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Article

Factors Influencing Compensation Demanded for Environmental Impacts Generated by Different Economic Activities

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Abstract: This work advances the understanding of compensation demanded for environmental impacts on atmosphere, lakes and rivers, soil, and ocean generated by mining, urban, fishing and agriculture activities. Our aims are to determine whether compensation demanded depends on the standard variables used in the field of risk perception (as perceived risk, public acceptability and trust in regulating authorities), and to explore whether these relationships depend on the environment affected and on the economic activity generating the impacts. General Linear Models were used to analyze survey responses from 427 citizens of Santiago, Chile. Results showed that compensation demanded depends on perceived risk, acceptability, and on the economic activity, but not on the environment affected. Acceptability depends on trust in authorities, on perceived risk and on the economic activity. Perceived risk depends on trust, the economic activity and the environment affected. Overall, environmental impacts from the mining industry are perceived as riskier, less acceptable, and have a higher compensation demanded than those generated by the other sectors. These results suggest that to achieve sustainable development, regulations should consider not only environmental impacts but also the economic activity originating them.

Keywords: environmental policy; compensation demanded; public acceptability; perceived risk; social trust; environmental impacts; economic activity

1. Introduction

It is important for risk managers to understand how people think and react to different risks. Such an awareness not only allows the development of effective communication strategies, but also enables more informed decisions that lead to greater public acceptance [1]. Traditional risk analysis usually does not include the impacts that may result from subjective judgments of those affected, such as loss of trust in institutions, political and social pressure and opposition to projects, among others [1–3].

During the past three decades, many studies have indicated that social trust significantly influences public acceptance of various technologies [4–7]. Moreover, many researchers have shown that there is a relationship between social trust in regulatory entities and perceived risk [8–10].

Hence, perceived risk, public acceptability and social trust are closely linked [11,12]. There are models in which it is implicitly or explicitly assumed that social trust is a determining factor of public acceptability and risk perceptions [13,14]. These models postulate that the level of trust that people place in both private and public institutions determines the perceived risk, which in turn determines the degree of acceptability of activities or impacts.

Numerous studies have found associations between perceptions of risk, acceptability and trust in regulatory institutions of various hazardous substances and technologies, including food [6,14,15], energy [16–18], and industrial facilities [19–21], but little is known about these relations for environmental impacts [22] and even less is known whether the economic activity originating the impacts has an influence. This issue is important because: (1) Environmental risks can be perceived differently from technological risks that are extensively studied, because environmental hazards causes negative externalities and are not perceived with a direct benefit as technological hazards are; (2) it contributes to the understanding of public perception of environmental hazards derived from different economic activities; and (3) comparing across different economic activities may help authorities to customize their environmental policies and strategies considering the economic activity they belong.

The following introduces the concept of compensation that is demanded in order to accept the risk imposed on society by environmental hazards. We also briefly describe the Chilean economic context in which four main economic activities have marked the economic growth of the country.

1.1. Demanded Compensation

Environmental economics characterizes environmental hazards (atmospheric contamination, climate change, *etc*.) as public bad [23–25] because they do not directly reflect the activity or technology behind them, which are indeed perceived as beneficial. Given the nature of public bad, its value is different from that of a private good or bad [26–28], since its consumption or production generates externalities. In other words, it directly affects the well-being of unrelated third parties who did not choose to incur that cost or benefit [29].

Welfare economics suggests two ways to measure changes in consumers' well being. First, willingness to pay (WTP) shows how much an individual would be willing to pay in order to obtain an improvement or benefit from an environmental change. Secondly, compensation demanded (CD) reflects what an individual would demand in order to accept an environmental change that would aggravate their situation. The choice between WTP or CD as a welfare change measure depends on the assumed property rights situation [30–32]. Hence, in the case where an individual believed he/she or the society has the property rights, it would be valid to ask how much society should be compensated for accepting the impacts on the environment from local projects.

A monetary compensation would increase the acceptability of unwanted local projects [33], but directly offering monetary compensation might generate what is known as "the bribe effect," when people consider the risk-generating activity to be illegal and choose not to accept a compensation, regardless of the amount being offered [33]. One way of diminishing this effect is to ask for in-kind compensations (e.g., schools, parks, hospitals, reforestation) instead of monetary compensations [34].

With a strong base in both theory and method, Earle (2010) reviewed 133 studies that develop some trust model in the risk-management field. Of these, 33 include environmental hazards. Within these, 13 develop some model of trust and risk; four provide a model of acceptability and trust; two focused on a model of acceptability, risk and trust; one is related to trust, perceived risk and perceived benefit; and one relates all four variables [35]. From all the studies reviewed, none includes the concept of compensation demanded for environmental hazard. As investigation in environmental hazards and risk management is an essential research area, further research is needed to clarify the relationship between compensation demanded and the other variables.

