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Uzbekistan's path to the WTO: Assessing export competitiveness through the product complexity index

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Abstract
This study utilizes the Product Complexity Index (PCI), developed by the Harvard Kennedy School's Growth Lab, to assess the knowledge intensity and diversification of Uzbekistan's exported products. The PCI offers a nuanced understanding of the economic capabilities embedded within a nation's export structure, highlighting the degree to which products are both knowledge-intensive and unique in the global market. Through this analytical tool, our research aims to illuminate Uzbekistan's progress in transitioning from a reliance on primary commodities to more complex, high-value exports. This transition is vital for fostering sustainable economic growth, enhancing competitiveness, and achieving long-term development objectives.

Keywords: product complexity index, exports, value added, export competitiveness

1. Introduction

Economic development involves transforming a country's production and export capabilities towards more complex products. Exporting low-productivity and low-wage commodities such as agricultural products and mineral resources leads to slow economic growth. Conversely, producing and exporting high-value products that require sophisticated production processes stimulates economic growth. Therefore, alongside export volume, the value added from exports is crucial for fostering economic growth in Uzbekistan. As Uzbekistan prepares for WTO accession, this strategic shift towards high-value, complex exports will be vital for improving competitiveness and achieving long-term development goals.

2. Literature Review

Product Complexity Index is based on the number of countries that can produce the product and the economic complexity of those countries. Although vast number of research has been conducted in analyzing trade competitiveness and assessing economic complexities of countries, there is lack of research on measuring export competitiveness through product complexity. The foundations of product and economic complexity can be traced back to the works of Lewis (1955) [7], Rostow (1959) [8], Kuznets (1966) [6], and Kaldor (1967) [4]. These scholars viewed economic development as a structural transformation process, where resources transition from lower productivity activities to higher productivity ones. This transformation acknowledges that each activity plays different roles in the economy due to differences in returns to scale, income elasticities of demand, and market structures.

After a long pause, Hidalgo *et al*. (2007) [2] and Hidalgo and Hausmann (2009) [3] contributed to these foundational ideas by revitalized the discussion by framing economic development as a process of learning to produce more complex products. Their work emphasizes that product complexity is determined by the capabilities required to produce a product, while the complexity of a country is based on the locally available capabilities.

Hausmann *et al*. (2007) [1] introduced empirical measures such as PRODY and EXPY. PRODY represents the income level associated with a product and is calculated as a weighted average of the income per capita of countries exporting the product, with weights based on the revealed comparative advantage. EXPY represents the productivity level of a country's export basket,

calculated as a weighted average of the complexity of exported products.

A key insight from this literature is that for a product to be exported with comparative advantage, multiple capabilities must be present. The lack of a single capability can prevent a product from being exported competitively. This is analogous to the O-ring theory of development (Kremer, 1993) [5], which posits that the absence of any crucial element can hinder overall production quality and success.

Hausmann *et al*. (2007) highlighted that not all products have the same developmental consequences. Some products facilitate economic development by embodying capabilities that can be redeployed into other production processes, while others do not. Their research demonstrated that richer countries export more complex products and that the measure of economic complexity (EXPY) is a strong predictor of future economic growth.

The literature on product complexity underscores the significance of the diversity and sophistication of capabilities required for producing different products. From early economic development theories to contemporary measures and empirical methods, understanding product complexity provides valuable insights into the processes underlying structural transformation and economic growth. This comprehensive perspective helps policymakers and economists identify strategic products that can drive sustainable development and competitive advantage in the global market. There is a lack of research on product complexity specifically and its importance in the economic growth.

3. Data and Methodology

The analysis of the complexity and value-added nature of Uzbekistan's export portfolio from 2017 to 2023 employs the Product Complexity Index developed by the Harvard Kennedy School's Growth Lab [1]. This methodology encompasses the following key steps:

3.1 Data Collection

1. Export Data: Collection of the detailed export data for Uzbekistan from 2017 to 2023. This includes the export volumes and values of all products exported during this period.
2. PCI Data: Obtaining the PCI values for each product, as calculated by the Growth Lab, to determine the complexity of individual exported goods.

3.2 Calculation of overall product complexity index

The overall PCI for each year t is calculated using the formula provided:

$$= \sum_{i=1}^{n} (PCI_{it} * \frac{E_{it}}{TE_t}) = \sum_{i=1}^{n} (PCI_{it} * \omega_{it})$$

Where,

$PCI_t^{overall}$ Represents the overall PCI of the exports of goods in period *t*;

PCI_{it} is the PCI of the *i*-exported product in period *t*;

E_{it} Denotes the export volume of product *i* in period *t*;

TE_t is the volume of the total exports of goods in period *t*;

ω_{it} Represents the share or weight of the *i*-exported product in the period *t*, calculated as $\omega_{it} = \frac{E_{it}}{TE_t}$.

3.3 Steps in the Analysis

1. **Weight Calculation:** For each year, the weight of each exported product is calculated by dividing the export volume of each product by the total export volume for that year.
2. **PCI Aggregation:** The PCI of each product is multiplied by its respective weight to determine its contribution to the overall PCI for that year.
3. **Summation:** These weighted PCIs are summed to obtain the overall PCI for the export portfolio for each year.

1.1 Overall trend in the export of goods (with/without gold)

In recent years, the Uzbek government has prioritized the development of the export sector. One of the priority directions of the "Action strategy for five priority areas of development of the Republic of Uzbekistan in 2017-2021" was to increase the country's liberalization and competitiveness in global trade. This strategy focused on liberalizing export activities, diversifying exported products and their destinations, and enhancing the overall export potential of the economy. As a result, Uzbekistan's total export volume grew steadily for the period 2017-2023, reaching $24.4 billion in 2023, a nearly 2-fold increase from $12.6 billion in 2017. In 2023 alone, exports increased by 26.5% compared to $19.3 billion in 2022.

