IS THERE A ROLE FOR ROYALTIES IN A LUNAR RESOURCES PROJECT? B. McKeown[1], A.G. Dempster[2], S. Saydam[3], J. Coulton[4]
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This study investigates the potential impact of implementing a royalty mechanism on the economics of a hypothetical commercial lunar ice mining operation and the consequent benefits that could accrue over a 50 year period. Resource extraction in outer space could play a critical role in the future development of a space economy, with a possible early focus of such activities being on water extracted from water ice deposits located in the permanently shadowed regions at the lunar poles. If such activities eventuate, it will be important that appropriate attention is paid to commercial considerations. One such consideration pertains to the sharing of benefits from space resources as required by Article 1 of the Outer Space Treaty (OST) which mandates the sharing of benefits of space exploration with all humankind. Since the signing of the OST in 1968, there has been considerable debate surrounding this issue, with no widely accepted resolution. Proposed solutions range from 'capacity sharing' for nations that lack the ability to undertake such activities independently, to proposals for the global sharing of monetary benefits through royalties or similar mechanisms. Recently, the Legal Subcommittee of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) set up a Working Group to explore options for a possible legal regime for the commercial exploitation of space resources, indicating the increasing global interest in possible commercial space resource activity. While no proposals for royalty or royalty type mechanisms have yet been made by the Working Group, part of the purpose of a legal regime for space resources includes the facilitation of *"…an equitable sharing by all States in the benefits derived from [space] resources……"* [1], indicating that such a mechanism could be given consideration.

The use of royalties as a component of fiscal frameworks in the terrestrial mining sector is prevalent. Such fiscal frameworks typically comprise a blend of taxes and royalties contained in the total economic rent remitted to State governments. The usage of royalties in this context varies significantly in terms of their type and rates, often varying by resource characterisation and project jurisdiction. The fiscal burden imposed by royalties and taxes on a terrestrial mining project can be substantial, with the Effective Tax Rate for a mining project often ranging from 40 – 60% [2]. A full understanding of the fiscal burden on a terrestrial mining project is therefore crucial prior to project development. The same could ultimately apply to a commercial space resource project.

The analysis in this study draws upon a modified financial model developed for the hypothetical lunar ice mining project outlined in the NIAC report for NASA titled *'Thermal Mining of Ices on Cold Solar System Bodies'* [3]. One objective is to examine the potential impact of a hypothetical fiscal regime on this project by testing the effects of various ad valorem royalty rates and corporate tax rates on select investment metrics, and to ascertain the maximum royalty rate that the project could accommodate at specific tax rates before becoming economically unviable (referenced to the minimum investment metrics selected for the project). The second phase of our analysis involves determining the potential cumulative benefits that could accrue over a 50 year period from the royalties generated in the first part of the exercise. To achieve this, we apply annual growth rate assumptions ranging from 2% p.a. to 10% p.a. to the royalty figures generated in the previous phase, assuming an unrestricted market. We then allocate the cumulative royalty benefits on a per capita basis to the populations of four countries, each representing one of the World Bank's country classification groups. To determine the allocation basis, we utilise the methodology developed by the International Seabed Authority under the United Nations Convention on the Law of the Sea (UNCLOS) for the benefits generated from potential deep sea mining activities in international waters. The UNCLOS allocation methodology for deep sea mining was chosen as it is the sole framework that has to date considered fiscal terms for resource exploitation activities in an area under global jurisdiction. The concluding part of our analysis takes an illustrative approach to examining the potential impact of a royalty regime on operational decision-making. Specifically, we explore how royalties could affect the cut-off grade of the conceptual lunar ice mining project.

Our study reveals that ad valorem royalties could significantly affect the economics of the conceptual lunar ice mining project and, depending on income tax rate assumptions, that the project could tolerate a low level of royalty at best (refer to Figure 1.). Furthermore, the global benefits generated over a 50 year period could be insubstantial on a per capita basis, even

for a country classified as a Low Income Country under the World Bank classification (refer to Figure 2.).

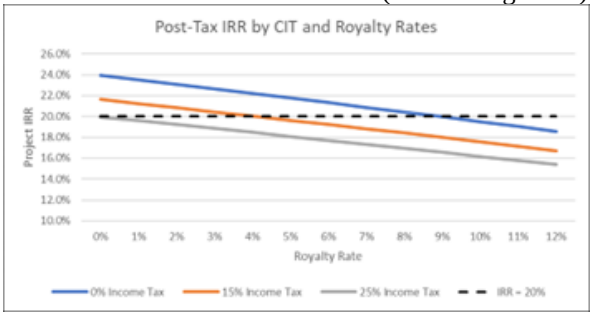

Figure 1: Post Tax Project IRR by Corporate Income Tax (CIT) Rate and Royalty Rate

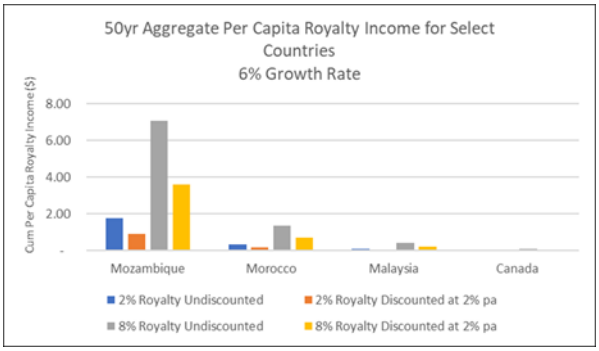

Figure 2: 50 year Aggregate Royalty Revenue Per Capita for Select Countries at 6% p.a. Growth Rate

With respect to potential impact on cut-off grade, we find that ad valorem royalties could have a lesser impact on ice deposits with high resource homogeneity than on deposits with lower resource homogeneity. Thus, understanding the geology of the potential resources to be exploited would be essential before implementing a monetary fiscal regime.

In conclusion, we suggest that rather than consider implementing a monetary-based fiscal regime, a focus on the "weak variants" [4] of benefit sharing from commercial space resource activities may be preferable, at least in the early stages where commercial viability is uncertain.

This presentation draws on findings in our research article titled "Commercial Lunar Ice mining: Is There A Role For Royalties?" [5].

References: [1]. UN Committee on the Peaceful Uses of Outer Space Legal Subcommittee fifty-eighth session. *Proposal for the establishment of a working group for the development of an international regime for the utilization and exploitation of space resources*. 2019; [2]. Otto, J., et al., *Mining royalties: a global study of their impact on investors, government, and civil society (English)*, in *Directions in development ; energy and mining*. 2006, World Bank Group: Washington, D.C.; [3]. Sowers, G., *NASA Innovative Advanced Concepts (NIAC) Phase I study: Thermal Mining of Ices on Cold Solar System Bodies*. 2020, Colorado School of Mines.; [4]. Aganaba-Jeanty, T., *Common benefit from a perspective of "Non-traditional Partners": A proposed agenda to address the status quo in Global Space Governance.* Acta Astronautica, 2015. **117**: p. 172-183.; [5]. McKeown, B., A.G. Dempster, S. Saydam and J. Coulton, *Commercial Lunar Ice Mining: Is There a Role for Royalties?* Space Policy, 2022: p. 101525.