

# MINING OF METAL ORES INDUSTRY AND ECONOMIC GROWTH NEXUS IN ARMENIA: CHALLENGES AND PROSPECTS

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## ABSTRACT

*The mining industry is pivotal in ensuring Armenia's foreign exchange earnings. Therefore, we investigate the role of real exports of companies representing the mining of metal ores industry using quarterly data (2012q1 2023q2) in explaining statistically significant changes in the real GDP in the short run based on the least squares estimation technique. We conclude that significant positive changes in the real GDP are not associated with the increase in the industry's real exports since the growth of the mining of metal ores industry in Armenia mainly reflects the developments in the global commodity market. Hence, we find no evidence of the "multiplier effect." Based on the findings, we substantiate the main challenges the industry could face and highlight the prospects ahead while meeting the objectives that the Mining Sector Development Strategy (until 2035) defined to ensure the industry's growth and attract new investors.*



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## 1. INTRODUCTION

The mining industry was considered one of Armenia's vital sources of foreign exchange earnings. During the period 2012-2022, the ratio of exports of seven companies representing the mining of metal ores industry (Zangezur Copper Molybdenum Combine CJSC (ZCMC), Agarak Copper Molybdenum Combine CJSC (ACMC), Teghout CJSC, Akhtala Mining and Processing Enterprise (AMPE) CJSC, Chaarat Kapan CJSC, Meghradzor Gold LLC and Lichkvaz CJSC) to the merchandise exports of Armenia varied from 26.5% to 37.5% (see Figure 1). However, in 2022, the industry exports-to-merchandise exports ratio reported the lowest

value over ten years, comprising only 22.1 percent (see Figure 1).

In 2021, the companies' exports reported the highest industry exports-to-merchandise exports ratio (37.5%), mainly attributed to the exports of concentrates and ferromolybdenum at higher prices (World Bank, 2024; Trading Economics, n.d.), compared to 2020, especially in the case of copper and molybdenum concentrates, since real exports (physical volumes) declined (see Figure 1). The companies' exports accounted for 8.01% of the GDP, the highest ratio reported since 2012 (see Figure 1). In 2022, the industry exports-to-merchandise exports ratio of 22.1% was primarily associated with the sharp increase in the exports of several product lines

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due to re-exports of several products (according to data from the Statistical Committee of Armenia (SCA, n.d.), and the United Nations Comtrade database (UN Statistics Division, n.d.)). In 2022, the exports of seven companies representing the mining of metal ores industry amounted to 1.17 billion US dollars (see Figure 1).

Dokholyan et al. (2023) discussed the recent industry developments, namely, the acquisition and/or transfer of the majority of shares of some companies to legal entities with either Russian capital and/or founders and shareholders, the challenges ahead concerning investments from Russia (namely, the companies affiliated with GeoProMining: ZCMC and ACMC; and transfer of the majority of shares of Teghout to VTB Bank) and possible alternatives to be addressed. However, due to the purpose of the research, the authors did not cover the activities of Lichkvaz CJSC in their investigation (Dokholyan et al., 2023) since the exploitation of the mine started only in March 2020 (Dokholyan et al., 2023).

In August 2023, Lichkvaz CJSC acquired the shares of Chaarat Kapan CJSC from British Chaarat Gold, offering 55.4 million US dollars through its affiliate Gold Mining Company (Union of Miners and Metallurgists of Armenia, August 17, 2023). The agreement was reached due to the appreciation of the Armenian dram against the US dollar starting from the second quarter of 2022, which mostly continued during 2023 as well (according to data from the Central Bank of Armenia (CBA, n.d.)). Thus, the company suffered losses from an increase in costs and expenses expressed in Armenian drams (Union of Miners and Metallurgists of Armenia, August 17, 2023).

Dokholyan et al. (2023) state that future sanctions to be imposed on the owner of GeoProMining are a challenge to address to avoid an industry decline. On November 2, 2023, the United States Department, in coordination with the US Treasury Department, imposed sanctions on individuals and legal entities in accordance with the US Presidential Executive Order No. 14024 (Executive Order No. 14024, 86 FR 20249, 2021), which targeted the personal wealth of the Trotsenko family (in particular, Gleb Trotsenko) (U.S. Department of State, 2023, November 2). However, before the imposed sanctions by the US became effective, Gleb Trotsenko, the primary beneficiary of ZCMC, had already transferred his shares to another person (Ministry of Justice of the Republic of Armenia, n.d.) thus enabling ZCMC to avoid sanctions. As a result, Svetlana Ershova became the company's largest shareholder, owning 47.64% of the shares, according to the State Register of Legal Entities of the Ministry of Justice of Armenia (Ministry of Justice of the Republic of Armenia, n.d.).

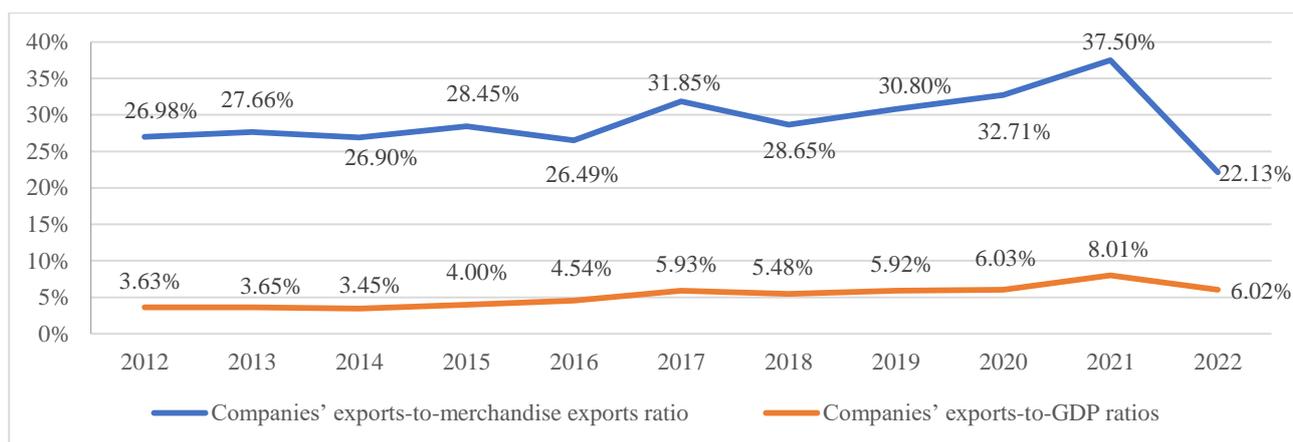
Armenia is also rich in deposits of various metallic minerals (Order of the President of Armenia No. NK-100-A, 2017), and the exports thereof can continue to be

a source of foreign exchange earnings in the medium term and over the long run. According to the estimates published in 2017 in the Concept Note on the Management of Deposits of Natural Resources of Armenia, the deposits of various metallic minerals of the existing companies representing the mining industry could suffice for about 100-120 years in the case of copper-molybdenum ores; for about 25-30 years, in the case of gold ores, and for about 20-25 years in the case of lead-zinc (multi-metallic) ores (Order of the President of Armenia No. NK-100-A, 2017). According to estimates from geological surveys and mineral explorations in Armenia, about 5-7% of the world's deposits of copper and 7-9% of molybdenum are in Armenia's territory (Melkumyan, 2014, p. 60).

