

# Mineral Depletion and the Rules of Resource Dynamics

## Executive Summary

Morris Adelman's perspective on the role of oil resources in a modern economy is examined and interpreted with particular reference to his paper, "Mineral Depletion, with Special Reference to Petroleum" (1990). The examination is supported by occasional references to his other publications.

The dominant perception among resource economists since the publication of Hotelling's paper (1931) was (and remains) that the economic dynamics of the oil industry were governed by Hotelling's famous "r-percent rule": price net of the marginal cost of production (the "Hotelling rent") would rise at the rate of interest. The rule was held to determine the flow of production from the resource, beginning at the current time and extending through to exhaustion of the resource. The positive rent at the margin of production and the associated rule were considered to be necessary features of a dynamic equilibrium of production in the face of scarcity of the resource, its exhaustibility.

Adelman broke with most resource economists in denying the relevance of exhaustibility to understanding the oil industry. To him, exhaustibility was an obvious but non-binding, and hence economically irrelevant, notion about the availability of oil. Flows of product were determined by deliberate investments in research, exploration and development, as well as by natural constraints. While interest rates were key parameters in the equilibrium, they were not direct regulators of flows of production. Instead, they were regulators of equilibrium among the deployments of the many assets of the economy, including the several assets utilized in the oil industry. The interest rate applied, then, to all irreversibly invested stocks of productive assets, but not at all to current decisions about flows of production from oil reserves.

The present paper uses Adelman's vision to re-interpret some canonical papers that have advanced a modern view of asset equilibrium in resource industry. It unifies the findings of the papers and of Adelman's own work as representing "r-percent rules". In this case, the r-percent rules apply to discrete decisions about managing stocks as opposed to continuing decisions managing flows from them. The term *rule* as used in the paper refers to optimal decisions about resource stocks. Many decisions are not optimal. However, almost identical *relations* involving the interest rate hold for non-optimal decisions. Furthermore, the rules and relations hold under both certainty and uncertainty and for decisions about both abandonment and development. Adelman's practical insights about the role of interest in decisions concerning many disparate assets are seen to capture the essence of equilibrium dynamics in a resource industry.