments used to achieve the high levels of domestic energy efficiency evident in the Nordic countries. The EU has given mainly peripheral attention to fuel poverty, concentrating more on the environmental policy perspective of energy efficiency.

Policy recommendations

Most policy responses across Europe are based on fiscal measures aimed at owner-occupiers, such as tax breaks, as well as grant aid to more vulnerable households. Information and advice is also a common component of the policy measures. It is recommended that each country adopts policies to improve the diffusion of energy saving measures to suit its own macro-economic and socio-economic conditions. It is argued that southern European nations like Greece, Spain and Portugal need to adopt the most radical policy shifts in tackling energy inefficiency and fuel poverty. Full-scale retrofitting programmes are recommended with heavy subsidisation of low-income households in an attempt to reduce the remarkable levels of housing deprivation, fuel poverty and related adverse health outcomes. The current Home Energy Efficiency Scheme (HEES) policy measure in the UK would appear to be somewhat successful

in tackling fuel poverty, with one third fewer households suffering in 1998 than in 1991. However, it is calculated in this study that, even if the scheme works at 100 per cent efficiency and is fully subscribed, it will take over 20 years for all fuel poor households in the UK to be lifted out of the fuel poverty net. The scheme, therefore, requires more funding.

An extensive programme is required to deal with the unsatisfactory level of fuel poverty and below par energy efficiency standards in Irish housing. If 10 per cent of fuel poor, energy inefficient households (that is, 24,000 homes) were retrofitted each year for a period of 10 years in Ireland, the total cost would amount to €45m per annum. Such a figure is easily raised through the introduction of a carbon energy tax in Ireland, however there are some serious distributional issues regarding such a tax, particularly among low-income households. While retrofitting programmes are expensive, costs can be minimised by ensuring economies of scale. Thus, a retrofitting programme aimed at improving the energy efficiency standards of the social housing sector could realise significant reductions in marginal costs by ensuring high levels of programme subscription and attendant economies of scale, rather than small, piecemeal *ad hoc* initiatives. Failure of governments to rectify the *status quo* will ensure that vulnerable householders will remain living in cold, uncomfortable housing conditions, exposing themselves and their children to a range of adverse health outcomes.

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1

Introduction

1.1. Background

Fuel poverty can be generically defined at the outset of this paper as the inability on the part of a household to afford adequate home heating.[1] It was identified formally in the UK in the early to mid 1970s at a time when the country was undergoing a period of high price inflation coupled with very steep rises in real oil prices as a result of the OPEC fuel crises.[2] The British Labour government decided initially to pass on fully the rising energy costs, which acted as a contractionary pulse in the economy and also as a means of promoting energy conservation. However, this meant the fuel price index rose by 9 per cent in real terms (Boardman, 1991) making home heating more financially burdensome for households. Despite a subsequent increase in state subsidisation of domestic energy costs, the levels of disconnection rose during this period.[3] Soon, researchers found that older people were living in cold housing and were unable to heat their homes to an adequate level of warmth (Wicks, 1978). In a survey of 1,000 older people Wicks showed that almost one in ten were at risk of hypothermia because their body temperature was so low. Yet, some researchers were slow to identify a causal relationship:

> There is, in fact, little evidence that the increase in prices for fuel in 1974-75 led to a new problem of fuel poverty (Bradshaw, 1980).

From Bradshaw's declaration, it is implicit that the problem of fuel poverty was always there, hidden under a blanket notion of poverty, but exacerbated as a result of the rising oil prices of the 1970s, and also perhaps by falling real incomes for some

[1] A more formal definition is derived later, but the term 'adequate' can be defined as 'comfortable and safe' at this point.
[2] Oil prices quadrupled within 12 months (1974-75) owing to OPEC's supply restrictions.
[3] Households that had their electricity and/or fuel supply cut off due to non-payment of bills.

households. It took some time before fuel poverty was recognised by the UK government as a valid term:

> I'm afraid I must take issue with the term, 'fuel poverty'. People do not talk of 'clothes poverty' or 'food poverty' and I do not think it is useful to talk of fuel poverty either (Peter Walker, Secretary of State for Energy, 1985).[4]

The extensive debate surrounding the issue in the 1980s and 1990s, where it had been argued that affordable warmth is a 'right rather than a privilege', has become poignant once again in the light of unstable worldwide fuel prices. Fuel poverty may be considered different to income poverty in one crucial way. Income poverty can be eradicated efficiently through income support, whereas the eradication of fuel poverty requires not just income subsidisation but also crucial investment in the capital stock (that is, housing stock), as fuel poverty is caused by a complex interaction between low income and domestic energy inefficiency. A straightforward *ad hoc* policy of income transfers (such as the fuel allowance in Ireland) may result in more people being able to afford adequate home heating. However, studies have shown that such funds are likely to be used inefficiently.[5] Energy inefficient households will spend more on fuel to achieve adequate household temperatures rather than invest in improvements to the building fabric, which will reap long-term net gains. This is because of market failures, which are most notably in the form of information gaps, that is, households often are unaware of the benefits – or existence – of energy saving measures.

In Ireland in the 1970s, there was little in the way of an informed debate concerning methodological or other aspects of fuel poverty. However, by the early 1980s there was recognition, at least, of a problem in the domestic sector regarding thermal standards and energy efficiency levels. A government-backed attic insulation scheme was introduced in 1980-82 and again in 1985-87 as a means to improving the heat retention (thermal efficiency) levels of Irish housing. There was still no formal recognition of the term 'fuel poverty', but income based policy measures were being implemented. Domestic energy conservation programmes were proposed in the programmes for government in 1993 and 1995, but little action followed (NEA, 1997). However, there has been a large

[4] As cited in Boardman (1991).
[5] See for example Haugland (1996).

input from the voluntary sector in the 1990s in Ireland, with groups like Energy Action funding research on fuel poverty as well as undertaking remedial work nationally to improve the thermal standards of Irish housing on a means-tested basis.

1.2. Driving forces and context

Ireland is an interesting case study within the context of EU-14[6] for a number of reasons. First, the Irish housing stock appears to be one of the most energy inefficient[7] in northern Europe[8] (Healy, 2003a). As a result of this energy inefficiency, energy consumption in the domestic sector is greater than necessary, as people inhabiting inefficient dwellings must consume more energy to heat their homes.[9] Consequently, environmental emissions are about three million tonnes per annum greater than they would be if homes were energy efficient (Clinch and Healy, 2000c). This is of considerable importance given that Ireland is having extreme difficulty in meeting its agreed target for stabilisation of greenhouse-gas emissions under the Kyoto Protocol and acidification precursors under the Gothenburg Agreement.[10] As such, environmental agreements for eradicating fuel poverty are very strong.

When fuel becomes more expensive (as it has done especially in Europe over the past two to three years), households find it increasingly difficult to heat their homes adequately. Those living in energy inefficient dwellings and on low incomes often cannot afford

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[6] EU-14 relates to all member states excluding Sweden, which joined the European Community Household Panel team subsequent to the time series analysed in this paper.

[7] 'Energy inefficient' in this case is defined in the housing engineering sense as dwellings lacking energy saving measures such as double-glazing, cavity wall insulation, draught stripping and so forth.

[8] 'Northern Europe' is defined broadly as the ten non-Mediterranean countries in the study (that is, excluding 'Southern'/Mediterranean nations including Italy, Greece, Spain and Portugal).

[9] It has also been shown that the poorest individuals tend to spend three times more than the average on energy relative to income (Clinch and Healy, 1999a).

[10] The Kyoto Protocol, signed by all EU member states, is a legally binding agreement on curbing emissions of greenhouse gases by 2010. While certain countries have been allowed an increase in environmental emissions (Ireland was allowed an increase of 13% over 1990 levels), many must reduce their emissions of greenhouse gases by 2010 or face legal action by the EU courts. The Gothenburg Agreement is similar to the Kyoto Protocol except that it aims to cut emissions of acidification precursors.

to heat their homes adequately and suffer from fuel poverty. The problem is a serious political, environmental, social and public health issue. The UK government, in particular, has invested considerably in assisting low-income groups in upgrading their housing. This has arisen primarily as a result of increased interest on the part of the current Labour government in combating the problem of high fuel poverty in Britain and Northern Ireland. Notwithstanding this investment, recent research has confirmed the persisting nature and considerable scale of the problem in the UK (DEFRA and DTI, 2001), leading some commentators to suggest that the structure, targeting and magnitude of remedial subvention programmes is far from optimal (Sefton, 2002).

Fuel poverty has many attendant effects, most notably on human health (Healy, 2003b; Rudge and Nicol, 2000). Ireland and the UK have the highest rates of seasonal mortality in northern Europe, and it has been shown that such mortality rates result, in no small part, from the inadequately protected, thermally inefficient housing stocks in these countries (Clinch and Healy, 2000a; Eurowinter Group, 1997). There are also strong associations between inadequately heated homes and increased rates of morbidity; higher incidences of various cardiovascular and respiratory disorders have been associated with cold exposure from within the home (Collins, 1986 and Evans *et al*, 2000). Thus, when temperatures fall during a typical British or Irish winter, households need to increase their expenditure on fuel considerably to heat their home adequately, owing to the poor level of heat retention in their homes. The problem of fuel poverty occurs, therefore, when a low-income household lacks adequate insulation levels and an efficient heating system to achieve affordable warmth.

Despite the substantial cost of retrofitting programmes, the net benefits to society (in terms of reduced energy consumption and environmental emissions and improvements in health and comfort) of eradicating fuel poverty through implementing domestic energy efficiency programmes are very substantial (Clinch and Healy, 2001; Ekins *et al*, 2001), yet Ireland is one of the few northern European nations lacking such state backed initiatives.

1.3. Aims of this paper

The core objective of this paper is to analyse the key policy issues regarding fuel poverty. More specifically, the paper aims to answer the following research questions:

a) What are the policy blockages that result in fuel poverty and market failure in domestic energy efficiency and why do they exist?
b) What are the policy implications arising therefrom?
c) What policy instruments are available to alleviate fuel poverty and rectify market failure?
d) What is the international experience regarding fuel poverty policy-making, and what lessons can be learned from these approaches?
e) What are the policy strategies available to reduce fuel poverty and improve domestic thermal standards?

To conduct this policy analysis, it is important first to examine empirically the levels of fuel poverty in EU-14, with a particular focus on the situation in Ireland. The paper devotes considerable space to this quantitative analysis using an original methodology developed by the author over three years of doctoral research.[11] A new (2001) national household survey of Ireland is employed for additional policy analysis (see (a) above), which elicits the main reasons for market failure and non-investment in energy efficiency in the domestic sector. In addition, a detailed literature review was conducted covering both refereed journal articles and other 'grey' studies; this review highlights the significant 'gaps' in the literature. Extensive discussions were undertaken with policymakers and practitioners in the area of fuel poverty to obtain the latest literature and identify the latest developments in the area. This was done at both the national and international levels. Discussions were also held in Ireland with officials from the Department of the Environment and Local Government, the Department of Health and Children, and the Department of Social and Family Affairs.

1.4. Why this study?

There has been virtually no comparative empirical analysis of fuel poverty undertaken hitherto. This research deficit has occurred, not because of a lack of interest in the area, but because of some major logistical reasons, most obviously the lack of comparable cross-country data. This has now been rectified with the availability of the

[11] The data employed in this paper originate primarily from the work undertaken for the author's PhD study in the Department of Environmental Studies, University College Dublin.

European Community Household Panel (ECHP). Data from this extensive, longitudinal survey relating to housing conditions and home heating have been analysed in this paper so as to quantify levels of fuel poverty across Europe using a consensual approach; these data are mainly indicators of housing deprivation which are based, à la Peter Townsend,[12] on socially perceived necessities. As such, this study represents the first pan-European quantitative analysis of fuel poverty using comparable, longitudinal data over the years 1994-97 inclusive. Such data are necessary first to inform policymakers on the extent and magnitude of the problem, and as a means to identify the most efficient policy measures to tackle fuel poverty.

1.5. Overview of study

There are two main components of the study. First, the context of fuel poverty and energy inefficient housing in Europe is delineated using cross-country data on energy efficiency standards and energy consumption in European housing. To derive robust cross-country estimates of fuel poverty, a new methodology is employed.[13] A variety of objective and subjective indicators of fuel poverty are utilised and a composite (weighted) measurement is derived. Multivariate Probit regression analysis is conducted for each indicator to validate the cross-tabulation results and to examine those factors that influence the probability of being fuel poor using Irish data. Sensitivity analysis is also conducted to test the effects of changing various methodological assumptions (including altering the respective weights assigned to each indicator of fuel poverty), and socio-economic and socio-demographic analysis conducted later identifies precisely who is suffering from fuel poverty across Europe.

Second, a detailed policy analysis is undertaken which identifies the market failure evident in domestic energy efficiency. An empirical examination of the reasons behind non-investment in energy saving measures in Ireland is also provided using the results of a 2001 UCD national household survey commissioned by Urban Institute Ireland. The policy implications of fuel poverty are discussed at some length. The paper presents the range of policy

[12] Peter Townsend's pioneering work on the theoretics and empirics of poverty and deprivation over the past three decades has been a key inspiration behind the methodology derived for use in this study (Townsend, 1979).

[13] This methodology was developed for use in the author's PhD thesis.

instruments available to reduce fuel poverty, and discusses current and past policies implemented in EU member states to mitigate the problem. The strategies implemented in Ireland with regard to assisting households to afford adequate warmth are critically examined. This allows for *ex post* exemplars to be identified and it illustrates a number of lessons learned from foreign policy approaches. Finally, pan European policy recommendations are delineated, with particular focus on the case of Ireland.

2

Previous research

2.1. Introduction

This chapter discusses of the existing literature in the field of fuel poverty and provides an overview of the three main approaches to measuring and defining the fuel poor. Despite a reasonably developed policy literature, there is a serious lack of robust empirical and theoretical literature regarding fuel poverty, both in a cross-country setting and in terms of investigating scientifically its effects on health. This is a major reason for devoting a substantial portion of this paper to empirical work analysing cross-country levels of fuel poverty. The following sections present an overview first of some key methodological issues, then some empirical reviews of fuel poverty levels, and finally the policy literature on fuel poverty under several main recurring themes, all of which are policy based and pertinent to this study. It should be noted that the literature review concentrates on peer reviewed published literature. Occasionally, a key piece of unpublished research or 'grey literature' is included in the discussion.

2.2 Measuring fuel poverty

Fuel poverty can be defined in a number of ways. The following are three major approaches.

2.2.1. Temperature

The earliest research on fuel poverty based its discussion on the notions of 'adequate home heating' and 'adequate warmth' (for example, Lewis, 1982 and Boardman, 1986). The term 'adequate warmth', however, is problematic, as various researchers and disciplines regard different temperatures as adequate for human health and comfort. The World Health Organisation, for instance, takes 20ºC as a benchmark temperature for those more vulnerable, such as older people and those with disabilities (Collins, 1986). Most medical literature favours a minimum temperature of 16ºC for able bodied, healthy people, but recommends a minimum of 18ºC for

sedentary activities and 21ºC for the more vulnerable. Boardman (1986) similarly advocates a temperature of 18ºC. These guidelines are taken in this paper as appropriate measurements of 'adequate warmth'.

Using a definition based on temperature, fuel poverty may be calculated by quantifying those households that fail to achieve minimum 'adequate' levels of household warmth. Such an approach, though theoretically simple, is problematic for a number of reasons, chiefly because of the inadequacy and unreliability of data on household temperatures. Milne and Boardman (2000) have found, for example, that living room temperature is not a good indicator of whole-house average temperature, as a warm living room may be found in an otherwise cold house, especially in low-income households without central heating. In addition, occupancy is an important factor in household warmth. A partially heated home (with a low mean whole-house temperature) may be classified incorrectly as 'fuel poor' if, say, only one person inhabits the house and only part of the house is occupied and heated. Furthermore, intermittent occupancy (for example, the house is only occupied for a few hours in the evening and at night) may also distort the results under this approach.

2.2.2. Expenditure

Another approach to measuring fuel poverty involves a more precise, quantitative method. Households spend varying proportions of their income on fuel; Clinch and Healy (1999a) demonstrated that the poorest 10 per cent of households in Ireland spend three times more on energy in the home relative to their income than the richest 10 per cent of households. As such, a 'fuel poverty line' can be set – similar to that in poverty research – where households are considered fuel poor if they spend more than X per cent of their income on energy in the home. Boardman (1991) has advocated a 10 per cent threshold based on net household income; UK policymakers and academics have recently changed this definition so that the denominator excludes housing costs (mortgage or rent payments). This has been considered a standard definition of fuel poverty and has been employed by the UK government in much of its analysis on fuel poverty (DETR, 1999).

Such an approach, while worthwhile, nevertheless fails to capture the deprivation and social exclusion elements of fuel

poverty. There does not appear to be any substantial rationale behind setting the budget line at 10 per cent of net income, and, therefore, this approach has been seen as lacking in any scientific basis (Healy, 2001). Studies using this method to calculate fuel poverty in the UK (e.g. the Department of the Environment, Transport and the Regions, 1999) have reported levels far greater than those using a consensual approach (see below) (Whyley and Callender, 1997). In addition, data on fuel expenditure as a proportion of household income at a micro level are not available in many European countries, and thus, an Expenditure approach cannot be utilised in a cross-country analysis of fuel poverty. An income-based analysis can also lead to confusion. Several definitions now exist, some with housing costs *included* in net household income, while other calculations *exclude* housing costs in the denominator of the definition; thus large variations are often reported using the expenditure approach because of the lack of uniformity in the equations employed for calculating fuel poverty. As such, this approach can be considered problematic and questionable on a number of methodological and logistical grounds.

2.2.3. Consensual

The consensual approach follows the method pioneered by leading poverty and deprivation researchers, Peter Townsend and David Gordon. Certain goods and services are considered to be necessary, not just by academics and 'experts' but by society at large. Some of these necessities fall under the umbrella of fuel poverty; the absence of certain items regarded as essential household attributes (or social norms) may be considered indicators of fuel poverty, as can the presence of certain unwanted household characteristics. For example, the vast majority of the population in the UK and Ireland considers possession of central heating in the home to be a necessity, as is double glazing (Callan *et al*, 1993, Gordon *et al*, 2000). The lack of these socially perceived necessities acts as an indicator of fuel poverty using an approach founded on consensual social indicators. Furthermore, the presence of damp in a house has been shown to be strongly associated with fuel poor households (Rudge and Nicol, 2000), and therefore can also be considered a useful *indicator* of fuel poverty. Such an approach attempts to capture the wider components of fuel poverty, such as social exclusion and material deprivation, and household size and occupancy, as opposed to

approaches based solely on home heating expenditure or household temperature. It also makes feasible the calculation of cross-country estimates of fuel poverty.

While the UK government has traditionally utilised the standard (Boardman) definition of fuel poverty in measuring the levels across the UK, the Department of the Environment, Food and Rural Affairs together with the Department of Trade and Industry have begun to look at an alternative measurement of fuel poverty using a Consensual approach in which a 'suite of indicators' is employed to calculate the incidence of fuel poverty (DEFRA and DTI, 2001). Such an approach is developed and employed in this paper.

There are some potential disadvantages using this approach. It is possible that the suite of indicators of fuel poverty used under this approach will capture the fuel poor more accurately in some countries more than others. For instance, the absence of central heating is likely to be of far greater significance to a household in a country that endures a harsh, cold climate (such as Finland or Germany) than a milder southern climate (such as Greece or Portugal). Thus, the results may overstate the incidence and magnitude of experience of the problem in some southern nations. Another disadvantage relates to the fact that the consensual approach is less well known among fuel poverty practitioners; the 'Standard', Boardman definition is still the most commonly employed definition of fuel poverty. Nevertheless, the advantages of such an approach outweigh the potential disadvantages by far.

2.3. Empirical evidence of fuel poverty

There is little published empirical work on fuel poverty. Milne and Boardman (2000) undertook an important study that analysed the significance of internal household temperatures in determining the amount of potential energy savings taken back in the form of improvements in householder comfort following energy efficiency retrofits. They showed that the internal temperature is the main determinant for the ratio of energy savings to comfort benefits after a retrofit. Their *ex post* study calculated that, at average household temperatures (16.5ºC) in the UK, about 30 per cent of the benefit of an energy efficiency improvement would be taken as a temperature increase, while the remaining 70 per cent of the benefits are taken as energy savings; in a very cold house (mean internal temperature of 14ºC) this falls to a 50:50 split, while in a warm house (internal

temperature of 20ºC), they quantified that all potential benefits are taken as energy savings. This is an interesting result as it corroborates previous research carried out by, *inter alia*, Skumatz (1996) and the Energy Saving Trust (1994). The former study evaluates a USA utility energy conservation programme and estimates that 75 per cent of total programme benefits are realised in terms of energy cost savings and emissions reductions; the latter estimates the proportion to be 70 per cent for the UK.

The above evidence was incorporated into a computer-modelling process of the Irish housing stock and its energy use to quantify the potential energy savings of a comprehensive energy efficiency programme to retrofit the entire dwelling stock in Ireland with such measures so as to bring its energy efficiency standards up to the latest (1997) Building Regulations (Clinch *et al*, 2001). This *ex ante* study estimated that 79 per cent of the benefits of this energy efficiency programme in Ireland would be realised as energy savings, the remainder being health and comfort benefits.

The most important recent work on fuel poverty has been undertaken by the UK Department of the Environment, Transport and the Regions (DETR, 1999) and the Departments of the Environment, Food and Rural Affairs, and Trade and Industry (DEFRA and DTI, 2001). This work quantified, in some detail, the extent and magnitude of fuel poverty in the UK using data from the House Conditions Survey of 1998. While a standard Boardman definition is employed in the calculations, the research indicates a move towards the investigation of deprivation indicators as a means to capturing the extent of fuel poverty in the UK. This approach, in which a suite of indicators is utilised to derive a composite measurement of fuel poverty, is developed and employed in this paper, and cross-country results are reported later.

2.4. Programme evaluation

There is a large (mainly *ex ante*) literature evaluating energy efficiency measures and proposed programmes aimed at improving the energy efficiency standards, but far less (*ex post*) literature dealing with the cost effectiveness of policy initiatives and programmes aimed at reducing fuel poverty and improving thermal standards. Some notable exceptions are outlined in this section.

Sefton (2002) analysed the cost effectiveness of the UK Home Energy Efficiency Scheme (HEES), recently updated by the UK

government. His research concludes that the structure, targeting and magnitude of remedial subvention programmes are far from optimal. Waldman and Ozog (1996) analysed a method of decomposing measured energy conservation into a natural component and an incentive induced component. They assert that ignoring the decomposition between natural and programme-induced savings would have overstated the programme benefits. Williams and Ross (1980) evaluated a range of US weatherisation programme policy initiatives and highlighted serious efficiency gaps and sub-optimal programme targeting. Their study is also of use in terms of identifying a number of market barriers to economic efficiency.[14]

In Ireland, Lawlor (1995) assessed the costs and benefits of government investments and subsidies applied to energy conservation in existing buildings, particularly in relation to heating and insulation. Other 'grey literature' includes that of Harvey (1996) and Quinn (1995).

2.5. Tax credits and subsidies

Tax credits for energy conservation retrofits have received considerable attention; the results of studies vary considerably, depending on assumptions regarding the individual case studies. Long (1993), in his econometric analysis, reports that income tax credits stimulate spending on residential energy conservation technologies. Haugland (1996) states that tax breaks given for investment in a Norwegian energy conservation programme were quite successful, although he estimates that 70 per cent of the programme participants were 'free riders' who would have invested in energy efficiency technologies anyway.[15] Hassett and Metcalf (1992), in their analysis of UK energy conservation programmes, estimate that a 10 percentage point change in the tax price for energy efficiency investments leads to a 24 per cent increase in the probability of investing through the take-up of tax credits. However, they stress the adverse effects of price uncertainty. Using data from the early 1990s, they argue that the actual change in the probability of households availing of tax credits falls to 1.5 per cent of total households in the UK. Nonetheless, this empirical

[14] A section on the literature dealing with market failure issues in fuel poverty follows.

[15] An interesting discussion of the 'free rider' problem can be found in Franz *et al* (1994).

study demonstrates that energy conservation tax credits can be significant in explaining the probability of take up of energy conservation retrofit programmes. However, it also demonstrates that, if there is a significant degree of price uncertainty evident, the effectiveness of tax credits is hugely reduced.

It is notable that less recent studies report different relationships between tax credits and energy conservation investment, perhaps owing to the increased uncertainty and instability of the energy markets previously (for instance, circa 1991 Gulf War and 1970s OPEC crises). Quigley (1991), based on a Californian study of residential energy conservation programmes, reports that the impact of tax credits has been sharply regressive – half the credits were claimed by households on incomes of more than $100,000 per annum. He again raises the issue of uncertainty as regards energy price inflation and the adverse effect that this can have on the robustness of potential policy recommendations. Walsh (1989), using more USA case studies, concurs and uses his empirical results to support this argument. However, he believes that the reasons for this market failure are primarily transaction costs (in this case, 'too much paper work') and information asymmetries. Price uncertainty is not seen as a major influential factor by Walsh.

2.6. Market failure

Why do many people not invest in energy saving measures, especially when it is seen that there is large room for reductions in energy costs? Scott (1993) proffered reasons as to why energy conservation opportunities are not harvested in Ireland; she followed this up with a later study (Scott, 1997) on a similar topic. Lack of information on the part of the householder, property-rights assignment, small energy saving potential, limited access to credit and transaction costs are all listed as potential explanations. In another paper, Scott (1995) proposes that the assumption of rational behaviour in Ireland, with regard to energy efficiency investments in the home, may not be a sound one. She concludes that irrational behaviour may be attributable for some 40 per cent of all cases of non-take-up in Ireland. For the 60 per cent majority, however, their 'decision' to spend more on energy than is potentially necessary can be explained by considering a number of (mainly) market failure explanations, as discussed previously. Finally, Scott (1996) argues the case for commuting the funds spent on social welfare schemes

to pay for a programme of household insulation.

Clinch and Healy (2000b) provide a discursive account of the reasons lying behind market and government failures relating to domestic thermal inefficiency and fuel poverty. Policy instruments available to policymakers to rectify such failure are also outlined, as are some *ex post* exemplars, and an optimal policy mix is developed within the context of Ireland to assist policymakers implementing cost effective fuel poverty alleviation strategies. This analysis is developed further in Chapter 6.

In the non-Irish literature, Brechling and Smith (1994), in an early paper, identify a number of potential explanations for market failure in the UK, including 'credit market failure' (individuals on low-incomes inhabit less efficient households, have less access to capital, and so on). Weber (1990) has argued that this problem is further compounded by the fact that individuals on low-incomes are less likely to obtain a loan at the market rate of interest and may feel it necessary to resort to an illegal money lender (or 'loan sharks'). Salvage (1992) has shown that less well off people tend to also have an aversion to borrowing. Lack of information is seen as a principal reason for poor response rates in energy conservation programmes by Williams and Ross (1980), Chapman (1996) and Carlsmith *et al* (1990). Tietenberg (1997) argues that information policies for curbing pollution are effective but not necessarily efficient. Analysis is 'sketchy', but he believes that the quality and quantity of information is important, that is, too much can lead to decreasing returns or negative results. In addition, Smith (1992) has argued that an information asymmetry between producers and consumers of energy efficiency measures may lead to adverse selection of retrofitting technologies. Transaction costs (the costs of learning about, and administering, energy saving measures) are thought to be a major reason for market failure by Convery (1998). The issue of assignment of property rights is also a matter for concern (Brechling and Smith, 1992 and Smith, 1992). The latter maintains that 'free rider' incentives may exist in a multi family dwelling, another compounding factor.

Brechling and Smith (1992) argue that policy proposals regarding energy conservation should be framed around the degree of energy market uncertainty (both as regards energy prices and the impact of policy measures on the take up of energy efficiency technologies). They conclude that a three-step approach would help clear the

market in the UK: information campaigns (both private and public led), regulation (for example, bringing the entire stock up to the latest building regulations) and subsidisation (interestingly – and controversially – not just to low-income families). Jaffe and Stavins (1994a, 1994b) believe that 'non market failure' causes, such as socio-economic considerations (for example, poorer households having high discount rates) and principal agent slippage, do not provide legitimate justification for government intervention. However, they argue that most of the 'market failure' causes (for example, transaction costs and information asymmetries) provide grounds for government intervention. The optimal policy mix depends on the degree of the 'energy paradox'.[16]

A study by Conniffe (2000) assessed the fuel allowance (the main social welfare measures to tackle fuel poverty in Ireland), and Quinn (2000) also examined the fuel allowance in a previous Policy Institute Blue Paper examining all free schemes operated by the Department of Social, Community and Family Affairs.

2.7. Environmental policy

As was highlighted earlier in the paper, there is a strong environmental policy perspective attached to fuel poverty. Inefficient use of energy in the domestic sector (resulting in fuel poverty) leads to excess environmental emissions of harmful air pollutants such as carbon dioxide (CO_2) (which results in global warming), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) (which results in acidification) and particulate matter (PM) (which has strong adverse effects on human health). Most of the environmental policy literature on fuel poverty pertains to global warming and the negative relationship between fuel poverty and climate change. Boardman (1998) has written on the matter of energy efficiency (and fuel poverty) as a means of increasing equity within the context of global warming. She argues that the need to reduce man's impact on the environment whilst enabling many millions of people to obtain a higher standard of living must be balanced against our obligations to future generations, and improving energy efficiencies (thereby reducing fuel poverty) is a key way to achieve this objective. Jaffe

[16] This term, coined by Jaffe and Stavins (1994b), describes the paradoxical situation whereby there is only a very gradual diffusion of highly cost effective energy efficiency measures among households.

and Stavins (1994) explore how alternative policy instruments – both economic incentives and command-and-control measures – could, in fact, hasten the penetration of energy saving measures. Nonetheless, they do not argue against government intervention in the sector; rather, they suggest that policy measures should be chosen judiciously in light of the relative importance of the various underlying explanations for the gradual diffusion of energy saving technologies. Rose and Lin (1995) stress that, while domestic energy efficiency may be a very worthy CO_2 mitigation strategy, it should not be oversold as costless in macro-economic terms. Their study points to 'slightly negative' returns to the US economy overall as a result of nationwide energy efficiency retrofitting programmes. Finally, Boardman (1993) discusses opportunities and constraints posed by fuel poverty on policies to alleviate global warming in the UK. She warns that a carbon/energy tax (proposed by the European Commission in 1992) would penalise heavily those who are poor, resulting in reduced consumption of fuel and attendant increases in the levels of fuel poor households in the UK and elsewhere.