Of 44 metallic mineral deposits registered in the state balance of mineral resources, only 23 mines (sites) obtained the right to use the subsoil (Decree of the Government of Armenia No. 730-L, 2023). Moreover, in 2021, only 13 of 23 mines were exploited (Decree of the Government of Armenia No. 730-L, 2023). As of January 8, 2024, 10 organizations have been granted subsoil geological survey permits (for metallic minerals) since August 19, 2020, out of which only three permits were granted in 2022 and only one permit in 2023 (Ministry of Territorial Administration and Infrastructure of the Republic of Armenia, n.d.); meanwhile, in total, 129 occurrences of various minerals found in Armenia were registered by State Cadastre of Mines, Deposits and Occurrences of Minerals of the Republic of Armenia (Decree of the Government of Armenia No. 730-L, 2023).

Emphasizing the mining industry's role in the Armenian economy, the Government of Armenia approved the Mining Sector Development Strategy (until 2035) and the respective action plan on May 11, 2023 (Decree of the Government of Armenia No. 730-L, 2023). The Strategy's purpose is to define mechanisms to regulate and develop the industry, use the subsoil rationally and integrally, manage and mitigate environmental and health risks, and distribute export revenues equitably and/or fairly to contribute to the long-run development of Armenia's economy (Decree of the Government of Armenia No. 730-L, 2023).

Moreover, the Strategy does not specify the role of companies' exports representing the mining of metal ores industry in explaining the statistically significant changes in the real GDP, particularly in the short run. The Strategy specifically does not address the measures to be implemented to make the investment climate more attractive for new investors (not only for legal entities with either Russian capital and/or founders and shareholders) in terms of stable legislation and tax burden to report higher industry growth rates and to contribute to the economic growth significantly.



**Figure 1.** Companies' (representing the mining of metal ores industry) exports-to-merchandise exports and companies' exports-to-GDP ratios from 2012 to 2022

Sources: SCA (n.d.); UN Statistics Division (n.d.). Note: Authors' calculations.

**Table 1.** Exports of companies representing the mining of metal ores industry by main product lines (at 6-digit level) from 2012 to 2022

Year	HS code: 260300**					HS code: 260800**					HS code: 261690**				
	Value (million USD)	Net Weight (tons)	Cost per Unit (USD)	Value (billion AMD)	Value, real (AMD billion)	Value (million USD)	Net Weight (tons)	Cost per Unit (USD)	Value (billion AMD)	Value, real (AMD billion)	Value (million USD)	Net Weight (tons)	Cost per Unit (USD)	Value (billion AMD)	Value, real (AMD billion)
2012	227.58	131,459	1,731	91.43	91.43	17.72	17,197	1,030	7.12	7.12	24.94	3,571	6,982	10.02	10.02
2013	279.91	173,207	1,616	114.66	108.38	17.04	18,344	929	6.98	6.60	0.0001	0	4,516	0.00	0.00
2014	235.87	185,089	1,274	98.10	90.03	13.81	14,338	963	5.74	5.27	32.72	5,802	5,639	13.61	12.49
2015	316.64	309,184	1,024	151.33	133.91	12.02	14,137	850	5.74	5.08	31.56	6,497	4,858	15.08	13.35
2016	370.05	402,589	919	177.81	159.58	10.51	9,569	1,098	5.05	4.53	31.43	5,699	5,515	15.10	13.55
2017	571.48	475,759	1,201	275.87	245.13	16.59	10,193	1,628	8.01	7.12	2.00	2,164	925	0.97	0.86
2018	525.47	424,816	1,237	253.80	220.02	20.49	12,473	1,643	9.90	8.58	3.27	3,100	1,056	1.58	1.37
2019	626.67	562,016	1,115	301.08	257.41	16.48	12,158	1,355	7.92	6.77	3.09	3,306	935	1.48	1.27
2020	559.87	470,467	1,190	273.78	231.29	10.40	10,481	992	5.09	4.30	11.64	5,977	1,947	5.69	4.81
2021	769.26	429,483	1,791	387.53	305.40	16.17	11,998	1,347	8.15	6.42	15.47	6,054	2,554	7.79	6.14
2022	662.91	410,686	1,614	288.81	209.58	18.91	11,752	1,610	8.24	5.98	85.40	20,640	4,138	37.21	27.00
Jan-Sep 2022*	511.95	304,787	1,680	230.03	167.86	14.65	8,951	1,636	6.62	4.84	66.90	15,523	4,310	30.39	22.39
Jan-Sep 2022*	362.50	240,012	1,510	140.76	99.77	8.68	6,250	1,389	3.38	2.40	54.35	13,870	3,918	21.15	14.99
Year	HS code: 261310**					HS code: 261390**					HS code: 720270**				
	Value (million USD)	Net Weight (tons)	Cost per Unit (USD)	Value (billion AMD)	Value, real (AMD billion)	Value (million USD)	Net Weight (tons)	Cost per Unit (USD)	Value (billion AMD)	Value, real (AMD billion)	Value (million USD)	Net Weight (tons)	Cost per Unit (USD)	Value (billion AMD)	Value, real (AMD billion)
2012	-	-	-	-	-	8.30	781	10,627	3.33	3.33	106.79	5,836	18,300	42.90	42.90
2013	-	-	-	-	-	6.65	780	8,526	2.72	2.57	102.39	6,659	15,376	41.94	39.64
2014	-	-	-	-	-	8.74	900	9,711	3.64	3.34	109.71	6,500	16,878	45.63	41.87
2015	-	-	-	-	-	6.16	984	6,264	2.94	2.61	55.51	5,582	9,944	26.53	23.48
2016	-	-	-	-	-	0.94	210	4,461	0.45	0.40	66.01	6,660	9,913	31.72	28.47
2017	0.88	90	9,827	0.43	0.38	7.76	1,125	6,895	3.74	3.33	84.39	6,797	12,416	40.74	36.20
2018	1.10	73	15,110	0.53	0.46	6.54	689	9,485	3.16	2.74	125.88	7,111	17,702	60.80	52.71
2019	0.94	62	15,215	0.45	0.39	16.96	2,030	8,352	8.15	6.97	142.43	8,870	16,057	68.43	58.50
2020	1.62	145	11,175	0.79	0.67	93.73	15,089	6,212	45.84	38.72	85.55	6,750	12,674	41.84	35.34
2021	0.92	61	15,036	0.46	0.36	121.40	10,172	11,934	61.16	48.20	188.74	8,159	23,132	95.08	74.93
2022	30.68	1,363	22,511	13.37	9.70	124.40	8,937	13,919	54.20	39.33	251.93	8,886	28,352	109.76	79.65
Jan-Sep 2022*	21.02	924	22,740	9.16	6.58	96.41	7,138	13,506	42.90	31.22	186.65	6,855	27,227	83.66	61.00
Jan-Sep 2023*	46.72	1,601	29,173	18.16	12.86	141.35	7,221	19,575	54.79	38.79	242.01	6,243	38,765	94.27	66.88

