Econometric Analysis of the Public Opinion Survey

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A Report Submitted to CARE and the Independent Panel Tasked with Reviewing the Socio-Economic and Environmental Implications of Hydraulic Fracturing in Western NL

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1 INTRODUCTION

Geologists have known for a long time now about the existence of organic-rich shale found deep below the earth's surface in various regions of the world. However, its exploitation for the development of energy sources has been relatively limited until recently. Due to its extreme impermeability extracting this resource with conventional drilling techniques was not economically practical. However, recent technological breakthroughs in multi-stage hydraulic fracturing and horizontal drilling have made extracting these so-called "unconventional" sources of oil and natural gas feasible.

The techniques required involve what is commonly referred to as *fracking* (hydraulic fracturing). This process consists of injecting large quantities of water, sand, and chemicals deep below the earth's surface at a very high pressure, so that the sedimentary rock can be broken and the oil and natural gas can be released. When combined with horizontal drilling techniques, fracking creates new channels from which unconventional fossil fuels can be extracted, making it economically feasible to extract oil and gas from shale. These advances are expected to result in a revolutionary shift in patterns of worldwide energy production (IEA 2012).

The optimism associated with the positive outcomes of further exploration and extraction of oil and natural gas has been at least partially offset by widespread concerns about potential social, economic, and environmental impacts associated with this type of energy development (Brasier et al. 2011; Willits et al. 2013; Wolske et al. 2013).

Indeed, as with other energy developments, the prospect of fracking in a given community is usually met with mixed reactions. Glowing descriptions of improved economic conditions, labour outcomes and job availability and general prosperity compete with frightening reports mentioning environmental degradation, health risks, and seismic impacts (Willits et al. 2013).

Fracking has been linked to issues including pollution and depletion of ground and drinking water (Abdalla & Drohan 2010), usually mentioned as the top concern by the public (Wolske et al. 2013); emissions of greenhouse gases (Howarth et al. 2011), leakage of methane into tap water, which could make it flammable and explosive (Osborn et al. 2011; Ehrenberg 2012), and seismic activity[1] (NAS 2012). In some jurisdictions, concerns have also been raised in relation with lack of regulations about and enforcement of rules governing the disclosure of the mix of chemicals used by extracting companies (Kirker & Burger 2011),[2] as well as the handling of potentially toxic wastewater flowback (Colborn 2011; Bamberger & Oswald 2012). Furthermore, when it comes to considering the ills of fracking, public opinion polls have revealed wider concerns, such as those related to undesirable social effects of the expansion of extractive operations, even if not directly related to the use of fracking as such (Brasier et al. 2011; Adgate et al. 2014; Jacquet 2014; Israel et al. 2015).

All of these concerns have been amplifi at least within some opinion circles, by alarming reports fuelled by an increasing amount of media attention (Davis & Fisk 2014), which contrasts with the relative paucity of the supply of scientifi contributions on the topic (Ehrenberg 2012). Indeed fracking is such a hot "topic of conversation" in mass media and social media that it is surprising how little the average citizen knows about it, with some studies suggesting that there is considerable confusion about what fracking means and what it entails. For example, most laypeople conceive of hydraulic fracturing as a more comprehensive set of procedures than what industry experts (and regulators) would (Wolske et al. 2103). Many laypeople also attribute only to fracking risks that are also common to other oil and gas extractive techniques with which they have no issue (Ehrenberg 2012) or assume that

[1] Although this problem seems to be related mainly to wastewater disposal rather than the fracturing process itself (Ehrenberg 2012).

[2] In the US, extracting companies are not required to reveal the exact mix of chemicals they use for fracking, something they often feel reluctant to do, because they each have their own formulas that they have developed over years of research. This reluctance to disclose these proprietary formulas is often misconstrued as the desire to cover up the use of toxic chemicals from the unsuspecting public (Kirker & Burger 2011).

it is a never-before tried technique instead of something that, not including several newer aspects, has been used since the 1940s.[3]

It has also been shown that mentioning the specifi term "fracking" conjures up a myriad of negative connotations that synonyms, such as shale-gas development, would not have, granting them a much more positive reaction from the public. Some studies go as far as to say that the harshness of the word fracking and its closeness to the common swearword in the English language is partly to blame for the bad press affl this extraction technique (Climek et al. 2013).

Further fuelling the scope for confusion, scientific evidence is not only relatively scarce, it is also relatively inconclusive about some aspects (Ehrenberg 2012). Indeed, there is still a high level of scientific uncertainty surrounding the potential environmental impacts of shale gas. On top of that, the current economic climate, characterized by low oil prices makes it less clear that the benefits associated with fracking are worth the potential risks.

All of this factors contribute to a climate of confusion and controversy that makes it difficult for regulators to agree on what is the best path to follow when it comes to fracking, since they cannot be sure at this stage whether banning, authorising, or even promoting will yield the most net benefits, both economically and politically.

Canada is one of the countries whose economy stands to benefit from this new source of energy. However, Canadian production from shale is still in the early stages relative to, for example, the US[4] and several provinces are hesitating before allowing further developments. In fact, several moratoria have been implemented or at least considered.

The province of Newfoundland & Labrador is also one of the regions of the country in which fracking could be performed and whose economy could substantially benefit from the availability of this new source of energy resources. However, there remain serious obstacles to the social acceptability of fracking among the people of NL (Newfoundland & Labrador) and, in particular the prospect of fracking in Western NL (Western Newfoundland) is a highly controversial issue.

In October 2014 an independent panel was appointed by Newfoundland and Labrador's Minister of Natural Resources, tasked with conducting a public review of the socio-economic and environmental implications of hydraulic fracturing in Western NL and making recommendations on whether hydraulic fracturing should be undertaken in Western NL. As part of the process of information gathering associated with the work of this Panel, a survey (titled *Hydraulic Fracturing in Western Newfoundland*) was commissioned to *MQO Research*. This survey was administered through the phone to residents of the province of NL (Newfoundland & Labrador) and aimed at studying their knowledge of and attitudes towards the energy industry in Western NL and the issue of fracking in particular.

The *CARE (Collaborative Applied Research in Economics)* Initiative (Memorial University of Newfoundland) supported this information-gathering effort and also funded further analysis of the data obtained through the field work beyond the descriptives statistics and comments that MQO Research provided. MQO's unpublished analysis report will be referred to henceforth as "MQO's report".

The present report to CARE has as its objective to assist CARE and the Independent Panel tasked with reviewing the socio-economic and environmental implications of hydraulic fracturing in Western NL (the Panel) with the interpretation of the information obtained from the survey.

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[3] Its combined use with horizontal drilling is more recent (only being done within the last decade) and more revolutionary but fracking has indeed been used for decades now. The use of larger quantities of water is also something that differentiates modern fracking from its older versions (Wolske et al. 2013).

[4] About a fourth of the natural gas consumed in the US in 2010 was extracted through fracking, employed in about 90% of the onshore oil and gas wells in that country (Ehrenberg 2012).

The structure of this report follows quite closely the order in which the survey *Hydraulic Fracturing in Western NL* presented questions to the respondents and the way in which MQO reported the results of their analysis of the survey responses. Indeed, it is suggested that this report and MQO's report be read side by side, since in order to avoid duplication most tabulations and general descriptive analysis included in MQO's report will not be made available in the present document.

A brief description of the data used for the analysis is offered, however, in Section 2, before Section 3 provides some brief notes about the main methodological issues encountered and simple explanations about the procedures used to address them. Technical detail has been kept to a minimum throughout the report and the interested reader is referred to the works quoted to find further information on the different econometric techniques.

Section 4 presents a brief set of general *a priori* hypotheses about the relation between socio-demographic variables and the attitudes of respondents to the activities of the O&G (Oil and Gas industry) in general and fracking in particular. Without being a full literature review, this section also contains several references to previous similar studies from other jurisdictions for the interested reader.

After that, the main component of the report goes on to describe and discuss the information obtained from each of the questions included in the survey instrument. Technical results on quantitative effects are relegated to Appendix B, while Appendix A contains the verbatim text of the survey instrument. Appendix C contains a comprehensive list with brief definitions of all the variables used and quoted in the report.

2 DATA

The survey *Hydraulic Fracturing in Western Newfoundland* was conducted between June 16th and July 4th, 2015 as a random telephone survey with residents of the whole province of Newfoundland and Labrador who were over the age of 18. A total of 840 respondents completed the survey. A total of 200 surveys were completed in Western NL to allow enough sample to examine that area separately. In order to bring the results of the survey back closer to a representative sample, both summary descriptives and tabulations and econometric analyses were made using sampling weights.[5]

A verbatim copy of the text used in the questionnaire administered in this study is included in Appendix A. Further details about the data are available from MQO's Report. The demographic profile of respondents is shown in Table 1.

A more detailed description of the variables employed in this report is included in Appendix C as Table 45. Further tabulations and descriptors of the data are available in MQO's Report. Additionally, in each of the following sections, some basic tabulations will be included, mainly of the dependent variables.

[5] Except when it was feasible, such as when testing the parallel regression assumption of the ordered regression models.

Table 1. Respondent demographic descriptives (in % of valid responses).

GENDER	OTHER NL	WESTERN NL	TOTAL
Female	51.76	52.31	51.86
Male	48.24	47.69	48.14
AGE			
18-24	7.04	5.03	6.69
25-34	16.95	14.46	16.51
35-44	13.72	12.96	13.59
45-54	23.66	23.91	23.7
55-64	17.98	22.59	18.79
65 years of age or older	20.65	21.05	20.72
ANNUAL HOUSEHOLD INCOME*			
Less than $25,000	6.38	13.76	7.73
$25,000 to $49,999	20.57	20.5	20.55
$50,000 to $74,999	21.09	16.98	20.33
$75,000 to $99,999	14.65	21.75	15.95
$100,000 or more	37.32	27.01	35.43
HIGHEST LEVEL OF EDUCATION			
Less than high school	6.1	9.04	6.62
Graduated high school	14.33	15.34	14.51
Some trade/technical college	5.92	13.1	7.19
Graduated trade/technical college	29.47	26.29	28.91
Some university	11.52	8.92	11.06
Graduated university	32.66	27.31	31.71
CURRENT EMPLOYMENT STATUS**			
Employed by company/organization	52.26	43.53	50.72
Self-employed	6.09	4.27	5.77
Not employed outside the house & looking for work	4.53	8.64	5.26
Not employed outside the house & not looking for work	4.7	6.48	5.01
Retired	28.89	31.31	29.32
A student	3.53	5.78	3.93
TYPE OF EMPLOYER			
Other employer	76.25	78.4	76.63
A university or community college	2.97	1.37	2.69
A provincial government department	13.28	16.17	13.79
A federal government department	3.61	2.8	3.46
The O&G industry	3.88	1.27	3.42

* *Note that about 10% of the respondents did not provide their income bracket.*

** *Only n=639 respondents provided this information about their job status.*

3 GENERAL METHODOLOGICAL NOTES

The main feature about the data used in this report is that the dependent variables, because of the way in which the information was gathered during the interview process, are *categorical*, as opposed to *continuous*, in nature. For example, most of the questions in the survey ask the respondents to choose an option, among usually five, from a rating scale to describe their opinion about an issue in terms of levels of agreement/support. Therefore, they require the use of econometric techniques especially designed to handle them, etc.[6]

Additionally, the independent variables are all, in practice, because of their inherent nature or because of the way in which they were collected, also categorical. This means that, although they can enter as explanatory variables in any type of regression, their interpretation is meaningful only after they have been transformed into one or more binary indicators.[7] The simplest categorical variables (the dichotomous ones), such as the variable that indicates respondent gender, take two values, so they can be used to construct two indicators (male and female in this example). As is most customary, one of them is left out as the "benchmark category" and only one of them is used as an explanatory variable in the model. When the variable is polytomous (that is, when it takes more than two values, in general j values), the simplest way to perform the transformation is to generate a binary indicator (*a dummy variable*) for each of the *j* categories and drop one of them from the right-hand-side of the model. One example is the variable that contains information on the maximum level of education attainment. The usual interpretation applies: each estimated coefficient shows the relative effect of the relevant indicator relative to the benchmark category and the difference in the effect of two categories is given by the difference between their estimated coefficients. However, it is also possible to generate fewer than the whole range of *j-1* individual indicators. For example, one could just include an indicator of having completed a university degree, so the benchmark would be a composite of all the other education attainment categories ("not having a degree") or include more than one, in which case the benchmark would be a composite of the ones not included in the model. In several instances, this option will be followed, since not in all cases will there be enough variability in the data to isolate the independent effect of all the possible categories.

Similarly, the categories of the dependent variables might have been collapsed into a smaller number of categories than those originally available from the question format. For example, post-estimation analysis after a multinomial logit model might suggest that the data do not allow to distinguish a significant difference between the set of estimated coefficients explaining two categories of a nominal variable, so they will be collapsed into a single one. In the extreme, both nominal and ordinal polytomous variables can be collapsed into a binary indicator and modelled using a logit or probit model.

3.1 Treatment of Missing Values And "Don't Know"/"No Response" Options

As in the case of any other survey, there are several variables with missing values in the data set, because respondents failed to or chose not to provide a valid answer. The most common treatment of missing cases is to drop them from analysis and perform the analysis only with complete observations.[8] Another approach would be imputation of missing values but this approach is not free of shortcomings. Given the type of information that we have, the imputation method would be particularly problematic in our study. However, in our case, when it comes to missing or invalid responses in the dependent variable ("don't know"/"no response"), we will sometimes acknowledge the fact that a "don't know/no response" answer carries more information than in other types of surveys in general.

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[6] All the analysis included in this report was done using Stata 13 (Statacorp 2013). Additional commands not included within this release of Stata are properly referenced in the text and notes. In particular extensive use was made of the suite of postestimation commands SPOST13, developed by Long and Freese (2014).

[7] Note, however, that we treat independent categorical variables with more than 5 categories as if they were continuous. This is the case of variables *Q1A*, *Q1B*, and *Q1C* (defined in Table 45). See Long and Freese (2006) for a practical description of how to treat categorical dependent variables or Long (1997) for a more mathematical approach.

[8] Although there are inherent problems with this approach (Allison 2001; Liitle & Rubin 2002; Sterne et al. 2009).

In the case of some of our dependent variables, for which we find a sizable proportion of these types of responses, we will therefore model them not as missing values. Instead, we will model them as a meaningful separate category which indicates that the respondents might lack information about the issue at hand, something that is in fact part of what the survey was meant to reflect.

3.2 Avoiding Perfect Prediction

In the analysis below, we employ mostly probabilistic models that analyse the probability that a given outcome arises given a combination of characteristics of the respondent. Once the results are analysed, these models make it possible to make probabilistic statements only. However, these models, by their very nature, cannot handle situations whereby, in a dataset, a given combination of explanatory factors results in a certain outcome. That is, they cannot handle cases that *perfectly predict* an outcome.

This situation can be problematic in relatively small datasets or when there is not enough variability in the data. In several occasions below, the analysis will need to be made simpler because the data lack enough information to support a probabilistic analysis. Consequently, unless some observations are discarded, a certain combination of explanatory factors will determine a given outcome with full certainty. For example, the models below could not estimate the effect of smoking and drinking alcohol on the probability of having a job if all of those individuals in the sample who smoked and drank had (or did not have) a job.[9]

3.3 Treatment of Dependent Ordinal Variables

In order to analyze the data associated with questions based on choosing an ordinal response from a discrete number of categories, several options were considered. The first one was to assume that, in spite of the ordinal nature of the responses, the variables could be treated as approximately continuous. This would allow us to use a very simple model based on OLS (Ordinary Least Squares). This model is easy to interpret, not the least because it assumes a linear functional form in the relationship among dependent and independent variables. This means that the marginal effect of each explanatory variable is constant, that is, independent of its value (and of the value of other explanatory variables).

This analysis through OLS is problematic, though, since the assumptions underlying this basic regression technique are violated when used to model a non-interval outcome variable. Accounting, however, for the fact that the ordinal categories, say 1 to 10, have really only an ordinal meaning and not a cardinal one (that is, although a rating of 4 means more knowledge than a rating of 3, it is definitely not clear that it means exactly as the same difference as between 7 and 6 or between 10 and 9), one would opt for an ordinal regression model. An ordinal logit or an ordered probit are the most common choices. These regressions can be easily run with conventional routines in most econometric software packages. In Stata, the corresponding commands are *ologit* (ordered logit) and *oprobit* (ordered probit).

Both models, in their conventional form, rest on the assumption that, although the effect of a given explanatory variable on the probability of choosing any given one of the categories is not constant (depending instead on the values of all explanatory variables), there is an overall direction of the effect of the explanatory variables and proportionality in the odds of choosing among different categories.

This *parallel regression assumption*,[10] more specifically, implies that the relationship between each pair of outcome groups is the same. Expressed in terms of odds of choosing each of the categories, one can say that the proportional odds between two different categories are constant, thus independent of the categories considered. In other words, the ordered logistic technique assumes that the coefficients that explain the relationship between, for example, the

[9] Further details about this problem can be found in Long and Freese (2006, p. 192).
[10] See Long and Freese (2006, p. 197-200) for further details.

lowest (rating of 1) versus all higher categories of the knowledge ranking are the same as those that describe the relationship between the next lowest category (rating of 2) and all higher categories, and so on. Hence, the alternative moniker of proportional odds assumption. Because the relationship between all pairs of groups is the same, only one set of coefficients (only one model) needs to be estimated to explain all categories. Otherwise, we would need, in the case of these knowledge variables, nine different models to describe the relationship between each pair of ratings.

The assumption allows us to have an elegantly simple and parsimonious model from which a generic interpretation of coefficients is straightforward. However, the assumption is often violated in practice.[11] Therefore, one should test the proportional odds assumption and there are several statistical tests that make it possible.[12] If the assumption is violated in such a way that leads to concern and it is judged that the gains from having a most stylized model do not outweigh the issues associated with this violation, less restrictive (and less parsimonious) models must be considered. The generalized ordered models, such as the generalized ordered logit model obtained by Stata's *gologit* (Kang Fu 1997) make this possible. However, this can lead to issues of interpretation and, if one wants to preserve the notion of ordinality in the explained variable, it can also lead to issues of nonsensical negative probabilities.[13]

At the extreme, one may choose to entirely give up on the ordinal nature of the information and instead consider all categories in the dependent variable as nominal outcomes. Thus, fully relinquishing the ordinality of the data would lead to the multinomial logit, which is widely applied, although it suffers from its own shortcomings (mainly issues related to the need to meet the assumption of independence of irrelevant alternatives).

Fortunately, an intermediate approach is available whereby the effects for some of the explanatory variables are constrained to be constant across categories, while other variables are more flexibly estimated. Models obtained with Stata's *gologit2* routine,[14] with the *autofit* option, will only relax the parallel lines constraint for those variables where it is violated, leaving the other ones constrained. This type of model would then be a "partial proportional odds" model (Peterson & Harrell 1990).

The proportional odds assumption is hard to maintain when there are many categories and many predictors. It is a testable at different levels of significance, with 0.05 often used as the default, but using a lower level allows us to have more stylized models. Testing at higher levels would call for more flexible, yet more cumbersome models.

The assumption is often violated in practice (as well as often simply ignored by researchers). One key reason why this assumption might be too strong in our case is that we have neutral categories, so as long as that neutral category is just a middle step between the extreme ones (usually, strongly oppose and oppose on one side versus support and strongly support on the other), the ordinal treatment of the variable will work. But, if those who choose the neutral category are in some way systematically different from the rest of respondents (perhaps the least sure, the least informed, or the least confident), the ordinality of the variable will be compromised. For example, we find that often the effect of gender on these scale variables cannot easily be modelled assuming parallel regressions: men are often

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[11] One extreme example could be the case of income affecting self-perceived levels of happiness. It is reasonable to assume that having less income makes people feel less happy but it might well not be the case that more income makes them happier and might even make them feel more miserable in some cases. Therefore, no single unidirectional effect of income could be found… Less extreme examples would involve significant changes in the size of the effect without implying changes in the sign of the effect.

[12] There are Score, Likelihood Ratio and Wald tests, such as the one proposed by Brant (1990) available for this purpose. Stata's *omodel* command (Wolfe & Gould 1998) provides the former and Stata's *brant* command provides the latter, while *oparallel* (Buis 2013) performs a battery of different tests. All of these tests are based on comparing the ordinal regression model estimates to those from a series of independent binary regression models where the slope confidents are not constrained to be equal. See Long and Freese (2006, p. 199-200).

[13] This is because, since the regression lines are no longer forces to be parallel, as simple geometry would suggest, they must cross at some point…When that issue affects a nontrivial number of cases in within-sample values of the explanatory variables, the use of a generalized ordered model is understandably problematic (McCullagh and Nelder 1989, p. 155).

[14] This is an updated version of Stata's *gologit* (generalised ordered logit) command (Williams 2006; Pfarr et al. 2010).

very sure that they oppose or that they support an issue. Similarly, those who consider themselves to be very well informed about an issue will be least likely to choose the neutral category and often divide themselves between the "opposers" and "the supporters," leading again to a violation of the parallel regressions assumption. Fracking is quite a controversial issue, so it is not surprising that this type of situation arises.