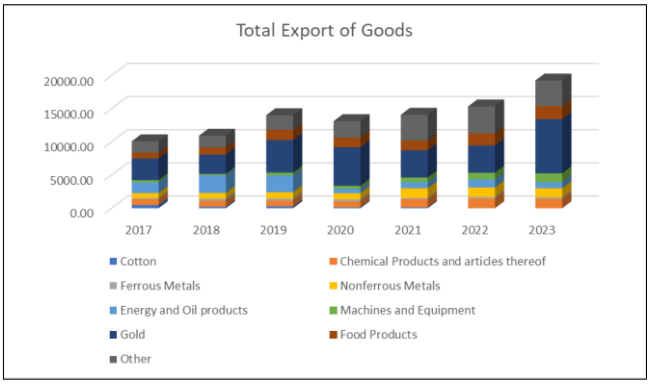


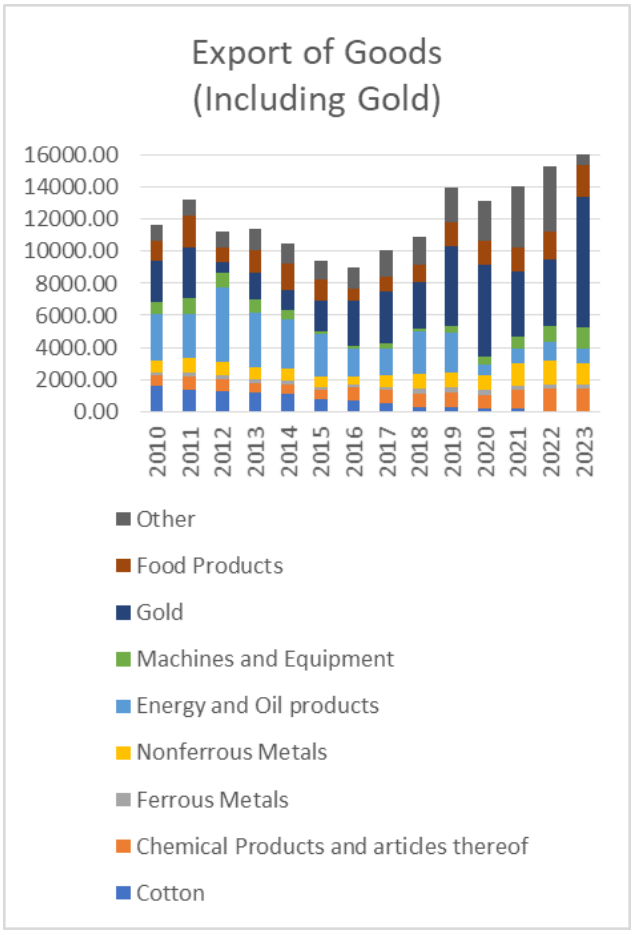
Fig 1: Total Export of Goods

During 2017-2023, the export geography of our country has expanded by 14 countries, and by 2023 Uzbekistan's products are exported to 122 countries (with an annual export volume of no less than 10,000 US dollars per country). Product diversification in exports has also expanded significantly, with the variety of exported products growing from 1219 distinct types in 2017 to 2,874 by 2023, a 2.4-fold increase, each valued at a minimum of $10,000 according to the 10-digit HS code.

Despite the dramatic growth in Uzbek exports in recent years, this increase has been significantly supported by a substantial rise in gold exports. The share of gold in total exports has grown dramatically, accounting for 33.4% of total exports and 42.4% of the export of goods in 2023. The value of gold exports nearly doubled in 2023, reaching $8.2 billion. While the overall export of goods grew by 26.5% in 2023, Instead of "growth rate slowed to -1.3%" it should be "growth rate slowed to 7.1%" in 2022. This indicates that the overall

[1] The Atlas of Economic Complexity (harvard.edu)

growth in Uzbekistan's export of goods is mainly supported by the rapid increase in gold exports.



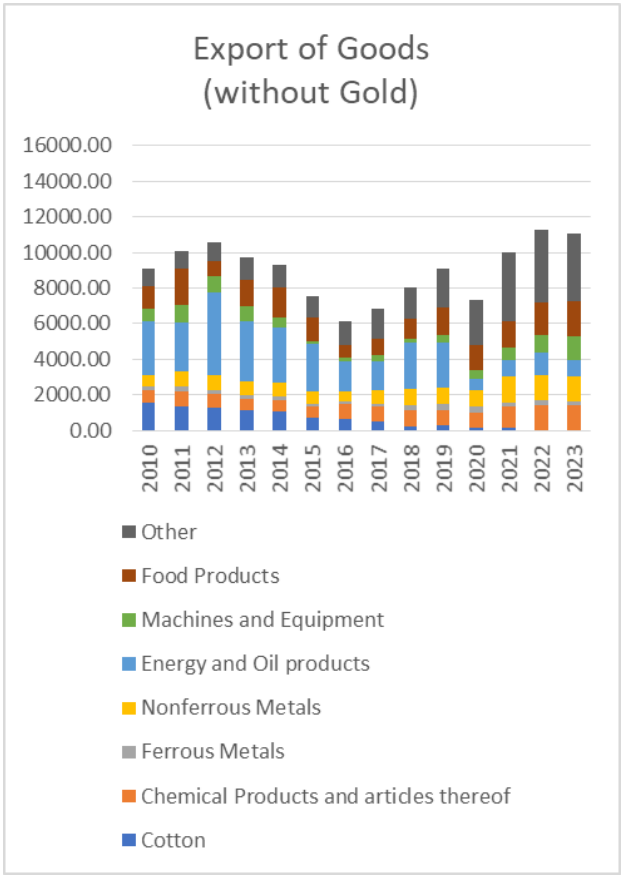


Fig 2: Export of Goods (with/without Gold)

1.2 Overall trend in the export of services

While the total volume of exported goods excluding gold decreased slightly in 2023, the overall export figures have been bolstered by a steady increase in service exports. Service exports more than doubled from $2.5 billion in 2017 to $5.2 billion in 2023. Although the export of services dropped to $2 billion in 2020 due to the COVID-19 pandemic, growth rebounded in subsequent years, reaching $2.6 billion in 2021, $4 billion in 2022, and $5.2 billion in 2023. The service sector's share of total exports also grew steadily, accounting for 21.2% in 2023. The main drivers of this growth in the service sector were the export of services in "Transport" and "Trips" categories.

Transport services are the largest category in terms of export volume, comprising 64.7% of service exports in 2017. This includes the transportation of natural gas through pipelines across the country. Transport service exports increased from $1.6 billion in 2017 to $2.2 billion in 2023. Between 2017 and 2021, the majority of transport exports were from "Transportation via pipelines." However, this service is unreliable due to geopolitical issues. Any changes in political relations between the exporter and importer of natural gas could lead to service disruptions, potentially causing a 40-60% decrease in exports for the service sector.

