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Resource dependence in Ecuador: an Extractives Dependence Index analysis

Introduction

Natural resources and the extractive industries play a central role in the economy of 81 countries and the lives of nearly 3.5 billion people (UN Environment 2019). At the macro level, proceeds from the extractive industry have encouraged economic growth and, when the right conditions are in place, even contributed to a sustainable development (Wise and Shtylla 2007). Although in recent years there has been a considerable discussion across different disciplines (economists, anthropologist, sociologist) about the influence of extractive industries on the social, economic, and political activities of a country, a number of papers suggest that governments often expect that the exploitation of natural resources will allow them to (Gilberthorpe and Papyrakis 2015):

- ◆ achieve economic growth,

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- ◆ provide additional employment opportunities,
- ◆ enhance social and community investment.

To benefit from the economic advantages of natural resources, in the last 35 years, developing countries have doubled their mining production. The large majority of the developing and transition countries have focused on the exploitation of mineral fuels (coal, oil and natural gas); while others, with the use of novel mineral exploitation technologies, have concentrated on the production of Ferro-Alloys and Industrial Minerals (Federal Ministry for Sustainability and Tourism (BMNT) 2018). The increasing demand for oil, gas, and mineral resources has led some countries to prioritize the extractive industries; yet, there is growing empirical evidence that in some cases governments have neglected other sectors of the economy, making them highly dependent and vulnerable to volatile commodity prices (IIED 2007, Brown et al. 2019).

Countries in Latin America and the Caribbean (LAC) region have abundant mineral and oil resources. According to the latest estimates by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), the region has 61% of the global lithium reserves (Chile, Argentina and Brazil), 37% of copper reserves (Chile, Peru and Mexico), 14% of iron reserves (Brazil), 12% of gold reserves (Brazil, Mexico and Peru) and nearly 20% of world crude oil reserves (Venezuela, Brazil, Ecuador). In 2017, minerals and fuels accounted for, on average, 65% of each country's exportable supply. Non-ferrous metal mining is a strategic sector for attracting foreign direct investment (FDI) to the region. The value of FDI (inflows) of extractives into the LAC region was US$ 171 billion (Bárcena 2018). Within the next few decades, the demand for minerals and oil commodities is projected to grow due to the continued rise in population, economic growth of China and India, changes in the trade patterns and market needs, and technological changes in the energy sector (Szurlej and Janusz 2014; Benalcazar et al. 2017; Grudziński 2018; Olkuski 2019). Hence, Latin American countries face the challenge of changing their model of primary-export specialization and move away from their dependence on natural resource-intensive exports in order to avoid being vulnerable to commodity cycles.

In this context, given the limited literature available on measuring the dependence on the extraction of oil, gas, and minerals of the Ecuadorian economy, the objective of this article is to twofold. First, to provide a snapshot of the historical and current situation of Ecuador's natural resource dependence. Second, to estimate the Extractives Dependence Index scores for Ecuador between 2003 and 2017. Based on the EDI scores obtained, we analyze the variation of this indicator and investigate the effect of extractives dependence on the Ecuadorian economy. This paper is organized as follows. Section 1 presents an overview of Ecuador's resource dependence. Section 2 describes the method used to assess the magnitude of Ecuador's resource dependence for the years 2003–2017, including the data used for the study. Section 3 summarizes the results and the paper ends with concluding remarks.