1.2. Chilean Economic Context

According to the International Monetary Fund, the Chilean economy is the sixth largest economy in Latin America and the Caribbean [36] and it is ranked as the second best emerging economy worldwide [37]. Its main economic sector is services, followed by mining (mainly copper, of which it is the main world producer [38]). Chile's export profile comprises approximately 58% mining, 34% industrial and 8% agricultural produce exports [39]. Chile also has a maritime economic exclusive zone that favors large commercial fishing activity.

However, as the country progresses, the population's demands for control and regulation of environmental impacts and risks grows. There is increasing opposition to economic activities that affect the environment, such as the explosive urban development of the country's main cities. On a regional level, 63% of the population is concentrated in three regions (Metropolitan Region, V and VII), with the former alone having more than 40% of the entire national population, thus exerting intense pressure on natural resources [40]. This urban growth has significantly affected the air quality in Santiago, thus adversely affecting the health of the population [41,42]. Another economic activity with greater opposition is mining. Large mining operations have generated a number of negative impacts on the environment [43,44]. These impacts have met with opposition from communities and stakeholders [45–47], thus making it more difficult to develop sustainable mining projects. We also find opposition to projects of agriculture mainly because the overexploitation of land and water conservation and use rights.

In this context, many companies in Chile have either voluntarily or mandatorily implemented a series of compensatory measures in order to offset the environmental impacts and their risks, and to achieve greater public acceptance for their projects [48–53]. Although these compensations have generally taken place within a well-defined regulatory framework [54–56], they do not guarantee the social acceptance of a project. It is necessary to consider other factors, such as the public opinion [57] and how much society trust institutions in charge of regulations [58–61].

This paper is organized as follows: Section 2 summarizes the aims of the study, proposed theoretical model and hypothesis. Section 3 explains the methodology, Section 4 the results, and finally we discuss the main implications of the results and highlight the conclusions of the study.

2. Aims and Hypothesis

The aim of this study is to analyze how demanded compensation to accept environmental impacts from different economic activities is influenced by the standard variables used in the field of risk perception research (as perceived risk, public acceptability and trust in authorities). To our knowledge, this is the first time that the dependence of compensation demanded with acceptability, perceived risk and social trust is analyzed. This research also contributes to the understanding of public perception of environmental hazards derived from different economic activities, providing important information to authorities and private sector to customize their environmental policies and strategies considering the economic activity they belong.

The conceptual model is shown in Figure 1. The direction and sign of these relationships are expressed in the following hypotheses:

H1: Perceived risk depends negatively on trust in regulatory institutions. There is an effect upon this relationship of the economic activity and the affected environment.

H2: Acceptability depends negatively on perceived risk and positively on social trust. There is an effect upon this relationship of the economic activity and the affected environment.

H3: Compensation demanded depends negatively on public acceptability, positively on perceived risk and positively on trust in authorities. There is an effect upon this relationship of the economic activity and the affected environment.

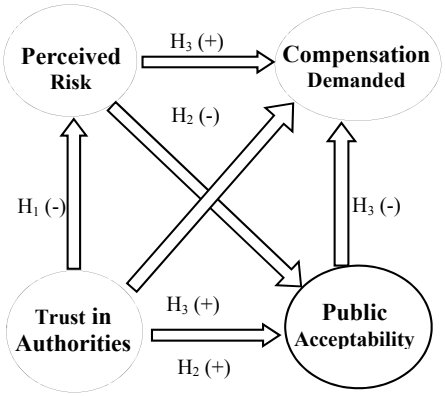

Figure 1. Proposed theoretical model for compensation demanded, public acceptability, perceived risk and social trust. All the relationships are affected by the economic activity and the affected environment, not shown in the figure.

3. Materials and Methods

3.1. Procedure and Participants

We used an online survey to poll a sample of the population of Santiago. A marketing agency implemented the survey and designed the sampling method in order to obtain participants with similar socio-demographic characteristic to those of the population of Santiago. An inclusion criterion was restricted to individuals aged 18 years or older. A one-time email invitation was sent to approximately 5000 people. The email contained an explanation of the study along with a link to the questionnaire. The survey was conducted in 2006.

A total of 427 people answered the online survey. The response rate was within the expected range of values assured by the agency for this type of application and the number of respondents was adequate for the required statistical analysis. Six participants were excluded because they did not answer several questions and were dropped at the beginning. The sample for the present study consisted of 421 participants (54% of whom were women), average age was 32 (SD = 1.8 years).

Participation in the study was voluntary and all information collected was treated as confidential in strict compliance with the norms pertaining to observational studies. All individuals gave their consent once they accessed the link provided in the e-mail invitation. Nevertheless, they could drop the survey at any time. The study was approved by Universidad Diego Portales's Research Committee. In the stored data, respondents were only identified by a number.