Sources: United Nations Statistics Division (n.d.); Central Bank of Armenia (n.d.); SCA (n.d.). **Notes:** \* The indicators were calculated based on quarterly data, considering the appreciation of the Armenian dram against the US dollar. \*\*260300: Copper ores and concentrates; 260800: Zinc ores and concentrates; 261310: Molybdenum ores and concentrates; roasted; 261390: Molybdenum ores and concentrates; other than roasted; 261690: Ores and concentrates of precious metals, other; 720270: ferromolybdenum. 2012=100. Authors' calculations.

One of the first attempts to explain the mining industry's role in explaining the GDP changes was made by Grigoryan (Grigoryan, 2013). By estimating the effect of the mining sector of Armenia on the economic growth for the period 2004-2010 (panel data estimation technique using marz-level (region-level) annual data), the author concludes that a percentage point increase in mining industry value added-to-GDP ratios would lead to a 4.418 percentage point increase in growth (Grigoryan, 2013, p. 14).

An attempt was made by Dokholyan and Makaryan (2022) to estimate the effect of the real exports of copper and molybdenum ores and concentrates on the real GDP using quarterly data spanning from the first quarter 2013 to the third quarter of 2021 (Dokholyan et al., 2022). The authors find that the increase in the real export of copper and molybdenum ores and concentrates has a negative and statistically significant impact on the economic growth of Armenia (Dokholyan et al., 2022, p. 71). "Capacity constraints" were mentioned as one of the possible explanations, mainly referring to the inability to export or the forced shutdown and/or suspension of company operations, along with the fact that an increase in metal prices was not always accompanied by the increase in the net weight of exported metal ores and concentrates (Dokholyan et al., 2022, pp. 71-72).

Dokholyan and Makaryan (2022) conclude that the increase in real exports of copper ores and concentrates, mainly associated with the adopted strategies of companies to fight against the decline in global prices (especially in the case of copper concentrates), could cause a statistically significant negative change in the real GDP in the short run, while the decline in the net weight of the exported concentrates associated with an increase in prices on the global market would result in a statistically significant positive effect on the real GDP (Dokholyan et al., 2022, p. 73). However, none of the papers mentioned above provide an estimate of the effect of the real exports of companies representing the mining of the metal ores industry on the real GDP.

Alternatively, from the perspective of mining regulation for the mining industry's sustainable development, the UNDP and UN Environmental Protection (2018) recommend ensuring the stability of the fiscal regime over time to strengthen the role of the legislative framework rather than rely on contracts in the long run (UNDP and UN Environment, 2018, p. 103). Hence, the stability of the fiscal regime is vital in attracting new investors.

The fiscal regime (including duties and payments) was changed twice from 2021 to 2022. According to the legislative changes adopted on July 15, 2021, duties on exporting copper and molybdenum concentrates, and ferromolybdenum to third countries by companies representing the mining of metal ores industry were defined to be transferred to the state budget for obtaining export permits and/or licenses per each application in which the net weight was stated and

based on which duties were accrued, multiplying the weight stated by the duty per ton of a respective product line (Law on Amendments and Additions to the Law on State Duty HO-310-N, 2021).

According to calculations of Dokholyan et al. (2023), the duty per ton-to-export receipts per ton ratio (expressed in Armenian drams) while exporting copper concentrates to third countries comprised 20% in May 2022, and reached 22% in June 2022 (Dokholyan et al., 2023, p. 93), while according to Makaryan (2023) this ratio, on average, accounted for 28.35% in the fourth quarter of 2022 (Makaryan, 2023, p. 61). This was a significant tax burden for companies representing the mining of metal ores industry, explained by the depreciation of the Armenian dram against the US dollar starting from the second quarter of 2022 (CBA) and the decline in copper prices compared to the prices in the second quarter of 2022 as well (World Bank, 2024).

The Parliament of Armenia adopted respective legislative changes on June 15, 2022, that canceled duties on exporting copper and molybdenum concentrates and ferromolybdenum to third countries for obtaining export permits and/or licenses, becoming effective on January 1, 2023, and a new hybrid royalty system was introduced to replace the existing royalty assessment scheme becoming effective on January 1, 2023, as well (Law on Amendments and Additions to the Law on State Duty, HO-150-N, 2022; Law on Amendments and Additions to the Tax Code of the Republic of Armenia, HO-149-N, 2022). Dokholyan et al. (2023) state that the introduction of a new hybrid royalty system could lead to a higher ratio of royalty payments-to-taxes paid by companies (including duties and payments), even exceeding 70% (cross-company average ratio) if prices increase starting from 2023 (Dokholyan et al., 2023, p. 95).

To attract new investors and ensure transparency in the mining industry, Armenia became a member of the Extractive Industries Transparency Initiative in 2017.

Therefore, the main purpose of the article is to estimate the role of exports of the companies representing the mining of metal ores industry in explaining changes in the real GDP in the short run to substantiate the main challenges ahead and prospects to meet the objectives defined by the Mining Industry Strategy to ensure the industry growth and attract new investors using quarterly data spanning from the first quarter of 2012 to the third quarter of 2023 and utilizing least squares estimation technique.

