GLOBAL ENERGY TRANSITION, COMMODITY PRICE DYNAMICS, AND STRUCTURAL TRANSFORMATION IN ARMENIA: EVIDENCE FROM COPPER, MOLYBDENUM AND GOLD

Arman MARTIROSYAN
PhD, Doctor of Science, Professor,
Department of Management and Economics, Yerevan State University
Andranik ARAKELYAN
BSc, MSc, Vrije Universiteit Amsterdam, University of Geneva

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Introduction

The global economy is undergoing a period of major structural change shaped by the acc elerating energy transition, geopolitical fragmentation, and persistent macro-financial uncertainty. The transition toward low-carbon energy systems is increasing demand for a range of industrial metals required for electrification, renewable energy deployment, power-grid expansion, and advanced industrial applications. In this context, copper has become one of the most strategically important metals due to its central role in electrici ty transmission, electric vehicles, renewable energy systems, while molybdenum remains an important input in high-strength steels, industrial equipment, and energy-related infrastructure [International Energy Agency, 2021; International Energy Agency, 2024; Soares et al., 2025]. At the same time, global inflationary pressures, geopolitical tensions, and financial market volatility have cont-ributed to a significant rise in gold prices, reinforcing gold's traditional role as a safe-haven asset and store of value [Baur & Lucey, 2010; Baur & Smales, 2020; Le Thi Thuy et al., 2024]. These developments have important implications for mineral-exporting economies. Rising commodity prices can improve export earnings, strengthen fiscal revenues, and support foreign exchange inflows. However, they may also deepen export concentration, increase exposure to external shocks, and reinforce dependence on a narrow set of primary commodities. The developmental significance of commodity price booms therefore depends not only on external market conditions, but also on domestic institutions, policy choices, and the capacity to convert temporary gains into long-term structural upgrading [Timbe et al., 2024; Valentine et al., 2024].

The Republic of Armenia represents a relevant case in this regard. Armenia is a small open economy with a significant mining component in its export structure, particularly in copper, molybdenum, and gold. This makes the country highly sensitive to shifts in global commodity markets. At the same time, recent Armenian trade statistics must be interpreted with caution. Following the Russia–Ukraine war, Armenia experienced a substantial increase in re-export activity, especially in precious metals, which signifi-

cantly inflated official import and export values. As a result, recent headline trade data do not always reflect the actual performance of Armenia's domestic mining sector [Ministry of Economy of the Republic of Armenia, 2024-2025; World Bank, 2025].

This distinction is particularly important for gold. Unlike copper and molybdenum, whose relevance to Armenia's export structure is more directly linked to domestic mining and industrial demand, recent gold trade values were heavily affected by transit and intermediary trade. Consequently, the relationship between global price dynamics and Armenia's underlying productive capacity cannot be understood by relying on post-2022 trade figures alone. A more accurate assessment requires separating the genuine price effect from the distortion created by re-export flows. Against this back-ground, this article examines how global structural shifts and commodity price dynamics affect the prospects for structural transformation in Armenia by the cases of copper, molybdenum, and gold. The study aims to distinguish between industrial metals whose demand is increasingly shaped by the energy transition and gold, whose price dynamics are driven primarily by macro-financial and geopolitical factors. It evaluates Armenia's exposure to commodity price changes through a price-revaluation exercise based on the country's pre-war export structure and assesses export concentration using the Herfindahl–Hirschman Index (HHI).

The main argument of the article is that Armenia is currently benefiting from a more favorable global price environment, but this does not automatically imply structural transformation. Higher prices create a real economic opportunity, yet without productive reinvestment and diversification they may simply reinforce dependence on a narrow mineral export base. The paper therefore seeks to show that the developmental outcome of current commodity dynamics depends less on the existence of favorable prices themselves than on how the gains are managed and transformed within the domestic economy. The remai nder of the article is structured as follows. The next section outlines the methodological approach. This is followed by a review of the relevant literature on energy transition demand, gold as a safe-haven asset, and structural transformation in resource-based economies. The analysis section then examines the price-revaluation effect for Armenia's key export metals, evaluates export concentration, and discusses the implications for structural transformation. The final sections present policy implications and conclusions.

Methodology

This study adopts a conceptual and descriptive quantitative approach to examine the implications of global commodity price dynamics for Armenia's economic structure. Rather than relying on econo-metric estimation, the paper combines a focused literature review with a counterfactual price-revaluation exercise and an export concentration assessment. This approach is appropriate because the main objective is not to estimate causal relationships at the firm level, but to evaluate how changes in world prices may affect Armenia's

export earnings and structural vulnerability under a cleaner and more interpretable analytical framework. The methodology consists of three main components.