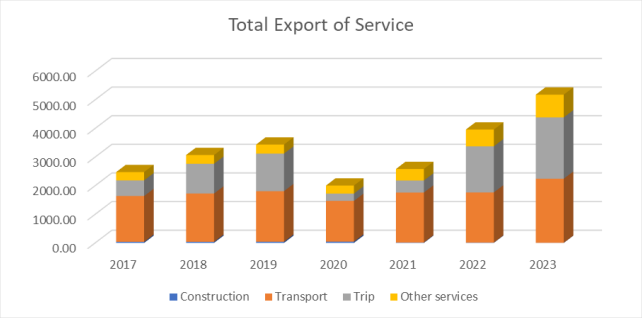


Fig 3: Total Export of Services

The second largest category in service exports is "Trips." In 2023, personal trips for education, medical purposes, and work each had an export share of less than 1%, while other personal trips (tourism) dominated with a 40.8% share of total service exports. In 2017, tourism service exports were $63.9 million. Over the past seven years, tourism exports grew rapidly, except in 2020, when the COVID-19 pandemic caused a significant decline to $11.5 million. By 2023, tourism exports surged to $2.1 billion, a 32-fold increase from 2017. This growth is attributed to reforms easing visa procedures, increased investment in the tourism sector, the development of new tourist locations, and enhanced promotion of the country's tourism image on popular platforms and in key markets.

2. Temporal analysis: PCI of Uzbekistan

Product Complexity Index (PCI) ranks the diversity and sophistication of the productive know-how required to produce a product. The PCI of the country is the indicator of the overall productivity and know-how available in the country. PCI is calculated every year for each product type and it can change over time due to the changes in the production process of each product. Over the period of 2017-2023, the PCI of the exported products from Uzbekistan ranged from -3.37 (Tin ores and concentrates) to 3.09 (Photographic plates and film).

For information: Product Complexity Index (PCI) shows the level of complexity based on the production process of the products that countries export. The index evaluates the variety and complexity of the knowledge and skills needed to produce a product. Products with a high index value are the most complex products and they can be produced by only a few countries. The most complex products include electronics and chemical products and have higher added value. Products with a relatively lower index value include raw materials and basic agricultural products and they have less added value. These types of products require basic or no processing technics and know-how and they can be produced by almost all countries.

The products with high PCI can only be produced by small number of countries while the opposite is true for the products with low PCI. The countries with higher PCI level have the advantage of gaining more value added from the products they sell to their partner countries. Therefore, analyzing the dynamics of the change in the overall country's PCI helps to understand if the country is exporting the products that it has more competitive advantage in the global market.

The overall PCI of the exports of Uzbekistan increased by 23.9% from -1.57 in 2017 to -1.2 in 2023. Top products that are contributing to the growth of the PCI in 2023 are "Bodies for the motor vehicles" (PCI=0.74), "Spark-ignition or rotary engines" (PCI=1.29), "Copper tubes and pipes" (PCI=0.62), "Telephone sets" (PCI=1.20). These products require complex processing technics and know-how for production therefore their PCI is high. Over the period of 2017-2023, the composition of exports has also changed from raw materials to more semi-finished and finished goods in sectors such as textile, non-ferrous metals, and machines and equipment industries.

In 2017, the export of cotton fibers as raw material amounted to $637.3 million, representing 9.1% of Uzbekistan's total exports. However, in 2020, the government implemented significant reforms in the cotton production industry, abolishing the state plan for the production and sale of raw cotton, as well as the purchase price of raw cotton. These reforms aimed to reduce the export of raw cotton and ensure that 100% of the raw cotton produced was processed domestically into finished goods.

As a result of these reforms, the export of raw cotton (PCI = -2.43) significantly decreased from $281.6 million in 2019 to a mere $70 thousand in 2023. Concurrently, the export of cotton yarn (PCI = -1.85) saw a substantial increase, growing 2.8 times from $428.1 million in 2017 to $1.2 billion in 2023. Similarly, the export of T-shirts and sweatshirts (PCI = -1.28) rose dramatically to $309.3 million in 2023, which is 4.5 times higher compared to $68.3 million in 2017.

Among textile products, woven fabric of silk (PCI = 0.37) experienced one of the most significant growth rates. Its exports increased by 1,45 times, from $27.9 thousand in 2017 to $40.4 million in 2023. Woven fabrics of silk have emerged as the top product contributing to the increase in the overall PCI among textile products. This transition underscores the effectiveness of the government's liberalization and reform efforts in the cotton industry, fostering a shift from raw material exports to higher-value finished goods, thereby enhancing the complexity and competitiveness of Uzbekistan's export portfolio.

Another significant shift in the composition and share of exported products can be observed in the non-ferrous metals category. In 2017, copper products held the highest export share among non-ferrous metals at 3%. The export value of raw copper materials, such as refined copper and copper alloys (PCI = -1.52), increased from $213.5 million in 2017 to $738 million in 2021. However, in subsequent years, their exports declined to $581.5 million in 2022 and $492.8 million in 2023. This decline in raw copper exports was accompanied by changes in the export of finished and semi-finished copper products.

Table 1: Top 10 Products with the highest PCI weight in 2023

Top 10 products with the highest PCI weight in 2023						
№	Name	HS code	Export amount in 2023 (thousand USD)	PCI	Export share in 2023	PCI weight in 2023
1	Bodies for the motor vehicles	8707	309301	0,7423	1,27%	0,0094
2	Spark-ignition and rotary engines	8407	166723	1,2938	0,68%	0,0088
3	Copper tubes and pipes	7411	187029	0,6221	0,77%	0,0048
4	Telephone sets	8517	61596	1,2031	0,25%	0,0030
5	Parts/accessories of motor vehicles	8708	50717	1,1989	0,21%	0,0025
6	Molybdenum and articles thereof	8102	47706	0,8772	0,20%	0,0017
7	Refrigerators and freezers	8418	58319	0,6579	0,24%	0,0016
8	Trailers and semi-trailers	8716	42645	0,8742	0,17%	0,0015
9	Electrical transformers and static converters	8504	29830	0,9125	0,12%	0,0011
10	Electric instantaneous or storage water heaters	8516	40269	0,6588	0,16%	0,0011
11	Reaction initiators and accelerators	3815	25282	1,0493	0,10%	0,0011
12	Agricultural and farming machinery	8436	24682	0,9191	0,10%	0,0009
13	Monitors and projectors	8528	52706	0,4247	0,22%	0,0009
14	Products of iron or no alloy steel	7210	62621	0,3249	0,26%	0,0008
15	Printing machinery	8443	18498	1,0475	0,08%	0,0008
16	Tractors	8701	16978	1,0226	0,07%	0,0007
17	Taps, valves and similar appliances	8481	10033	1,7168	0,04%	0,0007
18	Electrical lighting or signaling equipment	8512	17314	0,9618	0,07%	0,0007
19	Ball or roller bearings, and parts thereof	8482	11383	1,4145	0,05%	0,0007
20	Copper plates, sheets and strip	7409	21963	0,7176	0,09%	0,0006

For instance, the export of copper wire decreased from $119.7 million in 2017 to $82.8 million in 2020. After 2020, the export value of copper wire (PCI = -0.34) surged, reaching $330.8 million in 2023. Additionally, there was a significant increase in the export of copper tubes and pipes (PCI = 0.62), which grew over 20 times from $9.2 million in 2017 to $187 million in 2023. Copper tubes and pipes now represent the product with the highest PCI share (0.005) in the country's total exports.