1. An overview of Ecuador's resource dependence

Since its independence from Spain in 1822, Ecuador's economic growth was primarily driven by the agro-export sector. Its main export commodity during its first century of independence was cocoa. By the early 1900s, with the drastic fall in prices of this agricultural commodity, Ecuador enhanced its domestic capacity to produce and export other agricultural products like sugarcane, rice, coffee, and bananas (Ayala Mora 2008). In the early 1920s, the discovery of oil fields in the Santa Elena peninsula of Ecuador attracted significant international attention and sparked the interest of foreign companies such as The Anglo Ecuadorian Oil Fields Ltd. (a subsidiary of British Petroleum), the Leonard Exploration Company (a subsidiary of Standard Oil) and the Anglo-Saxon Petroleum Company Ltd. (affiliated to the Royal Dutch Shell) to invest in oil exploration and exploitation (Martz 1987; Acosta 2012). In the decade of the 1960s, the discovery of new petroleum fields in the Amazon basin of Ecuador resulted in a significant increase in oil production. The additional revenues from oil allowed the government to invest in a sustained urbanization process, in education, and even in the construction of Ecuador's largest hydropower plant, the Paute hydroelectric plant (Larrea 2006). In 1973, the country joined the Organization of the Petroleum Exporting Countries (OPEC), withdrew from the organization in 1992, and rejoined in 2007. It is one of the smallest OPEC members with a reported crude oil production, in 2018, of 517,200 barrels per day (OPEC 2019). Figure 1 shows Ecuador's GDP and OPEC's crude oil prices (1988–2017).
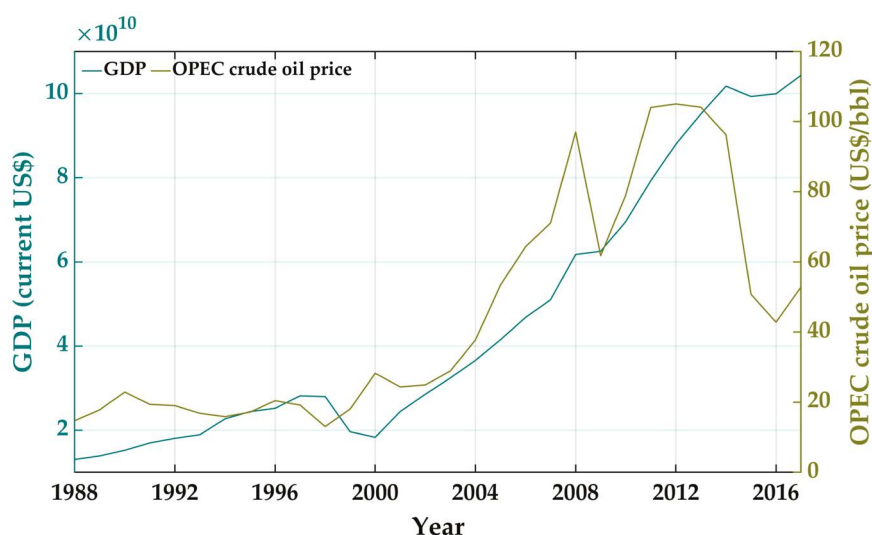

Fig. 1. Ecuador's GDP and OPEC's crude oil prices, 1988–2017
Source: own study based on (The World Bank 2019a, 2019b)

Rys. 1. Produkt Krajowy Brutto Ekwadoru oraz ceny ropy naftowej (OPEC), 1988–2017

Although its natural comparative advantages and low labor costs have helped Ecuador position itself as a major oil exporter, the low diversification and its dependence on natural resources has left the economy exposed to the oil price volatility, affecting the economic structure of the country as well as the allocation of factors of production (Acosta 2009). In 2000, the mining, oil and refining industry contributed 6.34% of the GDP, peaking at 15.17% in 2008, and dropping to 5.89% in 2017 (BCE 2019a). Foreign direct investment (FDI) inflows between 2003 and 2018 amounted to US$ 11.813 billion with 40.7% of FDI directed towards extractives activities and yet, when compared with the other countries in the LAC region, Ecuador has one of the lowest FDI inflows (CEPAL 2018; BCE 2019b).

According to the Observatory of Economic Complexity (OEC), Ecuador's major exports include petroleum, bananas, crustaceans, and flowers. Its largest trading partners are the United States, Vietnam, Chile, Russia, China, Colombia and Spain (Simoes and Hidalgo 2011; OEC 2019). In addition, in 2017, Ecuador's trade deficit narrowed US$ 18.4 million, as total exports amounted to US$ 19.312 billion while imports reached US$ 19.330 billion. Figure 2 shows Ecuador's main exports in 2017.

