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Economic Analysis and Evaluation of the Dependence of Industrial Sectors on Innovation Potential

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Abstract: In the industrial sector of the national economy, particularly within the manufacturing subsectors, engaging in the initial, intermediate, and final stages of the national innovation process, especially initiating the first stage requires courage and a high level of entrepreneurial risk. This entrepreneurial spirit must be especially strong in the machinery, equipment, food, and light industry subsectors, where ideas for the creation of new products, technologies, and services should form more rapidly. As this characteristic is most evident in the food production subsectors of Azerbaijan's manufacturing industry, the econometric model based on the country's official statistical data demonstrates statistically significant results, despite some variables showing low statistical significance. Overall, the model is statistically robust and satisfies the normality condition. The practical implication of the findings suggests that continued state investment policies in the food and machinery-equipment manufacturing subsectors could further enhance innovation potential in both areas. The proposed model also implies that the production of innovative food products and machinery based on local raw materials could become more cost-efficient while simultaneously improving quality indicators to meet modern domestic and international market demands.

Keywords: Innovation potential; industrial production; food industry; machinery and equipment; investment policy

1. Introductıon

One of the main directions of modern economics is to measure the level of development of the industrial sector, to analyze changes taking place in this area, and to assess their impact on the broader economic system. In particular, the total volume of industrial output (goods, works, and services) is considered one of the key indicators of sustainable economic growth. Various production fields including the extractive industry, manufacturing, energy sector, and high-tech industries play a vital role in shaping industrial output. A deep analysis of the structure and dynamics of industrial production serves as a fundamental source of information for economic policy planning and more efficient allocation of resources. In this context, the application of econometric models to identify the

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main determinants of industrial output, measure their impact, and examine their interrelations is of high importance.

The objective of this study is to analyze the extent to which specific production fields (i.e., subsectors) influence the formation of total industrial output. In order to evaluate the innovation potential within a country's national economy and its industrial sectors, it is first necessary to assess the environment in which innovation activities are carried out. This includes examining scientific research, design and engineering activities, pilot testing capabilities, educational institutions, skilled human resources, technical infrastructure, and the state of collaboration with organizations that offer practical innovation opportunities. The current level of national economic development in Azerbaijan and the existing socio-economic conditions do not fully meet the modern requirements for increasing the volume and diversity of domestic industrial production. The degree of openness and level of liberalization in the national economy necessitate that subsectors involved in machinery and equipment manufacturing, particularly those producing food, clothing, and household goods not only align with international market demands but also adapt to domestic market expectations (Azerbaijan, 2030). This, in turn, may help uncover the potential for expanding not only the production and variety of innovative domestic products, but also the capacity to develop the very technologies on a national basis that underpin such innovations.

Although some Azerbaijani economists focus on innovation activities and their implications for technological and organizational improvements in production, we believe that equal attention should be given to uncovering the potential capabilities behind the emergence of innovations and their commercialization for competitive advantage (Karimli, 2013). While such an approach reflects real-world conditions, it may overlook critical but less visible dimensions of innovation, such as innovation activity levels, innovation costs, and measurable outcomes. These aspects are essential for the effective organization of innovation processes and for ensuring that newly introduced products are truly competitive (Gasumov, 2024).

Some other scholars define innovation activity as a system of measures aimed at increasing the efficiency of the technical and economic parameters of core production assets through the application of innovations (World Bank, 2021). In our view, this approach overly narrows the scope of innovation by failing to treat it as a qualitative transformation or process improvement. Instead, it reduces innovation to incremental adjustments and proposals, which risks underestimating the complexity and transformative nature of innovation as a driving force. Therefore, we find this perspective insufficient.

We agree with researchers who conceptualize innovation as a set of processes involving creativity, invention, and the application of new technologies. These processes encompass innovations, inventions, patents, trademarks, know-how, and other similar intangible assets that represent genuine economic value (Atakishiyev et al., 2008). Identifying and harnessing such innovation potential in Azerbaijan's national economy is vital for driving development, unlocking latent opportunities, and integrating them into the broader economic cycle.