2.8. Other policy issues

There are some other interesting policy studies of note. Hartman (1988) examines 'self selection bias' in voluntary energy conservation programmes. He argues that traditional cost benefit tests fail to take account of this bias (where programme participants self select into the voluntary programmes), which reduces potential benefits substantially if applied to the population as a whole. Ingham *et al* (1991), in their analysis of UK energy efficiency barriers, estimate that half of the improvement that occurred in energy efficiency during the period 1971-87 would have occurred regardless of state subvention. Finally, Thompson (1997) develops an interesting model that accounts for risk in the discounting process. Rather than deciding whether or not to invest in an asset with an uncertain future benefit stream, the consumer is actually choosing between two future cost streams, each of which is uncertain. This ostensibly minor alteration in discounting theory has implications for how risks associated with energy saving measures should be incorporated into the discounting process.

2.9. Summary and conclusions

There is a substantial literature dealing with policy aspects of fuel poverty. It is, arguably, the most frequently researched aspect of fuel poverty in the academic literature. Much of the research is discursive and qualitative, and there are far fewer studies dealing with empirical aspects of fuel poverty policy or that use data in their study methodology. There is a substantial literature, in particular, on issues related to market failure. In terms of policy instruments analysed, most studies have concentrated on taxes and charges and subsidies. However, there are far fewer studies analysing the effects of information or other economic instruments (including tradable permits). Furthermore, much of the literature on programme evaluations is poor, with few of the potential benefits of domestic energy efficiency taken into account in an often narrow frame of analysis. Finally, much of the policy literature on fuel poverty is 'grey', that is, it is non-refereed, report style literature. While this literature is sometimes of a good scientific standard, the quality of the research is more susceptible to variations as it is generally not peer reviewed.

Despite these caveats, one major conclusion could be drawn from the literature: policy response to tackle fuel poverty must be country specific and either statutory based (top down) or local authority based (bottom up). Policy responses must be framed in a manner that allows for statutory government and local government to work together in combating fuel poverty effectively. This is because fuel poverty is concentrated among low-income social groups, many of whom live in social housing, but significant 'efficiency gaps' also exist among the more well off in society, warranting a more top down approach.

3

Domestic energy efficiency in Europe

3.1. Introduction

Before the fuel poverty results are presented, it is important to describe the current energy efficiency standards existing in the domestic sector across Europe. This is important because the incidence of national fuel poverty is inextricably linked to a country's building regulations and housing standards concerning domestic thermal (and energy) efficiency. This chapter therefore provides the context and background for interpreting variations in cross-European levels of fuel poverty that are revealed in Chapter 4.

3.2. Context

From an architectural perspective, energy efficiency standards vary considerably across Europe. This results in differing abilities to afford adequate home heating and, in turn, large variations in cross-country incidences of fuel poverty. Data presented in Table 3.1 demonstrate the diffusion of key energy saving measures in a number of European countries.

Overall, just over a third of households in the 13 European states included in this Table have floor insulation, which represents the lowest penetration of all four energy saving measures. Approximately a half of all households have cavity wall insulation. Some 61 per cent have double-glazing and 63 per cent have roof (or attic/loft) insulation, which is the highest level of penetration found in this overview of energy efficiency levels. Some cross-country variations are now reported, first in northern Europe and subsequently in the southern states.

Table 3.1. % of Households with Various Energy Efficiency Measures (1996)

	Cavity wall insulation	*Double glazing*	*Floor insulation*	*Roof insulation*
Germany	24	88	15	42
Denmark	65	91	63	76
Netherlands	47	78	27	53
Belgium	42	62	12	43
France	68	52	24	71
UK	25	61	4	90
Ireland	**42**	**33**	**22**	**72**
Greece	12	8	6	16
Portugal	6	3	2	6
Austria	26	53	11	37
Finland	100	100	100	100
Sweden	100	100	100	100
Norway	85	98	88	77
Mean	*49*	*61*	*37*	*63*

Source: Eurostat (1999).

3.2.1. Northern Europe[17]

It is apparent from Table 3.1 that the British and Irish housing stocks appear to be among the most energy inefficient in northern Europe when examined using multiple criteria; such a finding is uncontroversial and has long been hypothesised by leading fuel poverty researchers, such as Boardman.[18] From Table 3.1 it can be seen that levels of cavity wall insulation are considerably below the EU average in both Ireland and the UK. Ireland has the lowest level of double-glazing in northern Europe, with just one third of all dwellings fitted with this measure; France and Austria are also below par in this regard. The UK has the lowest penetration of floor insulation in northern Europe, with just 4 per cent of dwellings equipped. The only energy efficiency measure with which Irish and

[17] Northern Europe (denoted EU-10 in tables) is defined in this study as: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden (if applicable) and the UK.

[18] See, for instance, Boardman (1991).

British households perform satisfactorily is roof insulation. The data also indicate problems in the Austrian and Belgian stocks, both of which are relatively energy inefficient. Conversely, countries with colder climates, such as Denmark, Finland, Sweden and Norway, demonstrate exemplary thermal efficiency standards. Of course, Scandinavian and similarly cold regions of Europe prioritise these measures in the design and construction of new housing, as they are essential protection to combat the relatively severe winters experienced in these colder climates where winter temperatures are often below freezing (Clinch and Healy, 1999a). Nonetheless, all parts of Europe experience cold winter spells; even the relatively warm climates of Spain and Italy endure average January temperatures of about 6°C, and enormous north south variations exist.[19] Bearing this in mind, the available data for southern Europe are alarming and indicate that large portions of southern European households are living in housing completely ill equipped to deal with environmental temperatures in winter.

3.2.2. Southern Europe[20]

Data on energy efficiency standards in southern Europe are notoriously difficult to obtain, and their reliability is often questionable. This is because data collection is not as standardised in many poorer countries of Europe where resources for statistical institutes are likely to be more stretched. Eurostat (1999) has provided robust data for Greece, but only scant data for Portugal and no data whatsoever for Italy or Spain are available. However, the data that are available, together with the analysis of general housing conditions conducted by Healy (2003a), indicate that energy efficiency in southern European housing is not a prioritised component of their building regulations. It is an often-overlooked fact that many parts of southern Europe also face cold winter temperatures, yet their housing stocks appear to be highly energy inefficient, and they are also the poorest countries in Europe (using measures such as income poverty and inequality as well as macro-economic indicators like GDP per capita).[21] Despite this, there has

[19] Much of northern Italy, for example, endures mean January temperatures of well below freezing point.
[20] Southern Europe is defined in this study as: Greece, Italy, Portugal and Spain.
[21] Italy being the exception here, with GDP per capita considerably above EU average.

been virtually no published research on fuel poverty in southern Europe. This paper attempts to rectify this deficit in the literature.

3.3. Environmental policy

Many countries demonstrating poor levels of domestic energy efficiency are consuming greater amounts of energy than necessary, as people inhabiting inefficient dwellings must consume more fuel to heat their homes to an adequate temperature. Irish energy consumption per household is the highest in northern Europe, at 102,000 Megajoules (MJ) in 1996, compared to an EU-13 average of 77,000 MJ in 1996 (Eurostat, 1999). Whilst a number of factors affect aggregate domestic energy consumption, it is very likely that such high levels are caused, in no small part, by the large efficiency gap evident with regard to thermal standards in Irish housing.[22] Consequently, environmental emissions, such as CO_2, SO_2, NOx and particulate matter (PM) are also greater. This is of considerable importance given that many European countries – including Ireland – are having extreme difficulty in meeting their agreed targets for stabilisation of greenhouse-gas emissions under the Kyoto Protocol and acidification precursors under the Gothenburg Agreement (Clinch and Healy, 2000c).

3.4. Caveats

Notwithstanding the strong correlation between domestic energy efficiency standards and levels of fuel poverty, income plays another key role in the level of fuel poverty nationally. Because of this, it is important not to draw strong (causal) conclusions when analysing domestic thermal standards and fuel poverty, as more affluent nations are likely to afford adequate home heat even if their housing stock is thermally inefficient more so than poorer countries with equally inefficient housing conditions. If fuel poverty were to be quantified on the basis of national energy efficiency standards in the domestic sector alone, the incidence of real fuel poverty would be erroneous, as many energy inefficient households are owned by well-off individuals who can afford to spend more (in real terms) on

[22] Note that, for instance, if the above data were adjusted to a per capita basis, Irish domestic energy consumption would not be such an outlier in the context of European levels. In fact, annual per capita domestic energy consumption in Ireland would fall to about 31,000MJ, which is below the per capita average (Eurostat, 1999).

home heating. Such households are not 'fuel poor' *per se*, as they are not enduring cold household temperatures, nor are they unable to afford adequate home heating. It is likely that there are many examples of such households in relatively well-off countries like Austria and Germany, two countries with less than exemplary thermal efficiency standards but high levels of national income. This is why the methodology utilised in this paper encompasses indicators that capture thermal standards *and* income based affordability criteria.

The next chapter describes the empirical results of the study. These are important data for a number of reasons, chiefly the following.

1. They illustrate, for the first time, pan European levels of fuel poverty using a harmonised methodology. Such data have not been available hitherto because of the lack of comparable data.
2. Policy analyses of fuel poverty have traditionally relied on little or no empirical evidence. The data presented in the following chapter provide a strong platform from which policy implications can be drawn. Furthermore, policy measures and strategies can be tailored (on a country by country basis) to fit the exact conditions of a given country so that the policy response is effective and efficient.

4

Fuel poverty in EU–14: cross-country results

4.1. Introduction

This chapter illustrates the levels of fuel poverty in 14 EU member states using the longitudinal European Community Household Panel (ECHP) datasets from 1994 to 1997 inclusive.[23] It is from these new findings that policy implications of fuel poverty can be derived. In addition, the results allow for an efficient set of policy instruments to be recommended on a country-by-country basis as a means of reducing European wide fuel poverty in a cost effective and efficient manner. Such information is valuable for the policy process. In this chapter, a country by country and year by year approach is utilised in presenting the results and the indicators of fuel poverty are split into two groups (objective and subjective indicators), each of which is dealt with sequentially. The data analysis in this chapter is original work undertaken for the author's doctoral award in 2003. The aim is that this review will provide the necessary information from which policy proposals can be made later in the study.

4.2. Methodology

In this paper, fuel poverty is quantified for 14 European countries using six harmonised indicators of housing conditions and energy use obtained from the ECHP, conducted each year by Eurostat. A consensual approach is employed, similar to that developed in poverty and deprivation analyses previously (for example, Gordon *et al*, 2000). The following social indicators of fuel poverty are analysed which may be sub-grouped as objective (factual) and subjective (self-reported) indicators:

Subjective Indicators

1. Households unable to heat home adequately
2. Households unable to pay utility bills over the past year
3. Households declaring unsatisfactory heating facilities

[23] More information on these datasets can be found in Appendix I and II, or alternatively readers should consult Eurostat (1996).

Objective Indicators

4. Households without central heating/electric storage heaters
5. Households with damp walls or floors
6. Households with rotten window frames

These (socially perceived) indicators are chosen from the entire ECHP database to best embody characteristics of the fuel poor, as each represents either a cause or manifestation of fuel poverty. The use of a consensual approach to calculating poverty and deprivation has been used in several studies in the past, including Gordon *et al*, (2000) and Townsend (1979). By adapting the methodology, this study builds on previous poverty work by employing these social indicators to capture *fuel* poverty. While these indicators on their own may provide a poor estimation of fuel poverty individually, the composite calculation of fuel poverty allows for a robust estimate to be achieved by combining the (weighted) indicators together.

A composite (weighted) measurement of fuel poverty is derived and sensitivity analyses[24] are conducted using these standardised longitudinal data. A variety of aggregate measurements of fuel poverty are derived. These results are weighted (composite) estimates of fuel poverty. Each indicator is assigned a weight, and each weight varies in the sensitivity analysis in accordance with its relevance to the qualitative definition of fuel poverty. Thus, 'Inability to Adequately Heat the Home', as the key indicator of fuel poverty, may be given a higher weighting than the other indicators, and so forth. A variety of sensitivity analyses are conducted to test the sensitivity of the results to various assignments of weights. For more information on the sensitivity analysis and the weighting procedures, readers should consult Appendix II and III in this paper.

Econometric analysis is also performed. Multivariate Probit regression models are developed for each indicator of fuel poverty and for each year of the database (1994-97 inclusive) to test the strength of the significance of relationships reported in the cross tabulations. Marginal effects are also estimated within this model. Once again, some discussion is given to identifying the potential impacts of exogenous factors (such as rising living standards) on fuel poverty for the period under analysis.

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[24] Sensitivity analysis allows for the impacts of varying a number of assumptions relating to the dependent variable (fuel poverty) to be analysed empirically to assess the sensitivity of the dependent variable to a range of (endogenous and exogenous) variables.

4.3. Subjective indicators

These indicators from the ECHP are based on householder declarations and are not based on *de facto* evidence. As such, it could be argued that they are open to a larger margin of error than objective indicators presented later. Nonetheless, they cover important ground as indicators of fuel poverty, as they encompass the qualitative definition of a fuel poor household.

4.3.1. Households unable to afford to heat home adequately

Fuel poverty can be defined as "the inability to afford adequate warmth in the home" (Lewis, 1982). Thus, this indicator is crucially important in estimating levels of fuel poverty, as it encompasses the standard qualitative definition of fuel poor households. It is, therefore, the key indicator of fuel poverty and is given precedence in the composite measurement of fuel poverty, derived later. Table 4.1 illustrates the results of this key indicator of fuel poverty. Results show that an alarming 45.5 per cent of households in Greece, 54.9 per cent in Spain and 74.4 per cent in Portugal declare this inability. The variation of results across countries is dramatic: households in Germany, the Netherlands, Austria, Luxembourg and Denmark have few problems heating their homes (all report incidences of 3 per cent or less respectively), while relatively rich nations, such as Italy and France, report substantial levels of fuel poverty (21.5 per cent and 7.2 per cent respectively).

The average rate throughout all 14 EU countries analysed is 16.9 per cent. A substantially different mean incidence of fuel poverty is found using this indicator across northern Europe, just 4 per cent. In this instance, countries such as the UK (5.8 per cent) and Ireland (6.4 per cent) are identifiable as relatively high sufferers of this indicator of fuel poverty in northern Europe. Longitudinally, it is worthwhile to note that, while many countries are realising significant reductions in fuel poverty across the four year time series, the most notable aggregate decreases in the incidence of fuel poverty are by the UK (a reduction of 70 per cent), Denmark (38 per cent) and Ireland (36 per cent). The success in the UK and Denmark may be largely attributed to the relatively aggressive state funded fuel poverty alleviation programmes in place, while in Ireland exogenous factors such as income growth and rising living standards are more likely to be the root cause.

Table 4.1. Households Unable to Heat Home Adequately (% of Households per Country)

	1994	*1995*	*1996*	*1997*	*Mean*
Germany	2.0	1.5	1.4	–	1.6
Denmark	4.2	2.9	2.8	2.6	3.1
Netherlands	2.0	1.8	2.0	2.2	2.0
Belgium	4.6	4.1	2.8	3.0	3.6
Luxembourg	2.6	3.1	3.5	–	3.1
France	8.5	7.3	7.0	5.8	7.2
UK	8.9	6.2	5.3	2.7	5.8
Ireland	**8.0**	**5.9**	**6.5**	**5.1**	**6.4**
Italy	22.4	22.7	20.6	20.3	21.5
Greece	46.8	45.5	46.8	42.9	45.5
Spain	58.7	57.7	53.3	49.7	54.9
Portugal	75.8	74.9	73.8	72.9	74.4
Austria	–	2.5	1.9	1.8	2.1
Finland	–	–	4.7	4.7	4.7
EU-10	*6.8*	*5.7*	*5.3*	*5.5*	*5.4*
EU-14	*20.4*	*18.2*	*16.6*	*17.8*	*16.9*

Source: Healy, J.D. and Clinch, J.P. (2002). Fuel Poverty in Europe: A Cross-Country Analysis Using a New Composite Measurement, Environmental Studies Research Series Working Paper 02/06, Department of Environmental Studies, University College Dublin.

4.3.2. Households unable to pay utility bills

This income based indicator is useful, as a household that has been unable to pay on time a scheduled utility bill (gas or electric) over the previous 12 months is likely to be finding it difficult to keep the home adequately heated and, as such, this indicates the potential existence of fuel poverty. Those unable to keep up to date with utility bills may also have suffered disconnection from the supplier, compounding the experience of fuel poverty. The results from the ECHP demonstrate that Mediterranean nations do not appear to suffer as highly with this indicator. Indeed, Italy, Spain and Portugal rank among the best countries in this exercise, however this indicator exhibits the lowest incidence across all countries in the

study. The highest level of late payment of utility bills is found in Greece, where a remarkable 32 per cent are affected. The UK (8.1 per cent) and France (7.6 per cent) also perform poorly.

Table 4.2. Households Unable to Pay Scheduled Utility Bills (% of Households)

	1994	***1995***	***1996***	***1997***	***Mean***
Germany	2.2	1.6	1.5	–	1.8
Denmark	3.2	2.6	2.4	2.6	2.7
Netherlands	1.4	1.1	1.2	1.4	1.3
Belgium	7.7	6.1	6.9	6.7	6.9
Luxembourg	3.1	2.2	2.8	–	2.7
France	8.8	7.2	7.3	7.0	7.6
UK	9.4	7.8	7.0	–	8.1
Ireland	**8.4**	**6.3**	**6.1**	**4.9**	**6.4**
Italy	3.8	3.8	4.5	4.1	4.1
Greece	36.5	30.1	–	29.3	32.0
Spain	5.2	4.3	3.7	4.1	4.3
Portugal	3.1	1.7	1.7	1.8	2.1
Austria	–	1.1	1.1	1.2	1.1
Finland	–	–	11.4	0	5.7
EU-10	*5.5*	*4.0*	*4.8*	*3.4*	*4.4*
EU-14	*7.7*	*5.8*	*4.4*	*5.7*	*6.2*

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

The mean (EU-14) proportion of households unable to afford to pay utility bills on time is 6.2 per cent, while the corresponding statistic for northern Europe (EU-10) is 4.4 per cent (Table 4.2). The time series shows that the UK has reduced the proportion of households unable to pay utility bills on time by a quarter, while Ireland has achieved an even larger reduction of 42 per cent. The impressive result for Ireland concerning this income based indicator is likely to be very closely related to the macro-economic success and attendant improvements in living standards witnessed in Ireland over the mid-1990s. Spain also reports positive longitudinal results: a reduction of 21 per cent over four years. Other countries report less

clear results, while some are showing increased difficulties in meeting the costs of utility bills.

4.3.3. Households lacking adequate heating facilities

Households declaring inadequate heating systems cannot, by definition, heat their home satisfactorily or efficiently, rendering this a good subjective indicator of fuel poverty. The results show that households declaring inadequate heating facilities are found in high numbers in certain southern countries (Greece and Portugal) but also in wealthier, colder, northern nations like France and the UK. An overall (EU-14) incidence of 11.5 per cent is calculated for this indicator. The highest incidence of inadequate heating facilities is found among Portuguese households, where two in five such households (39.7 per cent) declare this indicator, while Greece (34.3 per cent) and Italy (17.9 per cent) also fare badly. In northern Europe a rate of 6.7 per cent is reported across all households, on average, while France performs poorest in this set of nations (one in nine households), with the UK (9.7 per cent) a close second. The longitudinal pattern across Europe shows some substantial decreases in the incidence of this indicator, but also some increases (for example, Portugal). The biggest downward trends are found in the UK (a 62 per cent reduction between 1994 and 1997) and France (a 15 per cent fall during the same period). Irish households are generally declaring improvements in their heating facilities over the time series.

This indicator acts as an interesting comparative crosscheck with the objective indicator of fuel poverty, 'Households Lacking Central Heating'. The disparity demonstrates the lack of awareness among householders regarding what represents an 'adequate' heating system. If householders were fully informed, only centrally heated and electric storage heating systems would be considered efficient, adequate means of home heating. The results, reported in Table 4.3, show that many households believe their system is adequate when, on an economic efficiency basis, they are not. The widest disparities are found in Portugal, Spain and Greece.[25]

[25] More on this disparity can be found in the section on 'objective' indicators below.

Table 4.3. Households Declaring a Lack of Adequate Heating Facilities (% of Households)

	1994	*1995*	*1996*	*1997*	*Mean*
Germany	6.1	4.6	3.7	–	4.8
Denmark	4.0	3.5	4.1	3.4	3.8
Netherlands	6.6	5.9	6.9	6.0	6.4
Belgium	8.7	7.3	8.1	7.6	7.9
Luxembourg	5.2	5.2	5.6	–	5.3
France	12.4	10.8	10.3	10.5	11.0
UK	14.3	10.0	9.1	5.5	9.7
Ireland	**9.6**	**7.4**	**7.6**	**7.0**	**7.9**
Italy	21.1	17.7	16.1	16.5	17.9
Greece	39.1	36.0	30.8	31.3	34.3
Spain	5.0	1.2	1.3	2.5	2.5
Portugal	39.2	39.3	40.1	40.3	39.7
Austria	–	7.2	6.7	4.8	6.2
Finland	–	–	3.0	2.8	2.9
EU-10	*8.4*	*6.9*	*6.5*	*6.0*	*6.6*
EU-14	*14.3*	*12.0*	*11.0*	*11.5*	*11.5*

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

4.4. Objective indicators

4.4.1. Presence of damp walls and/or floors

The presence of damp indicates that the dwelling is not energy efficient. It may also be a manifestation of a continuously unheated or ineffectively heated home. In either case, it acts as a good objective indicator of fuel poverty. Some 12.7 per cent of all European households contain damp patches. Again, Greece (18.8 per cent), Spain (21.5 per cent) and Portugal (33.4 per cent) are suffering worst in this regard. In northern Europe an average incidence of 9.8 per cent is found, and the UK (13 per cent), Belgium (14.4 per cent) and France (16.3 per cent) all perform poorly with regard to the presence of damp. Ireland displays average levels of damp households. Caution is required in interpreting these data, as the presence of damp in no way identifies fuel poverty as a causal factor and the

data cannot indicate the extent or magnitude of the problem of damp in each household.

Table 4.4. Households with Damp Spores (% of Households)

	1994	***1995***	***1996***	***1997***	***Mean***
Germany	9.5	7.8	6.4	–	7.9
Denmark	6.6	6.2	6.5	5.6	6.2
Netherlands	12.0	12.0	9.8	9.5	10.8
Belgium	15.8	16.7	12.3	12.8	14.4
Luxembourg	7.2	8.2	7.2	–	7.5
France	19.5	17.1	14.6	14.0	16.3
UK	17.2	14.3	12.2	8.1	13.0
Ireland	**10.5**	**9.4**	**8.9**	**9.4**	**9.6**
Italy	7.2	5.4	4.8	4.1	5.4
Greece	20.8	17.7	18.5	18.2	18.8
Spain	25.6	19.2	20.4	20.8	21.5
Portugal	32.7	32.3	33.5	35.2	33.4
Austria	–	10.1	8.3	8.1	8.8
Finland	–	–	3.9	3.7	3.8
EU-14	*15.4*	*13.6*	*12.0*	*12.5*	*12.7*
EU-10	*12.3*	*11.3*	*9.0*	*8.9*	*9.8*

Source: Healy, J.D. and Clinch, J.P. (2002), *op.cit.*

These results, tabulated in Table 4.4, are particularly important from a public health perspective, as chronic exposure to damp is strongly associated with ill health, mainly via increased respiratory and cardiovascular diseases (Williamson *et al*, 1997). There have been some dramatic reductions in the presence of damp throughout the 1990s. The UK has experienced a 53 per cent fall in damp spores, while the level of household damp has fallen by 44 per cent in Italy and by 28 per cent in France between 1994 and 1997. There has been no substantial improvement with regard to damp in Irish homes over the years 1994 to 1997 inclusive.

4.4.2. Lacking central heating

Households not possessing central heating or similar heating systems (such as electric storage heating) generally find it more difficult to efficiently heat the home. It was shown by Clinch and Healy (1999a) that other heating systems, such as solid fuel and liquid petroleum gas (LPG), are dearer, dirtier and less efficient, and are generally possessed by low-income households. As such, they act as economically regressive generators of home heating. The lack of either central heating or electric storage heating is a good objective indicator of fuel poverty. It is interesting to note that this indicator of fuel poverty is reported at a repeatedly higher incidence than any other indicator across all countries in the study, yet the provision of central heating is often considered to be the most effective measure in eradicating fuel poverty (Brophy *et al*, 1999).

Some 91.7 per cent of Portuguese households do not have central heating fitted in their homes, whilst the corresponding percentages for Spain and Greece are 67.2 per cent and 45.7 per cent.[26] In northern Europe the highest incidence of this fuel poverty indicator is located in Belgium (23.9 per cent) and Ireland (20.2 per cent). An average rate in this group of ten countries of 12.5 per cent is calculated, while across all Europe one-in-four households (25 per cent) fail to possess central heating or electric storage heaters (Table 4.5). Across Europe, the penetration of central heating is increasing almost universally, but not at a similar rate of penetration. Countries formerly lacking in such measures are catching up; for instance, Ireland has increased its penetration of central heating by 31 per cent over the four-year period from 1994 to 1997, and a similar rate is found for the UK (32 per cent). Progress in Ireland in this domain is most likely attributable to exogenous factors related to Ireland's aforementioned economic success during the 1990s, while the state funded Home Energy Efficiency Scheme in the UK has likely been a major factor in the improved diffusion of central heating in England, Scotland, Wales and Northern Ireland. Elsewhere in northern Europe, Austria has reduced its proportion of households without central heating by almost a half (49 per cent) during the four years 1994-97. In southern Europe Spain has progressed, with a 13 per cent reduction in households lacking central heating,

[26] Yet, southern European countries suffer from cold winters which, though not as severe as in northern Europe, are still cold enough for fuel poverty and cold related ill health (Healy, 2002b).

though other southern countries have not made such advances.

Table 4.5. Households without Central or Electric Storage Heating (% of Households)

	1994	***1995***	***1996***	***1997***	***Mean***
Germany	12.4	10.3	8.6	15.3	11.7
Denmark	3.2	1.8	1.0	1.0	1.8
Netherlands	14.4	13.2	12.7	11.4	12.9
Belgium	25.8	24.3	24.0	21.4	23.9
Luxembourg	7.6	6.9	5.4	–	6.6
France	10.6	10.1	9.8	8.9	9.9
UK	14.8	12.1	10.7	10.0	11.9
Ireland	**23.8**	**20.8**	**19.8**	**16.4**	**20.2**
Italy	26.6	18.6	17.3	17.7	20.1
Greece	44.7	46.9	46.4	44.7	45.7
Spain	71.6	69.9	65.2	62.2	67.2
Portugal	92.5	92.1	92.2	89.9	91.7
Austria	–	19.8	17.9	10.0	15.9
Finland	–	–	3.4	16.3	9.9
EU-10	*14.1*	*13.3*	*11.3*	*12.3*	*12.5*
EU-14	*29.0*	*26.7*	*23.9*	*25.0*	*25.0*

Source: Healy, J.D. and Clinch, J.P. (2002), *op cit.*

These results are interesting when they are crosschecked with the corresponding subjective indicator of adequate heating facilities. The disparity between what the public believes constitutes an adequate heating system and what actually is adequate in energy efficiency literature is interesting for another reason: it demonstrates one key cause of market failure (what is referred to as the 'information gap') in the market for domestic energy efficiency.[27] The exceptions to the trend are Denmark, Finland and France, where households over declare inadequate heating facilities. Such anomalies are probably

[27] Clinch and Healy (2000b) outline the wide range of reasons for this market failure, and the information gap – where households are not aware of the full benefits of energy efficiency measures – is considered a major explanation for this phenomenon.

owing to cross-country cultural idiosyncrasies. The data illustrate the importance of exercising caution in analysing subjective, self-reported data based on human perception on a multi-country level, notwithstanding the obvious benefits of such an approach in capturing individuals' actual experiences and feelings.

4.4.3. Rotten window frames

Window frames that have become rotten are not energy efficient and can be considered a good (objective) indicator of fuel poverty. Rot is most commonly found in Portugal where a quarter (25.2 per cent) of all households have rotten windows, compared with a EU-14 mean incidence of 8.6 per cent. In northern Europe 12.7 per cent of British households are suffering from this indicator of fuel poverty, and in France the corresponding percentage is 10.4 per cent (Table 4.6). This compares to a northern European mean of 7.2 per cent. There have been very substantial decreases in the proportion of households with rotten windows over the four-year period. The reduction in the UK represents a 35 per cent fall on 1994 levels, while in Ireland the corresponding fall is 25 per cent, though the reduction is not declining linearly over time. In southern Europe Greece has reduced its level of rotten windows by 37 per cent.

Again it is important to note that the presence of rotten windows does not demonstrate fuel poverty per se. However, rotten windows are a strong indication of household energy inefficiency which, in turn, may make it difficult for homes to afford adequate home heating and, as such, the presence of rot is a potential indicator of fuel poverty and is useful when used in a suite of indicators to derive a composite incidence of fuel poverty.

The above results act as stand alone indicators of housing deprivation in EU-14. However, to derive a meaningful overall estimate of fuel poverty (from which policy proposals are to be formulated later), these indicators must be aggregated together into a composite variable. The next section describes how this is done.