3.2. Survey Instrument

The survey was designed according to the questionnaire used by Bronfman (2008) that was implemented to a sample of undergraduate students in 2003; that is, we took the social trust, perceived risk and public acceptability variables with their 7-point scales. We adapted them to fit our focus on environmental hazards and added a new question to measure demanded compensation, either in-kind or monetary. All questions were tested using a focus group of 10 lay people. The revised questions are detailed in Table 1.

Table 1. Study variables and measurement scales.

Scale	Question Description	Scale Points	
		(1)	(7)
Trust	How much trust do you have for the entities in charge of regulating the hazards to which the national population is exposed as a result of (*name of hazard*)?	Little Trust	A Lot of Trust
Perceived Risk	In your opinion, to how much risk in general is the national population exposed as a result of (*name of hazard*)?	Little	A Lot
Acceptability	We are inevitably exposed to various types of hazards that affect us in different forms and degrees. Given that, in your opinion, how acceptable is the risk to which the national population is currently exposed as a result of (*name of hazard*)?	Unacceptable	Acceptable

Table 1. *Cont.*

Scale	Question Description	Scale Points	
		(1)	(7)
Compensation Demanded	Compensation to society is a tool that can be applied, for example, in reforesting affected areas, cleaning and repairing aquifer resources, restoring degraded soil, monetary compensation to affected people, etc. In your opinion, how much should society be compensated in the case of (*name of hazard*)?	Little	A Lot

Participants had to answer these 4 questions for each of 16 environmental hazards. Explicitly, these 16 environmental hazards reflected the impact of 4 main economic activities (mining, fishing industry, agriculture and urban activities) on 4 affected environments components (atmosphere, oceans, lakes and rivers and soil). Even though urban activities is not precisely an economic activity, the survey asked for environmental impacts due to mining activities, agriculture activities, fishing activities and urban activities. We decided to name these four sources of environmental impacts as economic activities just to make the comparison more appealing. We were interested in studying different environmental impacts caused by multiple economic activities gathered in cities with impacts from economic activities that are more likely to be situated outside cities such as fishing, mining and agricultural activities

3.3. Statistical Analysis

We wanted to test the different impacts of the economic activities and environment affected and to assess the relationship proposed in the theoretical model. Thus, to test the underlying hypothesis we used a General Linear Model (GLM) using the command Univariate GLM of IBM SPSS Version 21.0.

$$Y_{ijk} = \mu + \alpha_j + \beta_k + \beta X_i + (\alpha\beta)_{jk} + \varepsilon_{ijk} \quad (1)$$

where:

μ = general mean

$\alpha_j = \mu_j - \mu$ = environment effect (atmosphere, lakes and rivers, ocean and soil)

$\beta_k = \mu_k - \mu$ = economic activity effect (mining, fishing, agriculture and urban activities)

βX_i = effect of the continuous variables (trust, perceived risk and acceptability)

$(\alpha \times \beta)_{jk}$ = interaction between environment affected and economic activity

ε_{ijk} = error term

Before performing the GLM, the normality of errors and variables was tested. Given their asymmetry and kurtosis lower than |2.0| and |9.0|, respectively, we verified that these assumptions are met [62]. In addition, the homogeneity of variances was tested using Levene's *F* test. The models' homoscedasticity with dependent variables acceptability and trust fulfilled this assumption, F (15, 6656) = 0.660, p = 0.826; F (15, 6656) = 0.592, p = 0.884, respectively. Compensation demanded and perceived risk did not comply, but by having balanced samples and variances that do not differ by a ratio greater than 2:1, we were able to proceed with the analysis, given that these techniques are robust to slight violations of this assumption [63–65]. The statistical significance was set at the 0.05 level.

4. Results

4.1. Descriptive Statistics

Table 2 indicates the mean values and their standard deviation for the four study variables for each of the 16 environmental hazards, considering the responses from all participants.

Table 2. Mean (standard deviation) of study variables by economic activity and environment affected.