Totally dispensing with this assumption would require us to use nominal models such as the multinomial logit, which afford the flexibility of a differently set of regressors for each category but at the cost of cumbersome complexity. In most occasions, we opt to use a generalised ordered model where only some of the variables are assumed to have a non-constant effect on the odds of falling in different response categories. We will flag the regressors that do not meet the condition (usually those indicating gender and level of knowledge about an issue but sometimes age indicators too) and proceed with the simpler, more economic and more intuitive interpretation offered by the ordinal model.

3.4 About Potentially Endogenous Variables

Part of the regression models reported below include variables, as explanatory variables, that correspond to responses given in other sections of the survey instrument. For example, we test whether knowing more about fracking affects the likelihood of supporting fracking. There are obvious issues of endogeneity in those cases.

Most often the interpretation would not add much (just like, for example, a model that predicted that rich people have money or that people with money feel rich), so we try to include in the model predictors that are relevant and that could be reasonably expected to be exogenous (say, having more information about energy issues and fracking in particular in NL) and we model the potential endogeneity when possible by jointly estimating some of the dependent variables.

However, at times we will choose to leave out of the right-hand-side of the model variables that would be significant but would distract from the interpretation of other more interesting results. These would consist mainly of the effects of predictors that are 100% exogenous and that can be easily observed and quantified (age and gender most clearly).[15]

In other occasions variables that are suspected to introduce endogeneity in the model will be left in the specification without further treatment. It is important in those cases to recall that a causal interpretation of their estimated coefficients would be suspect.

3.5 The Need for Respondent "Profiles"

One feature of the nonlinear models used in this report is that they result in estimated marginal effects of the explanatory variables that are not constant but, instead, depend on the values of all the variables in the model. For this reason, depending on where we measure the effect of a variable the effect on the probability of a given outcome of the dependent variable will be different. For example, how much a little extra income affects the probability that someone is in favour of further O&G exploration depends not only on how rich that person is but also on her age, education level, and so on.

A usual way to deal with this issue is to report marginal effects at the means, that is, for the individual with average values of all explanatory variables. This would enable one to consider the marginal effect of extra income on the probability for the "average" or "typical". But, since most of the explanatory factors in our models are themselves

[15] Endogeneity is not always easy to treat in econometrics models (mainly due to the lack of valid strong instruments, but also because of computational complexity). See Cameron and Trivedi (2005) for further details.

categorical variables, this means that our hypothetical "typical" individuals can in fact be anything but. For example a given real individual would fall in a given income category, rather than having an average probability of falling in each of the different income categories.[16]

For this reason, in most cases, even if sometimes a table with marginal effects (and see next section about the issues related to this terminology in our case), we will report predicted probabilities for different respondent "profiles". This will be archetypes of respondent with plausible characteristics. For each of the St. John's CMA (Census Metropolitan Area) and the Western NL region, we look at four male and four female respondents with different combinations of education, age, and income. For each of them, we will calculate the predicted probabilities that they choose each outcome in the dependent analysed and, in order to minimize clutter within the main report, we will report this wealth of results within Appendix B. Without looking at tables or marginal effects or these sets of predicted probabilities, and contrary to the case of the simpler OLS models, the estimated coefficients of nonlinear models provide only qualitative information about the effects of explanatory factors but not quantitative information.

3.6 A Note on Marginal versus Discrete Changes

In our case, almost all variables[17] are binary indicators so when we report "marginal effects" we are actually reporting for most of them the effects of changing the value of the indicator from 0 to 1 in a discrete fashion (say from being female to being male). We will use the two terminologies interchangeably with frequent reminders that the marginal effects are actually discrete in the case of almost all our variables.[18]

4 HYPOTHESES

The main hypotheses we could work with before analysing the data had to do with results obtained by the few previous studies on attitudes towards and opinions about hydraulic fracturing and, in general, about attitudes towards energy issues and environmental risks.

Relative to the magnitude of the controversy and the amount of attention the press pays to the issue, there is relatively little scientific work done on opinions and attitudes towards fracking. However, several polls have been conducted in North America that provide a basis on which to build our working hypotheses.

When it comes to the degree of awareness about the issue, we expected the level of familiarity with fracking to be relatively limited,[19] with male, older, more educated, and richer respondents being more aware of the existence of fracking and more likely to state higher levels of knowledge about it.[20] By extension, we also expected the same type of demographic effects on general knowledge about the O&G in NL.

Going beyond knowledge itself, we had some expectations about the degree of support for fracking. For example, in general, one would expect women to be more frequently against fracking, not only because women tend to be more wary of risks in general and environmental risks in particular (Xiao & Dunlap 2007), but because this is a type of effect that has been found consistently by previous studies on attitudes towards fracking in particular (Theodori, 2009;

[16] An alternative would be to *set all* the non-relevant variables to their most frequent value instead. There should be no meaningful qualitative differences in the results regardless of the approach taken.

[17] The exception would be variables *Q1A*, *Q1B*, and *Q1C*.

[18] See Gould (2000) for a succinct but thorough review of how to interpret the results of logistic regressions, including binay, ordered, and multinomial used in this report.

[19] Although Wolske et al. (2013) state that about 50-60% of poll respondents in the US are at least "somewhat aware" of fracking, and that this awareness appears to be increasing.

[20] See Wolske et al. (2013) for a list of surveys that found evidence of these effects in the case of the US.

Brasier et al. 2011; Wolske et al. 2013; Boudet et al. 2014; Davis & Fisk 2014). We also expected males to be less likely to feel neutral about fracking (Climek et al. 2013).

We expected those respondents with more information about fracking to be less supportive of the practice, following previous results from the US (e. g. Boudet et al. 2014) and definitely to be less likely to state their neutrality about the issue.

We expected those older respondents to be more in favour of fracking, since they are usually found less concerned about environmental issues (Boudet et al. 2013; Davis & Fisk 2014).

Similarly, we expected income to be a key explanatory variable, with richer individuals being more likely to position themselves against fracking (Jacquet 2012; Boudet et al. 2013), since environmental quality is a normal good[21] and rich respondents might, in principle, be expected to need the economic benefits of fracking less than their less well-off counterparts. Similar effects had been documented in at least one Canada-wide survey.[22] We suspected, though, that in the case of NL, there might be a more positive view of the industry among those who enjoy higher incomes, since many of the people in the higher income brackets would have in recent years benefitted directly or indirectly from the operations of the O&G industry. In any event, we hypothesized that richer individuals would be more likely to have reached a conclusion about their views on fracking and less likely, thus, to remain neutral or uncertain when asked about their position about it.

We expected more educated respondents to be less supportive of fracking and definitely less likely to remain neutral about the issue (Jacquet 2012; Wolske et al. 2013). This effect should be particularly significant in the case of university-level education.

Following, for instance, Davis and Fisk (2014), we expected those living in the urban areas of the province (mainly the St. John's CMA) to be less supportive of fracking.

In terms of the reasons for opposing/supporting fracking, we expected opposers to base their choice on environmental concerns and supporters to focus on economic benefits. It is usually found that those who expect fracking to deliver economic benefits to their region are more supportive of the practice, while those who fear environmental or health issues are much less supportive of drilling (Theodori, 2009; Jacquet, 2014).

Although we have cited a few previous works for the interested reader, this section was not meant in any way to constitute a literature review. For a more comprehensive survey of previous studies of the attitudes towards and opinions about fracking, the reader is referred, instead, to, for instance, Wolske et al. (2013).

We note that, on occasion, when the *a priori* expected sign of a coefficient turns out to be the estimated one, we will use a one-sided (*one-tailed*) tests to report levels of significance in the tables of results. Otherwise, we report the results of two-sided tests, not presuming what the sign of the effect will be.

[21] Economists define as *normal* (as opposed to *inferior*) a good or service whose demand increases with income.

[22] An EKOS research poll in October 2014 (canadians.org/media/results-ekos-research-poll-october-2014), which focused on gathering opinions about a fracking moratorium.

5 KNOWLEDGE OF OIL AND NATURAL GAS EXPLORATION

After a few introductory warm-up questions, through three separate consecutive questions (*Q1A*, *Q1B*, and *Q1C*), respondents were asked to assess their own level of knowledge of:

- *Oil and natural gas exploration in the whole of Newfoundland and Labrador*
- *Oil and natural gas exploration in Western NL*
- *Hydraulic fracturing, commonly referred to as fracking*

When it comes to the exact format of the question, respondents were asked to state their knowledge of each issue using a 10-point scale where 10 meant "very knowledgeable" and 1 meant "not knowledgeable at all". Most respondents stated to have a relatively poor knowledge of oil and natural gas exploration and fracking, with the majority of respondents stating a rating of 5 or less and very few indicating a high level of knowledge of oil and natural gas exploration (a rating of 8 or higher on the 10-point scale). In fact, in all three cases, only about one in ten respondents indicated having a high level of knowledge. Probably as expected, the issue about which a highest proportion of high level of knowledge was revealed was the first one, about oil and natural gas exploration in the whole of NL.[23]

Figure 1 shows histograms with the weighted frequency distributions of the three variables smoothed into a Kernel density estimate in order for the reader to visualize the distribution of responses to the three questions. In all cases we see the effect of respondents having used rating "5" as a focal point but also quite clearly that there is a large proportion of the sample showing low levels of knowledge particularly in the case of oil and gas exploration in Western NL and in the case of fracking.

The assumption that these variables are normally distributed was rejected in all three cases at the usual levels of significance.

[23] Although the measures are not directly comparable, it is likely that the level of awareness about fracking in NL is somewhat lower than in Atlantic Canada as a whole. 85% of respondents in the Atlantic Provinces were "very or somewhat aware of fracking," according to an EKOS research poll conducted in October 2014 (canadians.org/media/results-ekos-research-poll-october-2014).

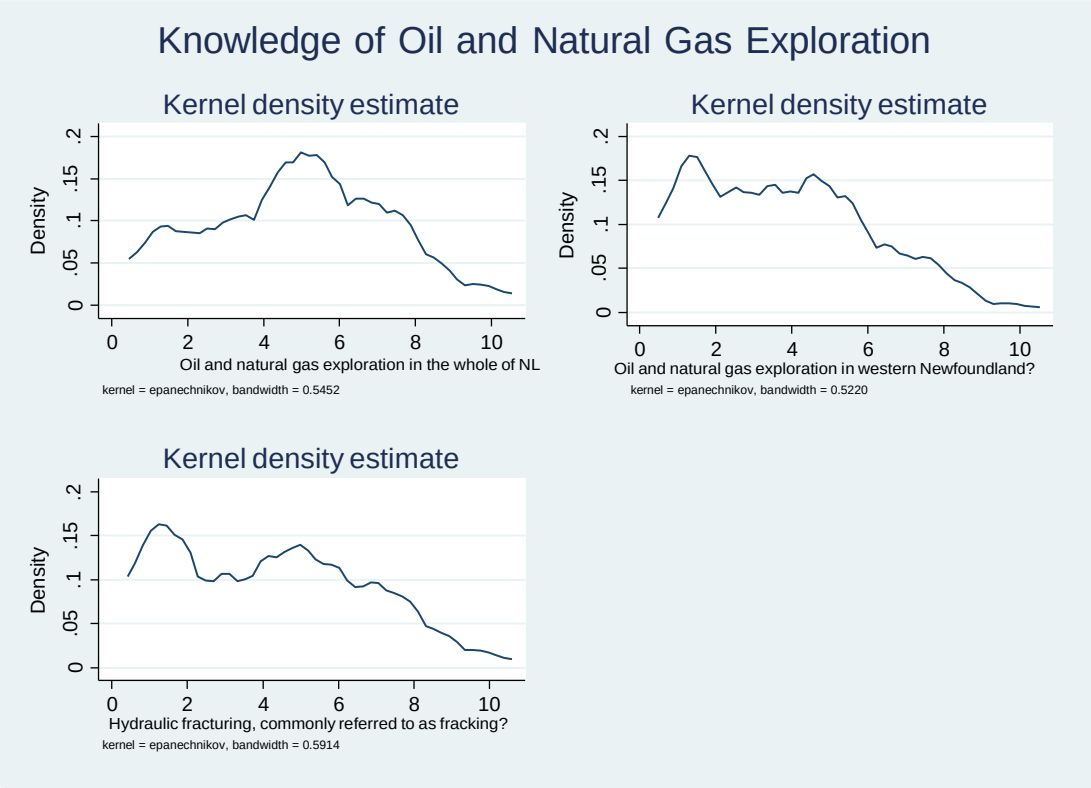

Figure 1. Variables *Q1*, *Q2*, and *Q3*. Kernel density estimates of weighted frequency distributions.

5.1 Methodological Notes

We report the results of running an OLS regression model, an ordered logit model, and two versions of the ordered logit model: the basic one is based on the parallel regressions assumption and a more flexible one is based on the partial parallel regressions assumption.

Before running most of the ordered models, the dependent variable was simplified into only three broad categories down from the original ten. This is because, if a cell with a given combination of explanatory and explained variables has very few cases, the ordered model may become unstable or not run at all. Therefore, the 10 original categories were collapsed into 3: values 1 to 5 were collapsed into a "poor knowledge" category, while values 6 and 7 and 8 to 10 were labelled "medium-level knowledge" and "high-level knowledge".

5.2 Results

5.2.1 OLS Models

Table 2 shows the results of the most basic (OLS) regressions. Breusch-Pagan tests (Breusch & Pagan 1979) showed that there was only some weakly significant heteroscedasticity in the case of the regression of *Q1B*, so all the p-values reported are based on conventional (non-robust) standard errors.

As expected, being male and being older have a positive and highly significant effect on the reported level of knowledge about each of the three issues. Having a completed college degree is linked to a higher level of knowledge about the O&G exploration in NL and also about fracking. The reported levels of the latter type of knowledge are also significantly higher for those with a technical postsecondary degree and those with an incomplete university degree (as compared to those with less than a secondary education (less than a completed high-school diploma). These results confirm our a priori hypothesis that more education is linked to higher levels of knowledge about energy topics.

We find a significantly negative effect of residing on the West of NL on the level of knowledge about the O&G exploration in the province (*Q1A*) but a positive effect on the other two variables: knowledge about O&G exploration in Western NL (*Q1B*) and about fracking (*Q1C*). Living in other areas of NL also decreases the reported knowledge about the industry compared to living in the St. John's area.

Self-employment is associated with more knowledge about fracking and there is a weakly significant negative effect of being unemployed and not looking for a job on *Q1C*. Not surprisingly, oil industry employees admit to knowing more about O&G exploration in NL and also more about fracking. However, there is no evidence that they know more about exploration in Western NL. An even more surprising result involves provincial government employees who reported significantly lower levels of awareness of the industry. In the case of exploration in Western NL, however, the effect was not significant at the usual levels.[24] Given the importance for the provincial economy of the O&G industry, we find this result rather paradoxical.

One potential way to explain these results is to admit that the rating scale proposed to the respondents might not have the same meaning for all of them. Perhaps what O&G employees mean by knowing a lot about fracking involves technicalities that other respondents do not consider. Indeed, perhaps those more involved with the issues are more aware of what remains uncertain and unknown about these issues and when they rate their level of knowledge they do it at a different scale than other individuals.[25] The same might apply to Federal Government employees and, even more, Provincial Government employees.

A look at the goodness of fit measures, which in the case of this basic OLS model represent the proportion of the variance of the dependent variable that is explained by the model, we can see that a substantially larger proportion of the variability of the dependent variables (all measured, let us recall, in a scale taking values from 1 to 10) can be captured by our model in the case of variable *Q1C* and to a lesser extent variable *Q1A*, with *Q1B* showing the lowest coefficient of determination. In general, even for the case of a cross-sectional dataset, these values are all relatively modest, indicating that many other unobserved factors determine a good proportion of the variability in the dependent variables.

A key advantage of the OLS is the intuitive way in which the untransformed coefficients can be interpreted in quantitative terms. Each coefficient represents the (constant) change *ceteris paribus* in the expected value of the

[24] Although it would have been significant at the 0.1 level of significance if we had a prior based on the negative sign of the effect.

[25] There is a stream of literature tha proposes to deal with this type of issue using anchoring vignettes, starting with the seminal contribution by King et al. (2004).

dependent variable (with the unchanged original scale ranging from 1 to 10) when the independent variable changes in one unit. For example, the expected value of *Q1A* for the average male is about one whole step higher in the scale than for the average female.

Although in this case, the basic OLS regressions should provide, apart from the usual advantages in terms of simplicity of interpretation, a good approximation to the qualitative effects of the explanatory factors in the model, the categorical nature of the dependent variables is accounted for next.

Table 2. OLS regressions on Q1 questions.
Using a scale of 1 to 10 where 10 is very knowledgeable and 1 is not knowledgeable at all, how would you rate your knowledge of…

	O&G IN NL	O&G IN WESTERN NL	FRACKING
Variables	*Q1A*	*Q1B*	*Q1C*
male	0.9228***	0.6077***	0.9151***
age_2534	1.2223***	1.5972***	1.2294**
age_3544	0.8836*	1.4648***	1.4511***
age_4554	1.3685***	1.9368***	2.2647***
age_5564	1.4463***	1.7898***	1.9688***
age_65plus	1.4118**	1.9209***	2.3615***
Inc2	-0.5725*	-0.5569	-0.2592
Inc3	-0.2305	-0.0250	0.1567
Inc4	-0.0822	-0.0163	0.5222
Inc5	-0.0160	0.1223	0.2354
HSchool	0.2702	-0.4135	0.5963
Sometradetechcollege	0.2497	-0.4819	0.7317
Tradetechncollege	0.4089	-0.2066	1.0423***
Someuniversity	0.4460	0.0429	1.5212***
University	0.7867**	0.0616	2.2998***
breWestern	-0.6363***	0.5778**	0.5357**
breotherNL	-0.3875**	-0.0897	0.1143
Selfemployed	0.4623	0.2633	0.7668**
notemplooking	-0.3628	-0.2131	0.1170
notempnotlooking	-0.5457	-0.4721	-0.7957*
Retired	-0.1214	-0.0081	0.0318
Student	0.0254	-0.1362	0.8778
universityemployee	-0.2618	-0.3712	-0.1346
NLgovemployee	-0.5053*	-0.4283	-1.0688***
FEDemployee	-0.7384	-0.0768	-0.2087
OILGASemployee	1.9413***	0.0259	1.0364**
Constant	3.3135***	2.0774***	0.2996
Observations	**756**	**756**	**756**
R-squared	**0.154**	**0.097**	**0.211**

**** p<0.01, ** p<0.05, * p<0.1*

5.2.2 Ordered Logit Models

In Table 3 and Table 4, we report the results of two sets of ordinal regression models. In the first case, the dependent variables are left unchanged, so they can take up to 10 values (from 1 to 10), while the second set simplifies the information by collapsing them into only three categories (the first one for those original values between 1 and 5, the second one for those original values between 6 and 8, and the third one for the values 9 and 10). Without this simplifying strategy, we would not have enough data to avoid perfect prediction and the results would also become somewhat overwhelming when it comes to their interpretation.

Furthermore, the first set of results assumes proportional odds between the variables categories, so the conventional ordered logit model is applied and only one set of estimated coefficients is reported. This assumption proved to be too strong in the case of all three variables, though, as suggested by the likelihood ratio tests, which reject the null at the 0.01 level of significance.[26] Therefore, in the second case (Table 4), a generalised logit model is used instead on the already simplified dependent variables.

We can see in Table 3 that the results of the ordered logit model, in qualitative terms,[27] are about the same as those obtained through the OLS model. We found, however, one more significant coefficient: the negative effect on variable *Q1A* of the indicator of working for the Federal Government.

The generalised ordered logit model when run using Stata's *gologit2* routine with the *autofit* option (at the 0.01 level of significance, in order to try and keep as simple a model as reasonably possible) results in models quite close to the basic ordered model, having to relax the proportional odds assumption for only a handful of explanatory variables. We highlight the corresponding coefficients in Table 4. For the rest of variables, it can be accepted that they meet the assumption. Even when we consider the highlighted problematic coefficients, we see that in general the differences that make them violate the proportional odds assumption are more of magnitude than of sign, so with due caution, we will report predicted probabilities for each category based on the ordered logit models. In any event, we also report marginal effects[28] based on the generalised ordered logit model (See Table 42 to Table 44 in Appendix B).

Just like in the case of the OLS results, these results do provide an insight into the magnitude of the effects in quantitative (as opposed to just qualitative) manner. However, they are expressed in terms of the probability of each outcome. For example, in the case of Table 42, we see that the "average" male is 17% less likely to have chosen one of the lowest category of *Q1A* (values 1 to 5) than the "average" female, almost 10% more likely to be in the middle category, and 7% more likely to have stated the highest levels of knowledge about the O&G industry in NL. As logic would suggest, the three estimated effects cancel each other (-17+10+7=0). Similarly, although the positive effects on the middle and high categories are somewhat split, falling within any of the age categories other than the benchmark one (18 to 25 year olds) decreases substantially the probability of being in the lowest category.