First, the article draws on a focused review of recent academic and policy literature on three related themes: the role of industrial metals in the global energy transition, the safe-haven function of gold under macro-financial uncertainty, and the relationship between natural resource dependence and structural transformation. This literature provides the conceptual basis for distinguishing between copper and molybdenum, which are linked more closely to industrial and transition-related demand, and gold, whose recent price dynamics are driven primarily by inflation, financial instability, central bank demand and geopolitical risk [International Energy Agency, 2021; International Energy Agency, 2024; Baur & Lucey, 2010; Baur & Smales, 2020].

Second, the empirical part of the study is based on a price-revaluation exercise using 2021 as the base-line year. The choice of 2021 is deliberate: it reflects Armenia's pre-war export structure and avoids the major distortions that entered Armenian trade statistics after 2022 due to the surge in re-export activity, especially in gold and other precious metals [Enterprise Armenia & Ministry of Economy of the RA, 2022; Ministry of Economy of the RA, 2025; World Bank, 2025]. Using 2021 as a clean benchmark, the paper takes the export values of copper, molybdenum, and gold and revalues them at more recent international prices. This makes it possible to estimate how much Armenia's export revenues would increase under higher global prices if the country exported approximately the same underlying metal basket as before the re-export shock. The exercise is therefore illustrative and counterfactual: it does not estimate actual recent export volumes, but isolates the pure revenue effect of higher prices.

Third, the study evaluates Armenia's export concentration through the Herfindahl–Hirschman Index (HHI). The HHI is calculated as:

$$HHI = \sum s_i^2$$

where sis_isi represents the share of each export category in total exports. A higher HHI indicates a more concentrated export structure and, therefore, greater vulnerability to external shocks. In the context of this paper, the HHI is used to assess whether higher prices for copper, molybdenum, and gold strengthen Armenia's export base or instead increase dependence on a narrow group of mineral commodities. This step is important because rising export earnings alone do not necessarily imply diversification or structural transformation. The quantitative analysis relies on publicly available Armenian trade data, international price data, and official policy reports. For Armenia's 2021 export structure, the study uses OEC-based trade statistics reported in recent Armenian academic research, while international price benchmarks are taken from the World Bank commodity price database, the World Gold Council, and the U.S. Geological Survey [Mardanyan & Kha-

chatryan, 2024; World Bank, 2024; World Gold Council, 2026; U.S. Geological Survey, 2021; U.S. Geological Survey, 2025]. The methodology therefore combines domestic trade structure with international market signals in order to build a clearer picture of Armenia's real commodity-price exposure.

This methodological approach has both strengths and limitations. Its main strength lies in its ability to separate the genuine price effect from the distortion by re-export flows, thereby providing a more realistic basis for evaluating Armenia's export dependence and structural opportunities. At the same time, the approach remains simplified: it does not incorporate firm-level productivity data, changes in export volumes, or broader general equilibrium effects. Nonetheless, for the purposes of this study, the combination of conceptual framing, price revaluation, and export concentration analysis provides a robust and policy-relevant foundation for assessing whether higher global metal prices are more likely to support structural transformation or deepen resource dependence in Armenia.

Literature review

Energy transition and industrial metals: The recent literature increasingly treats the global energy transition as a material-intensive transformation rather than solely an energy-policy shift. The expansion of renewable energy generation, grid infrastructure, electrified transport, and storage systems requires large volumes of mineral inputs, which has brought industrial metals back to the center of development and industrial-policy debates. In particular, copper has emerged as one of the most strategically important materials because of its central role in electricity transmission, renewable power systems, electric vehicles, and industrial electrification more broadly [International Energy Agency, 2021; International Energy Agency, 2024]. The International Energy Agency (IEA) has consistently identified copper among the key minerals required for clean energy technologies and warns that mineral supply constraints could become a bottleneck for decarbonization if investment does not keep pace with demand growth [IEA, 2021].

Recent empirical and policy-oriented studies reinforce this view. Soares et al. argue that the energy transition is significantly reshaping global copper demand and project continued upward pressure on copper consumption through 2030, driven by renewable energy deployment and electric mobility [Soares et al., 2025]. Their findings support the broader argument that copper demand is increasingly structural rather than purely cyclical. This literature suggests that copper is not simply another traded raw material, but a core input into the infrastructure of decarbonization [IEA, 2021; Soares et al., 2025].