Even though the PCI is improving year by year, the index still remains low at -1.2 (2023). Top products that are dragging down the overall PCI are "Gold", "Cotton yarn", "Petroleum gases and other gaseous hydrocarbons", "Refined copper and copper alloys". The production process of these products is not complex therefore they belong to the category with low PCI. On the other hand, their export shares are amongst the top in Uzbekistan, which is increasing their negative effect on the PCI.

Gold is one of the top products exported by Uzbekistan that has a very low PCI (-2.52). The export share of Gold in total exports of goods was 42.4% in 2023 and was never lower than 25% for the whole period covered in this report. This implies that the effect of the gold on the PCI of the country is considerable. In 2023 only, the export of gold doubled compared to 2022 and reached $8,154 million. Consequently, the overall PCI of the country declined from -1.06 in 2022 to -1.2 in 2023 (by 12.9%). The following graph illustrates the relationship between gold's contribution to the overall PCI, the share of gold in the total export of goods, and the overall PCI of the country. The data reveal a negative correlation between the share of gold in the export of goods and gold's contribution to the overall PCI, indicating that as the share of gold in export of goods increases, its contribution to the PCI decreases.

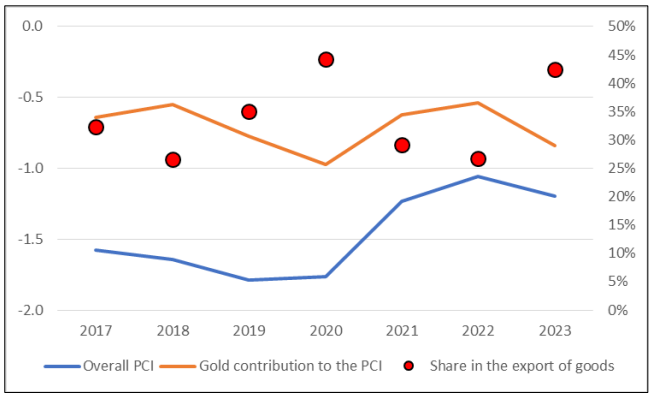


Fig 4: Overall PCI and PCI of gold only

This trend is particularly evident in 2020 and 2023, when the share of gold in exports was at its highest, 44.2% and 42.4% respectively, and correspondingly, the contribution of gold to the PCI was at its lowest, -0.97 and -0.94 respectively. Conversely, there exists a positive relationship between the overall PCI and gold's contribution to it; as the contribution of gold to the PCI increases, the overall PCI of the country also rises. Given the significant share of gold in total exports, it emerges as the primary driver of the overall PCI.

Starting in 2021, the overall PCI of the exports of goods "made in Uzbekistan" began to grow sharply, leveling up to -1.23 in 2021 and -1.06 in 2022, compared to -1.76 in 2020. This growth was driven primarily by increased exports of high-complexity products such as spark ignition and rotary engines (PCI=1.29), bodies for motor vehicles (PCI=0.74), and copper tubes and pipes (PCI=0.62). The export value of spark ignition and rotary engines surged from just $404.9 thousand in 2020 to $39.6 million in 2021, and further to $246.1 million in 2022. Similarly, exports of bodies for motor vehicles grew from $39.7 thousand in 2020 to $19.1 million in 2021, reaching $164.6 million in 2022. The export value of copper tubes and pipes also rose significantly, from $44.6 million in 2020 to $109.9 million in 2021, and $155.8 million in 2022. Conversely, the export of gold decreased from $5.804 billion in 2020 to $4.1098 billion in 2021 and $4.1103 billion in 2022, contributing to the positive growth of the overall PCI.

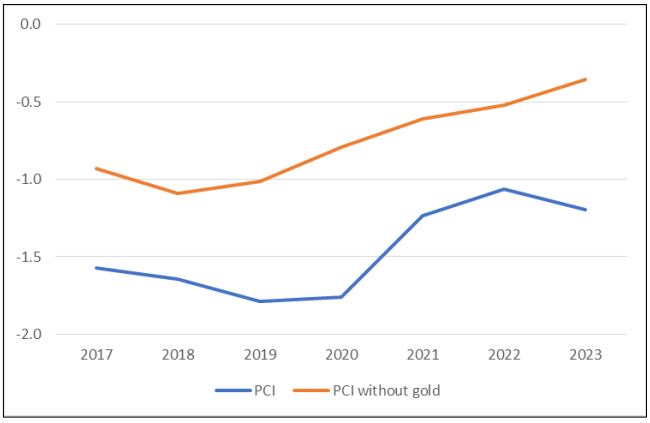


Fig 5: Overall PCI and PCI without gold

To look more closely how the Export of Gold is affecting the PCI of the country, gold was excluded from the calculations. In 2023, the PCI without Gold is -0.36, which is 0.84 points higher than the PCI with gold -1.20. The overall PCI without gold increased from -0.93 in 2017 to -0.36 in 2023 while the PCI with gold increased from -1.57 in 2017 to -1.2 in 2023. The results show that the complexity of the export of goods excluding gold is increasing year by year.

4. Sectoral contribution: PCI by category

To better understand the origins of PCI growth and declines in Uzbekistan's export composition, products were categorized as per the presidential decree (PQ-3448) in 2017. Analysis reveals that the categories experiencing the most significant PCI growth are mineral products, chemical products, textile products, non-ferrous metals, and machines and equipment, with export shares ranging from 2.4% to 13% of total exports. Conversely, categories with the most significant PCI declines include precious and semi-precious stones and plastic and rubber products, with export shares of 34.1% and 1.6% respectively.

