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ABSTRACT

This study analyzes the impact of the extractive industry on the economy of Tajikistan. This impact assessment is based on Input-Output analysis. However, because during the time of assessment Tajikistan lacked Input-Output Tables (IOTs), it was decided to develop IOTs from the beginning from the Supply and Use Tables (SUTs) of 2011. The results of analysis with the use of reconstructed IOTs showed that the economic impact of the extractive industry in the Tajikistan economy is 1.37%. This impact is smaller than those of the extractive industry in neighboring Kazakhstan and Kyrgyzstan, which are 1.53% and 1.45%, respectively. This indicates that, if the current way of extracting and exporting mining products is improved, the impact of the mining sector on Tajikistan's economy could be greater than now.

Keywords: Supply and Use Table; Input-Output Tables; Economic impact; Extractive industry; Tajikistan

I. Introduction

The Republic of Tajikistan (RT) is a mountainous landlocked country in Central Asia with an area of 142,600 km^2 (MFA 2018). The population of Tajikistan is about 9.5 million and it had an estimated gross domestic product (GDP) of US$7.9 billion in 2020 and a real GDP growth rate of 4.5% (TAJSTAT 2021). Tajikistan has abundant deposits of natural resources, both mineral and fuel (more than 800 mineral deposits) (Extractive Transparency Initiative (EITI) of Tajikistan 2020). Tajikistan's extractive industries are represented by the mining sector. The mining sector's exports accounted for about 61.8% of the country's total exports in 2020. The total volume output of the mining sector has grown at an average annual rate of 2.0%, increasing output from TJS974.6 million in 2011 to TJS4,853.0 million in 2019 or 4.9 times the earlier achievement (TAJSTAT 2021).

The extractive industry is a vital part of Tajikistan's economy, which provides raw materials to other industrial sectors, and contributing to the development of the

national economy. Based on the National Development Strategy (NDS) for 2030 promulgated in 2016, the Tajikistan economy has undertaken a major initiative for transforming its economy from an agrarian-based to a manufacturing-based economy. This transformation effort is likely to increase demand for mining products (NDS 2016; EITI of Tajikistan 2017).

In this context, it is important to access the impact of the extractive industry on other economic sectors and on the economy as a whole. The method chosen to trace these impacts uses Leontief Input-Output Tables (IOTs). Since specific IOTs for Tajikistan was not available at the time of the research, the study also aimed at developing IOTs for Tajikistan for 2015 using the SUTs developed earlier by the Agency on Statistics in 2011 with the assistance of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (Mirzoahmedov 2018).

II. Methodology

The research has focused on the development of IOTs by following the steps listed below:

- *Based on SUTs for 2011, the SUT for 2015 was constructed.* For this exercise, the methodology found in the *"Handbook on SUTs and IOTs with Extensions and Applications"* prepared by the United Nations (UN) in 2018 was used, together with data from the National Account of Tajikistan for 2016, the Statistical Yearbook of RT for 2016, and the Foreign Economic Activity of RT for 2016.
- *Based on SUTs updated for 2015, the IOTs for 2015 was developed*. For this exercise, the Guideline of Eurostat (2008) and the Handbook of UN (2018) were used, following Model B of Technology Assumption[1] depicted in the Handbook

[1] This shows that each industry has its specific way of production, irrespective of product mix.

of UN (Appendix 1, Figure 1). Based on reconstructed IOTs for 2015, three tables, i.e., the Transaction Flow Table (Appendix 2, Chart 1 provides the general structure); the Technical Coefficient A Table, and the Total Input Coefficient B Table were developed. Once these three tables were constructed, they were used to respond to the research question set out in the Introduction section of this paper.

III. Results of the Construction of the IOTs

The results of the reconstruction of IOTs for 2015 are presented in Tables 1, 2, and 3 in a summary format in which original 93 sectors were condensed to 6 sectors. The six-sector model of the **Transaction Flow Table** is shown in Table 1.