Although molybdenum receives less standalone attention than copper in the transition lite rature, it is increasingly recognized as part of the broader family of energy-transition-relevant minerals. The IEA explicitly includes molybdenum within the scope of minerals used in clean energy technologies and related infrastructure [IEA, 2021]. Its importance derives primarily from its role in high-strength steels, corrosion-resistant alloys, indust-

rial equipment, and energy infrastructure, which makes it indirectly but meaningfully connected to electrification and capital-intensive low-carbon systems. This means that molybdenum demand is shaped less by consumer-facing green technologies and more by industrial construction, transmission systems, and heavy engineering associated with the transition [International Energy Agency, 2021].

A second important theme in the literature concerns the tension between rising demand and limited supply responsiveness. The IEA's recent outlooks stress that demand for transition minerals has continued to grow strongly, while supply expansion remains constrained by long project lead times, concentration of processing capacity, and investment uncertainty [IEA, 2024]. This supply-demand imbalance is particularly important for copper, where recent analyses warn of widening deficits under net-zero pathways [IEA, 2024; Soares et al., 2025]. As a result, price dynamics in industrial metals are increasingly interpreted as reflecting both cyclical fluctuations and longer-term structural pressures. For small mineral-exporting economies, this distinction matters because a structurally tighter market may create medium-term opportunities for export revenue growth and investment, rather than only temporary windfall gains [IEA, 2024].

From a development perspective, this literature also implies that the benefits of the energy transition will not be distributed automatically across mineral-producing countries. The key issue is not only whether a country possesses relevant minerals, but whether it can translate favorable price and demand conditions into broader industrial upgrading. The emerging scholarship on critical minerals therefore intersects with older debates on structural change, productive capabilities, and economic complexity. In this view, a resource-rich country benefits sustainably from rising mineral demand only if resource rents are transformed into investment, diversification, and capability accumulation. Otherwise, higher prices may simply reinforce enclave extraction and export concentration [Timbe et al., 2024; Valentine et al., 2024].

For Armenia, this body of literature is especially relevant. Copper and molybdenum connect the country directly to the industrial side of global transformation, yet the magnitude of the developmental benefit depends on domestic institutions, investment patterns, and the degree to which the mining sector generates spillovers to the wider economy. This is why the literature on critical minerals alone is insufficient; it must be combined with research on commodity dependence, export concentration, and structural transformation [IEA, 2024; Timbe et al., 2024].

Gold, commodity cycles, and resource-based economies: In contrast to copper and molybdenum, gold occupies a distinct position in the commodity literature. Its price dynamics are shaped less by industrial demand and more by financial, monetary, and geopolitical variables. A substantial body of research treats gold as a hedge and safe-haven asset, particularly during periods of heightened uncertainty. Baur and Lucey's seminal

study showed that gold can act as a hedge and, under certain conditions, a safe-haven against losses in financial markets [Baur & Lucey, 2010]. More recent research extends this argument by showing that precious metals, and gold in particular, respond positively to geopolitical risk and can protect investors during periods of heightened political tension and uncertainty [Baur & Smales, 2020].

Recent studies confirm that gold continues to perform this safe-haven role in modern crisis environments. Evidence from more recent international data indicates that gold retains hedge and safe-haven properties across major markets, although the strength of this role varies across countries and episodes [Le Thi Thuy et al., 2024]. This literature is especially important for the present study because it clarifies that the recent rise in gold pric es should not be interpreted primarily as an effect of the energy transition. Instead, gold price increases are better understood through the lenses of inflation expectations, global financial instability, monetary uncertainty, central bank behavior, and geopolitical fragmentation [Baur & Lucey, 2010; Baur & Smales, 2020; Le Thi Thuy et al., 2024].

The broader literature on commodity cycles provides an important bridge between industrial metals and gold. Commodity prices are influenced by both structural and cyclical forces, including global growth, monetary conditions, geopolitical shocks, and expectations about future scarcity. In the current period, industrial metals and gold have both experienced upward price pressures, but for different reasons. Copper is increasingly linked to electrification and infrastructure demand, while gold reflects uncertainty and portfolio reallocation under stress [Soares et al., 2025; Le Thi Thuy et al., 2024]. This divergence is conceptually important for commodity-exporting countries whose export baskets include both industrial and monetary metals, because global shocks may affect different export commodities through different causal mechanisms.

