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Determinants of vegetarianism and partial vegetarianism in the United Kingdom

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Determinants of Vegetarianism and Partial Vegetarianism in the United Kingdom

Eimear Leahy\textsuperscript{a}, Seán Lyons\textsuperscript{a}\textsuperscript{b} and Richard S.J. Tol\textsuperscript{a}\textsuperscript{b}\textsuperscript{c}

Abstract: Vegetarianism is increasing in the western world. Anecdotally, this trend can be attributed to heightened health, environmental and animal welfare concerns. In this paper we investigate the factors associated with vegetarianism among adults and children in the UK. Using the 2008 Health Survey for England, we use a logit model to assess the relationship between vegetarianism and the socioeconomic and personal characteristics of the respondents. We also analyse the factors associated with varying levels of meat consumption using an ordered logit model. This paper adds to the existing literature as it is the first paper to estimate the determinants of vegetarianism using a large dataset containing individual level consumption data.

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1. Introduction

Meat production is set to double by 2050 due to an increase in the world population and increased wealth in developing countries (FAO, 2010). At present, in less developed countries, low income levels force many people to follow vegetarian diets. In developed countries, where people are vegetarians by choice, vegetarianism is increasing (Leahy, Lyons and Tol, 2010b). The notion of partial vegetarianism is also becoming increasingly popular in developed nations. Catholics have long been urged to abstain from meat consumption on Fridays. However, the heightened interest in partial vegetarianism has been driven mainly by celebrity endorsed movements such as the Meatless Monday campaign which began in 2003. Concern for animal welfare and the environment are among the factors driving this trend. The relationship between meat consumption, especially red meat, and global environmental change has been acknowledged (FAO, 2006). Ruminant livestock are major emitters of methane, the second-most important anthropogenic greenhouse gas.

Meat consumption also has implications for an individual’s health. In developed countries, excessive meat consumption can be a health concern (Giovannucci et al., 2004, Drewnowski and Specter, 2004, Hu et al., 2000, Rose, Boyar, and Wynder, 1986, James et al., 1997). Barnard, Nicholson and Howard (1995) studied the medical costs associated with meat consumption in the USA. The authors estimate that costs of between $30-60 billion per year result due to the higher prevalence of hypertension, heart disease, cancer, diabetes, gallstones, obesity and food-borne illness among omnivores compared with vegetarians.

Leahy, Lyons and Tol, (2010b) examined the determinants of vegetarianism at an aggregate level. The findings suggest that there is a Kuznets-like relationship between income and meat expenditure. For the poor, an increase in income results in higher meat expenditure. However, at the global average income, meat consumption levels off and at very high levels of per capita income vegetarianism increases. Higher levels of education were also associated with increased vegetarianism and, in poor countries, vegetarianism is negatively associated with the per capita level of meat production.
Leahy, Lyons and Tol (2010a) find that the proportion of vegetarians in the UK is increasing (see Figure A1). In this paper, we analyse the determinants of vegetarianism at the individual level. This study provides a much richer analysis of the characteristics of vegetarians. This should be of benefit to those forecasting future numbers of vegetarians and the associated environmental or health benefits. Because partial vegetarianism can lead to important environmental and health benefits, we also assess the personal and household characteristics associated with varying levels of meat consumption.

Previous papers which aim to establish the motivations of vegetarians have usually been carried out on small or unrepresentative samples (Beardsworth and Bryman, 1999, Fox and Ward, 2006, Jabs, Devine and Sobal, 1998). The majority of the literature instead focuses on the health advantages of following a vegetarian diet. In a study of almost 11,000 participants, with whom a follow up study was carried out 17 years later, Sanjoaquin et al. (2004) find that vegetarians showed a moderately but nonsignificantly lower risk of colorectal cancer compared with non vegetarians. Also, the risk of colorectal cancer was not seen to increase with higher meat consumption among non vegetarians. Key et al. (1999) find with the use of Poisson regression analysis that from a total sample of 76,172, of which 36.5% are vegetarian, mortality from ischemic heart disease was 24% lower in vegetarians than in non vegetarians and 26% lower in vegans. Appleby, Davey and Key (2002) find that non-meat eaters, especially vegans, are found to have a lower prevalence of hypertension and lower systolic and diastolic blood pressures than meat eaters. The differences can largely be explained by differences in body mass index, however. Key et al. (2009) studied the cancer risk among British vegetarians. In this study the sample size was 61,566 and the average follow-up took place 12.2 years after the initial interview. Results show that vegetarians face a much lower risk of stomach cancer, ovarian cancer, bladder cancer and cancer of the lymphatic and haematopoietic tissues than meat eaters.

In his summation of the literature on the health effects of vegetarianism, Panebianco (2007) concluded that the merits of meat avoidance include a lower incidence of obesity, a reduced risk of chronic diseases such as heart disease, hypertension, and type 2 diabetes, a lower death rate from ischemic heart disease, lower blood cholesterol levels, a lower incidence of certain cancers including prostate and colon cancer, and greater longevity. Some authors for example, Worsley and
Skrzypiec, (1997) have suggested, however, that there is a link between teenage vegetarianism and eating disorders, especially among females.

While literature on the determinants of vegetarianism is lacking, research into meat consumption has been extensive. The factors affecting meat demand have been studied at a micro level for example in Ireland by Newman et al. (2001), in the USA by Nayga (1995), in the UK by Burton et al. (1994), in Japan by Chern et al. (2002) and in Mexico by Gould et al. (2002). Results suggest that the demand for meat is affected by factors such as income, household size, education level and professional status. Changing socio economic patterns have also resulted in changing the pattern of meat demand. Meat products which are seen as being convenient and versatile have become popular in developed countries (Newman et al., 2002, Meat and Livestock Commission, 1996). During the 1990s in the UK it was found that price and income were declining in importance and the demand for meat was dominated by preferences and tastes (Burton et al., 1996, 1999). Various health scares such as the BSE crisis have resulted in a noticeable demand shift away from red meat towards white meat (Burton et al., 1999). A recent analysis of the role of the media on the demand for meat shows that animal welfare advertising has a small but statistically significant effect on pork and poultry demand (Tonser and Olynk, 2010).