As explained in Section 3.5, however, in the case of our study focusing on the effects of changing one variable at a time, while keeping the rest at their mean values might not be the best strategy when reporting predictions from our non-linear models. This is first because marginal changes make no sense for the variable in question if it is binary (we thus cannot, estimate the marginal effect of, say, variable *male*, but only the *discrete* effect of being male versus female). Further, when the rest of variables are also binary they are usually set at their mean values for simplicity. But

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[26] See Appendix B, Section 20.1.1.

[27] In this case, because of the large number of categories in the dependent variable, the normalization in the ordered modelled was such that, as shown by the estimates of the cuttoff points, the latent index underlying the choice modelling is not far apart from the actual 1-10 scale used in the questionnaire. Therefore, the estimated coefficients of the ordered model are actually quite comparable to the ones from the OLS regression.

[28] Although in this case, they are not *marginal* as such but *discrete*, since we only have binary variables in the model (as explained in Section 3.6).

this means, in our case, that our hypothetical "typical" individuals can in fact be anything but. For example, a given real individual would fall in a given income category, rather than having a non-zero average probability of falling in each of the different income categories.[29]

Therefore, we constructed hypothetical respondent profiles, so we can illustrate the discrete effects of the variables on the probability of the different outcomes. Since we have built them based on a multiplicity of variables, we relegate their reporting to Appendix B (see Section 20.1.3 for the case of Q1 variables) and we leave it to the reader to choose which comparisons to consider.

In order to facilitate this task, we have highlighted in the tables a couple of examples. For example, we see that a well-off (income over $100,000) male, age 25 to 35, from the St. John's area with a completed university degree is about equally likely to have chosen the middle and highest categories for the simplified QA (around 35%) and a bit less likely to have chosen the lowest category (about 29%). By comparison, a woman with otherwise the same characteristics and also from St John's would have chosen the lowest category with a 46% probability and the highest category with only a 20% likelihood. These two archetypes correspond to realistic profiles of the respondents.

Our reported tables of predictions also make it possible to compare typical profiles from St. John's and Western NL. For example, a mid-income ($50,000 to $74,999) male, age 55 to 65, from the St. John's area with no completed university degree but (since all the other educational dummies are also implicitly set at zero, not their mean values) not even a high school diploma has a probability of about 57% of falling in the lowest category of *Q1A*, while his Western NL counterpart would have a predicted 73% chance of having chosen an option within that category.

In sum, we confirmed the expectations about the effects of age, gender, and education levels on the level of knowledge about energy issues. However, we failed to unveil much in terms of significant relationships between income and knowledge levels.

[29] An alternative would be to *set all* the non-relevant variables to their most frequent value instead.

Table 3. Ordered logit regressions on Q1 questions.
Using a scale of 1 to 10 where 10 is very knowledgeable and 1 is not knowledgeable at all, how would you rate your knowledge of…

	O&G IN NL	O&G IN WESTERN NL	FRACKING
Variables	*Q1A*	*Q1B*	*Q1C*
male	0.7490***	0.5335***	0.7005***
age_2534	1.0899***	1.4594***	1.1105***
age_3544	0.8134*	1.3000***	1.2581***
age_4554	1.2065***	1.7554***	1.9233***
age_5564	1.2577***	1.7091***	1.7822***
age_65plus	1.2775***	1.8331***	2.0661***
Inc2	-0.3942	-0.4812	-0.0095
Inc3	-0.1358	0.0307	0.3051
Inc4	-0.0126	-0.0036	0.5034
Inc5	0.0627	0.1067	0.3516
HSchool	0.3178	-0.3065	0.5891*
Sometradetechcollege	0.3174	-0.4051	0.7570**
Tradetechncollege	0.5028*	-0.0800	1.0691***
Someuniversity	0.4971	0.0872	1.4082***
University	0.8121**	0.1674	1.9856***
breWestern	-0.5312***	0.4817**	0.4485**
breotherNL	-0.3278**	-0.0898	0.1043
Selfemployed	0.4212	0.0960	0.5666*
notemplooking	-0.3542	-0.2237	0.0887
notempnotlooking	-0.4202	-0.4999	-0.7570**
Retired	-0.1105	-0.0852	-0.0168
Student	0.1726	0.0593	0.9716**
universityemployee	-0.2825	-0.3678	-0.0416
NLgovemployee	-0.4131*	-0.2534	-0.8115***
FEDemployee	-0.6316*	-0.0780	-0.1645
OILGASemployee	1.6442***	0.0957	0.8087**
Cut1	-0.6938	0.3024	2.1149***
Cut2	-0.1048	0.9507	2.6951***
Cut3	0.5583	1.6290***	3.2372***
Cut4	1.0805*	2.1938***	3.7263***
Cut5	2.1172***	3.0670***	4.5377***
Cut6	2.7058***	3.6065***	5.0685***
Cut7	3.6269***	4.3061***	6.0019***
Cut8	4.9029***	5.7581***	7.0564***
Cut9	5.4974***	6.2251***	7.8630***
Observations	**756**	**756**	**756**

**** p<0.01, ** p<0.05, * p<0.1*

Table 4. Generalised ordered logit regressions on Q1 questions.
Using a scale of 1 to 10 where 10 is very knowledgeable and 1 is not knowledgeable at all, how would you rate your knowledge of…

	O&G IN NL		O&G IN WESTERN NL		FRACKING	
Variables	1	2	1	2	1	2
male	0.7446***	0.7446***	0.3642*	0.3642*	0.6024***	0.6024***
age_2534	1.0725*	1.0725*	1.7918*	1.7918*	2.5366***	2.5366***
age_3544	0.6160	0.6160	2.0743*	2.0743*	2.9089***	2.9089***
age_4554	0.9359	0.9359	2.3468**	2.3468**	3.6442***	3.6442***
age_5564	0.9404	0.9404	1.8883*	1.8883*	3.1360***	3.1360***
age_65plus	1.0951*	1.0951*	2.2026*	2.2026*	3.5500***	3.5500***
Inc2	-0.5783*	-0.5783*	-0.4086	0.1430	-0.4027	-0.4027
Inc3	-0.4325	-0.4325	0.0662	0.0662	-0.2684	-0.2684
Inc4	-0.0750	-0.0750	-0.0414	-0.0414	0.2443	0.2443
Inc5	0.0243	0.0243	0.1515	0.1515	-0.0826	-0.0826
HSchool	0.3397	0.3397	-0.5491	-0.5491	0.4060	0.4060
Sometradetechcollege	-0.0088	-0.0088	-0.3423	-0.3423	0.1931	0.1931
Tradetechncollege	0.2965	0.2965	-0.4007	-0.4007	0.4485	0.4485
Someuniversity	0.3587	0.3587	-0.3003	-0.3003	0.7016	0.7016
University	0.6283	0.6283	0.1069	0.1069	1.7747***	1.0608**
breWestern	-0.7080***	-0.7080***	0.6174**	0.6174**	0.6407**	0.6407**
breotherNL	-0.3175*	-0.3175*	0.0433	0.0433	0.1405	0.1405
Selfemployed	0.4646	0.4646	0.1157	1.0065**	0.6560*	0.6560*
notemplooking	-0.0509	0.8302*	0.0211	0.0211	0.3306	0.3306
notempnotlooking	-0.3566	-0.3566	-0.8043	-0.8043	-0.1298	-0.1298
Retired	-0.1897	-0.1897	0.1639	0.1639	0.0585	0.0585
Student	-0.0177	-0.0177	0.1110	0.1110	1.8134**	1.8134**
universityemployee	-0.5961	-0.5961	0.0269	0.0269	-0.1684	-0.1684
NLgovemployee	-0.6241**	-0.6241**	-0.4885	-0.4885	-0.7492**	-0.7492**
FEDemployee	-1.3308***	-1.3308***	-0.3920	-0.3920	-0.8951	-0.8951
OILGASemployee	1.4654***	1.4654***	0.1977	0.1977	1.0091**	1.0091**
Constant	-1.5379**	-3.1135***	-3.4172***	-4.8591***	-5.3134***	-6.5159***
Observations	**756**	**756**	**756**	**756**	**756**	**756**

****p<0.01, **p<0.05, *p<0.1*

6 OPINIONS OF THE IMPACT OF THE OIL AND GAS INDUSTRY

Respondents were next asked about their opinion of the impact of the O&G industry on NL and separately on Western NL. The respondents were given the option to choose among five options ranging from "very negative" to "very positive" an impact. As shown in Table 5, a strong majority (72% of those who provided a valid answer) of respondents stated that they expected the O&G industry to have a *positive impact* on NL, while very few (7% of those who provided a valid answer)[30] believed this industry had either a *very negative* or a *negative impact*.

Table 5. Opinion about the impact of O&G on NL (Q2A).
Which of the following best matches your opinion of the impact of the oil and gas industry on Newfoundland and Labrador?

	NO.	COL %	CUM %
Very negative impact	18	2.2	2.2
Negative impact	36	4.4	6.6
Neutral impact	177	21.6	28.1
Positive impact	432	52.6	80.7
Very positive impact	158	19.3	100.0
Total	**822**	**100.0**	

Since only a very small fraction of the respondents in the sample chose the options "very negative impact" and "negative impact," we collapsed the information into only two categories: "negative or neutral impact" (29% of respondents with valid answers) and "positive impact" (71% of them).

A second question elicited respondents' views about the impact of the O&G industry on Western NL. It can be seen in Table 6 that the opinions about the effect of the O&G industry on Western NL differed substantially from those about impacts for the whole of Newfoundland and Labrador. Only about 43% among those respondents who provided a valid answer said that they viewed it as either a *positive impact* or a *very positive impact* on Western NL (compared to a 72% for the case of the whole province). In this case, a greater share of the respondents chose instead the *neutral impact* option. In fact, 41% of the total sample (46% of those who provided an answer other than "don't know") chose this neutral option; while for the whole province the corresponding share was 22%.

The share of "don't know" responses was substantially higher (9%) for Western NL than for the whole province (only 2%), although it matches the notion that less is known about O&G exploration in that particular region of NL, something that the data from the previous questions had already reflected.

[30] For the analysis of these two questions, "don't knows" and "no responses" were eliminated.

Table 6. Opinion about the impact of the O&G on Western NL (Q2B).
Which of the following best matches your opinion of the impact of the oil and gas industry on Newfoundland and Labrador?

	NO.	COL %	CUM %
Very negative impact	19	2.6	2.6
Negative impact	69	9.0	11.6
Neutral impact	347	45.6	57.2
Positive impact	279	36.7	93.8
Very positive impact	47	6.2	100.0
Total	**760**	**100.0**	

As explained below, we ended up using a binary regression technique to model the answers to this question after collapsing the five original categories into only two. It is clear that the views on the impact of the industry on the Western part of NL are much less positive than on the province in general. Less than half of those respondents (about 44%) who provided a valid answer consider the impact positively.

6.1 Methodological Notes

Just like in the case of the variables about knowledge of the O&G industry and about fracking, the first approach to analysing the answers to these responses would be to exploit their ordinal nature. However, partly because there are very few responses in the "very negative impact" and "negative impact" categories, the assumption of parallel regressions was not tenable. Furthermore, a generalized ordered model resulted in this occasion in relatively serious problems with in-sample predictions of negative probabilities (even after collapsing the five original categories into just three). Therefore, the most efficient way to model the responses was to collapse them all into only two, resulting in a binary variable that takes the value 1 when the respondent stated states a "positive" or "very positive" impact of the O&G industry. A simple binary regression model (either logit of probit) can be used for this task. We chose to use the logit model.

6.2 Results

Table 7 shows the results of binary regressions of the dependent binary variables resulting from collapsing the initial five categories into just two. The marginal effects of a variable are nonconstant (they depend on the values of all relevant variables) but the estimated coefficients reported already provide information about both the sign of the effect and the significance of the variable. In particular, Table 7 shows the results of the two relevant probits plus a bivariate probit that jointly estimates the two variables. Indeed, as shown by the strong significance of the estimated correlation coefficient (ϱ=0.79), it is more efficient to estimate both variables jointly.[31]

In general, we can see that, in line with the hypotheses brought forward in Section 4, being both richer and male tends to significantly improve the opinion about the impact of the industry in NL (in general) but not about its impact Western NL (in particular). College-educated respondents tend to be significantly more positive than those with less that a high-school diploma about the impact of the industry on NL. However, they are also less optimistic about the effect on the Western part of the province. Retirees and university employees are significantly more likely to appreciate the impact of the industry as positive but that effect is not significant in the case of Western NL, where only those who work for the federal government (while the indicator for their provincial government counterparts

[31] An attempt was also made to model these variables with the indicator of whether the respondent was aware of the Panel Review (variable *Q4*) as a predictor. We ran a joint estimation of the three variables but, although it had in principle a significant positive effect on *Q2AVERB*, it showed no significant effect of the answer to *Q4* once the correlation among the dependent variables was accounted for.

would only be significant in a one-sided test) or the O&G industry itself appear to hold similar positive views. We note that, when both dependent variables are estimated jointly through the seemingly unrelated bivariate probit model, O&G employees are also shown to have a significantly better opinion about the contribution of their employer to NL in general.

It is noteworthy that no significant age effects were detected. We would have expected some positive effects of age on the perceived impact of the industry.

Since, once again, these categorical regression models can only provide qualitative insights into the effects of the explanatory variables of the likelihood of the different outcomes of the dependent variables, we also report some estimates of marginal effects. Table 8 shows not the marginal but, in this case, the discrete effects estimated at the means on the probability that a respondent states a "positive" or 'very positive" impact of the O&G industry on both NL, in general, (*Q2AVERB*) and Western NL, in particular, (*Q2BVERB*). It is obvious now harder to find effects significantly different from zero, since we are talking about the probability that both indicators take the value 1 and we saw from each of the individual regressions that only rarely would a given factor affect significantly both variables in the same direction. This said, we still see a positive effect of the highest income indicators, working for the government (although again working for the province would only be significant under a one-sided test) or in O&G, or being retired. Having completed a university degree has an overall negative effect on the effect of the industry.

In order to appreciate the estimated quantitative effects of changing the values of the independent variables of the model on the probability of having a positive opinion about the industry in a more realistic way, we report a full battery of predicted probabilities for different archetypical profiles in Appendix B (see Section 20.2). These predictions results from postestimation analysis of the bivariate probit results, so they involve four different types of predictions, namely the probability of having a positive opinion about the impact of the O&G industry on NL and on Western NL (Pr(*Q2AVERB*=1 & *Q2BVERB*=1)), the probability of having a positive opinion about the impact of the O&G industry on NL but not on Western NL (Pr(*Q2AVERB*=1 & *Q2BVERB*=0)), the probability of having a negative opinion about the impact of the O&G industry on NL but a positive one on Western NL (Pr(*Q2AVERB*=0 & *Q2BVERB*=1)), and the probability of having a negative opinion about the impact of the O&G industry on both NL and on Western NL (Pr(*Q2AVERB*=0 & *Q2BVERB*=0)).

As the results reported earlier would suggest, the most likely scenario tends to be the second combination, because generally respondents are quite happy with the effect of the industry on the province, although less positive about the impact on Western NL. The first combination is also relatively likely, while the other two tend to have predicted values so low that they are never significantly different from zero.

Table 7. Individual Probit and Joint Bivariate Probit regressions (Q2).
Which of the following best matches your opinion of the impact of the oil and gas industry on NL(Q2AVERB)*/Western NL*(Q2AVERB)*?*

	PROBIT	PROBIT	BIVARIATE PROBIT	
Variables	*Q2AVERB*	*Q2BVERB*	*Q2AVERB*	*Q2BVERB*
male	0.2194**	-0.0470	0.2707**	-0.0304
age_2534	-0.5460*	-0.1989	-0.5574	-0.3391
age_3544	-0.6174*	0.0332	-0.5818	-0.1198
age_4554	-0.2035	0.1963	-0.1958	0.0603
age_5564	-0.1865	0.1463	-0.1909	0.0303
age_65plus	-0.5447	-0.0140	-0.5233	-0.1309
Inc2	0.5592***	0.0724	0.6039***	0.0756
Inc3	0.6702***	0.3215	0.8209***	0.3309
Inc4	0.6574***	0.3635	0.7968***	0.3826
Inc5	0.8201***	0.3825	0.9400***	0.3865
HSchool	0.1519	-0.2852	0.0332	-0.2620
Sometradetechcollege	0.3495	-0.1701	0.2138	-0.0336
Tradetechncollege	0.2860	-0.2037	0.2189	-0.1479
Someuniversity	0.5163*	-0.0640	0.4131	0.0211
University	0.4531*	-0.5837**	0.3387	-0.5400**
breWestern	-0.5932***	-0.1433	-0.5429***	-0.1368
breotherNL	-0.1099	0.1278	-0.1249	0.1415
Selfemployed	0.2355	0.2461	0.1186	0.2952
notemplooking	0.1896	0.2275	0.3338	0.3214
notempnotlooking	-0.1107	0.0208	-0.1023	-0.0026
Retired	0.5298**	0.3221	0.4878**	0.3176
Student	-0.1544	0.6023	0.0082	0.4626
universityemployee	0.7513	0.0510	0.7702**	0.0911
NLgovemployee	0.0470	0.2403	0.0317	0.2788
FEDemployee	0.1177	1.0632***	-0.0212	1.1045***
OILGASemployee	0.6484*	0.5971*	0.6631*	0.6190*
Constant	-0.0749	-0.4476	-0.1554	-0.4059
ρ			0.7858***	
Observations	**740**	**690**	**680**	**680**

**** p<0.01, ** p<0.05, * p<0.1*

Table 8. Marginal effects on probability of joint outcomes from Bivariate Probit regression.

VARIABLES	Pr(*Q2AVERB=Q2BVERB*=1)
male	0.0011
age_2534	-0.1407
age_3544	-0.0773
age_4554	0.0106
age_5564	0.0004
age_65plus	-0.0747
Inc2	0.0455
Inc3	0.1465
Inc4	0.1649*
Inc5	0.1735*
HSchool	-0.0911
Sometradetechcollege	-0.0052
Tradetechncollege	-0.0448
Someuniversity	0.0197
University	-0.1768**
breWestern	-0.0782
breotherNL	0.0442
Selfemployed	0.1096
notemplooking	0.1297
notempnotlooking	-0.0059
Retired	0.1331*
Student	0.1540
universityemployee	0.0490
NLgovemployee	0.0986
FEDemployee	0.2861***
OILGASemployee	0.2471**
Observations	**680**

**** p<0.01, ** p<0.05, * p<0.1*

7 REASONS FOR EXPECTING POSITIVE/NEGATIVE IMPACT OF O&G

After responding about their thoughts on the impact of the O&G industry on NL, in general, and Western NL, in particular, the respondents were asked to provide reasons for their answers. Those who saw the impact as positive for Newfoundland and Labrador mentioned a series economic reasons. These included, as expected, employment outcomes, economic growth, increased revenues for the government, and higher wages and wealth (Boudet et al. 2014).

Those who stated "negative" and "neutral" impacts, on the other hand, focused mainly on environmental aspects, the perception that with oil prices currently low, there is little benefit at this time from the O&G industry, and also the feeling that consumer prices would rise as an effect of the operations of the industry.

These types of results are consistent with what previous studies have found, particularly in the case of the US. Those who believe and value that the O&G will provide economic benefits tend to be more supportive of the industry, whole those who focus on environmental or health issues are much less supportive (e.g. Theodori, 2009; Brasier et al. 2011; Jacquet, 2014).

We show in Table 9 the frequencies of the most commonly mentioned reasons classified depending on the type of response to *Q2AVERB* and *Q2BVERB* and split between responses about the Western part of the island of Newfoundland and those from the rest of the province.

Interestingly, but in line with other results found throughout, when talking about the case of the whole province of NL, only a few respondents expressed concerns related to fracking. However, about a quarter of respondents mentioned it as a concern for Western NL. General worries about the operation of the O&G industry are also mentioned more often in the case of Western NL. Issues of increased costs to consumers are much more seldom mentioned in connection with the West of NL, though.

Table 9. Top reasons to explain opinion about impact of O&G.

	NEWFOUNDLAND & LABRADOR	WESTERN NL
Positive Impact	(n=591)	(n=332)
Employment / Job creation	65%	66%
Economic Growth / Business development	43%	27%
Government revenue / Less taxes	25%	12%
Wage / Salary increase / Things are more affordable	21%	13%
Negative Impact	(n=58)	(n=89)
Environmental harm	45%	42%
Oil prices are poor / There is no benefit at this time / It should be kept within the province	23%	20%
Cost to consumers / Things are more expensive	22%	3%
Concerns about fracking	5%	25%
There is public outcry against the oil and gas industry operating here/ It could have a negative impact	8%	15%

7.1 Methodological Notes

Since each respondent was permitted to mention as many reasons as desired (although five was the maximum number of reasons mentioned by a given respondent), all answers about a given reason were collected without regard for the ordering in which they were provided into one binary variable. A series of binary variables were thus constructed and for each respondent any number of them could take the value of one if that issue was mentioned by that particular respondent at any stage.