Table 2: Export share of each category in total exports

Export share of the categories in total exports									
№	Name	2016	2017	2018	2019	2020	2021	2022	2023
1	Live animals and their products	0,1%	0,2%	0,1%	0,1%	0,2%	0,2%	0,3%	0,2%
2	Products of plant origin	4,6%	4,8%	3,8%	7,5%	8,3%	9,0%	7,9%	6,8%
3	Animal or vegetable oils	0,0%	0,0%	0,0%	0,1%	0,2%	0,0%	0,2%	0,1%
4	Food products	0,4%	0,6%	0,5%	0,6%	0,7%	0,9%	1,3%	1,1%
5	Mineral products	17,8%	15,4%	23,2%	17,0%	5,1%	6,2%	6,8%	4,1%
6	Chemical products	4,2%	3,9%	3,7%	3,0%	3,6%	4,6%	4,8%	4,1%
7	Plastic and rubber products	4,0%	4,0%	3,9%	2,7%	2,2%	2,5%	2,2%	1,6%
8	Leather and natural fur products	0,6%	0,6%	0,5%	0,3%	0,2%	0,3%	0,2%	0,2%
9	Wood	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,1%
10	Fibrous cellulosic materials	0,2%	0,3%	0,3%	0,2%	0,3%	0,4%	0,6%	0,4%
11	Textile products	14,7%	14,1%	12,2%	12,4%	14,1%	18,9%	17,0%	13,0%
12	Shoes and other accessories	0,1%	0,1%	0,1%	0,2%	0,3%	0,3%	0,3%	0,2%
13	Articles of stone, plaster, cement or similar materials	1,1%	0,8%	0,2%	0,2%	0,5%	0,8%	0,9%	0,6%
14	Precious and semi-precious stones	29,1%	30,5%	25,4%	32,8%	40,5%	26,0%	22,4%	34,1%
15	Non-ferrous metals	6,6%	8,2%	10,1%	8,3%	8,5%	10,0%	8,7%	6,6%
16	Machines and equipment	1,3%	1,4%	1,0%	1,4%	1,4%	1,7%	3,1%	2,9%
17	All types of vehicles	0,6%	1,5%	0,6%	1,2%	1,5%	2,4%	1,9%	2,4%
18	All types of apparatus and instruments	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,1%
20	Other industrial products	0,0%	0,1%	0,1%	0,1%	0,2%	0,2%	0,3%	0,2%

The "Products of Plant Origin" category, with a 6.8% share in total exports, has a noticeable impact on the overall PCI. However, despite fluctuations in their PCI between 2017 and 2023, the overall PCI remained unchanged. Categories such as “Live animals and their products”, “Animal or vegetable oils”, “Wood”, “Fibrous cellulosic materials”, “Shoes and other accessories”, “Articles of stone, plaster, cement or similar materials”, “All types of apparatus and instruments”, and “Other industrial products” experienced minimal change over this period and had a negligible effect on the overall PCI due to their relatively small export shares, ranging between 0.2% and 0.6%.

6. Top 5 categories with a positive trend in PCI growth

6.1 Textile Products

Uzbekistan's textile industry has emerged as a significant contributor to the country's export economy, thanks in large part to a series of strategic reforms issued during 2017-2023. These reforms have fostered modernization, sustainability, and innovation within the industry, leading to notable improvements in export performance and product complexity [2]. The export of finished textile goods reached $1.6 billion in 2018 and facilities to process more than 80% of the cotton fiber and more than 45% of the cotton yarn were created. Moreover, the total export of textile products increased to $3.2 billion in 2023 compared to $1.5 billion in 2017.

Fig 6: PCI of Textile Products

As a result of the reforms [3] implemented, in 2023, textile products became the second top category among all 21 categories with 13% share in total exports in 2023. Due to the high export share, textile products are one of the leading indicators of total PCI of the country. The PCI of textile products increased from -0.36 in 2017 to -0.17 in 2023 (53% growth). Top products with the positive effect on PCI are “Woven fabrics of silk” (PCI=0.37) and “Synthetic staple fibers” (PCI=0.28). The export volume of the woven fabrics

[2] PQ-4453 (September 2019) allowed the enterprises whose export share of finished textile products is not less than 60% in the total volume of gross income will be exempted from property tax until January 1, 2023.

[3] PF-2 (January 2023) - the companies exporting finished textile products will be provided with credit funding of $100 million in 2023 and $15 million in 2024 by the Foundation for Reconstruction and Development at annual rate of 4% subject to repayment by January 1, 2028

of silk experienced tremendous increase from just $108.7 thousand in 2017 to 40.4 million in 2023. Synthetic staple fibers' exports increased by almost 5.5 fold from $5.98 million in 2017 to $32.7 million in 2023. However, cotton yarn is leading in terms of negative effect on both overall PCI and PCI of the textile goods. It has a 4.87% share in total exports which is the highest in this category. The very low PCI of cotton yarn, coupled with its high export share, significantly reduced the overall PCI of textile products. Despite this, the positive PCI growth in the textile category has had the most substantial impact on the country's total PCI.

6.2 Non-ferrous Metals

Uzbekistan's non-ferrous metals industry has demonstrated significant growth in its PCI between 2017 and 2023, despite experiencing fluctuations in the intervening years. The export dynamics within the industry saw notable shifts, such as "Refined copper and copper alloys" (PCI=-1.51) exports increased from $320.5 million in 2017 to $580.7 million in 2020. These changes initially dragged down the PCI to -0.12 in 2018 compared to -0.09 in 2017. The decline continued to the lowest point of PCI for the whole period -0.13 in 2020 due to stable increase in the export amount of this key product.

However, starting in 2020, the export of finished copper products began to rise significantly which resulted in the improvement of PCI. For example, the export of copper tubes and pipes (PCI=0.62) increased by 4 times from $46.4 million in 2020 to $187 million in 2023. On the other hand, the export of copper raw material (refined copper and copper alloys) decreased considerably from $738 million in 2021 to $492.8 in 2023. These shifts in the export of key products drove the PCI to the highest point for the whole period -0.03 in 2023. This progress can be largely attributed to a series of strategic presidential decrees [4] aimed at modernizing the industry and enhancing its export capabilities.