The majority of meat demand studies to date have used household expenditure surveys with which it is difficult to predict individual consumption patterns because data is collected at the household level. Also, such surveys do not usually contain detailed information about eating out. Expenditure does not necessary equal consumption (e.g., someone may buy meat for her dog). Expenditure surveys cannot distinguish between people who eat a lot of cheap meat and people who eat a little bit of expensive meat. There can also be problems with the accuracy of purchase recall, and the frequency of purchase. All this makes expenditures surveys less suitable for studying the patterns of vegetarianism. The advantage of this paper is that the data we use is collected at the individual level and respondents are asked about general eating patterns as opposed to expenditure at a point in time. To our knowledge, this is the first empirical analysis of the determinants of vegetarianism and partial vegetarianism using a large micro dataset.

The paper continues as follows. Section 2 describes the data and methods used and section 3 discusses the results. Section 4 provides a discussion and conclusion.
2. Data and Methods

We use the 2008 Health Survey for England in which 15,102 adults and 7,521 children took part. 3,473 children were from the core sample and 4,048 were from a later boost sample (Department of Health, 2010). A response rate of 64% was achieved for the core sample and 73% for the boost sample. The Health Survey for England specialises in different topics each year. The 2008 survey focuses on physical activity and fitness levels. Participants were interviewed, and for those in the core sample this was followed by a nurse visit. Adults and children were asked a range of questions about general health, fruit and vegetable consumption, alcohol consumption, smoking, and physical activity. Respondents aged 16 and over were asked to self-complete a section on eating habits while an interviewer completed the section on children’s eating habits. Adults and children were asked how often they consume both red and white meat; 6 or more times a week, 3-5 times a week, 1-2 times a week, less than once a week, or rarely or never. We classify those who identify themselves as consuming both red and white meat “rarely or never” as vegetarians. While this is not perfect, it is the best measure available to identify vegetarians.

The Health Survey for England also contains information on income and other socio-economic variables which we use as explanatory variables in our models. The analysis is made up of two parts. In the first we use logit regression models to analyse the factors associated with vegetarianism. The dependent variable is a binary variable, equalling 1 if the respondent eats red meat or white meat “rarely or never” and 0 if he/she eats any type of meat more often. We carry out separate analyses for adults and children.

The independent variables are a series of individual and household characteristics. The household income level is included as an explanatory variable and enables us to establish whether vegetarians are more likely to be found in higher income or lower income households. The income variable is not continuous; rather it is divided into 12 binary categories. A graph of the relationship between household income and the percentage of vegetarians aged between 2 and 16 is shown in Figure A2 of the Appendix. At the micro level, there is no evidence of a Kuznets-like relationship as is the case at the aggregated level across nations (Leahy, Lyons and Tol, 2010b). Instead, vegetarianism appears to increase with income but for adults, at extremely
high income levels, the proportion of the population that is vegetarian falls (see Figure A3 of the Appendix).

For the analysis of vegetarianism among children we also control for the social class of the household reference person (HRP)\(^1\) as we expect to find a positive relationship between vegetarianism and higher social classes. As the presence of other vegetarians in a household may increase the likelihood that a child will be vegetarian, we control for the number of other vegetarians in the household. We expect to find that vegetarians are more prevalent in urban areas (and in particular big cities) than in rural areas or small towns. Therefore we control for the region in which the child lives and the degree of urbanisation. Also included is the age and gender of the child. Anecdotally, vegetarianism is becoming more prevalent among young adults and females in particular. We wish to ascertain whether there is a link between vegetarians and the health conscious. The child’s body mass index (BMI) is measured and the number of portions of fruit and vegetables consumed daily are counted. Children are also asked whether they get the recommended amount of physical activity or not. The recommended amount of exercise for children is a minimum of 60 minutes of moderate\(^2\) to vigorous exercise every day of the week. Children are also asked if they are trying to lose weight. We expect to find a positive relationship between being on a diet and vegetarianism. Other control variables include having a long term illness, because this may mean respondents are obliged to follow restricted diets, and ethnic origin because this may influence meat eating patterns, particularly those of red meat.

We then do the same analysis for adults. The questions asked to adults and children vary slightly. With regard to adults, we control for all of the above except we do not know if adults are trying to lose weight and, instead of controlling for the social class of the HRP, we control for the social class of the respondent. In addition, we include the education level and economic status of the individual because those educated to higher levels and those in professional occupations may have a higher probability of being a vegetarian. The explanatory variables also include smoking and alcohol intake. We expect to find that vegetarians are more health conscious and so, alcohol intake might be lower than that of non vegetarians. Similarly, we expect to find that

\(^1\) The HRP is the highest earner in the household. If household members cannot be separated by income, the oldest person is chosen.

\(^2\) Moderate activity is defined as an activity that makes one out of breath or sweaty, indicating that one is doing cardiovascular activity.
non smokers are more likely to be vegetarians than smokers. Finally, we control for the marital status of the individual. Pribis, Sabate and Fraser (1999) find no differences in marital status between vegetarians and non vegetarians. However, the sample used was small (158 adults) and unrepresentative of the population. A list of the variables included in our models and some descriptive statistics on them is set out in Table 1.

[Table 1 about here]

In the second part of the analysis we examine the factors associated with varying levels of meat consumption. We construct an ordered logit model in which the dependent variable is the level meat consumption. First we construct a red meat consumption scale. 0 indicates that red meat is consumed rarely or never, 1 indicates that red meat is consumed less than once a week, 2 indicates that red meat is consumed 1-2 times a week, 3 indicates a consumption level of 3-5 times a week and 6 means that red meat is consumed at least 6 times per week. We do the same for white meat and then combine the two scales in order to rank total meat consumption. Thus, the dependent variable takes a value of 0 if the consumption level is rarely or never in both of the red and white meat categories, 1 if it is less than once a week in one of the categories and 0 in the other, 2 if it is less than once a week for both red and white meat consumption or 1-2 times a week in one of the categories and zero in the other and so on until we have a variable which takes a value of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 12. We run separate models for children and adults.