## **2. LITERATURE REVIEW**

Since the beginning of the twenty-first century, most low- and lower-middle-income mineral-rich economies, despite the aftermath of the global financial crisis, have reported high economic growth rates associated with the mining industry (McMahon et al., 2014).

Silverstovs and Herzer (2007), using annual data covering the period 1960-2001, tested for the evidence of the export-led growth hypothesis in the case of Chile and found evidence for bidirectional Granger causality between mining exports and non-exported GDP. Molapo et al. (2016) identify evidence of bidirectional causality between the real GDP growth and exports of the mining industry and manufacturing in Lesotho.

Koitsiwe and Adachi (2015), using quarterly data spanning from 1994 to 2012, find that there is a unidirectional causality that runs from mining revenue to the real GDP in the case of Botswana.

In the case of South Africa, Rangasamy (2008) finds evidence of unidirectional Granger causality that runs from the exports to the economic growth, and in the long run the mining production (excluding gold) “has a positive relationship with expenditure on gross domestic product” (Nhlangwini & Mongale, 2019, p. 109). Zayone et al. (2020), using annual data covering 1980-2017, conclude that mineral exports drive the growth of non-export GDP in Angola in the long run.

In the case of the second largest producer and exporter of copper, Peru, Larios-Meño et al. (2021), using monthly data for the period 2005-2018, find that the country's dependence on the mining of copper has deepened since copper exports and prices on the global market significantly affect the Peruvian GDP. Kyophilavong (2016) finds that in the case of Laos, “the mining boom positively impacts real GDP, real exports, and real investment” (Kyophilavong, 2016, p. 57).

Using annual data from 1981 to 2010, Sahoo et al. (2014) state that a long-run Granger causality relationship runs from the economic growth and industrial production to the exports of minerals of India. According to Otchia (2015), in the Democratic Republic of the Congo, the mining industry could drive the country's exports in the long run, but it could not be considered one of the sources of growth.

Badel and Lyngaas (2023) stress the role of mining revenues due to the “transformative impacts” thereof in Guinea (Badel and Lyngass, 2023, p. 42). Ennin and Wiafe (2023) by investigating the short- and long-run effect of foreign direct investment (FDI) in the mining industry on Ghana's GDP for the period 1995- 2015, conclude that the effect is positive in the short-run. Gochoero and Boopen (2020), using annual data covering the period from 1988 to 2008, state that FDI in the mining industry of Zimbabwe significantly affects the country's GDP in the long run.

### 3. DATA AND RESEARCH METHODS

Our dataset originally included 46 quarters, spanning from the first quarter of 2012 to the second quarter of 2023.

The methodology change explains the choice of this sample and the transition to the System of National Accounts 2008 by the Statistical Committee of Armenia and data compatibility starting from 2012. Therefore,

we used quarterly data in the case of our models to estimate respective equations using quarterly data, with 2012 as the basis year. We calculated the seasonally adjusted quarterly real GDP values based on chained indices of GDP real volumes (%), (SCA, n.d.) and the GDP value of 2012 (SCA, n.d.).

In the period 2020-2022, copper and molybdenum exports of ZCMC accounted for about 70-80% of the company's total exports, and exports of ferromolybdenum comprised only 20-30% (HS code: 720270) (see Table 2). Hence, ZCMC was considered a company representing the mining of metal ores industry. Therefore, for the purpose of this research, ferromolybdenum was considered to be the export of a company that mostly represented the mining of metal ores.

In the case of the exports of molybdenum concentrates, Armenia has started exporting roasted molybdenum concentrates since 2017; however, exports were irregular and have become regular only starting from the first quarter of 2022 (UN Statistics Division, n.d.); therefore, the values thereof were not included in the industry total exports (sum of exports of product lines (at 6-digit level of HS codes) by companies representing the mining of metal ores industry) (see Table 1).

Nominal export values (HS codes: 260300, 260800, 261390, 261690, 720270) were retrieved from the UN Comtrade database (UN Statistics Division, n.d.), and we relied on the methodology used by Dokholyan and Makaryan (2022) to convert nominal quarterly values into real ones (2012=100).

Due to the purpose of this research, we have defined the following two models to determine the role of exports of copper concentrates (HS code: 260300), other products (sum of the exports of the following HS codes: 260800, 261390, 261690, and 720270), and products containing molybdenum: molybdenum concentrates and ferromolybdenum (sum of the following HS codes: 261390 and 720270) in explaining statistically significant changes in the real GDP, based on the export pattern of various products and the share of copper concentrates in the industry exports (see Table 1).

*Real GDP = f (real exports of copper concentrates; the sum of real exports of zinc concentrates, unroasted molybdenum concentrates, concentrates containing gold, and ferromolybdenum)*  
(1),

*Real GDP = f (real exports of copper concentrates, sum of real exports of unroasted molybdenum concentrates and ferromolybdenum)*  
(2).

Respective regression equations were estimated for three different periods: 2012q1-2019q4, 2012q1-2022q4, and 2012q1-2023q2. The possible expectations of the Armenian Government substantiated the choice of the periods: what would it expect at the end of each period? The estimates were required to understand how real exports could explain the statistically significant changes in the real GDP, allowing the Government of Armenia to define strategic goals and objectives.

Before the COVID-19 pandemic started spreading across the globe at the beginning of 2020, the estimates of the first period could assist the Government of Armenia in understanding how the decline in industry exports would affect the economic growth in Armenia to undertake respective crisis-response measures. The estimates for the second period could help the Government of Armenia define priorities since the composition of exports changed owing to the

introduction of export duties as a new tax burden upon overcoming the aftermath of the global pandemic (see Table 1). Meanwhile, the estimates of the third period could assist the Government of Armenia in building insight into what could be expected in response to future changes in global demand (caused by the recurrence of a new pandemic as well) upon fiscal regime changes and the strategies adopted by the companies.