Table 4.6. Households with Rotten Window Frames (% of Households per Country)

	1994	*1995*	*1996*	*1997*	*Mean*
Germany	6.4	5.4	4.2	–	5.3
Denmark	6.1	5.2	5.8	5.2	5.6
Netherlands	9.8	10.2	9.8	8.8	9.7
Belgium	9.2	10.3	8.7	8.3	9.1
Luxembourg	4.8	5.2	4.4	–	4.8
France	11.2	10.7	9.7	10.0	10.4
UK	15.3	14.1	11.6	9.9	12.7
Ireland	**8.9**	**6.4**	**7.0**	**6.7**	**7.3**
Italy	8.0	6.2	5.2	5.3	6.2
Greece	11.8	9.6	8.5	7.4	9.3
Spain	9.7	7.7	6.4	6.6	7.6
Portugal	24.2	26.1	25.0	25.3	25.2
Austria	–	5.5	4.4	3.8	4.6
Finland	–	–	2.5	2.6	2.6
EU-10	*9.0*	*8.1*	*6.8*	*6.9*	*7.2*
EU-14	*10.5*	*9.4*	*8.1*	*8.3*	*8.6*

Source: Healy, J.D. and Clinch, J.P. (2002), *op.cit*.

4.5. Composite measurement of fuel poverty

A variety of aggregate measurements of fuel poverty are now derived using the results from the ECHP. These results are weighted (composite) estimates of fuel poverty. Each indicator is assigned a weight, and each weight varies in the sensitivity analysis in accordance with its relevance to the qualitative definition of fuel poverty. Thus, 'Inability to Afford Adequate Home Heating', as the key indicator of fuel poverty, may be given a higher weighting than the other indicators, and so forth. A variety of sensitivity analyses are conducted to test the sensitivity of the results to various assignments of weights. For economies of space and ease of reading, the indicators are denoted in the weighting equations as follows:

α = Unable to afford to heat home adequately
β = Unable to pay utility bills on time

π = Lack of adequate heating facilities
δ = Damp walls and/or floors
λ = Rotten window frames
μ = Lacking central heating

4.5.1. Scenario 1: Key indicator given strong preference
Here, the key indicator of fuel poverty, 'Households unable to afford to heat home adequately' (α), is given a weight of 0.5; each of the five subsequent indicators is assigned a weight of 0.1 respectively, that is:

$$0.5\,\alpha + 0.1\,\beta + 0.1\,\pi + 0.1\,\delta + 0.1\,\lambda + 0.1\,\mu$$

Under this analysis, the highest incidences of composite fuel poverty in southern Europe include: Portugal (56.4 per cent), Spain (37.8 per cent), Greece (36 per cent) and Italy (16.1 per cent). In northern Europe, France (9.1 per cent) the UK (8.4 per cent) and Ireland (8.3 per cent) appear to have the highest rates of composite fuel poverty. The mean rate of fuel poverty across EU-14 is 14.8 per cent, and in northern Europe a mean of 6 per cent is found.

4.5.2. Scenario 2: Equal weights
If it is thought that all indicators are of equal importance, then equal weights can be assigned to each of the six indicators. Under this scenario, all indicators are given a weighting of 0.17 respectively, that is:

$$0.17\,\alpha + 0.17\,\beta + 0.17\,\pi + 0.17\,\delta + 0.17\,\lambda + 0.17\,\mu$$

Under this scenario, rates of composite fuel poverty in southern Europe are decidedly lower: Portugal (44.4 per cent), Greece (29.7 per cent), Spain (26.3 per cent) and Italy (12.5 per cent). In northern Europe relatively high rates are calculated for Belgium (11 per cent), France (10.4 per cent), the UK (10.2 per cent) and Ireland (9.6 per cent). The average EU-14 rate is calculated as 13.4 per cent, while the northern European rate is found to be 7.4 per cent.

4.5.3. Scenario 3: Subjective indicators only
It may be useful to consider the subjective and objective indicators separately. Disaggregating in this manner, so that only subjective social indicators of fuel poverty are considered, implies giving a weighting of 0.33 to each of the three subjective indicators, that is:

$$0.33\ \alpha + 0.33\ \beta + 0.33\ \pi$$

The four southern European countries once more demonstrate the highest composite levels of fuel poverty. Under this scenario, Portugal has a rate of 38.7 per cent, followed by Greece (34.7 per cent); both of these levels are lower than the previous two scenarios. However, Spain (20.6 per cent) and Italy (14.5 per cent) display slightly higher levels of composite fuel poverty under this scenario. In northern Europe the highest rates are found in France (8.6 per cent), the UK (7.9 per cent) and Ireland (6.9 per cent). An EU-14 average of 11.3 per cent is calculated, while in northern Europe the mean is found to be 5 per cent. These results, being the lowest found in the sensitivity analysis, act as lower bound estimates of fuel poverty.

4.5.4. Scenario 4: Objective indicators only

Under this Scenario, the indicators are disaggregated in the same manner as in Scenario 3, but in this case only objective social indicators of fuel poverty are analysed. Again, an equal weighting of 0.33 is assigned to each indicator, that is:

$$0.33\ \delta + 0.33\ \lambda + 0.33\ \mu$$

These results fall in the upper bound tail of estimates of fuel poverty for northern Europe, but not for southern countries. High levels are reported in Portugal (50.1 per cent), Spain (32.1 per cent) and Greece (24.6 per cent). In northern Europe, the highest levels are found in Belgium (15.8 per cent), the UK (12.5 per cent) and Ireland (12.4 per cent). A relatively low EU-14 average of 15.4 per cent is calculated, together with a relatively high EU-10 average (for northern Europe) of 9.8 per cent.

4.5.5. Scenario 5: Key indicator and objective indicators given preference

If it is felt that the key indicator and the objective indicators are more reliable than the subjective indicators, then weights may be distributed as follows:

$$0.5\ \alpha + 0.17\ \delta + 0.17\ \lambda + 0.17\ \mu$$

This leads to the very highest results in southern Europe, with composite levels of fuel poverty of 62.8 per cent in Portugal, 43.8 per

cent in Spain, 35.3 per cent in Greece and 16.1 per cent in Italy. Rates of 9.9 per cent in Belgium, 9.8 per cent in France and 9.5 per cent in Ireland are also relatively high. An average rate of 16.3 per cent of all households in EU-14 is calculated, while in northern Europe a rate of 7 per cent is found under this scenario.

4.5.6. Scenario 6: Key indicator given moderate preference

While it seems wise to weight the key indicator of fuel poverty higher than other indicators, a weight of 0.5 may seem too generous. Hence, in this case, the first scenario is altered so that a weight of one-third is given to the key indicator and all other five indicators are assigned equal weights of 0.134, that is:

$$0.33\,\alpha + 0.134\,\beta + 0.134\,\pi + 0.134\,\delta + 0.134\,\lambda + 0.134\,\mu$$

Under this final scenario, middle bound estimates are derived for both northern and southern Europe. Portugal reports a composite rate of 50.3 per cent, while the respective rates in Greece (32.8 per cent), Spain (31.9 per cent) and Italy (14.3 per cent) demonstrate a centralised estimate of the range produced under the sensitivity analysis. In northern Europe France is calculated to have the highest level of fuel poverty using this scenario, with 9.8 per cent affected. However, Belgium (9.5 per cent), the UK (9.3 per cent) and Ireland (9 per cent) are all showing very similar rates. The average incidence of fuel poverty in northern Europe is 6.7 per cent, while the corresponding incidence for all 14 countries in this analysis is 14 per cent. These results appear to be robust and are used as good middle bound estimates of fuel poverty (Figure 4.1).

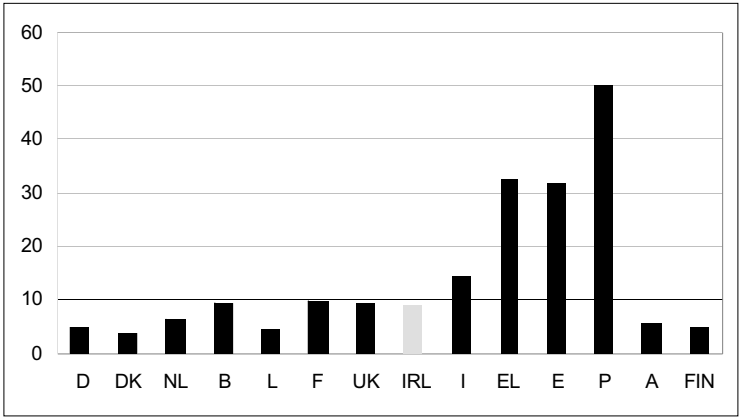
Table 4.7. Sensitivity Analysis of Fuel Poverty Results (% of Households, 1994-97)

Scenario	*1*	*2*	*3*	*4*	*5*	*6*
Germany	4.0	5.5	2.7	8.3	5.0	4.7
Denmark	3.6	3.9	3.2	4.5	3.9	3.7
Netherlands	5.1	7.2	3.2	11.1	6.7	6.2
Belgium	8.0	11.0	6.1	15.8	9.9	9.5
Luxembourg	4.2	5.0	3.7	6.3	4.8	4.6

France	9.1	10.4	8.6	12.2	9.8	9.8
UK	8.4	10.2	7.9	12.5	9.3	9.3
Ireland	**8.3**	**9.6**	**6.9**	**12.4**	**9.5**	**9.0**
Italy	16.1	12.5	14.5	10.6	16.1	14.3
Greece	36.0	29.7	34.7	24.6	35.3	32.8
Spain	37.8	26.3	20.6	32.1	43.8	31.9
Portugal	56.4	44.4	38.7	50.1	62.8	50.3
Austria	4.7	6.5	3.1	9.8	6.0	5.6
Finland	4.8	4.9	4.4	5.4	5.1	4.9
EU-10	*6.0*	*7.4*	*5.0*	*9.8*	*7.0*	6.7
EU-14	*14.8*	*13.4*	*11.3*	*15.4*	*16.3*	14.0

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

Figure 4.1. Composite Fuel Poverty in EU-14 (% of Households, 1994-97)



4.6. Ireland

It is important to devote some space to discussing the explicitly Irish findings of this cross-European empirical analysis of fuel poverty. A number of observations can be made from the Irish results, which are summarised in Table 4.8.

Table 4.8. Irish Fuel Poverty Results (% of Households)

Indicator of fuel poverty	*1994*	*1995*	*1996*	*1997*	*Mean*
Unable to heat home	8.0	5.9	6.5	5.1	6.4
Unable to pay utility bills	8.4	6.3	6.1	4.9	6.4
Inadequate heating facilities	9.6	7.4	7.6	7.0	7.9
Presence of damp	10.5	9.4	8.9	9.4	9.6
Lacking central heating	23.8	20.8	19.8	16.4	20.2
Rotten windows	8.9	6.4	7.0	6.7	7.3
Composite indicator	–	–	–	–	9.0

4.6.1. Longitudinal improvements

The period 1994-97 inclusive has witnessed significant improvements regarding the situation facing fuel poor households in Ireland. Progress has been made in a number of domains:

There are 40 per cent fewer households unable to afford to pay their scheduled utility bills:

- there are over 25 per cent fewer households enduring inadequate heating facilities
- there is almost a third fewer households without central or electric storage heating systems
- exactly 25 per cent fewer households have rotten window frames
- there are 36 per cent fewer households declaring an inability to afford adequate home heating, the key indicator of fuel poverty in this analysis.

It is likely that exogenous macro-economic variables, such as rising living standards, have contributed, in no small part, to the above progress. While these longitudinal findings are unequivocally positive, it should be noted that policies aimed at further improvements in GDP and overall macro-economic prosperity will not result in the complete alleviation of this housing deprivation. This is because it is very likely that a substantial proportion of households will not be able to afford to invest in costly remedial work to their housing. Even if they are in a position to afford such remedial work, some may not feel authorised to do so because of property rights issues. Such market 'blockages' explain only part of

the market failure problem in this area, and it is to this subject that the paper returns in Chapter 5.

4.6.2. Penetration of central heating

While the diffusion of central heating technology has improved over the four-year time period, it is still notable that one in six Irish households were not centrally heated in 1997. Considering that Ireland endures a relatively long winter climate, with average temperatures below 10ºC for five months of the year, this finding highlights the need for state assistance in helping to improve the penetration of central heating nationally. Such assistance could be means tested and aimed at subventing those groups in society most vulnerable to suffering fuel poverty. The socio-economic analysis contained later in this chapter pinpoints these groups.

4.6.3. Ireland versus Europe

Across 14 member states over the period 1994-97, Ireland's composite level of fuel poverty (at 9 per cent) falls somewhere in the middle ranking of countries by level of fuel poverty. However, if the four southern states are excluded, so that the analysis covers the 10 northern European member countries, the incidence of fuel poverty in Ireland is among the highest. France (9.8 per cent), Belgium (9.5 per cent) and the UK (9.3 per cent) all demonstrate similar levels of fuel poverty to that found in Ireland (9 per cent). Conversely, Denmark demonstrates negligible levels of fuel poverty, with a composite rate of just 3.6 per cent. This result highlights the need for tailored country-by-country policy responses. Blanket European wide policy measures to eradicating fuel poverty would be inefficient in achieving their objectives.

This section has provided a quantitative analysis of fuel poverty in Ireland and in 13 other European Union member states. However, it is necessary to probe these data further to identify precisely who in society suffers most from fuel poverty so that appropriate policy measures can be implemented to maximum effect on a country-by-country basis. The following section presents a detailed socio-economic and socio-demographic analysis of fuel poverty in EU-14 to identify those social groups most at risk of fuel poverty. It is these social groups to which policymakers must pay particular attention when developing policy strategies to mitigate the problem.

4.7. Conclusions

This chapter has provided vital new comparative data on fuel poverty in the European Union. They illustrate, for the first time, pan European levels of fuel poverty using a new harmonised methodology based on Peter Townsend's approach to measuring poverty and deprivation in the 1970s and 1980s (Townsend, 1979; 1987). Such analysis has not been available hitherto because of the lack of comparable cross-country survey data.

The aggregate (composite) rate of fuel poverty in Ireland is found to be 9 per cent for the years 1994-97 inclusive using a middle bound estimate. A dynamic result is reported in this analysis, with levels of fuel poverty in Ireland falling by about a third over the four years 1994-97. In terms of comparative EU ranking, Irish fuel poverty is among the highest in (ten) northern European member states, but substantially lower than that found in southern Europe.

5

Socio-economic analysis of fuel poverty in EU–14

5.1. Introduction

This chapter presents the results of a detailed socio-demographic and socio-economic analysis of the ECHP data on fuel poverty.[28] A detailed profile of those households unable to afford adequate heat in their home – the key indicator of fuel poverty – now follows. This isolates those groups in society most vulnerable and at risk of suffering fuel poverty.

5.2. Sociological type

Some households need more fuel than others because their circumstances dictate that the home must be heated for longer intervals or because they require higher temperatures (for example, households occupied by older people or those with very young children), or simply because the house is larger or older or both. For some households, heating costs may be disproportionately high because these costs may fall on one person (for example, single adult households). Furthermore, there are some households that are known through poverty and deprivation research to face severe financial hardship (for example, single parent households). All of these factors affect the probability of certain household groups enduring fuel poverty. The socio-economic and socio-demographic analysis in this section examines a variety of household types based on demographic (for example, marital status, sociological type, house type) and economic (for example, main income source, housing tenure) variables.

For economy of space, the mean results (over the four-year time series) are presented henceforth. Table 5.1 presents the incidence of

[28] A detailed longitudinal multivariate (Probit) regression analysis was undertaken on the data to test the validity of the associations found in the cross tabulations and correlations reported hitherto using Irish data. The results of this analysis are reported in Appendix IV.

fuel poverty across Europe by social group using an amalgamation of Eurostat's taxonomies for Sociological and Economic typologies; this allows for maximum disaggregation of the results across EU-14 whilst retaining statistical robustness.

5.2.1. Lone parents

The results show that, across Europe, the group most at risk of suffering from persistent fuel poverty is lone parents, especially those whose children are all under 16 years of age, where an average (EU-14) incidence of 21.8 per cent is found. In northern Europe an average (EU-10) incidence of fuel poverty of 10.3 per cent is calculated for this household group. The highest incidence is calculated in Portugal, where some 71.4 per cent of single parents are declaring fuel poverty. Spain fares particularly poorly also, with 62.7 per cent of this category of single parents affected. The proportion in Greece is also high, at 48.5 per cent.

The Irish rate of fuel poverty for single parents (whose children are all under 16 years of age) is 19.3 per cent, making this the highest level in northern Europe. Elsewhere in northern Europe, single parents exhibit high levels of fuel poverty in the UK (18.6 per cent) and France (15 per cent). Single parents with at least one child over 16 years generally demonstrate lower levels of fuel poverty. This is probably because of their improving financial situation as their children grow up and become less dependent. However, the results demonstrate only slightly reduced incidences among this household group. The problem of fuel poverty among lone parent households is acute for two reasons: first, they generally suffer from low incomes and will therefore find it difficult to make ends meet regarding fuel bills; second, their financial circumstances entail that they are more likely to live in poor (energy inefficient) housing which makes home heating even less affordable. The result that Irish lone parents suffer worst by fuel poverty in northern Europe is of serious cause for concern for Irish policymakers in this domain.

5.2.2. Lone pensioners

Both male and female pensioners exhibit high levels of fuel poverty. However, there is a gender bias towards females, with 22.1 per cent of female lone pensioners suffering from fuel poverty across Europe, compared with 20.4 per cent for male lone pensioners; the gender gap becomes insignificant in northern Europe, with many

Table 5.1. Fuel Poverty in Europe by Socio-Demographic Group (Mean % of Households, 1994-97)

	D	*DK*	*NL*	*B*	*L*	*F*	*UK*	*IRL*	*I*	*EL*	*E*	*P*	*A*	*FIN*
1 male aged less than 30	1.8	3.4	2.5	3.9	7.8	8.8	7.5	**6.0**	20.5	22.4	50.2	52.9	3.4	7.0
1 male aged 30-64	2.1	4.5	2.2	5.7	6.2	13.1	9.6	**11.4**	14.3	40.6	52.9	78.2	3.1	7.9
1 male aged 65+	1.4	3.6	2.9	3.6	2.0	6.0	8.3	**11.8**	25.6	62.6	67.7	85.3	0.7	3.6
1 female aged –30	2.6	4.1	1.7	3.3	4.9	9.8	6.6	**9.7**	20.6	29.7	50.9	56.3	3.9	10.5
1 female aged 30-64	3.9	6.8	4.6	7.5	3.4	12.3	10.2	**9.8**	20.3	52.6	54.4	79.4	2.8	7.2
1 female aged 65+	2.4	3.0	4.8	4.1	1.8	8.1	7.3	**7.8**	30.1	68.0	74.2	88.9	4.1	4.9
Single parent (All children <16)	2.4	3.9	12.0	6.9	9.3	15.0	18.6	**19.3**	22.9	48.5	62.7	71.4	3.3	8.8
Single parent (≥1 child 16+)	3.2	3.3	5.8	4.6	4.3	13.5	10.2	**11.8**	24.9	50.5	60.1	77.7	2.5	7.0
Couple without children (≥1 person 65+)	0.9	1.4	1.5	2.7	2.4	4.3	5.3	**4.5**	21.0	58.4	61.5	74.4	0.9	4.5
Couple without children (both <65)	1.6	1.9	0.9	3.1	2.2	6.0	4.4	**3.9**	14.8	41.1	45.6	64.7	1.4	3.8
Couple with 1 child	0.9	1.6	1.6	2.9	4.2	5.0	5.6	**5.1**	18.0	31.6	46.9	63.9	1.8	3.0
Couple with 2 children	1.1	1.3	0.9	3.9	1.0	4.8	3.7	**3.8**	18.4	33.9	46.0	63.1	1.9	3.6
Couple with 3+ children	1.6	2.2	0.3	3.6	6.0	6.4	9.5	**8.3**	32.0	41.2	58.5	84.2	4.4	2.8
Couple with 1+ child (≥1 child 16+)	2.3	1.7	1.1	3.2	1.7	7.6	5.1	**4.0**	22.2	42.7	51.2	68.8	1.4	3.9
Other households	2.1	2.7	5.0	5.0	0.4	6.9	9.2	**7.0**	23.3	47.4	58.2	79.0	1.3	2.9

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

countries demonstrating higher levels of fuel poverty amongst male lone pensioner households. A remarkable 85.3 per cent of male Portuguese lone pensioners and 88.9 per cent of female lone pensioners are unable to afford adequate home heating, while Spanish and Greek lone pensioners also face similar difficulties.

Ireland appears to have the highest fuel poverty among lone pensioner households in northern Europe, with 11.8 per cent for males and 7.8 per cent for females. The UK also fares badly in this respect, corresponding statistics are 8.3 per cent (male) and 7.3 per cent (female) respectively, as does France (6 per cent and 8.1 per cent respectively). A key reason for many lone pensioners suffering fuel poverty is likely to be their financial situation, with many subsisting on very modest state pensions. Others may be living in older, less well-insulated dwellings and, thus, find it hard to heat the home even on less modest pensions. It is likely that a combination of both factors is at play with this social group.

5.3. House type

It is useful to identify the type of accommodation where fuel poverty is highest. It might be expected that terraced and semidetached houses generally would be better protected from the cold because the adjoining walls on either or both sides of the dwelling act as an insulator of heat. The results of this analysis do not necessarily corroborate such a hypothesis. In fact, the incidence of fuel poverty across Europe is highest in flat complexes (or multi-family dwellings), which indicates the existence of housing deprivation. Detached houses have a generally lower incidence of fuel poverty, especially in northern Europe where just 2.8 per cent of such homes declared an inability to adequately heat the home.

Table 5.2 illustrates the results of fuel poverty across Europe by house type. Southern countries demonstrate the highest levels of fuel poverty across all house types. Portugal has the highest incidence of fuel poverty among detached, semidetached and terraced households (with 79.2 per cent and 81.5 per cent affected). Spanish households living in small and large multi-family dwellings exhibit the highest incidence of fuel poverty, with 57.8 per cent of households living in small apartment complexes and 43.8 per cent of households living in large apartment complexes declaring fuel poverty.

Detached, semidetached and terraced houses are less susceptible to fuel poverty in northern Europe. However, the incidence

Table 5.2. Fuel Poverty in Europe by Housing Type (Mean % of Households, 1994-97)

	D	*DK*	*NL*	*B*	*L*	*F*	*UK*	*IRL*	*I*	*EL*	*E*	*P*	*A*	*FIN*
Detached	1.0	2.8	1.0	2.9	2.1	6.3	2.4	**4.7**	26.3	56.5	59.2	79.2	1.4	3.5
Semidetached/Terraced	1.1	4.1	1.6	4.0	2.4	8.1	6.3	**7.4**	11.1	55.0	73.0	81.5	0.9	4.2
Small MFDs	1.8	3.6	3.4	4.1	4.1	9.2	11.2	**14.1**	25.4	36.2	57.8	57.2	3.0	4.4
Large MFDs	2.3	2.9	3.0	4.1	7.2	6.6	9.2	**17.4**	13.9	28.1	43.8	38.9	2.9	6.8
Other	2.8	4.5	2.0	6.0	–	5.8	5.6	**18.0**	35.9	47.8	70.3	95.4	2.4	6.2

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

Table 5.3. Fuel Poverty in Europe by Marital Status (Mean % of Households, 1994-97)

	D	*DK*	*NL*	*B*	*L*	*F*	*UK*	*IRL*	*I*	*EL*	*E*	*P*	*A*	*FIN*
Married	1.2	2.1	1.0	2.9	2.5	5.0	4.5	**4.7**	20.7	45.5	52.4	71.6	1.4	3.6
Separated	–	–	–	8.8	–	14.0	11.2	**18.3**	21.4	48.5	66.9	81.9	–	–
Divorced	3.5	5.1	5.7	6.1	–	12.4	13.7	–	12.7	49.1	58.0	67.7	3.2	6.4
Widowed	2.1	3.5	4.4	4.0	–	7.5	8.2	**7.0**	25.8	55.9	63.6	83.9	2.5	4.8

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

of fuel poverty in large and small flat complexes in northern Europe is substantial. For apartment blocks with less than 10 dwellings, Ireland shows the highest levels of fuel poverty, with 14.1 per cent affected, followed by the UK (11.2 per cent) and France (9.2 per cent). For large multi-family dwellings (apartment blocks with 10 or more units), Ireland, again, demonstrates the highest incidence of fuel poverty, with 17.4 per cent affected – higher than the equivalent proportion of Italian dwellings of this type.[29] The UK also has a relatively high incidence of fuel poverty for this dwelling type, with 9.2 per cent declaring an inability to adequately heat their home. 'Other' households are also affected by fuel poverty, although this house type accounts for a substantially smaller proportion of all households in the survey.

It is likely that the high levels of fuel poverty in the UK and Ireland among householders inhabiting apartments may be due to an income effect. Traditionally, households in apartment blocks in these countries are more likely to be living on more modest incomes than those living in detached dwellings. As such, they may have limited disposable income available for home-heating purposes. However, such an assertion cannot be made with confidence, as household income and dwelling type is not correlated well, particularly in recent years in Ireland with a property boom 'forcing' some more affluent people to opt for apartment dwellings.

5.4. Marital status

Marital status is a most interesting variable against which to analyse fuel poverty. As with poverty and deprivation research, it is likely that levels of fuel poverty may be highest among persons whose marital status is known to be associated with financial hardship. The separated and divorced, for example, are more likely to suffer from poverty than the married (Duncan *et al*, 1993), and this is generally because such households are more likely to be subsisting on a sole income. In addition, they may be lone parent families raising children, compounding a potential (fuel) poverty trap.

The results show a marked pattern of fuel poverty across Europe, with the highest levels found among separated households. An EU-14 mean incidence of fuel poverty of some 33.9 per cent is

[29] Note, however, that there are relatively low numbers of this housing form in Ireland.

calculated for this household type, followed by 21 per cent of widowed households. If the analysis is shifted to EU-10 (northern European countries), an average incidence of fuel poverty of 13.1 per cent of separated households is reported. Widowed persons suffer to a far less extent in northern Europe, however divorced households appear to suffer from fuel poverty, with 7.1 per cent of such households in northern Europe declaring an inability to afford adequate household warmth. Conversely, married households suffer proportionately less than other households, with incidences in EU-14 and EU-10 of 15.6 per cent and 2.9 per cent respectively.

5.4.1. Separated, divorced and widowed

It is clear that fuel poverty is strongly related to income poverty, and, as such, it is no surprise that low-income households declare the highest levels of fuel poverty across Europe. While sample sizes for separated, divorced and widowed households were too small to calculate reliable estimates for certain countries, it is clear that separated households in southern Europe demonstrate alarming levels of fuel poverty, with a remarkable 81.9 per cent affected in Portugal. Spanish separated households do not fare well either, with an incidence of 66.9 per cent, while the proportions of separated households in Greece (48.5 per cent) and Italy (21.4 per cent) are higher than any levels found in northern Europe. There are, however, some notably high incidences among separated households in EU-10, most especially in Ireland where 18.3 per cent are suffering fuel poverty.

Divorced households in southern Europe demonstrate very high levels of fuel poverty, with Portugal most affected (81.9 per cent), followed by Spain (66.9 per cent) and Greece (48.5 per cent). Italy's level of fuel poverty among divorced households (12.7 per cent) is less than the UK's level of 13.7 per cent which appears to be the highest in northern Europe. Widowed households are suffering from fuel poverty, though not, it appears, in northern Europe where low incidences are calculated. Some 83.9 per cent of widowed households in Portugal, 63.6 per cent of those in Spain and 55.9 per cent of those in Greece are declaring fuel poverty. Taken as a whole, these results indicate that marital status strongly affects the likelihood of fuel poverty. Married households are found to have mostly negligible levels of fuel poverty outside southern Europe.

5.5. Highest educational attainment

Educational attainment is, in general, a good indicator of household income and social class and poverty research has consistently shown a strong association between low education levels and high levels of poverty and deprivation. This study tests this hypothesis with fuel poverty. The results demonstrate an inverse relationship between educational attainment and fuel poverty both in northern Europe and across EU-14. Average incidences of fuel poverty of 7.4 per cent are found across Europe for those with third-level qualifications. This increases to 12 per cent among those whose highest educational attainment was secondary level, and 19.2 per cent among those households who did not complete their second-level education. In northern Europe, a similar pattern is found, although the incidences are far lower. A negligible level of fuel poverty of just 2.2 per cent is reported amongst households with third-level qualifications, followed by 3 per cent among those who completed secondary school, while an incidence of fuel poverty of 4.7 per cent of households is found for households that left formal education prior to completing secondary school education.

Comparatively, the results show some interesting patterns across Europe. In northern Europe incidences of fuel poverty among households with low levels of educational attainment (secondary schooling uncompleted) are relatively high in Ireland, the UK and France, with levels of 8.4 per cent, 8.3 per cent and 8.2 per cent respectively. Levels in southern Europe are dramatic, with some 79 per cent affected in Portugal, 62.5 per cent in Spain and 54.9 per cent in Greece (Table 5.4). Conversely, households with a third-level qualification in northern Europe appear to suffer negligible rates of fuel poverty. However, moderate to high incidences are found in some southern countries. Spain reports an incidence of some 29.6 per cent among households with high levels of educational attainment, while Portugal and Greece perform similarly poorly in this regard (21.9 per cent and 21.4 per cent respectively). The results again point to a strong relationship between fuel poverty and household income.

5.6. Main income source

It is very useful to examine fuel poverty by the household's main income source, as it is also a good indication of income level. Dependence on unemployment assistance, state pension or other

Table 5.4. Fuel Poverty by Highest Educational Attainment (Mean % of Households, 1994-97)

	D	*DK*	*NL*	*B*	*L*	*F*	*UK*	*IRL*	*I*	*EL*	*E*	*P*	*A*	*FIN*
3rd Level	0.8	2.0	0.7	2.6	3.7	3.9	2.4	**1.8**	7.9	21.4	29.6	21.9	1.7	2.8
2nd Level	1.4	2.4	1.2	3.4	2.3	5.9	4.6	**3.2**	14.7	32.7	40.9	49.7	1.4	4.5
2nd Level not completed	1.9	3.8	2.7	4.0	2.8	8.2	8.3	**8.4**	25.5	54.9	62.5	79.0	2.2	5.0

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit*

Table 5.5. Fuel Poverty in Europe by Main Income Source (Mean % of Households, 1994-97)

	D	*DK*	*NL*	*B*	*L*	*F*	*UK*	*IRL*	*I*	*EL*	*E*	*P*	*A*	*FIN*
Wages (employee)	1.3	2.1	0.7	2.8	3.3	6.0	3.2	**3.4**	18.4	36.5	47.6	71.6	1.7	4.1
Self-employed/Farming	1.0	2.5	0.6	3.7	1.8	6.1	3.0	**2.9**	17.2	41.5	44.6	64.6	1.1	2.9
Pensions	1.8	3.4	3.1	3.2	1.9	6.1	5.9	**7.5**	24.9	58.3	65.3	81.8	2.2	5.0
Unemployed	4.9	10.3	5.0	9.5	–	21.3	17.7	**23.3**	46.6	–	79.2	81.1	9.9	6.6
Other social transfers	4.6	6.5	7.4	8.2	–	19.5	16.3	**17.4**	44.0	65.5	73.9	84.5	3.7	8.3
Private	0.8	1.5	1.4	5.4	–	8.9	3.5	**6.8**	28.8	37.5	52.6	56.0	6.5	7.6

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

social transfers implies that such households live on a modest level of household income. Such income may preclude households from heating their home adequately in a direct sense through not being able to afford fuel bills, or indirectly through being unable to invest in household energy efficiency improvements. Those unemployed and those on other forms of social welfare payments demonstrate the highest incidences of fuel poverty in Europe. Some 27.7 per cent of those on social welfare and 26.3 per cent of those unemployed are demonstrating fuel poverty overall, while in northern Europe the respective proportions are 10.2 per cent and 12.1 per cent. Self-employed and waged households generally display low or negligible levels of fuel poverty across Europe. Unfortunately, it is not possible to disaggregate the data to capture those households below a certain income level.