We could use simple binary regression models (probit or logit) to model the probability that someone mentioned a given reason. However, because every respondent could have chosen to mention either none or any number of reasons joint estimation of these binary regressions was more advisable. Again, to keep things manageable not only for interpretation but also for computational purposes, we only modeled the four most commonly mentioned reasons by any respondent for each type of explanation (a reason for explaining the perceived impact of the industry in NL, in general, versus a reason to explain the perceived impact of the industry in Western NL, in particular). The modeled reasons appear highlighted in in Table 10 and Table 11.

Two multivariate probit models[32] were estimated, one referring to the whole of and the other one referring to the western part of the province only. These models help analyse in each case what factor determine the likelihood that a given reason for the expected impact of the O&G industry was mentioned.

As already explained, we have no way to distinguish whether a given reason was ranked higher than or simply mentioned ahead of other reasons, so we can only use the information as binary dependent variables (the indicators of whether the reason was mentioned at all by the respondent or not). However, for those respondents who mentioned at least one reason, we also were able to construct indicators of the share of reasons that a given reason represented for each respondent.

That is, we were able to distinguish between say someone who only mentioned a concern about job creation (so that reason's individual *share* would be 100%) and someone for whom job creation was just one among several other reasons for the expected impact of the industry on the province (so the individual's proportion for that reason would only be 50%, if only another reason was mentioned; 33%, if two other reasons were mentioned; and so on). These share variables were constructed as ratios of 1 over the variable *2aDsumof4reasons*, in the case of the whole province, and *2aEsumof4reasons*, in the case of Western NL. The values of all these variables appear tabulated and summarized in Table 14, Table 15, and Table 16.

Table 10. Reasons to explain opinion about impact of O&G in NL.

VARIABLE	OBS.	WEIGHT	MEAN	STD. DEV.	MIN	MAX
Q2Djobs	840	840	0.457957	0.498526	0	1
Q2Denviroharm	840	840	0.040624	0.197535	0	1
Q2Dwages	840	840	0.151265	0.35852	0	1
Q2Dpopgrowth	840	840	0.049372	0.216772	0	1
Q2Decongrowth	840	840	0.307119	0.461574	0	1
Q2Dtaxrevenue	840	840	0.177033	0.381924	0	1
Q2Dcosttoconsumers	840	840	0.020603	0.142135	0	1
Q2Dsocietalgains	840	840	0.061522	0.240428	0	1
Q2Dpooroilprice	840	840	0.043763	0.204689	0	1

[32] Using 100 draws during the simulate of the relevant probabilities.

Table 11. Reasons to explain opinion about impact of O&G in Western NL.

VARIABLE	OBS.	WEIGHT	MEAN	STD. DEV.	MIN	MAX
Q2Ejobs	840	840	0.258336	0.437981	0	1
Q2Eenviroharm	840	840	0.052953	0.224073	0	1
Q2Ewages	840	840	0.053522	0.225206	0	1
Q2Epopgrowth	840	840	0.025915	0.158975	0	1
Q2Eecongrowth	840	840	0.107623	0.310089	0	1
Q2Etaxrevenue	840	840	0.04687	0.211486	0	1
Q2Ecosttoconsumerss	840	840	0.003376	0.05804	0	1
Q2Esocietalgains	840	840	0.02936	0.168914	0	1
Q2Epooroilprice	840	840	0.032168	0.176551	0	1

We then used the same explanatory variables as we used in the multivariate probits to find out how those proportions were influenced by respondent characteristics. The flavour of the model in this case changed from a collection of jointly binary models into a variant of the multinomial logit. As explained in the introductory section, the conventional form of this model is used to model nominal variables, whereby respondents choose one option among a discrete set of unordered ones. In our case, we use the *fractional* version of the multinomial model, so we model the shares of different reasons.[33] We use Stata's *fmlogit* (fractional multinomial logit) routine (Buis 2008) to run this model, whose interpretation is similar to the conventional multinomial logit. It should be stressed that this further analysis based on the fractional multinomial logit could only be performed on the information from respondents who mentioned one of the four most commonly mentioned reasons for the impact of the industry. The number of responses modelled were thus only n=505 for the case of the whole of NL and n=244 for the case of Western NL.

7.2 Results

The results reveal that the list of main reasons why people say that they expect a positive or negative impact from the O&G sector can be to quite a great extent explained by the type of person interviewed. Table 12 and Table 13 contain the summarised results of the two multivariate probits. In order to avoid issues of perfect prediction, two of the usual age categories indicators (for ages 25 to 34 and 35 to 44) had to be kept out of the specification, so the base category is in this case respondents aged 18 to 44. We comment on the determinants of choosing diff reasons to explain one's opinions about the impact of the industry below. Similarly in the case of the model specifi for Western NL, the lowest income category indicator (Inc2) could not be included, so the base category for that set of binary income indicators becomes "less than $50,000". This does not apply to the model about the whole province reported in Table 12, though.

7.2.1 Jobs

When it comes to the likelihood of mentioning "employment/job creation, "gender[34] and age do not seem to pay much of a significant role, with only the age group 55 to 64 being significantly more likely to mention that reason (and only in the case of impacts on the whole province). In fact, as mentioned above, the effects of age is for some of the indicators so weak that perfect prediction issues would ensue if we had included all the age group indicators in the model. This is the reason why we omitted the groups 25 to 34 and 35 to 44, which makes the comparison category in this particular analysis those respondents under 45.

[33] Our information is somewhat limited by the fact that each of our individuals has a set of identical shares for the reasons they mention, since they were not in actuality allocating importance or share to each reason themselves.

[34] Although one might expect a positive effect of the variable male on economic benefits of the O&G industry.

Table 12. Multivariate probit on reasons for opinion on impact of O&G on NL.

VARIABLES	*q2*djobs	*Q2*Decongrowth	*Q2*Dwages	*Q2*Dtaxrevenue
male	-0.0238	-0.0042	0.2914**	0.3300***
age_4554	0.1387	0.2980**	0.3309**	0.3522**
age_5564	0.3235**	0.4075***	0.2125	0.5428***
age_65plus	0.0677	0.1564	0.4535**	0.5922***
Inc2	0.4421*	1.0006***	0.7121**	-0.0840
Inc3	0.6088**	1.0875***	0.9250***	0.1624
Inc4	0.4740*	1.2877***	0.6923**	-0.0311
Inc5	0.4470*	1.3034***	0.6638**	0.3869
HSchool	0.2308	0.2043	0.2214	0.0281
Sometradetechcollege	0.6827***	0.6231**	0.1248	-0.1246
Tradetechncollege	0.4424**	0.3334	0.2896	0.3603
Someuniversity	0.5733**	0.3702	0.7789**	0.2362
University	0.5119**	0.6347**	0.3275	0.3897
breWestern	-0.4822***	-0.3880**	-0.3182*	-0.0452
breotherNL	0.1231	-0.2955**	-0.0472	-0.0837
NLgovemployee	-0.0205	0.0130	0.2762+	-0.4697**
OILGASemployee	0.4735+	0.1989	0.1767	-0.1447
Q1A	0.0444	0.0382	-0.0533	0.0244
Q1B	-0.0010	-0.0463	0.0671*	-0.0066
Q1C	-0.0294	0.0646**	-0.0118	0.0166
Constant	-1.1457***	-2.3465***	-2.3632***	-1.8825***
ϱ_{21}	0.0599			
ϱ_{31}	0.1731**			
ϱ_{41}	0.330***			
ϱ_{32}	0.0597			
ϱ_{42}	-0.0589			
ϱ_{43}	-0.0685			
Observations	**756**	**756**	**756**	**756**

*Based on robust standard errors: *** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

Table 13. Multivariate probit on reasons for opinion on impact of O&G on Western NL.

VARIABLES	Q2Ejobs	Q2Eecongrowth	Q2Ewages	Q2Etaxrevenue
male	0.0344	-0.0599	0.2434+	0.0336
age_4554	0.0630	0.3964**	0.1153	0.3756*
age_5564	0.0392	0.5598***	0.1199	0.4477**
age_65plus	0.0813	0.3118	-0.0160	0.2059
Inc3	0.5029***	0.2125	-0.1406	0.1354
Inc4	0.4819**	0.5302***	0.3433	0.2666
Inc5	0.4963***	0.4291**	-0.3821	0.3828*
HSchool	0.1010	0.7816*	-0.0756	0.2501
Sometradetechcollege	0.2944	1.3089***	0.7232*	0.2781
Tradetechncollege	0.1836	0.7251	0.5208+	0.4596
Someuniversity	0.6180**	0.9600**	0.8830**	0.4361
University	-0.0724	0.7469*	0.4810	0.4156
breWestern	0.0682	-0.2122	-0.3281	-0.4058
breotherNL	0.2137	0.0256	-0.0870	-0.1729
Selfemployed	-0.0255			
NLgovemployee	0.0890	0.1980	0.3041	-0.2918
OILGASemployee	0.6363*	0.6724*	0.0425	-0.3514
Q1A	0.0076	-0.0176	-0.0147	0.0394
Q1B	0.0721*	0.0988**	0.0819+	-0.0626+
Q1C	-0.0733**	-0.0236	-0.0449	-0.0135
Constant	-1.3859***	-2.8789***	-2.1937***	-2.2453***
ϱ_{21}	0.5687***			
ϱ_{31}	0.43941***			
ϱ_{41}	0.5602***			
ϱ_{32}	0.2695***			
ϱ_{42}	-0.1755*			
ϱ_{43}	-0.3805***			
Observations	**756**	**756**	**756**	**756**

*Based on robust standard errors: *** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

All categories of income included in the model[35] are significant, indicating that those with higher income levels are significantly more likely to consider employment as part of the impacts (in this case beneficial) of the O&G industry, both in NL, in general, and Western NL, in particular.

In the case of the whole of NL, we can see that the higher their post-secondary education levels (including, in this case, both university education and trade college education), the more likely are respondents to have considered the effect of the O&G industry on the labour market. The effect of educational attainment indicators is only significant for the variable *Someuniversity* (indicating who has an incomplete college degree), however, when it comes to the effects of the industry in the West of NL.

[35] Once again perfect prediction issues prevented us from including the second income category (Inc2, indicating the income bracket [$25,000 to $49,999]).

Somewhat surprisingly, we detect a negative effect on the likelihood of mentioning labour market effects on the whole province of residing in the West of NL, as compared to residing in the St. John's CMA. Otherwise, place of residence exerts no other significant effects.

In order to keep the model reasonably parsimonious, we included only two variables related to job status. The first one indicates whether the respondent works for the provincial government and the second one reflects whether the respondent works for the O&G industry. The latter respondents were significantly more likely to mention jobs, somewhat not surprisingly, as part of the advantages of having O&G operators both in the whole province and in Western part of the province. Note, however, that in the former case, the effect was only found significant at the conventional levels of significance by assuming that a one-tailed test could be used, which, in turn, implies that a positive effect was to be expected at the outset.

Finally, respondents with more awareness of the O&G industry in Western NL were significantly more likely to bring up job creation as a benefit from the sector. On the other hand, those who know more about fracking were less likely to mention labour market impacts among the reasons to judge the impact of the industry in the West of NL, presumably because many of those with more of an incentive to learn about fracking are also the type of respondents who care more about the environmental aspects of the industry than about its economic benefits.

7.2.2 Economic Growth/Business Development

Another related and oft mentioned effect of the O&G industry in a region has to do with "economic growth and business development". We find that, relative to the under 45 demographic, older respondents are more likely to consider the impact of the industry on economic growth, although the effect dampens after the age of retirement. The pattern of effects is remarkably similar between the case of NL as a whole and the West of the province.

We also see, as in the case of "employment/job creation" above, that those with more income are more likely to bring up economic growth when asked about the impacts of the industry. These effects are, however, much stronger when respondents are referring to the case of NL as a whole.

Again, those with more education (in particular, those with an incomplete trade college degree and with some college education) are more likely to consider economic development as one beneficial impact of the O&G industry.

We also see quite a strong positive effect of residing in St. John's CMA on the probability of mentioning economic growth as a benefit of the O&G industry, since both indicators for other areas of NL show significant negative estimates, although these are only significant when it comes to the case of NL as a whole. And again, O&G employees are more likely to consider the economic benefits of their sector.

When it comes to awareness, and once more in line with the results found in the case of labour market benefits, we estimate a positive effect of the knowledge of the industry in Western NL for the case of that part of the province only and we observe a negative effect (if not significant) of knowledge about *fracking* on the likelihood to mention economic growth as a benefit in Western NL, while, in this case, the effect is actually positive in the case of the whole province. This suggests that most respondents are particularly concerned about the environmental negative effects of fracking in the Western part of the province, where issues like impacts on Gros Morne National Park have received a lot of media attention. On the other hand, when thinking about the province in general, even those who declare to know relatively more about fracking, bring economic development to the discussion.

7.2.3 Wages

Our results show that when it comes to the effects of the O&G industry in NL, men (as compared to women), richer, and older respondents are more likely to identify increased wage rates. These socio-demographic determinants are the main drivers behind the decision of a respondent's to list wages among the impacts of the industry, although they seem to have no significant effect when it comes to the effects of the sector in the Western part of the province. We do find, instead, some positive effects of education for the case of Western NL, particularly for the indicators of incomplete postsecondary degrees. Also, those who declared to know more about the industry in the West of NL are more likely to consider wage increases as a benefit both in the case of NL and in the case of the Western region.

7.2.4 Increased Tax Revenues

Another potential benefit that some of the respondents recognized was the potential for increased tax revenues accruing to the provincial government and their local communities. These results suggest that it is difficult to find a discernible pattern to predict who is more likely to list tax revenues among the benefits of the industry on the Western part of NL.

However, we find that males and older respondents are more likely to list them, as well as several categories of older respondents that do not include those over 65. Interestingly, but in line with previous results, we find that those who know more about the industry in the West of the province are less likely (although this effect is only weakly significant in a one-tailed test) to mention tax revenues among the impacts of the industry in that same Western part of the province.

Finally, the estimated correlation coefficients between each pair of errors of the individual binary probit regressions confirm that a joint estimation is more advisable than individual ones. In the case of the multivariate regression for the Western part of the province, all the individual correlation coefficients between each pair of equations are statistically significant. This suggests that, as revealed by our comments above, our model specification failed to capture a relatively large component of the data generation process in this case, so that a relatively large component of explanatory factors remain in the error component and correlate across equations. Conversely, in the case of NL as a whole, our model explained much better the probability of mentioning each reason for judging the impact of the O&G industry, so less was left in the error. Therefore, the estimated correlations are weaker. This said, several of them are individually statistically significant and a likelihood-ratio test of the joint hypothesis that they are all equal to zero strongly rejects that null.[36]

7.2.5 Fractional Multinomial Logit

In the next three tables, we describe the variables constructed to conduct a fractional multinomial logit (fmlogit) analysis of the shares of the reasons mentioned by the respondents to explain their opinion about the impact of O&G. Table 14 and Table 15 show that most respondents only mentioned, at most, a couple of reasons, with three and four reasons being definitely more the exception than the rule. When asked about the impact of O&G on Western NL, the number of reasons was even less, with many respondents, as mentioned above, not providing any reason at all. In the case of the impacts on both regions, Table 16 shows that job creation was not only the most frequently mentioned reason but also, as expected, often mentioned by itself or as a part of a short list of reasons. Similarly, economic growth is mentioned often and therefore ends up taking a relatively high share of the mentioned reasons mentioned by the average respondent.

[36] The test statistic was estimated as $\chi2(6) = 51.102$ (Prob > $\chi^2 = 0.0000$ (while it was, for the case of Western NL, $\chi2(6) = 119.912$ (Prob > $\chi2 = 0.0000$).

Table 14. Frequency distribution of variable q2Dsumof4reasons.

	FREQ	PERCENT	CUM.
0	282	33.57	33.57
1	272	32.38	65.95
2	217	25.83	91.79
3	63	7.5	99.29
4	6	0.71	100
Total	**840**	**100**	

Table 15. Frequency distribution of variable q2Esumof4reasons.

	FREQ.	PERCENT	CUM.
0	568	67.62	67.62
1	167	19.88	87.5
2	85	10.12	97.62
3	19	2.26	99.88
4	1	0.12	100
Total	**840**	**100**	

Table 16. Summary descriptives of variables used for fmlogit analysis of Q2.
Reasons to support answers to: Which of the following best matches your opinion of the impact of the O&G on NL/ Western NL?

VARIABLE	OBS.	MEAN	STD. DEV.	MIN	MAX
q2Dsumof4reasons	840	1.094048	0.974998	0	4
shq2Djobs	558	0.431004	0.37153	0	1
shq2Dwages	558	0.121565	0.253898	0	1
shq2Decongrowth	558	0.29092	0.362046	0	1
shq2Dtaxrevenue	558	0.156511	0.282337	0	1
q2Esumof4reasons	840	0.47381	0.776152	0	4
shq2Ejobs	272	0.59038	0.390706	0	1
shq2Ewages	272	0.087316	0.22652	0	1
shq2Eecongrowth	272	0.225797	0.340936	0	1
shq2Etaxrevenue	272	0.096507	0.243204	0	1

The results of the fmlogit analysis are shown in Table 17 (for the case of NL) and Table 18 (for the case of Western NL). In both cases, the base category is the share of reason "job creation". Only a very small number of coefficients are significant in any of the fmlogit models. However, we can see that males worry significantly more than females in proportional terms about wages and tax revenues, as opposed to job creation, with economic growth taking also a positive but non-significant sign.

Older respondents, including those over the age of retirement are, understandably, more concerned about the impact of O&G on tax revenues than on job creation, compared to those under 25.

We see some significant effects of the highest income indicators (particularly *Inc5*) on the share of economic growth and tax revenue, while, again compared to those in the lowest rung of the income scale, tend to give the wage increasing impact of O&G less importance than they give to job creation as such.

Although not all the coefficients end up being significant, there is a consistent negative sign on all categories of the multinomial logit for the indicator of residing in Western NL. That suggests that, relative to residents of areas of NL other than St John's, Western Newfoundlanders see job creation as more of a key contribution of the O&G when judging its impact (both on their own region and NL in general).

Table 17. Fractional multinomial logit: share of reasons for opinion on impact of O&G on NL.

VARIABLES	*shq2Decongrowth*	*shq2Dwages*	*shq2Dtaxrevenue*
male	0.0122	0.5204*	0.7328***
age_4554	0.2680	0.4138	0.3693
age_5564	0.2599	-0.0429	0.6572**
age_65plus	0.2381	0.5317	1.0580***
Inc3	0.3112	0.1016	0.3250
Inc4	0.5569*	-0.2847	-0.1714
Inc5	0.7478**	0.0006	0.7382**
University	0.1952	0.1355	0.0664
breWestern	-0.0490	-0.1601	0.4647
breotherNL	-0.6194***	-0.3212	-0.3713
Selfemployed	0.5660	-0.5644	0.2902
OILGASemployee	-0.0408	-0.3067	-0.3563
Q1A	-0.0072	-0.1558*	-0.0105
Q1B	-0.0457	0.1098	-0.0145
Q1C	0.1167**	0.0436	0.0774
Constant	-1.1881***	-1.4349**	-2.4554***
Observations	**505**	**505**	**505**

**** p<0.01, ** p<0.05, * p<0.1*

Table 18. Fractional multinomial logit: share of reasons for opinion on impact of O&G on Western NL.

VARIABLES	*shq2Econgrowth*	*shq2Ewages*	*shq2Etaxrevenue*
male	-0.3528	0.4607	0.1354
age_4554	0.8443**	0.0941	1.1252**
age_5564	1.4384***	-0.1656	1.2977**
age_65plus	0.5689	-0.2943	0.9126
Inc3	-0.3606	-0.9730	-0.1638
Inc4	0.4785	0.1910	0.1321
Inc5	0.0820	-1.5305**	0.1756
University	0.4610	0.6200	0.7179*
breWestern	-0.6566	-0.8745	-0.8118
breotherNL	-0.4214	-0.5665	-0.6693*
Selfemployed	0.0340	-0.4975	-0.1826
OILGASemployee	0.5885	-1.0082	-1.8269
Q1A	-0.0523	-0.0374	0.1819
Q1B	0.0588	0.0115	-0.3468***
Q1C	0.0591	0.0326	0.1019
Constant	-1.7679***	-1.0495	-2.6260***
Observations	**244**	**244**	**244**

**** p<0.01, ** p<0.05, * p<0.1*

8 SOCIAL LICENSE

The next questions presented to the respondents were about the notion of social license: defined for the respondents as having a strong majority of the population in favour of an issue. The exact preamble to the questions read:

These statements ask about social license and by social license we mean that the strong majority of the population is in favour of it.

The first question (although they were both rotated in order when presented to the respondent) then applied this notion to whether the O&G sector had a social license to undertake hydraulic fracturing in Western NL, while a second one asked about the social license of the O&G sector to operate in offshore NL.