The development literature on resource-based economies helps explain why this distinction matters at the macroeconomic level. Traditional resource-curse arguments suggest that dependence on natural resources may weaken long-term growth through volatility, weak institutions, rent-seeking, and deindustrialization. Dutch disease models further emphasize that commodity booms can appreciate the real exchange rate and crowd out tradable sectors such as manufacturing. Recent literature, however, has become more nuanced. Rather than treating natural resource abundance as inherently harmful, newer studies argue that the negative outcome depends on whether resource wealth is accompanied by weak structural transformation, low economic complexity, and poor policy management [Timbe et al., 2024; Valentine et al., 2024; Braunstein, 2025]. In this view, the key variable is not resource abundance itself, but the economy's capacity to convert rents into productive diversification [Timbe et al., 2024]. This shift in the literature is especially relevant for small open economies. Timbe et al. show that lack of structural transformation is central to the emergence of the resource curse, while Valentine et al. link

natural-resource dependence to lower economic complexity unless mediated by stronger financial and developmental institutions [Timbe et al., 2024; Valentine et al., 2024]. Braunstein, writing specifically in the context of critical minerals and decarbonization, argues that the classic resource-curse framework must now be reconsidered in light of the new geopolitics of energy transition minerals [Braunstein, 2025]. These contributions suggest that rising demand for transition-related commodities does not automatically generate development. Instead, the developmental outcome depends on industrial policy, institutional quality, export structure, and reinvestment mechanisms [Braunstein, 2025; Timbe et al., 2024]. Taken together, the literature points to an important research gap that is directly relevant to Armenia. There is extensive work on critical minerals and clean energy transitions, and there is also a large literature on gold as a safe haven and on the macroeconomics of resource dependence. However, there is much less integrated analysis of how these distinct commodity price drivers interact within a small mineral-exporting economy whose export basket includes both transition-relevant industrial metals and safe-haven precious metals [International Energy Agency, 2024; Brauns tein, 2025]. For Armenia, this gap is significant because the coexistence of copper, molybdenum, and gold within the export structure creates a mixed pattern of exposure: part of the external opportunity is tied to decarbonization, while another part is tied to instability in the global financial and geopolitical environment.

Accordingly, the present study builds on these literatures by examining not only whether commodity prices are rising, but also why they are rising and what that means for structural transformation in Armenia. This distinction is essential for policy analysis, because a price increase driven by long-term electrification demand has different developmental implications from a price increase driven by temporary financial stress or geopolitical shock [Soares et al., 2025; Le Thi Thuy et al., 2024].

Scientific novelty

The scientific novelty of this study lies in several interrelated contributions.

First, the article develops an integrated analytical framework that links global structural shifts to commodity price dynamics and, in turn, to the prospects for structural transformation in Armenia. Unlike narrower approaches that examine either the energy transition or commodity dependence separately, this study combines both perspectives and shows how external global processes can influence the domestic development trajectory of a small open economy.

Second, the paper distinguishes between different categories of export commodities within Armenia's mining sector and analyzes them through separate causal mechanisms. In particular, copper and molybdenum are examined primarily as industrial metals whose demand is increasingly shaped by the global energy transition, while gold is treated as a monetary and safe-haven asset whose price dynamics are influenced mainly by macro-

financial uncertainty, inflationary pressures, and geopolitical instability. This distinction allows for a more precise interpretation of Armenia's external exposure, avoids treating all mineral price increases as originating from the same source.

Third, the study introduces export concentration analysis into the discussion of structural transformation in Armenia by incorporating the Herfindahl–Hirschman Index (HHI) indicating structural vulnerability. This makes it possible to assess not only the benefits of rising commodity prices, but also the risks associated with dependence on a limited number of export products. In this sense, the article moves beyond a simple discussion of revenue gains and places commodity price dynamics within a broader framework of diversification, resilience, and long-term development.

Fourth, the paper provides a policy-oriented interpretation of how commodity price increases may ge-nerate different development outcomes. It argues that rising prices do not automatically produce structural transformation, but instead create a conditional opportunity whose outcome depends on fiscal management, institutional quality, industrial policy, and the ability to reinvest resource-based gains into more diversified and productive sectors. This perspective is particularly relevant for Armenia, where mining plays an important role in the export structure but where the broader challenge remains how to convert resource advantages into sustainable long-term growth.

Thus, the novelty of the article lies in its integrated treatment of energy transition, commodity price dynamics, export concentration, and structural transformation within the specific context of Armenia's mining-based economy.