Table 1. Transaction Flow Table for 2015 (TJS, thousand)

TRANSPOSE		INTERMEDIATE DEMAND								
	Sectors	**Agriculture Sector**	**Mining Sector**	**Industry Sector**	**Construction Sector**	**Service Sector**	**Financial Sector**	**TOTAL Intermediate**	**Final Demand Y**	**Total (Gross) Outputs X**
		1	**2**	**3**	**4**	**5**	**6**			
				Quadrant I					**Quadrant II**	
1	Agriculture Sector	7,423,807.12	2,449.40	1,321,981.29	19,164.89	153,733.45	22,258.84	**8,943,394.99**	**11,788,100.00**	**20,731,494.99**
2	Mining Sector	4,665.19	321,980.50	203,317.76	903,133.66	50,565.91	2,670.34	**1,486,333.36**	**917,400.00**	**2,403,733.36**
3	Industry Sector	1,708,833.83	98,282.08	1,572,077.14	4,113,221.96	3,357,102.14	557194.55	**11,406,711.71**	**6,220,200.00**	**17,626,911.71**
4	Construction Sector	281,513.73	8,853.13	791,471.74	282,304.78	400,446.49	218,819.86	**1,983,409.73**	**5,973,800.00**	**7,957,209.73**
5	Service Sector	3,396,778.78	163,667.67	1,054,541.58	1,673,891.92	7,213,871.82	1,029,899.96	**14,532,651.73**	**22,604,600.00**	**37,137,251.73**
6	Financial Sector	723,971.00	1,854.62	63,239.16	297,334.81	1,085,943.50	2,194,755.39	**4,367,098.48**	**904,600.00**	**5,271,698.48**
	TOTAL	**13,539,569.66**	**597,087.39**	**5,006,628.68**	**7,289,052.02**	**12,261,663.31**	**4,025,598.94**			
							Quadrant III			**Quadrant IV**
	V- VALUE ADDED	**7,191,925.33**	**1,806,645.97**	**12,620,283.02**	**668,157.72**	**24,875,588.42**	**1,246,099.53**	**48,408,700.0**	**48,408,700.0**	**91,128,300.0**
	X -TOTAL (GROSS) INPUTS	**20,731,494.99**	**2,403,733.36**	**17,626,911.71**	**7,957,209.73**	**37,137,251.73**	**5,271,698.48**			**91,128,300.0**

Based on the Transaction Flow Table (Table 1), the **Technical Coefficient Table A ($\boldsymbol{a_{ij}}$)** (Table 2) was developed. This corresponds to the Leontief matrix **A** = $\boldsymbol{a_{ij}}$ which is the direct requirement of the production inputs of the i- industry that are needed per unit of production of the j- industry (Miller & Blair 2009). It was calculated using the following equation (1):

$$\boldsymbol{a_{ij} = \frac{x_{ij}}{x_j}} \quad (1)$$

Table 2. Technical Coefficient Table, A (a_{ij})

	Sectors	**1**	**2**	**3**	**4**	**5**	**6**
1	Agriculture Sector	0.36	0.001	0.07	0.002	0.004	0.004
2	Mining Sector	0.0002	0.13	0.01	0.11	0.001	0.0005
3	Industry Sector	0.08	0.04	0.09	0.52	0.09	0.11
4	Construction Sector	0.01	0.004	0.04	0.04	0.01	0.04
5	Service Sector	0.16	0.07	0.06	0.21	0.19	0.20
6	Financial Sector	0.03	0.001	0.004	0.04	0.03	0.42
	Total	**0.653**	**0.248**	**0.284**	**0.916**	**0.330**	**0.764**

Table 3 is the **Total Input Coefficient Table B** = $\boldsymbol{b_{ij}}$ which is the requirements of the gross output of industry i to produce a unit of final production j (Miller & Blair 2009). The Total Input Coefficients B (b_{ij}) are calculated based on equation (2):

$$X = AX + Y$$

$$Y = (I - A)X$$

$$\boldsymbol{X = (I - A)^{-1}Y = BY} \quad (2)$$

Where: X is total outputs; A= (a_{ij}) – matrix of IO-Coefficients; Y- final demand, I- Identity matrix which is equivalent to $(I - A)^{-1}$, the Inverse Matrix[2] of $(I - A)$. A

[2] The matrix $x = (I - A)^{-1}y$ is called the Leontief Inverse Matrix or the interdependence coefficients or total requirements matrix and is like a "big black box." It is necessary, then, to clarify its economic significance (UN 2009).

column vector with the inverse matrix expresses as $B = (I - A)^{-1} = \{b_{ij}\}$, and represents Total Input Coefficient B (b_{ij}).