Between 1988 and 2017, crude oil and refined petroleum products constituted on average about 45% of the country's total exports, confirming Ecuador's strong economic dependence on this sector. Ores and metal exports represented only 1% of the total merchandise exports. However, this is expected to increase over the coming years with the exploitation of projects such as the 'Cascabel' (copper-gold), 'Fruta del Norte' (gold-silver), 'Loma Larga'
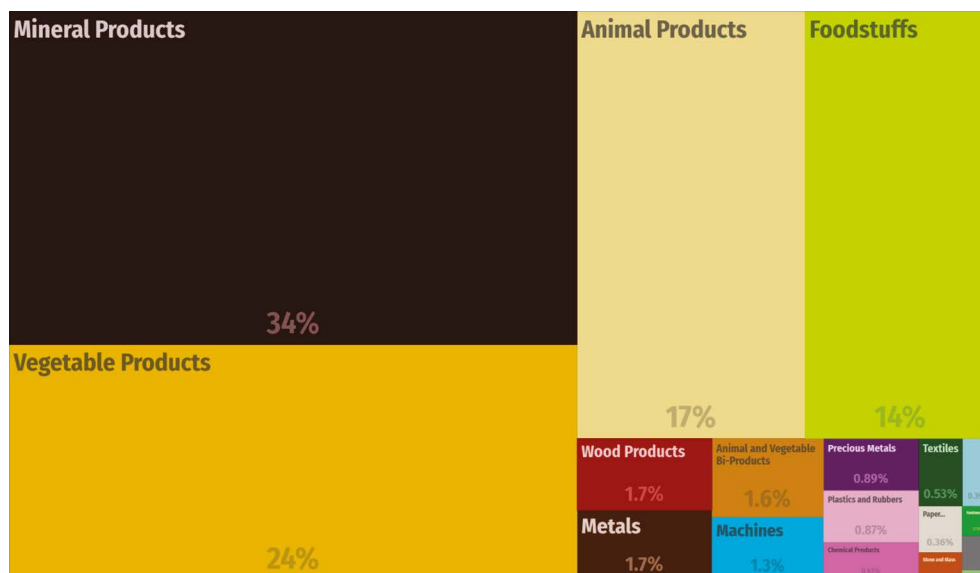

Fig. 2. Ecuador's main exports, 2017
Source: Simoes and Hidalgo 2011; OEC 2019

Rys. 2. Całkowity eksport towarów z Ekwadoru, 2017

(gold-copper-silver) and 'Río Blanco' (which according to recent estimates by the Ecuadorian ministry of energy and non-renewable natural resources could be the one of the world's largest deposits of gold and silver) (MRNNR 2019). From these key projects, and by using as a reference the experience from the Chilean large-scale mining projects, the Ecuadorian government expects to boost revenues from ores and metal exports while providing investment incentives to the mining industry. Ecuador's extractive exports as a share of total merchandise exports are shown in Figure 3.
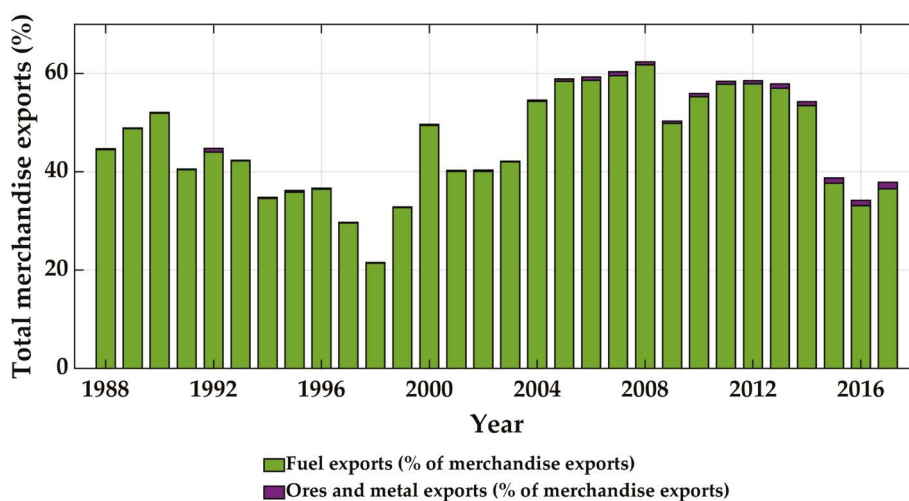