To unlock such potential opportunities, the first step must be directed toward creating an innovation- and startup-friendly environment within the established economic structures of the country. This also includes stimulating the national economic motives that drive such an environment (Miadjenovic 2015). Although this process may require time, activating the existing potential does not necessarily take long. What truly demands time and strategic effort is bringing together talented specialists who possess both scientific knowledge and practical skills, and who are inclined toward innovation,

invention, creativity, and entrepreneurial behavior. These individuals must be supported in generating startup and innovation ideas, developing project designs, and evaluating the outcomes of research and technical-economic achievements (Harvard Business School, 2022a).

If Azerbaijan's manufacturing sector can offer a sufficiently attractive investment environment, particularly for machinery and equipment, as well as for the textile and apparel industries and if this environment is adequately supported by both domestic and foreign investment, then it can be stated unequivocally that the scale of output in both subsectors will expand. Consequently, the potential to enter domestic and international markets, compete effectively, and meet solvent demand will increase. In Azerbaijan's current investment climate, this process of improvement and development can be substantiated by the broader application of digitalization, which not only extends across sectors but also penetrates them in depth.

However, national firms operating in the production of machinery, equipment, textiles, and apparel often face challenges such as high technological costs and a shortage of experienced professionals. Another challenge that highlights the need to expand digitalization efforts in the country is the misconception that digital technologies merely simplify processes and improve efficiency. In reality, the adoption of digital tools must go beyond optimization and lead to the formulation of strategies that increase value creation and ensure the global competitiveness of export-oriented products (Porter, 1986).

Firms and enterprises using digital technologies must structure their operations to align with the demands of international markets, not only to create and enhance value, but more importantly, to make machinery, equipment, and textile products export-ready and competitive. Developing such management strategies will not only enhance operational efficiency through digital transformation, but also foster customer loyalty and satisfaction among buyers in international markets. This reality positions digital transformation, supported by digital technologies, as a key facilitator of mutually beneficial trade for both domestic producers and international buyers. The modern global markets for machinery, equipment, textiles, and apparel are characterized by constantly shifting competitive dynamics and high levels of intensity and flexibility. In such an environment, national firms and companies engaged in the production of these goods can achieve significant economic and social outcomes not only through the application of digitalization, but—more importantly through their ability to respond effectively to the flexible and ever-changing market conditions of the export destinations (Porter, 1986).

Given that these market shifts manifest across international, regional, and local levels, the advancement of digital information and communication technologies (ICT) imposes a new strategic demand on national firms: to remain agile in their operations and planning. However, the transformation of market conditions is not driven solely by the speed of digitalization. More critically, it depends on the capacity of firms to produce goods and services that align with consumer preferences reflecting their desires, tastes, and behavioral trends and to meet those needs efficiently. In this context, the ability of national producers to anticipate and respond to changes in consumer demand becomes a key competitive advantage. Rather than focusing solely on technological upgrades or internal efficiency gains, firms must prioritize external market alignment by offering tailored solutions that match evolving customer expectations in both global and domestic markets.

Adaptation to rapidly changing market conditions (conjunctural shifts) is not based on long-term planning, but rather on short-term goals that respond to continuously evolving consumer behavior and

solvent demand (Krugman & Obstfeld, 2017). This type of rapid and real-time responsiveness is more characteristic of the food and apparel manufacturing subsectors than of the machinery and equipment industries. This is due to the fact that changes in market conditions in the machinery and equipment sector typically occur over longer periods, making short-term flexibility less applicable. Nonetheless, flexibility plays a crucial role in fostering innovation by enabling manufacturers to respond quickly to market needs and adapt to new circumstances within a short timeframe. Many large firms have significantly increased efficiency in their production and logistics operations by prioritizing flexibility in supply chain and production management. This has led to shorter production cycles and accelerated turnover (World Bank, 2021).

It is essential that Azerbaijani producers of machinery, equipment, textiles, and apparel place greater emphasis on flexible production and marketing strategies, as well as consumer satisfaction and behavioral responsiveness. In recent years, economists have pointed out that national producers struggle to internalize the concept of operational flexibility. To address this challenge, the use of digital technologies and analytical tools is increasingly recommended (Keynes, 1978).