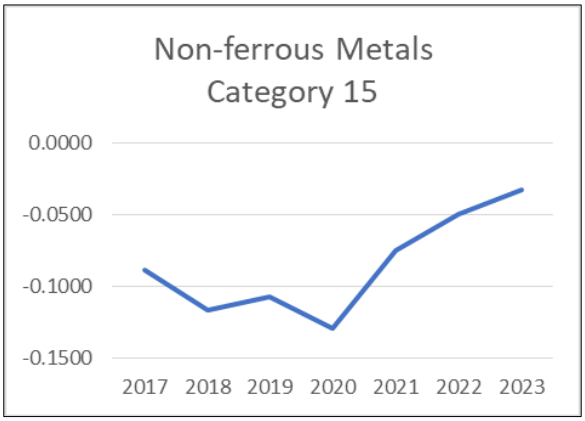


Fig 7: PCI of Non-ferrous products

Increase in the export of finished products, which have higher PCI value, indicate a shift from raw material exports to value-added finished goods. This shift has positively impacted the overall PCI of the non-ferrous metals category, reflecting an increase in the complexity and value-added nature of the industry.

6.3 Mineral Products

Mineral products industry has seen a remarkable improvement in its PCI from 2017 to 2023, reflecting a significant shift towards more complex and value-added products. The PCI increased by 83% over this period, rising from -0.38 in 2017 to -0.063 in 2023. This growth, however, was not without its challenges. In 2018, the PCI experienced a sharp decline to -0.61, primarily due to a 61% increase in exports of petroleum gas, which had a low PCI of -2.33 and the highest export share of 28% within the category. This initial setback underscored the need for diversification and value addition in the sector, which was addressed through various presidential decrees [5] aimed at modernizing the industry and enhancing its export potential.

As Uzbekistan's strategy to reduce reliance on low-complexity exports like petroleum gas took effect, the PCI of mineral products improved markedly. Starting in 2019, the export of petroleum gas began to decline, allowing the PCI to recover and grow for the remainder of the period. On January 18, 2020 the Prime Minister Abdulla Aripov in his speech at the meeting of the political council of the Liberal-Democratic Party of Uzbekistan (UzLiDeP), said that Uzbekistan may stop exporting natural gas by 2025 and increase the production of high-value-added products.

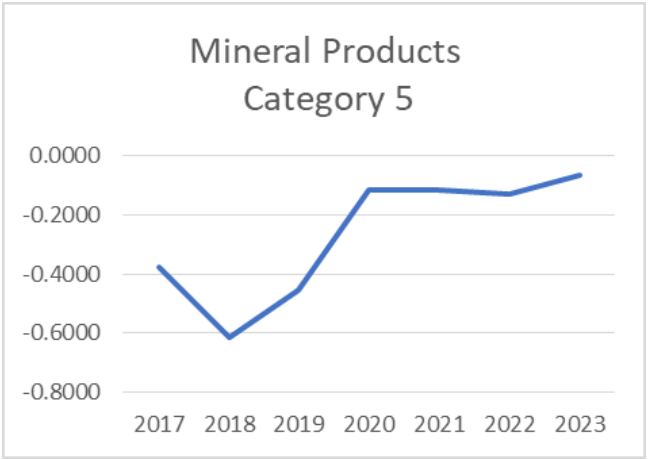


Fig 8: PCI of Mineral Products

Bolstered by reforms [6], which emphasized sustainable practices and financial health of the mineral and chemical products sector, the industry is gradually reducing the export of raw materials such as natural gas and organizing deep

[4] PQ-5011 (March 2021) aimed at increasing the volume of deep processing of copper raw materials to 55,000 tons in 2021 and to 70,000 tons in 2022 and create new production capacities and diversify production in the electrical engineering industry.
PQ-295 - Expenses for scientific research and experimental design in the areas of efficient use of energy and water resources, increasing labor productivity, ensuring ecological safety, and managing and controlling production and product quality through information systems, will be reimbursed up to 50%, but not exceeding 1 billion sums. Additionally, up to 20% of costs related to project planning, engineering, and technology transfer services for implementing these scientific and experimental works will be covered by the Republic of Uzbekistan

[5] PQ-3145 (July 2017) focused on modernizing production facilities and encouraging investment, laying the groundwork for subsequent improvements and R&D in the industry.

[6] PQ-4992 (February 2021) emphasized creation of multi-stage value-added chains from raw materials to finished products, including through technological transformation by establishing new capacities for producing semi-finished products,

processing in the country. As an example, the export of "Petroleum jelly and mineral waxes" (PCI=0.11) started to increase in 2021 and experienced tremendous growth until 2023. The export amount of the petroleum jelly and mineral waxes rose from just $353.8 thousand in 2020 to $45.9 million in 2023. By 2023, the mineral products category's export share stood at 4.1% of total exports, or $993.8 million, reflecting a more diversified and sophisticated export portfolio. This strategic shift, supported by government policies, has been instrumental in enhancing the overall complexity and resilience of Uzbekistan's mineral products industry.

6.4 Chemical Products

Chemical products industry in Uzbekistan has seen substantial growth in its PCI over the period from 2017 to 2023, reflecting significant advancements and diversification in the sector. The PCI of chemical products increased by 48%, rising from -0.042 in 2017 to -0.022 in 2023. Main derivative of growth in overall PCI of the category was "Reaction initiators", which has positive PCI of 1.05 and high added value. The exports of reaction initiators increased from $2.4 million in 2017 to $12.3 million in 2023. This improvement has been driven by strategic presidential decrees [7] aimed at modernizing the industry and enhancing export potential.

Despite overall progress, the industry faced challenges such as the decline in PCI to -0.031 in 2021, primarily due to a 1.5 times increase in the exports of chemical fertilizers, a product with a negative PCI of -1.3. The export value of chemical fertilizers experienced a significant increase, rising from $98.8 million in 2020 to $243.9 million in 2021. Despite this growth, the overall PCI was negatively impacted. To address these fluctuations, a series of presidential decrees issued in 2022 played a pivotal role in significantly advancing the chemical and gas-chemical sectors. These policy interventions facilitated a resurgence in the PCI, which returned to positive growth in 2022 (-0.03) and continued in 2023 (-0.02).