For both the logit and ordered logit models we include all of the explanatory variables we believe may influence meat consumption. We then test for joint significance of the insignificant variables. Due to the large number of explanatory variables in our models, only the results of the more parsimonious models are presented. Full regression results are available on request from the authors.

3. Results

3.1 Vegetarianism

The dependent variable equals 1 if the respondent is a vegetarian, 0 otherwise. For each categorical explanatory variable there is a reference category which acts as a
baseline against which the characteristics of respondents, or their households, are compared. The results are presented in terms of odds ratios which reflect the odds that a respondent with a given characteristic will be a vegetarian, relative to those in the reference category. An odds ratio of 1 indicates that respondents with that characteristic are equally likely to be vegetarians as those in the reference category. An odds ratio greater than 1 indicates a higher probability that the respondent will be a vegetarian, while a ratio below 1 indicates that the probability is lower.

Table 2 displays the results of the model which investigates the factors associated with vegetarianism among children.

[Table 2 about here]

The odds ratio for fruitveg indicates that as daily fruit and vegetable consumption increases so too does the probability that a child will be a vegetarian. However, we cannot exclude reverse causality. It could be the case that vegetarians just consume more fruit and vegetables as part of their daily calorie intake. Unfortunately, we do not have an instrumental variable with which we can solve this problem of simultaneity. Thus, the results on the fruitveg variable should be interpreted with caution.

Results also show that children that are trying to lose weight are one and a half times more likely to be vegetarians than their counterparts who are not on a diet. Consistent with anecdotal evidence is the fact that girls are 3 times more likely to be vegetarians than boys. Children of Asian origin (excluding China) are 3 times more likely to be vegetarians than White children, most of whom are of British origin. Given that non-Chinese Asians in Britain are primarily from the Indian subcontinent where vegetarianism and veganism is widespread for religious regions, this result is not surprising.

Interestingly, one of each of the income and social class variables is significant. Children from households that earn between £41,601 and £52,000 a year are 1.8 times more likely to be vegetarians than children who live in households earning between £10,000 and £20,000. One may suspect that because we do not control for the education level of the HRP, the income variable may be picking up some education effect. While the survey did ask adult respondents to state their level of education, the survey did not include a specific question about the education level of the HRP. Creating this variable by finding all of the HRPs who responded to the survey reduces
the number of observations to 469. Children living in households where the HRP is a semi-skilled manual worker are 1.6 times more likely to be vegetarians than children living with reference persons who are managerial or technical workers. Since we do not control for the education level of the HRP, we would have expected that the reference group, managerial and technical workers, who achieve relatively high levels of education (30% of this group have a degree or higher) would be more likely to be vegetarians than the less well educated semi-skilled manual workers (6% have a degree or higher). Thus, there is some factor, other than education, that we don’t observe that would explain this result. Finally, children living in the East Midlands are significantly more likely to be vegetarians compared to those living in the South East. This result must be explained by some factor we do not observe.

Table 3 shows the results of the model which investigates the factors associated with vegetarianism among adults. The number of observations is much higher than is the case for children, as is the number of significant variables. The results of the parsimonious model are presented. The omitted variables prove individually and jointly insignificant.

[Table 3 about here]

Results show that there is a positive correlation between vegetarianism and the consumption of fruit and vegetables. However, as stated previously, we cannot draw any causal inferences between the two variables using this data. Similarly, adults getting the recommended amount of physical activity per week are 23% more likely to be vegetarians than adults who do not meet the criteria. The odds ratio for bmi indicates that the lower a person’s bmi, the higher the probability that the person is a vegetarian. This suggests that people chose to become vegetarians for health reasons. However, it could be the case that the non-consumption of meat reduces the bmi. Thus, we interpret the odds ratios on these variables with caution. We know only that the variables are positively correlated but we cannot say that one causes the other.

3 A total of 17,684 respondents from 9,870 households took part in the survey but over 60% of households did not provide an interview from the HRP. This, along with the exclusion of a child’s interview in other households, reduces the total number of observations dramatically. The education level of the HRP was not significant in an earlier version of the model. Thus, we decided to omit it.

4 For adults, the recommended amount is at least 30 minutes of moderate activity 5 days a week or at least 30 minutes of vigorous activity 3 days a week.
The results of this model show that smokers are 39% more likely to be vegetarians than non-smokers. Simple cross tabulations show, however, that smoking levels are lower among vegetarians than meat eaters. It is thus surprising that the odds ratio on smoker is greater than one. A more thorough investigation of this result shows that the addition to the model of age, living in London, working in a 1 or 2 person organisation or belonging to an ethnic minority increases the odds ratio on smoking so much so that its effect changes from negative to positive. This happens because the correlation between Asians and smoking is negative while the correlation between Asians and vegetarianism is positive. The same correlations hold for living in London or working in a very small organisation. Vegetarianism is negatively correlated with both smoking and age but younger adults are more likely to be vegetarians and older adults are more likely to be smokers.

As was the case in the previous model, the odds of being a vegetarian are increased for non-Chinese Asians. The probability of being a vegetarian is 4 times higher if an adult is Asian compared to White. Also as expected are the odds ratios on female and age. Adult females are twice as likely to be vegetarians as males and the younger the adult, the higher the probability that he/she is a vegetarian.

An interesting result is that of the number of employees in the respondent’s workplace. People working in organisations that employ only one or two people are almost 1.7 times as likely to be vegetarians as those working in organisations with between 25 and 500 employees. This is probably because becoming a vegetarian is not only a diet choice but also a lifestyle choice. We do not observe the reason why vegetarians choose to work in very small organisations but it may be that they do not want to work for large multi-national corporations, government offices or state funded agencies. This result may also be driven by the fact that non-Chinese Asians are over represented in workplaces containing one or two employees. These may be small, family run businesses such as food stores, but we cannot explore this possibility further using the available data.