Economic Activity	Affected environment (Hazard)	CD	PA	PR	TA
Mining	Atmospheric pollution due to	5.95 (1.41)	2.47 (1.73)	5.39 (1.40)	2.07 (1.41)
	Lakes and rivers polluted by	5.95 (1.45)	2.45 (1.71)	5.30 (1.48)	2.00 (1.40)
	Soil pollution due to	5.93 (1.42)	2.55 (1.73)	5.20 (1.50)	2.01 (1.35)
	Ocean pollution by	5.93 (1.45)	2.50 (1.78)	5.22 (1.50)	2.04 (1.36)
Urban	Atmospheric pollution due to	5.85 (1.51)	2.50 (1.78)	5.72 (1.36)	2.08 (1.42)
	Lakes and rivers polluted by	5.75 (1.52)	2.60 (1.82)	5.36 (1.40)	2.12 (1.38)
	Soil pollution due to	5.69 (1.61)	2.58 (1.81)	5.28 (1.45)	2.06 (1.33)
	Ocean pollution by	5.68 (1.54)	2.58 (1.74)	5.17 (1.42)	2.13 (1.37)
Fishing	Atmospheric pollution due to	5.81 (1.47)	2.67 (1.76)	4.94 (1.51)	2.15 (1.42)
	Lakes and rivers polluted by	5.75 (1.52)	2.69 (1.81)	4.98 (1.53)	2.11 (1.42)
	Soil pollution due to	5.67 (1.55)	2.70 (1.70)	4.65 (1.68)	2.03 (1.35)
	Ocean pollution by	5.67 (1.53)	2.76 (1.71)	4.63 (1.62)	2.11 (1.38)
Agriculture	Atmospheric pollution due to	5.60 (1.50)	2.85 (1.70)	4.75 (1.53)	2.14 (1.35)
	Lakes and rivers polluted by	5.60 (1.55)	2.76 (1.75)	4.71 (1.62)	2.15 (1.36)
	Soil pollution due to	5.60 (1.54)	2.78 (1.72)	4.70 (1.71)	2.08 (1.35)
	Ocean pollution by	5.59 (1.53)	2.81 (1.74)	4.87 (1.48)	2.19 (1.42)

CD = Compensation demanded, PA = Public acceptability, PR = Perceived risk and TA = Trust in authorities; Data were sorted by CD in decreasing order within each economic activity.

Compensation demanded was high; none of the mean score is smaller than 5 on the 7-point scale. Public acceptability was low, as not even one mean has a level of acceptability over 3 points on the scale. Perceived risk could be considered high (its average varies from 4.63 to 5.72 points). Trust in authorities in charge of regulating the risks presents the lowest scores, with very small variations between hazards or economic sectors.

The mining sector has the greatest compensation demanded (M =5.94, SD = 1.43) and is the least accepted (M = 2.49, SD = 1.73). In terms of perceived risk, urban activities exhibit the greater perceived risk (M = 5.38, SD = 1.42).

The mean values for the affected environments (atmosphere, lakes and rivers, soils and ocean) in compensation demanded, acceptability and trust show no clear differences. Polluted rivers and lakes are perceived with the greatest risk (M = 5.14, SD = 1.46) and contaminated soils exhibit the least perceived risk (M = 4.94, SD =1.53).

4.2. The Influence of Social Trust on the Perception of Risks (H1)

The results show that trust in regulatory institutions does not depend on either the economic activity or the affected environment. In addition, there is no significant effect of the interaction between the environment affected and the economic activity.

The GLM indicated that there is no effect of the interactions between trust and the affected environment or the economic sector; as such, they were excluded from the model.

The final model found a negative and significant effect of trust over perceived risk (F (1, 6655) = 72.1, $p < 0.05$). Both main effects, economic activity (F (3, 6655) = 74.4, $p < 0.05$) and the affected environment (F (3, 6655) = 5.6, $p < 0.05$), turned out to be significant. The interaction between factors also proved to be significant (F (9, 6655) = 4.7, $p < 0.05$).

Figure 2 illustrates the marginal means of perceived risk according to economic activity and the environment affected while social trust remains fixed at its mean value of 2.09. This graph shows that mining and urban activities are the economic activities that are perceived as the riskiest. Once controlled by social trust, mining and urban activities are above the other economic activities on the mean values of perceived risk in all affected environments.

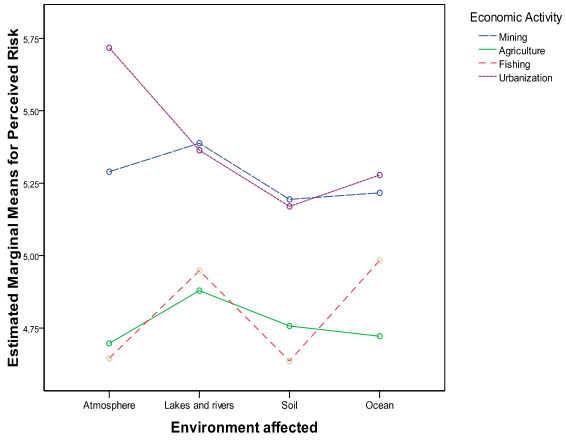

Figure 2. Estimated marginal means of perceived risk by economic activity and environment affected.

In order to understand the effect upon perceived risk of the economic activities or affected environments, it is necessary to consider the interaction term. That is, the effect of the economic activity also depends on the environment being affected by that activity and *vice versa* (see Table 3). Thus, for an equal level of trust, atmospheric pollution due to urban activities is perceived with the highest risk.

Table 3. General Linear Model (GLM) results predicting perceived risk from social trust, economic activity and environment affected.

