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Mineral endowment, labor productivity, and comparative advantage in mining ☆

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Abstract

Labor productivity in the U.S. copper mining industry tripled between 1975 and 1995, allowing the industry to recover its comparative advantage. Mine level data on output and labor input indicate that over three-quarters of this increase came from labor productivity growth at individual mines, and less than a quarter from shifts in output from low- to high-productivity mines. This finding supports the hypothesis that new technology and innovation are as important or more important than mineral endowment in shaping labor productivity trends and comparative advantage in mining. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Economists and others have traditionally assumed that comparative advantage in mining depends largely on mineral endowment. Countries with the best mineral

☆ The article is based on Aydin (1998) and Tilton and Landsberg (1999).

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deposits will enjoy relatively low production costs, and mining will take place first in these countries. Over time, as their deposits are depleted, comparative advantage will shift to those countries with the next best deposits. Once these deposits are gone, mining will move on to another group of countries and to a new set of deposits, whose production costs are higher than those previously exploited but lower than those of other deposits still remaining to be developed.

This view of mining is consistent with a generalized static Hotelling world where perfect information about the magnitude and nature of mineral deposits prevails along with the absence of innovation and technological change.[3] Over time, labor productivity should fall, both within individual countries and for the world as a whole, as mining shifts to poorer grade, more remote, and more-difficult-to-process deposits.

One widely recognized deficiency of this traditional view of mining is its failure to take account of exploration and the finding of new, low-cost deposits. Such discoveries may interrupt the inevitable movement of mining up the ladder of successively poorer quality deposits, and for a time at least allow labor productivity to rise and the costs of mining to fall. Eventually, however, diminishing returns should set in as the more promising geologic sites are fully explored.[4]

A greater challenge to the traditional view comes from the empirical studies by Barnett and Morse (1963), Barnett (1979), Slade (1982, 1985), and others. These works find that mineral commodities have become less scarce, not more scarce, over the past century due in large part to technological innovations that have reduced the costs of finding and producing them.[5]

This raises the possibility that innovation and new technology may be as important as, or more important than, changes in mineral endowment in understanding global trends in mining. In this vein, Tilton and Landsberg (1999) have recently questioned the traditional view that changes in mineral endowment are largely responsible for trends in labor productivity and shifts in comparative advantage on the basis of their examination of the U.S. copper mining industry over the past several decades.

[3] Hotelling (1931) in his seminal contribution examines the optimum output of a single mine over its life under a number of assumptions, including perfect information on the quantity and quality of the mine's deposit and the absence of technological change. A generalized static Hotelling world retains the Hotelling assumptions while encompassing a number of deposits. For any given deposit, the ore is homogeneous, but quality may vary among deposits.

[4] For an interesting empirical study of the role of exploration in the long-run supply of copper and iron ore, see Trocki (1990). For a more general economic analysis of exploration, see Eggert (1987) and the contributions found in Tilton et al. (1988).

[5] Slade (1982) also concludes that the long-term downward trend in real prices for many mineral commodities has in recent years come to an end, raising the possibility of greater scarcity in the future. Using more recent data and more recent time-series techniques, Berck and Roberts (1996) challenges this finding. For a recent review of the literature in this field, see Krautkraemer (1998).