The region in which a person lives is also an important variable in our model. Living in London significantly increases the odds that a person is a vegetarian compared to the reference group, the South East, while the same is the case for residents of the East Midlands. The population of London is more culturally diverse, better educated and younger on average than the UK in general, so, this result is not surprising. However, descriptive statistics on the East Midlands show that its
population achieves lower levels of education and the average age of respondents is older than that of the UK in general. Descriptive statistics also show there are fewer Asians living in the East Midlands (as a percentage of all of those living in the East Midlands) than there are in other parts of the UK. Thus, there must be some unobservable characteristic associated with the East Midlands that explains the higher percentage of vegetarians there. Living in Yorkshire and Humber, however, has the opposite effect. Residents of this region are significantly less likely to be vegetarians than those in the reference group. In the South East of England, the reference category in this group, the weighted percentage of vegetarian adults is 3.4% whereas for the UK in general it is 4%. In the East Midlands, 4.6% of adults are vegetarians while in London the figure is much higher at 9.7%. In Yorkshire and Humber it is lower at 2.5%.

As expected, adults who have completed higher education are significantly more likely to be vegetarians than those in the reference category (no educational qualifications). Having a third-level degree (or higher) increases the odds of being a vegetarian by 95%. The probability of being a vegetarian is 46% higher for those with higher education below degree level. It is likely that the well educated are better informed about the health, ethical and environmental benefits associated with vegetarianism. They may also find it easier to source high quality alternatives to meat compared to those with no educational qualifications.

Divorced respondents are 1.4 times more likely to be vegetarians than their married counterparts. Unfortunately, we cannot tell how long people have been following vegetarian diets, however, it may be that divorce triggers lifestyle changes such as the adoption of a meat free diet – but we cannot exclude the possibility that vegetarianism somehow increases the probability of divorce. Being part of a cohabiting couple increases the odds of being a vegetarian by about 1.5 compared to that of being married. The preference for cohabitation over marriage represents a lifestyle choice that may be correlated with vegetarianism.

Finally, as the number of people living in a household increases; the probability of being a vegetarian is reduced. This result is expected as almost 60% of all vegetarian adults live in one or two person households.
### 3.2. Meat consumption

Table 4 shows the results of an ordered logit model with which we investigate the factors associated with varying levels of meat consumption among children. The dependent variable represents the level of meat consumption in an average week and varies between 0 and 12. As stated previously, we do not observe every stage between 0 and 12. For this reason, we use an ordered logit as opposed to a count model. We employ the same explanatory variables as was the case in the vegetarian analysis. Again, we test for joint significance of the insignificant variables and the results of the parsimonious model are presented.

[Table 4 about here]

Asian children are seen to consume meat significantly fewer times per week than children of English origin whereas Black children and children of Chinese origin, especially, consume meat significantly more often. As expected, the odds ratio on female is significant and indicates that girls consume meat fewer times per week than boys. The odds ratio on age shows that for children, meat consumption, increases with age, which is to be expected. This is likely to be the case for any food group.

Children who get the required amount of physical activity per week eat meat more often than children who do not exercise enough. It may be that active children have a bigger appetite for meat products or, by exercising often, they can afford to incorporate a greater amount of relatively high fat foods into their diet (for a given weight), or that meat consumption provides the drive to exercise. Since we do not know the causal relationship between these two variables, we can only say for definite that there is a positive relationship between the two. Results also show that there is a negative correlation between weekly meat consumption and daily fruit and vegetable consumption.

Children living in London eat less meat than those in the reference category. These children are probably influenced, if not dictated, by their relatively well educated parents who realise the health concerns that are associated with eating large quantities of meat. Income also plays a role in the frequency of meat consumption. Children living in relatively high income households, earning between £70,001 and £80,000 a year, tend to eat significantly less meat than the children who live in households that earn £10,400 - £20,400 annually. As stated earlier, at extremely high income levels
excessive meat consumption can be a health concern. This finding is reinforced in this model by the odds ratio for the highest income earners. Children living in households that earn over £150,000 a year eat almost 60% more meat (if we are to believe that portions sizes are roughly the same in each sitting) than their counterparts in the reference category. A graph showing the relationship between household income and meat consumption among children can be seen in Figure A4 of the Appendix. From this graph it appears that the frequency of meat consumption is fairly stable across income levels.

Children living in households in which the reference person is a skilled manual worker eat meat more often than do the children of managerial/technical workers. It is possible that the social class variables are picking up some income effect here or it may be to do with tastes and preferences of these workers who, in turn, influence the eating habits of their children.

Finally, as household size increases so too does the frequency with which children consume meat. This may be due to the economies of scale associated with buying meat for big households. While the use-by date might be an issue for small households, this is less likely to be the case in bigger households and, thus, they may be inclined to buy meat more often. Also, it may be a characteristic of larger households that they are more prepared to take the time and effort to prepare a meal including meat when there are a larger number of people to share it with. Alternatively, family size may reflect aspects of social class not captured by other explanatory variables.

Table 5 shows the results of the model which investigates the factors associated with varying levels of meat consumption for adults.

[Table 5 about here]

Both the number of days per week an adult consumes alcohol as well as the number of units consumed on the adults heaviest drinking day in the last 7 days are positively associated with meat consumption. This may be partly due to the fact that those who eat large quantities of meat are less health conscious and enjoy consuming more alcohol than those who are concerned about their health. Again, the direction of causation is not known. This problem arises again with the bmi variable. The higher a respondent’s bmi, the more meat that respondent is likely to consume and vice versa, as was the case in the vegetarian analysis.
As expected, ethnicity is strongly correlated with levels of meat consumption. Asians consume over 60% less meat than Whites while Blacks and respondents of mixed ethnic backgrounds consume significantly more. The odds ratio on female is consistent with that of the previous model while respondents who live in the South West of England consume meat on fewer occasions than those living in the South East. Since we control for income, education, social class and employment status, this result must be explained by some factor that we do not observe.