Most respondents agreed that the O&G sector has a social license to operate in offshore NL. The results, as expected, were very different when it came to fracking, which received much less support. However, disagreement with the notion that the O&G sector enjoyed a social license to operate offshore in the province was higher among residents in the Western region (18%), compared to those in St. John's CMA (6%) and other parts of Newfoundland (6%).

8.1 Methodological Notes

Although we detected some minor problems with the assumption of proportional odds, we opted to go ahead and use ordered regression models. We identify the problematic indicators below, so we can report the results with the appropriate cautionary notes. We used a SURE (seemingly unrelated regression) approach taking advantage of Stata's *bioprobit* (bivariate ordered probit) routine (Sajaia 2008) to jointly model the two indicator variables, suspecting that there would be a significant correlation between the errors of the two individual ordered regressions that *ologit* or *oprobit* would yield. This model allows us to test whether this correlation is significant and makes it possible to

estimate efficiently the regression coefficients from each model. Because of this joint modelling, through this section we report models based on analysing only those observations with valid values for both *Q3A* and *Q3C*.

8.2 Results

Table 19 reports the results of two independent ordered probit regressions (one for each of the two variables, *Q3A* and *Q3C*, indicating whether the respondent agreed that a social license could be assumed for the proposed practice). Additionally, a *bioprobit* model was used to estimate jointly both regressions. The significant correlation coefficient[37] estimated by the bivariate model suggests that a more efficient estimation was achieved when the two responses were modelled jointly. We will, therefore, comment on the results obtained by this joint estimation technique.

We note, however, that preliminary exploratory analysis detected problems of violations of the parallel regressions assumption when estimating the individual ordered probits. The coefficients of some of the income indicators would not meet the assumption, but it was mainly the variables about knowledge/awareness of the industry in the province (variables *Q1A*, *Q1B* and *Q1C*) that again tended to present problems in terms of meeting the assumption of parallel regressions. That is because those respondents who see themselves as well informed are more likely to *both* agree and disagree more, so it is too constraining to impose a common coefficient for all the changes from "strongly disagree" to "strongly agree". This fact, and the issues of loss of observations that the use of a generalised ordered logit would create in this case[38] prompted us to use the bivariate ordered probit model. We proceed with caution, though, when it comes to the interpretation of the coefficients reported for some of the variables, mainly, as explained above, those associated with level of knowledge about the industry.

Thus, both the most parsimonious ordered probits, as well as the joint *bioprobit*, make it possible to keep things simple and study only one coefficient for each explanatory variable per dependent variable. Demographics play a significant role in the data generation process behind variable *Q3A* (indicating whether the O&G sector has social license to operate in offshore in Western NL) suggesting that both males and older respondents are less inclined to agree with the statement. On the other hand males are actually more likely to agree that "the O&G sector has a social license to operate in offshore Newfoundland" (*Q3C*). On the other hand, age does not seem to have any significant influence on that likelihood.

Respondent income is another variable that seems to positively affect both dependent variables, although it is more strongly significant in the case of *Q3C*. In the case of educational indicators, we find that a higher level of education is inversely related to the likelihood of agreeing with the first statement (about offshore operations in the West of the province), with several binary indicators showing strongly significant coefficients. On the other hand, when it comes to "offshore operations in NL," we cannot find any significant effect of education.

Residents in the West of NL are particularly unlikely to agree that offshore operations should be performed in their area of the province, relative to those residing in the capital area of St John's, and that effect is even stronger when referring to the case of the province in general. There is, however, no significant effect of the indicator of residing in other parts of the province, such as Central NL.

Self-employed respondents are less likely to agree with the statement in *Q3A*, while more likely, just like retired respondents, to agree with the more general statement in *Q3C*. Again, we see a disparity between how Newfoundlanders feel about the O&G sector operations on the West of NL and how they feel about its operations in general in the province of NL. When it comes to the respondent's type of employer, we can see that only working

[37] The likelihood-ratio test of the null that the equations are independent turned out a statisti equal to 32 distributed $\chi 2(1)$, and thus highly significant.

[38] The use of the more flexible generalized ordered logit model leads to a sizable loss of observations for which in sample crossing of the (now non-parallel) lines would result in predicted negative outcome probabilities.

for the industry itself makes it more likely to think that there is a social license for the O&G sector to operate in the West. The effect is not significant for the whole of the province, suggesting that other employees in general are not significantly less likely than O&G workers to support O&G operations, unless one is talking about the West in particular. Indeed, no other significant effects were detected related to the type of employer.

We turn now to the estimated coefficients of the variables *Q1A*, *Q1B*, and *Q1C*, analysed as dependent variables in Section 1. This time we see that *Q3A* and *Q3C*, about operations in the whole of the province and in the West of NL, are affected significantly by the awareness variables but in different directions, depending on which type of awareness we are considering. We included interaction terms between these variables to see if the degree of awareness/ knowledge about the operations of the O&G sector and the issue of fracking exerted significantly different effects depending on whether the respondent had a college degree.

Starting with *Q1A* (a ten category index of knowledge about knowledge of O&G exploration in NL), we see that it only exerts a positive effect on *Q3A* if the respondent has a university degree. Otherwise, the effect is negative, but not significantly different from zero. Conversely, those who say they know more about exploration in the West of NL are more likely to agree to the statement in *Q1A*, but less if they have a completed college degree. Unsurprisingly, the more a respondent declared to know about fracking, the less they feel that there is a social license for the O&G to operate in Western NL, an effect that is even stronger for college-educated respondents. The effect, in line with other results described throughout this report is, however, much weaker for the case of operations in NL in general. Furthermore, although knowing more about exploration in NL as a whole did not have any significant effect on *Q3A*, it does have a significant and positive effect on *Q3C*. Once again, we find that O&G operations in Western NL are different and much more controversial.

The results discussed above describe the significance and direction of the effects of explanatory variables, but only in qualitative terms. In order to get an idea of the strength of those effects, we can look at the changes in the predicted probability of choosing each of the response categories of questions *Q3A* and *Q3C*. In principle, however, it would be slightly more accurate and more complete to run predictions on joint outcomes for the variables using the results from the bivariate ordered probit. However, given that variables *Q3A* and *Q3C* have five outcomes each, an inordinate large number of predictions would have to be reported for each set of respondent profiles. A more manageable, if still quite verbose way to provide an idea of quantitative effects is to run the predictions by archetypical profile using the results from each individual ordered regression separately. Since, these nonetheless take a large amount of space, they have been relegated to Sections 20.3 and 20.4 in Appendix B.

This section reveals a few somewhat surprising results as compared with our initial expectations. However, it should be stressed that the question analysed deals with opinions of the respondents about what other people think, rather than about their own individual opinions. This might explain why, in some cases, we fail to see an expected effect or we even find, like in the case of variable *male* and the age indicator variables in the equation for *Q3A*, an effect opposite in sign to the expected one.

Table 19. Individual & bivariate ordered probits: O&G has social license to operate offshore.

	INDIVIDUAL *OPROBITS*		*BIOPROBIT*+	
Variables	*Q3A*	*Q3C*	*Q3A*	*Q3C*
male	-0.2046**	0.2698***	-0.2068**	0.2709***
age_2534	-1.0183***	-0.1194	-1.0142***	-0.1147
age_3544	-0.8719***	-0.3986	-0.8688***	-0.3880
age_4554	-0.9557***	-0.2056	-0.9506***	-0.2001
age_5564	-1.1015***	-0.1008	-1.0934***	-0.0985
age_65plus	-1.3815***	-0.4757	-1.3759***	-0.4754
Inc2	0.2429+	0.4580**	0.2438	0.4528**
Inc3	0.2889+	0.2937+	0.2895	0.2907
Inc4	0.2020	0.6317***	0.1997	0.6299***
Inc5	0.2495	0.8674***	0.2490	0.8641***
HSchool	-0.3814*	0.0899	-0.3860*	0.0935
Sometradetechcollege	-0.3770*	0.1821	-0.3805*	0.1866
Tradetechncollege	-0.6112***	0.0317	-0.6114***	0.0329
Someuniversity	-0.4269*	-0.0424	-0.4308*	-0.0428
University	-0.3525	0.0277	-0.3513	0.0209
breWestern	-0.2384*	-0.5020***	-0.2405*	-0.5022***
breotherNL	-0.0888	-0.1039	-0.0852	-0.1082
Selfemployed	-0.4284**	0.3911*	-0.4310**	0.4037*
notemplooking	0.1184	-0.0591	0.1266	-0.0624
notempnotlooking	-0.3133	0.0930	-0.3113	0.0887
Retired	0.2065	0.4054**	0.2049	0.4101**
Student	-0.3543	0.0318	-0.3477	0.0309
universityemployee	-0.1653	0.0812	-0.1541	0.0970
NLgovemployee	-0.1912	-0.1781	-0.1939	-0.1799
FEDemployee	0.1288	0.0443	0.1131	0.0449
OILGASemployee	0.4388*	0.0068	0.4419*	0.0041
Q1A	-0.0526	0.0783**	-0.0539	0.0753**
Q1B	0.1432***	0.0040	0.1432***	0.0052
Q1C	-0.1049***	-0.0537*	-0.1046***	-0.0529*
intUni*Q1B*	-0.1340**	-0.0649	-0.1328**	-0.0671
intUni*Q1A*	0.1371**	0.0218	0.1350**	0.0261
intUni*Q1C*	-0.1036**	0.0453	-0.1021**	0.0434
Cut1	-2.5856***	-1.4682***		
Cut2	-1.5206***	-0.8574**		
Cut3	-0.8054**	-0.3152		
Cut4	0.3353	1.6470***		
Observations	**669**	**669**	**669**	**669**

+ *Output on estimated cut points omitted for bivariate model* (bioprobit).

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

9 AWARENESS OF THE PANEL AND THE REVIEW OF HYDRAULIC FRACTURING

After being told that a panel had been put together in order to conduct an independent review and providing recommendations concerning hydraulic fracturing in Western NL, respondents were asked if they had been aware of this before the interview call. About half of the respondents revealed awareness of the Panel and the review, although those who were aware of it were in a slight minority. There was no substantial difference in terms of the distribution of responses between the Western part of the province and the rest of NL, although residents from that part of the province did appear to be more aware of the existence of the Panel review.

Table 20. Percent distribution of responses to Q4 about awareness of Panel Review.

	REST OF NL	WESTERN NL	TOTAL
No	56.76	49.85	55.54
Yes	43.24	50.15	44.46
Total	**82.33**	**17.67**	**100**

9.1 Methodological notes

The indicator of whether respondents were aware or not of the panel review was a binary variable whose values were split almost 50-50 between zero and one ("no" and "yes"). This made it an ideal candidate to be modelled using a conventional probit or logit model. In practice, both models are equivalent, so we used a probit model in order to take advantage of the Stata command *hetprob* (heteroskedastic probit), which allows us to run a probit with heterogeneous scale. This is because the standard probit model assumes that the error distribution of the latent model has a unit variance and normalizes the estimated coefficients accordingly (Yatchew & Griliches 1985). Assuming that the distribution of the error is about the same for all observations might be untenable in some cases. The heteroskedastic probit model relaxes the assumption, allowing the error variance to vary with the value of some predictors in the regression model. Further details of this model, and the potential implications of this form of model misspecification, should consult, for example Alvarez and Brehm (1995), Allison (1999), and Williams (2009, 2010).

9.2 Results

We can see that a clear determinant of awareness of the Panel review is age. Older respondents likely tend to be more aware of the news in general and probably of the news related to politics and regulatory processes at the provincial level. In general, just like age has been shown to correlate with knowledge about fracking in general (e. g. Wolske et al. 2013), we expected older respondents to also know more about the Panel review in particular. It should be noted, however, that we only found significant the effect of binary indicators of group ages above 35 and that including the additional dummy indicating the group 25-35 years old[39] would results in additional non-significant coefficients for age group dummies. Therefore, we omitted also *age_2535*, so our base age category is in essence "younger than 35" for this model.

[39] The base group could only be 18-25 implicitly included.

Table 21. Probit and heteroskedastic probit of Q4: awareness of existence of Panel Review.

	PROBIT	HETPROBIT	
Variables	*Q4*reviewaware	*Q4*reviewaware	ln(σ^2)
Male	0.0852	0.2707	
age_3544	0.3386**	0.4767*	
age_4554	0.4632***	0.5769**	
age_5564	0.5975***	0.9986***	
age_65plus	0.8128***	1.3251***	
Inc2	0.2210	0.7548	
Inc3	0.3123	0.8638*	
Inc4	0.3566	0.8029*	
Inc5	0.4192*	0.9033*	
HSchool	0.0349	0.1987	
Sometradetechcollege	-0.2293	-0.3399	
Tradetechncollege	0.4640**	1.1274**	
Someuniversity	0.6606**	1.3565***	
University	0.6586***	1.4126***	
breotherNL	-0.0162	-0.2115	0.9434***
breWestern	0.2681*	0.4546*	0.6286**
Selfemployed	0.3113	0.5883*	
notemplooking	0.2914	0.3413	
notempnotlooking	-0.0092	-0.0788	
Retired	0.1770	0.2166	
Student	-0.8482**	-1.3725*	
OILGASemployee	0.4448+	0.5845+	
NLgovemployee	0.2548+	0.4372*	
Q1A	0.0744***	0.1185**	
Q1C	0.0620**	0.0957**	
Constant	-2.1253***	-3.9252***	
Observations	**756**	**756**	**756**

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

We find that the effect of income indicators tend to be only significant[40] when we account for the heteroscedasticity between residents of the St. John's CMA and the rest of the province but, in any event, indicators of higher income have a positive effect on the probability of being aware of the Panel, again in line with expectations.

As expected, even after controlling for age, having postsecondary education increases signifi the probability that a respondent is aware of the Panel Review process. This matches our *a priori* expectations too: better educated respondents are better informed about the regulatory issues surrounding energy development. And again, not surprisingly, it is those residents from the Western part of the province that tend to have more knowledge about the Panel.

We included only two variables indicating the type of employer and we detected a weakly significant positive effect of working for the industry and of working for the NL provincial government on the probability of being aware of the Panel. Note, however, that these effects are quite weak statistically. They could only be found when other indicators

[40] Since in this case there is really no reason to justify reporting the indicators of significance based on one-side hypothesis tests.

are kept off the model and almost always require the use of a one-sided test, which in this case we can justify by admitting that one can easily assume that those working for two of the main parts involved in the decision-making process should be more aware than the average employee about said process.

In line with expectations, increased awareness/knowledge about the of the operations O&G sector in NL and about fracking are associated with significantly higher levels of awareness of the existence of the Panel.[41]

10 SUPPORT OF AND OPPOSITION TO "FRACKING" IN WESTERN NL

There is, as shown in Table 22, a much greater share of respondents who are opposed to fracking in Western NL than in favour, as revealed by the responses to Q5. More than twice as many respondents oppose it, whether *strongly* or not, while only 19% were overall in support and about one in four stated to be neutral about it. Those respondents from the West of NL oppose fracking in the Western part of the province much more frequently too (52% of them) than those in the capital, St. John's CMA (39%) or other areas of the province (43%). These figures suggest that in NL support for fracking is much less widespread than what previous studies (e.g. Davis and Fisk 2014) have found for the case of the US, where opposition and support for fracking are usually found evenly split, when there are not actually more supporters than detractors.

The share of supporters of fracking is, however, about the same (approximately 20%) regardless of which part of the province one considers[42] (those opposed to fracking reduce the proportion associated with the *neutral* category in the case of the Western part of the province).

Table 22. Distribution of Q5 by broad region of residence.

REGION	OPPOSE	NEUTRAL	SUPPORT	NO RESPONSE	TOTAL
St. John's CMA	38.9	35.17	18.36	7.57	100
Western	51.78	23.61	19.21	5.4	100
Other NL	43.34	30.59	20.57	5.5	100
Total	**43.36**	**30.87**	**19.6**	**6.17**	**100**

Similarly, older respondents, those over 55, were significantly more often opposed than the younger demographic (50% vs. 34% respectively) and, as in the case of the geographic split, those respondents in opposition to fracking reduced the *neutral* category, leaving the share of supporters across age groups approximately equal across age categories (Table 23). In particular, when looking at a finer disaggregation by age category (not shown in Table 23), one could see that 60% of those in the youngest demographic (18-25-year-olds) said to feel neutral about the issue, while only 22% of those over 65 chose that option.

[41] Note that we have left out *Q1B* of the regression. Since the three variables *Q1A*, *Q1B*, and *Q1C* are strongly correlated some of the coefficients would should as less significant when all the variables were used at once. Our results might include some issues of variables omission for this reason (the shown effect of *Q1A* could be capturing the effect of *Q1B* instead, which is of course also significant and positive) but this should not detract from the main, and obvious, message: knowing more about the issue makes people more aware about this particular aspect of the decision process.

[42] And about the same as what the American studies find (e.g. Davis and Fisk 2014).

Table 23. Distribution of Q5 by broad age category.
In general, which of the following best represents how you feel about hydraulic fracturing, commonly called fracking, for oil and gas in Western NL?

AGE	OPPOSE	NEUTRAL	SUPPORT	NO RESPONSE	TOTAL
18 to 34	34.02	38.74	22.64	4.6	100
35 to 54	42.35	33.65	17.45	6.55	100
Over 55	49.69	23.7	19.88	6.74	100
No response	100	0	0	0	100
Total	**43.36**	**30.87**	**19.6**	**6.17**	**100**

It is also noteworthy that a relatively large proportion of respondents (6.17%) declared not to know whether they supported fracking in Western NL or not. This suggests that there is a relative large share of the population who feels that they do not have enough evidence to form an opinion or simply have not had enough interest to do so. This type of result is routinely found in studies of attitudes towards and opinions about fracking, as shown, for instance, in the literature review included in Wolske et al. (2013).

10.1 Methodological Note

Although it originally contained five response categories, in order to optimise the analysis of the responses to Q5 and to simplify its interpretation, a simplified three-category version of the variable was used in this section. Therefore, *Strongly Oppose* and *Oppose* were collapsed into *Oppose* and *Support* and *Strongly Support* into *Support*, leaving *Neutral* unchanged. A generalised ordered logit model was run after a preliminary likelihood-ratio test ($\chi^2(32) = 106.57$ with Prob > $\chi^2 = 0.0000$) rejected the parallel regressions assumption showed that several variables including all the income indicators would fail to meet the assumption, even when tested at 0.01 level of significance. This means that even a model based on the partial parallel regressions assumption would be rather complex. Additionally, using the generalized ordered logit model would result in a great loss of observations. Therefore, we had to resort to a most flexible but least parsimonious multinomial logit that treats all the categories of the dependent variable as unordered. We report and discuss only the results of this multinomial logit. We note in passing that, given the type of question analysed in this section, it is worthwhile to use a model that, if quite complex, makes it possible to explicitly model the factors that make it more likely for certain respondents to choose the "neutral" category when asked about their views about fracking in Western NL.

In this section, we add to the right-hand-side of the explanatory model a battery of factors obtained from questions places further down in the questionnaire. The first set is a series of binary indicators of whether respondents. The first set of new explanatory variables stems from data obtained from *Q9*. In this part of the questionnaire, several statements were read to the respondents and they were asked to choose their level of agreement with them. The statements were:

1. *The government of Newfoundland and Labrador can effectively regulate the oil and natural gas industry.*
2. *The oil and natural gas industry will be operated in an environmentally responsible manner.*
3. *Western NL needs the jobs and revenues from the oil and natural gas industry.*
4. *The oil and natural gas industry is committed to providing information to the public.*
5. *If the oil and natural gas industry is successful, it will create long-term benefits for western Newfoundland.*
6. *The oil and natural gas industry can be operated in an environmentally responsible manner.*

As explained in Section 12, the ordinal responses about these statements were simplified into binary variables, so the transformed variables (labelled *q9canregulate*, *q9willenviro*, *q9Wneedsjobs*, *q9willinform*, *q9Wbenefits*, and *q9canenviro*) were used as explanatory variables for the responses to *Q5*.

The second set of variables stem from the transformations involved in analysing *Q11* (*What type of additional information is needed?*, asked right after *Q10*: *Do you think there is a need to provide more information on the oil and natural gas industry to the people in Newfoundland and Labrador?*), dealt with in Section 13. These binary indicators of types of additional information mentioned are labelled *q111enviroimpact*, *q112safetyprocedures*, *q113econbenefits*, and *q118risks* and are just a subset of the ones constructed.[43]

10.2 Results

We report the results of the multinomial logit model expressed with "oppose" as the base outcome, so we will comment on the effects of the different explanatory variables on the other two outcomes relative to the benchmark "oppose". Some of the results will be better understood by considering the estimated marginal[44] effects of each variable on the probability of choosing each of the three outcomes and the predicted probabilities of choosing each outcome for the hypothetical profiles we list in Appendix B (Section 20.6).

Older respondents are much less likely to be neutral about the issue of fracking in Western NL than to oppose it, although, once we control for age and all other covariates in the model, students are also less likely to state neutrality. Income exerts the opposite effect, with all indicators showing highly significantly positive coefficients. Males were also expected to be less likely to choose the neutral option, so we can use a one-sided test to achieve a significant result. Otherwise their negative coefficient would not be statistically different from zero. This suggests (something we could see if we reported the model with neutral as the base outcome or by looking at the postestimation analysis results in Table 25) that students and older respondents tend to be against fracking in the West of NL, while males and richer respondents tend to support it.