Making this shift a reality, however, requires not only the adoption of digital technologies but also their effective implementation to yield tangible results. For Azerbaijan's economy, and particularly for manufacturers in the machinery, textile, and apparel industries aiming to enter international markets and remain competitive, this becomes a strategic necessity. Firms in these sectors must embrace digital transformation and information technologies in a timely manner, while developing and executing adaptive management strategies aligned with the dynamic nature of global market conditions (Gasumov et al., 2022). Among the key challenges that firms may encounter are those related to pricing and product quality. However, issues such as regulatory compliance, taxation, customs procedures, and trade regulations as well as difficulties in finding reliable buyers can also significantly hinder the efficiency of commercial operations.

To ease international market access and streamline sales processes for national firms particularly those involved in machinery, food, and apparel production, it is vital to adopt and internalize international standards and regulatory documents governing financial, legal, and consulting services (Harvard Business School, 2022a). We concur with economists who argue that developing short- and long-term business strategies aligned with international market demands, and establishing durable trade partnerships, are the most effective ways to overcome these obstacles (Harvard Business School, 2022b). While it is important to define the timing and duration of sales cycles, it is equally vital for domestic producers to clarify the goals, scale, and intended outcomes of production activities. As stated by both classical and contemporary economists, production, investment, and consumption processes are functionally equal in terms of their roles and responsibilities (Hasanov & Gurbanov, 2022). When considering the repeated nature of production in Azerbaijan, emphasis should be placed on the allocation of income between investment (savings) and consumption. The rationale for prioritizing investment over consumption and its corresponding implications must be clearly understood. For instance, if a specific industrial sector seeks to expand its operations through reinvestment of income while maintaining sustainable consumption levels, and assuming other influencing factors are held constant, then a stable ratio between investment and consumption will emerge. In this case, if sectoral income is sufficiently high, the share allocated to consumption may decrease while remaining indirectly dependent on total income. Meanwhile, the sector's income is directly and indirectly influenced by the volume of production output (Bogart, 2013).

2. Materıals and Methods

An analysis of the structure of industrial production across various types of economic activities in the country reveals that the production volumes of machinery, equipment, food, textiles, and apparel subsectors within the manufacturing industry have exhibited instability when measured as a proportion of total manufacturing output at current prices (see Table 1). This volatility highlights the uneven contribution of these key subsectors to overall industrial performance. Moreover, the observed variability among both dependent and independent variables necessitates the development of a robust analytical framework namely, a correlation or regression model to evaluate the nature and strength of interrelationships.

Table 1. Total Value of Industrial Output (Goods, Services, and Works) and Priority Subsector Contributions in the National Economy of the Republic of Azerbaijan (at current prices, in million AZN)

Year	Total Industry	Mining and Quarrying	Manufacturing	Food Products	Textiles	Apparel	Electrical Equipment	Machinery and Equipment	Motor Vehicles and Trailers
2010.0	27978.2	20862.5	5735.7	1924.6	29.4	34.7	75.0	151.2	3.0
2011.0	35096.2	26894.3	6392.4	2107.6	52.3	38.5	171.6	151.7	3.8
2012.0	34565.0	25607.2	7031.8	2574.6	57.0	38.5	162.3	151.2	3.0
2013.0	33898.1	24655.9	7244.9	2286.4	50.2	31.9	180.4	275.8	82.4
2014.0	32110.3	24012.0	8060.6	2422.0	49.1	36.7	165.0	278.6	93.7
2015.0	26369.4	21389.4	4470.0	2304.7	37.8	31.4	162.3	184.2	108.6
2016.0	32300.2	23112.9	8899.5	2964.7	96.8	80.7	202.8	294.0	155.1
2017.0	41665.1	30544.3	11120.8	3095.8	248.3	103.6	205.1	169.4	126.1
2018.0	47977.7	34931.5	10764.5	3059.8	243.3	103.6	200.6	164.9	136.1
2019.0	46999.2	32999.2	11788.3	3888.4	288.3	109.5	213.4	226.1	74.5
2020.0	37269.3	22486.3	15887.0	3803.0	360.4	149.2	221.2	266.5	93.1
2021.0	58332.4	44745.3	11164.4	4090.3	368.4	185.3	213.6	383.9	165.2
2022.0	68363.0	64741.5	3611.6	4490.7	369.8	208.3	188.3	358.4	172.3
2023.0	67296.4	45117.5	18431.2	4547.6	372.3	193.7	217.3	564.7	193.7