As was the case in the model looking at meat consumption among children, a high level of income proves statistically significant. This time we see that adults who live in households earning between £100,001 and £150,000 a year eat meat more often than those in the reference category. Not only can these people afford to buy meat for home consumption more often, it may also be the case that residents of these high income households eat in restaurants offering a large number of meat dishes more often than their poorer counterparts. This may also partly explain the positive association with alcohol consumption. Figure A5 in the Appendix shows the relationship between household income and meat consumption frequency among adults. Again, it is stable across income levels.

The education variables show that adults with any level of education above O level eat meat significantly more often than those with no educational qualifications. Marital status also plays a role in explaining varying levels of meat consumption. Single people eat less meat than married people, probably because they cannot avail of economies of scale in food expenditure and they may be less inclined to buy a lot of meat in case it reaches its use-by date before being consumed. Being divorced is also associated with a lower level of meat consumption. As stated previously, reducing or eliminating meat from the diet may be one of a number of lifestyle changes associated with divorce. Cohabiting couples also consume meat on fewer occasions than married people. Again, this could be explained by different lifestyle choices of those who opt to cohabit as oppose to marry. Individuals living in rented accommodation eat meat less often than mortgage holders. While this result may be explained simply by preferences, it is likely that adults who rent are likely to be younger and have a lower level of disposable income than those who opt to buy their own home. Finally, the odds ratio for household size is consistent with that of the previous model except the effect is even stronger for adults than it is for children.
Discussion and Conclusion

In this paper, we investigate the factors associated with vegetarianism at the individual level. We find that gender, ethnic origin, the region in which a person lives, their level of education and other lifestyle choices are all significantly associated with vegetarianism. Consistent across both the adult and child analyses are the findings that vegetarians are more likely to be female as opposed to male and Asian as opposed to White. The identification of causal relationships between some of the variables in our models and vegetarianism is constrained by the data. We are unable to correct for problems of simultaneity due to the lack of suitable instrumental variables and because the data are cross sectional. Also, due to data limitations, we cannot test the hypotheses that people become vegetarians for health, environmental or animal welfare reasons.

We also investigate the factors driving the frequency of meat consumption. Only a few variables are found to be significant in the meat consumption analysis for both children and adults; being female and being Asian both negatively affect the level of meat consumed while Blacks are found to consume meat significantly more often than Whites. The household size variable is important for the level of meat consumed by both adults and children. The larger the household, the more often meat is consumed. It thus appears that there are economies of scale in food consumption and small households may be deterred from consuming meat as often because of the associated cost, limited life span of meat, or the effort required in preparation.

The U-shaped relationship between income and vegetarianism at the aggregate level does not exist at the micro level. It is neither the richest nor the poorest of households that have the highest levels of vegetarianism. Nevertheless, most adult vegetarians belong to households earning between £80,001 and £90,000 a year while most children live in households earning between £90,001 and £100,000, both well above the national average. We see that there is much more variation in the level of vegetarianism across income levels than there is in meat consumption frequency.

As expected, vegetarianism increases with education (37% of vegetarians are educated to degree level or higher) while for those that do eat meat, respondents who discontinued education after A levels are the most frequent consumers. This is probably because the well educated are aware of the health and environmental benefits that are associated with a low meat, if not a meat free, diet.
Acknowledgements

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References


Table 1. Descriptive Statistics

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<td>1</td>
<td>12</td>
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<tr>
<td>otherveg</td>
<td>The number of other vegetarians living in the household</td>
<td>17,684</td>
<td>0.02</td>
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<td>Age of respondent</td>
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<td>33.21</td>
<td>24.80</td>
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<td>Body mass index (kg/m^2) of respondent</td>
<td>15,667</td>
<td>23.89</td>
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<td>fruitveg</td>
<td>The number of portions of fruit and vegetables consumed per day</td>
<td>16,189</td>
<td>4.12</td>
<td>2.21</td>
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<td>daysdrink</td>
<td>The number of days a week respondent consumes alcohol</td>
<td>10,578</td>
<td>2.14</td>
<td>2.33</td>
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<td>unitsday</td>
<td>The number of units of alcohol consumed on the heaviest drinking day in previous week</td>
<td>6,896</td>
<td>6.31</td>
<td>6.11</td>
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<td>73.50</td>
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<td>1 if respondent smokes cigarettes or a pipe daily, 0 if not</td>
<td>10,605</td>
<td>0.27</td>
<td>0.44</td>
<td>0</td>
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<td>adequateactivity</td>
<td>1 if respondent gets adequate exercise, 0 if not</td>
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<td>0.32</td>
<td>0.47</td>
<td>0</td>
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<td>ondiet</td>
<td>1 if child is trying to lose weight, 0 if not</td>
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<td>1 if respondent suffers from at least one long term illness, 0 if not</td>
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<td>0.36</td>
<td>0.48</td>
<td>0</td>
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<tr>
<td>female</td>
<td>1 if female, 0 if male</td>
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<td>0.53</td>
<td>0.50</td>
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<th>%</th>
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<td>Number of employees in workplace</td>
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<td>Ethnicity</td>
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*White British, Irish or other*
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<tr>
<td>Asian</td>
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<td>Chinese</td>
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<td>Mixed ethnic backgrounds</td>
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<tr>
<td>Other</td>
<td>Any other ethnic origin</td>
<td>98</td>
<td>0.56</td>
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</table>