Just as one would expect, those better informed about the issue of fracking in Western NL are significantly less likely to consider themselves neutral about fracking as stated in Q5 and more likely to oppose it. The effect of Q1A, measuring knowledge about the operation of the O&G industry in NL also has a negative coefficient but only significant if a one-sided test is assumed acceptable.

The four variables that indicate the degree of agreement with a series of statements (analysed themselves in Section 12) have a highly significant positive effect on the likelihood to choose the neutral option. Those who agree, whether strongly or not, with the statement that the "oil and natural gas industry will be operated in an environmentally responsible manner"(*q9willenviro*); that "Western NL needs the jobs and revenues from the oil and natural gas industry"(*q9Wneedsjobs*); that "the oil and natural gas industry is committed to providing information to the public" (*q9willinform*); and that "if the oil and natural gas industry is successful, it will create long-term benefits for western Newfoundland"(*q9Wbenefits*) are significantly more likely to feel torn about fracking as compared to *oppose* fracking. Those respondents who agreed with these positive views about the O&G industry were significantly less likely to oppose, and, as explained below, indeed more likely to support fracking in Western NL.

Those most aware about the existence of the Review Panel are less likely to be neutral on the issue. However, we see from postestimation analysis of the multinomial logit results (Table 25) that the effect of variable *Q4* is positive both on the probability of opposing and of supporting (although not significantly in the latter case) fracking in Western NL. This seems to be simply saying that those who know about the Panel Review are those most engaged with the issue, whether because they are really opposed to fracking or precisely the opposite, which is not at all surprising.

[43] See details in Section 13.

[44] Although, in fact, they are actually "discrete" effects in most cases, since the variables are almost all binary and not continuous.

Table 24. Multinomial logit of Q5: View of fracking in Western NL.
In general, which of the following best represents how you feel about hydraulic fracturing, commonly called fracking, for oil and gas in Western NL?

VARIABLES	NEUTRAL	SUPPORT
male	-0.3725+	0.4973+
age_2534	-6.2593***	-6.1002***
age_3544	-5.8932***	-5.9015***
age_4554	-6.1844***	-6.1787***
age_5564	-6.7322***	-6.5392***
age_65plus	-6.9934***	-6.3917***
Inc2	1.2822*	0.1675
Inc3	2.1027***	1.1937*
Inc4	2.1432***	0.4322
Inc5	1.6034**	0.3412
HSchool	-0.5359	-1.4735***
Tradetechncollege	-0.2863	-1.3669***
University	0.0209	-0.3107
breWestern	-0.6133+	-0.3025
breotherNL	-0.3080	0.0854
Retired	0.3276	-0.0454
Student	-3.5498**	-2.1408+
OILGASemployee	-0.3925	1.3900**
Q1A	-0.1212+	-0.2906***
Q1B	0.0507	0.1776*
Q1C	-0.1547**	0.0082
q9canregulate	0.1257	0.7200*
q9willenviro	0.6248**	2.3055***
q9Wneedsjobs	0.8555***	1.1385**
q9willinform	0.5861**	1.0537***
q9Wbenefits	0.5831*	1.7756**
q9canenviro	0.2242	1.7042***
*Q4*reviewaware	-0.6132**	0.1814
q111enviroimpact	0.0266	-0.5650*
q112safetyprocedures	-0.4745	-1.9806***
q113econbenefits	0.6826*	0.7969*
q118risks	-0.3527	-0.7684+
Constant	4.2172**	-0.2114
Observations	**596**	**596**

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

We included in the regression some indicators about whether the respondents mentioned different aspects of the issue about which "there is a need to provide more information on the oil and natural gas industry to the people in Newfoundland and Labrador" (*Q10* in the questionnaire, while the different aspect indicators where coded using information from *Q11*). Some of these indicators are about environmental concerns, about operational safety, or about risks surrounding the sector…but only those who felt the need for further information about the economic benefits appear significantly more likely to feel neutral about fracking in NL. This suggests that respondents likely tend to be worried about the negative potential impacts of fracking in terms of safety, environmental effects, and

social disruption, and that it is the uncertainty about the size of its economic benefits that keeps them wondering whether fracking is a good idea or not.

We know, after having tried in vain to summarize the information using a simpler ordered model, that we should not expect full symmetry in the estimated effects of the different variables. Most of the effects will nonetheless follow a discernible pattern in one direction (in favour or against fracking in NL and through declaring neutrality), so some of the results we observe by looking at the "support" equation of the multinomial model will simply correspond to the flipside of what the other equation revealed. Indeed, we confirm that male and richer respondents are significantly more likely to support fracking, while older respondents and students are significantly less likely, all compared with opposing it.

We see a new significant effect of two educational variables: those with a high school education and those with a trade/technical degree are less likely to support fracking. We see no significant effect of the Indicator *University* on any of the outcomes. This might be because the effect of having a college degree on the views about fracking actually could depend on the type of degree in particular (say Engineering, Economics, or Chemistry versus Political Science, English, or Anthropology).

O&G employees are significantly more likely to support fracking in Western NL rather than oppose it. This is also the case of those who say to know more about the industry in Western NL, while general knowledge about the O&G sector in NL exerts the opposite effect.

Additionally, and as anticipated above, respondents who agreed with the series of optimistic statements presented to them under Q9 about the O&G industry were significantly more likely to support fracking in Western NL.

And finally, we see again the divide between those who feel uncertain and uninformed about the environmental and safety issues surrounding fracking and those who are more concerned about the exact economic benefits. The former are against fracking in Western NL and the latter are in support.

Wald tests of the null hypotheses that any combination of two of the three categories in the multinomial model could be combined rejected with strong confidence those hypothesis, which confirms the advisability of using a multinomial logit in favour of a simpler two-category model such as a binary logit.[45]

In order to facilitate the interpretation of the results of the multinomial logit model, discrete effects (not marginal because of the discrete nature of the explanatory variables) measured at mean values of the explanatory variables are reported in Table 25. The reader interested in the size of the quantitative effects is referred, however, to the set of predicted probabilities calculated for different respondent profiles and relegated to Appendix B (Section 20.6).

[45] See Long and Freese (2006, p. 239 for details on these and other similar types of postestimation tests after a multinomial logit).

Table 25. Discrete effects at means from multinomial logit: View of fracking in Western NL.

VARIABLES	OPPOSE	NEUTRAL	SUPPORT
male	0.0501	-0.1085**	0.0584**
age_2534	0.7557***	-0.6124***	-0.1433***
age_3544	0.6876***	-0.5537***	-0.1339***
age_4554	0.8076***	-0.6507***	-0.1569***
age_5564	0.7737***	-0.6277***	-0.1460***
age_65plus	0.7677***	-0.6311***	-0.1365***
Inc2	-0.2641**	0.3035**	-0.0394
Inc3	-0.4237***	0.4280***	-0.0042
Inc4	-0.4084***	0.4662***	-0.0578
Inc5	-0.3292**	0.3651***	-0.0359
HSchool	0.1652*	-0.0870	-0.0782***
Tradetechncollege	0.1156	-0.0249	-0.0907***
University	0.0102	0.0166	-0.0268
breWestern	0.1349+	-0.1298*	-0.0051
breotherNL	0.0577	-0.0772	0.0195
Retired	-0.0648	0.0814	-0.0166
Student	0.4828***	-0.4076***	-0.0752*
OILGASemployee	-0.0628	-0.1668	0.2296*
Q1A	0.0385*	-0.0178	-0.0207**
Q1B	-0.0188	0.0053	0.0136*
Q1C	0.0308**	-0.0375**	0.0067
q9canregulate	-0.0591	0.0035	0.0555*
q9willenviro	-0.2378***	0.0484	0.1894***
q9Wneedsjobs	-0.2201***	0.1607**	0.0594*
q9willinform	-0.1676***	0.0987*	0.0689**
q9Wbenefits	-0.1896**	0.0852	0.1044***
q9canenviro	-0.1165*	-0.0014	0.1178***
*Q4*reviewaware	0.1126*	-0.1524***	0.0398
q111enviroimpact	0.0217	0.0281	-0.0498*
q112safetyprocedures	0.1598*	-0.0700	-0.0897***
q113econbenefits	-0.1721**	0.1272*	0.0449
q118risks	0.1048	-0.0598	-0.0449
Observations	**596**	**596**	**596**

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

11 REASONS TO SUPPORT, OPPOSE OR STATE NEUTRALITY HYDRAULIC FRACTURING IN WESTERN NL

We find that the reasons respondents suggested for supporting fracking in Western NL follow along the lines of those responses provided earlier when asked for reasons for their view of the impact of the O&G industry in the province. Indeed, the reasons respondents list most frequently in support of fracking are related to its potential for job creation (42%), its potential for boosting the economy (35%), the belief that it is a safe extraction process (20%), and the notion that it is better to have more resources (13%).

When it comes to the reasons for opposing fracking in Western NL, two environment-related concerns top the list of responses: worries about general environmental concerns (55%) and concerns about water quality (53%). Less frequently mentioned reasons are: unknown risks (18%), lack of a social license (15%), soil contamination and possible earthquakes (12%), and health effects (10%). Very few respondents worried that the Review Panel is biased (2%) or that the decision-making process is predetermined (2%).

Finally, much as expected, the main reasons mentioned for declaring oneself neutral about fracking in Western NL are general lack of information about the topic in general (50%), lack of information on the associated risks (48%), and lack of information on benefits (42%).

11.1 Methodological Notes

We had indicators of whether a given reason had been mentioned by a respondent, so we could model the probability that a given reason be chosen using individual logits or probits. However, since there was at the outset the strong suspicion that the errors of those individual regressions would be correlated, we ran an *mvprobit* (multivariate probit)[46] for each of the types of response for *Q5* (*oppose*, *neutral*, and *support*). For each of these categories, we only included the most commonly mentioned reasons, though, in order to keep the computation manageable within the multivariate probit framework, and also to avoid perfect prediction issues.

We also use a relatively limited specifi based mostly on demographic factors, as well as the degree of awareness about the industry in this province. However, even from these simpler models we can only find a few significant relationships.

11.2 Results

11.2.1 Explaining Support for Fracking

Among the reasons for supporting fracking in Western NL, *job creation* was the most frequently mentioned, and we can see that some of the respondents with higher income would be more likely to mention it (Table 26). It is not surprising to find this effect, since the fortunes of many of the households in the higher income brackets in this province are directly or indirectly linked to the economic benefits afforded by the O&G industry. Otherwise, we cannot find any other factor that significantly affects the likelihood to mention that reason. Similarly, being male is the only significant factor increasing the likelihood of mentioning an improved economy as a reason to support fracking. We do find more significant coefficients when considering the regression on the indicator of having mentioned safety considerations as a reason to support fracking, with older and richer respondents being more likely to mention that reason and university educated ones being less likely.

A likelihood-ratio test can be used to test the null hypothesis that all of the correlation coefficients between the errors of the individual binary regressions are jointly zero. In this case, this hypothesis could only be rejected at the 0.1

[46] See Cappellari and Jenkins (2003) for details on this type of model.

level of significance, not at the usual 0.05. We nonetheless report the *mvprobit* results for consistency with the other categories and because in qualitative terms the results would make little difference. Furthermore, the correlation coefficient responsible for the overall lack of significance is actually the correlation between the error of the equation for *q6jobs* and *q6economy*. Since it is reasonable to expect that unobserved factors affecting the former would also to a large extent affect the latter, a one-sided test based on assuming a positive correlation would be acceptable. In that case, all three correlation coefficients would be estimated as individually (and thus also jointly) significant.

Table 26. Multivariate probit regression of reasons to support fracking in Western NL.

VARIABLES	q61jobs	q61economy	q6itssafe
male	-0.0933	0.4013*	0.1266
age_3544	0.4860	0.5590	0.4818
age_4554	-0.1245	0.3584	0.6647*
age_5564	0.3160	-0.1932	0.6967**
age_65plus	-0.1370	-0.0405	1.0531***
Inc3	-0.5034	0.1203	0.3008
Inc4	-1.3054***	-0.3746	0.7188
Inc5	-0.4367	0.0354	0.7651**
University	0.1534	-0.3224	-0.5916*
breWestern	-0.0679	0.2832	0.2614
Selfemployed	0.3266	-0.0077	0.2893
Q1A	-0.1094	0.0994	0.0175
Q1B	0.0012	-0.0457	-0.0258
Q1C	-0.0825	-0.0524	0.0804
Constant	0.9767**	-0.8084**	-2.2940***
ρ_{21}	0.1986+		
ρ_{31}	-0.7120***		
ρ_{32}	-0.5736***		
Observations	**147**	**147**	**147**

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

11.2.2 Explaining Opposition to Fracking

The next *mvprobit* model deals with the three chief reasons behind an opposition to fracking in Western NL. As shown in Table 27, the first one (concerns about "Greenhouse gases/more macro pollution and the environment") was more often mentioned by those opposers to fracking who were younger than 35 (with all other age category indicators showing a significantly negative sign in the regression) and those with a college degree. Respondents from the West of NL who opposed fracking were significantly less likely to do it because of these large-scale environmental concerns. On the other hand, those opposers who said to be better informed about fracking (*Q1C*) were more likely to mention this reason for their opposition.

The modelling of the other, less frequently mentioned, reasons for opposing fracking did not yield many significant coefficients. However, we can see that males are more likely than females to oppose fracking because of local pollution (such as local water pollution) issues, which is somewhat surprising. The same effect is found for those who said to be better informed about fracking. We also find some relation between higher income and the probability of opposing fracking citing unknown risks as the reason.

In this case the likelihood-ratio test used to test the null hypothesis that all three correlation coefficients between the

errors of the individual binary regressions are jointly zero strongly rejected the null. However, this was because of the strong correlation between the errors of the first and second and first and third regressions. The correlation between the errors of the regressions of the reason "Local water quality/contamination/more local and personal environment comments" and "other unknown risks" was not at all significant.

Table 27. Multivariate probit regression of reasons to oppose fracking in Western NL.

VARIABLES	q62greenhouseetc	q62localpollution	q62unknownrisks
male	-0.1888	0.2946*	0.1647
age_3544	-0.9029***	0.0995	0.2098
age_4554	-0.5403*	-0.0352	0.5022
age_5564	-0.8680***	0.3306	0.5442
age_65plus	-0.7165**	0.2323	0.4637
Inc3	0.1227	0.0006	0.0837
Inc4	0.0187	-0.0290	0.6196**
Inc5	0.3106	-0.1527	-0.1072
University	0.3710**	0.1370	-0.1884
breWestern	-0.5466***	-0.0367	-0.3281
Selfemployed	-0.1614	0.4896	0.1606
Q1A	-0.0769	-0.0716	-0.0834
Q1B	0.0335	0.0671	0.0299
Q1C	0.0915**	0.0685*	0.0222
Constant	0.5276	-0.4329	-1.2370***
ϱ_{21}	-0.2262**		
ϱ_{31}	-0.2143**		
ϱ_{32}	-0.640		
Observations	**343**	**343**	**343**

****p<0.01, **p<0.05, *p<0.1*

11.2.3 Explaining Neutrality about Fracking

Finally, the third multivariate probit, models the main reasons presented by those 252 respondents who said they felt neutral about fracking in Western NL. All the reasons for neutrality have to do, unsurprisingly, with the lack of information to perform a full cost-benefit analysis in the mind of the respondent (Table 28). The first reason we consider is "Lack of knowledge on the topic in general" and, again, as expected, it is mentioned more frequently by those respondents who reside in the West of NL and less frequently who said they knew more about O&G operations in Western NL (*Q1B*) and about fracking (*Q1C*). Interestingly, though, we find that respondents with more knowledge of the operations of the O&G industry in NL in general are more likely to feel neutral about fracking in the West of the province because of this general lack of information. This might suggest that even those people who are quite comfortable with what they know about the sector in general feel they need to deal with some uncertainties regarding fracking in particular. We had found the these individuals better informed about the O&G industry were less likely to be neutral about fracking but, if they are, they are significantly more likely to justify it on the grounds of lack of information.

We observe a similar type of effect when we look at the results of the binary model to explain the choosing of "Need more information on risks" as a reason for neutrality. Those who know more about fracking are much less likely to be neutral about it (that is, they are more likely to have made up their mind one way or another). But if they happen to be still neutral, they are more likely to say it is because they need more information about the risks and also about the

benefits than those who know less about it. This, together with the fact that, as previously explained, fracking-aware respondents are significantly less likely to mention a general lack of information about fracking to explain their neutral position confirms that feelings about fracking tend to be polarized. That is, those who care most about fracking and say they have more information about it either focus on uncertainties about the risks or on uncertainties about the benefits but not on both, if they have not yet made their minds up between opposing or supporting the practice in Western NL.

In this case, not only does the likelihood-ratio test used to test the null hypothesis that all three correlation coefficients between the errors of each pair of individual binary regressions are jointly zero strongly reject the null (with a test statistic distributed as a $\chi^2(3)$ and equal to 136.28, so Prob > χ^2 = 0.0000). In fact, all three individual correlations between errors are highly significantly different from zero.

Table 28. Multivariate probit regression of reasons for being neutral fracking in Western NL.

VARIABLES	q63lackofinfo	q63moreinforisk	q63moreinfobenefits
male	-0.1862	0.0826	0.1966
age_4554	0.4021	-0.0808	-0.2081
age_5564	-0.2195	0.4413	-0.1992
age_65plus	0.4168	-0.0283	-0.2052
Inc4	-0.0371	-0.1638	-0.1563
Inc5	-0.0195	-0.2796	-0.3041
University	0.0658	0.1036	-0.2798
breWestern	0.5948**	0.0297	0.0460
Q1A	0.2157***	0.0663	-0.1188*
Q1B	-0.2153***	-0.0942	0.0169
Q1C	-0.1994***	0.1608**	0.1387*
Constant	0.2381	-0.9366***	-0.4887*
ϱ_{21}	-0.6308***		
ϱ_{31}	-0.8291***		
ϱ_{32}	0.9186***		
Observations	**219**	**219**	**219**

**** p<0.01, ** p<0.05, * p<0.1*

12 STATEMENTS ABOUT FRACKING IN WESTERN NL – LEVEL OF AGREEMENT

A series of statements describing positive aspects of the O&G industry and fracking both in general and in Western NL in particular were read to the respondents, who were asked to which extent they agreed or disagreed with each of them. In general, the level of agreement is quite strong for many of these statements.

For example, most respondents agree that Western NL needs the jobs and revenues from the industry (73%) and that the O&G sector will yield long-term benefits in that part of the province (70%). Very few disagreed with these two statements (14% and 16%, respectively).

A majority of respondents (65%) believe that the O&G industry can be operated in an environmentally responsible manner and only about a fifth do not but, as expected, a lesser proportion believes that the industry will in fact be operated in an environmentally responsible manner (46%).[47] However, respondents tended to agree somewhat differently with these two statements, depending on their socio-demographic characteristics. For example, younger adults were more likely to agree that the O&G industry can be operated in an environmentally responsible manner.

When considering the raw distribution of the responses about the other statements, we also see relatively strong general support for the industry. Some 60% of respondents believe that the provincial government can effectively regulate the O&G industry and about half of the respondents believe that the industry is committed to providing information to the public. Disagreement was, however, among the highest for these two statements, with 25% and 30% of respondents, respectively, indicating they disagreed with them.

In general, the data suggest that the public believes that there is a strong possibility to do fracking in Western NL in a safe, well-regulated, and environmentally responsible manner that will result in needed increases in economic welfare for that part of the province. Next, we try to uncover further patterns between explanatory factors and the responses to these statements.

12.1 Methodological Notes

Before attempting to analyse the determinants of the responses to each individual statement using independent ordered regression techniques, the information obtained from all six of them was summarized into a single index. This was simply constructed adding up, for each respondent, the numerical values (any of 1 to 5 for *strongly disagree* to *strongly agree*) obtained from each response.

The minimum value of the index is then 6 and the maximum is 30. The average value of 20.7[48] suggests that most respondents who provided a valid answer about these six statements showed a relatively high degree of agreement with most of said statements.

A simple OLS regression provides a way to explain how this summary of views about the O&G industry is affected by different explanatory factors.

Individual ordered regressions could then be used to model the responses about each individual statement. However, most of the individual regressions suffered from the pervasive issues of violations of the parallel regressions assumption and issues of loss of observations when a gologit was attempted. Therefore, in order to keep consistency across statements we used the most flexible model, the multinomial logit, on six simplified variables with only three

[47] And almost 30% of respondents disagreed with this statement.
[48] The average score per question was 3.44.

categories: disagree (incorporating both the original *strongly disagree* and *disagree*), *neither agree nor disagree*, and agree (encompassing the original *agree* and *disagree* categories).

12.2 Results

The results of the OLS regression (reported in Table 29) clearly show a positive effect of income on the level of agreement with the statements. The age indicators corresponding to those over 45 suggest a significantly negative effect of older age on the level of agreement compared to those under 25. The other age category indicators have no significant effect, though.