**Table 2.** Exports of companies representing the mining of metal ores industry by company and product from 2020 to 2022

Company	Exported products	2020		2021		2022	
		%, in the exports of respective products	%, in the company's total exports	%, in the exports of respective products	%, in the company's total exports	%, in the exports of respective products	%, in the company's total exports
ZCMC	Copper Concentrate	57.72	62.62	56.00	58.62	75.04	55.13
	Molybdenum Concentrate: unroasted	88.33	19.03	82.82	15.08	89.09	15.82
	Ferromolybdenum	100	18.35	100	26.30	100	29.06
ACMC	Copper Concentrate	7.27	87.83	11.17	88.69	15.59	85.53
	Molybdenum Concentrate	5.07	12.17	8.19	11.31	10.91	14.47
Teghout	Copper and Molybdenum Concentrate	20.52	94	21.95	93.35	4.74	100
	Molybdenum Concentrate	6.60	6	8.99	6.65	-	-
AMPE	Copper Concentrate	2.23	100	2.36	100	4.63	100
Chaarat Kapan	Copper Concentrate	12.25	82.87	8.51	67.19	-	-
	Zinc Concentrate	100	17.13	100	18.40	100	18.92
	Gold concentrates containing precious metals	-	-	84.45	14.40	95.20	81.08
Meghradzor Gold	Concentrate containing gold	100	100	15.55	100	1.53	100
Lichkvaz	Gold Concentrate	-	-	-	-	3.27	100

Sources: State Revenue Committee of Armenia (SRCA, n.d.).

Note: Authors'

The real values of all export variables were seasonally adjusted (method: Moving Average). Then, we took the natural log of all variables to be included in regression equations. Upon performing the Augmented Dickey-Fuller test, we found out that the given variables were not stationary. To ensure the stationarity of these variables, they were taken in the first difference. The multicollinearity problem was not identified as well.

Then, we estimated the regression equations for different periods, including the first difference of the log of the seasonally adjusted value of real exports of copper concentrates lagged 4 periods in two equations. The equations were estimated using the Least Square method (NLS and ARMA).

$$Dl_{gdpsa}_t = \alpha_0 + \alpha_1 * dlcopsa_{t-4} + \alpha_2 * dlexpothersa_t + \varepsilon_t \tag{3}$$

$$Dl_{gdpsa}_t = \beta_0 + \beta_1 * dlcopsa_{t-4} + \beta_2 * dlexpmolybsa_t + v_t \tag{4}$$

$$Dl_{gdpsa}_t = \gamma_0 + \gamma_1 * dlcopsa_t + \gamma_2 * dlexpmolybsa_t + \tau_t \tag{5}$$

$$Dl_{gdpsa}_t = \delta_0 + \delta_1 * dlcopsa_t + \delta_2 * dlexpothersa_t + \eta_t \tag{6}$$

Where:

$Dl_{gdpsa}_t$  is the first difference of the log of the seasonally adjusted value of real GDP in period t (quarter);

calculations.

$dlcopsa_{t-4}$  is the first difference of the log of the seasonally adjusted value of real exports of copper concentrates lagged 4 periods (quarters);

$dlcopsa_t$  is the first difference of the log of the seasonally adjusted value of real exports of copper concentrates in period t (quarter);

$dlexpothersa_t$  is the first difference of the log of the seasonally adjusted value of real exports of zinc, unroasted molybdenum concentrates, concentrates containing gold, and ferromolybdenum in period t (quarter);

$dlexpmolybsa_t$  is the first difference of the log of the seasonally adjusted value of real exports of unroasted molybdenum concentrates and ferromolybdenum exports in period t (quarter).

$\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1, \beta_2, \gamma_0, \gamma_1, \gamma_2, \delta_0, \delta_1, \delta_2$  are model unknown parameters;

$\varepsilon_t, v_t, \tau_t, \eta_t$  are the error terms in period t.

Upon estimating the equations, we performed all necessary tests and found no evidence of autocorrelation and heteroskedasticity, and the errors were normally distributed. No model specification errors were found either.

#### 4. RESULTS AND DISCUSSION

In the case of the first model, the changes in variables included in the equations explained the variance in real GDP by about 20% over the first period, by about 12%

over the second period, and only about 4% over the third period (see Table 3, Estimation # 1, 2, 3). In the first quarter of 2020 (when the pandemic started to spread across the globe), according to the estimation results of the first period, the Government of Armenia could expect, on average, a decrease in the real exports of copper concentrates lagged four periods by 1% could cause an increase in the real GDP by 0.058% in period t (see Table 3, Estimation #1). Meanwhile, the changes in the real exports of the remaining products would not lead to any significant effect on the real GDP (see Table 3, Estimation #1).

At the beginning of the first quarter of 2023 (when the companies were not required to pay export duties, the new hybrid royalty system became effective, and the Armenian dram appreciated in comparison to 2022 (CBA)), the Government of Armenia could expect that based on the estimation results of the second period, a

1% increase in the real exports of copper concentrates lagged four periods could lead to a decrease in the real GDP by 0.062% in period t, however, only significant at 10 percent significance level (see Table 3, Estimation #2).

Meanwhile, a 1% increase in the real exports of the rest of the products by the industry companies in period t could cause a decline in the real GDP by 0.047% in the same period, again only significant at a 10 percent significance level (see Table 3, Estimation #2).

At the beginning of the third quarter of 2023, the estimation results of the third period could indicate that the changes in the real exports of all products (except copper concentrates) and the copper concentrates separately did not explain statistically significant changes in the real GDP (see Table 3, Estimation #3).

**Table 3.** Estimation Results-1 (Method: Least Square)

<i>Dependent variable</i> <i>dlgdps<sub>t</sub></i>	<b>Estimation #1:</b> Sample: 2012 q1-2019 q4 Adjusted sample: 2013 q2-2019 q4	<b>Estimation #2:</b> Sample: 2012 q1-2019 q4 Adjusted sample: 2013 q2-2022 q4	<b>Estimation #3:</b> Sample: 2012 q1-2023 q2 Adjusted sample: 2012 q2 – 2023 q2
<i>Constant</i>	0.0134 (4.368)***	0.014 (2.994)***	0.010 (2.507)**
<i>dlcopsa<sub>t-4</sub></i>	-0.058 (2.192)**	-0.062 (-2.012)*	
<i>dlcopsa<sub>t</sub></i>			0.031 (1.227)
<i>dlxpothersa<sub>t</sub></i>	0.024 (1.386)	-0.047 (-1.981)*	-0.036 (-1.594)
<i>R-squared</i>	0.260	0.162	0.082
<i>Adjusted R-squared</i>	0.199	0.116	0.039
<i>Included observations</i>	27	39	45

Note: t statistic values in parentheses. \*\*\* denotes significant at 1 percent significance level; \*\* denotes significant at 5 percent significance level; \* denotes significant at 10 percent significance level.

Source: Authors' calculations.