Analysis

1. Quantitative framework: using the pre-war export structure as the baseline

A major problem in interpreting Armenia's recent trade statistics is that they were heavily distorted after the Russia–Ukraine war by re-export flows, especially in gold and other precious metals. Official data show that in 2024 total exports reached USD 13.1 billion, while raw or semi-processed gold alone accounted for USD 5.6 billion, or 42.8% of total exports. At the same time, Armenia imported USD 5.94 billion of raw or semi-processed gold, equivalent to 34.8% of total imports, strongly suggesting that a significant share of this trade reflected transit or intermediary operations rather than domestic mining output [Ministry of Economy of the RA, 2025]. The Ministry's quarterly outlook for early 2024 is even more explicit: 99.9% of exported gold in the first quarter of 2024 was of non-Armenian origin [Ministry of Economy of the RA, 2024]. Independent reporting also documented that large volumes of Russian gold entered Armenia and were later exported to the United Arab Emirates and other destinations [Hetq, 2024a; Hetq, 2024b]. The World Bank noted that precious stones, metals re-exports had previously accounted for roughly one-third of Armenia's exports before collapsing sharply in 2025 [World Bank, 2025].

Because of this distortion, the most defensible way to introduce a quantitative element into the research is to take 2021 as the clean benchmark year and then ask the following counterfactual question: if Armenia exported the same underlying basket of domestically grounded metals as in 2021, how much export revenue would those metals generate at current or near-current prices? This isolates the price effect from the re-export effect. For the 2021 export values, the present analysis uses OEC-based statistics reported in a peer -reviewed Armenian academic article by Mardanyan and Khachatryan. According to that source, in 2021 Armenia exported USD 844 million copper ore, USD 127 million molybdenum ore, and USD 256 million in gold, for a combined total of USD 1.227 billion [Mardanyan & Khachatryan, 2024]. The price-revaluation exercise uses the following benchmarks. For copper, the World Bank Pink Sheet gives an average 2021 price of USD 9,317 per metric ton [World Bank, 2024]. For gold, the same Pink Sheet gives an average 2021 price of about USD 1,801/oz, while your requested current analytical assumption is USD 4,000/oz [World Bank, 2024]. For molybdenum, a clean annual 2021-to-2026 series is less accessible, so I use a transparent approximation based on USGS molybdic oxide prices: an early-2021 benchmark midpoint of roughly USD 12.35/lb (based on the March 2021 published range of USD 12.0–12.7/lb) and a recent benchmark of USD 24.9/lb from August 2025 [U.S. Geological Survey, 2021; U.S. Geological Survey, 2025]. This produces a consistent ratio-based estimate of the re-venue effect under higher prices.

2. Copper: a strong and clean price effect

Copper remains the clearest case because it was Armenia's largest metal export before the war and is directly linked to the country's own mining sector. Taking the 2021 export value of USD 844 million and revaluing it at a recent copper price of USD 12,951/mt against a 2021 benchmark of USD 9,317/mt implies a price increase of about 39.0%. Under this counterfactual, Armenia's 2021 copper exports would now be worth approximately USD 1.173 billion, generating an additional USD 329 million in export revenue from price alone [Mardanyan & Khachatryan, 2024; World Bank, 2024]. This is economically meaningful. On its own, the copper price effect would increase Armenian export earnings by a sum equivalent to roughly 11% of total 2021 exports, assuming a total export benchmark of around USD 3.0 billion for that year [Enterprise Armenia & Ministry of Economy of the RA, 2022]. The copper result therefore confirms that Armenia's external opportunity is not merely a by-product of post-war trade rerouting; part of the gain is real and stems from higher world prices for a metal that Armenia already exported at scale before the re-export shock [IEA, 2024; Soares et al., 2025].

3. Molybdenum: a significant supporting effect

For molybdenum, the 2021 export value is taken as USD 127 million, again based on OEC-derived trade data reported by Mardanyan and Khachatryan [Mardanyan & Khachatryan, 2024]. Because Armenia-specific molybdenum price series are less readily available in a directly comparable annual format, the analysis uses U.S. Geological

Survey published price benchmarks for molybdic oxide as an illustrative proxy. In March 2021, U.S. molybdic oxide prices ranged between USD 12.0 and USD 12.7/lb, implying a midpoint of USD 12.35/lb [U.S. Geological Survey, 2021]. In August 2025, the USGS reported an average molybdic oxide price of USD 24.9/lb [U.S. Geological Survey, 2025]. This suggests an approximate doubling of molybdenum prices over the period.

Applying this price ratio to Armenia's 2021 molybdenum export value raises the implied revenue from USD 127 million to approximately USD 256 million, an increase of around USD 129 million [Mardanyan & Khachatryan, 2024; U.S. Geological Survey, 2021; U.S. Geological Survey, 2025]. While this estimate is more approximate than the copper calculation, it still demonstrates that molybdenum materially strengthens the overall mining-price effect and should not be treated as marginal in Armenia's export structure.