Predictor	Estimate	Std. Error	t_{obs}	$p(\|t\| > \|t_{obs}\|)$
(Intercept)	5.517	0.079	70.2	0.000
continuous variable				
Social Trust	−0.114	0.013	−8.5	0.000
β_k *: Economic activity* [a]				
Mining	−0.061	0.104	−0.59	0.556
Agriculture	−0.556	0.104	−5.3	0.000
Fishing	−0.295	0.104	−2.8	0.005
α_j *: Environment affected* [b]				
Atmosphere	0.439	0.104	4.2	0.000
Lakes and rivers	0.086	0.104	0.82	0.411
Soil	−0.108	0.104	−1.0	0.298
$(\alpha \times \beta)_{jk}$ *: Interactions between environment affected and economic activity*				
Mining × Atmosphere	−0.366	0.147	−2.5	0.013
Agriculture × Atmosphere	−0.464	0.147	−3.2	0.002
Fishing × Atmosphere	−0.777	0.147	−5.3	0.000
Mining × Lakes and rivers	0.086	0.147	0.58	0.561
Agriculture × Lakes and rivers	0.072	0.147	0.49	0.626
Fishing × Lakes and rivers	−0.120	0.147	−0.82	0.414
Mining × Soil	0.086	0.147	0.58	0.561
Agriculture × Soil	0.143	0.147	0.97	0.330
Fishing × Soil	−0.239	0.147	−1.6	0.105

Note: [a]: Urban activities as a base category; [b]: Ocean as a base category.

4.3. Acceptability and Its Relation to Perceived Risk and Trust in Authorities (H2)

The full GLM model showed that none of the interactions between perceived risk or social trust and the factors were significant; as such, they were eliminated from the final model (see Table 4).

The greater the perceived risk, the less it is accepted (F (1, 6663) = 249.5, $p < 0.05$). Meanwhile, trust in regulatory institutions turned out to be significant (F (1, 6663) = 359.5, $p < 0.05$), thus indicating that a greater trust corresponds to a greater acceptance of environmental risks. The model shows that the acceptability of an environmental risk depends on the economic activity that generates it (F (3, 6663) = 2.7, $p < 0.05$), but not on the environment that is affected (F(1, 6663) = 0.12, $p = 0.95$).

Figure 3 illustrates the marginal means of social acceptability by economic activity and environment affected, while social trust and perceived risk remain fixed at their mean values (2.09 and 5.06, respectively). It can be clearly appreciated that there is no interaction between factors, because all of the lines representing each economic activity are parallel. Agriculture and mining are the most and least accepted, respectively.

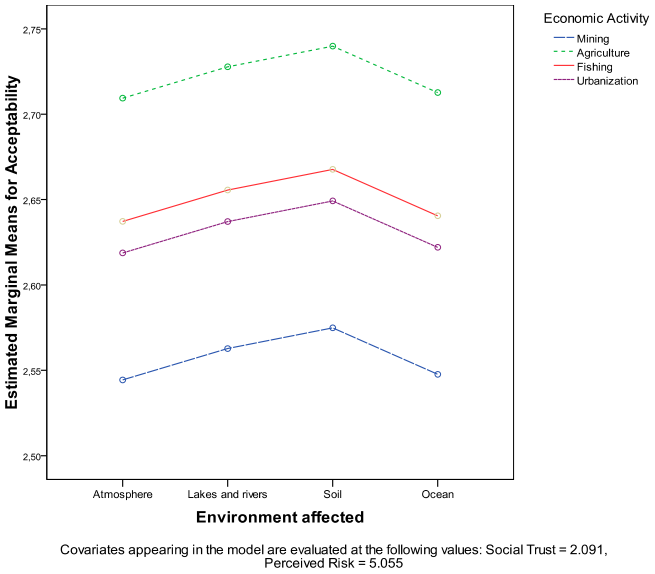

Figure 3. Estimated marginal means of public acceptability by economic activity and environment affected.

Table 4 presents the model's estimates. For the same level of perceived risk and social trust, greater differences were found in agriculture *vs.* mining, with mining being the least accepted economic activity.

Table 4. GLM results predicting acceptability from perceived risk, social trust, economic activity and environment affected.

Variable	Estimate	Std. Error	t_{obs}	$p(\|t\| > \|t_{obs}\|)$
(Intercept)	3.201	0.092	34.8	0.000
continuous variable				
Perceived risk	−0.213	0.014	−15.8	0.000
Trust in authorities	0.282	0.015	19.0	0.000
β_k *: Economic activity* [a]				
Mining	−0.165	0.058	−2.9	0.004
Urban	−0.091	0.058	−1.6	0.119
Fishing	−0.072	0.058	−1.3	0.210
α_j *: Environment affected* [b]				
Atmosphere	−0.003	0.058	−0.06	0.955
Lakes and rivers	0.015	0.058	0.26	0.793
Soil	0.027	0.058	0.47	0.636

Note: [a]: Agriculture as a base category; [b]: Ocean as a base category

4.4. Demanded Compensation and Its Relation to Perceived Risk and Acceptability (H3)

In the full GLM model, the interactions between the affected environment, trust in authorities, acceptability and perceived risk were not significant. Neither was the interaction between trust in authorities, perceived risk and economic activity. In addition, there is no significant effect of the interaction between the environment affected and the economic activity. They were, thus, excluded from the final model (See Table 5).