**Table 4.** Estimation Results-2 (Method: Least Square)

<i>Dependent variable</i> <i>dlgdps<sub>t</sub></i>	<b>Estimation #4:</b> Sample: 2012 q1-2022 q4 Adjusted sample: 2013 q2- 2022 q4	<b>Estimation #5:</b> Sample: 2012 q1-2023 q2 Adjusted sample: 2012 q2-2023 q2
<i>Constant</i>	0.0134 (3.016)***	0.011 (2.758)***
<i>dlcopsat<sub>t-4</sub></i>	-0.050 (-1.704)*	
<i>dlcopsa<sub>t</sub></i>		0.0377 (1.566)
<i>dlxpmolybsa<sub>t</sub></i>	-0.059 (-2.657)**	-0.059 (-2.829)***
<i>R-squared</i>	0.223	0.183
<i>Adjusted R-squared</i>	0.180	0.144
<i>Included Quarters</i>	39	45

Note: t statistic values in parentheses. \*\*\* denotes significant at 1 percent significance level; \*\* denotes significant at 5 percent significance level; \* denotes significant at 10 percent significance level.

Source: Authors' calculations.

Regarding the second model, we estimated the equation for the second and third periods based on the estimation results of the first model (see Table 3, Estimation #1). In the case of the second model, the changes in variables included in both equations explained the variance in the

real GDP by about 18% and 14.4% (see Table 4, Estimations # 4, 5).

At the beginning of 2023, the Government of Armenia, relying on the estimates of the second period, could expect that a 1% increase in the real exports of copper

concentrates lagged four periods could result in a decrease in the real GDP by 0.050% in the period  $t$ , however, only significant at 10 percent significance level (see Table 4, Estimation #4). Moreover, a 1% increase in the real exports of molybdenum concentrates and ferromolybdenum in period  $t$  would cause a decline in the real GDP by 0.059% in that same period (see Table 4, Estimation #4).

At the beginning of the third quarter of 2023, the Government of Armenia could expect that the changes in the real exports of copper concentrates would not result in any significant changes in the real GDP, while an increase in the real exports of molybdenum concentrates and ferromolybdenum by 1% in the  $t$  period could cause a decline in the real GDP by 0.059% in the same period, and significant at 1 percent significance level (see Table 4, Estimation #5).

#### **4.1 Copper concentrates**

In the case of real exports of copper concentrates (with the prices of basis year, only the changes in physical volumes explain the increase of real exports), as a result of the estimation of the first period, the statistically significant minor negative effect of the real exports on the real GDP in the period  $t+4$  (see Table 3, Estimation #1) was explained by the fact that growth in real exports, in general, was accompanied by a negative growth rate of GDP (UN Statistics Division, n.d.; SCA, n.d.).

On the contrary, in the case of a decline in real exports, the real GDP reported an increase (UN Statistics Division, n.d.; SCA, n.d.). This, in turn, is explained by the fact that price volatility in the world market primarily determines the exports of copper concentrates. Hence, the growth of exports is not determined by economic growth. The strategies adopted by companies were crucial (in case of price decline, there was an increase in physical volumes, and the contrary was reported (Dokholyan and Makaryan, 2022).

Therefore, at the beginning of 2020, when the lockdown started in China and then in Europe (as the latter were considered the leading export markets (see Table 5)), the Government could expect that due to the reduction of prices (World Bank, 2024), or “inability to export” (Dokhlyan and Makaryan, 2022) the decline in real exports volume in period  $t$  would not have a statistically significant negative effect on the real GDP in period  $t+4$ . However, Armenia would be deprived of foreign exchange earnings. In the third or fourth quarters of 2020, if the demand for copper had increased after the lockdown, and even if the increase in prices (World Bank, 2024), had been accompanied by a reduction in real exports (UN Statistics Division, n.d.) (see Table 1), this would have had a statistically positive effect on the real GDP.

According to the estimation results of the second period, the minor negative effect of copper concentrates’ real exports on the real GDP (although it was significant at a

10% significance level) (see Table 3, Estimation #2, Table 4, Estimation #4) was explained by the factors presented above, as well as by the fact that in the period 2021-2022, high economic growth rates were accompanied by a reduction in the real exports for several quarters (SCA, n.d.; UN Statistics Division, n.d.), which was explained by export duties as well (Dokholyan et al., 2023; Makaryan, 2023). In 2021, copper prices began to rise in the world market, which continued until the second quarter of 2022 (World Bank, 2024).

However, the real exports were affected by the export duties introduced by the Government of Armenia, becoming effective in the third quarter of 2021 (Dokholyan et al.; 2023; Makaryan, 2023). Meanwhile, if the prices had been high (World Bank, 2024) and the Armenian dram’s exchange rate against the US dollar had not appreciated (CBA, n.d.), the duties would not have been considered a significant burden in terms of the export duty-to-export receipts ratio (paid per 1 ton) (Dokholyan et al., 2023; Makaryan, 2023).

After the second quarter of 2022, until the end of the year, the prices were lower than the prices in the first quarter of 2022 (World Bank, 2024), which was accompanied by a significant appreciation of the Armenian dram against the US dollar (CBA, n.d.), thus forcing Chaarat Kapan to quit exporting copper concentrates in 2022 (see Table 2).

Moreover, according to the estimation results of the third period, the changes in copper concentrates’ real exports did not explain the statistically significant changes in the real GDP in the short run (see Table 3, Estimation #3, see Table 4, Estimation #5).

This was mainly due to the above-discussed developments and the fact that the high economic growth rates of the first three quarters of 2023 (SCA, n.d.) were accompanied by a decline in real exports (see Table 1). Thus, it is expected that in the medium term, if there is no increase in real exports of copper concentrates, accompanied by economic growth, the changes in real exports will not have a positive and statistically significant impact on the real GDP in the short run.

Therefore, in this case, the growth of real exports of other products exported by industry companies is essential. This will ensure an inflow of foreign exchange earnings for Armenia and will have a statistically significant impact on the real GDP. This becomes important when the company can increase, for example, the export of molybdenum concentrates or ferromolybdenum, etc., instead of the given product.

#### **4.2 Export of other products (zinc, unroasted molybdenum concentrates, concentrates containing gold, and ferromolybdenum)**

In the case of the sum of real exports of these products, the statistically insignificant impact on the real GDP, especially in the third period (see Table 3, estimations

#1, 2, 3), was explained by the fact that in the period 2012-2018, the volumes were almost at the same level and substantially lower than the exports of copper concentrates (and the real GDP was mainly increasing (SCA, n.d.)) (see Table 1).