4. Gold: very large price upside, but recent trade statistics are unusable as a production proxy

Gold must be interpreted differently. The recent export surge in Armenian gold trade data cannot be used as a measure of Armenia's own mining performance because official data show that most of the 2024 gold trade was re-exported foreign-origin metal [Ministry of Economy of the RA, 2024; Ministry of Economy of the RA, 2025]. However, this does not mean that gold is irrelevant to the paper. It simply means that the correct quantitative exercise is to apply the new global gold price to the pre-war baseline value of Armenian gold exports, rather than relying on distorted post-war trade values.

Using the 2021 OEC-based export value of USD 256 million for Armenia's gold exports [Mardanyan & Khachatryan, 2024], and revaluing it from the 2021 average price of roughly USD 1,801/oz to your requested current analytical benchmark of USD 4,000/oz, the implied export value rises to approximately USD 569 million. This produces an additional revenue effect of about USD 313 million [World Bank, 2024]. It is worth noting that this USD 4,000 assumption is analytically defensible as a "current high-price scenario": it is above the 2025 annual average of USD 3,431/oz, but slightly below the World Gold Council's reported Q4 2025 average of USD 4,135/oz [World Gold Council, 2026].

Thus, even after excluding the re-export distortion, gold still contributes a very large price-driven up-side to Armenia's potential export revenues. The crucial point is that the upside should be attributed to the global gold price environment, not to the inflated headline gold export figures observed in 2023–2025.

5. Combined result: a three-metal price revaluation

Once the three metals are combined, the quantitative result becomes clearer. Armenia's baseline 2021 exports in copper ore, molybdenum ore, and gold totaled USD 1.227 billion [Mardanyan & Khachatryan, 2024]. Revaluing those same three export categories at the higher price benchmarks used in this study gives the following results:

Copper: USD 844 million → USD 1.173 billion

Molybdenum: USD 127 million → USD 256 million
Gold: USD 256 million → USD 569 million

The combined revalued total is therefore approximately USD 1.998 billion, compared with the base- line USD 1.227 billion. This implies a total price-only increase of about USD 771 million across the three metals [Mardanyan & Khachatryan, 2024; World Bank, 2024; U.S. Geological Survey, 2021; U.S. Geological Survey, 2025].

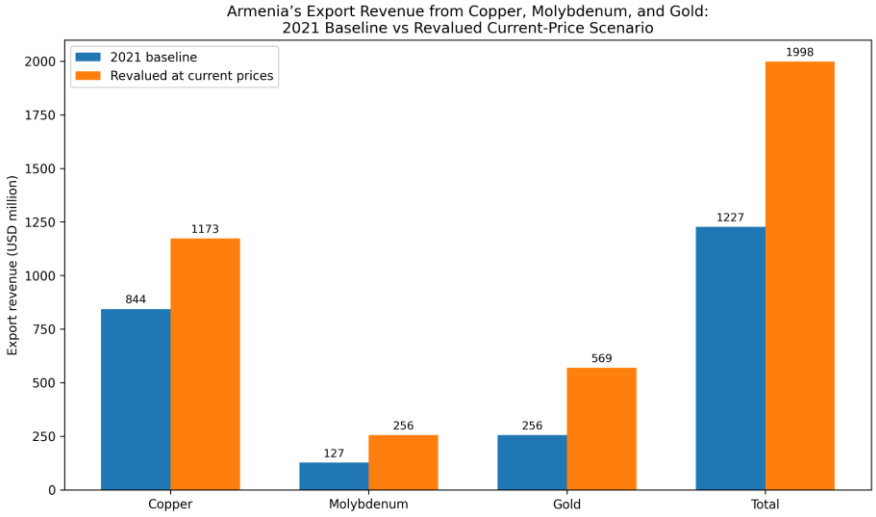

Figure 1. Armenia's export revenue from copper, molybdenum and gold

In proportional terms, the three-metal export basket would be about 62.8% larger under these higher-price assumptions than it was in 2021. Relative to Armenia's roughly USD 3.0 billion total exports in 2021, the revalued three-metal basket would amount to about 66.6% of total exports [Enterprise Armenia & Ministry of Economy of the RA, 2022]. This is an analytically important result because it shows that even after removing the re-export noise, the underlying export revenues are highly sensitive to global metal prices.