Fig. 3. Ecuador's total merchandise exports (extractive exports), 1988–2017
Source: own study based on (The World Bank 2019a)

Rys. 3. Całkowity eksport produktów przemysłu wydobywczego z Ekwadoru, 1988–2017

2. Method

2.1. The Extractive Dependence Index

A plethora of literature has explored the links between resource dependence, economic growth, poverty, and governance across developing countries. On one hand, some studies pay more attention to the causal factors of resource dependence and focus on the development of cross-sectional analyses that document empirical evidence related to the resource course and The Dutch Disease. For instance, Thomas and Treviño (2014) focused on the relationship between resource dependence and its impact on the taxation revenue in Sub-

-Saharan Africa. Bazilian et al. (2013) studied the impact of oil and gas dependence of West African countries, those located in the Gulf of Guinea, on their agricultural sector and socio-economic development. Coxhead (2007) looked into the effect of China's economic expansion on the natural resource dependence of South East Asian economies. Similarly, Wu et al. (2018) investigated the links between economic growth and resource-oriented industry dependence at the provincial level in China.

On the other hand, several studies have concentrated on the development of methods to quantify the dependence of a country on resource extraction. These measures, which have been derived from economic and statistical theories, serve as indicators of the importance of the extractive industry in a country and as potential guides for policy actions. One of such indices was proposed by Baunsgaard et al. (2012) who used a fiscal indicator to classify resource-dependent countries based on their mineral and fuel revenue dependency. In their study, countries with fuel and mineral revenues above the range of 20 to 25 percent of total fiscal and export revenue are classified as resource-dependent countries. Another measure is the Mining Contribution Index (MCI) developed by the International Council of Mining and Metals (ICMM), a composite measure that comprises four variables: mineral and metal export contribution in 2016; increase/decrease in mineral and metal export contribution for the years 2011–2016, mineral production value expressed as percentage of GDP in 2016; and mineral rents as a percentage of GDP (ICMM 2018). In a more recent study, Addison and Roe (2018) proposed the WIDER (MCI-W), an extension of the Mining Contribution Index that uses GDP purchasing power parity from the World Bank to assess the current levels of mining contribution to national economies.

The present study uses the Extractives Dependence Index (EDI) proposed by Hailu and Kipgen (2017) to assess the magnitude of Ecuador's resource dependence (oil, gas, and minerals) between 2003 and 2017. The EDI is an indicator that allows to monitor the resource dependence of a country over time by considering the share of export earnings from extractives in total export earnings, the share of revenue from extractives in total fiscal revenue, and the extractive industry value added in GDP. EDI scores range between zero (low level of dependence) and 100 (very high level of dependence).

The equation for the Extractives Dependence Index (EDI) is comprised of three elements:

- export earnings ($EIX_{i,t} \cdot (1 - HTM_{i,t})$),
- fiscal revenue ($REV_{i,t} \cdot (1 - NIPC_{i,t})$),
- extractive industry value added in GDP ($EVA_{i,t} \cdot (1 - MVA_{i,t})$).