Source: State Statistical Committee of AR, 2023

Figure 1 illustrates the dynamics of the examined statistical indicators. The graph presents the annual dynamics of the total industrial output value and the output values of the priority production sectors that constitute it over the period 2010–2023. Based on the graphical representation, there is a generally increasing trend across all sectors. The dynamics of the mining industry reveal that it is the primary driving force behind industrial output. In contrast, other specific sectors such as food, textile, and clothing manufacturing display relatively low values, indicating a weak influence on total industrial production. The indicators for the production of electrical equipment as well as machinery and equipment are relatively stable, with a slight upward trend. Overall, the graph shows that industrial output is predominantly shaped by the mining sector. The influence of other sectors remains limited but demonstrates potential for further development.

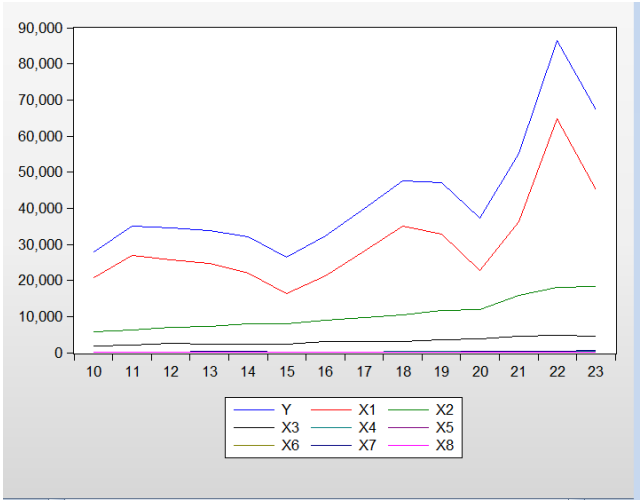

Figure 1. Graphical depiction of the statistical indicators

The Ordinary Least Squares (OLS) method was used to estimate the parameters of the model.

The multiple linear regression model constructed using the OLS method makes it possible to identify which industrial sectors have the greatest impact on the total industrial output.

The general form of the constructed multiple regression model is as follows:

Y (Total industry) = 0.996794217562*(mining and quarrying) + 1.30428448974*(manufacturing) - 0.0579023804616*(food products) - 4.16546949467*(textiles) + 0.295330482826*(apparel) + 2.64326304883*(electrical equipment) - 1.01344296625*(machinery and equipment) + 0.685700549387*(motor vehicles and trallers) - 99.3266707965 (1)

As seen from the general form of the model, holding other factors constant, a one-unit increase in the production value of the mining industry leads to an increase of 0.996794217562 units in the total industrial output. Similarly, holding other factors constant, a one-unit increase in the production value of the manufacturing industry results in an increase of 1.30428448974 units in the total industrial output. Thus, the constructed model demonstrates a high level of compatibility with the actual data and is reliable for future forecasting. The predictive power of the model is notably high. The actual and predicted values almost completely overlap, indicating that the model can provide reliable results for future periods as well.