Right after the period 2019-2020, the exports began to increase due to the increase in the exports of unroasted molybdenum concentrates and concentrates containing gold. However, they recorded a decline in 2021, which was followed by an increase in 2022 (see Table 1).

Moreover, although the real exports of these products rose sharply in 2022 compared to 2018, these volumes were still lower than the exports of copper concentrates (see Table 1). Therefore, it is expected that in the case of an increase in the real exports of these products in the medium term, accompanied by GDP growth, the changes in the sum of the latter will begin to have a positive and statistically significant impact on the real GDP in the short run, especially in the case of increase in the exports of concentrates containing gold.

### 4.3 Unroasted molybdenum concentrates and ferromolybdenum

The changes in the exports of these products had a statistically significant negative effect on the real GDP (see Table 4, Estimation #4) based on the estimation results using quarterly data for the period 2012-2022. This was mainly explained by the increase in real exports compared to 2012 (though not for all periods), as well as by the fact that the decline in exports was mainly accompanied by the GDP growth (see Table 1), (UN Statistics Division, n.d.; Dokholyan et al., 2023; SCA, n.d.; SRCA, n.d.). According to the results of Estimation #5 (see Table 4, Estimation #5).

A similar result was reported regarding the total exports of these two products for the third period, which was expected. In the world market, in the case of an increase in the demand for these products, the increase in the exports of the latter in the medium term could lead to statistically significant and positive changes in the real GDP in the short run if an increase in the real GDP is accompanied with the growth of the real exports of the products.

**Table 5.** Exports of companies representing the mining of metal ores industry by main product lines (at 6-digit) and by main partners (% , product line exports)

260300	2018-2021	2022	Jan-Sep 2022	Jan-Sep 2023	261390	2018-2021	2022	Jan-Sep 2022	Jan-Sep 2023
EU	32.70%	31.10%	36.30%	20.70%	EU	10.20%	15.90%	14.50%	36.30%
China	29.50%	41.80%	37.86%	70.90%	China	76.80%	64.70%	69.50%	39.00%
Switzerland	34.30%	24.30%	23.11%	3.10%	Switzerland	10.10%	0.00%	0.00%	0.00%
Canada	3.00%	0.00%	0.00%	0.00%	South Korea	2.20%	8.40%	4.92%	22.80%
Iran	0.00%	0.70%	0.45%	2.40%	Other	0.70%	11.00%	11.09%	1.90%
Russia	0.00%	1.80%	2.28%	0.30%	<b>261690</b>	<b>2018-2021</b>	<b>2022</b>	<b>Jan-Sep 2022</b>	<b>Jan-Sep 2023</b>
Other	0.40%	0.30%	0.01%	2.60%	Switzerland	100.00%	96.40%	100.0%	72.00%
<b>260800</b>	<b>2018-2021</b>	<b>2022</b>	<b>Jan-Sep 2022</b>	<b>Jan-Sep 2023</b>	Malaysia	0.00%	3.60%	0.0%	23.10%
EU	100.0%	100.0%	100.0%	100.0%	EU	0.00%	0.00%	0.0%	4.90%
<b>261310</b>	<b>2018-2021</b>	<b>2022</b>	<b>Jan-Sep 2022</b>	<b>Jan-Sep 2023</b>	<b>720270</b>	<b>2018-2021</b>	<b>2022</b>	<b>Jan-Sep 2022</b>	<b>Jan-Sep 2023</b>
Russia	100.0%	100.0%	100.0%	98.80%	EU	95.10%	78.70%	81.29%	80.10%
EU	0.0%	0.0%	0.0%	1.20%	Russia	4.60%	20.60%	17.75%	19.60%
					Other	0.20%	0.70%	0.95%	0.20%

Source: UN Statistical Division (n.d.). Note: Authors' calculations.

### 4.4 Prospects and Challenges Ahead

Overall, the third period's estimation results with respect to both models indicate that the economic growth in Armenia is not associated with an increase in the real exports of the industry since the growth thereof reflects the developments in the global commodity market. This means that, in general, an increase in the real exports of the industry would not cause statistically significant changes in the real GDP. Moreover, the industry grows on its own and is isolated, and the export growth thereof does not contribute to the economic growth in Armenia. However, it remains a driver of merchandise export growth, as in the Democratic Republic of the Congo, in the long run (Otchia, 2015). Hence, other industries were the drivers of the economic growth in Armenia, namely the tourism industry (Tadevosyan et al., 2023). Therefore, we did not find evidence of the “multiplier effect” in the case of Armenia; meanwhile, according to

the estimates, “for the mining sector of Armenia, GDP multiplier is estimated at the level of 1.8” (World Bank, 2016, p. 61).

In the case of copper concentrates with export duties in place and continuing appreciation of the Armenian dram against the US dollar in 2022 (y./y.) (CBA, n.d.), and during nine months of 2023, over the same period of 2022), the decrease in physical volumes and the decline in prices to a certain extent, led to a substantial decline in export receipts expressed in Armenian drams (see Table 1).

The decline in physical volumes of unroasted molybdenum concentrates accompanied by an increase in prices led to an increase in export receipts expressed in US dollars in 2022 (y./y.), while the decline in revenue expressed in Armenian drams was reported (see Table 1) again owing to the appreciation of Armenian dram (CBA, n.d.).

During the first nine months of 2023 over the same period of 2022, the price increase of unroasted molybdenum solemnly substantiates a large increase in export receipts by the companies expressed in US dollars and Armenian drams (see Table 1), thus compensating the appreciation of the Armenian dram against the US dollar (CBA, n.d.).

Mainly the increase in prices of ferromolybdenum in 2022 (y./y.) and during the first nine months of 2023 over the same period of 2022 explains the increase in export receipts expressed in US dollars and Armenian drams (see Table 1).

Therefore, the increase in prices of commodities in the global market will determine the rise in export receipts by companies (expressed in Armenian drams) if the national currency does not depreciate against the US dollar. Moreover, the increase in prices in the global market that reflects forecasts regarding the developments with respect to the global economy, contributes to the attraction of new investments in the given industry.

Hence, only a continuous increase in the real exports (concerning all products) could lead to a statistically significant positive effect on the real GDP over the medium term and long run, and the increase in the value-added of the industry would be translated into positive GDP multiplier estimates.