The overall highest incidence of fuel poverty in the unemployed category is demonstrated in Portugal, where 81.1 per cent are considered fuel poor, as is shown in Table 5.5. Elsewhere in southern Europe, Spain (79.2 per cent) and Italy (46.6 per cent) also show high levels. In northern Europe 23.3 per cent of Irish unemployed households are suffering from fuel poverty. Likewise, there are high incidences in France amongst the unemployed (21.3 per cent) and the UK (17.7 per cent). For those whose main income source is other forms of social welfare, high levels are found, again, in southern Europe. Portugal (84.5 per cent), Spain (73.9 per cent), Greece (65.5 per cent) and Italy (44 per cent) all demonstrate high incidences of fuel poverty. In northern Europe, the highest incidence of fuel poverty among this group of social welfare recipients is found in France (19.6 per cent), followed by Ireland (17.4 per cent) and the UK (16.3 per cent).

5.7. Housing tenure

Housing tenure is an important dynamic of fuel poverty, as noted by Whyley and Callender (1997). This is because it gives households varying levels of control over their home, heating systems and their energy consumption. Owner-occupiers may be considered as fully autonomous, while tenants may be more limited as regards what they feel they can afford to do to improve their housing or even what they are authorised to do to improve their housing (Clinch and Healy, 2000b).

Table 5.6 illustrates the results for this section. Owner-occupiers suffer least from fuel poverty, while tenants suffer most. Those

Table 5.6. Fuel Poverty in Europe by Housing Tenure (Mean % of Households, 1994-97)

	D	*DK*	*NL*	*B*	*L*	*F*	*UK*	*IRL*	*I*	*EL*	*E*	*P*	*A*	*FIN*
Owner	0.8	2.2	0.5	2.9	2.3	5.6	3.1	**4.1**	19.9	49.3	52.0	71.8	1.1	3.8
Tenant	2.3	4.8	3.7	5.4	5.0	9.6	11.9	**20.9**	27.3	52.8	67.3	77.8	3.5	8.6
Rent-Free	0.7	4.5	1.9	2.7	–	7.1	5.6	**9.2**	22.8	51.3	67.2	83.4	3.0	6.0

Source: Healy, J.D. and Clinch, J.P. (2002), *op. cit.*

whose accommodation is provided free of charge by the state suffer above average. The mean incidence of fuel poverty for tenant households across all of Europe is found to be 21.5 per cent, while in northern Europe the corresponding proportion is 7.6 per cent. In southern Europe rates of fuel poverty among tenant households are very high, with levels of 77.8 per cent in Portugal, 67.3 per cent in Spain, 52.8 per cent in Greece and 27.3 per cent in Italy are all above the average (EU-14) level. In northern Europe, the highest incidence among tenants is found in Ireland, where a remarkable 20.9 per cent of tenant households declare fuel poverty. The UK (11.9 per cent) and France (9.6 per cent) also suffer relatively highly in this regard (Table 5.6).

5.8. Ireland as an outlier

This section pays special attention to the socio-economic and socio-demographic findings pertaining to the Irish case. It is worthwhile dwelling on these results, as Ireland exhibits a remarkable outlier status in the analysis presented in this paper.

The results presented over the past few pages demonstrate that fuel poverty in Ireland is concentrated among a number of household types and social groups, to a far greater degree than in other northern European member states. As highlighted in the previous chapter, Ireland demonstrates the highest level of fuel poverty among lone parents in northern Europe, with one in five such households affected. Lone pensioners in Ireland also declare levels of fuel poverty that are substantially higher than elsewhere in northern Europe. In terms of dwelling type, fuel poverty is generally highest in multi-family units. Ireland demonstrates the highest incidence of fuel poverty in northern Europe amongst both small and large multi-family dwellings (14.1 per cent and 17.4 per cent respectively). Marital status is also a good predictor of fuel poverty. Some 18.3 per cent of separated households in Ireland demonstrate fuel poverty – the highest incidence among this group in northern Europe. Almost a quarter of unemployed households in Ireland declare fuel poverty indicators, which again is the highest incidence in northern Europe. Moreover, housing tenure is found to be a very good predictor of fuel poverty. Tenants face the worst problems in this regard, and Irish tenant households are most burdened by fuel poverty in northern Europe, with over one in five

such households affected. This result is particularly remarkable when it is considered that the next highest incidence of tenant fuel poverty, 11.9 per cent in the UK, is almost half that reported in Ireland.

Thus, while Ireland does not suffer from the highest overall (national) incidence of fuel poverty in northern Europe, the country is marked by a particularly unequal distribution of fuel poverty severity, with very high incidences found among groups on low-incomes (often living on a sole income). However, the levels found still fall short of those reported in southern Europe, particularly in the poorer member states, such as Portugal and Greece.

5.9. Conclusion

Socio-demographic and socio-economic analysis identifies the unemployed, tenants, lone parents, those separated, and those living in large multi-family dwellings as most at risk of suffering fuel poverty in Ireland. In addition, a linear relationship is found between educational attainment and incidence of fuel poverty in most EU member countries, including Ireland. Irish fuel poverty is found to be the most compounded in all of the ten northern European member states analysed in this paper, with low-income households suffering to a remarkably high degree.

Policy analyses of fuel poverty have relied hitherto on little or no empirical substantiation. The original data presented in this chapter provide a strong platform from which strong policy implications can be drawn. Furthermore, policy measures and strategies can be tailored (on a country by country basis) to fit the exact conditions of a given country so that the policy response is cost effective and efficient in meeting its objective.

In the following chapter, the paper addresses a question of major importance. If the benefits of domestic energy efficiency are so great, why has the market failed to deliver energy efficiency in the housing sector? The reasons for this market failure are addressed empirically using the results of a major new national household survey, conducted by Urban Institute Ireland in 2001.

Table 5.7. Summary of Incidences of Fuel Poverty in Ireland by Socio-demographic and Socio-economic Groups (% of Households, 1994-97)

Socio-demographic Group	1 male aged –30	6.0
	1 male aged 30-64	11.4
	1 male aged 65+	11.8
	1 female aged –30	9.7
	1 female aged 30-64	9.8
	1 female aged 65+	7.8
	Single parent (All children <16)	19.3
	Single parent (≥1 child 16+)	11.8
	Couple without children (≥1 person 65+)	4.5
	Couple without children (both <65)	3.9
	Couple with 1 child	5.1
	Couple with 2 children	3.8
	Couple with 3+ children	8.3
	Couple with 1+ child (≥1 child 16+)	4.0
	Other households	7.0
House Type	Detached	4.7
	SemiDetached/Terraced	7.4
	Small MFDs	14.1
	Large MFDs	17.4
	Other dwellings	18.0
Marital Status	Married	4.7
	Separated	18.3
	Divorced – Widowed	7.0
	Never married	6.2
Main Income Source	Wages (employee)	3.4
	Self-employed/Farming	2.9
	Pensions	7.5
	Unemployed	23.3
	Other social transfers	17.4
	Private	6.8
Housing Tenure	Owner	4.1
	Tenant	20.9
	Rent Free	9.2
Highest Educational Attainment	Primary education	8.4
	Secondary education	3.2
	Third-level education	1.8

Note: '–' denotes sample size not significant

6

Reasons for market failure (and non-investment)

6.1. Introduction

Energy efficiency in the home makes good economic sense. This has been shown repeatedly in a number of well-conducted *ex ante* and *ex post* economic evaluation studies on energy efficiency.[30] The costs and benefits of improving the thermal efficiency of the Irish dwelling stock to the latest (1997) building regulations have been quantified by Clinch and Healy (2001), who report a net social benefit of some €3.1 billion through a state backed retrofitting programme that is clearly welfare improving. The private and external benefits (energy, environmental, health and comfort) outweighed the labour and materials' costs of the programmes by 3:1, while the private benefits to the individual household in terms of reduced fuel bills and increased health and comfort are very substantial (a private benefit cost ratio of 1.7:1 is calculated) (Clinch and Healy, 2003). If the benefits of domestic energy efficiency are so great, why then do households not invest in retrofitting these measures into their homes. This question was asked in a national household survey of Ireland, conducted in the spring of 2001 by Urban Institute Ireland (UII). Households that were not equipped with a list of key energy saving items ('energy inefficient households') were asked what was the major reason behind their non-investment in energy efficiency. Over 200,000 households in Ireland were classifiable as energy inefficient. The results are illustrated in Figure 6.1.

6.2. Reasons for non-take-up

Many authors, including Clinch and Healy (2000b), hypothesised the reasons for market failure in domestic energy efficiency in Ireland. This study identified these reasons empirically by asking respondents why they do not invest in energy saving measures when the benefits clearly outweigh the costs.

[30] See the review of empirical studies in Chapter 2.

6.2.1. Information gap

One of the principal reasons for financially viable energy conservation measures not being taken up is the lack of knowledge on the part of householders of the opportunities for saving on fuel bills. This information gap is likely to be greater in low-income households where the benefits would be greatest. In addition, an information asymmetry between buyers and sellers of energy efficiency measures may occur, leading to adverse selection of such technology.[31] Lack of information is seen as a key reason for market failure in the UK according to Williams and Ross (1980) and Carlsmith *et al* (1990), and this study concurs strongly with British policy analysis of market failure in domestic energy conservation.

The results of the UII national household survey demonstrate a large 'information gap' in the market for domestic energy efficiency. Some 32.3 per cent of energy inefficient households are not *aware* of the benefits of energy saving measures, while a further 19 per cent did not know of their *existence*. This implies that over half of energy inefficient households in Ireland (amounting to approximately 120,000 homes) are unaware of the benefits of retrofitting these measures into their homes, despite ongoing information and awareness campaigns funded by the Irish government; as such, this appears to be, by far, the strongest impediment to the diffusion of energy efficiency in the residential sector. This result has clear implications for policymakers.

In addition, if the housing market worked effectively, the monetary value of the energy efficiency measures would be reflected in the resale value of the house. However, if the public is lacking in knowledge as regards the benefits of the measures, this will not happen. Therefore, if individuals are likely to move house in the meantime, they may not be willing to make an investment with a long payback period.

6.2.2. Socio-economic considerations

The least energy efficient households are more likely to be lower income households (Clinch and Healy, 1999a). Such households are much less likely to have available funds and, thus, are most likely to have to resort to a loan. They are less likely to be in the position of accessing credit (particularly at the market rate of interest)[32] and

[31] See Smith (1992).
[32] See Weber (1990) for more on this issue.

they are more likely to have more pressing alternative uses for any extra funds. They may, additionally, have an aversion to borrowing funds, as has been reported by Salvage (1992). It has also been shown that low-income households tend to have higher discount rates, that is, they exhibit myopic tendencies whereby they place a greater value on income now as opposed to in the future, partly resulting from the higher degree of uncertainty about the future stemming from their financial instability. Therefore, *ceteris paribus*, such households are unlikely to invest in something that might not pay for itself for over 30 years (Clinch and Healy, 2000b).

These financial constraints are found to be significant barriers in the market for domestic energy efficiency. Some 31.6 per cent of respondents (75,000 households) reported an inability to pay for these measures, while a further 5.5 per cent (13,000 households) reported more pressing priorities for expenditure. In addition, borrowing constraints were identified by another 3 per cent of householders (7,000 households). Therefore, over 40 per cent of energy inefficient households blame income constraints as barriers to improving their home's thermal efficiency.

6.2.3. Property rights failure

Some of the least energy efficient houses in the UK and Ireland are tenant-occupied (Brechling and Smith, 1992; Healy, 2003a). Tenants may feel that they are not responsible for undertaking investments in energy efficiency or authorised to do so. Indeed, it is not financially sound for a tenant to invest if they expect to move out in the short to medium term. Likewise, landlords may feel that the benefits to them of such investment may not be recouped if they are unable to raise rents. Also, if investment does take place in a multi-occupancy dwelling, 'free rider' incentives may exist in relation to the financing of the public good (Smith, 1992).

The results of the UII national household survey of Ireland indicate that some 8,000 households (3.4 per cent) did not feel responsible to undertake the retrofit because they rented the dwelling they occupied and felt it was the landlord's responsibility. The Coase Theorem states that economic efficiency can only be obtained when there is complete allocation of competitively assigned property rights. In this regard, the need to overcome this barrier is essential to reducing market failure.

6.2.4. Transaction costs

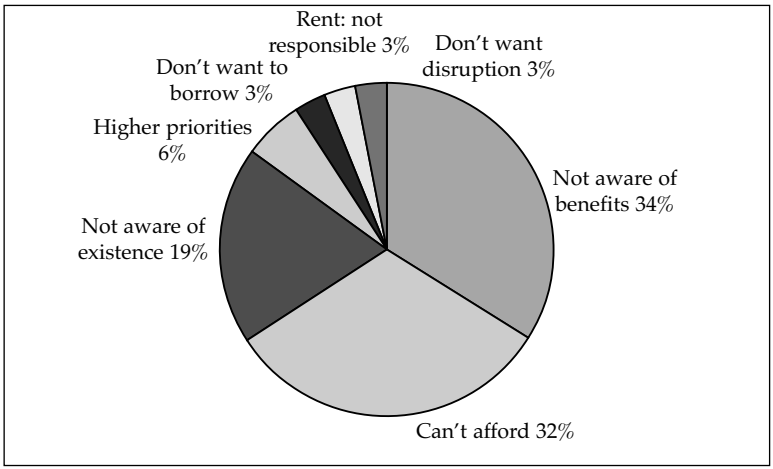
Another potential 'blockage' in the market for energy efficiency measures is that of the fixed costs of learning about, and administering, energy conservation measures. Examples of transaction costs include the time householders must spend to learn about the various options, locate a suitable installer and oversee the work. Some householders may also be concerned about the appropriate techniques and the quality of the workmanship, as well as the attendant disruption of installing these measures. Such costs are not reflected in cost benefit analysis and, therefore, the full costs of retrofitting households with energy conservation measures may be significantly higher to the individual than is suggested by the figures. The amplitude of these transaction costs may overwhelm the potential pay off of such an effort, acting as a performance inhibiting 'wedge' which prevents the implementation of cost effective energy conservation measures in the home (Convery, 1998). These transaction costs are difficult to measure, but have been seen as potential factors in explaining the slow take up of financially viable measures in the UK, especially in the domestic sector.[33] The results presented in this paper do not corroborate the hypothesis that transaction costs act as a major impediment to the diffusion of energy saving measures in Irish households. In fact, just 3 per cent of energy inefficient households (about 7,000 homes) identify such costs as the major reason for not installing these measures.

6.2.5. Other blockages

In addition, the absolute benefits per household are relatively small. Clinch and Healy (2000b) showed that, when the value of all the energy savings of the energy conservation programme under evaluation in Ireland were added together, they amount to an average of almost €254m per annum, undiscounted over 30 years. However, spread over the number of households, the mean financial gain per household is small at about €207 per annum. In addition, low and (until recently) declining real energy prices, making the energy budget a falling share of total household expenditure, may also act as a barrier; this hypothesis is explored formally in Hassett and Metcalf (1992).

[33] This slow diffusion of apparently cost effective energy conservation technologies across households has been denoted the 'energy paradox' by Jaffe and Stavins (1994a, 1994b).

Figure 6.1. Reasons for Non-Investment in Energy Saving Measures in Ireland



Source: Healy, J.D. and Clinch, J.P. (2004), "Quantifying the severity of fuel poverty, its relationship with poor housing and reasons for non-investment in Ireland", *Energy Policy*, 32: 207-220.

In addition to these constraints, programmes of energy efficiency have not been implemented because of the perception on the part of policymakers that it takes over-generous grants for take up to be satisfactory. Policymakers can also argue that there are relatively few pre and post intervention studies from which net benefits can be shown, so scepticism remains regarding *ex ante* research projects. There may also be concern that those more affluent in society reap the benefits more so than the poor because of free rider issues. In addition, another inhibitor includes the fact that benefits of energy efficiency improvements are spread out among several government departments and gains to individual department may be comparatively minor.

Finally, energy is underpriced, because it fails to reflect externalities associated with the consumption of fossil fuels. In this regard, it could be argued that the under pricing of energy contributes to market failure by sending out perverse market signals and encouraging inefficient consumption of energy in the home.

6.3. Summary

There are a number of reasons why energy conservation measures may not be taken up by the private household: such a household is unlikely to take into account all the benefits to themselves and to wider society of such measures; they may have to borrow funds at an interest rate that would make the investment prohibitive; they may not be aware of such energy saving measures; the transaction costs of installing such measures may render the investment unwise. Moreover, the households that would benefit most from the installation of more energy efficient technologies are: least likely to make such a long-term investment; more likely to have to borrow funds (often at a rate of interest higher than the market rate); more likely to have more pressing priorities for extra funds; likely to find it more difficult to obtain such funds; less likely to be aware of energy efficiency opportunities; less likely to live in their own house.

The findings of the statistically representative UII national household survey of Ireland indicate a large 'information gap' in the market of domestic energy efficiency measures, with over a half of energy inefficient households either unaware of the existence or unaware of the benefits of energy saving measures in the home. In addition, over a third of such households identified financial constraints to retrofitting, with only a very small proportion blaming transaction costs. Taken as a whole, these results argue for government intervention to rectify this market failure.

It is clear that consumers need to be better informed regarding energy efficiency in the home. It is heartening to note that the Irish government has recently increased the funding it allocates for such information campaigns, however care needs to be taken in the development and implementation of such information based strategies. This is primarily because there are a number of important caveats associated with various types of information programmes (for instance, the correct medium must be chosen, economies of scale must be attained, and so on). As such, costly state funded information and awareness campaigns on domestic energy efficiency should be developed carefully using the hindsight of past exemplars. The next chapter outlines the policy implications of this empirical review of fuel poverty in Europe. This discussion will be of particular interest to policymakers whose remit covers fuel poverty, but also those concerned more generally with public health, housing policy, social welfare and family affairs, and

environmental policy. The range of policy instruments available to rectify this market failure is outlined in Chapter 7, followed later by a discussion of some international policy responses to addressing fuel poverty and market failure in domestic energy efficiency. This discussion enables a policy mix to be formulated and recommended based on a 'lessons learned' approach.

7

Policy implications

7.1. Introduction

The relatively poor thermal efficiency standards of Ireland, the UK and southern Europe are a serious cause for concern. This is because low-income households are less able to protect themselves adequately from the cold owing to the energy efficiency characteristics of their dwelling, making home heating unaffordable. It is clear that the welfare regime and socio-economic characteristics generally play a big role in mitigating fuel poverty. Countries such as Finland, Denmark, Germany and the Netherlands have relatively strong social welfare support and more equitable income distribution, and despite enduring harsh winter climates all report levels of fuel poverty far lower than those found in southern Europe, the UK and Ireland, where income poverty and inequality are both relatively high. Ireland demonstrates the strong positive role of economic growth and rising disposable income in reducing the incidence and intensity of fuel poverty. Notwithstanding the positive longitudinal results of this analysis, the remaining high incidences of persistent fuel poverty in southern Europe and parts of northern Europe – including Ireland – result in a number of major policy implications. This chapter outlines some of the key implications of existing trends in fuel poverty for policymakers in four major areas: environmental policy, housing policy, social welfare and public health.

7.2. Environmental policy

7.2.1. EU-14

A key policy implication of inefficient use of energy in southern and western Europe relates to environmental agreements on stabilisation of greenhouse-gas emissions and acidification precursors (the Kyoto and Gothenburg Protocols respectively). With 1990 as the base year, most countries in Europe are required to reduce their energy related environmental emissions by 2010, with the notable exceptions being the 'Cohesion' countries which have been allocated an increase over

1990 levels. These policy targets are challenging and require dramatic reductions in business as usual levels of energy related environmental emissions across Europe. It can be seen from this research that there is a significant 'efficiency gap' regarding domestic energy efficiency in Europe, especially in southern Europe, the UK and Ireland. Reducing fuel poverty through improving the energy efficiency characteristics of housing in Europe would assist policymakers in achieving these looming environmental policy targets on global warming and acidification by reducing the demand for household energy use.

7.2.2. Ireland

The environmental policy implications are of particular interest for Ireland, as the country is a signatory to both the Kyoto and Gothenburg Protocols on greenhouse gases and acidification precursors respectively. Ireland's spectacular economic success over the past decade has made its Kyoto and Gothenburg emissions' targets for 2010 very formidable due to the strong link between economic growth and energy use. Furthermore, the base year was set at 1990, a time when the Irish economy was performing poorly, and consequently emissions' targets were not based on forecasts of future economic prosperity. Ireland's quota of greenhouse-gas emissions for 2010 is 62 million tonnes. Ireland has already surpassed this level, and emissions are currently around 66 million tonnes per annum (Clinch and Healy, 2000c). The business as usual prediction for Ireland is for an overshoot of up to 25 per cent (about 11 million tonnes) of greenhouse gases. It is clear that Ireland, and other EU member states, must implement policies over the next decade to curb such environmental emissions; otherwise, the European courts will impose a substantial fine.

Similarly, Ireland is a signatory to the Gothenburg Protocol on acidification precursors, which aims to reduce acidifying pollutants (SO_2 and NOx) dramatically over the coming decade. These reductions are even more dramatic in magnitude than those stipulated under the Kyoto Protocol. Currently, Ireland emits approximately 176,000 tonnes of SO_2. Business as usual predictions for the end of the decade indicate that emissions are unlikely to decline without some intervention. The Gothenburg Protocol requires that Ireland reduces its emissions of sulphur dioxide to just a quarter of current (2000) levels (42,000 tonnes). Furthermore, a similarly stringent quota has been set for emissions of nitrogen

oxide (65,000 tonnes), which is just about half the level of current emissions (124,000 tonnes).

Previous research in Ireland indicated that a programme to improve the thermal efficiency of the Irish housing stock to bring it in line with current (1997) building regulations would reduce emissions of CO_2 by over 8 million tonnes per annum, thereby reducing the Kyoto overshoot by 28 per cent. Furthermore, improving domestic energy efficiency in Ireland would reduce emissions of SO_2 and NOx significantly, resulting in a reduction of corresponding overshoots in SO_2 and NOx by 12 per cent and 14 per cent respectively (Clinch and Healy, 2000c). The study also quantified improvements in particulate matter (PM) that is thought to be particularly pernicious to human health. As such, it makes sense on environmental policy grounds alone to improve domestic energy efficiency and reduce fuel poverty in Ireland.

7.3. Housing policy

7.3.1. EU-14

As was demonstrated in Chapter 4, serious levels of housing deprivation exist in southern Europe. In a recent study, Healy (2003a) demonstrated that all four southern European countries demonstrate the highest levels of overcrowding in the European Union (using both objective and self-reported measurements). This study demonstrated that damp is found to be a serious problem in Portugal, Spain and Greece. These findings have profound public health repercussions, as damp, in particular, has been shown to be detrimental to human health. Northern European countries suffer less from poor housing conditions. However, 15 per cent of Irish households are statistically overcrowded and 18 per cent of British households declare a shortage of space (Healy, 2003a). Belgium, France, the UK and Ireland demonstrate the highest levels of poor housing cumulatively and over time using the ten housing indicators (Healy, 2003a). Such results indicate that current housing policies in countries most affected by housing deprivation are not wholly successful in alleviating housing stressors, such as overcrowding and damp conditions, particularly among vulnerable households. Furthermore, the time series data allow for comparisons over time, and it is clear that most countries in EU-14 are experiencing improved housing conditions during the period 1994-97.

Energy efficiency standards vary considerably across the EU, with southern states displaying near negligible thermal standards, while northern countries like Norway, Finland and Sweden demonstrate exemplary standards. It is alarming to note that those households who rent their accommodation are far more at risk of suffering fuel poverty. This is especially the case in countries such as Portugal where up to 78 per cent of tenants report fuel poverty. While the ECHP does not allow for the data to be disaggregated according to private versus social tenants, it is clear from previous research that the majority of fuel poor tenant households are local authority (social) tenants as opposed to tenants renting from a private source (Healy and Clinch, 2002).

In addition to these implications, the results of the socio-demographic analysis in Chapter 4 indicate that those living in apartment blocks (multi-family dwellings) are often suffering disproportionately from fuel poverty. The incidence of fuel poverty by dwelling type is highest among such households in Germany, the Netherlands, Belgium, France, the UK, Ireland, Austria and Finland. Such a finding highlights the need to combat deprivation (including fuel poverty) among households in multi-unit dwellings. A policy measure aimed at partial or full cost subvention of energy efficiency programmes in multi-family dwellings in the EU could be one effective way to reduce housing deprivation and reduce fuel poverty across the member states

7.3.2. Ireland

One in ten households in Ireland are damp, and this percentage is not falling significantly over the period analysed. In addition, over one in five households lack central heating. These findings have a number of implications, many of which fall in the public health domain, but there is also a lesson for policymakers in charge of housing policy. Strategies to improve housing conditions and reduce housing deprivation and fuel poverty need to be focused at improving the housing stock itself, as opposed to providing income based supplements which act as merely short term solutions. Policy measures to damp proof the home and install central heating (subject to a means test), although initially expensive, will have far larger benefits and will prove more effective in reducing deprivation and fuel poverty than providing a fuel allowance, which is, by its nature, an inefficient means of reducing fuel poverty (Brophy *et al*, 1999).

Substantial percentages of social housing in Ireland – as much as 34 per cent, according to Healy and Clinch (2004) – are fuel poor. Such a finding has implications for those responsible for policy in the areas of social housing in Ireland. While the ECHP data are limited in terms of the degree to which tenant households can be disaggregated into social and private tenants, the analysis is indicating that there appears to be a problem as regards the maintenance and refurbishment of social housing.

Moreover, the incidence of fuel poverty among large and small multi-family dwellings in Ireland is the highest in northern Europe. This indicates that serious housing deprivation exists among householders in this housing type in Ireland, and policymakers responsible for housing welfare should address this finding through implementing policy initiatives aimed at improving the thermal efficiency and general conditions found in multi-family units. However, it is important to note that such dwelling types are less commonly found in Ireland than in most other European countries. Thus, while the severity of fuel poverty appears to be high among such households, the extent (in terms of physical numbers) is relatively low.

In terms of thermal standards, over half of Irish households lack cavity wall insulation and as much as two-thirds lack double-glazing. A recent analysis by Healy (2003a) confirmed that Irish households also face serious financial pressures in meeting housing costs, with 20 per cent of Irish homes declaring that their housing costs were 'heavily' financially burdensome. This raises a much talked about concern regarding housing affordability in Ireland. It is clear that a substantial portion of Irish householders are unable to make ends meet because of the relatively high costs of mortgage repayments and rents (Healy, 2003a). This raises clear concerns regarding housing affordability for policymakers responsible for housing policy. In addition, 6 per cent of households in Ireland (approximately 70,000 households) declare that they are 'totally' or 'very' dissatisfied with housing. These households are also declaring multiple deprivation indicators. It is clear that these findings regarding the affordability of housing have implications for future housing policy. Change in housing policies to reduce the cost of home ownership or to suppress further increases in rents may be required to curb these trends. In addition, affordable housing strategies may be initiated as a means of helping first time buyers to acquire their first home.

7.4. Social welfare

7.4.1. EU-14

As detailed in Chapter 5, it is clear that certain social groups suffer disproportionately from fuel poverty. Across Europe, these are mainly low-income households, such as: lone parents, the unemployed, tenants, lone pensioners and those living in multi-family dwellings. The fact that fuel poverty, like income poverty, is most conspicuous in less well-off households points to an income problem: it is clear that low-income households (who generally live in the least efficient dwellings)[34] are unable to retrofit because of financial constraints. In this regard, policies should be implemented that improve the affordability of undertaking such remedial work. This may take the form of full or partial cost subvention of low-income households carrying out household retrofitting of energy efficiency measures. The fact that fuel poverty among vulnerable social groups is highest throughout Europe indicates that none of the fourteen member states analysed here can be complacent about the issue. However, it should be noted that the standard deviation of the incidence of fuel poverty by social group is lowest in countries like Germany, Belgium and Austria. In these member states, fuel poverty is relatively evenly distributed across all social groups, unlike in southern Europe, Ireland and the UK, where variations in the incidence of fuel poverty can be up to 45 percentage points (see Chapter 4).

Those whose main income source is unemployment assistance or social welfare support consistently report higher incidences of fuel poverty across EU-14 than other households, although pensioners follow close in many countries. The two factors that are clearly to blame for the high levels of fuel poverty found among these social groups are income and poor (energy inefficient) housing. Government-backed energy efficiency programmes should target unemployed households and other recipients of social welfare in an attempt to reduce fuel poverty effectively.