The indicator is formulated as follows:

$$EDI_{i,t} = \sqrt{\left[\left(EIX_{i,t} \cdot (1 - HTM_{i,t})\right)\right] \cdot \left[\left(REV_{i,t} \cdot (1 - NIPC_{i,t})\right)\right] \cdot \left[\left(EVA_{i,t} \cdot (1 - MVA_{i,t})\right)\right]}$$

✍ $EIX_{i,t}$ –   export revenue from oil, gas and minerals (% of total export revenue) for country i in year t,

$HTM_{i,t}$ –   export revenue from high-tech manufactures (non-resource exports) for country i as a percentage of global HTM exports in year t,

$REV_{i,t}$ –   revenue generated from the extractive industry as a percentage of the fiscal (total tax and non-tax) revenue for country i in year t,

$NIPC_{i,t}$ –   total non-resource tax revenue as a percentage of gross domestic product for country i in year t,

$EVA_{i,t}$ –   value added of extractive sector as a percentage of gross domestic product for country i in year t,

$MVA_{i,t}$ –   manufacturing value added per capita for country i in year t.

2.2. Data

The historical data sets (2003–2017) used for the calculation of Ecuador's EDI were gathered from various information sources. The estimates of export revenue from oil, gas and minerals (*EIX*) were taken from the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC 2019), the Central Bank of Ecuador (BCE 2019c), the Ministry of Economy and Finance (Ministerio de Economía y Finanzas 2019), and merged with data (on oil sales revenue) from the national oil company, Petroecuador. Export revenue from high-tech manufactures (*HTM*) as a share of global HTM exports was derived from the United Nations Conference on Trade and Development database (UNCTAD 2018) (values were square root transformed). Revenue generated from the extractive industry as a percentage of the fiscal revenue (*REV*) was obtained from Ecuador's Internal Revenue Service (IRS) (Servicio de Rentas Internas 2019). The total non-resource tax revenue as a percentage of GDP (*NIPC*) was taken from the Government Revenue Dataset of the United Nations University (ICTD/UNU-WIDER 2018). Value added of the extractive sector as a percentage of total value added (*EVA*) was estimated from the National Accounts Main Aggregates Database of the United Nations (UN 2019) (natural log-transformed) and min-max normalized to the range [0, 1] with other Latin American countries. Historical values for manufacturing value added per capita (*MVA*) were obtained from The World Bank and the United Nations Industrial Development Organization (The World Bank 2019c; UNIDO 2019). Raw MVA data were square root transformed and min-max normalized to the range [0, 1] with other Latin American countries in the region.

3. Results

The results from estimating Ecuador's EDI scores show its strong dependence on natural resources between 2003 and 2014, in particular on the oil extraction sector. EDI scores in the pre-financial crisis period (2003–2007) range from 36.60 to 44.19 and exhibit a weak negative correlation to OPEC's crude oil price ($r = -0.16$), whereas in the post-financial

crisis period, EDI scores exhibited a strong positive correlation to OPEC's crude oil price ($r = 0.84$). Figure 4 shows Ecuador's EDI scores for the years 2003–2017.