Attracting new investments will also increase real exports, allowing the mining industry to grow faster, as the Strategy envisions (Decree of the Government of Armenia No. 730-L, 2023).

In this case, for the medium-term and long-run development of the industry, forecasts on the macroeconomic stance of trading partners and regarding the developments in the global economy are essential. These will affect the prices of metals and the possibility of attracting new investments. The major trading partner is Europe (see Table 5).

If the Russian-Ukrainian and Israeli-Palestinian wars continue, the possibility of the outbreak of other conflicts would cause an increase in global arms and ammunition production in the medium term. The world exports of the respective group (Arms and ammunition, their parts and accessories) increased in 2022 (y./y.) and continued during the first nine months of 2023 over the same period of 2022 (UN Statistics Division, n.d.). Hence, the growth of global production of arms and ammunition would translate into higher demand for the metals exported by Armenia.

The Strategy (Decree of the Government of Armenia No. 730-L, 2023) provides a detailed analysis of the strengths and weaknesses, opportunities, and threats (SWOT) of the mining industry. As weaknesses, the following factors were identified: machinery and equipment operated by companies, namely old vs. new technology, the fiscal system, investment climate attractiveness, etc. (Decree of the Government of Armenia No. 730-L, 2023).

Price volatility in commodity markets that affect both companies' sales and tax revenues, the high-cost structure (especially transportation and energy costs), the constant introduction of restrictions and rigorous environmental and social standards worldwide, etc. were mentioned as threats (Decree of the Government of Armenia No. 730-L, 2023).

Introducing and utilizing advanced technology, improving the environmental situation, promoting the growth of the green economy, and benefiting from the growing market demand were identified as opportunities (transition to the green economy needs introducing new technology that requires several times more metals and minerals than the traditional economy needs), etc. (Decree of the Government of Armenia No. 730-L, 2023).

The Government of Armenia also plans to design essential incentives, create conditions, and build the required infrastructure that could help the mining companies switch to the power supply that is generated from renewable energy sources that utilize solar batteries, etc. (Decree of the Government of Armenia No. 730-L, 2023). This will be considered an integral part of the transition process to the green economy in our country (Decree of the Government of Armenia No. 730-L, 2023).

Transition to renewable energy would allow mining companies to become price competitive in the global market, especially while offering concentrates of the same grade (Decree of the Government of Armenia No. 730-L, 2023). This is pivotal when facing price volatility and appreciation of the Armenian dram against the US dollar or when prices sharply decline in the long term.

According to the Strategy, the Government plans to improve the investment climate (Decree of the Government of Armenia, No. 730-L, 2023). The Government plans to introduce a system of evaluating individual investment projects by drafting a respective order on how to carry out the evaluation thereof, modernize the legislation, make the legislative framework more stable to avoid frequent changes and amendments to certain laws, etc. (Decree of the Government of Armenia No. 730-L, 2023).

Regarding the stability of the legal framework and attracting investors, Dokholyan et al. (2023), proposed to elaborate special stability agreements, allowing new investors to apply the existing fiscal regime for about 10-15 years, starting from the point of investment based on the practice applied in Chile and stated by Castillo (2021).

However, Makaryan (2023) proposed to legally define the concepts of "stability agreement" and "stability period" in Article 7 of the Law of the Republic of Armenia on Foreign Investments and sign such agreements with investors for the period of the investment project, or at least for a period exceeding five years (Makaryan, 2023, p. 66).

The UNDP and UN Environment (2018) emphasize the role of stability of fiscal regime instead of relying on agreements and/or contracts. We believe that the options proposed by Dokholyan et al. (2023) and Makaryan (2023) could be more acceptable in the case of Armenia to attract new investors in the medium term, considering the frequency of legislative changes in the period 2021-2022.

However, in the long run, we think that having a stable fiscal regime and legislation regulating the industry according to respective international standards is pivotal for Armenia. Meanwhile, designing the respective legislative framework is required in the medium term.

As for attracting new investors, the Government of Armenia needs to specifically target companies and/or investors that are not either companies with Russian capital or investors with Russian citizenship and consider the options to intervene in the medium term in case new sanctions are imposed, as Dokholyan and Makaryan (2022) and Dokholyan et al. (2023) propose.

Although the stability of the national currency is fundamental for the investors, a sharp appreciation of the local currency can lead to a decrease in export receipts (expressed in Armenian drams), especially when taxes, salaries, and other expenses must be paid or transferred to in local currency.

Meanwhile, export receipts expressed in US dollars might even report an increase. This could force investors to consider the option of quitting Armenia by selling the company and/or operations to another buyer and/or investors, as was the case of Chaarat Gold.

## 5. CONCLUSION

Using quarterly data (2012q1-2023q2) and based on the estimates (least squares estimation technique) we find that the changes in exports of copper concentrates, and the sum of exports of other products (zinc concentrates, unroasted molybdenum concentrates, concentrates containing gold and ferromolybdenum) do not explain statistically significant changes in the real GDP in the short run. Meanwhile, an increase in the sum of exports

of ferromolybdenum, and unroasted molybdenum concentrates could result in a minor negative change in the real GDP in the short run.

Our results suggest that economic growth is not associated with changes in the real exports of the mining of metal ores industry. Moreover, developments in the global market drive industry growth and an increase in real exports would not necessarily cause economic growth. In addition, the industry is growing on its own, and other sectors of the economy, namely the tourism industry, contribute to Armenia's economic growth. No evidence for the “multiplier effect” is found.

Hence, the real exports of the companies could start having a statistically significant impact on the real GDP in response to an increase in global demand when prices of commodities rise, thus resulting in an increase in real exports and positively contributing to economic growth. Attracting new investors, thus resulting in higher real exports, would start significantly affecting economic growth, along with increased exports of existing companies.

Hence, attracting new investors needs to be prioritized by the Government of Armenia. Priority should be given to the stability of the legal framework (requiring high standards) and fiscal regime over the long run; meanwhile, the “stability agreements” (Makaryan, 2023) could be opted for in the medium term.

The Government of Armenia should target and attract investors outside Russia to avoid future possible Western sanctions being imposed on the owners and/or companies (including affiliated ones).

Transitioning to renewable energy sources in mines upon the required conditions and infrastructure being in place by designing respective incentives would make Armenian companies more price competitive by selling the concentrates of the same grade in the global market. Switching to new technology (equipment) would allow the companies to fight price volatility, especially in the case of appreciated and/or overvalued Armenian dram (against the US dollar) in the long run.

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