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Individual preferences for mineral resource development: Perspectives from an urban population in the United States

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ABSTRACT

The literature on mining community preferences for mineral development, which is the basis for engaging local communities, mainly focuses on rural communities, and may not provide enough insight into an urban community's needs, concerns, and preferences. To bridge this gap, this work uses Salt Lake City, Utah in the United States of America (USA) as a case study to understand an urban population's preferences for mineral resource development. The work considered 16 mining project attributes and four demographic factors (gender, age, education, and income), which have previously been identified as important for explaining individual preferences for mining projects in the USA. The study recruited 628 participants from Salt Lake City to participate in a survey and used a discrete choice model to examine their preferences.

The results show that 15 of the 16 attributes have statistically significant influence on the preferences of these urban dwellers. The probability of the respondents preferring mineral development increases with job opportunities, availability of independent information, income increase, infrastructure improvement, and mine buffer but decreases with noise pollution, air pollution, increase in housing costs, and crime increase. Older, male respondents with higher levels of income and education are more likely to prefer mineral development. The issues that drive the preferences of these urban dwellers are generally similar to those of rural dwellers. However, the study finds that job and housing cost are more important for our urban dwellers than for rural dwellers in other studies. The results suggests that our respondents prefer mines with longer lives.

1. Introduction

In recent years, concerns about corporate sustainability and how to account for public perceptions of development have increased throughout the world (Liu et al., 2013; Takahashi and Sato, 2015; Wang et al., 2012). The public and government regulators have increasingly demanded that companies engaged in mineral resource development do so in a sustainable manner and obtain free, prior and informed consent through participation and consultation of the host communities (Hodge, 2014). There are numerous examples of mining projects that have been postponed, interrupted, or even shut down due to a lack of public support (Browne et al., 2011; Davis and Franks, 2011; Moffat and Zhang, 2014; Prno and Slocombe, 2012; Thomson and Boutilier, 2011). The most frequent issues are the (potential) impacts of mining activities on the ecosystem and associated impacts on the lifestyles of host communities and mistrust between stakeholders and mining companies due to the negative legacy of mining (Brereton, 2014; Hodge, 2014). Also, conflicts occur when local communities perceive that their interests and values have not been adequately addressed by mining companies or government agencies. Many stakeholders now view community engagement in mine planning

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and design, operation, and closure as best practice in mineral resource development. Therefore, these stakeholders are interested in public perceptions of mineral development and what drives these perceptions.

However, most of the current work in the literature on the drivers of public perception focus on rural communities and rural indigenous people, and may not provide enough insight into the perceptions of urban communities (ICMM, 2012a; Ivanova and Rolfe, 2011; Petkova et al., 2009). While the emphasis on rural and vulnerable populations is warranted because of the disproportionate impact of mining on them, it is still important to understand the perceptions of urban populations. First, urban populations are still affected by the socio-economic impacts of mining, which usually reach farther than the immediate locality (Xing et al., 2017). Even the environmental impacts can affect urban communities when they rely on natural resources (e.g. water) located in rural communities that can be impacted by mining. For example, the Olifants Water Management Area in South Africa, is a significant water resource that provides drinking water and water for power generation for urban communities (Water affairs, 2013), which has been significantly impacted by coal mining in the rural headwaters (Hobbs et al., 2008). Secondly, urban communities also have mining activity close by. For example, most urban communities have quarries that mine rock to meet their demand for construction materials (e.g. aggregates for concrete and asphalt). Also, there are occasional examples of large scale mining near urban centers (e.g. Bingham Canyon Mine near Salt Lake City, Utah, USA).

There is evidence in the literature that rural and urban communities have different attitudes and behaviors in relation to environmental concern (Freudenburg, 1991). These differences have been attributed to a variety of causes including sociostructural factors and socialization experiences (Berenguer et al., 2005). However, there is at least some evidence that the different ways in which specific interventions affect the two populations is a factor in the differing attitudes and behaviors (Bjornlund et al., 2013). It is important then to explore the perceptions of urban dwellers, separate from those of rural dwellers, relative to mineral developments as a first step in understanding the differences between the two, if any. Such work will inform public policy and be useful to various stakeholders in mineral development discussions. The evaluation of these urban perceptions should answer the following questions: (1) what are the factors that affect urban public preferences regarding new mineral projects, and how do these factors affect individual preferences? (2) what is the effect of demographics on individual preferences?