6. Interpretation: real opportunity, but also rising concentration risk

The quantitative exercise supports a more balanced conclusion than a simple reading of post-2022 data on trade. On the one hand, Armenia has a genuine opportunity to benefit from higher world prices. Even without distorted re-export flows, the country's pre-war export structure would generate roughly USD 771 million more revenue from copper, molybdenum, and gold under current price conditions. This is a substantial sum for a smal l open economy and provides real fiscal and external-space potential.

On the other hand, the exercise also highlights a structural vulnerability. The gain comes mainly from higher prices for a narrow group of mineral exports rather than from broad-based diversification. In other words, the same external shock that improves Armenia's

export earnings may also increase concentration in the export basket. This means that favorable prices alone do not constitute structural transformation. Structural transformation would require that the additional mining-related revenues be converted into wider productive capabilities — through infrastructure, skills, local supplier development, technological upgrading, and diversification into other tradable sectors [Timbe et al., 2024; Valentine et al., 2024]. Otherwise, Armenia may experience higher revenues without becoming less dependent.

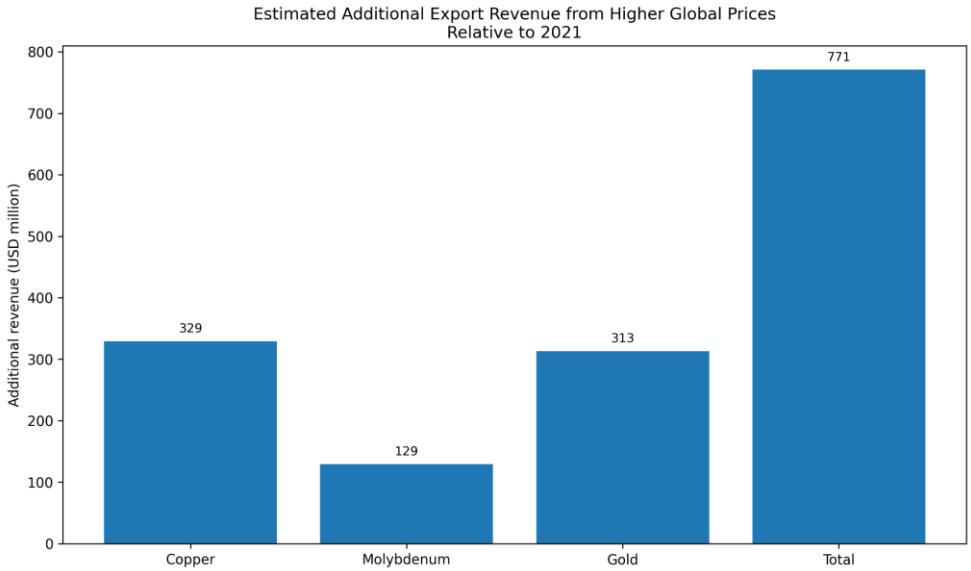

Figure 2. Estimated additional export from higher global prices

For that reason, the main quantitative conclusion of this section is not simply that Armenia benefits from higher prices. It is that Armenia's clean, pre-war metal export basket would now be worth nearly USD 2.0 billion instead of USD 1.227 billion, implying a price-only gain of around USD 771 million. This number captures the real commodity-price opportunity much more accurately than the inflated post-war export totals and pro vides a better empirical base for discussing structural transformation.

To complement the price-revaluation exercise, the level of Armenia's export concentration can be assessed using the Herfindahl–Hirschman Index (HHI) and is calculated as the sum of squared export shares across categories. Using the 2021 pre-war baseline a dopted in this study, Armenia's exports are taken at approximately USD 3.0 billion, of which copper accounted for USD 844 million, molybdenum for USD 127 million, gold for USD 256 million, and all other exports for the remaining USD 1.773 billion [Enterprise Armenia & Ministry of Economy of the RA, 2022]. Accordingly, the HHI can be calculated as follows:

$$HHI = (844/3000)^2 + (127/3000)^2 + (256/3000)^2 + (1773/3000)^2$$

= 0.4375 or 4,375 when expressed on the conventional 0–10,000 scale. This is a relatively high level of concentration and suggests that Armenia's export structure was already heavily dependent on a limited number of product groups even before the post-war re-export distortions. The result is important for the broader argument of the paper: although higher global prices for copper, molybdenum, and gold may substantially increase Armenia's export revenues, they do not by themselves imply diversification. On the contrary, if the additional gains come mainly from a narrow group of mineral exports, the country may become even more exposed to external commodity-price volatility. Thus, the HHI result supports the view that favorable price conditions create a real economic opportunity, but without parallel expansion of the non-mining export base they are more likely to reinforce export dependence than to produce genuine structural transformation.