Table 3. Total Input Coefficient Table B (b_{ij})

	Sectors	Agriculture Sector	Mining Sector	Industry Sector	Construction Sector	Service Sector	Financial Sector
		1	**2**	**3**	**4**	**5**	**6**
1	Agriculture Sector	**1.59**	0.01	0.14	0.09	0.03	0.05
2	Mining Sector	0.01	**1.16**	0.02	0.15	0.01	0.02
3	Industry Sector	0.22	0.07	**1.16**	0.68	0.15	0.31
4	Construction Sector	0.04	0.01	0.06	**1.08**	0.02	0.10
5	Service Sector	0.38	0.11	0.14	0.19	**1.28**	0.48
6	Financial Sector	0.12	0.01	0.03	0.10	0.07	**1.75**
	Sectoral Multipliers	**2.35**	**1.37**	**1.54**	**2.48**	**1.56**	**2.71**

IV. Discussions

The Table 3 indicates that the multiplier effect of the extractive industry is 1.37%, which responds to the research question of the economic impact of the extractive industry to the economy of Tajikistan. Sector-by-sector review indicates that the Financial Sector has the greatest impact, with a multiplier effect of 2.71%, followed by the Construction Sector with 2.48%. The lowest multiplier effect was observed in the Mining Sector at **1.37**%.

According to the Economic Indicators for South and Central Asia IOTs compiled by the ADB in 2018, the impact of the extractive industry on the Tajikistan economy is lower than those of its neighbor countries. The output multiplier[3] of Kazakhstan was 1.53% in 2015, and that of Kyrgyzstan was 1.45%. This indicates that, if the current way of extracting and exporting mining products of Tajikistan is improved, the impact of the Mining Sector on Tajikistan's economy could be greater than now.

Additionally, the Transaction Flow Table (Table 1) indicates that the contribution of the Mining Sector to total gross output is **2.6%** of GDP in the Tajikistan economy, and

[3] The output multiplier effects of these two countries are those of the Mining and Quarrying Industry.

the contribution of the mining sector to the creation of value added in Tajikistan is **1.9%**, which is smaller than its contribution to gross output. This indicates that the contribution of extractive industry to the creation of value-added elements of the economy could be greater if the extractive industry shifts its emphasis from its current raw material-oriented production to finished product-oriented production.

V. Conclusion

This study provides deeper insight on the current role of the extractive industry in the Tajikistan economy. As stated earlier, Tajikistan's extractive industry has potential to further contribute to its economic development. Therefore, the country should use its natural resources in a more efficient manner by adding value to its raw materials. For this purpose, the Tajikistan government should improve governance by enhancing transparency and accountability, introducing effective policy measures, and developing programs for better management of revenues from extractive industry.

While developing these policy measures the Tajikistan government should be aware of potential risks including *resource curse/Dutch disease* and environmental degradation. This indicates the need of a further analysis focusing on policy aspects of the extractive industry.