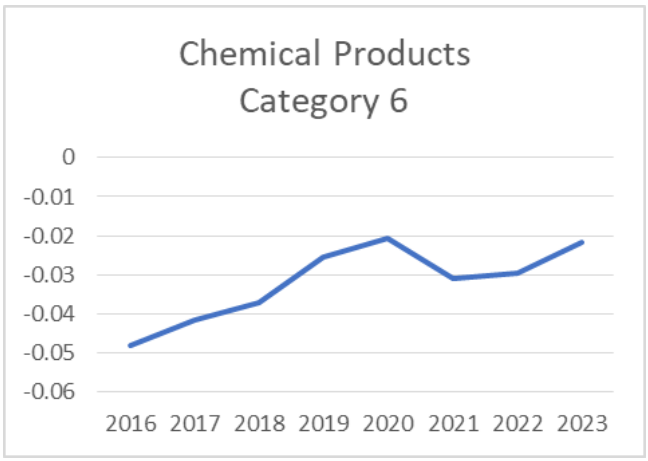


Fig 9: PCI of Chemical Products

6.5 Machines and Equipment

From 2017 to 2023, Uzbekistan's machines and equipment industry has shown significant growth in its PCI from 2017 to 2023, driven by a series of strategic presidential decrees. Over this period, the PCI increased by 1.6 times, reflecting the sector's enhanced sophistication and diversification. Despite an initial decline in PCI from 0.013 in 2017 to 0.006 in 2018, largely due to reduced exports of telephone sets, refrigerators and freezers, and electric heating apparatus, the industry has made a strong recovery. The export value of telephone sets, for instance, dropped dramatically from $107.7 million in 2017 to $24.5 million in 2018.

Despite this setback, the industry rebounded strongly, driven by strategic presidential decrees [8], which emphasized the introduction of advanced technologies for deep processing of existing raw materials and the expansion and diversification of high-value added finished products. These targeted interventions laid the foundation for the sector's recovery and subsequent growth.

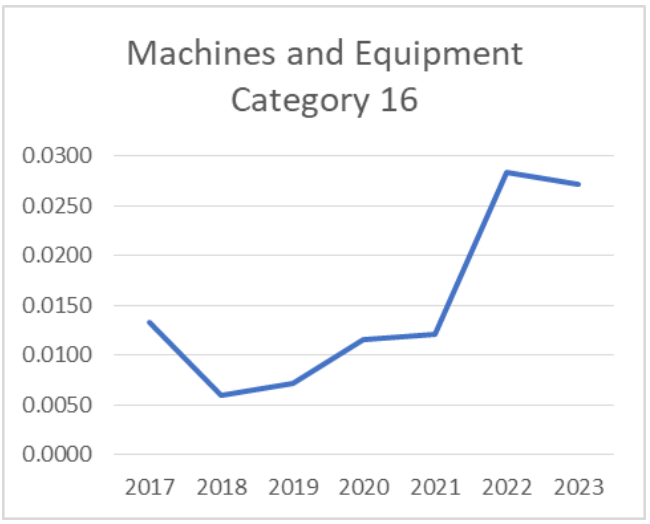


Fig 10: PCI of Machines and Equipment

As a result, the upward trend in PCI resumed post-2018, with a notable surge in 2022, driven by a substantial increase in the export of high-value products. A key highlight was the export of spark-ignition or rotary engines, which skyrocketed from $19.1 million in 2021 to $164.6 million in 2022, significantly boosting the PCI. Additionally, the contributions of telephone sets, refrigerators and freezers, and monitors and projectors in 2021 and 2022 further accelerated growth. These strategic governmental efforts have not only enhanced the export capacity but also the overall complexity and value addition within Uzbekistan's machines and equipment industry, positioning it as a vital player in the global market.

[7] PQ-4265 (April 2019) focused on modernization and expansion of existing facilities for the production of complex mineral fertilizers in large enterprises of the country, as well as construction of new energy-efficient facilities the decree laid a strong foundation for sustained growth in the chemical sector.

[8] PQ-4348 (May 2019) supported local enterprises producing electrical engineering and household products by covering 50% of certification expenses for foreign market compliance, up to $20,000 per case.
PQ-5011(March 2021) ensures covering 50% of transportation costs by road, rail, and air for exporting electrical engineering and household appliances to all countries, including neighboring ones, until January 1, 2024.

7. Top 5 products with a negative trend in PCI growth

7.1 Precious and Semi-Precious Stones

"Precious and semi-precious stones" has the highest export share of 34.1% among all categories. The overall PCI shows a downward trend starting with -0.65 in 2017 and decreasing to -0.86 in 2023. The main driver of the changes in the PCI of this category is "Gold" (PCI=-2.52) and it is the top product with the negative effect on the PCI. Gold itself has an export share of 33.38% in total exports which is almost 98% of exports of "Precious and semi-precious stones". As the PCI of gold is highly negative, the increase in the export of gold in 2019 (69%), 2020 (18%), and 2023 (98%) contributed to the decline in the overall PCI. All the positive growth patterns in other years are directly related with the decrease in gold exports. "Articles of jewelry", on the other hand, is the top product with the positive effect on the PCI (0.19). The export of articles of jewelry increased from $274.9 thousand in 2017 to $409.6 million in 2023. Increase in the exports of articles of jewelry shows the improvements in the precious metal industry in processing raw materials to export finished goods which have higher PCI and added value.

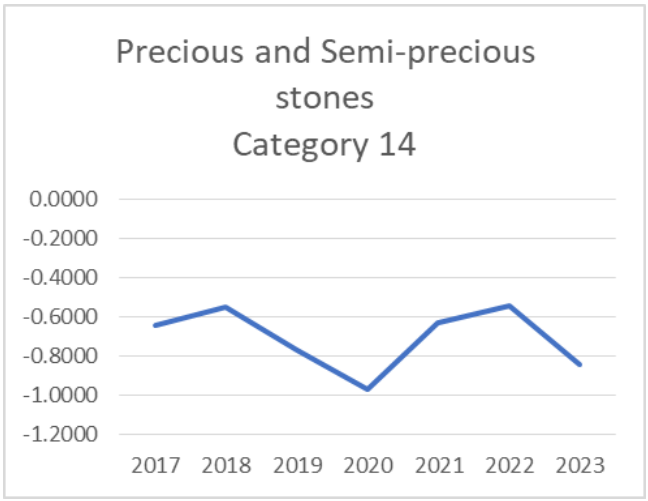


Fig 11: PCI of Precious and Semi-precious stones

7.2 Plastic and Rubber Products

"Plastic and rubber products" has also experienced a decline over the period of 7 years. The PCI decreased from 0.013 in 2017 to 0.004 in 2023. Plastic and rubber products have relatively low export share 1.6% compared to other categories discussed. The main drivers of the changes in the overall PCI of this category are the polymers of ethylene, floor, wall or ceiling coverings of plastics, articles for the conveyance or packing of goods (3923). Above-mentioned products have positive average PCIs of 0.19 and 0.77 over the given period. Therefore, their relationship with the overall PCI is also positive. Articles for the conveyance or packing of goods has an average -0.19 for the period covered. Consequently, its relationship with the overall PCI is negative.