Policy Implications

The analysis shows that Armenia is facing a real but conditional opportunity. Even after excluding the distortion caused by post-2022 re-exports, higher global prices for copper, molybdenum, and gold significantly increase the potential export revenues of the country. At the same time, these gains re-main concentrated in a narrow group of mineral commodities and therefore do not automatically imply structural transformation. The main policy question is how to convert higher mining-related revenues into broader and more sustainable economic development.

First, Armenia should manage commodity-related windfalls cautiously. Revenues generated by high international prices are inherently volatile, and treating them as permanent can increase fiscal vulnerability once prices decline. For this reason, part of the additional income from mining exports should be managed with a stabilization logic in order to reduce procyclical spending and improve resilience to future commodity shocks.

Second, higher export earnings should be redirected toward productive reinvestment. If the gains are used only for short-term consumption, their long-term effect will be limited. By contrast, if they are invested in infrastructure, energy, logistics, industrial capabilities, and technological modernization, they can support wider productivity growth. In the Armenian case, mining revenues should be viewed as a potential source of financing for broader upgrading rather than as an end in themselves.

Third, export diversification should remain a strategic priority. The HHI analysis confirms that Armenia's export structure is highly concentrated, and the price-revaluation exercise suggests that higher metal prices may strengthen this dependence even further. This means that favorable market conditions can improve export earnings while simultaneously increasing structural vulnerability. To reduce this risk, Armenia should support non-mining tradable sectors and encourage new export activities aside the mining sector.

Finally, policy should focus on strengthening domestic linkages around mining. Structural transformation becomes more likely when mineral extraction supports related activiti es such as engineering, transport, maintenance, technical services, and skills develop-

ment. Without such spillovers, mining remains an enclave sector with limited developmental impact. In addition, recent gold re-export dynamics showed that headline export growth can give a misleading impression of structural improvement. Therefore, official analysis and policymaking should clearly distinguish between export growth generated by domestic production and that generated by temporary intermediary trade.

Conclusions

This article examined how global structural shifts and commodity price dynamics affect Armenia's economic prospects through the cases of copper, molybdenum, and gold. A central contribution of the study was to separate the genuine price effect from the distortion created by post-2022 re-export flows. Using the 2021 pre-war export structure as a baseline, the analysis showed that Armenia's three-metal export basket would now be worth nearly USD 2.0 billion instead of USD 1.227 billion, implying a price-only gain of about USD 771 million. This result confirms that Armenia is benefiting from a significantly more favorable global price environment. However, the HHI calculation also shows that the country's export structure remains highly concentrated. As a result, higher commodity prices improve export revenues but do not automatically lead to diversification or structural transformation. On the contrary, without a broader expansion of the non-mining export base, they may reinforce existing dependence on a narrow group of internationally volatile commodities. The main conclusion of the article is therefore balanced. Armenia is presented with a real economic opportunity, but the developmental outcome depends on domestic policy choices. If higher mining-related revenues are managed prudently and reinvested into productive capabilities, diversification, and local linkages, they can support a more resilient development path. If not, favorable prices may simply strengthen a re-source-dependent growth model. In this sense, the current period should be seen not only as a time of high commodity prices, but also as a critical window for shaping Armenia's long-term economic trajectory.

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Arman MARTIROSYAN, Andranik ARAKELYAN

Global energy transition, commodity price dynamics, and structural transformation in Armenia: evidence from copper, molybdenum and gold

Key words: energy transition; commodity price dynamics; copper; molybdenum; gold; export concentration; structural transformation; Armenia

This article examines how global structural shifts and commodity price dynamics affect Armenia's economic prospects through the cases of copper, molybdenum, and gold. The study distinguishes between industrial metals, whose demand is increasingly shaped by the energy transition, and gold, whose price dynamics are driven mainly by macro-financial uncertainty and geopolitical risk. To avoid the distortion caused by post-2022 re-export flows, the analysis uses Armenia's 2021 pre-war export structure as a baseline and revalues it under higher current prices. The results show that Armenia's combined exports of copper, molybdenum, and gold would rise from USD 1.227 billion to nearly USD 2.0 billion, implying a price-only gain of about USD 771 million. At the same time, the export concentration analysis shows that Armenia remains highly dependent on a narrow group of mineral commodities. The article concludes that higher global metal prices create a real economic opportunity for Armenia, but without productive reinvestment and diversi-fication they are more likely to reinforce resource dependence than to generate genuine structural transformation.