If educational attainment can be considered a good predictor of income, then the results of the socio-economic analysis of fuel poverty in Chapter 4 corroborate the assertion that fuel poverty is highest among low-income households, though cross-country variations are anything but uniform. The strongest correlation

[34] See Clinch and Healy (1999a).

between fuel poverty and educational attainment is found in southern Europe. In Portugal, for instance, 79 per cent of those who did not complete their second-level education declare fuel poverty, compared with 21 per cent of those who attained a third-level qualification. This pattern is repeated almost universally across the 14 member states analysed. Such a finding points again to an income factor, but also, potentially, to the importance of education as a means to understanding the benefits of domestic energy efficiency. It could be argued that those less well educated are less likely to be aware of the net benefits of installing energy saving measures in their home, or they may not even be aware of the existence of such technologies. As such, educational attainment may be positively associated with reducing fuel poverty through closing information gaps and increasing the affordability of energy efficiency investment (through potentially increased household income). It is clearly important, therefore, that member states continue to invest in, and promote, all forms of education.

7.4.2. Ireland

Fuel poverty is found to be heavily compounded among certain social groups in Ireland, to a far greater extent than in other European countries. Over the four years 1994 to 1997, the highest incidences of fuel poverty are found among those unemployed (23.3 per cent), tenants (20.9 per cent), lone parents (19.3 per cent), the separated (18.3 per cent) and those living in large multi-unit dwellings (17.4 per cent). Such results place Ireland in the bottom of the league table of fuel poverty by socio-economic group in northern Europe. These findings point to a strong income effect. It appears that low-income social groups are finding it more difficult than others to heat their homes adequately. This is not a particularly surprising or controversial result. What *is* surprising and controversial is the extent and magnitude of the problem among low-income groups *in Ireland* relative to the rest of northern Europe.

The persistently poor performance demonstrated by Ireland in the socio-economic analysis indicates some level of government failure. This is because it is clear that the state has previously failed to implement adequate forms of 'safety nets' or so-called poverty proofing measures for low-income households to combat fuel poverty. It is clear that the fuel allowance in Ireland (which is reviewed periodically by the Department of Social and Family

Affairs) is not a sufficient measure to combat fuel poverty.[35] There is some evidence to suggest, however, that the fuel allowance does reduce the severity of experience of fuel poverty suffering among certain low-income household groups (Healy and Clinch, 2004).

For households with children, the highest incidence of fuel poverty in Ireland occurs among lone parents, followed by couples with three or more children. As children are particularly vulnerable to the adverse health effects of cold, damp homes, it is disturbing to note the relatively high incidences of fuel poverty among households with children. Such findings are of obvious concern for those involved in community and public health and children's health.

A relatively high incidence of fuel poverty is found among lone pensioners in Ireland, especially lone male pensioners, where an incidence of 11.8 per cent is found. Again, it is known that pensioner households are classifiable as a low-income group, particularly those living on a sole pension. The fuel poverty results for those over 65 years of age show that older people are suffering from cold, damp homes to a greater extent than average. Such a finding indicates that government needs to intervene with increased financial assistance. This could take the form of an increase in the fuel allowance for the over 65s, or eligibility for full cost grants to improve the energy efficiency of their home using voluntary groups like Energy Action.

7.5. Public health

7.5.1. EU-14

Fuel poor households persistently report lower levels of health status (and higher levels of poor or impaired physical and emotional health) than those not so classified (Healy, 2002a). Inhabiting cold, damp housing often leads to increased risk of respiratory infection and cardiovascular strain (Eurowinter Group, 1997). Moreover, a dynamic relationship is reported. Many fuel poor households are

[35] The fuel allowance in Ireland is provided for under the National Fuel Scheme. It is intended to help households who are dependent on long-term social welfare or health board payments and who are unable to meet their own heating requirements. The Scheme operates for 29 weeks from early October to mid-March and, under the latest (2002) review, the fuel allowance is currently €9 per week, formerly (IR£7 per week). An additional Smokeless Fuel Allowance of €3.90 per week is payable if a household lives in areas where the sale of bituminous coal is banned (see information leaflet SW 17a).

self-aware of their health risks and reduced health status. A major finding of previous research by this author into the health effects of fuel poverty relates to housing as a self-perceived causal factor of the levels of poor health status, or more particularly of the levels of chronic diseases. Fuel poor households are relatively far more likely (three times, in fact) to blame housing conditions as a key cause for their illness than other households. In addition, European countries with poor domestic thermal efficiency and high fuel poverty invariably demonstrate high seasonal variation in mortality and *vice versa* (Healy, 2003b). Thus, fuel poverty and domestic energy inefficiency can result in premature mortality.

7.5.2. Ireland

Such results are of strong significance for those responsible for public health in Ireland. As fuel poor households are generally among the most vulnerable of all low-income social groups, it is likely that most are in receipt of a social welfare medical card. In this regard, policymakers should bear in mind that poor thermal conditions in housing and high levels of fuel poverty are resulting in higher levels of ill health, the costs of which are being borne predominately by the state. Clinch and Healy (2000d) showed that this excess morbidity associated with domestic energy inefficiency and fuel poverty amounts to an excess exchequer expenditure of €58m in Ireland per annum.

As many as 2,000 excess winter deaths in Ireland are associated with fuel poverty and domestic energy inefficiency (Healy, 2003b). The majority (87 per cent) of this excess mortality occurs in the over 65-age group in Ireland (Clinch and Healy, 2000a). Thus, the public health implications of fuel poverty are far reaching, with the potential for premature mortality among the very young and also among older people.

7.6. Summary

There are a number of key policy implications of the empirical results documented in Chapter 4 of this paper.

Improving domestic energy efficiency and reducing fuel poverty is of strong benefit to policymakers responsible for environmental policy, especially as a means to meeting (in part) the Kyoto and Gothenburg Protocols on global warming and acidification respectively. This is especially the case for Ireland, a country with a

particularly burdensome task in meeting its emissions quotas in light of the spectacular economic growth witnessed over the past decade. Conservative estimates indicate that the alleviation of fuel poverty in Ireland (via improving domestic energy efficiency to current building regulations) would reduce the business as usual overshoots of emissions' quotas of CO_2, SO_2 and NOx by 28 per cent, 12 per cent and 14 per cent respectively. Thus, domestic energy efficiency is a key strategy in helping policymakers achieve looming global environmental policy agreements.

Southern Europe demonstrates the worst housing conditions overall. Problems of damp, overcrowding and inadequate heating facilities are common here, but also in the UK and Ireland. Tenants are especially vulnerable to fuel poverty, and it is clear that more investment is needed in the social housing sector, especially in Ireland where approximately one third of local authority tenants are fuel poor. Large apartment blocks containing multi-family units are also highly affected by fuel poverty across Europe and, again, Ireland demonstrates this trend strongly.

It is also clear that there is a large variation in Europe with regard to existing policies aimed at reducing the hardship of low-income groups. While the variation in the incidence of fuel poverty among various social groups in countries such as Austria, Belgium and Germany is relatively small, variations in the incidence of fuel poverty in southern European nations, Ireland and the UK can be as much as 45 percentage points. Those groups most in need of state targeting include: the unemployed, lone parents, lone pensioners and tenants. Ireland is marked by the largest socio-economic variations in fuel poverty in EU-14. It is unlikely to be a coincidence that Ireland demonstrates among the highest levels of income poverty and inequality among the member states (Eurostat, 2003).

Finally, there are a number of public health implications of fuel poverty. It has been shown that excess winter morbidity associated with fuel poverty and domestic energy inefficiency in Ireland results in an excess exchequer spend of €58m per annum. Furthermore, it has been estimated that as many as 2,000 excess winter deaths in Ireland could be prevented by the alleviation of fuel poverty (Healy, 2003b). Ireland has the second highest seasonal variation in mortality in Europe, and this has been shown to be associated with the thermally inefficient housing stock. It is clear that the public health implications of fuel poverty are of critical importance.

8

Policy instruments

8.1. Introduction

This chapter outlines the policy instruments available to correct market failure and improve the thermal standards of housing and thereby reduce fuel poverty. There are a variety of economic and other instruments available and, although it is not the purpose of this paper to provide a generic discussion on the benefits and drawbacks of each of these instruments, it is useful to present the range of instruments from which an efficient policy mix can be derived later in the paper.[36]

8.2. Regulation

Regulation, also known as command and control, endeavours to improve the performance of the market via the setting of standards (for example, building regulations). Non-compliance with a standard results in a penalty, usually in the form of legal action and/or fines. Regulation is likely to be most effective for new housing where minimum standards can be set for insulation. However, it could be mandatory that energy conservation measures be installed each time a house is sold; this would encourage retrofitting of the existing housing stock and thereby improve energy efficiency standards over time. It might also be required that information on the energy efficiency of a house (energy rating) be issued whenever a house is sold (see Section 8.5). Landlords could be required to provide minimum heating standards and/or specify the thermal characteristics of the residence to potential tenants.

8.3. Taxes and charges

Environmental taxes and charges are economic instruments. These instruments are put in place by a policymaker to alter market signals to encourage or discourage certain activities or behaviour. A tax on

[36] Much of the material from this chapter is drawn from Clinch and Healy (2000b).

energy generated from fossil fuels (often denoted a 'green tax', 'energy tax' or 'carbon tax') may be part of a strategy to reduce emissions of greenhouse gases. This would provide an incentive to invest in energy conservation measures. However, energy tends to be price inelastic and so, when the substitutes for energy generated from fossil fuels are limited, such a tax on its own may not be effective unless combined with other policy instruments. In addition, there are some key potential negative impacts associated with a tax on energy, the most obvious of which relates to equity. Many see an energy tax as regressive, punishing those households who already may be fuel poor, thereby compounding their experience of fuel poverty and pushing them deeper into a fuel poverty trap.

8.4. Tradable permits and offsets

Emissions trading is also an economic instrument. Rather than being a price instrument (like a tax), it is a quantity based instrument, whereby compliance with greenhouse emissions or other quotas can be achieved, in part, by purchasing from others whose emissions are below the quota they hold. A price emerges for the exchanges, which reflects the scarcity value of the environment. If such a trading system is put in place, it may be possible for emitters who emit a low level of greenhouse gas emissions to sell the carbon reduction to a company that requires emission credits. Such a system will increase the incentive to invest in energy efficiency. It is likely that tradable permits could exist in the run up to the Kyoto Protocol deadline of 2010, by which time many countries worldwide – including those in Europe – must achieve certain quotas in emissions of energy related CO_2 to avoid punitive fines being imposed. Under such an arrangement, Ireland would likely be in a position where it would need to purchase some emissions' permits from a country selling excess unused permits, as business as usual predictions forecast an overshoot of the Irish emissions' target by some 25 per cent of current levels of CO_2.

8.5. Information

The failure of the market to provide information on the benefits to the householder of energy efficiency can be corrected by improved information provision by the government (see 'Institutional Development' below). As such, information provision can be

considered an economic instrument. Provision of information on the benefits of energy efficiency improvements, in the form of an easy to read leaflet and a list of installation companies etc, would substantially reduce the information deficit. As mentioned above, the inclusion of an energy rating in the specifications of a house on the market could be quite effective, as could the provision by landlords of information regarding the thermal characteristics of the residence available to rent. As the information gap may be considered a key reason for market failure (see Chapter 6), it makes sense to invest in information campaigns alerting householders to the existence and benefits of simple energy saving measures in the home. Such campaigns are currently underway in Ireland, funded through Sustainable Energy Ireland.

8.6. Subsidies and tax relief

Removal of subsides, if any, on energy products would enhance the incentives for the conservation and efficient use of energy. Tax relief (for example, on the costs of retrofitting) and grants for energy conservation measures in homes by the government are other potential instruments. Such an instrument has been used extensively to promote energy efficiency in the domestic sector in the USA (see Chapter 8).

8.7. Voluntary approaches

A voluntary agreement by estate agents that information on the thermal specifications of houses be included in sales literature could have potential. While voluntary agreements by firms to reduce environmental emissions have been shown to work, in the absence of other incentives it may be difficult to get individual households to agree voluntarily to install energy conservation measures in the absence of other incentives.

8.8. Institutional development

Energy efficiency is usually the concern of a number of government departments; in the case of Ireland, this could amount to at least half a dozen state departments and organisations. However, it is helpful if a focal point is established to co-ordinate policy approaches and to lead the information campaign. In this regard, a positive recent development in Ireland has been the establishment of the Sustainable Energy Authority under the Irish Energy Centre (now

Sustainable Energy Ireland) in 2001, which now has a full state backed mandate in this domain.

8.9. Research and development

The stimulation of research into the best opportunities for energy efficiency is essential. The construction of cost benefit analyses and the recommendation of appropriate policy responses is often hampered by a lack of available data. In this regard, it is important that governments invest in research that provides up to date data on fuel poverty and domestic energy efficiency, as the quantitative literature in this field is undesirably thin. Policymakers cannot attempt to tackle the problem of fuel poverty in an effective and efficient manner unless they have the means (that is, the data) from which policy proposals and strategies can be formulated.

8.10 Summary

There is a range of instruments available to policymakers to rectify market failure with regard to fuel poverty and domestic energy efficiency. Regulatory policies are probably best suited to newly built houses, as is the case currently. This is because there are some logistical problems with imposing command and control measures on existing dwellings. Carbon or green taxation is becoming a reality now in Europe. However, there are a number of controversial issues surrounding the use of this economic instrument in the housing sector. It is very important that such a tax avoids becoming regressive (that is, hitting those on the lowest incomes the hardest) and such a tax, were it to be implemented in Ireland, could hit the fuel poor very hard, increasing the severity of experience of households caught in a fuel poverty trap. As such, it is essential that such taxation is implemented extremely carefully (if at all) in the domestic sector and should only be aimed at upper income households. Tradable permits are likely to be used as a means to implementing the Kyoto Protocol over the next few years up until 2010. Unfortunately, the economic growth witnessed during the past decade is likely to ensure that Ireland is a buyer of emissions permits as opposed to a seller.

Chapter 7 of this paper identified information gaps and asymmetries as key causes for non-investment in energy saving measures in the home in Ireland. In this regard, strategies based on

improving information and reducing the information gap evident among householders would be highly beneficial. Tax relief is another potential economic instrument, which can be used effectively to promote investment in retrofits among the well-off in society. Owing to their nature, voluntary approaches may not work in the domestic sector as individual households are unlikely to agree voluntarily to install energy conservation measures in the absence of other incentives. The establishment of the state funded Sustainable Energy Authority in Ireland, formerly the Irish Energy Centre, is a very beneficial institutional development.

Finally, fuel poverty is a very under-researched field, particularly in terms of empirically grounded studies. Increased funding for research projects aimed at both assessing and reviewing the situation in Ireland (and elsewhere) is required so that policymakers can base their policy strategies and measures on firm, scientifically robust data and statistics. In this respect, research and development is a powerful policy instrument to assist policymakers tackling the problem of fuel poverty and market failure in domestic energy efficiency.

9

International fuel poverty policy

9.1. Introduction

This section reviews the various policy measures that have been implemented in a number of countries in Europe and in the USA since fuel poverty was first identified after the oil shocks of the 1970s. It quickly becomes apparent from this comparison that policies to address fuel poverty in Europe vary considerably in extent and in effect. It is hoped that this chapter will provide valuable insights into the effectiveness of various policy measures, as the chapter evaluates the relative success or otherwise of various responses to tackling fuel poverty worldwide. It is from this chapter that the policy recommendations in Chapter 10 are derived.

9.2. Ireland

The fundamental policy measure in place to combat fuel poverty in Ireland has been based on income subsidisation. Income supplement allowances have been in place since 1942, initially as an emergency measure to enable those living in urban areas to meet high fuel costs associated with wartime shortages and rationing of coal. Concessionary schemes for specific groups on social welfare were subsequently implemented for various fuels; these included electricity in 1969, Liquid Petroleum Gas (LPG) (1978) and natural gas (1991). Additionally, a supplementary welfare fuel allowance was introduced in 1977 after the oil crises of the 1970s. Over €240m was spent in 2001 on income supplements for 'Free Schemes' in Ireland, €61m of which (25.4 per cent) was spent on the fuel allowance (Table 9.1). This figure represents a 29 per cent increase in payments made 10 years ago. In physical numbers, some 374,000 households availed of this fuel allowance in 2001.

Table 9.1. Total Exchequer Expenditure on the Fuel Allowance in Ireland, 1992-2001

Year	***€000***
1992	47,432
1993-4	7,647
1994	50,666
1995	54,276
1996	56,298
1997	57,070
1998	57,004
1999	55,809
2000	55,487
2001	61,136

Source: Department of Social, Community and Family Affairs (2002).

There were two intermittent initiatives aimed at improving the thermal standards of Irish housing. The first was during the period 1980-82, followed by a scheme in 1985-87. Both of these schemes mainly funded improvements in levels of attic insulation in homes nationwide. The initiatives were well subscribed and successful, with 88,000 households (over 10 per cent of all dwellings in Ireland at that time) benefiting from the grants. As such, attic insulation is the one energy saving measure with which Ireland performs well relative to its European counterparts, as data in Chapter 3 demonstrated. However, the mid-1980s were economically regressive years for Ireland, and the country underwent a period of severe fiscal rectitude in an attempt to control an ever increasing national debt. In this regard, both programmes were cut during subsequent spending cuts and never restored.

Domestic energy conservation programmes were proposed in the programmes for government in 1993 and 1995, but very little action followed. The latest Green Paper on Sustainable Energy (Department of Public Enterprise, 1999) and the National Climate Change Strategy (Department of the Environment and Local Government, 2000) have given increased power to the statutory body responsible for energy efficiency awareness, the Irish Energy Centre, to develop fuel poverty policy and strategy within a new

state-funded body known as Sustainable Energy Ireland (SEI). Exchequer funding for various measures and programmes comes from within the framework of the National Development Plan (2000-2006), which has allocated monies to energy efficiency programmes in housing. The Green Paper is strong on proposals on improving thermal efficiency in the domestic sector, but far less strong on methods of implementation.

Energy efficiency is to be promoted through information and awareness campaigns regarding the benefits of energy efficiency in the home:

- the government is to 'encourage' retrofitting of older, less efficient, housing with improved insulation measures to increase their thermal efficiency
- households suffering, or at risk, from fuel poverty are to be 'protected'
- enhanced standards for new buildings in the form of updated Building Regulations will be implemented
- there will be a new emphasis on building and appliance labelling, thereby assisting energy consumers make more informed decisions
- back-up will be provided to develop the expertise of builders and contractors in areas such as insulation, heating systems, et cetera.

The Irish Energy Centre (now Sustainable Energy Ireland) runs a yearly energy-awareness campaign. However, the results presented in Chapter 6 indicate an enormous information gap among fuel poor households with over 50 per cent of such households (approximately 120,000 dwellings) unaware of the benefits or existence of such energy saving measures in the home. The Centre has also begun to commission research into fuel poverty and the identification of those social groups in Ireland most affected.

Sustainable Energy Ireland is now in the process of launching a Low-income Housing Programme Strategy through an extended funding programme, which is due very shortly. The Extended Funding Programme represents a significant step in the right direction in that it will be the first major energy efficiency programme specifically targeted at addressing fuel poverty in low-income households. A managing agent for the Extended Funding Programme will be appointed shortly and funding of agencies will

commence by the end of the year. The measures to be carried out will initially include cavity wall and attic insulation, draught proofing, hot water cylinder jacket, low energy lamps and energy advice. SEI currently spends €0.9m (2003) on fuel poverty alleviation initiatives, and this is set to rise to €1.6m in 2004 (Stokes, 2003).

The Department of the Environment and Local Government has issued a number of building regulations that successively increased the required thermal standards of new built homes. Building regulations from 1991, 1997 and 2001, in particular, have raised minimum insulation levels across the new built stock, but of course these requirements have no effect on the existing one million dwellings built prior to the regulations, some of which have little or no insulation in place. Utilities such as Bord Gáis and the ESB have implemented measures to tackle fuel debt. Approximately one in ten gas and electricity customers in Ireland now use prepayment and rescheduling services in an attempt to avoid late payment and disconnection. Bord Gáis has, for some time now, implemented a system of energy certification for new houses and the ESB has introduced demand side measures to reduce demand for electricity at peak times when prices are highest by introducing reduced rate night time prices and selling energy saving measures in its shops nationwide.

Energy Action is the main voluntary actor at play in Ireland with regard to improving energy efficiency.[37] Approximately 10,000 households have benefited from their services since its foundation in 1988, most of which were in the Dublin area, although projects have been undertaken in regions as remote as Tory Island. Energy Action has also commissioned research on the economics of energy efficiency in the domestic sector. The work, undertaken by the Energy Research Group and Environmental Institute, University College Dublin, indicated huge net benefits to society (in the region of €3 billion) resulting from a proposed large-scale programme of improved domestic energy efficiency (Brophy *et al*, 1999). It is clear that such a programme is welfare improving. Heat and Energy Action Tallaght also addresses fuel poverty in a disadvantaged area

[37] Energy Action is a Dublin based charity that addresses the thermal needs of the elderly and needy, and provides training and employment opportunities for the long-term unemployed. Established in 1988, the core aim of Energy Action is the alleviation of fuel poverty in Dublin by provision of insulation in the homes of older people.

of south Dublin by bringing the issues to a national level and organising conferences on fuel poverty from time to time.

Under the Green Paper on Sustainable Energy, some €7.62m is allocated to fuel poverty measures over the period 2002-2006. Energy Action receives €220,000 from this programme and FÁS funds Energy Action with €550,000 for training employees as well as supporting projects through their Social Economy funding mechanism in an effort to deliver the aforementioned SEI Low-income Housing Programme. Over the five years 2002-2006, Ireland will spend at least €316m on measures aimed at combating fuel poverty, however almost 97 per cent of this money is devoted to income supplements (that is, the fuel allowance), while only a relatively tiny sum (approximately €10m) will be invested in retrofitting schemes. This policy of *ad hoc* income subsidisation is at odds with the policy measures in the UK (discussed later), which are based on subsidised retrofitting programmes aimed at improving the thermal efficiency of the housing stock.

It is fair to state that there is a richness of voluntary and academic work in the area of fuel poverty in Ireland, which contrasts sharply with the absence of initiative given to the problem at both government and local authority levels. The reasons for this are unclear. It is possible, however, that the lack of rigorous fuel poverty research in Ireland heretofore (owing mainly to a lack of data and appropriate research funding opportunities) has played a significant role in the government's unwillingness to tackle the issue fervently.

9.3. United Kingdom

British policy measures have been far more aggressive in tackling the issue, notwithstanding similarly high levels of fuel poverty. This has led the way in terms of introducing policy measures to combat fuel poverty. Strategies aimed at improving energy efficiency were first introduced in the UK in 1978 with the Home Insulation Scheme providing grants for up to two thirds of the cost of the remedial work undertaken for improving thermal efficiency in owner-occupier households. Pensioners were allowed higher allowances and local authority households were included in the scheme from 1979 onwards. A programme of energy conservation in the social housing sector was also introduced in 1978 under the Local Authorities Energy Conservation Programme. Initially, this scheme

was proposed to be a ten-year programme of retrofitting work to insulate attics and draught proof doors and windows. Local authorities were to be given a 'ring fenced' sum of money within their housing improvement programme, which was to be dedicated to energy efficiency work. However, government cutbacks in 1980 resulted in a ten-fold reduction in the level of remedial work performed by local authorities. Statistics demonstrate that just 66,000 social-sector homes were insulated in 1987, while 630,000 dwellings were improved in 1979. It is argued that the ability of local authorities to improve their housing stocks in the UK over the past two decades has been severely diminished owing to the cut in exchequer funding between 1979 and 1997 which amounts to some 75 per cent in real terms. Local authority tenants were also able to apply for funding to insulate their attics during the period 1980 to 1990. However, the take-up was poor, with just 6 per cent of grants going to local authority tenants.

Since 1991, a Home Energy Efficiency Scheme (HEES) has been in existence in the UK. This is based on the 1978 Home Insulation Scheme and allows for means-tested grants to improve the energy efficiency of the household; those on either income or disability benefit are entitled to apply for subsidies. Funding has risen successively over the years, from £23m in its first year (1991) to £75m in 1998 and almost £150m per annum for the latest 2000-2002 scheme. The mean grant per household was £160 up to the current 1999 scheme, however this is expected to at least double with the latest scheme. Just 8,000 households availed of the grant in 1991, however this rose to 600,000 households in 1995/96 and 500,000 households in 2000-2002, 300,000 of whom are over 60 years. It is thought that, for a typical three bedroom semidetached property, the scheme reduces heating costs by up to £600 per annum, depending on the energy efficiency conditions pre-retrofit. A grant maximum of £700 is now in place, over twice that in the previous scheme. A special programme, entitled *HEES Plus*, is aimed at the elderly and grants of up to £1,800 are available to such households to improve the heating system as well as insulation levels of the dwelling.

Local Energy Advice Centres have been in place for almost ten years in the UK under the aegis of the Department of the Environment and the Energy Saving Trust. Such centres provide independent, authoritative and free information on the scope for energy efficiency improvements to the domestic and commercial

sectors. There are almost 40 centres currently in operation with an immediate catchment of approximately 15 million people. About 26,000 customers were advised during 1993/94, and it appears from *ex post* research that reaction is generally positive, with two-thirds regarding the centres as 'extremely' or 'very' useful, and the same proportion of customers stating that they would use the service again (NEA, 1997). Research has estimated that £57m has been saved in fuel bills as a result of implementing this information provision service which also helps to reduce the transaction costs of installing energy saving measures in the home.

British local authorities have been required since 1990 to provide the Department of the Environment with full details of their work on energy efficiency. The British government's 1990 White Paper on the Environment specified that a given proportion of local authority spending on housing must be dedicated to thermal efficiency improvements. Some local authorities have gone further and beaten the minimum threshold set by government.

Utilities have also responded to fuel poverty by developing a range of initiatives aimed at reducing the numbers in fuel debt; payment rescheduling and prepayment cards are two such examples. In this regard, the levels of disconnections have fallen by 87 per cent between 1990 and 1997 (NEA, 1997), and prepayment subscribers' account for one in seven of all electricity customers in the UK. Voluntary organisations are also very much evident in the UK, with Neighbourhood Energy Action (NEA) (established 1981) and Heatwise (established in 1983) both active voluntary organisations in England/Wales and Scotland respectively. NEA attracts funding from government, utilities and other private sources. Between 1981 and 1989, NEA undertook remedial energy efficiency work in 730,000 homes in England and Wales. It also funds research on fuel poverty. The Scottish counterpart, Heatwise, based in Glasgow, has draught-proofed 110,000 Scottish houses over ten years. It receives mainly European funding, especially through the European Social Fund mechanism, with additional monies from the Glasgow Development Agency and the UK Department of the Environment.

Many of the above British statutory policy measures apply to Northern Ireland as well. However, there are some differences. Grants for private sector housing promote energy efficiency indirectly, as all new built homes in this sector must comply with strong building regulations. Although a domestic energy efficiency

scheme, similar to the HEES in Britain, is also implemented with similar grant thresholds to the equivalent British scheme, a further £60m subsidy has been dedicated for low-income homes to deal with relatively high electricity prices in Northern Ireland over the period 1996-99.

The British government's approach to mitigating fuel poverty has been criticised for a number of reasons. First, the regressive redistributive taxation policies, especially those introduced in the 1980s, resulted in an increase in the numbers suffering fuel poverty and a widening of the gap between rich and poor. It could be argued that the UK government's policies have been excessively conservation driven, making inadequate use of income based measures to support the low-income fuel poor. Electricity costs of vulnerable, low-income households rose when VAT was introduced on domestic fuels, making home heating increasingly unaffordable for low-income households using electric storage heaters and other electric sources of heat. In 1988, a number of changes occurred in the social welfare regime in the UK, one of which removed heating related additional subventions formerly made available under the previous supplementary benefit system. The system of triggering cold weather payments is seen by some as unsatisfactory (NEA, 1997), as the threshold is set so high that it ensures that payments are rarely triggered. Finally, the latest Home Energy Efficiency Scheme has been criticised as highly inefficient (Sefton, 2002), with problems of 'free-riding' identified.[38] Notwithstanding these criticisms, the UK has achieved significant reductions in the number of fuel poor over the decade. The evidence presented in DEFRA and DTI (2001) suggests that between 1991 and 1997 there were over a third fewer households falling into a fuel poverty trap.

9.4. Netherlands

The Netherlands has been exemplary in tackling domestic energy inefficiency and related problems of fuel poverty. *Ad hoc* grants for insulation were implemented as long ago as 1974 during the first OPEC oil crisis. A national insulation programme was also developed and initiated in 1979, and comprised of mandatory

[38] Free riders are those programme participants availing of state subvention who would have borne the costs of the work even in the absence of state assistance.

insulation for all new built homes and large grants for retrofitting existing ones. Subsidies covered a broad range of energy saving technologies, not just roof insulation, and included double-glazing, cavity wall insulation, floor insulation, roof insulation and draught proofing. The programme was altered in 1982 so that grants to owner-occupiers ceased and only tenants were targeted. This was to address the relatively low take up of the scheme among low-income groups and to reduce the numbers of free riders among upper income households. In 1987 the programme evolved into a house improvement scheme of which efficiency measures became one key part. A number of fixed subsidies (up to a maximum ceiling) were available for insulation measures and double-glazing, or alternatively 25 per cent of remedial work on home improvements could be claimed if energy efficiency improvements were incorporated in the remedial work.

For over a decade, Dutch utilities have charged an environmental levy on energy bills paid by customers with all proceeds being used to subsidise energy efficiency improvements in the domestic sector. This levy, which is up to 2 per cent of the total cost of bills, is matched by government subsidies that are then earmarked for investment in Combined Heat and Power (CHP) technology, retrofitting insulation and so forth. Exchequer spending on energy conservation was also doubled in 1991 under the National Environmental Energy Plan Plus and the Energy Conservation Memorandum to the equivalent of about €16 per capita. A third of the latest budget is devoted to domestic energy efficiency measures, with particular emphasis on retrofitting insulation. Energy utilities are required by law to promote efficient energy consumption and are made responsible for conservation programmes. The Dutch government has also created a statutory energy agency, similar to the Irish Energy Centre, called Novem. However, budgets are proportionately far higher than those allotted to the equivalent Irish agency, with Novem receiving large R&D funding which has been used in the domestic sector to monitor various state of the art heating systems and evaluate their efficiency with a view to curbing energy use in this sector by 25 per cent over three years.