**Household income**

| hhinc_1      | < £10,400                      | 2,135| 14.72|
| hhinc_2      | £10,400 - £20,400              | 3,401| 23.45|
| hhinc_3      | £20,401 - £31,200              | 2,538| 17.50|
| hhinc_4      | £31,201 - £41,600              | 1,897| 13.08|
| hhinc_5      | £41,601 - £52,000              | 1,611| 11.11|
| hhinc_6      | £52,001 - £60,000              | 764  | 5.27 |
| hhinc_7      | £60,001 - £70,000              | 566  | 3.90 |
| hhinc_8      | £70,001 - £80,000              | 487  | 3.36 |
| hhinc_9      | £80,001 - £90,000              | 200  | 1.38 |
| hhinc_10     | £90,001 - £100,000             | 231  | 1.59 |
| hhinc_11     | £100,001 - £150,000            | 463  | 3.19 |
| hhinc_12     | > £150,000                     | 210  | 1.45 |
Table 2: Determinants of vegetarianism among children

|                | Odds Ratio | Std. Err. | z     | P>|z|  |
|----------------|------------|-----------|-------|-------|
| fruitveg       | 1.17       | 0.06      | 3.11  | 0.002*** |
| ondiet         | 1.53       | 0.36      | 1.83  | 0.067*  |
| female         | 3.02       | 0.77      | 4.33  | 0***   |
| asian          | 3.02       | 0.93      | 3.59  | 0***   |
| socialHRP_5    | 1.64       | 0.47      | 1.74  | 0.082*  |
| hhinc_5        | 1.83       | 0.56      | 1.96  | 0.05**  |
| region_4       | 2.15       | 0.67      | 2.44  | 0.015**  |

Number of obs  3394
LR chi2(7)      58.76
Prob > chi2     0
Pseudo R2       0.072
Pearson chi2(254) 231.37
Prob > chi2     0.8427
|                  | Odds Ratio | Std. Err. | z    | P>|z| |
|------------------|------------|-----------|------|-----|
| fruitveg        | 1.18       | 0.03      | 6.38 | 0***|
| adequateactivity| 1.23       | 0.15      | 1.7  | 0.089*|
| bmi              | 0.95       | 0.01      | -3.85| 0***|
| smoker           | 1.39       | 0.19      | 2.37 | 0.018**|
| age              | 0.98       | 0         | -3.72| 0***|
| female           | 2.12       | 0.28      | 5.8  | 0***|
| asian            | 4.24       | 0.81      | 7.55 | 0***|
| workplace_2      | 1.66       | 0.37      | 2.25 | 0.024**|
| region_3         | 0.6        | 0.15      | -2.01| 0.044**|
| region_4         | 1.63       | 0.29      | 2.76 | 0.006***|
| region_7         | 1.98       | 0.31      | 4.41 | 0***|
| educlevel_1      | 1.95       | 0.26      | 5.04 | 0***|
| educlevel_2      | 1.46       | 0.27      | 2.01 | 0.044**|
| maritalstat_5    | 1.42       | 0.3       | 1.66 | 0.097*|
| maritalstat_7    | 1.48       | 0.25      | 2.37 | 0.018**|
| hhsize           | 0.83       | 0.04      | -3.53| 0***|

Number of obs 8163
LR chi2(16) 327.97
Prob > chi2 0
Pseudo R2 0.1192
Pearson chi2(8146) 8254.36
Prob > chi2 0.1975
Table 4. Factors influencing levels of meat consumption among children

|               | Odds Ratio | Std. Err. | z     | P>|z|  |
|---------------|------------|-----------|-------|-------|
| asian         | 0.54       | 0.07      | -5.06 | 0***  |
| black         | 1.66       | 0.27      | 3.12  | 0.002*** |
| chinese       | 3.56       | 1.73      | 2.62  | 0.009*** |
| female        | 0.82       | 0.04      | -3.68 | 0***  |
| age           | 1.02       | 0.01      | 1.78  | 0.076*  |
| adequateactivity | 1.14      | 0.07      | 2.20  | 0.028**  |
| fruitveg      | 0.98       | 0.01      | -1.58 | 0.114  |
| region_7      | 0.82       | 0.07      | -2.17 | 0.03**  |
| hhinc_8       | 0.73       | 0.1       | -2.17 | 0.03**  |
| hhinc_12      | 1.58       | 0.3       | 2.39  | 0.017**  |
| socialHRP_4   | 1.16       | 0.08      | 2.26  | 0.024**  |
| hhsize        | 1.06       | 0.03      | 2.19  | 0.029**  |
| Number of obs | 4597       |           |       |       |
| LR chi2(12)   | 95.61      |           |       |       |
| Prob > chi2   | 0          |           |       |       |
| Pseudo R2     | 0.0059     |           |       |       |
| AIC           | 16104.8    | 1         |       |       |
| BIC           | 6246.32    |           |       |       |
Table 5. Factors influencing levels of meat consumption among adults

|                | Odds Ratio | Std. Err. | z     | P>|z|   |
|----------------|------------|-----------|-------|-------|
| unitsday       | 1.02       | 0         | 4.23  | 0***  |
| daysdrink      | 1.03       | 0.01      | 2.48  | 0.013**|
| bmi            | 1.02       | 0.01      | 4.06  | 0***  |
| asian          | 0.36       | 0.09      | -4.32 | 0***  |
| black          | 1.5        | 0.35      | 1.72  | 0.086*|
| mixedrace      | 1.92       | 0.51      | 2.45  | 0.014**|
| female         | 0.87       | 0.05      | -2.7  | 0.007***|
| region_9       | 0.84       | 0.07      | -2.25 | 0.025**|
| hhinc_11       | 1.27       | 0.18      | 1.72  | 0.085*|
| educlevel_1    | 1.15       | 0.08      | 1.93  | 0.054*|
| educlevel_2    | 1.3        | 0.11      | 3.05  | 0.002***|
| educlevel_3    | 1.46       | 0.12      | 4.47  | 0***  |
| educlevel_4    | 1.28       | 0.1      | 3.32  | 0.001***|
| maritalstat_1  | 0.77       | 0.06      | -3.3  | 0.001***|
| maritalstat_5  | 0.67       | 0.07      | -3.86 | 0***  |
| maritalstat_7  | 0.87       | 0.07      | -1.82 | 0.069*|
| tenure_4       | 0.84       | 0.06      | -2.62 | 0.009***|
| hhsize         | 1.17       | 0.03      | 7.34  | 0***  |

Number of obs                           5264
LR chi2(18)                               245.01
Prob > chi2                                0
Pseudo R2                                  0.0139
AIC                                        17407.51
BIC                                        17591.43
Appendix

