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How cost efficient are Australia's mining industries?

J. Asafu-Adjaye*, R. Mahadevan

The University of Queensland, Brisbane, Australia

Abstract

This paper uses a stochastic translog cost frontier model and a panel data of five key mining industries in Australia over 1968–1969 to 1994–1995 to investigate the sources of output growth and the effects of cost inefficiency on total factor productivity (TFP) growth. The results indicate that mining output growth was largely input-driven rather than productivity-driven. Although there were some gains from technological progress and economies of scale in production, cost inefficiency which barely exceeded 1.1% since the mid-1970s in the mining industries was the main factor causing low TFP growth.

JEL classifications: C33; L72; O3; O56

Keywords: Total factor productivity growth; Cost inefficiency; Technological progress; Technical and allocative efficiency; Stochastic translog cost frontier

1. Introduction

The mining sector is one of the most important industries in natural resource-rich Australia which is also one of the largest suppliers of minerals in the world. The Australian mining sector has become increasingly export-oriented as mineral exports have risen from approximately 24% of Australian commodity exports in the 1960s to 60% in 1994–1995. It is widely acknowledged in the literature that one way of securing continued export growth is to improve cost competitiveness via total factor productivity (TFP) growth.

Previous studies on Australia's mining sector have often centered on partial measures of labour productivity growth which completely ignore the joint use of

*Corresponding author. Fax: +61-7-3365-7299.

E-mail address: j.asafu-adjaye@economics.uq.edu.au (J. Asafu-Adjaye).

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other inputs and hence are biased in the evaluation of productivity performance. More recently, the Productivity Commission (1999) and Parham and Makin (2000) have attempted to measure TFP growth of the Australian mining sector. However, there are three main drawbacks in these studies. First, they used aggregate level data of the mining sector. This casts doubts on the broad implications drawn for the various mining industries within the sector. Second, the TFP growth measure was obtained by using the non-frontier approach, which imposes the constant returns to scale condition without any statistical validation. But the nature of returns to scale has an important bearing on input shares and hence the magnitude of TFP growth estimates. Rodrik (1996) explains that if the true elasticity is below one, then the greater use of one input would cause the factor share of that input to fall over time and the true TFP growth would increase correspondingly. Third, the previous studies' used the growth accounting method to decompose mining sector output growth into input growth and TFP growth only. However, such a decomposition does not further identify the sources of TFP growth because the residual measure of TFP growth in the methodology represents 'anything and everything' of output growth that is not accounted for by input growth. Hence, accurate policy measures cannot be drawn based on these results.

The main contribution of this paper lies in the empirical examination of the sources of output growth and TFP growth of five key mining industries within the mining sector from 1968 to 1969 and 1994 to 1995. This study is an improvement over previous studies in the following ways. First, disaggregated industry level data are used. Second, a stochastic cost frontier model is estimated for each industry, which allows for industry-specific factors to be distinct from random errors in their effect on productivity growth. Thus, it is concerned with industry operation under conditions of disequilibrium where cost inefficiency on the form of technical and allocative inefficiencies prevail. The Tornqvist index used by previous studies assumes long-run equilibrium and does not account for any such inefficiencies. Thirdly, the constant returns to scale condition is relaxed in the model to realistically capture scale effects on TFP growth. Fourth, each of the mining industry's output growth is not just decomposed into input growth and TFP growth but TFP growth is further decomposed to study the sources of TFP growth for useful conceptual and empirical policy analysis.

In this study, a stochastic cost frontier is chosen over a stochastic production frontier for the following reasons. First, all mineral exploration is controlled by the Australian authorities. Thus the cost function is appropriate given that it assumes that prices and output are exogenous while input demands and total cost are endogenous (Greene, 1980; Kumbhakar, 1991). It is realistic for input demands to be endogenous as industries often decide on the amount of inputs to be used after observing the market prices of inputs. Second, unlike the estimation of the production frontier which is carried out with observations on output and inputs only, the cost frontier estimation used input prices and thereby can be used to draw inferences about cost efficiency.

The paper is organised as follows. The next section discusses the theoretical framework underlying the stochastic cost frontier and the decomposition of output