9.5. Germany

In 1978 a comprehensive energy saving programme was introduced in Germany that enabled households to opt for grants (for tenants)

or tax credits (for owner-occupiers) to retrofit insulation and improved heating systems. The total cost of the scheme was then €2.2m, with a 50:50 split between tax breaks and subsidy payments. The scheme worked as follows: a 25 per cent grant was made available to cover the range of €4,000-11,800 per home, or a tax allowance was given for ten years which amounted to 10 per cent of the total cost of the investment. Innovative, state of the art options were also funded, such as solar energy. However, most of the subsidy (77 per cent) went towards double-glazing.

The scheme has been considered cost ineffective in more recent reviews (Convery, 1998; NEA, 1997), owing to the low energy benefits arising from the retrofitting of costly measures such as double-glazing. However, the less than robust private energy benefits of this scheme would imply that it would more likely pass a cost benefit test if the programme evaluation were widened to capture the non-energy benefits to householders, such as improved health status and comfort. Current housing strategies in Germany include an element to improve the affordability of home-heating costs and considerable effort is made to reduce transaction costs for householders wishing to undertake remedial work. In addition, an informational component is integrated into the policy strategy, with many state funded energy efficiency advice centres in operation.

9.6. Denmark

In 1975, the Danish government introduced grants and incentives for energy efficiency programmes. The first scheme (1975-80) provided a grant covering 20-35 per cent of the total cost of the remedial work, depending on employment status. Tax credits were also introduced for households investing in energy efficiency improvements. The cost of the programme amounted to approximately €700m in 1980 and was deemed less than cost effective; householders were reported to be using the grant for general home improvements as opposed to those specific to energy efficiency. Furthermore, households not investing in such measures were found to be suffering from myopia, displaying high discount rates and failing to realise the long-term nature of the benefits of improving the thermal efficiency of their dwelling. In 1980 the programme was modified and re-implemented. It allotted an enormous sum of money (about €1.6 billion) and very substantial per capita grants to improve thermal efficiency in the domestic sector. The fund was rapidly exhausted owing to the large

level of subsidisation available to participating households, but was considered more successful using narrow cost benefit assessment.

Denmark has continued to implement rigorous and aggressively funded fuel poverty alleviation programmes over the past decade. The Danish Energy Agency – which is the Danish equivalent to the Irish Energy Centre and Novem in the Netherlands – currently implements four major schemes to improve thermal efficiency and reduce fuel poverty in Denmark. First, a 50 per cent grant is available to those homes wishing to install central heating and connect to a CHP generator. Second, a 50 per cent grant is available to pensioners for energy saving measures such as insulation, lagging jackets, draught stripping, double-glazing and improved heating controls. Third, a fuel allowance is provided to pensioners on a sliding scale: between 25 per cent and 75 per cent of heating costs are covered depending on how much energy is consumed in the dwelling. Fourth, an urban renewal programme has been implemented by the Agency that requires that houses refurbished using subsidies by the government must also undertake energy efficiency improvements as part of the subsidised remedial work.

9.7. Norway

Norwegian housing, like that in Sweden and Finland, is highly energy efficient. The government in Norway has enforced strict building regulations since the 1960s, well before any oil crises were evident. The retrofitting of older dwellings has been encouraged in the private owner-occupier sector by generous tax breaks. Some commentators have argued that, while the tax breaks given for investment in Norwegian energy conservation programmes have been very successful, a large number of programme participants were free riders who would have invested in efficiency improvements even in the absence of the programme (Haugland, 1996). In fact, Haugland estimates that 70 per cent of the participants were free riders.[39] Full state subsidisation of tenant households took place predominately during the 1970s and 1980s. The effect of Norwegian policy measures in tackling fuel poverty has resulted in a situation where almost 100 per cent of Norwegian households are equipped with double-glazing, 88 per cent have floor insulation,

[39] An interesting discussion of the 'free rider' problem can be found in Franz and Weaver (1994).

85 per cent have cavity wall insulation and 77 per cent have roof insulation (Healy, 2003a).

9.8. France

Fuel poverty appears to be an issue that is raised periodically in France, particularly in times of economic stagnation when generalised poverty, inequality and deprivation become more widespread. Non-governmental organisations, such as *Secours Catholique*, have employed the theme 'the right to energy' under their social service campaign strategies. Limited income supplements have been made available and some administrative options are now underway for consumers of electricity and other utilities so as to curb disconnections. Overall, though, France is similar to many southern European countries in that both statutory and local level support measures have not been implemented to alleviate fuel poverty, and its existence as a *bona fide* social problem is still not yet acknowledged formally at either level. This is made all the more questionable when it is considered that levels of fuel poverty in France are among the highest in northern Europe (see Chapter 4).

9.9. USA

The US government does not appear to formally recognise fuel poverty as a distinct entity separate from generalised income poverty. However, it has encouraged energy conservation and improved residential energy efficiency using mainly fiscal measures such as tax credits as well as subsidisation of low-income households. Thus, it is not fuel poverty *per se* that has driven the US government over the past two plus decades to encourage improved thermal efficiency in the domestic sector; rather, it is the wish to keep energy demand stable, thereby retaining a level of autonomy over security of supply. The oil crises of the 1970s also placed an onus on the US government to keep energy costs affordable. If it was not possible to rule out a future energy supply crisis, then the next best step was to reduce reliance on energy so that the US would have increased power over the affordability of fuel costs.

In 1978 the National Energy Act introduced an explicit policy of energy conservation. A credit of 15 per cent against federal income tax liability was permitted for up to $2,000 of qualifying expenditures on insulation and energy conserving devices (Quigley,

1991). In addition, a 30 per cent credit was given for investment in renewable resources, later increased to 40 per cent in 1980. Before the introduction of these tax credits, the US government had undertaken a direct programme to increase the insulation levels in dwellings occupied by low-income households.

The Energy Conservation in Existing Buildings Act of 1976 authorised the Department of the Environment to develop and implement a national weatherisation assistance programme to assist in achieving a minimum level of thermal efficiency in the homes of low-income households. Funding was relatively generous with a ceiling of $1,600 per dwelling. Throughout 1984, about $1.4 billion in federal funds had been allocated to low-income households. In the state of California alone, some 66,000 homes were weatherised out of a total number of 1.4 million eligible units. However, some commentators have found that these energy tax credits do not lead to more widespread diffusion of energy saving technologies, again pointing out the issue of free riding. Walsh (1989) concludes that the effective discount rate may be too small, transaction costs in the form of bureaucratic paperwork may be too large, and information gaps may exist.

After the second OPEC oil shock of the late 1970s, the Low-income Home Energy Assistance Program block grant was established to encourage low cost weatherisation by low-income households. Federal spending on this programme rose from $279m in 1982 to $398m in 1985. In 1986, the Department of the Environment released almost $2.1 billion to all states to continue the retrofitting programmes. Modest subsidies for solar energy investment through the Solar Energy and Energy Conservation Bank have been witnessed during the later part of the 1980s and early 1990s.

9.10 European Union

The EU has adopted a number of policies of relevance to fuel poverty, each of which is discussed in a variety of green and white papers. Perhaps the most controversial and contentious energy policy of the EU relates to its promotion of green/carbon/energy taxes, the principal of which is based on the notion that consumption that results in a depletion of a non-renewable resource (and/or is highly polluting) should be taxed the hardest (NEA, 1997). Exemptions of the tax are available for renewable resources and for utilities. Directive 93/76 sets out requirements for the mitigation of

CO_2 emissions by improving energy efficiency, eco-labelling, thermal insulation of new buildings and energy rating of buildings. Regulation 92/880 requires domestic appliances such as refrigerators and freezers to carry an energy label indicating the mean annual energy consumption for each product. Boiler directive 92/42 is a requirement for minimum efficiency standards to be attained for central heating boilers.

There are a number of research programmes in the area of energy. These include JOULE/THERMIE, SAVE and ALTENER, all of which provide funding for research projects concerned with energy conservation and energy efficiency; however the domestic sector is probably the least targeted area of research in each of these EU funded programmes.

In short, the EU has given mainly peripheral attention to fuel poverty, concentrating more so on the environmental policy perspective of energy efficiency.

9.11 Summary

This chapter has presented an overview of the various policy measures to tackle fuel poverty in a range of countries in Europe and the USA. Some conclusions can be drawn from the review.

Despite exhibiting similar levels of fuel poverty, the UK and Ireland are at two extremes in terms of their policy response to tackling the issue, the British response being entirely conservation-focused, the Irish being income-focused, at least until now with the establishment of the Low-income Housing Programme Strategy. Northern European countries employ a mixture of incentives and command and control instruments with a high level of state subsidisation of low-income households. A major difference appears to be with regard to how private rented households are 'incentivised' more effectively in continental Europe than in the UK and Ireland. The USA, while not recognising fuel poverty *per se*, addresses the issue from a security of supply perspective. Economic instruments – mainly tax credits – for 'weatherization' programmes are the main policy response in the USA. Despite some caveats discussed earlier, they appear to have proved effective in maintaining and improving domestic thermal standards in the USA. Table 9.2 summarises these policy responses in selected countries.

Table 9.2. Summary of Key Policy Responses in Selected Countries

Denmark	Grants from 1975. Tax credits from late 1970s. Income subsidisation of low-income households.
France	Some voluntary sector involvement. Limited income supplements.
Germany	Grants and tax breaks in late 1970s. Information.
Ireland	Traditionally income subsidisation of low-income homes and *ad hoc* grant schemes in 1980s. Currently, information provision and rich voluntary and academic sector input. Comprehensive low-income grant scheme to be introduced 2003/2004.
Italy	Limited grant aid and income supplements.
Netherlands	*Ad hoc* grants in early 1970s via national insulation programme. Energy tax 1990s to date. Information provision and strong technology based R&D.
Norway	Stringent building regulations since 1960s. Tax breaks for owner-occupiers. Subsidisation of tenants in 1970s and 1980s.
UK	Building Regulation from late 1970s. Strong information provision. Comprehensive grant schemes for low-income homes. Significant voluntary sector input. Seminal R&D.
USA	Tax breaks and subsidisation of low-income homes via federal 'weatherisation' programmes. Building regulations since 1976.

It is clear from this critical review of international policy response to fuel poverty that tailored policy responses are needed for each country analysed in this study, because each country exhibits differing fuel poverty characteristics and differing socio-economic circumstances. The next chapter attempts to present these responses, placing special weight on the case of Ireland.

10

Policy recommendations

10.1. Introduction

Because of the highly multidisciplinary nature of fuel poverty research, policy implications are far-reaching, and departmental policies need to be formulated in conjunction with each other to avoid intergovernmental stasis and to achieve economies of scale in an effective fuel poverty alleviation strategy. It is clear that the fundamental public health implications of this and other research have to be addressed primarily through appropriate interventions in social welfare (through income supplements) and housing policy (through general housing refurbishment programmes and improved standards in social housing). However a broad proposal can be made that is based on strong economic grounds. Such a proposal is described at the end of this chapter.

10.2. Ireland

Irish housing is characterised by below average levels of energy efficiency, with roof insulation being the exception. Fuel poverty is also a problem in Ireland, with Irish households ranked among the most fuel poor in northern Europe. The level of seasonal mortality in Ireland is the second highest in EU-15, with a winter mortality rate some 21 per cent above the average rate of mortality. Although some improvements have been witnessed as regards the level of thermal efficiency over the past six years, much of this can be ascribed to the high numbers of new built homes completed in this period, all of which, theoretically at least, are energy efficient. Just one in three households in Ireland are double-glazed and one in five have floor insulation, indicating that these measures need to be retrofitted in existing dwellings. The Irish economy has enjoyed economic growth rarely seen in a developed country, with per capita GDP almost doubling between 1990 and the present (Healy, 2002b). However, it is clear that this wealth has not been distributed particularly equitably, and the Irish have the joint highest level of income inequality, the second highest level of income poverty and

the highest level of child poverty in the EU (Eurostat, 2003). Because of these adverse socio-economic conditions in Ireland, it is clear that high levels of grant aid are required so that low-income and vulnerable households are in a position to improve the energy efficiency of their dwelling and escape fuel poverty.

The fuel allowance should continue. Some 347,000 households benefit from this scheme, which runs for 29 weeks and provides an income supplement of between €9 and €12.90 per week to assist in meeting the costs of home heating. Previous research has indicated that, while it may not take people out of the fuel poverty trap, it alleviates their suffering by reducing the severity of experience of fuel poverty (Healy and Clinch, 2004). It is also clear that the government funded information strategy, which attempts to persuade households to invest in energy saving measures using their own private funds, is not working particularly well. Data in this paper show that the penetration of energy efficiency technologies in the home has not increased significantly over the past six years. In addition, the results of the national household survey of Ireland regarding market failure indicate that over 50 per cent of all energy inefficient households remain unaware of the extent of the benefits of energy efficiency in the home; more worryingly, two-fifths of these households are not aware that such measures exist. Quite obviously, there is a large information gap regarding the net benefits of improving energy efficiency among Irish households, and current information strategies appear to be making little, if any, progress in this matter.

As was stated earlier, the Green Paper on Sustainable Energy allocated some €7.62m on fuel poverty measures over the period 2002-2006. However, such funds are piecemeal and insignificant when it is considered that approximately €400m is needed to make a serious impact on levels of domestic thermal efficiency and fuel poverty. The charity Energy Action receives €220,000 from this programme and FÁS funds Energy Action with €550,000 for training employees as well as supporting projects through their Social Economy funding mechanism in an effort to deliver the aforementioned SEI Low-income Housing Programme. The latest SEI low-income housing programme, designed to improve the thermal conditions of those most fuel poor, is a decided step in the right direction. However, its limited funds (€0.9m in 2003 and €1.6m in 2004) dictate that the programme will be unlikely to result in more than a small improvement on the current situation.

10.3. Austria

In Austria, thermal efficiency was found to be fair, with below-average levels of cavity wall, floor and roof insulation and poor penetration of double-glazing. Levels of fuel poverty and excess winter mortality were both found to be moderate. It is suggested that the state invests in improved information campaigns in an attempt to encourage the diffusion of energy saving devices among Austrian households. Tax credits may also be incorporated in such a strategy, although it is important to estimate an appropriate level of tax credit and design a scheme that will minimise the numbers of free riders. Low-income households may need some support in the form of grants; however, in the absence of comparable socio-economic data on Austrian levels of poverty and inequality, such a strategy requires more close examination.

10.4. Belgium

Similar results to Austria were found for Belgium with respect to thermal efficiency, fuel poverty and seasonal mortality. The socio-economic environment in Belgium is characterised by moderate levels of income poverty, inequality and deprivation. In this regard, a programme of improved energy efficiency in Belgian housing should offer means-tested grants to vulnerable low-income households. In addition, it is recommended that state investment in information campaigns be continued so that well-off householders may be alerted to the benefits of installing such measures and encouraged to do so using their private funds.

10.5. Denmark

Denmark has excellent thermal standards in housing, with over two thirds of all houses equipped with cavity wall and floor insulation, three quarters fitted with roof insulation, and almost all with double glazing and central heating systems. Fuel poverty is negligible, although excess winter mortality is moderate. It is suggested that current policy measures, detailed earlier in this paper, be continued. It is also suggested that more information be provided alerting people to the dangers of cold exposure during winter, especially outdoors. The moderate level of seasonality in mortality in Denmark may well be associated with inadequate protection from the cold outdoors rather than cold strain from within the household.

10.6. Finland

Finish housing is exemplary in terms of thermal efficiency, with all homes fully insulated and double-glazed against the cold. In addition, almost all homes are equipped with central heating. It is not surprising, therefore, that levels of fuel poverty and related seasonal mortality are both very low. Current policy measures should be retained to maintain these high standards and refurbishment programmes should be undertaken from time to time to replace worn-out insulation measures.

10.7. France

Although France displays reasonably good levels of thermal efficiency in the domestic sector, with only poor levels of floor insulation, it exhibits a rate of fuel poverty among the highest in northern Europe. The level of relative excess winter deaths is also in the higher end of the range calculated across EU-15. French policymakers should begin investing funds, as a matter of course, in the housing stock to improve domestic energy efficiency and reduce fuel poverty and associated ill health. Because of the relatively high levels of inequality and high levels of deprivation found among French households, it is suggested that substantial subsidisation of low-income households is part of any policy measure to tackle fuel poverty and domestic energy inefficiency in France. Information campaigns may be used to good effect for the more well-off to encourage retrofitting using private funds. If exchequer funding allows, a tax credit may also be used successfully if an appropriate level is assigned.

10.8. Germany

Although German housing is not the most energy efficient in Europe, fuel poverty is very low and excess deaths are low to moderate. The relatively strong welfare system in place in Germany, and the attendant moderate levels of income poverty and deprivation, also play a part in the results presented in this paper. Thermal standards should be improved, however, even if the main purpose is not to reduce fuel poverty. An inefficient housing stock is consuming greater quantities of fuel than necessary, which results in excess emissions of environmental pollutants, such as CO_2, SO_2 and NOx; all of these pollutants have strong environmental policy

significance, and Germany is legally bound to stabilising emissions of such pollutants under climate change and acidification agreements (Kyoto and Gothenburg). Tax credits ought to be employed in an effort to improve the levels of cavity wall, floor and roof insulation. Improved information provision may also be effective in such a strategy. Vulnerable households may be targeted for state assistance.

10.9. Greece

The results of the study demonstrate that Greece exhibits among the poorest domestic thermal efficiency in Europe, with negligible levels of floor insulation and double-glazing and poor levels of cavity wall and roof insulation, although about half of Greek households have central heating. One in three households in Greece are fuel poor; this is the second highest level of fuel poverty in Europe. Associated seasonal mortality is also relatively high, with an 18 per cent increase in deaths during winter. A full-scale energy efficiency programme is required to improve the thermal standards of Greek households to allow households to afford adequate home heating during the winter months. It is obvious that a country like Greece will need to subsidise heavily its contingent of low-income households. This is because income poverty is among the highest in Europe, as is income inequality, while over a half of households exhibit multiple deprivation indicators.[40] Generous grant schemes must be provided to vulnerable households to assist in undertaking remedial work, otherwise such households will remain caught in a fuel poverty trap. Informational campaigns may assist upper income households in retrofitting, but it is likely that a tax credit may be needed to encourage such households to carry out remedial work. Such a strategy, however, is unlikely to be implemented unless macro-economic conditions in Greece change considerably so that exchequer finances would permit such substantial capital outlays by the state.

10.10. Italy

Thermal standards in Italian housing remain difficult to assess robustly in the absence of good-quality data. However, it seems reasonable to surmise from other data relating to housing

[40] See Healy (2002b, 2002d).

deprivation (presented in Chapter 4) that energy efficiency is not a priority in Italian housing. The relatively high level of fuel poverty in Italy and the 16 per cent variation in winter mortality rates also give weight to this hypothesis. Italy suffers from above average income inequality and poverty, while deprivation is particularly evident. As such, policymakers should subsidise households vulnerable to fuel poverty to retrofit their homes to improve the energy efficiency of the dwelling. Information campaigns could be targeted at the more well-off. Tax credits may be a useful incentive, should exchequer finances allow such an economic instrument to be implemented. It is likely that an energy efficiency programme in the domestic sector in Italy would yield significant reductions in environmental emissions, which Italian policymakers must curb by 2010 under the Kyoto Protocol.

10.11. Luxembourg

Thermal efficiency in households in Luxembourg is not among the highest in Europe, however levels of fuel poverty are very low, at less than 5 per cent. The excellent socio-economic environment in Luxembourg, characterised by low income poverty and low levels of multiple deprivation, also assists in maintaining below average levels of seasonal variations in mortality. However, it is recommended that domestic energy efficiency be improved via information programmes and tax credits to reduce energy consumption and related environmental emissions. Such an outcome would be beneficial in terms of assisting Luxembourg achieve its environmental policy targets on emissions of greenhouse gases and acidification precursors.

10.12. Netherlands

Strong thermal efficiency is found in the Netherlands, particularly with regard to double-glazing and central heating, where four fifths of all households are so equipped. Despite good thermal standards in Dutch housing, a moderate level of fuel poverty is found in this study in the Netherlands. Seasonal mortality is similar to Germany, with a low to moderate rate of 11 per cent found. It is suggested that current policy measures are continued; however it may be useful to examine the potential for introducing a means-tested fuel subsidy (similar to that in Ireland) to reduce the level of fuel poverty further.

Much has been done in the Netherlands to improve the thermal standards of the housing stock, yet a significant number of households report fuel poverty. Moreover, the Netherlands has the lowest level of poverty, the second lowest level of income inequality and, equally, the second lowest level of multiple deprivation in EU-14. This suggests that a relatively small number of Dutch households are suffering from a form of deprivation specific to home heating, being unable to afford adequate warmth in the winter. As such, a fuel allowance may achieve a reduction in the fuel poverty rate in the Netherlands if integrated into the ongoing energy efficiency programme.

10.13. Norway

Thermal efficiency is excellent in Norway, though not quite as exemplary as in Sweden or Finland, and excess winter deaths are not a substantial problem. This study was unable to estimate fuel poverty, as data on Norway are not collected in the European Community Household Panel; however it is possible to surmise that former and current policies on energy efficiency in housing have been successful in diffusing energy efficiency measures across the housing stock. The low seasonal mortality found there attests this.

10.14. Portugal

Portuguese housing is found to be the most energy inefficient of all housing in the EU. While the country endures the least severe winter of the entire group of countries analysed in this study, the negligible insulation levels and poor heating systems in place in Portugal entail that half of Portuguese households are unable to afford adequate warmth in the home during cold winter spells. Furthermore, Portugal suffers from the highest income poverty in EU-15 (with 24 per cent of households below 60 per cent of median equivalised income), the highest income inequality (37 on the Gini-scale), and the second-highest level of generalised deprivation (56 per cent of households reporting multiple deprivation indicators). It is perhaps unsurprising, but nonetheless alarming, to note that the level of related seasonal mortality in Portugal, at 28 per cent, is the highest in the EU by far.

Portugal, like Greece, is a relatively poor country, and improving the thermal efficiency of housing does not appear to be a key

priority for policymakers. Current strategies are based on information campaigns encouraging households to invest using their own funds. It is clear that such a strategy is not going to achieve substantial improvements in the diffusion of energy saving measures in a country where income poverty is rife and fuel poverty affects half the population. Low-income households in Portugal must be heavily subvented to retrofit their homes with insulation and central heating upgrades. The more well-off should be encouraged through tax breaks and improved information campaigns, so that energy consumption and related emissions are curbed to assist in achieving Kyoto and Gothenburg policy targets.

10.15. Spain

Data on Spanish energy efficiency levels is very difficult to obtain, and Eurostat currently do not have these important data. Available statistics indicate that about two fifths of Spanish households are equipped with central heating, higher than Portugal but lower than Greece. It could be surmised that Spanish households are insulated to levels between those found in Portugal and Greece. This would appear to be a good conjectural, as the level of fuel poverty calculated in Chapter 4 shows that about one in three households are suffering in Spain (similar to that found in Greece). Once again, Spain (like Greece and Portugal) is a country characterised by relatively high levels of income poverty, income inequality and generalised deprivation. There is little in the way of fuel poverty policy in place in Spain and it is recommended that government provide grants to vulnerable, low-income households to enable them to improve the energy efficiency of their dwelling so that they may be able to afford adequate warmth. Again, a tax concession could be introduced to encourage owner-occupiers and upper income households to retrofit. Improved information on the benefits of energy saving measures would also be beneficial.

10.16. Sweden

Swedish households are fully equipped with all insulation measures examined in this study, and all homes are fitted with central heating. Comparable estimates of fuel poverty and other social indicators are unavailable, as Sweden has only just joined the European Community Household Panel. However, seasonal

variations in mortality are among the lowest found in Europe, despite having among the coldest winters, and Sweden is among the richest nations in the world – using macro-economic measures such as of per capita GDP – and among the least afflicted by income poverty. In addition, the strong social welfare support mechanism entails that income distribution is relatively flat. It is argued that the strict building regulations enforced in the past have ensured that housing standards are high with regard to thermal efficiency in Sweden.

10.17. UK

The UK has taken the problem of fuel poverty seriously over the past decade. A Home Energy Efficiency Scheme has been in place since 1991, with several successive modifications providing for increased funding of energy efficiency improvements in British households. The strategy appears to have been something of a *tour de force*, reducing fuel poverty by one-third between 1991 and 1998. Notwithstanding this apparent success, thermal standards appear to be lagging in British households and are comparable, overall, to those found in Ireland. Although double-glazing had reached a 61 per cent penetration by 1996, floor and cavity wall insulation remains paltry in the UK. The level of fuel poverty is among the highest in northern Europe, along with Ireland, France and Belgium. Seasonal mortality is also among the highest in the UK, with an 18 per cent increase in mortality rates during the winter period. Income poverty, inequality and deprivation are all above the EU average in the UK. It is suggested that the current HEES policy measure be continued but its funding should be increased. Presently, a target of 250,000 households per annum is in place in Britain, which means that it would take 20 years to retrofit all 5 million households currently in fuel poverty; this assumes full take up of the scheme, which is highly unlikely. Improved information campaigns and tax concession schemes could also be integrated into the UK's fuel poverty strategy to encourage the more affluent to retrofit using their own funds.

A summary of the policy recommendations, on a country-by-country basis, is provided in Table 10.1.

10.18. A proposal: domestic energy efficiency retrofits

Research has shown that energy efficiency programmes in the domestic sector make good economic sense using even the narrowest criteria of assessment. An economic evaluation was recently undertaken of an Irish programme to retrofit all energy inefficient homes with energy saving measures to bring the thermal standards of the housing stock to the latest (1997) building regulations (Clinch and Healy, 2001). It was demonstrated that, while the costs of such a retrofitting exercise are large (€2.07 billion undiscounted, or €1.6 billion at a 5 per cent discount rate), the benefits in terms of reductions in energy bills alone outweighed the costs by 1.7. In addition, the researchers indicated that the external benefits in terms of reduced environmental emissions of CO_2, SO_2, NOx and PM_{10} were all highly significant in physical and monetary terms. Such environmental benefits are of particular importance for Ireland, a country with particularly challenging environmental policy targets in meeting global environmental Protocols set at Kyoto and Gothenburg on global warming and acidification respectively. The benefits to human health of such programmes are also highly significant, with reductions in morbidity and premature mortality as a result of warmer, more affordable homes. Improvements in thermal comfort were also monetised using a proxy for willingness to pay (Clinch and Healy, 2003). Overall, a net social benefit of some €3.1 billion (discounted at 5 per cent) was reported and a benefit-cost ratio of 3:1 is calculated. A remarkable internal rate of return of 33 per cent is also found. Such programmes also have relatively quick payback periods, the costs of this programme becoming negative after seven years.

10.18.1. Costing and implementation

The undiscounted cost of undertaking the above programme was €2.07 billion. This figure corresponds to the 1.1m homes built prior to the 1997 building regulations in need of some remedial work. A mean per household cost of €1,882 can be calculated from the above data. Healy and Clinch (2004) calculated that about 227,000 homes were classifiable as fuel poor (using self-reporting measures), and a further 10,000 to 13,000 households could be defined as 'energy inefficient'. If 10 per cent (24,000 homes) of the fuel poor, energy inefficient housing stock (which amounts in total to about 240,000 houses) were retrofitted each year by Energy Action (and other

Ireland	Fair	Moderate	High	Fair	Improve double-glazing and cavity wall and floor insulation. Grants to low-income households. Improve information.
Italy	–	High	High	Fair	Improved information on energy efficiency and cold exposure. Grants to low-income households. Improve information and offer tax credits.
Luxembourg	Fair	Low	Moderate	Excellent	Improve information and offer tax credits.
Netherlands	Good	Moderate	Low/ Moderate	Excellent	Fuel subsidy to low-income households and improved information on dangers of cold exposure.
Norway	Excellent	–	Low	–	Continue current policies.
Portugal	Poor	High	High	Poor	Full-scale energy efficiency programme required. Grants to low-income households. Improve information and offer tax credits.
Spain	–	High	High	Poor	As for Portugal.
Sweden	Excellent	–	Low	–	Continue current policies.
UK	Fair	Moderate	High	Fair	More grants to low-income households to invest in cavity wall and floor insulation. Improve information and offer tax credits.

Note: The qualitative summary of findings in Table 10.1 is based on the quantitative findings of Healy (2002d).

Table 10.1. Summary of Key Findings in Relation to Energy Efficiency, Fuel Poverty and Excess Winter Mortality and Recommended Policy Strategies

	Thermal efficiency	*Fuel poverty*	*Excess winter mortality*	*Socio-econ environment*	*Suggested policy interventions*
Austria	Fair	Moderate	Moderate	–	Improve cavity wall, floor and roof insulation and double-glazing, via information and tax breaks.
Belgium	Fair	Moderate	Moderate	Fair	As for Austria, plus grants to low-income households.
Denmark	Excellent	Low	Moderate	Excellent	Continue current policies. Provide more information on dangers of cold exposure.
Finland	Excellent	Low	Low	–	Continue current policies.
France	Good	Moderate	Moderate	Fair	Improve double-glazing and floor insulation. Grants to low-income households. Improve information and offer tax credits.
Germany	Fair	Low	Low / Moderate	Good	Improve cavity wall, floor and roof insulation. Information and tax credits. More grants to low-income households.
Greece	Poor	High	High	Poor	Full-scale energy efficiency programme required. Grants to low-income households. Improve information and offer tax credits.

voluntary sector groups) for a period of 10 years, the total cost would amount to €45m per annum.

Targeting is of utmost importance. A programme aimed specifically at the social housing sector has clear benefits in terms of targeting the lowest income households. However, previous research has shown that much social housing in Ireland is of good thermal standard (Clinch and Healy, 1999a) and, consequently, not all social housing would need investment. There is then the problem of the private rented sector, which, evidence suggests, may suffer among the worst thermal standards. However, there is a clear problem here with property rights and take up is likely to be low here unless there is increased regulation in the rented sector. If a minimum level of energy efficiency was required by law in all rented dwellings (including privately rented households), landlords would clearly invest in energy efficiency using their own funds and would not require state aid to do so. This may be the best way to achieve improved thermal standards in the private rented sector to avoid free riding on state backed retrofitting programmes.

An obvious alternative would be to use a means-tested mechanism to target the retrofit at households below a certain income threshold. There is a potential here for some bias, including self-selection bias. If income thresholds are used as criteria for targeting, it is important that there is widespread public awareness about the programme. Carefully designed publicly funded information campaigns would need to be launched to alert households to the potential availability of state funds to retrofit.