The final model offers the following results: demanded compensation depends positively on perceived risk (F (1, 6659) = 897.8, $p < 0.05$), negatively on acceptability (F (1, 6660) = 211.6, $p < 0.05$) and trust in authorities (F (1, 6659) = 36.8, $p < 0.05$. The model shows that there is a significant effect of the economic activity on demanded compensation (F (3, 6659) = 9.4, $p < 0.05$), but not of the affected environment (F (3, 6659) = 0.07, $p = 0.98$). There is an effect of the interaction between social acceptability and the economic activity (F (3, 6659) = 4.5, $p < 0.05$).

Figure 4 illustrates the marginal means of demanded compensation by economic activity and environment affected, with trust in authorities, public acceptability and perceived risk fixed at their mean values. It can be clearly observed that there is no effect of the interaction between factors and that mining is the activity with greater compensation demanded while urban activities being the least.

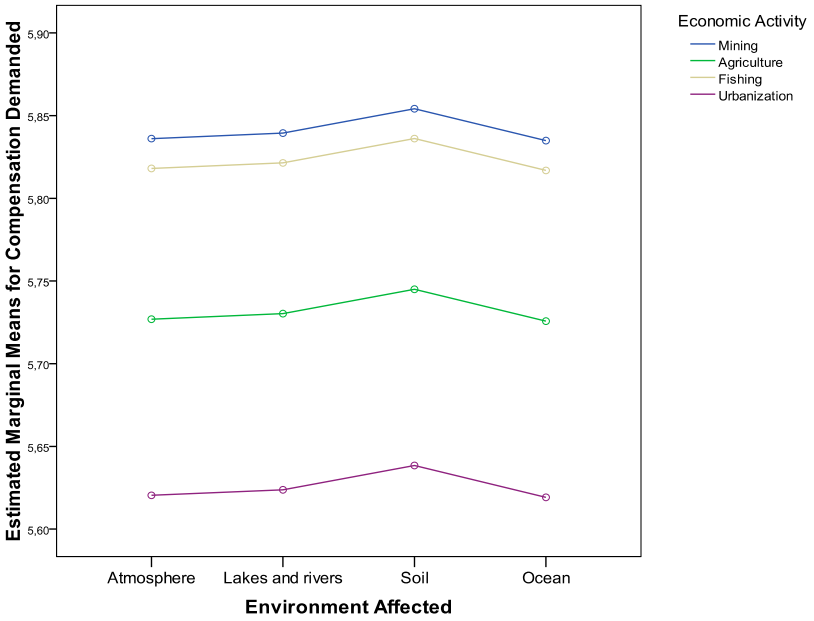

Figure 4. Estimated marginal means of demanded compensation by economic activity and environment affected.

In order to interpret the effect of the economic sectors on demanded compensation, the interaction between acceptability and the economic activity must be considered. For example, by controlling for risk, trust and acceptability, mining, agriculture and fishing have a greater incremental effect than urban activities on compensation demanded, but, at the same time, this effect is diminished when the relation between economic activity and acceptability is considered (see Table 5). We can consider that both agriculture and fishing decrease the compensation by virtue of being the two most accepted activities. We can also state that the effect of acceptability on compensation demanded depends on the economic sector (slope effect). Therefore, this effect is greater for agriculture and fishing (greater negative slope). In general, mining is the activity that shows the greatest compensation demanded.

Table 5. GLM results predicting demanded compensation from trust in authorities, perceived risk, acceptability and economic activities.

Variable	Estimate	Std. Error	t_{obs}	$p(\|t\| > \|t_{obs}\|)$
(Intercept)	4.328	0.094	45.9	0.000
continuous variable				
Perceived risk	0.336	0.011	30.0	0.000
Acceptability	−0.094	0.019	−5.0	0.000
Trust in authorities	−0.076	0.012	−6.1	0.000
β_k *: Economic activity* [a]				
Mining	0.315	0.082	3.8	0.000
Agriculture	0.331	0.086	3.9	0.000
Fishing	0.412	0.085	4.9	0.000
α_j *: Environment affected* [b]				
Atmosphere	0.001	0.047	0.03	0.979
Lakes and rivers	0.005	0.047	0.10	0.923
Soil	0.019	0.047	0.41	0.681
$(\alpha \times \beta)_{jk}$ *: Interactions between environment affected and economic activity*				
Acceptability × Mining	−0.038	0.027	−1.4	0.157
Acceptability ×Agriculture	−0.085	0.027	−3.2	0.002
Acceptability × Fishing	−0.081	0.027	−3.1	0.002

Note: [a]: Urban activities as a base category; [b]: Ocean as a base category.