To bridge this gap, this work uses Salt Lake City, Utah in the United States (U. S.) as a case study to understand an urban population's preferences for mineral resource development. We used a survey (discrete choice experiment) of over 600 residents from Salt Lake City to acquire data on and model individual preferences for mineral development. Our specific objectives were to: (1) find the factors that affect individual preferences for mineral resource development, and determine how these factors affect urban individual preferences; and (2) determine the effect of demographics on individual preferences. This work provides unique insights from an urban population to add to the discussion on community preferences for sustainable mineral development in the literature.

2. Methods

2.1. Discrete choice theory

Discrete choice theory, based on the Nobel winning work by McFadden (1974) has transformed the world of market research. The basis of discrete choice theory is random utility maximization (Marschak, 1959). The individual decision maker's overall preference for a choice alternative is a function of the utility, which the alternative holds for the individual. Individual n's utility for alternative i ($\mathbf{U}_{ni}$) is separable into two components: (i) the component that can be explained by the observed (by a researcher) variables; and (ii) the component that can be explained by unobserved variables – often, deemed random (Equation (1)).

$$\mathbf{U}_{ni} = \mathbf{V}_{ni} + \boldsymbol{\varepsilon}_{ni} \tag{1}$$

$\mathbf{V}_{ni}$: observed component measured for alternative i of individual n

$\boldsymbol{\varepsilon}_{ni}$: unobserved random component for alternative i of individual n

The conditional logit model (CL), sometimes also called the multinomial logit model, was first formulated by McFadden in the 1970s (McFadden, 1974). In this model, the observed utility of each alternative, $\boldsymbol{V}_{ni}$, is a linear function of $\boldsymbol{X}_{ni}$. The error terms, $\boldsymbol{\varepsilon}_{ni}$, are assumed to be independently and identically distributed (iid) with type 1 extreme value distribution. $\boldsymbol{X}_{ni}$ is a vector of attributes specific to the ith alternative as perceived by the nth individual. The utility and probability are shown in Equations (2) and (3).

$$\mathbf{U}_{ni} = \mathbf{V}_{ni} + \boldsymbol{\varepsilon}_{ni} = \boldsymbol{\beta}^T\mathbf{X}_{ni} + \boldsymbol{\varepsilon}_{ni} \tag{2}$$

$\boldsymbol{\beta}$: a coefficient vector for $\boldsymbol{X}_{ni}$

The probability that individual n chooses alternative i is:

$$P_{ni} = \frac{\exp\left(\boldsymbol{\beta}^T\mathbf{X}_{ni}\right)}{\sum_{j=1}^{J}\exp\left(\boldsymbol{\beta}^T\mathbf{X}_{nj}\right)} \tag{3}$$

Discrete choice theory, has been successfully used in econometrics, stakeholder analysis for large engineering projects, and in other disciplines to understand behavior in choice situations (Dimitropoulos and Kontoleon, 2009; Walekhwa et al., 2009; Willis et al., 2011; Winslott Hiselius, 2005). This provides a framework to objectively and quantitatively understand the characteristics of mining projects and demographic factors that are determinants of community preferences. A few researchers have already used choice theory, with limited number of attributes, to explore individual preferences for mineral development in rural settings in Australia (Ivanova and Rolfe, 2011; Petkova et al., 2009). Choice theory will facilitate data-driven community consultation if properly applied to mining.

2.2. Identifying relevant factors

The general approach in this work was to design a valid discrete choice experiment (survey) to assess the preferences of individuals living in Salt Lake City. To design a valid discrete choice experiment, you need to identify the relevant factors that affect individual preferences relating to the choice in question. Once the list of factors has been decided, you use them to design a choice experiment. In addition to the choice questions, we asked participants about relevant demographic factors to evaluate their influence on the preferences. We used a focus group to assess validity of the survey since it is a best practice.

The classification and selection of relevant factors that affect