Figure A1. Vegetarianism over time in the UK

- All-vegetarian households
- Vegetarians
Figure A2. Vegetarianism across income levels: Children
Figure A3. Vegetarianism across income levels: Adults
Figure A4. Meat consumption frequency across income levels: Children

- **Meat consumption level** (% of households at each income level)
- **Household income level**

Legend:
- Red: Meat consumption level
- Blue: % households at that income level
Figure A5. Meat consumption frequency across income levels: Adults
<table>
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<th>Title/ Author(s)</th>
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*Tim Callan, Claire Keane, John R. Walsh and Marguerita Lane* |
|      | 358    | Towards a Better and Sustainable Health Care System - Resource Allocation and Financing Issues for Ireland  
*Frances Ruane* |
|      | 357    | An Estimate of the Value of Lost Load for Ireland  
*Eimear Leahy and Richard S.J. Tol* |
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|      | 354    | Research and Policy Making  
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|      | 352    | Designing a property tax without property values: Analysis in the case of Ireland  
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Alan Barrett and Jean Goggin

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Iulia Siedschlag, Xiaoheng Zhang, Donal Smith

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Sue Scott and Dorothy Watson

The Likely Economic Impact of Increasing Investment in Wind on the Island of Ireland
Conor Devitt, Seán Diffney, John Fitz Gerald, Seán Lyons
and Laura Malaguzzi Valeri

333 Estimating Historical Landfill Quantities to Predict Methane Emissions
Seán Lyons, Liam Murphy and Richard S.J. Tol

332 International Climate Policy and Regional Welfare Weights
Daiju Narita, Richard S. J. Tol, and David Anthoff

331 A Hedonic Analysis of the Value of Parks and Green Spaces in the Dublin Area
Karen Mayor, Seán Lyons, David Duffy and Richard S.J. Tol

330 Measuring International Technology Spillovers and Progress Towards the European Research Area
Iulia Siedschlag

329 Climate Policy and Corporate Behaviour
Nicola Commins, Seán Lyons, Marc Schiffbauer, and Richard S.J. Tol

328 The Association Between Income Inequality and Mental Health: Social Cohesion or Social Infrastructure
Richard Layte and Bertrand Maître

327 A Computational Theory of Exchange: Willingness to pay, willingness to accept and the endowment effect
Pete Lunn and Mary Lunn

326 Fiscal Policy for Recovery
John Fitz Gerald

325 The EU 20/20/2020 Targets: An Overview of the EMF22 Assessment
Christoph Böhringer, Thomas F. Rutherford, and Richard S.J. Tol

324 Counting Only the Hits? The Risk of Underestimating the Costs of Stringent Climate Policy
Massimo Tavoni, Richard S.J. Tol

323 International Cooperation on Climate Change Adaptation from an Economic Perspective
Kelly C. de Bruin, Rob B. Dellink and Richard S.J. Tol

322 What Role for Property Taxes in Ireland?
T. Callan, C. Keane and J.R. Walsh

320 Beneath?
_Elish Kelly, Seamus McGuinness, Philip O’Connell_

A Code of Practice for Grocery Goods Undertakings and An Ombudsman: How to Do a Lot of Harm by Trying to Do a Little Good
_Paul K Gorecki_

319 Negative Equity in the Irish Housing Market
_David Duffy_

318 Estimating the Impact of Immigration on Wages in Ireland
_Alan Barrett, Adele Bergin and Elish Kelly_

_Seamus McGuinness, Elish Kelly, Philip O’Connell, Tim Callan_

316 Mismatch in the Graduate Labour Market Among Immigrants and Second-Generation Ethnic Minority Groups
_Delma Byrne and Seamus McGuinness_

315 Managing Housing Bubbles in Regional Economies under EMU: Ireland and Spain
_Thomas Conefrey and John Fitz Gerald_

314 Job Mismatches and Labour Market Outcomes
_Kostas Mavromaras, Seamus McGuinness, Nigel O’Leary, Peter Sloane and Yin King Fok_

313 Immigrants and Employer-provided Training
_Alan Barrett, Séamus McGuinness, Martin O’Brien and Philip O’Connell_

312 Did the Celtic Tiger Decrease Socio-Economic Differentials in Perinatal Mortality in Ireland?
_Richard Layte and Barbara Clyne_

311 Exploring International Differences in Rates of Return to Education: Evidence from EU SILC
_Maria A. Davia, Seamus McGuinness and Philip, J. O’Connell_

310 Car Ownership and Mode of Transport to Work in Ireland
_Nicola Commins and Anne Nolan_

309 Recent Trends in the Caesarean Section Rate in Ireland 1999-2006
Aoife Brick and Richard Layte

308 Price Inflation and Income Distribution
Anne Jennings, Seán Lyons and Richard S.J. Tol

307 Overskilling Dynamics and Education Pathways
Kostas Mavromaras, Seamus McGuinness, Yin King Fok

306 What Determines the Attractiveness of the European Union to the Location of R&D Multinational Firms?
Iulia Siedschlag, Donal Smith, Camelia Turcu, Xiaoheng Zhang

305 Do Foreign Mergers and Acquisitions Boost Firm Productivity?
Marc Schiffbauer, Iulia Siedschlag, Frances Ruane

304 Inclusion or Diversion in Higher Education in the Republic of Ireland?
Delma Byrne

303 Welfare Regime and Social Class Variation in Poverty and Economic Vulnerability in Europe: An Analysis of EU-SILC
Christopher T. Whelan and Bertrand Maître

302 Understanding the Socio-Economic Distribution and Consequences of Patterns of Multiple Deprivation: An Application of Self-Organising Maps
Christopher T. Whelan, Mario Lucchini, Maurizio Pisati and Bertrand Maître

301 Estimating the Impact of Metro North
Edgar Morgenroth

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Richard Layte, Sinead O’Hara and Kathleen Bennett

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Paul K Gorecki, Seán Lyons and Richard S.J. Tol