5. Discussion and Conclusions

This research furthers the understanding of how demanded compensation for environmental impacts caused by some of the main economic activities is influenced by the public's acceptability of the risks imposed to society, the risk itself and the trust in regulating authorities. Therefore, the findings will be discussed in two aspects: whether the relationships between variables exist and if those relationships are affected by the economic activity affected, the environment affected, or both.

5.1. Social Trust

Our results show that the population's level of trust in regulators is low and independent of the economic activity that generates the environmental impacts or of the impacts itself. This result is a cause of concern that revealed the complexity and challenge for policy makers to gain trust within society.

A number of studies assessed the critical role of the population's trust in regulatory institutions when it comes to implementing risk management policies [3,58,59]. Raising trust in Chilean regulatory institutions is neither trivial nor immediate. Some high visibility events occurred during the last decade that could have, in part, influenced this low level of trust in authorities. In 2004, the operations of Celco, a cellulose-processing plant, caused the death and massive migration of the black-necked swans from the natural reserve "Carlos Anwandter" [66]; the general population was strongly opposed to this type of project; they also expressed a significant level of mistrust in the government entities that were responsible. A similarly complex event that put into question the Chilean government was the approval of the Pascua-Lama mining project in 2006. This project's operation implied a threat to biodiversity and

irreversible damages to the glaciers that supply water to that region [44]. The evaluation report on environmental management, which was elaborated upon by the OECD in 2005 [67], severely questioned the Chilean environmental regulatory institutions at that time. One of the most relevant aspects of the report was the recommendation for a stronger environmental institutionalism endowed with greater resources, as well as the need for a better enforcement capacity and more integration of environmental aspects in public policies. These antecedents could partly help to explain the population's low trust in regulatory entities at the time of our study.

Bearing this in mind, it is crucial that regulatory entities seek effective ways of creating transparent and participative public policies. They should inform the public of the environmental risks of the various economic activities and, in this way, increase trust in regulatory entities [61]. Actually, the Chilean environmental law establishes diverse mechanisms whereby the population can obtain information and education on environmental issues. It also proposes mechanism so that people can demand their rights when their quality of life is being undermined [56]. Although this mechanism has improved over time, with a substantial rise in public consultation from the period before the law was passed to the present, the low level of public trust reflects that these efforts may have been insufficient [57].

5.2. The Influence of Social Trust on the Perception of Risks

Our results are consistent with the findings of others who have studied this relationship in a context of new technologies [8,9,68]; that is, where perceived risk is a consequence of trust placed in regulatory institutions. A novel result, however, is that perceived risk also depends on the economic activity that generates the impact and the environment affected. Even when controlling for trust, the environmental impacts of urban activities and mining are perceived with high risk. Regarding urban activities, it should be considered that the poll was applied to a Santiago sample and over 40% of the national population is concentrated in Santiago. The capital has experienced an accelerated growth over the past years. Between 1940 and 2002, its urban surface grew to nearly six times its previous size, and the number of inhabitants rose by over 500% [69]. The inhabitants of Santiago are exposed to a high level of atmospheric pollution during autumn and winter as a result of particulate matter which is present at that time, and during spring and summer due to ozone [40]. This has been historically translated into episodes of environmental alert, pre-emergency and emergency states, which have been associated with adverse effects on citizens' health [41].

As for mining, we have already established that the mining sector plays a remarkable role in the country's economy and it is consequently well known by the population. This could suggest that people are more aware of the risks and environmental effects and, therefore, perceive it as one of the riskiest sectors with higher environmental impacts than agriculture or fishing. Also, mining impacts are created from a few significant projects, rather than agriculture or fishing, which are distributed along the national territory.

5.3. Acceptability and Its Relation with Perceived Risk and Trust

Our results concur with the literature that empirically demonstrates that acceptability is associated with perceived risk and trust in regulatory institutions [4–7,11,12]. Moreover, there is evidence which shows that, for environmental hazards, both trust in regulatory institutions and perceived risk would determine social acceptability [13,14,70].

The low trust in regulatory institutions leads people to perceive an activity or technology and its impacts as unacceptable in instances where, under different circumstances, they would have found them to be perfectly acceptable [5]. Therefore, if people do not trust the entities in charge of regulating the environmental hazards, they will also show a lower acceptability of these risks.