Table 2. Descriptive statistics of the statistical indicators

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Mean	43071.09	30164.17	10536.49	3145.821	176.8357	90.18571	170.4214	250.6786	81.75000
Median	36148.40	26250.75	9311.500	2982.250	139.5500	95.15000	183.2500	209.8000	85.85000
Maximum	86383.40	64745.30	18431.20	4890.900	388.6000	162.3000	231.2000	564.7000	193.7000
Minimum	26369.40	16362.30	5735.700	1924.600	29.40000	34.70000	75.00000	151.2000	3.000000
Std. Dev.	16767.92	12498.20	4220.647	980.3407	140.4227	38.20972	50.39819	117.9205	59.73276
Skewness	1.432886	1.620992	0.834096	0.531724	0.357849	0.038857	-0.833939	1.472788	0.039912
Kurtosis	4.256062	5.232150	2.401674	1.936951	1.504093	2.204577	2.458782	4.548128	2.197644
Jarque-Bera	5.711036	9.037560	1.832168	1.318914	1.604144	0.372597	1.793596	6.459317	0.379252
Probability	0.057526	0.010902	0.400083	0.517132	0.448399	0.830026	0.407874	0.039571	0.827268
Sum	602995.2	422298.4	147510.9	44041.50	2475.700	1262.600	2385.900	3509.500	1144.500
Sum Sq. Dev.	3.66E+09	2.03E+09	2.32E+08	12493882	256341.0	18979.78	33019.70	180768.3	46384.03
Observations	14	14	14	14	14	14	14	14	14

The descriptive statistics of the variables used in the model are presented in Table 4. This table provides summary statistics for 14 observations covering the period from 2010 to 2023. The indicators include statistical summaries for various industrial sectors as well as total industrial output.

3. Discussion

The OLS regression results provide a clear view of the structure and determinants of industrial output in Azerbaijan. The findings confirm that the mining and quarrying sector remains the primary driver of industrial growth, with its output closely correlated with total industrial output. Manufacturing also contributes positively, though to a lesser extent, highlighting its secondary role in the current industrial landscape. Subsections such as textiles, apparel, and machinery and equipment exhibit negative or relatively weak coefficients, reflecting limitations in scale, technological capability, competitiveness, and operational flexibility. These results align with the descriptive trends shown in Figure 1, where these subsectors display lower output levels and limited responsiveness over the period 2010–2023.

The positive coefficient for electrical equipment underscores the potential of technology-intensive industries to contribute more significantly to total industrial output if adequately supported by innovation policies, investment, and digitalization initiatives. This observation reinforces the theoretical argument that developing an innovation-friendly environment, fostering skilled human capital, and integrating digital tools are essential for strengthening manufacturing subsectors.

The model demonstrates high predictive accuracy, with actual and predicted values closely aligned, confirming the appropriateness of the selected explanatory variables. At the same time, the findings reveal structural imbalances: heavy reliance on extractive industries and underdeveloped high-value manufacturing sectors. To achieve sustainable industrial growth, policies should focus on diversifying production, promoting technologically advanced and flexible manufacturing, and enhancing integration with global markets. Strengthening the performance of machinery, textiles, and apparel subsectors will not only reduce output volatility but also increase Azerbaijan's industrial resilience and competitiveness in both domestic and international markets.

4. Conclusion

Based on the official statistical data of the Republic of Azerbaijan from 2010 to 2023, the model constructed for total industry and its priority sub-sectors is statistically robust. In future research, the model could be further simplified by retaining only statistically significant variables. The scientific significance of this study lies in its practical utility for economists and industrial analysts, enabling more precise and evidence-based decision-making. The analysis supports the identification of priority sectors and contributes to the effective formulation of industrial policy. From an economic perspective, the model's results are useful for analyzing the structural dynamics and development trends of the industrial sector. The mining and manufacturing industry variables exhibit a strong and statistically significant impact on total industrial output. This suggests that these two sectors represent the primary drivers of industrial production. In particular, the extraction of mineral resources and their initial processing serve as key pillars of economic growth. Although manufacturing sub-sectors such as food, textiles, clothing, electrical equipment, machinery, and automobile production play an important role in the economy, they do not demonstrate statistically significant effects in the model. This may reflect their relatively small share in GDP or their underdeveloped status. Alternatively, it may indicate low productivity and value-added levels in these sectors. Government policy should not only continue to invest in the mining and manufacturing sectors, but also focus on enhancing the potential of other branches within the manufacturing industry. Value-added should be created in these sectors through technology transfer, innovation, and the development of human capital, thereby increasing their share within the industrial structure. According to the constructed model, the value of industrial production is primarily dependent on raw material extraction and initial processing industries. For a more balanced and sustainable industrial development, economic policy should prioritize the diversification of the manufacturing sector and the expansion of high value-added production.

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