Investigating the Impact of Royalties on Commercial Lunar Ice Mining

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This research investigates the potential economic impact of introducing a royalty system on a conceptual lunar ice mining operation and the possible global benefits such royalties could generate over a 50 year period. The extraction of space resources, particularly lunar water ice, is poised to play a critical role in a burgeoning space economy. This ice, initially vital for life support, could eventually be used to produce rocket propellant, marking a significant step in space exploration and space resource utilisation. Current research predominantly focuses on the technical feasibility of such space resource ventures, often overlooking the commercial aspects vital for the sustainable development of a space economy. For terrestrial mining, understanding the fiscal environment is crucial, and this will be equally true for space resource extraction. A major consideration in this area is addressing the ‘Benefit of Mankind’ issue. This revolves around how benefits from space resource activities should be equitably shared among humanity, a topic of ongoing debate since the signing of the Outer Space Treaty in 1968.

Our study is grounded in a financial model based on the report generated for the NASA Innovative Advanced Concepts (NIAC) Program titled ‘Thermal Mining of Ices on Cold Solar System Bodies’ [1]. We explored various combinations of ad valorem royalties and tax rates to assess their impact on key investment metrics for the project to determine the highest royalty rate the project could sustain without becoming commercially unviable. Additionally, we evaluated the potential global benefits of these royalties, applying growth rate assumptions to project them out over a 50 year period. These benefits were then allocated on a per capita basis to the populations of four countries, each representing a different World Bank economic classification, following the precedent set by the International Seabed Authority for allocating benefits from potential deep sea mining activities in international waters. The findings of our study indicate that the implementation of ad valorem royalties could significantly influence the economic viability of a lunar ice mining project, with indications being that such a project may only be able to support a relatively low level of royalty at best. Moreover, the benefits accrued over 50 years appear minimal on a per capita basis, even for countries classified as Low Income by the World Bank. This highlights the need for a carefully structured economic approach to space resource extraction, ensuring fair distribution and sustainable development.

1. Sowers, G., *NASA Innovative Advanced Concepts (NIAC) Phase I study: Thermal Mining of Ices on Cold Solar System Bodies*. 2020, Colorado School of Mines.