Recent work by Scott (2003) has estimated that the introduction of a carbon energy tax in Ireland could result in revenues of approximately €40m per year. In theory, a carbon energy tax, *á la* that proposed by Scott, could yield revenues, which would be earmarked for such a retrofitting programme, and, as such, the programme could be implemented at zero additional cost to the state, or very close. A ten-year programme, like the one specified above, targeting the least energy efficient homes could result in a large improvement in the thermal conditions of the least energy efficient housing in Ireland. However, the introduction of a carbon energy tax is a controversial political move; such taxation policies are seen as regressive, with a high burden being placed on low-income households.

It would be possible, alternatively, to phase out the fuel allowance in Ireland and divert at least some of the €61m spent (in

2001) on this income supplement towards housing improvement programmes. Once again, however, such a move would be politically controversial and it is likely that some level of fuel subsidisation may be required even if a national retrofitting programme were implemented.

Not all countries examined in this analysis exhibit similar thermal conditions, nor do all countries demonstrate similar levels of fuel poverty and related mortality effects (see Chapter 4). In addition, and perhaps crucially, socio-economic environments vary dramatically across Europe, with levels of income poverty, inequality and deprivation varying by as much as 40 percentage points from country to country.[41] In this regard, policy measures must be tailored to suit the individual country in question so as to maximise the effect of a given policy response.

10.19. Conclusion

Because of the cross-country design of the study, and because of the reliance on harmonised social indicators, the research has a number of limitations. Cross-country comparisons need to be undertaken with some degree of caution, and individual variations need to examined and interpreted carefully. It should be noted that the ECHP describes housing conditions as perceived by householders themselves. Generally, respondents were asked to describe conditions, and very occasionally an opinion was sought. It is, therefore, important to bear in mind the subjective nature of the survey data. Such subjectivity can explain, at least partly, some cross-country variations. Finally, it is important to note that the data from the ECHP cover the years 1994 through to 1997 inclusive. Therefore, the review of cross-country levels of fuel poverty reflects incidences throughout that time period. Changes in levels of fuel poverty may have occurred in this time. Many countries experienced a downward trend in fuel poverty over the years 1994 to 1997 as living standards rose, so it is quite probable that this positive trend has continued in many countries in EU-14 since 1997. In this respect, the data should be treated with care, as they may not correspond precisely to the current climate.

Thermal efficiency standards vary from country to country because of the differing housing policies implemented. Countries

[41] See Healy (2002b) for more on this.

with more severe winter climates (especially those in Scandinavia) have, for many years now, invested heavily in energy efficiency retrofitting programmes in existing buildings while implementing strong building regulations for new-built houses. Such countries are also characterised by strong welfare systems with relatively equitable income distributions and low levels of poverty and deprivation. The problem of fuel poverty, therefore, is not an issue of any great concern in these countries. However, housing policies in countries in western and southern Europe have traditionally not placed great emphasis on thermal efficiency. Building regulations have been less stringent, and investment programmes in thermal efficiency in the domestic sector have generally been *ad hoc* in design. To make matters worse, social welfare systems are less supportive to those vulnerable in society, particularly in southern European countries. When households in these countries experience a cold winter spell, they are far less well protected from the cold indoors and far less able to afford adequate warmth. These factors have resulted in serious problems of fuel poverty in southern and Western Europe.

Chapter 8 outlined the responses of some European countries and the USA in their attempts to improve the energy efficiency standards of housing over the past three decades. Most policy responses are based on fiscal measures aimed at owner-occupiers, such as tax breaks, as well as grant aid to more vulnerable households. Information and advice is also a common component of the policy measures. It is recommended that each country adopts policies to improve the diffusion of energy saving measures to suit their own macro-economic and socio-economic conditions. It is argued that southern European nations like Greece, Spain and Portugal need to adopt the most radical policy shifts in tackling energy inefficiency and fuel poverty. Full-scale retrofitting programmes are recommended with heavy subsidisation of low-income households in an attempt to reduce the remarkable levels of housing deprivation, fuel poverty and related adverse health outcomes. The current HEES policy measure in the UK would appear to be somewhat successful in tackling fuel poverty, with one third fewer households suffering in 1998 than in 1991. However, it is calculated in this study that, even if the scheme works at 100 per cent efficiency and is fully subscribed, it will take over 20 years for all fuel poor households to be lifted out of the fuel poverty net. The scheme, therefore, requires more funding.

Ireland will spend at least €63m per annum over the next five years on measures aimed directly at fuel poverty alleviation, yet most of this money is aimed at income subsidisation which is of limited long-term benefit to fuel poor households living in severely energy inefficient dwellings. Irish policymakers need to decide upon a coherent and comprehensive strategy to deal with domestic energy inefficiency and fuel poverty. Previous limited *ad hoc* energy efficiency programmes were highly successful in improving the diffusion of roof insulation in Irish households. However, a more extensive programme is now required to deal with the unsatisfactory level of fuel poverty and below-par energy efficiency standards in Irish housing. While weatherisation and retrofitting programmes are expensive, costs can be minimised by ensuring economies of scale. Thus, a retrofitting programme aimed at improving the energy efficiency standards of the social housing sector would realise significant reductions in marginal costs through economies of scale, rather than small, piecemeal *ad hoc* initiatives. Such a programme, targeted specifically at the social housing sector, would also bypass potential problems of so-called 'free riding'.

While there was some excuse for the lack of government intervention in this area when macro-economic conditions were less favourable in Ireland, there was very little excuse recently in light of superlative economic growth over the past decade. The gap between rich and poor widened during the 1990s[42], and it is apparent that government strategy in the area of fuel poverty should be heavily supportive of low-income households. The fuel allowance should continue, as the study found that it appears to reduce the severity of experience of fuel poverty among more vulnerable households. In addition, the considerable information gap exhibited among energy inefficient and fuel poor households (reported in the national household survey) indicates that a far more aggressive information and awareness campaign needs to be executed with more emphasis on the range of benefits of installing energy saving measures in the home, not just savings in fuel bills.

It is clear from this paper that government and market failures are responsible for the high levels of housing deprivation, fuel poverty and related adverse health effects found in southern and western Europe. Failure of governments to rectify the *status quo* will

[42] Although the latest data appear to indicate that income inequality and income poverty is finally falling after several years of economic buoyancy.

entail that vulnerable households will remain living in cold, uncomfortable housing conditions, exposing themselves and their children to a range of adverse health outcomes. Moreover, the risks to older householders of such housing deprivation have been demonstrated to be potentially fatal.

Appendix I

European Community Household Panel: an overview[43]

The European Household Panel (ECHP) is a standardised, multi-purpose and longitudinal survey, providing comparable information across EU member states on income, work and employment, poverty and social exclusion, housing, health and other diverse social indicators regarding the living conditions of private households and persons. The crucial feature of the ECHP is the harmonisation of its methodology and results through the creation and use of a centralised questionnaire. During the first wave (year) of the questionnaire in 1994, data was collected in 12 countries in Europe (namely, all EU member states as of 1994); this increased to 13 in 1995 (when Austria joined), 14 in 1996 (with the inclusion of Finland) and 15 in 1997 (with the participation of Sweden). Consequently, some flexibility was granted to each participating country to adapt common procedures to relate to their own local situations. Data are collected by National Data Collection Units in each country. These Units, normally research institutes or national statistics' centres, tailor the questionnaire to make it suitable for their own respective countries. High response rates (more than 70 per cent) were obtained for all four waves of the study, and some 60,000 households and 130,000 adults are interviewed successfully in each wave. An outline of the sample size and allocations per country is provided in Table A.1.

[43] Some of this section is taken from Eurostat (1996).

Table A.1. Sample Size and Response Rate for ECHP in 1994

Country	*No of households ('000)*	*Selected sample*	*Completed sample*	*% of households surveyed*	*Response rate (%)*
B	4,100	4,886	4,192	1.0	85.8
DK	2,400	5,500	3,482	1.5	63.3
D	36,900	10,572	5,054	0.1	47.8
EL	4,000	6,131	5,523	1.4	90.1
E	13,700	8,000	7,206	0.5	90.1
F	27,700	11,117	7,344	0.3	66.1
IRL	1,100	7,252	4,048	3.7	55.8
I	12,900	7,989	7,115	0.6	89.1
L	150	2,826	1,011	6.7	35.8
NL	6,500	5,926	5,187	0.8	87.5
P	3,600	6,238	4,881	1.4	78.2
UK	23,800	8,104	5,779	0.2	71.3
EU-12	*136,850*	*84,541*	*60,822*	*0.4*	*71.9*

Source: Columns 2, 3 and 4 taken from Eurostat (1996); columns 5 and 6 are the author's calculations.

The probability-based (random) sample size for each member state was determined on the basis of a number of theoretical and practical considerations. Generally, countries with larger populations received larger sample sizes to allow for maximum desegregation of results. In Germany, legal regulations restricted the sample size to about 5,000 households; as such, Germany is the least well-sampled country in the study. The highest response rate was found in Greece and Spain where over 90 per cent of households successfully completed the ECHP questionnaire in 1994. The lowest response rate was in Luxembourg, with just one-in-three households agreeing to undertake the interview.

The sample was normally distributed proportionately across geographical regions across each member state. This enabled maximum precision of estimates at the national level. Italy and Spain, however, chose to sample disproportionately high allocations in smaller regions with a view to ensuring a minimum sample size for each region of the country. Apart from this variation in sampling

rates across regions in some larger countries, in general all of the population was sampled at the same rate within each country. Thus, there was no over-sampling of any particular groups. In some cases, certain small parts of the population were not covered because of the sampling frame selected. For instance, in Ireland households were selected from the electoral register which excludes households recently arrived in Ireland and those not covered for some other reason. Households comprised exclusively of persons aged less than 18 years are also not covered. In Germany, the Netherlands and Greece, non-nationals unable to speak the national language were also excluded. Collective dwellings were also omitted from the sample frame in Greece. Rural communities of less than 5,000 accommodations were not sampled in France. Foreigners not registered as permanent residents in Italy were excluded. Institutional housing was not sampled in the Netherlands. Finally, new-built Portuguese homes were not sampled.

The data used in this paper come from the first four waves of the ECHP, undertaken in 1993-94, 1994-95, 1995-96 and 1996-97. These data were purchased directly from Eurostat Luxembourg using a tailored research contract for the Department of Environmental Studies, University College Dublin.

Appendix II

Weighting procedures in the ECHP survey methodology

Each household in the sample is weighted in inverse proportion to the probability with which it was selected. The design weights are incorporated into the methodology to compensate for differences in the probabilities of selection into the sample, with the weight given to each household being inversely related to its probability of selection. With multi-stage sampling design employed, it was important that the reference is to the overall (relative) selection probabilities of households, not the absolute values. In application, weights are scaled such that the mean value per household (with interview completed) is 1. If p_i is the overall sampling probability of household 'i' and n_i the number of households successfully enumerated in the sample, then the design weights can be denoted as follows:

$$w_i = \frac{1}{p_i} \left[\frac{\sum n_i}{\sum n_i / p} \right]$$

The weights are calculated for all households selected, but the summation and n_i on the right is confined to households with the interview completed successfully. This ensures that the weights are normalised, that is:

$$w_i = \Sigma . n_i = \Sigma n_i$$

Non-response rates are introduced to reduce the effect of differences in unit response rates in different parts of the sample. These weights are based on known characteristics of the sample. Weighting for non-response is particularly important when rates of non-response are high and generally variable from one part of the population to another. It was found that ECHP non-response rates are often high with large variations across population groups. To correct for gross distortions in the distribution of the achieved sample, it was necessary to weight for non-response according to various

characteristics of the households. Weighting involves the division of the sample into certain appropriate weighting classes, and within each weighting class the weighting-up of the responding units in inverse proportion to the response rate so as to compensate for the non-responding cases in that class.

The non-response weight (for a single classification) is computed as follows:

$$w_{\mathrm{j}} = \frac{\overline{R}}{R_{\mathrm{j}}}$$

The numerator is the overall response rate for the household interview (that is, n_j as the number of interviewed cases in class j):

$$\overline{R} = \left[\frac{\sum n_{\mathrm{j}}}{\sum \left(n_{\mathrm{j}} / R_{\mathrm{j}} \right)} \right]$$

In the presence of design weights, the above expression is in terms of weighted numbers:

$$\overline{R} = \left[\frac{\sum n_{\mathrm{j}}^{\mathrm{d}}}{\sum \left(n_{\mathrm{j}}^{\mathrm{d}} / R_{\mathrm{j}} \right)} \right]$$

Weights are applied also to correct distributional problems with households and persons in the sample frame. Extreme values are trimmed to avoid inflation in variances.

More details of the survey and its methodology can be found in Eurostat (1996).

Appendix III

Weighting procedure in the sensitivity analysis of fuel poverty

For economies of space and ease of reading, the indicators are denoted in weighting equations as denoted below. The first two are income-related indicators; the remaining four indicators pertain to the capital stock itself.

α = Unable to afford to heat home adequately
β = Unable to pay utility bills on time
π = Lack of adequate heating facilities
δ = Damp walls and/or floors
λ = Rotten window frames
μ = Lacking central heating

The sensitivity analysis weights the indicators as follows:

Table A.2. Weighting Equations for Calculating Composite Fuel Poverty

Scenario	*Weighting equation*
1	$0.5\,\alpha + 0.1\,\beta + 0.1\,\pi + 0.1\,\delta + 0.1\,\lambda + 0.1$ _
2	$0.17\,\alpha + 0.17\,\beta + 0.17\,\pi + 0.17\,\delta + 0.17\,\lambda + 0.17\,\mu$
3	$0.33\,\alpha + 0.33\,\beta + 0.33\,\pi$
4	$0.33\,\delta + 0.33\,\lambda + 0.33\,\mu$
5	$0.5\,\alpha + 0.17\,\delta + 0.17\,\lambda + 0.17\,\mu$
6	$0.33\,\alpha + 0.134\,\beta + 0.134\,\pi + 0.134\,\delta + 0.134\,\lambda + 0.134\,\mu$

Appendix IV

Multivariate (Probit) regression analysis of fuel poverty in Ireland

It is useful to conduct more rigorous statistical and econometric analysis of the results to test the strength of the significance of the results. In this regard, this section presents a multivariate Probit regression analysis which examines those factors that influence the probability of being fuel poor.[44] A number of indicators of fuel poverty are regressed against socio-economic and other characteristics of households. A Probit analysis allows us to examine the household characteristics that are significantly associated with each indicator of fuel poverty. The added value over the bivariate analysis presented in the cross tabulations is that we can examine the effect of each variable holding all else equal. The results for the earlier waves of the survey are generally more robust. This is most likely because of the larger sample size. Overall, the predictive power of the models is good and it is reassuring that, in general, the same variables remain significant across the four waves.

The results of the Probit model for the household's ability to heat the home adequately, the main indicator of fuel poverty, are set out in Table A.3 and A.4 of this paper. The results suggest that, *inter alia*, being younger, the number of children, marital status, income source, housing tenure, being in receipt of a housing allowance, having poor health status and being less well educated are significantly associated with being unable to heat the home adequately. The marginal effects suggest that age, marital status, health, education and being in receipt of a housing allowance are most strongly related to the inability to heat the home adequately.

[44] The Probit regression model extends the principles of generalised linear models to treat the case of dichotomous and polytomous dependent variables. These methods differ from standard regression in substituting maximum likelihood estimation of a link function of the dependent for regression's use of least squares estimation of the dependent itself. The function used in Probit is the inverse of the standard normal cumulative distribution function.

The results of a Probit model for the household's inability to pay utility bills in the last twelve months are set out in Tables A.5 and A.6. The results suggest that, *inter alia*, being younger the number of children, marital status, being unemployed or on benefit, living in rental or local authority accommodation, having poor health status and being less well educated are significantly associated with being unable to pay bills in the last twelve months. Interestingly, those households in receipt of a housing allowance are significantly less likely to be unable to pay their bills. The marginal effects suggest that age, income source and education are most strongly related to being unable to pay bills in the last twelve months.

Results showing those factors that influence the probability of a household having inadequate heating facilities are set out in Tables A.7 and A.8. The results suggest that, *inter alia*, being younger, household composition, marital status, tenure, accommodation type, having poor health status and being less well educated are significantly associated with the respondents perception of the lack of adequate heating facilities. The marginal effects suggest that health status and education are most strongly related to the respondent's perception of the lack of adequate heating facilities.

The results of a Probit model examining the probability of the presence of central heating in the household are set out in Tables A.9 and A.10. The results suggest that, *inter alia*, being younger, household composition, marital status, being unemployed or on benefit, living in rental or local authority accommodation, having poor health status, being less well educated and being in receipt of a housing allowance are significantly associated with a lack of central heating in the accommodation. The marginal effects suggest that marital status, income source, housing tenure, health status and education are most strongly related to the absence of central heating in the accommodation.

Results showing those factors that influence the probability of the presence of damp in a household are presented in Tables A.11 and 12. The results suggest that, inter alia, being younger, the number of children, marital status, being unemployed or on benefit, living in rental or local authority accommodation, accommodation type, having poor health status and being less well educated are significantly associated with the presence of damp in the respondent's accommodation. The marginal effects suggest that health status, tenure, accommodation type and education are most

strongly related to the presence of damp.

Finally, the results of a Probit model for the presence of rot are presented in Tables A.13 and A.14. The results suggest that, *inter alia*, the number of children, marital status, being unemployed or on benefit, living in rental or local authority accommodation, having poor health status and being less well educated are significantly associated with the presence of rot in the respondent's accommodation. The marginal effects suggest that health status, tenure and education are most strongly related to the presence of rot.

Table A.3. Ability to Heat Home Adequately: Results of a Probit Model for 1994 and 1995

Dependent Variable: HEAT HOME		***1994***				***1995***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		2.512	80.83	–	–	2.261	72.71	–	–
Age Group	16-34	-.328	-17.43	[.000]***	-9.1%	-.359	-19.21	[.000]***	-9.7%
	35-44	-.184	-9.94	[.000]***	-5.1%	-.181	-9.70	[.000]***	-4.9%
	45-54	-.026	-1.53	[.124]	-0.7%	-.018	-1.04	[.296]	-0.5%
	55-64	-.078	-5.01	[.000]***	-2.1%	-.044	-2.81	[.005]**	-1.2%
Household	Number of Adults	-.145	-40.93	[.000]***	-4%	-.115	-33.21	[.000]***	-3.1%
Composition	Number of Children	-.054	-10.78	[.000]***	-1.5%	-.031	-6.17	[.000]***	-0.8%
Marital Status	Separated	-.298	-8.32	[.000]***	-8.3%	-.306	-8.37	[.000]***	-8.3%
	Divorced	-.025	-.96	[.333]	-0.7%	.068	2.57	[.010]**	1.8%
	Widowed	-.149	-9.07	[.000]***	-4.1%	-.128	-7.77	[.000]***	-3.4%
	Single	-.106	-8.34	[.000]***	-2.9%	-.040	-3.14	[.002]**	-1%
Income	Self employed	-.094	-7.23	[.000]***	-2.6%	-.167	-12.94	[.000]***	-4.5%
	Pension	-.183	-13.62	[.000]***	-5.1%	-.178	-13.24	[.000]***	-4.8%
	Unemployed	-.267	-10.66	[.000]***	-7.5%	-.231	-8.29	[.000]***	-6.2%
	Other benefit	-.249	-13.47	[.000]***	-6.9%	-.188	-9.81	[.000]***	-5.1%
	Private Income	-.147	-4.99	[.000]***	-4.1%	-.291	-9.47	[.000]***	-7.9%
Tenure	Tenant	.024	2.34	[.019]**	0.6%	-.040	-3.90	[.000]***	-1.1%
	Rent free	-.499	-26.45	[.000]***	-13.9%	-.099	-4.76	[.000]***	-2.7%

Accommodation type	Semidetached								
	Terraced	.074	6.98	[.000]***	2%	.128	11.53	[.000]***	3.4%
	Apartment Small	-.150	-12.58	[.000]***	-4.2%	.278	21.32	[.000]***	7.5%
	Apartment Large	-.091	-7.50	[.000]***	-2.5%	.023	2.02	[.043]**	0.6%
	Other Accommodation	.066	2.13	[.033]**	1.8%	.118	5.26	[.000]***	3.2%
Health Status	Good	-.124	-11.54	[.000]***	-3.4%	-.076	-7.02	[.000]***	-2%
	Fair	-.281	-22.08	[.000]***	-7.8%	-.264	-20.57	[.000]***	-7.1%
	Bad	-.793	-46.44	[.000]***	-22.2%	-.738	-42.60	[.000]***	-20.1%
	Very Bad	-.740	-29.12	[.000]***	-20.7%	-.683	-25.13	[.000]***	-18.6%
Education	Secondary finished	-.077	-5.59	[.000]***	-2.1%	.016	1.16	[.242]	0.4%
	Secondary not finished	-.850	-68.20	[.000]***	-23.8%	-.768	-60.63	[.000]***	-20.9%
Housing allowance		-.399	-19.93	[.000]***	-11.1%	-.396	-19.05	[.000]***	-10.7%
Number of Observations			128045				127912		
Log Likelihood			-63773.5				-61995.9		
Mean of Dependent Variable			.740708				.761336		
Percentage Correct Prediction			75.7%				77%		
Pseudo			.147070				.128931		

***significant at 1% level; **significant at 5% level

Table A.4.Ability to Heat Home Adequately: Results of a Probit Model for 1996 and 1997

Dependent Variable: HEAT HOME		***1996***				***1997***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		2.151	68.04	–	–	.844	33.60	–	–
Age Group	16-34	-.348	-18.22	[.000]***	-8.9%	-.197	-11.60	[.000]***	-6.8%
	35-44	-.180	-9.49	[.000]***	-4.6%	-.060	-3.57	[.000]***	-2.1%
	45-54	-.889	-.49	[.618]	-0.2%	-.035	-2.25	[.024]**	-1.2%
	55-64	-.010	-.62	[.532]	-0.2%	-.077	-5.38	[.000]***	-2.7%
Household	Number of Adults	-.121	-34.08	[.000]***	-3.1%	-.012	-3.86	[.000]***	-0.4%
Composition	Number of Children	-.027	-5.21	[.000]***	-0.7%	-.017	-3.83	[.000]***	-0.5%
Marital Status	Separated	-.246	-6.30	[.000]***	-6.3%	-.068	-2.07	[.038]**	-2.3%
	Divorced	.048	1.86	[.062]**	1.2%	.088	4.57	[.000]***	3%
	Widowed	-.149	-8.93	[.000]***	-3.8%	.050	3.29	[.001]***	1.7%
	Single	.729	.56	[.573]	0.1%	.125	11.56	[.000]***	4.3%
Income	Self employed	-.128	-9.71	[.000]***	-3.3%	.189	15.12	[.000]***	6.5%
	Pension	-.191	-14.09	[.000]***	-4.9%	-.059	-4.79	[.000]***	-2%
	Unemployed	-.239	-8.19	[.000]***	-6.1%	-.169	-6.83	[.000]***	-5.9%
	Other benefit	-.206	-10.66	[.000]***	-5.3%	.111	6.53	[.000]***	3.8%
	Private Income	-.084	-2.49	[.013]**	-2.1%	.195	7.03	[.000]***	6.8%
Tenure	Tenant	.106	9.88	[.000]***	2.7%	-.336	-36.17	[.000]***	-11.6%
	Rent free	-.094	-4.46	[.000]***	-2.4%	-.176	-9.69	[.000]***	-6.1%

Accommodation type	Semidetached								
	Terraced	.359	31.50	[.000]***	9.2%	.273	28.72	[.000]***	9.5%
	Apartment Small	.422	31.79	[.000]***	10.8%	-.039	-3.59	[.000]***	-1.3%
	Apartment Large	.045	3.93	[.000]***	1.1%	.149	13.90	[.000]***	5.1%
	Other Accommodation	.613	23.43	[.000]***	15.8%	-.661	-34.72	[.000]***	-23%
Health Status	Good	-.034	-3.13	[.002]**	-0.8%	.132	14.71	[.000]***	4.6%
	Fair	-.181	-13.87	[.000]***	-4.6%	-.058	-5.49	[.000]***	-2%
	Bad	-.658	-37.36	[.000]***	-16.9%	-.456	-29.65	[.000]***	-15.8%
	Very Bad	-.653	-23.38	[.000]***	-16.8%	-.452	-17.84	[.000]***	-15.7%
Education	Secondary finished	-.028	-1.99	[.046]**	-0.7%	-.065	-6.48	[.000]***	-2.2%
	Secondary not finished	-.786	-60.65	[.000]***	-20.2%	-.298	-30.89	[.000]***	-10.3%
Housing allowance -		.385	-18.35	[.000]***	-9.9%	-.159	-9.81	[.000]***	-5.5%
Number of Observations			130639				138130		
Log Likelihood			-60067.0				-84430.0		
Mean of Dependent Variable			.778542				.655578		
Percentage Correct Prediction			78.8%				67.4%		
Pseudo			.137743				.064895		

***significant at 1% level; **significant at 5% level.

Table A.5. Ability to Pay Utility Bills in Past Year: Results of a Probit Model for 1994 and 1995

Dependent Variable: BILLS		***1994***				***1995***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-2.09	-57.48	–	–	-1.761	-45.79	–	–
Age Group	16-34	.333	13.33	[.000]***	4.8%	.299	11.20	[.000]***	3.5%
	35-44	.224	9.06	[.000]***	3.2%	.209	7.94	[.000]***	2.5%
	45-54	.228	9.70	[.000]***	3.3%	.186	7.32	[.000]***	2.2%
	55-64	.172	8.04	[.000]***	2.5%	.060	2.57	[.010]**	0.7%2
Household	Number of Adults	.080	18.06	[.000]***	1.1%	.047	9.91	[.000]***	0.5%
Composition	Number of Children	.121	20.78	[.000]***	1.7%	.104	16.87	[.000]***	1.2%
Marital Status	Separated	.345	8.54	[.000]***	5%	.392	9.073	[.000]***	4.6%
	Divorced	.234	8.23	[.000]***	3.4%	.220	7.23	[.000]***	2.6%
	Widowed	.142	6.38	[.000]***	2%	.101	4.17	[.000]***	1.2%
	Single	.048	3.01	[.003]**	0.7%	.038	2.21	[.027]**	0.4%
Income	Self employed	.256	15.79	[.000]***	3.7%	.248	14.56	[.000]***	2.9%
	Pension	.197	10.91	[.000]***	2.8%	.133	6.78	[.000]***	1.5%
	Unemployed	.381	13.31	[.000]***	5.5%	.529	16.69	[.000]***	6.3%
	Other benefit	.296	13.80	[.000]***	4.3%	.308	13.10	[.000]***	36%
	Private Income	.357	10.24	[.000]***	5.2%	.452	12.11	[.000]***	5.3%
Tenure	Tenant	.186	14.28	[.000]***	2.7%	-.107	-7.14	[.000]***	-1.2%
	Rent free	.115	4.53	[.000]***	1.6%	.376	15.37	[.000]***	4.4%

Accommodation type	Semidetached								
	Terraced	.096	6.89	[.000]***	1.4%	.034	2.33	[.020]**	0.4%
	Apartment Small	.208	13.40	[.000]***	3%	-.029	-1.7	[.081]*	-0.3%
	Apartment Large	.144	9.07	[.000]***	2.1%	-.167	-9.70	[.000]***	-1.9%
	Other Accommodation	-.137	-3.07	[.002]**	-2%	-.425	-10.89	[.000]***	-5%
Health Status	Good	-.170	-12.73	[.000]***	-2.4%	-.198	-13.80	[.000]***	-2.3%
	Fair	-.021	-1.34	[.179]	-0.3%	-.045	-2.67	[.008]**	-0.5%
	Bad	.140	6.42	[.000]***	2%	.109	4.55607	[.000]***	1.3%
	Very Bad	.298	9.65	[.000]***	4.3%	.293	8.40	[.000]***	3.5%
Education	Secondary finished	.090	5.35	[.000]***	1.3%	.037	2.00	[.045]**	0.4%
	Secondary not finished	.327	20.65	[.000]***	4.7%	.284	16.57	[.000]***	3.3%
Housing allowance -		.289	-14.21	[.000]***	-4.2%	-.365	-16.87	[.000]***	-4.3%
Number of Observations			128045				127912		
Log Likelihood			-34807.6				-28796.8		
Mean of Dependent Variable			.084267				.064685		
Percentage Correct Prediction			91.5%				93.5%		
Pseudo			.034908				.029552		

***significant at 1% level; **significant at 5% level.

Table A.6. Ability to Pay Utility Bills in the Past Year: Results of a Probit Model for 1996 and 1997

Dependent Variable: BILLS		***1996***				***1997***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-2.219	-48.89	–	–	-2.189	-55.85	–	–
Age Group	16-34	.577	16.85	[.000]***	4.7%	.236	8.42	[.000]***	2.4%
	35-44	.478	14.20	[.000]***	3.9%	.207	7.53	[.000]***	2.1%
	45-54	.4450	13.61	[.000]***	3.6%	.167	6.38	[.000]***	1.7%
	55-64	.216	6.82	[.000]***	1.7%	.091	3.72	[.010]**	0.9%
Household	Number of Adults	.042	7.89	[.000]***	0.3%	.084	16.92	[.000]***	0.8%
Composition	Number of Children	.1341	20.17	[.000]***	1.1%	.118	18.78	[.000]***	1.2%
Marital Status	Separated	.411	8.26	[.000]***	3.3%	.208	4.35	[.000]***	2.1%
	Divorced	.336	10.82	[.000]***	2.7%	.156	5.18	[.000]***	1.6%
	Widowed	.127	3.93	[.000]***	1%	.162	6.48	[.000]***	1.6%
	Single	.119	6.21	[.000]***	0.9%	.047	2.71	[.027]**	0.4%
Income	Self employed	-.020	-.91	[.360]	-0.1%	.277	15.63	[.000]***	2.8%
	Pension	.039	1.62	[.104]	0.3%	.146	7.23	[.000]***	1.5%
	Unemployed	.638	19.32	[.000]***	5.2%	.445	13.54	[.000]***	4.6%
	Other benefit	.365	15.15	[.000]***	3%	.221	9.18	[.000]***	2.3%
	Private Income	-.056	-.94	[.343]	-0.4%	.286	7.10	[.000]***	2.9%
Tenure	Tenant	-.053	-3.25	[.001]**	-0.4%	.075	5.08	[.000]***	0.7%
	Rent free	.023	.68	[.495]	0.1%	-.093	-2.95	[.000]***	-0.9%