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Appendix 1

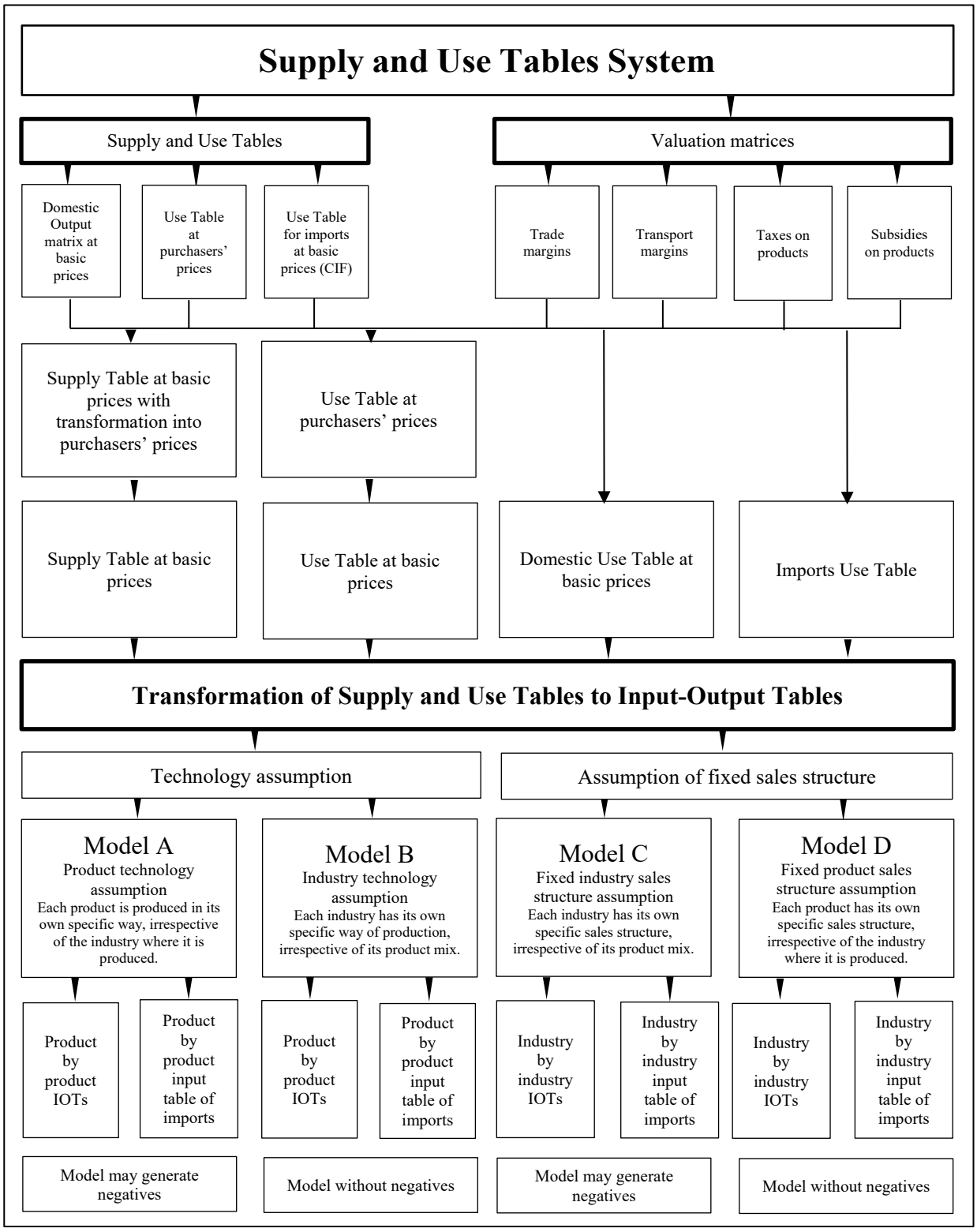

Figure 1. Transformations of SUTs to IOTs
Source: UN (2018:327).

Appendix 2

The process of development the IOTs is presented in the following Diagram 1. This was utilized in the inter-sectoral analysis for the "input-output" model of Leontief (1936).

Chart 1. General Structure of the Transaction Flow Table

		INTERMEDIATE DEMAND					**FINAL DEMAND**	
		1	**2**	**…**	***n***	**Total**	**Y Final Demand**	**X Total (Gross) Outputs**
Industries/Producers		Quadrant I					Quadrant II	
	1	x_{11}	x_{12}	…	x_{1n}	$\sum x_{1j}$	y_1	x_1
	2	x_{21}	x_{22}	…	x_{2n}	$\sum x_{2j}$	y_2	y_1
	…	…	…	…	…	…	…	…
	n	x_{n1}	x_{n2}	…	x_{nn}	$\sum x_{nj}$	y_n	x_n
	Total	$\sum x_{i1}$	$\sum x_{i2}$	…	$\sum x_{in}$	$\sum_{i-1}^{n}\sum_{j-1}^{n} x_{ij}$		
Primary Inputs		Quadrant III					Quadrant IV	
	V - Value added	v_1	v_2	…	v_n	$v = \sum v_j$	$\sum v_j = \sum Y_i$	
	X - Total (Gross) Inputs	x_1	x_2	…	x_n	$x = \sum x_j$		$\sum x_j = \sum x_i$

Source: Miller & Blair (2009:3), Mirzoahmedov (2015:112).

The following designations are introduced: **1, 2** – industries; ***n*** - number of industries (types of products); ***i, j*** - numbers of the producing and consuming industries; $\mathbf{Y_i}$ – GDP; $\mathbf{V_j}$ – column vector of the gross value-added matrix (components by industry); $\boldsymbol{X_i}$ – column vector of (product) output; $\boldsymbol{X_j}$ – row vector of (product) input and matrix of $\mathbf{x_{ij}}$ **-** Total Output (Miller & Blair 2009; Mirzoahmedov 2015).