298 Irish Public Capital Spending in a Recession
Edgar Morgenroth

297 Exporting and Ownership Contributions to Irish Manufacturing Productivity Growth
Anne Marie Gleeson, Frances Ruane

296 Eligibility for Free Primary Care and Avoidable Hospitalisations in Ireland
Anne Nolan
Managing Household Waste in Ireland: Behavioural Parameters and Policy Options
*John Curtis, Seán Lyons and Abigail O’Callaghan-Platt*

Labour Market Mismatch Among UK Graduates; An Analysis Using REFLEX Data
*Seamus McGuinness and Peter J. Sloane*

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*Richard S.J. Tol, Nicola Commins, Niamh Crilly, Sean Lyons and Edgar Morgenroth*

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*David Duffy*

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*Maurizio Pisati, Christopher T. Whelan, Mario Lucchini and Bertrand Maître*

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*Richard S.J. Tol*

Policy Options to Reduce Ireland’s GHG Emissions: Instrument choice: the pros and cons of alternative policy instruments
*Thomas Legge and Sue Scott*
283 Accounting for Taste: An Examination of Socioeconomic Gradients in Attendance at Arts Events
*Pete Lunn and Elish Kelly*

282 The Economic Impact of Ocean Acidification on Coral Reefs

281 Assessing the impact of biodiversity on tourism flows: A model for tourist behaviour and its policy implications
Giulia Macagno, Maria Loureiro, Paulo A.L.D. Nunes and *Richard S.J. Tol*

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*Seán Diffney, Seán Lyons* and *Laura Malaguzzi Valeri*

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*Jean Goggin* and *Iulia Siedschlag*

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*David Anthoff*

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*Eimear Leahy* and *Seán Lyons*

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*David Anthoff, Richard S.J. Tol* and Gary W. Yohe

275 Projecting the Future Numbers of Migrant Workers in the Health and Social Care Sectors in Ireland
*Alan Barrett* and Anna Rust

274 Economic Costs of Extratropical Storms under Climate Change: An application of FUND
*Daiju Narita, Richard S.J. Tol, David Anthoff*

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*Thomas Conefrey* and *John D. Fitz Gerald*

272 The Games We Used to Play
An Application of Survival Analysis to the Sporting Life-course
*Pete Lunn*

2008

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*Edgar Morgenroth*
BENCHMARKING, SOCIAL PARTNERSHIP AND HIGHER REMUNERATION: WAGE SETTLING INSTITUTIONS AND THE PUBLIC-PRIVATE SECTOR WAGE GAP IN IRELAND

Elish Kelly, Seamus McGuinness, Philip O’Connell

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Anne Nolan

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Nicola Commins and Anne Nolan

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Frances Ruane

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Daiju Narita, Richard S. J. Tol and David Anthoff

ARE OVER-EDUCATED PEOPLE INSIDERS OR OUTSIDERS?
A Case of Job Search Methods and Over-education in UK
Aleksander Kucel, Delma Byrne

257 Metrics for Aggregating the Climate Effect of Different Emissions: A Unifying Framework
Richard S.J. Tol, Terje K. Berntsen, Brian C. O’Neill, Jan S. Fuglestvedt, Keith P. Shine, Yves Balkanski and Laszlo Makra

256 Intra-Union Flexibility of Non-ETS Emission Reduction Obligations in the European Union
Richard S.J. Tol

255 The Economic Impact of Climate Change
Richard S.J. Tol

254 Measuring International Inequity Aversion
Richard S.J. Tol

253 Using a Census to Assess the Reliability of a National Household Survey for Migration Research: The Case of Ireland
Alan Barrett and Elish Kelly

David Anthoff, Richard S.J. Tol and Gary W. Yohe

251 The Impact of a Carbon Tax on Economic Growth and Carbon Dioxide Emissions in Ireland
Thomas Conefrey, John D. Fitz Gerald, Laura Malaguzzi Valeri and Richard S.J. Tol

250 The Distributional Implications of a Carbon Tax in Ireland
Tim Callan, Sean Lyons, Susan Scott, Richard S.J. Tol and Stefano Verde

249 Measuring Material Deprivation in the Enlarged EU
Christopher T. Whelan, Brian Nolan and Bertrand Maître

248 Marginal Abatement Costs on Carbon-Dioxide Emissions: A Meta-Analysis

247 Incorporating GHG Emission Costs in the Economic Appraisal of Projects Supported by State Development Agencies
Richard S.J. Tol and Seán Lyons

246 A Carton Tax for Ireland
Richard S.J. Tol, Tim Callan, Thomas Conefrey, John D.
Fitz Gerald, Seán Lyons, Laura Malaguzzi Valeri and Susan Scott

Non-cash Benefits and the Distribution of Economic Welfare
Tim Callan and Claire Keane

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Jacqueline O’Reilly and Miriam M. Wiley

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J. Fitz Gerald, M. Keeney and S. Scott

Climate Policy Versus Development Aid
Richard S.J. Tol
220 Exports and Productivity – Comparable Evidence for 14 Countries
The International Study Group on Exports and Productivity

219 Energy-Using Appliances and Energy-Saving Features: Determinants of Ownership in Ireland
Joe O’Doherty, Seán Lyons and Richard S.J. Tol

218 The Public/Private Mix in Irish Acute Public Hospitals: Trends and Implications
Jacqueline O’Reilly and Miriam M. Wiley

217 Regret About the Timing of First Sexual Intercourse: The Role of Age and Context
Richard Layte, Hannah McGee

216 Determinants of Water Connection Type and Ownership of Water-Using Appliances in Ireland
Joe O’Doherty, Seán Lyons and Richard S.J. Tol

215 Unemployment – Stage or Stigma?
Being Unemployed During an Economic Boom
Emer Smyth

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Richard S.J. Tol

213 Adolescents’ Educational Attainment and School Experiences in Contemporary Ireland
Merike Darmody, Selina McCoy, Emer Smyth

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Frances P. Ruane, Xiaoheng Zhang

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42