The negative effect of education on the degree of agreement is also clear, with all the indicators showing highly significant coefficients. Discouraged unemployed workers are less likely to agree with the statements.

Finally, those respondents who feel they have more information about the operations of the O&G industry are more in agreement with these positive statements about the industry and even more if they also have a university degree. However, those who say they know more about fracking are much less in agreement and even less if they have a university degree.

We report all six individual multinomial logit models (using *strongly disagree* as the base outcome category) in Table 30 and Table 31. It is more difficult to identify discernable patterns of effects based on significant coefficients in most of the individual models but those that can be found respond to the general patterns identified by the OLS approach used above.[49]

[49] Note that there are no reported predictions in the appendix obtained from these multinomial logits, because we judged that the OLS provides enough quantitative information about the general attitudes towards the statements and because reporting the predictions for each outimce on each of the six statements for all of the respondent profiles would be overwhelming.

Table 29. OLS regression of index of support for statements about the O&G in NL.

VARIABLES	Q9index
male	-0.2623
age_2534	-0.7970
age_3544	-0.8461
age_4554	-1.3233*
age_5564	-1.5253*
age_65plus	-2.1000**
Inc2	1.1220*
Inc3	1.6513***
Inc4	1.7462***
Inc5	1.9458***
HSchool	-1.4120**
Sometradetechcollege	-1.9324**
Tradetechncollege	-1.6635***
Someuniversity	-2.1197***
University	-3.5847***
Selfemployed	-0.4379
notemplooking	-0.0534
notempnotlooking	-1.5612**
Retired	0.2339
Student	-0.0937
breotherNL	0.1998
breWestern	0.0767
universityemployee	-0.8674
NLgovemployee	-0.2238
FEDemployee	0.3265
OILGASemployee	0.8726
Q1A	0.1514
Q1B	0.2128**
Q1C	-0.3602***
intUni*Q1B*	-0.3226
intUni*Q1A*	0.4939**
intUniQ1C	-0.2511
Constant	16.3580***
Observations	**616**
R-squared	**0.210**

**** p<0.01, ** p<0.05, * p<0.1*

Table 30. Multinomial logit regressions for (three first) statements about the O&G in NL.

	GOVERNMENT OF NL CAN EFFECTIVELY REGULATE THE O&G		O&G WILL BE OPERATED IN AN ENVIRONMENTALLY RESPONSIBLE MANNER		WESTERN NL NEEDS JOBS AND REVENUES FROM THE O&G	
Variables	*Neither agree nor disagree*	*Agree*	*Neither agree nor disagree*	*Agree*	*Neither agree nor disagree*	*Agree*
male	-1.3421***	-0.0899	-0.6728**	-0.1811	-0.3554	0.0043
age_2534	-0.8042	-1.3146*	-0.2132	-0.2981	-15.8520	-15.8018
age_3544	-1.1164	-1.2166	-0.0716	-0.2089	-15.8619	-15.6100
age_4554	-1.2978	-1.7514**	-0.2885	-1.0442*	-16.5720	-16.0219
age_5564	-2.0170**	-1.9114**	-1.0660	-0.9874	-16.9890	-16.5012
age_65plus	-2.2340**	-1.9903**	-2.6303***	-1.5863**	-17.4168	-16.7429
Inc2	0.7194	0.9566**	0.0545	-0.0022	0.1410	0.8009
Inc3	0.3120	0.9717**	0.4509	0.2540	-0.0944	0.6540
Inc4	0.7568	1.1513**	0.2294	0.0097	-0.6393	0.4666
Inc5	0.1409	0.7334*	0.5419	0.4862	-0.2682	0.6411
HSchool	2.0689*	-0.1155	1.3136	-0.7851	15.0812	-0.1501
Sometradetechcollege	1.9807	-0.3460	0.9878	-1.7543***	14.5510	0.1344
Tradetechncollege	1.8493	-0.4887	1.1832	-1.2688**	15.1043	-0.3203
Someuniversity	1.3729	-0.5497	1.4067	-1.6020***	14.8622	-0.4522
University	2.4271*	-0.6784	1.7294	-2.3808***	15.0322	-0.7277
breWestern	0.0851	0.1610	-0.5408	-0.3656	0.1898	0.1996
breotherNL	-0.2489	0.3255	-0.2193	-0.1527	-0.2037	-0.0418
Selfemployed	0.5819	0.2080	0.8267	0.2384	-0.5843	0.1584
notemplooking	0.8587	0.5425	-1.3247*	-0.4659	-0.4446	-0.0150
notempnotlooking	0.0232	-0.4344	-0.3802	-1.0229**	0.7254	-0.5423
Retired	0.0254	0.3379	1.0779**	0.5567	-0.2860	0.0417
Student	-0.6874	-0.7964	0.4501	-0.1468	-0.5569	-0.6259
universityemployee	0.2460	-0.1073	-0.0445	0.2032	1.2848	0.2379
NLgovemployee	0.2673	0.4990	-0.1379	-0.6866**	0.4022	0.5584
FEDemployee	-0.0904	0.5643	0.9493	0.4025	-0.8713	-0.2807
OILGASemployee	0.8374	1.0939	0.6563	0.5283	1.9869*	1.0177
Q1A	0.0673	0.0398	-0.0862	0.0789	-0.1497	-0.0336
Q1B	0.0316	0.0658	0.2368**	0.2628***	0.1369	0.1586
Q1C	-0.0362	-0.0802	-0.0889	-0.3371***	-0.0832	-0.1702**
intUni*Q1B*	0.1037	-0.1912	-0.5292***	-0.3396**	-0.1274	-0.0718
intUni*Q1A*	-0.0444	0.3346**	0.4110**	0.1333	0.3123	0.3419**
intUni*Q1C*	-0.2473	-0.2447**	-0.1635	0.1285	-0.1991	-0.3263**
Constant	-1.0093	1.7945*	-1.0557	2.9610***	2.1638	18.0060
Observations	**724**	**724**	**688**	**688**	**725**	**725**

****p<0.01, **p<0.05, *p<0.1*

Table 31. Multinomial logit regressions for (three last) statements about the O&G in NL.

	O&G IS COMMITTED TO PROVIDING INFORMATION TO THE PUBLIC		IF O&G IS SUCCESSFUL, IT WILL CREATE LONG-TERM BENEFITS FOR WESTERN NEWFOUNDLAND		O&G CAN BE OPERATED IN AN ENVIRONMENTALLY RESPONSIBLE MANNER	
Variables	*Neither agree nor disagree*	*Agree*	*Neither agree nor disagree*	*Agree*	*Neither agree nor disagree*	*Agree*
male	-0.2268	-0.3658*	-0.6619*	-0.4122*	-0.5374*	-0.3591
age_2534	-1.1294	-0.7119	-2.4143**	-1.5319*	-0.0101	0.1110
age_3544	-1.0311	-1.2040*	-1.6414	-1.1389	0.2340	-0.2303
age_4554	-0.5819	-1.2945**	-1.6523	-0.9204	-0.1819	-0.3983
age_5564	-1.3652	-1.0048	-1.2257	-1.5471*	-0.4890	-0.5235
age_65plus	-1.4334	-1.1655	-1.7062	-1.7690*	-1.2183	-1.0947
Inc2	-0.2438	0.2574	0.9725	0.7462*	0.0318	0.5373
Inc3	1.0239*	0.9105**	1.1193	1.2242***	0.5071	0.8337*
Inc4	1.3753**	0.7248	1.5311**	1.3287***	0.8950	0.9800**
Inc5	-0.0114	0.8009*	1.4680**	1.6096***	0.1036	0.9861**
HSchool	-0.5312	-0.8203*	14.4252	-0.3323	1.0498	-0.7356
Sometradetechcollege	0.1187	-0.9608*	12.8680	-0.2866	0.5151	-0.8138
Tradetechncollege	-0.5442	-1.3766***	14.6912	0.0160	1.4843	-0.6495
Someuniversity	0.0958	-1.7247***	14.0051	-0.4920	1.4588	-0.5107
University	-1.6581	-1.3848**	14.2153	-1.3626*	-0.2876	-1.6506**
breWestern	-0.6433	-0.2882	0.2129	0.0138	-0.0325	0.1670
breotherNL	-0.3394	-0.1492	0.3339	0.3766	0.3455	0.2949
Selfemployed	0.6469	-0.1439	-0.7969	-0.4897	0.4920	0.5921
notemplooking	0.1373	-0.0126	1.5122*	0.9105	0.7787	0.3448
notempnotlooking	0.3643	-0.6486	0.2566	-0.8987*	-0.9021	-0.7836
Retired	-0.2299	-0.0744	-0.1059	0.2469	0.5259	0.3311
Student	-1.4422	-0.4145	-0.4621	0.2104	0.6581	0.3785
universityemployee	-0.7154	-1.0430*	-0.5278	-0.3870	1.0253	-0.2536
NLgovemployee	-0.5514	-0.2010	0.3728	0.3550	0.3655	0.3097
FEDemployee	-0.6038	-0.5397	0.2061	0.8172	0.9957	1.3626*
OILGASemployee	1.8178**	0.9353	12.7199	14.0792	-0.5190	0.6794
Q1A	-0.0474	0.1007	0.1306	0.1369	-0.0613	0.1099
Q1B	-0.0739	0.1221	-0.0347	0.1604	0.1360	0.1320
Q1C	-0.1266	-0.1878***	-0.0513	-0.2617***	-0.1479	-0.2122***
intUni*Q1B*	0.0169	-0.2377*	-0.2165	-0.2245	-0.2806	-0.1356
intUni*Q1A*	0.2469	0.0565	0.2302	0.2781*	0.6982***	0.2776*
intUni*Q1C*	0.0036	0.0166	-0.1421	-0.1068	-0.3166*	-0.1827
Constant	1.5039	2.5861***	-14.2314	2.1211**	-1.1760	1.6764*
Observations	**712**	**712**	**717**	**717**	**714**	**714**

****p<0.01, **p<0.05, *p<0.1*

13 NEED FOR MORE INFORMATION

Respondents were specifically asked (*Q10*) if they felt the people of the province need more information about the O&G industry. This kind of issue had appeared already mentioned as a response to earlier questions by a fraction of the respondents. For example, those feeling neutral (saying that they would neither support nor oppose fracturing in Western NL) indicated a need for more information when asked to explain that choice. However, when asked directly about it, respondents revealed that basically all of them (and, in particular, not only those neutral about fracking) feel that there is a need for further information about the industry. Not very surprisingly, the largest share of respondents (46%) are those who mention the need for further "information on the environmental impact" of the industry operations (variable *q111enviroimpact*), as shown in Table 32. However, other frequently mentioned types of information are "general information about what is being done/will be done and where" (*q1111generalinfo*, with an 18%), "how the oil and gas will be extracted (process involved)" (*q116extractionprocess*, with 17%), and "economic benefits" (*q113econbenefits*, with 16%).[50]

Table 32. Summary descriptives: indicators of types of further information needed.

VARIABLE	OBS.	MEAN	STD. DEV.	MIN	MAX
q111enviroimpact	793	0.46327	0.498964	0	1
q112safetyprocedures	793	0.086409	0.281144	0	1
q113econbenefits	793	0.157609	0.364604	0	1
q114companiesinvolved	793	0.055735	0.229554	0	1
q111experelesewhere	793	0.047954	0.213803	0	1
q116extractionprocess	793	0.16874	0.374758	0	1
q118risks	793	0.110369	0.313547	0	1
q119benefits	793	0.089092	0.285056	0	1
q1110moremedia	793	0.060201	0.238009	0	1
q1111generalinfo	793	0.183779	0.387548	0	1

13.1 Methodological Notes

A multivariate probit model (*mvprobit*) was used to jointly model the choice of whether to mention a particular type of information. The analysis was constrained to the four most commonly mentioned types. Furthermore, the model had to be streamlined substantially in order to find significant effect patterns between the explanatory factors and the dependent variables. Preliminary testing led to the elimination of all income variables, none of which had any significant effect on the probability of mentioning any type of information.

13.2 Results

The results of the *mvprobit* (reported in Table 33) suggest that males, older respondents, and employees of the O&G industry, as expected, are somewhat less likely to have mentioned any of these four types of information.

Paradoxically, however, those who said they knew more about the operation of the O&G industry in NL (variable *Q1A*) are signifi more likely to have mentioned one of this top four types of information. The eff of knowledge (variable *Q1C*) about fracking is less clear: respondents with a high level of knowledge about fracking are more likely to mention the need for information on environmental effects of the industry operations, but less likely to demand other generic information.

[50] See Appendix A for fuller labels on the rest of indicator variables.

Table 33. Multivariate probit on indicators of type of information (Q11).
What type of additional information is needed? (After a positive response to: Do you think there is a need to provide more information on the oil and natural gas industry to the people in Newfoundland and Labrador?)

VARIABLES	q111enviroimpact	q113econbenefits	q116extractionprocess	q1111generalinfo
male	0.0826	-0.2442**	-0.0249	-0.1401
age_4554	0.0389	-0.3436**	-0.1369	-0.3795***
age_5564	-0.2741**	-0.0746	-0.0559	-0.4082***
age_65plus	-0.1301	-0.4862***	-0.5423***	-0.4346***
OILGASemployee	-0.3063	-0.4450	-1.1946**	-0.1472
University	0.0621	0.2226*	-0.3232***	-0.1081
Q1A	0.0427	0.0284	0.0573	0.0755**
Q1B	-0.0359	0.0173	-0.0726**	-0.0216
Q1C	0.0559**	-0.0105	0.0361	-0.0567**
Constant	-0.4413***	-0.9814***	-0.8782***	-0.6580***
ϱ_{21}	0.4260***			
ϱ_{21}	0.0774			
ϱ_{41}	-0.3684***			
ϱ_{32}	-0.1856**			
ϱ_{42}	-0.2694***			
ϱ_{43}	0.1523**			
Observations	**837**	**837**	**837**	**837**

**** p<0.01, ** p<0.05, * p<0.1*

14 GROS MORNE NATIONAL PARK

As question Q13, respondents were asked to indicate what they believe would be a reasonable size for a buffer zone around the Gros Morne National Park, located on the West Coast of NL, since some of the potential oil and natural gas resources may be close to the Park. This issue has received a relatively large amount of press in the last few months and the results indeed reveal that respondents deeply care about Gros Morne. Most feel the need to keep exploration away from the Park, with 60% indicating that a buffer zone of 25 km or more would be reasonable and only 8% accepting one of 5 km or less.

Table 34 Frequency distribution of preferred size of buffer zone around Gros Morne

	FREQ.	PERCENT	CUM.
5 km or less	63	8.47	8.47
5-25 km	202	27.15	35.62
25 km or more	479	64.38	100
Total	**744**	**100**	

14.1 Methodological Notes

After dropping the 4% of observation with "don't know" and other extreme responses, we ordered the three remaining categories assuming they had a meaningful order with the two extremes implying no need for a buffer zone at all and the notion that no reasonable buffer zone would suffice. In this case the choice of using the ordered regression model is supported by the tests of the assumption of parallel regressions, which is met when tested at the 1% level of significance.

14.2 Results

As shown in Table 35, only very few coefficients turned out to be significant in the ordered logit model, since there is very little variation in the values of the dependent variable. Basically, all respondents want to protect Gros Morne, so our probabilistic models cannot help us much in this case. We can see, however, that, as expected, males tend to demand a smaller buffer zone than females. Residents in the West of NL, tellingly, appear to strongly support a smaller buffer zone, perhaps because for them the land surrounding the park is a source of income more than an area of recreation. We see that effect at a lesser scale when considering residents in other zones of NL that are not St. John's.

Similarly, those who trust the industry to self-regulate and operate in an environmentally friendly manner do not ask for very large buffer zones, together with those who are concerned about the need to create jobs in this area of NL.

On the other hand, university employees tend to ask for the large category of buffer zone.

In Section 20.7 within Appendix B predicted probabilities for each category of Q13 are reported for the case of the different archetypical respondents used throughout this report.

Table 35. Ordered logit on preferred size of buffer zone around Gros Morne (Q13).
Some of the potential oil and natural gas resources may be close to Gros Morne National Park. There will be no exploring or drilling in the park and if there is oil and natural gas in that area, there is consideration being given to having a buffer zone around the park where no exploration or drilling could take place. In your opinion, which of the following is a reasonable size for a buffer zone around the park? (5 km or less; 5-25 km, more than 25 Km)

VARIABLES	Q13
male	-0.4703**
age_2534	0.3189
age_3544	0.9771**
age_4554	0.2893
age_5564	-0.4425
age_65plus	0.1154
Inc2	0.8085*
Inc3	0.2126
Inc4	-0.0676
Inc5	-0.6203
University	0.1483
breotherNL	-0.3219+
breWestern	-0.7545**
Selfemployed	0.9393**
OILGASemployee	-0.5583
NLgovemployee	0.1869
universityemployee	2.0495**
Q1A	0.0030
Q1B	-0.0412
Q1C	0.0466
q9canregulate	-0.4074*
q9willenviro	-0.6068**
q9Wneedsjobs	-1.5106***
q9willinform	-0.0331
q9Wbenefits	0.0545
q9canenviro	-0.3413
cut1	-4.8914***
cut2	-2.8380***
Observations	**556**

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

15 OVERALL IMPACT OF HYDRAULIC FRACTURING FOR OIL AND NATURAL GAS ON WESTERN NL

Towards the end of the questionnaire and after having been answering different questions more or less directly related to their opinions about fracking in Western NL, respondents were asked two further overarching questions. The first one was aimed at finding out their opinions about the overall impact of fracking on Western NL and the responses suggest that views about this controversial issue tend to be indeed mixed. Four in ten respondents believe that there will be a positive impact of fracking in Western NL, while 27% expect that impact to be negative, and another 23% expect it to be neutral. Note also that close to 1 in 10 respondents did not provide a valid answer to this question, in line with results obtained elsewhere (Wolske et al. 2013), which confirms that, apart from those who are already relatively in favour of fracking and those who are definitely against, there is a good share of the population who has not reached a verdict on the issue.

Table 36. Frequency distribution of Q14: overall opinion about impact of fracking in Western NL.

	PERCENT	CUM.
Very negative impact	10.27	10.27
Negative impact	17.02	27.29
Neutral impact	23.34	50.63
Positive impact	35.23	85.86
Very positive impact	5.1	90.96
No response	9.04	100

As shown in Table 37, negative expectations were significantly more prevalent in the Western region (38%), compared to those in the rest of the province, where they averaged about 25%. However, most of this extra proportion of negative reactions comes directly from the neutral category, since the share of positive reaction across the province is about the same.

Table 37. Distribution of responses to Q14: Western NL versus rest of NL.

	OTHER NL	WESTERN NL	TOTAL
Very negative impact	9.01	16.14	10.27
Negative impact	16.09	21.38	17.02
Neutral impact	24.78	16.61	23.34
Positive impact	36.08	31.30	35.23
Very positive impact	5.06	5.32	5.10
No response	8.99	9.25	9.04
Total	**100**	**100**	**100**

Once again, those who are optimistic about the overall impact of fracking in Western NL mention various economic reasons for this expected impact. The most frequently mentioned reasons involve job creation (74%) and a boost economy (56%). Respondents who expect the overall impact of fracking to be negative mention most frequently two reasons to support their position: general environmental concerns (62%) and worries about water quality (57%). These findings are fully consistent with responses analysed earlier in Section 7, and with most previous results found in the literature of US-based studies.

15.1 Methodological Notes

Similarly to the case of several of the previously analysed responses, we found that the assumption of proportional odds was not tenable in this case, both when analysing through an ordered regression model the original variable Q14 and when analysing a simplified version thereof with only three categories (*Negative*, *Neutral*, and *Positive* impact). Again, just like in the case of other variables in the dataset, we experimented with a more flexible technique to model ordered outcomes, the generalised ordered regression model. However, although this model showed that[51] only a handful of variables failed to meet the parallel regressions assumption, negative predicted probabilities would result for a relatively large number of cases in the sample. Therefore, and to keep reporting simpler, we only report the results of two multinomial models based on the simplified version of the dependent variable. The first model includes only the usual sociodemographic factors used in most earlier specifications. The second model uses some of the dependent variables of previous models, some of which, though, had been also used as explanatory variables before. Particularly in this case, however, no causal meaning should be attached to their coefficient, since they are likely to be affected by issues of endogeneity. That is to say, for example, that we will not be able to say that "believing that Western NL needs the jobs and revenues from the oil and natural gas industry makes one more likely to expect a positive impact of fracking on Western NL". At most, we will be able to say that "those types of respondents that think that Western NL needs the jobs and revenues from the oil and natural gas industry tend to also be the type of respondent who expect a positive impact of fracking on Western NL". In any event, there will be no quantitative predictions made using them because their likely endogeneity would bias their coefficients.