The fluctuations observed in the trajectories of the estimated EDI scores can be explained from the construction of this composite index. In the case of Ecuador, high global crude oil prices increase the resource dependence of the country, hence affecting the score and increasing its value. However, the EDI also considers alternative sources of revenue and manufacturing value added per capita, two areas which the Ecuadorian government has intensively targeted with institutional frameworks and development strategies. For instance, the government established a National Development Plan (2007–2010) ('Plan Nacional de Desarrollo') and the National Plan for Good living (2009–2013) ('Plan Nacional del Buen Vivir') which set out several objectives to abandon the agro-export model. Objective 10 aimed to transform the productive structure of the country by diversifying its economy and setting up new industries with high productivity and competitiveness. Nonetheless, Ecuador's EDI scores show that despite the significant efforts to diversify its productive infrastructure, the country continues to be dependent on the extractive sector. It is worth noting that there is a significant drop in Ecuador's EDI scores of nearly 22.61 points between 2012 and 2015. The apparent lower scores and lower resource dependence, as was the case of Angola and Kuwait described by Hailu and Kipgen (2017), could reflect the low global oil prices and the drop in export revenue from crude oil due to Ecuador's pre-sales of oil (also referred to as oil-for-loan deals) to China (Rodas Saá 2018). Moreover, Ecuador's high dependence on
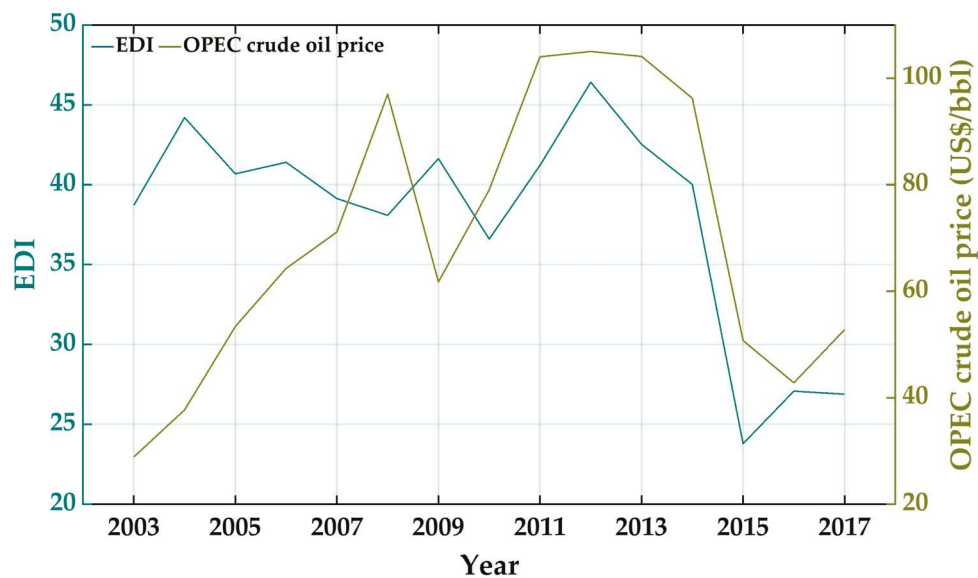

Fig. 4. Ecuador's EDI scores, 2003–2017

Rys. 4. Wartość EDI Ekwadoru w latach 2003–2017

export earnings from the extractive industry implies that there is the absence of sustained economic growth. Despite the significant proceeds from the extractive industry between 2007 and 2015, the Ecuadorian economy has not diversified the structure of its exports, showing the absence of a clear productive strategy, and continuing its dependence on low value-added agricultural commodities.

In addition, several studies have shown that the Ecuadorian extractive dependence has not facilitated or created linkages to other sectors of the economy since the crude oil is sold into international markets and the technologies used for the oil extraction and refining are acquired from North American and European countries, without any participation of the national market. Furthermore, extractive industries have caused a 'resource movement effect', shifting capital (technology and public spending) towards the oil sector but not employment, as these sectors are capital-intensive rather than labor-intensive (Acosta 2009; OXFAM International 2009).

Conclusions

In this study, we aimed to provide a snapshot of the historical and current situation of Ecuador's resource dependence and quantify its level of dependence with the use the Extractives Dependence Index. The EDI is a generally accepted method for measuring a country's aggregate dependence on natural and mineral resources, having the advantages of being constructed with three elements that use available data from international organizations such as the United Nations and the World Bank. Ecuador's EDI scores show that the production structure of the country remains highly dependent on the rents generated by the extractive industries. Furthermore, it demonstrates that the government's compelling interest in exploiting natural resources has had a significant impact on the economy and has strengthen the characteristics of a primary export economy. Moreover, the results show that Ecuador's economy is vulnerable to external shocks, as it exports commodities with a high level of volatility. In short, the estimated EDI scores provide an indication that Ecuador's extractives revenues have become far more significant over the last decade and that there is a need for a diversification of the economy. Finally, Ecuador's dependence on external flows has forced the local government to seek new areas of oil exploitation and grant numerous mining projects which could lead to a change in EDI scores. For further research, it would be desirable to extend this study to other countries of the Latin American region since one of the EDI advantages is that allows to standardize and compare scores between countries.