Controlling for perceived risk and trust, the economic activity influences the acceptability of an environmental hazard. However, the environment affected—whether it is water, air or soils—do not affect people's levels of acceptability. In general, people have a low acceptability of the risk imposed to society for the environmental impacts for all sectors. Mining had a significantly lower acceptability than all other activities. Some authors suggest that the public's unacceptability of risks generated by mining are more related to a lack of education or to the "not in my backyard" idea, and they suggest that no person with a certain level of culture and common sense could oppose the need for mining [71]. However, we advance a different explanation. First, there is a feeling of inequality between the local community that is being affected by mining and those who received its benefits [45]. Viveros (2014) finds that interviewees perceive insufficient royalty rates in comparison to mining companies' revenues and that economic benefits have not been shared with the affected communities. Second, mining processes are characterized by generating environmental impacts that are generally irreversible. Mining relies on mineral resources that determine where can be located, letting little flexibility to avoid environmental impacts [47]. This would lead the population to oppose such risks. Finally, in the year in which the study was conducted, the Pascua-Lama project was being developed and became a symbol for social opposition to the environmental risks generated and stirred a controversy that even made it to the international level, causing a detrimental effect to the government's image [46].

Considering the current stage of the mining sector and its future development, regulatory agencies must react quickly to implement policies to improve social trust in decision makers' actions to regulate environmental mining impacts.

5.4. Compensation Demanded and Its Relation with Perceived Risk, Acceptability and Trust in Authorities

Our results show that compensation demanded depends on how risky the environmental impact is perceived to be, on its acceptability as well on how trusty authorities in charge of regulating those impacts are. Our results agree with the hypothesis that the classical variables used in the field of risk perception are related to each other [11–14] and are also related to the compensation demanded. Our results support empirically and theoretically that compensation demanded is suitable to be used in this type of relationship when it comes to environmental impacts. People that perceives higher risk for environmental impacts also declared higher compensations, independently of the environment affected. The effect of acceptability on the compensation demanded is negative and depends on the economic activity, thus indicating that there is not only a main effect of acceptability, but also that this increases or decreases depending on the economic activity. Social trust instead has a negative effect over compensation demanded. This might suggest that people whose trust in authorities is low tend to declare higher compensation for the risk posed by environmental impacts in general, but, as we saw from the model, there is no discrimination whether the regulation is for the environment affected or the economic activity behind those impacts. It is interesting to note that in summary, respondents do not seem to

discriminate between which environment (air, water, soil, or ocean) is affected when it comes to a demand for compensation. What matters is the economic activity responsible for the impacts and for compensating society for their effect.

Respondents point to mining, the economic activity that generates greater wealth for the country, as the economic activity with the highest compensation demanded. We believe that this is not arbitrary and could be explained by two aspects: First, the "deep pocket" theory, or agents with great wealth [72,73]. This theory postulates that people are inclined to demand greater compensation from those whom they believe are wealthier and more able to afford such compensations [74]. Second, the "defendant identity effect", where damage compensations are biased according to the identity of the sued party [75].

In Chile, the mining industry, particularly copper, is structured in large-scale mining, represented by 17 private companies and one state-owned enterprise, the National Copper Corporation (Codelco), which is the biggest copper mining company in the world; mid-scale mining, represented by 22 mostly local companies; and minor-scale mining. Only three mining companies, namely Codelco, Escondida and Anglo American are responsible for over 60% of the national production (identity effect). This represented, in 2012, 12.8% of the national GDP and over 62% of total export income [39] (deep pocket theory).

The mining sector in Chile has been a constant theme of public discourse. Mining reflects a source of wealth that has motivated very intense social movements throughout the twentieth century, with clearly visible historic landmarks (e.g., the nationalization of the copper industry). We should realize that the status of the mining industry in Chile occupies a very different place in comparison to that of other activities in the collective imagination.

Since mining is the economic activity with less acceptability, perceived as one of the most risky, and, considering its strong identity in the public imagination (identity effect), as a source of great wealth (deep pocket), it is not unusual that participants demanded greater compensations from this economic activity over the others.

As the main conclusion, we can state that, of all economic activities, the mining environmental impacts are perceived to be least acceptable, with a greater risk and with a greater demanded compensation. Considering Chilean mining's export profile, government institutions should develop public policies for the mining sector that guarantee the use of natural resources in a sustainable manner and that promote an equitable distribution of the economic benefits and impacts of the activity.

Our results help understand why environmental impacts from certain economic activities are perceived more riskier and less acceptable that those from others, and why society demands higher compensations from them. It is vital then for regulatory institutions to consider this heterogeneity in the way environmental impacts are regulated.

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Author Contributions

All authors have directly participated in the original idea, planning, execution, or analysis of this study. Virna Vaneza Gutiérrez had the original idea. Both Virna Vaneza Gutiérrez and Nicolás C. Bronfman designed the survey, as well as planned and executed the study. Virna Vaneza Gutiérrez and Luis Abdón Cifuentes performed the statistical analysis and drafted the manuscript. All authors of this paper have read and approved the final submitted version.

Conflicts of Interest

The authors declare no conflict of interest.

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