Accommodation type	Semidetached								
	Terraced	-.016	-.89	[.373]	-0.1%	.811	.52	[.020]**	0.0%
	Apartment Small	.126	6.44	[.000]***	1%	.214	12.68	[.081]*	2.2%
	Apartment Large	.071	3.77	[.000]***	0.5%	.121	7.06	[.000]***	1.2%
	Other Accommodation	.170	5.20	[.000]***	1.4%	-.255	-6.42	[.000]***	-2.6%
Health Status	Good	.042	2.48	[.013]**	0.3%	-.174	-12.05	[.000]***	-1.8%
	Fair	.277	13.80	[.000]***	2.2%	-.044	-2.60	[.008]**	-0.4%
	Bad	.392	13.55	[.000]***	3.2%	.039	1.60	[.000]***	0.4%
	Very Bad	.491	11.13	[.000]***	4%	.209	5.71	[.000]***	2.1%
Education	Secondary finished	.034	1.66	[.095]*	0.2%	.055	3.07	[.045]**	0.5%
	Secondary not finished	.163	8.50	[.000]***	1.3%	.346	21.22	[.000]***	3.6%
Housing allowance -		.566	-26.37	[.000]***	-4.6%	-.244	-10.86	[.000]***	-2.5%
Number of Observations			130639				138130		
Log Likelihood			-20753.7				-27432.9		
Mean of Dependent Variable			.042198				.053993		
Percentage Correct Prediction			95.7%				94.5%		
Pseudo	.033154		.023387						

***significant at 1% level; **significant at 5% level.

Table A.7. Households Lacking Adequate Heating Facilities: Results of a Probit Model for 1994 and 1995

Dependent Variable: FACILITY		***1994***				***1995***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-1.73	-54.57	–	–	-1.73	-53.12	–	–
Age Group	16-34	.156	7.69	[.000]***	3.4%	.196	9.49	[.000]***	4%
	35-44	.080	3.99	[.000]***	1.8%	.056	2.75	[.006]**	1.1%
	45-54	-.014	-.76	[.445]	-0.3%	-.036	-1.84	[.066]*	-0.7%
	55-64	.058	3.42	[.001]**	1.2%	.546	.31	[.754]	0.1%
Household	Number of Adults	.058	15.18	[.000]***	1.2%	.028	7.25	[.000]***	0.5%
Composition	Number of Children	.015	2.86	[.004]**	0.3%	.021	3.81	[.000]***	0.4%
Marital Status	Separated	.136	3.55	[.000]***	3%	.134	3.30	[.001]**	2.7%
	Divorced	.046	1.76	[.078]*	1%	.059	2.17	[.029]**	1.2%
	Widowed	.048	2.68	[.007]**	1%	.055	3.05	[.002]**	1.1%
	Single	.122	8.96	[.000]***	2.7%	.100	7.25	[.000]***	2%
Income	Self employed	.213	15.27	[.000]***	4.7%	.197	13.97	[.000]***	4%
	Pension	.095	6.44	[.000]***	2.1%	.037	2.48	[.013]**	0.7%
	Unemployed	.028	1.00	[.317]	0.6%	-.495	-.15	[.878]	-0.1%
	Other benefit	.112	5.75	[.000]***	2.5%	.100	4.80	[.000]***	2%
	Private Income	.141	4.47	[.000]***	3.1%	.042	1.18	[.234]	0.8%
Tenure	Tenant	.411	36.87	[.000]***	9.1%	-.031	-2.70	[.007]**	-0.6%
	Rent free	.466	23.60	[.000]***	10%	.160	7.16	[.000]***	3.2%

Accommodation type	Semidetached								
	Terraced	-.192	-16.79	[.000]***	-4.3%	-.326	-.26	[.791]	0%
	Apartment Small	-.093	-7.22	[.000]***	-2%	.013	.96	[.334]	0.2%
	Apartment Large	-.421	-29.57	[.000]***	-9.4%	.767	.58	[.558]	0.1%
	Other Accommodation	.188	6.31	[.000]***	4.2%	-.091	-3.57	[.000]***	-1.8%
Health Status	Good	-.029	-2.55	[.011]**	-0.6%	-.518	-.43	[.667]	-0.1%
	Fair	.168	12.29	[.000]***	3.7%	.198	14.03	[.000]***	4%
	Bad	.442	24.31	[.000]***	9.8%	.503	26.78	[.000]***	10.3%
	Very Bad	.491	18.47	[.000]***	10.9%	.554	19.24	[.000]***	11.4%
Education	Secondary finished	.820	.567	[.571]	0.1%	.020	1.32	[.184]	0.4%
	Secondary not finished	.414	31.37	[.000]***	9.2%	.449	32.16	[.000]***	9.2%
Housing allowance		.056	2.86	[.004]**	1.2%	.018	.87	[.383]	0.3 %
Number of Observations			128045				127912		
Log Likelihood			-51706.4				-47941.7		
Mean of Dependent Variable			.155766				.133506		
Percentage Correct Prediction			84.4%				86.6%		
Pseudo			.057798				.0.36574		

***significant at 1% level; **significant at 5% level.

Table A.8. Households Lacking Adequate Heating Facilities: Results of a Probit Model for 1996 and 1997

Dependent Variable: FACILITY		***1996***				***1997***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-1.74	-52.09	–	–	-2.14	-62.31	–	–
Age Group	16-34	.177	8.30	[.000]***	3.3%	.176	8.02	[.000]***	2.9%
	35-44	.057	2.73	[.006]**	1.1%	.085	3.87	[.000]***	1.4%
	45-54	-.016	-.84	[.400]	-0.3%	-.027	-1.31	[.190]	-0.4%
	55-64	-.028	-1.57	[.115]	-0.5%	.125	.06	[.946]	0%
Household	Number of Adults	.024	6.10	[.000]***	0.4%	.077	18.59	[.000]***	1.3%
Composition	Number ofChildren	.034	6.16	[.000]***	0.6%	.032	5.70	[.000]***	0.5%
Marital Status	Separated	.154	3.54	[.000]***	2.9%	.174	4.19	[.000]***	2.9%
	Divorced	.115	4.29	[.000]***	2.1%	.025	.94	[.345]	0.4%
	Widowed	.089	4.78	[.000]***	1.6%	.100	5.27	[.000]***	1.7%
	Single	.117	8.28	[.000]***	2.2%	.086	5.94	[.000]***	1.4%
Income	Self employed	.168	11.56	[.000]***	3.2%	.219	14.33	[.000]***	3.7%
	Pension	.031	2.07	[.038]**	0.6%	.141	8.90	[.000]***	2.3%
	Unemployed	.126	3.89	[.000]***	2.3%	.017	.51	[.608]	0.2%
	Other benefit	.076	3.60	[.000]***	1.4%	.043	2.01	[.044]**	0.7%
	Private Income	-.015	-.39	[.689]	-0.2%	.052	1.42	[.155]	0.8%
Tenure	Tenant	-.102	-8.61	[.000]***	-1.9%	.324	26.40	[.000]***	5.4%
	Rent free	.090	3.85	[.000]***	1.7%	.433	20.62	[.000]***	7.3%

Accommodation type	Semidetached								
	Terraced	-.092	-7.21	[.000]***	-1.7%	-.122	-9.96	[.000]***	-2%
	Apartment Small	-.035	-2.43	[.015]**	-0.6%	-.099	-7.07	[.000]***	-1.6%
	Apartment Large	.162	12.55	[.000]***	3%	-.432	-27.34	[.000]***	-7.3%
	Other Accommodation	-.408	-13.22	[.000]***	7.7%	-.248	-9.23	[.000]***	-4.2%
Health Status	Good	.035	2.80	[.005]**	0.6%	.056	4.42	[.000]***	0.9%
	Fair	.241	16.25	[.000]***	4.5%	.251	17.03	[.000]***	4.2%
	Bad	.557	28.84	[.000]***	10.6%	.522	27.17	[.000]***	8.8%
	Very Bad	.575	19.10	[.000]***	10.9%	.559	18.80	[.000]***	9.4%
Education	Secondary finished	-.035	-2.25	[.024]**	-0.6%	-.049	-3.21	[.000]**	-0.8%
	Secondary not finished	.411	29.27	[.000]***	7.8%	.485	35.94	[.000]***	8.1%
Housing allowance -		.415	-.19	[.843]	0%	.108	4.88	[.000]***	1.8%
Number of Observations			130639				138130		
Log Likelihood			-45534.8				-42951.1		
Mean of Dependent Variable			.120840				.106277		
Percentage Correct Prediction			87.9%				89.3%		
Pseudo			.040669				.056184		

***significant at 1% level; **significant at 5% level.

Table A.9. Presence of Central Heating: Results of a Probit Model for 1994 and 1995

Dependent Variable: CRLHEAT		***1994***				***1995***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		2.32	77.78	–	–	2.04	68.11	–	–
Age Group	16-34	-.133	-7.46	[.000]***	-4.2%	-.145	-8.22	[.000]***	-4.5%
	35-44	-.886	-.50	[.616]	-0.2%	-.020	-1.14	[.252]	-0.6%
	45-54	.122	7.36	[.000]***	3.9%	.137	8.24	[.000]***	4.2%
	55-64	.067	4.53	[.000]***	2.1%	.075	5.05	[.000]***	2.3%
Household	Number of Adults	-.109	-32.01	[.000]***	-3.4%	-.093	-27.83	[.000]***	-2.9%
Composition	Number of Children	-.034	-7.13	[.000]***	-1.1%	-.865	-1.77	[.076]*	-0.2%
Marital Status	Separated	-.260	-7.51	[.000]***	-8.3%	-.293	-8.27	[.000]***	-9.1%
	Divorced	.086	3.52	[.000]***	2.7%	.035	1.46	[.144]	1.1%
	Widowed	-.086	-5.44	[.000]***	-2.7%	-.103	-6.54	[.000]***	-3.2%
	Single	-.150	-12.56	[.000]***	-4.8%	-.107	-8.96	[.000]***	-3.3%
Income	Self employed	-.134	-10.80	[.000]***	-4.3%	-.196	-15.96	[.000]***	-6.1%
	Pension	-.134	-10.39	[.000]***	-4.3%	-.156	-12.16	[.000]***	-4.8%
	Unemployed	-.372	-15.25	[.000]***	-11.9%	-.372	-13.97	[.000]***	-11.6%
	Other benefit	-.235	-13.00	[.000]***	-7.5%	-.168	-8.95	[.000]***	-5.2%
	Private Income	-.038	-1.37	[.169]	-1.2%	-.090	-3.01	[.003]**	-2.8%
Tenure	Tenant	-.078	-7.90	[.000]***	-2.5%	-.168	-17.25	[.000]***	-5.2%
	Rent free	-.499	-26.70	[.000]***	-16%	.037	1.84	[.065]*	1.1%

Accommodation type	Semidetached								
	Terraced	.011	1.15	[.246]	-0.3%	.328	30.98	[.000]***	10.2%
	Apartment Small	-.091	-8.00	[.000]***	-2.9%	.381	31.20	[.000]***	11.9%
	Apartment Large	.026	2.26	[.024]**	0.8%	.165	14.92	[.000]***	5.1%
	Other Accommodation	-.019	-.667	[.504]	-0.6%	.135	6.49	[.000]***	4.2%
Health Status	Good	-.197	-19.58	[.000]***	-6.3%	-.151	-14.91	[.000]***	-4.7%
	Fair	-.282	-23.52	[.000]***	-9%	-.246	-20.29	[.000]***	-7.6%
	Bad	-.695	-41.64	[.000]***	-22.2%	-.629	-37.09	[.000]***	-19.6%
	Very Bad	-.564	-22.39	[.000]***	-18%	-.493	-18.22	[.000]***	-15.4%
Education	Secondary finished	-.076	-6.21	[.000]***	-2.4%	-.053	-4.18	[.000]***	-1.6%
	Secondary not finished	-.805	-70.94	[.000]***	-25.8%	-.774	-66.11	[.000]***	-24.1%
Housing allowance -		.745	-37.27	[.000]***	-23.8 %	-.678	-32.61	[.000]***	-21.1 %
Number of Observations			128045				127912		
Log Likelihood			-54516.4				-70449.8		
Mean of Dependent Variable			.167941				.686042		
Percentage Correct Prediction			83.2%				71.5%		
Pseudo			.053848				.140859		

***significant at 1% level; **significant at 5% level.

Table A.10. Presence of Central Heating: Results of a Probit Model for 1996 and 1997

Dependent Variable: CRLHEAT		***1996***				***1997***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		2.06	67.42	–	–	.760	30.10	–	–
Age Group	16-34	-.126	-7.05	[.000]***	-3.7%	-.564	-.33	[.739]	-0.1%
	35-44	.283	-.15	[.874]	0%	.070	4.17	[.000]***	2.4%
	45-54	.150	8.95	[.000]***	4.4%	.100	6.34	[.000]***	3.4%
	55-64	.107	7.16	[.000]***	3.2%	.074	5.20	[.000]***	2.5%
Household	Number of Adults	-.093	-27.57	[.000]***	-2.7%	-.028	-8.51	[.000]***	-0.9%
Composition	Number of Children	-.015	-3.02	[.002]**	-0.4%	.013	2.97	[.003]**	0.4%
Marital Status	Separated	-.271	-7.28	[.000]***	-8.1%	-.073	-2.20	[.027]**	-2.5%
	Divorced	.025	1.06	[.288]	0.7%	.076	3.84	[.000]***	2.6%
	Widowed	-.127	-7.99	[.000]***	-3.8%	.013	.91	[.361]	0.4%
	Single	-.075	-6.30	[.000]***	-2.2%	.041	3.76	[.000]***	1.4%
Income	Self employed	-.154	-12.38	[.000]***	-4.6%	.048	3.89	[.000]***	1.6%
	Pension	-.127	-9.91	[.000]***	-3.8%	-.140	-11.31	[.000]***	-4.8%
	Unemployed	-.399	-14.48	[.000]***	-11.9%	-.241	-9.70	[.000]***	-8.2%
	Other benefit	-.154	-8.20	[.000]***	-4.5%	-.039	-2.34	[.019]**	-1.3%
	Private Income	-.020	-.63	[.528]	-0.6%	.220	7.65	[.000]***	7.5%
Tenure	Tenant	.017	1.71	[.087]*	0.5%	-.082	-8.70	[.000]***	-2.8%
	Rent free	-.076	-3.77	[.000]***	-2.2%	-.304	-16.86	[.000]***	-10.4%

Accommodation type	Semidetached								
	Terraced	.358	33.62	[.000]***	10.7%	.160	16.99	[.000]***	5.5%
	Apartment Small	.401	32.57	[.000]***	11.9%	.143	12.88	[.000]***	4.9%
	Apartment Large	.083	7.47	[.000]***	2.4%	.123	11.46	[.000]***	4.2%
	Other Accommodation	.442	19.75	[.000]***	13.1%	.027	1.43	[.150]	0.9%
Health Status	Good	-.161	-15.57	[.000]***	-4.8%	.209	23.14	[.000]***	7.1%
	Fair	-.238	-19.23	[.000]***	-7.1%	.169	15.55	[.000]***	5.7%
	Bad	-.617	-35.98	[.000]***	-18.4%	-.107	-6.94	[.000]***	-3.6%
	Very Bad	-.539	-19.46	[.000]***	-16%	-.045	-1.77	[.077]*	-1.5%
Education	Secondary finished	-.070	-5.45	[.000]***	-2.1%	-.117	-11.17	[.000]***	-4%
	Secondary not finished	-.780	-65.85	[.000]***	-23.2%	-.602	-61.11	[.000]***	-20.6%
Housing allowance -		.680	-32.17	[.000]***	-20.3 %	-.115	-7.00	[.000]***	-3.9 %
Number of Observations			130639				138130		
Log Likelihood			-68958.1				-83135.2		
Mean of Dependent Variable			.713359				.668892		
Percentage Correct Prediction			73.5%				67.8%		
Pseudo			.141218				.065727		

***significant at 1% level; **significant at 5% level.

Table A.11. Presence of Damp: Results of a Probit Model for 1994 and 1995

Dependent Variable: DAMP		***1994***				***1995***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-1.689	-55.03	–	–	-1.482	-47.52	–	–
Age Group	16-34	.185	9.25	[.000]***	4.3%	.172	8.50	[.000]***	3.7%
	35-44	.068	3.40	[.001]**	1.6%	.048	2.40	[.016]**	1%
	45-54	.016	.84	[.396]	0.3%	-.017	-.92	[.356]	-0.3%
	55-64	.031	1.86	[.062]*	0.7%	-.109	-.62	[.995]	0%
Household	Number of Adults	.065	17.36	[.000]***	1.5%	.034	9.10	[.000]***	0.7%
Composition	Number of Children	.055	10.69	[.000]***	1.3%	.062	11.92	[.000]***	1.3%
Marital Status	Separated	.192	5.20	[.000]***	4.5%	.206	5.31	[.000]***	4.5%
	Divorced	.127	5.11	[.000]***	3%	.212	8.52	[.000]***	4.6%
	Widowed	.026	1.49	[.135]	0.6%	.079	4.39	[.000]***	1.7%
	Single	.117	8.94	[.000]***	2.7%	.111	8.25	[.000]***	2.4%
Income	Self employed	.014	1.03	[.301]	0.3%	-.011	-.81	[.413]	-0.2%
	Pension	.044	3.03	[.002]**	1%	.133	.08	[.929]	0%
	Unemployed	.145	5.52	[.000]***	3.4%	.164	5.61	[.000]***	3.6%
	Other benefit	.068	3.57	[.000]***	1.6%	.125	6.29	[.000]***	2.7%
	Private Income	.018	.58	[.560]	0.4%	.039	1.15	[.248]	0.8%
Tenure	Tenant	.453	41.82	[.000]***	10.7%	.094	8.52	[.000]***	2%
	Rent free	.503	25.84	[.000]***	11.8%	.030	1.30	[.191]	0.6%

Accommodation type	Semidetached								
	Terraced	.044	4.08	[.000]***	1%	-.132	-11.04	[.000]***	-2.8%
	Apartment Small	-.212	-16.05	[.000]***	-5%	-.154	-11.15	[.000]***	-3.3%
	Apartment Large	-.366	-26.49	[.000]***	-8.6%	-.164	-12.64	[.000]***	-3.5%
	Other Accommodation	-.098	-3.05	[.002]**	-2.3%	-.055	-2.34	[.019]**	-1.2%
Health Status	Good	.108	9.47	[.000]***	2.5%	.130	11.01	[.000]***	2.8%
	Fair	.280	20.78	[.179]	6.6%	.312	22.42	[.000]***	6.8%
	Bad	.556	30.7	[.000]***	13.1%	.577	30.81	[.000]***	12.6%
	Very Bad	.606	22.89	[.000]***	14.3%	.635	22.14	[.000]***	13.8%
Education	Secondary finished	-.016	-1.24	[.213]	-0.4%	-.041	-2.93	[.003]**	-0.9%
	Secondary not finished	.280	22.13	[.000]***	6.6%	.250	19.06	[.000]***	5.4%
Housing allowance -		.027	-1.46	[.143]	-0.6 %	-.108	-5.61	[.000]***	-2.3%
Number of Observations			128045				127912		
Log Likelihood			-54516.4				-50777.9		
Mean of Dependent Variable			.167941				.143614		
Percentage Correct Prediction			83.2%				85.6%		
Pseudo			.053848				.029082		

***significant at 1% level; **significant at 5% level.

Table A.12. Presence of Damp: Results of a Probit Model for 1996 and 1997

Dependent Variable: DAMP		***1996***				***1997***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-1.67	-51.99	–	–	-2.25	-66.84	–	–
Age Group	16-34	.166	7.93	[.000]***	3.3%	.133	6.10	[.000]***	2.3%
	35-44	.067	3.24	[.001]**	1.3%	.100	4.62	[.000]***	1.7%
	45-54	-.016	-.81	[.413]	-0.3%	.010	.496	[.620]	0.1%
	55-64	-.017	-.95	[.339]	-0.3%	.897	.481	[.630]	0.1%
Household	Number of Adults	.051	13.34	[.000]***	1%	.107	26.31	[.000]***	1.8%
Composition	Number of Children	.071	13.29	[.000]***	1.4%	.059	10.74	[.000]***	1%
Marital Status	Separated	.179	4.25	[.000]***	3.6%	.259	6.51	[.000]***	4.5%
	Divorced	.138	5.42	[.000]***	2.8%	.073	2.81	[.005]**	1.2%
	Widowed	.100	5.43	[.000]***	2%	.156	8.24	[.000]***	2.7%
	Single	.112	8.14	[.000]***	2.2%	.146	10.29	[.000]***	2.5%
Income	Self employed	.120	.08	[.936]	0%	.045	2.86	[.004]**	0.8%
	Pension	.035	2.34	[.019]**	0.7%	.125	7.91	[.000]***	2.2%
	Unemployed	.302	10.16	[.000]***	6.1%	.184	6.03	[.000]***	3.2%
	Other benefit	.163	8.16	[.000]***	3.3%	.138	6.79	[.000]***	2.4%
	Private Income	-.023	-.615	[.538]	-0.4%	.132	3.74	[.000]***	2.3%
Tenure	Tenant	.050	4.39	[.000]***	1%	.358	29.82	[.000]***	6.3%
	Rent free	.065	2.77	[.005]**	1.3%	.465	22.36	[.000]***	8.1%

Accommodation type	Semidetached								
	Terraced	-.133	-10.91	[.000]***	-2.6%	.115	9.95	[.000]***	2%
	Apartment Small	-.215	-14.94	[.000]***	-4.3%	-.221	-15.00	[.000]***	-3.8%
	Apartment Large	-.068	-5.27	[.000]***	-1.3%	-.382	-24.85	[.000]***	-6.7%
	Other Accommodation	-.254	-9.73	[.000]***	-5.1%	-.356	-12.69	[.000]***	-6.2%
Health Status	Good	.101	8.32	[.000]***	2%	.180	14.17	[.000]***	3.1%
	Fair	.274	19.11	[.000]***	5.5%	.312	21.15	[.000]***	5.5%
	Bad	.571	29.83	[.000]***	11.5%	.608	31.65	[.000]***	10.7%
	Very Bad	.654	22.14	[.000]***	13.2%	.643	21.70	[.000]***	11.3%
Education	Secondary finished	-.319	-.21	[.828]	0%	-.051	-3.52	[.000]***	-0.8%
	Secondary not finished	.329	24.32	[.000]***	6.6%	.345	26.63	[.000]***	6%
Housing allowance -		.065	-3.31	[.001]**	-1.3%	.098	4.60	[.000]***	1.7%
Number of Observations			130639				138130		
Log Likelihood			-48208.4				-44812.9		
Mean of Dependent Variable			.129747				.111909		
Percentage Correct Prediction			87%				88.8%		
Pseudo			.034251				.055268		

***significant at 1% level; **significant at 5% level.

Table A.13. Presence of Rot: Results of a Probit Model for 1994 and 1995

Dependent Variable: ROT		***1994***				***1995***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-1.88	-54.56	–	–	-1.66	-48.03	–	–
Age Group	16-34	.071	3.18	[.001]**	1.2%	.130	5.74	[.000]***	2.1%
	35-44	.015	.708	[.479]	0.2%	.031	1.40	[.160]	0.5%
	45-54	-.365	-.01	[.986]	0%	.679	.31	[.753]	0.1%
	55-64	.030	1.57	[.116]	0.5%	.010	.55	[.577]	0.1%
Household	Number of Adults	.025	5.90	[.000]***	0.4%	.146	.34	[.731]	0%
Composition	Number of Children	.058	10.19	[.000]***	1%	.059	10.19	[.000]***	0.9%
Marital Status	Separated	.214	5.32	[.000]***	3.7%	.247	5.90	[.000]***	4%
	Divorced	.191	7.15	[.000]***	3.3%	.224	8.28	[.000]***	3.6%
	Widowed	.067	3.39	[.001]**	1.1%	.121	6.15	[.000]***	2%
	Single	.193	13.17	[.000]***	3.3%	.172	11.58	[.000]***	2.8%
Income	Self employed	-.725	-.43	[.663]	-0.1%	-.057	-3.45	[.001]**	-0.9%
	Pension	.012	.76	[.441]	0.2%	-.021	-1.26	[.205]	-0.3%
	Unemployed	.100	3.44	[.001]**	1.7%	.073	2.20	[.027]**	1.2%
	Other benefit	.099	4.78	[.000]***	1.7%	.128	5.91	[.000]***	2.1%
	Private Income	-.209	-5.17	[.000]***	-3.6%	-.164	-3.93	[.000]***	-2.7%
Tenure	Tenant	.546	45.55	[.000]***	9.4%	.034	2.76	[.006]**	0.5%
	Rent free	.460	21.41	[.000]***	7.9%	-.038	-1.44	[.149]	-0.6%

Accommodation type	Semidetached								
	Terraced	.019	1.54	[.122]	0.3%	-.071	-5.31	[.000]***	-1.1%
	Apartment Small	-.205	-13.71	[.000]***	-3.5%	-.038	-2.54	[.011]**	-0.6%
	Apartment Large	-.378	-23.59	[.000]***	-6.5%	-.040	-2.81	[.005]**	-0.6%
	Other Accommodation	.137	4.19	[.000]***	2.3%	-.874	-.33	[.741]	-0.1%
Health Status	Good	.056	4.28	[.000]***	0.9%	.138	10.26	[.000]***	2.2%
	Fair	.244	16.07	[.000]***	4.2%	.310	19.76	[.000]***	5.1%
	Bad	.512	25.63	[.000]***	8.8%	.591	28.74	[.000]***	9.7%
	Very Bad	.523	17.97	[.000]***	9%	.634	20.49	[.000]***	10.4%
Education	Secondary finished	.628	.405	[.685]	0.1%	-.035	-2.19	[.028]**	-0.5%
	Secondary not finished	.220	15.29	[.000]***	3.8%	.235	15.94	[.000]***	3.8%
Housing allowance		.061	2.96	[.003]**	1%	-.109	-5.21	[.000]***	-1.8%
Number of Observations			128045				127912		
Log Likelihood			-40874.9				-38996.7		
Mean of Dependent Variable			.107095				.095753		
Percentage Correct Prediction			89.2%				90.4%		
Pseudo			.042783				.021697		

***significant at 1% level; **significant at 5% level.

Table A.14. Presence of Rot: Results of a Probit Model for 1996 and 1997

Dependent Variable: ROT		***1996***				***1997***			
Explanatory Variables		*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*	*Coeff*	*t Stat*	*P-Value*	*Marginal Effects*
Constant		-1.76	-48.36	–	–	-2.27	-59.69	–	–
Age Group	16-34	.124	5.19	[.000]***	1.8%	.496	.01	[.984]	0%
	35-44	.050	2.12	[.033]**	0.7%	.033	1.34	[.179]	0.4%
	45-54	.043	-1.93	[.053]*	0.6%	-.016	-.69	[.489]	-0.2%
	55-64	-.206	-.10	[.920]	0%	-.798	-.37	[.709]	0%
Household	Number of Adults	-0.12	-2.82	[.005]**	-0.1%	.053	11.24	[.000]***	0.6%
Composition	Number of Children	.062	10.41	[.000]***	0.9%	.069	11.07	[.000]***	0.8%
Marital Status	Separated	.259	5.75	[.000]***	3.7%	.313	7.28	[.000]***	3.9%
	Divorced	.208	7.58	[.000]***	3%	.162	5.84	[.000]***	2%
	Widowed	.132	6.39	[.000]***	1.9%	.155	7.29	[.000]***	1.9%
	Single	.197	12.81	[.000]***	2.8%	.248	15.41	[.000]***	3%
Income	Self employed	-.084	-4.71	[.000]***	-1.2%	-.013	-.712	[.476]	-0.1%
	Pension	-.026	-1.55	[.121]	-0.3%	.066	3.63	[.000]***	0.8%
	Unemployed	.222	6.68	[.000]***	3.2%	.097	2.81	[.005]**	1.2%
	Other benefit	.150	6.82	[.000]***	2.1%	.098	4.35	[.000]***	1.2%
	Private Income	-.088	-2.02	[.043]**	-1.2%	-.041	-.95	[.341]	-0.5%
Tenure	Tenant	.016	1.25	[.210]	0.2%	.476	35.44	[.000]***	5.9%
	Rent free	-.043	-1.53	[.125]	-0.6%	.515	22.54	[.000]***	6.4%

Accommodation type	Semidetached								
	Terraced	-.094	-6.74	[.000]***	-1.3%	.108	8.20	[.000]***	1.3%
	Apartment Small	-.138	-8.44	[.000]***	-2%	-.233	-13.67	[.000]***	-2.9%
	Apartment Large	.018	1.26	[.206]	0.2%	-.417	-22.82	[.000]***	-5.2%
	Other Accommodation	-.228	-7.46	[.000]***	-3.3%	-.291	-9.36	[.000]***	-3.6%
Health Status	Good	.118	8.37	[.000]***	1.7%	.198	13.16	[.000]***	2.4%
	Fair	.276	16.77	[.000]***	4%	.336	19.61	[.000]***	4.2%
	Bad	.548	25.42	[.000]***	7.9%	.589	26.90	[.000]***	7.3%
	Very Bad	.632	19.40	[.000]***	9.1%	.677	20.84	[.000]***	8.4%
Education	Secondary finished	-.016	-.99	[.318]	-0.2%	-.091	-5.46	[.000]**	-1.1%
	Secondary not finished	.260	16.95	[.000]***	3.7%	.257	17.48	[.000]***	3.2%
Housing allowance		-.060	-2.75	[.006]**	-0.8 %	.050	2.17	[.029]***	0.6%
Number of Observations			130639				138130		
Log Likelihood			-35432.2				-32360.9		
Mean of Dependent Variable			.081144				.070318		
Percentage Correct Prediction			91.8%				92.9%		
Pseudo			.021062				.041182		

***significant at 1% level; **significant at 5% level.

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