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RESOURCE DEPENDENCE IN ECUADOR: AN EXTRACTIVES DEPENDENCE INDEX ANALYSIS

K e y w o r d s

resource dependence, Ecuador, extractives dependence index, extractive industries

A b s t r a c t

Natural resources and the extractive industries play a central role in the economy of developing countries and the lives of nearly half of the world's population. The increasing demand for oil, gas, and mineral resources has led some countries to prioritize the extractive industries; yet, there is growing empirical evidence that in some cases governments have neglected other sectors of the economy, making them highly dependent and vulnerable to volatile commodity prices. Latin American countries face the challenge of changing their model of primary-export specialization and move away from their dependence on natural resource-intensive exports in order to avoid being vulnerable to commodity cycles. In this context, given the limited literature available on measuring the dependence on the extraction of oil, gas and minerals of the Ecuadorian economy, the objective of this article is to two-fold. First, to provide a snapshot of the historical and current situation of Ecuador's natural resource dependence. Second, to estimate the Extractives Dependence Index (EDI) scores for Ecuador for the years 2003 to 2017. The EDI is a generally accepted method for measuring a country's aggregate dependence on natural and mineral resources. Based on the EDI scores obtained, we analyze the variation of this indicator and investigate the effect of extractives dependence on the Ecuadorian economy. Results show that despite the government's significant efforts to diversify Ecuador's economy, the country has a persistent dependence on the extractive sector.

**ZALEŻNOŚĆ ZASOBOWA W EKWADORZE:
ANALIZA WSKAŹNIKOWA UZALEŻNIENIA OD PRZEMYSŁU WYDOBYWCZEGO**

S ł o w a   k l u c z o w e

przemysł wydobywczy, zależność zasobowa, Ekwador,
wskaźnik uzależnienia od przemysku wydobywczego

S t r e s z c z e n i e

Zasoby naturalne oraz przemysł wydobywczy odgrywają kluczową rolę w gospodarkach krajów rozwijających się i mają wpływ na niemal połowę populacji świata. Rosnący popyt na ropę naftową, gaz ziemny oraz pozostałe surowce mineralne spowodował, że część krajów stawiana na pierwszym miejscu rozwój sektora wydobywczego, zaniedbując pozostałe gałęzie gospodarki, co może powodować – w obliczu coraz liczniejszych dowodów empirycznych – uzależnienie i wysoką podatność tych pozostałych sektorów na wahania cen surowców. Dużym wyzwaniem dla krajów Ameryki Południowej jest zmiana modelu funkcjonowania gospodarek, nastawionych w pierwszej kolejności na

eksport, i odejście od uzależnienia od wydobycia surowców mineralnych, w celu uniknięcia podatności na cykle koniunkturalne, którym podlegają ceny tych surowców.

W związku z powyższym oraz z uwagi na ograniczoną liczbę artykułów w literaturze światowej na temat uzależnienia gospodarki Ekwadoru od wydobycia gazu ziemnego, ropy naftowej i innych surowców mineralnych, cel niniejszego artykułu jest dwojaki. Po pierwsze, przedstawienie krótkiego rysu historycznego oraz obecnej sytuacji w obszarze zależności zasobowej Ekwadoru. Po drugie, oszacowanie wartości wskaźnika uzależnienia od przemysłu wydobywczego (*Extractives Dependence Index* – EDI) dla Ekwadoru za lata 2003–2017. Bazując na otrzymanych wynikach, analizie poddano zmienność otrzymanych wartości oraz zbadano wpływ uzależnienia od przemysłu wydobywczego na gospodarkę Ekwadoru. Wyniki tej analizy wskazują, że pomimo podejmowanych przez rząd Ekwadoru działań na rzecz większego zdywersyfikowania gospodarki, w dalszym ciągu utrzymuje się silne uzależnienie od sektora wydobywczego.