15.2 Results

The results of the two multinomial logits are reported in Table 38 with *negative impact* as the base outcome. The results reveal that older respondents are significantly less optimistic about fracking than the youngest age category (those under 25). Indeed, they are significantly less likely to expect a neutral impact too, so they are more likely to expect a negative impact of fracking. The effect of age is also increasing in age with the strongest effect being linked to being over 65. We can see, on the other hand (and particularly when we look at the more parsimonious model), that richer respondents are more optimistic about fracking.

Being a student and also having some higher education makes it less likely for a respondent to expect a negative impact of fracking, as suggested by our *a priori* hypotheses, although we only see the significance of the latter coefficients in the simpler model. Retirees are more optimistic about the impact of fracking, however.

Those who have more information about the operations of the O&G industry in Western NL are significantly more likely to choose *positive* or *very positive*, as their expected impact of fracking. The more a respondent indicates that he or she knows about fracking, however, the more likely to expect a negative impact.

As expected, those who agreed with the positive-sounding statements about the fracking and the operations of the O&G sector in Western NL are also significantly more optimistic about fracking there. Another unsurprising result is the one that links larger preferred sizes of the buffer zone for Gros Morne to a significantly higher probability to expect a negative impact of fracking in Western NL. We stress that we do not attach any causal meaning to these last estimated coefficients, making statements only in terms of types of respondents. For example, we find those respondents who are convinced that Gros Morne should be protected by a larger buffer zone to be also the same who feel pessimistic about fracking, but we cannot say that one condition causes the other.

Table 39 reports discrete effects at the means of all variables in the simpler model and in Section 20.8 in Appendix B predicted probabilities from the simpler multinomial logit model are reported. The predicted probabilities for

[51] Using a 0.01 level of significance when testing.

the negative impact category ("outcome 2") are for all respondent types consistently higher in Western NL than in St, John's. The *neutral impact* category is about the same between Western NL and St. John's respondent types, so the corresponding differences appear mainly in the *negative impact* category, much more frequently chosen by respondents who live in St. John's. Furthermore, it is noteworthy how large the predicted share of the neutral category ("outcome 3") is for most respondent types and how little difference the model predicts between males and females for all profiles.

Table 38. Full and simplified multinomial logit on overall expected impact of fracking in Western NL.

VARIABLES	*NEUTRAL IMPACT*	*POSITIVEIMPACT*	*NEUTRAL IMPACT*	*POSITIVEIMPACT*
male	0.0382	0.1151	0.0829	0.1967
age_2534	-4.4952**	-4.0845**	-4.3769***	-4.0290***
age_3544	-4.5436**	-4.6200**	-3.8694**	-4.1246***
age_4554	-4.5184**	-5.1437**	-4.0461**	-4.6556***
age_5564	-5.1898**	-5.2716**	-4.8936***	-4.8615***
age_65plus	-6.7113***	-6.1608***	-5.8526***	-5.7517***
Inc2	0.2805	0.7149	0.5823	0.8894*
Inc3	0.2620	1.3581*	0.4918	1.3624***
Inc4	-0.0010	1.4115*	0.2082	1.2208**
Inc5	0.0851	1.0699	0.4295	1.2417**
HSchool	1.5312*	0.8514	0.3980	-0.5621
Sometradetechcollege	0.9600	0.2760	0.7739	-0.4152
Tradetechncollege	-0.1355	-0.3753	-0.0599	-0.8260*
Someuniversity	0.2681	-0.4802	-0.0026	-1.1652**
University	-0.1375	-0.3783	-0.7688	-1.6601***
breotherNL	-0.2986	-0.4386	-0.0514	-0.1853
breWestern	-1.0285**	-0.5264	-0.5962	-0.4544
Selfemployed	-0.7428	-0.3058	-0.3798	-0.1737
notemplooking	-0.7340	0.5791	-0.2308	0.4439
notempnotlooking	-0.9096	-1.2629	-0.6760	-1.3170**
Retired	-0.0151	0.6906	0.5736	0.8845**
Student	-5.1724***	-3.2841*	-4.2022***	-2.4789*
universityemployee	0.1415	0.8408	0.2249	-0.0477
NLgovemployee	-0.4005	-0.2943	-0.1154	-0.2229
FEDemployee	-0.0247	-0.9079	0.4031	-0.1589
OILGASemployee	-0.7341	0.1353	0.0323	0.9173
Q1A	-0.0350	-0.1227	0.0917	0.0244
Q1B	0.0315	0.2205**	0.0283	0.2188***
Q1C	-0.2961***	-0.3005***	-0.3557***	-0.3906***
q9canregulate	0.4981	1.0210***		
q9willenviro	-0.0959	0.7209*		
q9Wneedsjobs	0.7548**	1.5616***		
q9willinform	0.0117	0.6384*		
q9Wbenefits	1.0951***	1.5171***		
q9canenviro	0.2940	0.6210*		
Q10	0.0893	0.2886		
Q13	-0.2532	-0.6948**		
Constant	5.5731*	3.4227	5.2454***	5.6559***
Observations	**522**	**522**	**681**	**681**

****p<0.01, **p<0.05, *p<0.1*

Table 39. Discrete effects at means from simpler multinomial logit on 3-category Q14.

VARIABLES	*NEGATIVE IMPACT*	*NEUTRAL IMPACT*	*POSITIVEIMPACT*
male	-0.0295	-0.0090	0.0385
age_2534	0.7715***	-0.2932***	-0.4783***
age_3544	0.7535***	-0.2576***	-0.4959***
age_4554	0.8018***	-0.2454***	-0.5564***
age_5564	0.8258***	-0.2961***	-0.5298***
age_65plus	0.8743***	-0.3165***	-0.5578***
Inc2	-0.1312**	-0.0092	0.1405
Inc3	-0.1726***	-0.0903	0.2629***
Inc4	-0.1474**	-0.1181	0.2655***
Inc5	-0.1694**	-0.0789	0.2483**
HSchool	0.0271	0.1596	-0.1867**
Sometradetechcollege	-0.0281	0.2327*	-0.2046**
Tradetechncollege	0.1034	0.0901	-0.1935**
Someuniversity	0.1296	0.1350	-0.2645***
University	0.2684**	0.0363	-0.3047***
breotherNL	0.0260	0.0136	-0.0396
breWestern	0.1024	-0.0583	-0.0441
Selfemployed	0.0484	-0.0496	0.0013
notemplooking	-0.0440	-0.0932	0.1372
notempnotlooking	0.2342*	-0.0008	-0.2334**
Retired	-0.1344**	-0.0078	0.1422*
Student	0.6063***	-0.2700***	-0.3363**
universityemployee	-0.0108	0.0527	-0.0419
NLgovemployee	0.0359	0.0051	-0.0410
FEDemployee	-0.0143	0.1084	-0.0941
OILGASemployee	-0.1078	-0.1078	0.2155**
Q1A	-0.0092	0.0148	-0.0056
Q1B	-0.0286**	-0.0224*	0.0510***
Q1C	0.0716***	-0.0196*	-0.0520***
Observations	**681**	**681**	**681**

****p<0.01, **p<0.05, *p<0.1*

16 FEELINGS ABOUT EXPLORING FOR AND EXTRACTING OIL AND NATURAL GAS AND ABOUT FRACKING IN WESTERN NL

Respondents were asked about their views on further exploration for oil and gas resources in Western NL and about fracking in particular. Most respondents who had made up their minds about the issue feel that there should be further exploration. However, the idea of fracking is much less palatable. About 30% of respondents do not consider it worth the risk. However, once again, a sizable proportion of respondents who said they did not know or refused to provide an answer.

Table 40. Distribution of statements on exploration and fracking in Western NL (Q18).

	PERCENT	CUM.
I am in favour of exploring and extracting oil and natural gas in western Newfoundland AND hydraulic fracturing.	16.58	16.58
I am in favour of exploring and extracting oil and natural gas in western Newfoundland, BUT NOT hydraulic fracturing.	25.27	41.85
I oppose hydraulic fracturing in western Newfoundland BUT NOT exploring and extracting oil and natural gas.	14.93	56.78
I oppose hydraulic fracturing AND exploring and extracting oil and natural gas in western Newfoundland.	8.92	65.7
I consider myself to be neutral on the topic.	10.67	76.37
I have not decided or I am unsure.	23.63	100

Feelings about exploring for and extracting oil and natural gas as well as for hydraulic fracturing in Western NL tend to be mixed. Only 17% of all respondents are in *favour of both exploring and hydraulic fracturing*, while just 9% *oppose both*. Four in ten report being *in favour of exploring for and extracting oil and natural gas but are not in favour of hydraulic fracturing* in Western NL. More than three in ten respondents considered themselves to be *neutral or undecided*.

16.1 Methodological Notes

Since there is no meaningful order that could be attached to the response categories in *Q18*, a multinomial logit model was used to explain the choices among four (rather than the original six) categories. This simplification involved the obvious equivalence of categories 2 and 3, which are really the same overall statement with only different order of the substatements. For simplicity, category 5 was merged with category 6, so all unsure, not responding, and undecided respondents were lumped together. A further simplification involved the independent variables, in particular the merging of age categories 18 to 24 and 25 to 34, so the base age category is in this case 18 to 34.

Likely due to the small size of some of the combinations of values of explanatory variables and the dependent variable, the calculation of the derivatives needed for predicted marginal (or rather, in most of our cases, *discrete*) effects was not feasible for some categories. For this reason, we refer the reader directly to the, in any event more valid, probability predictions. We present these, as in the case of previous questions, in Appendix B, Section 20.9

16.2 Results

Table 41 reports the results of the multinomial logit[52] on *Q18*, with the combination of "don't know", "neutral response", and "undecided" as the base outcome. Only a few coefficients are found significant but most of the results are in line with previously detected relationships between explanatory variables and responses about views on fracking and the activities of the O&G sector.

[52] Both a test for combining of alternatives and of the independence of irrelevant alternatives confirm that none of the four categories in this variables are close substitutes of one another, given the explanatory variables included in the model (Long and Freese, 2006, Ch. 6).

Males are significantly more likely to support both further exploration and extraction *and* fracking in Western NL than to be neutral about it (or unable/unwilling to provide a response). However, and this is one example of how interpretation of a multinomial logit can at times be confusing, males are also much more likely to choose the second option (favour further exploration and extraction, *but* oppose fracking) than the base category, so post-estimation analysis will be needed to get an idea about how gender affects the choice between the first and second options. Most likely, the effect of gender will not be significant when it comes to that comparison. We find a weakly significant effect also on the third category, so overall we find that the truly substantial effect is that males are less likely than females to be undecided/neutral about these energy development issues.

Those respondents between 35 and 44 are less likely to oppose both exploring-extracting and fracking in Western NL than respondents under 35. The respondents in the next age category (45 to 54) are significantly more likely to favour exploration and extraction, while opposing fracking, than to feel neutral about these issues. Even older respondents are less likely to favour both items.

One of the strongest relationships we have consistently found throughout this report is that linking income levels to attitudes towards energy development issues and fracking in particular. This section is no exception: we find that richer respondents are significantly less likely to position themselves as neutral, and also less likely to oppose both exploration-extraction and fracking, while being significantly more likely to favour both items.[53]

University educated respondents are significantly more likely than those without a high-school diploma to oppose both items or at least fracking. A less clear effect is the negative one of variables *HSchool* and *Tradetechncollege* on choosing category one (favouring both items in the statement).

Those suffering the consequences of the downturn in the economic cycle are, not surprisingly, less inclined to oppose both further development of energy sources in Western NL and fracking. However, we only find a significant effect for variable *notemplooking*, that is, unemployed respondents who are currently looking for a job.

Similarly, retirees, who were more likely to expect a positive impact of fracking on Western NL, are also significantly less likely to state their opposition to both items. The positive effect on the other categories is, however, not statistically significant.

We find that provincial government employees are less likely to oppose both items as compared with employees of any other business (other than the Federal government or the O&G industry).

Interestingly, respondents with a higher level of self-reported knowledge about the operations of the O&G industry in Western NL are substantially and significantly more likely to favour both further developments in that part of the province and also fracking. Conversely, those with a higher level of self-reported knowledge about fracking in particular are much more likely to choose option 2, whereby they oppose fracking only and also much more likely to oppose both propositions.

[53] The effect on category 2 (favours exploration and extraction but opposes fracking) is less significant but also positive for a couple of income categories as compared to the base (which represents the lowest income bracket in the sample).

Table 41. Multinomial logit on 4-category statements about exploration and extraction in Western NL.

VARIABLES	FAVOURS BOTH	OPPOSES FRACKING	OPPOSES BOTH
male	0.7832***	0.6428***	0.5122+
age_3544	-0.6979*	-0.1322	-1.0246*
age_4554	-0.4962	0.6185**	0.0670
age_5564	-0.7571*	0.4423	0.4075
age_65plus	-1.5535***	0.4829	-0.2387
Inc2	1.8810***	0.8117**	-0.4071
Inc3	1.7405**	0.4334	-1.5008***
Inc4	1.8062**	0.9299**	-1.9137***
Inc5	2.2571***	0.7365*	-1.9499***
HSchool	-0.9026*	0.1913	0.5064
Sometradetechcollege	-0.1578	0.5678	-0.0646
Tradetechncollege	-0.8487*	0.6310	-0.2355
Someuniversity	-0.7807	0.5581	-0.0327
University	-0.5292	0.9963**	1.8625**
breotherNL	0.0061	-0.0517	-0.1285
breWestern	-0.1791	-0.0893	-0.4756
Selfemployed	0.2419	0.3531	0.1715
notemplooking	0.5133	0.2411	-1.7602**
notempnotlooking	-0.5997	-0.0329	-0.3526
Retired	0.4509	-0.0630	-1.4117**
Student	0.4825	0.6163	0.0595
universityemployee	-0.8418	-0.6676	-1.2933
NLgovemployee	-0.4361	0.0680	-1.0561*
FEDemployee	-0.5235	-0.0791	-0.4905
OILGASemployee	1.2491*	0.2047	-13.1100
Q1A	-0.0962	0.0266	-0.1165
Q1B	0.2645***	0.0328	-0.0148
Q1C	0.0971	0.2115***	0.2991***
Constant	-2.5985***	-2.7412***	-0.8545
Observations	**752**	**752**	**752**

**** p<0.01, ** p<0.05, * p<0.1; + denotes one-sided test*

17 CONCLUSIONS

After analysing all the responses to the questionnaire, several general patterns emerge.

There seems to be a relatively low level of self-reported knowledge about fracking and it is likely that some respondents even confuse terminology and are unaware that some types of O&G exploration and extraction strategies that they support are in fact associated with hydraulic fracturing. Most respondents, however, consider themselves to be quite familiar with the operations of the O&G industry in NL in general.

Although there is a rather positive overall opinion of the O&G industry among residents in this province, respondents are much less optimistic about the effects of this sector on Western NL in particular. Definitely, the prospect of fracking in Western NL confirms itself as rather controversial and is likely responsible for the concerns about pursuing further energy developments in the West of NL, which is otherwise supported by a relatively large share of the respondents.

There appear to be signifi diff demographic profi when it comes to attitudes towards the O&G industry in NL. In line with expectations, we found that those for whom economic considerations, such as employment prospects, economic growth, and tax revenue increases, are important share a very optimistic view of the O&G sector and its impact both on the whole province and even on Western NL. There is normally a way to classify these respondents in terms of easily identifi sociodemographic traits, since gender, age, income level, and education level can help us determine who is more likely to fall within this category. Sometimes, employment status is also a signifi determinant. In general, it is older males with higher incomes and lower educational levels who focus more on economic considerations. Often, though, we fi that respondents of diff ages care about diff aspects of the overall economic eff of fracking, with older respondents caring relatively more about increased tax revenue prospects and relatively less about job creation, while younger respondents tend to care more about jobs. Similarly, certain types of respondents are more interested in economic growth per se, while others care comparatively more about wage increases.

We find, however, also some quite unexpected results in terms of the attitudes towards fracking, since we had assumed at the outset that higher incomes would be associated with less support for fracking and that older respondents would be more accepting of the practice. However, and contradicting several previous results from other areas (including Canada), we find that richer respondents tend to favour fracking and older respondents tend to be somewhat more in opposition.

Other demographic sections of the sample tend to believe more frequently that the O&G sector has negatively impacted Newfoundland. The main reasons for this view have to do with concerns about environmental harm, particularly in association with fracking, and other safety considerations. However, some respondents also bring into the mix the perception that with oil prices currently low, there might be little benefit at this time from further energy developments; and the feeling that prices for consumers would be higher was also mentioned.

Interestingly, fracking and all the negative views about the industry that it brings to the minds of respondents seem to be associated mostly, if not only, with the proposals involving Western NL, but not the whole province. This makes the attitudes towards the O&G presence and future operations in Western NL much more controversial than in general. In fact, as mentioned above, most people think that having the O&G industry in the province brings more benefits than costs. In general, though, there is a wide divide between the views about the O&G sector in NL and the O&G sector in Western NL.

Very few respondents seemed to worry about the potential for socially destabilising effects of the O&G operations, so there seems to be little concern about so-called “boomtown” effects. However, it is possible that some of the surprising effects we found linking age with an increased likelihood to oppose fracking could be explained by sentiments associated to the fear of social disruption that the O&G industry might bring to some areas. However,

these reasons have not been explicitly mentioned by the respondents, so it would be premature to try to explain the somewhat surprising negative effects of age on acceptability of fracking based on these grounds.

As found in other jurisdictions, there is a sizable proportion of respondents who feel themselves to be "on the fence," that is, undecided, about many of the issues considered. It is, however, normally possible to explain and predict who is more likely to fall into that category. Males, for example, are normally more likely to have made up their minds about the issues. Not surprisingly, those with lower levels of self-reported knowledge about the industry are more likely to state neutrality about the issues presented to them. In principle, all of this suggests a need to make available more information about the O&G to the people of NL. Information on environmental impacts and other risks would be the most common type of information requested.

This is not to say, however, that providing more information will necessarily result in increased support for fracking. Indeed, it may actually be the opposite. This is because the higher the self-reported level of information about fracking respondents possess, the more they oppose fracking. In some occasions we also saw that having more knowledge about the topic made respondents both more likely to oppose it and more likely to support it. This is consistent with the idea that there are polarizing views around the issue of fracking.

Indeed, and particularly when it comes to fracking in Western NL, we can see that opinions are subject to polarizing effects, with some informed respondents feeling strongly against it and others feeling strongly in favour. In general, however, fracking in Western NL is quite a controversial proposition. In general, it is those who are well informed and concerned about economic aspects that support fracking, while those who know more and worry more about environmental impacts are much more likely to oppose it.

In any event, if any type of information is going to persuade "undecided" and perhaps even "opposing" individuals to support fracking it will have to be mostly aimed at assuaging their concern about environmental impacts and about the regulations requiring companies to disclose information about their activities and the associated risks and environmental impacts.

In some instances, we found that, although a University degree tends to place respondents among the detractors, education attainment levels can have diverse effects on the degree of acceptability of fracking and other operations of the O&G sector.

Those most optimistic about the past and future impacts of the O&G industry in NL and also in Western NL appear to be those who have gained or stand to gain more from the operations of the sector. We see that richer respondents and those employed by the O&G sector have consistently better opinions about the industry, including fracking. In general, however, there is quite a lot of support for the practice, even in the case of Western NL, in terms of the trust in the regulatory framework (including the Review process), the ability of the industry to provide reliable information, and the possibility that fracking can be done with reasonably low environmental effects. This said, when compared to the views about the O&G industry in NL in general, fracking in Western NL receives little support.

Consistent with the confirmed reluctance shown towards fracking in Western NL, we found that respondents are clearly concerned about the environmental impacts on Gros Morne National Park, with most suggesting that a buffer zone of at least 25 km be maintained.

Opinions about exploring for oil and gas in Western NL are very positive, with most feeling we should explore for it and extract it. This suggests that hydraulic fracturing itself may be the issue behind the different feelings respondent have between NL as a whole and Western NL specifically.

In sum, the results of the survey reveal that most of the people in the province share a high degree of optimism about and good will towards the oil and natural gas sector and that they accept and even welcome most of its operations.

However, there remain many uncertainties surrounding the particular issue of hydraulic fracturing in Western NL, which is opposed by a larger proportion of the population than in other jurisdictions.

When it comes to analysing who is more opposed to fracking in Western NL, the results show that the demographic patterns behind the attitudes towards fracking might be significantly different from those found in other regions of North America or in the context of other energy developments.

However, when it comes to why, the usual factors tend to apply, with concerns about local water pollution and other environmental and health safety concerns sitting at the top of reasons why fracking is seen with suspicion. On the other hand, worries about the social ills brought by further operations of the industry seem to worry Newfoundlanders and Labradorians much less, which falls in line with the notion that they appreciate the positive net contributions of the sector to the economic life of the province in recent years.

It would be worth to direct some efforts to clarify what the scientific evidence is with regards to the environmental effects of fracking, in order to help undecided citizens find a position about the issue. Working on better communicating the expectations about the predicted economic benefits of further exploration and fracking would be a worthwhile secondary strategy.

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APPENDICES

The following Appendices can be found at:
http://nlhfrp.ca/wp-content/uploads/2016/05/Appendix-P_Supplement.pdf