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**DETERMINATION OF AN EMPLOYMENT ESTIMATOR FORMULA IN UPSTREAM
INDUSTRIES DUE TO MINING TECHNOLOGY IN SOUTH AFRICA**

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ABSTRACT

Mining has had a positive contribution in the economy of South Africa for over 150 years through rents, income terms of trade, capital formation and employment. Since historically the mining industry in South Africa is considered as backbone of the country's economy, or a base industry of the country's economy, this thesis sought to develop an employment estimator formula to estimate employment opportunities induced in upstream industries to the mining industry in South Africa, in particular mining production backward linkage envelope, as the results of demand for input goods and services.

To achieve this objective, data from the Mining Qualifications Authority (MQA), LinkedIn, mining magazines and company websites with respect to the number of employees per major groups of occupations, locations of companies supplying mines with goods and services, countries of origin of these companies and goods and services they provide were collected. In this research, goods and services are used as proxies of technologies and companies are taken as the embodiment of such technologies. The data collected consisted of 123 companies and 13 company types, with employee data divided into eight major groups of occupations and mining input goods and services divided into 12 nodes of technology.

The analysis of data showed that South African companies had significant or dominant presence in 11 of the 12 nodes. This led to the conclusion that the consumption of locally manufactured goods and services by mines in South Africa is significant enough to support the creation of employment opportunities in the local upstream industries to the mining industry.

This paved way to the derivation of the employment estimator formula. While the thesis set out to estimate the induced employment opportunities due to consumption of goods and services (input technology), it was later determined that providers of goods work predominately off mine site and therefore it was uncertain that employment therein (including services they provide) is directly induced by the establishment of a specific mine. On the other hand, the data showed that the mining related services such as contract mining and engineering services take place on a specific mine site and therefore there is a high certainty that employment therein is induced directly by a specific mine. To this effect, the derivation of the employment estimator formula (four equations) was confined to data related to mining contractor and engineering services company types.

One deterministic and three stochastic equations were derived, with stochastic equations further divided into normal stochastic and time-dependent stochastic. The latter was further divided into two equations, i.e., one that deals with the high rate of automation of tasks and the other that deals with the low rate of automation of task due to incorporation of fourth industrial revolution (4IR) technologies into work routines. While all equations have very strong correlations with mine data used for validation, it was determined that stochastic equations provide realistic estimation of induced employment opportunities.

Notwithstanding the above, the employment estimator formulae derived in this thesis are applicable only to mining contractors and engineering services companies. In this regard, it is recommended that further work must be done to extend their application beyond aforementioned company types. It is also recommended that the methodology

used in this thesis be applied in deriving other versions of employment estimator formulae at different nodes along the mineral value chains.

Keywords:

Employment estimator formula, employment opportunity, backward linkages, mining technology, mining goods and services, mining industry.