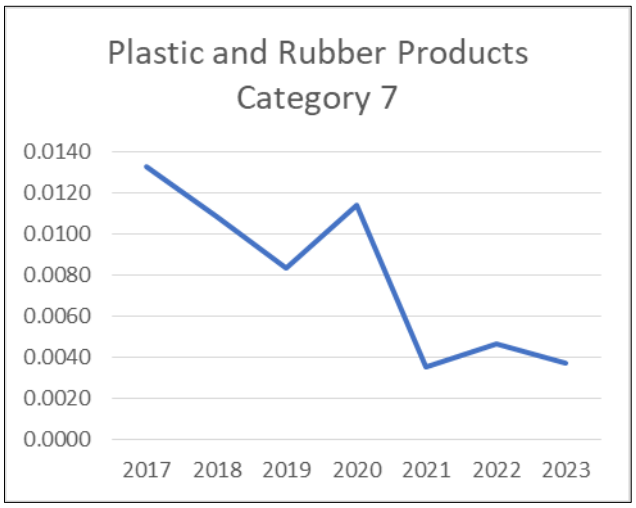


Fig 12: PCI of Plastic and Rubber Products

7.3 All Types of Vehicles and Their Parts

"All types of vehicles and their parts" underwent the least change in the overall PCI over the given period. The PCI decreased from 0.019 in 2017 to 0.016 in 2023 (-18%) for 7 years. The export share of the category is 2.4% therefore even small changes in the exports of goods in the category will affect the overall PCI of the country. The main drivers of the PCI decline are "Motor cars and other motor vehicles (PCI=1.07) and "Railway and tramway freight cars" (PCI=-0.08). The downward trend in 2018 was due to the decline in the export of the motor cars and other motor vehicles from $130.03 million in 2017 to $29.03 million in 2018.

At the same time, the export of railway and tramway freight cars increased from $1.1 million in 2017 to $6.02 million in 2018. As this product has a negative PCI, this increase caused the overall PCI to fall. The highest growth in the exports was recorded with the "Bodies for motor vehicles" (PCI=0.74) in 2017-2023. The exports of this products increased from $83.1 thousand in 2017 to $309.3 million in 2023. Due to its relatively high PCI, the increase in the export of bodies for motor vehicles significantly contributed to the growth of the overall PCI.

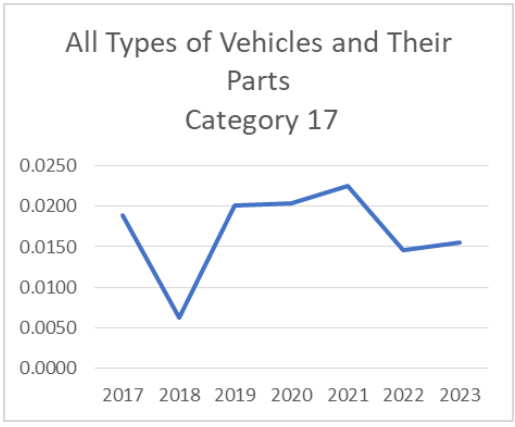


Fig 13: PCI of All Types of Vehicles and Their Parts

7.4 Food Products

The PCI of "Food products" experienced a slight decrease from -0.007 in 2017 to -0.008 in 2023. Although the change in the PCI is minor, relatively high export share of the food products in the total exports (1.1%) makes it unneglectable." Fruit and vegetable juice" (PCI=-0.84) and "Cigars and tobacco" (PCI=-0.98) are the products that are dragging down the PCI of food products.

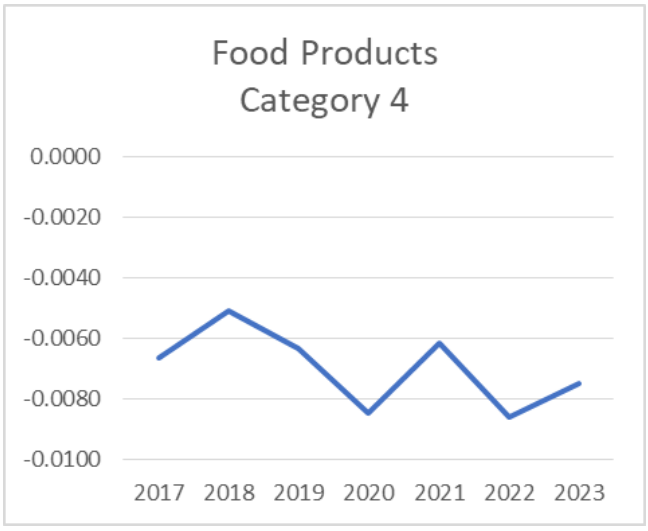


Fig 14: PCI of Food Products

The export of fruit and vegetable juices increased from $9.6 million in 2017 to $51.4 million in 2023. Cigars and tobacco products' export has experienced the highest growth in exports and reached $43.9 million in 2023 which is almost 250 times more compared to $0.19 thousand in 2017. "Chocolate and other cocoa products" (PCI=0.19) has the highest PCI weight and the exports of this product type increased from $5.2 million in 2017 to $13.3 million in 2023. Due to the positive PCI of this product type, the over PCI benefited from the increase in the exports over the years.

7.5 Articles of stone, plaster, cement or similar materials

"Articles of stone, plaster, cement or similar materials" has experienced 4.5 times decline over the whole period of 2017-2023. The PCI decreased steadily from 0.0008 in 2017 and to -0.0042 in 2022, which was followed by slight increase in 2023 (PCI=-0.0028). The products that dragged down the PCI over the given period are ceramic products (PCI=-0.93) and worked monumental (PCI=-0.93). The export amount of the ceramic products increased from $11.7 thousand in 2017 to $52.3 million in 2023 which resulted in the decline in the PCI. At the same time, worked monumental product's exports increased from $327.8 thousand in 2017 to $150.9 million in 2023.

On the other hand, mineral wools and expanded mineral products' exports increased from $1.5 million in 2017 to $2.07 million in 2022. As this type of product has relatively high PCI (0.79), the effect of the export growth on the PCI was positive. The most notable growth in the exports of mineral wools and expanded mineral products was observed in the final year and the exports reached $6.5 million in 2023 which resulted in the positive growth of the PCI in the same year.

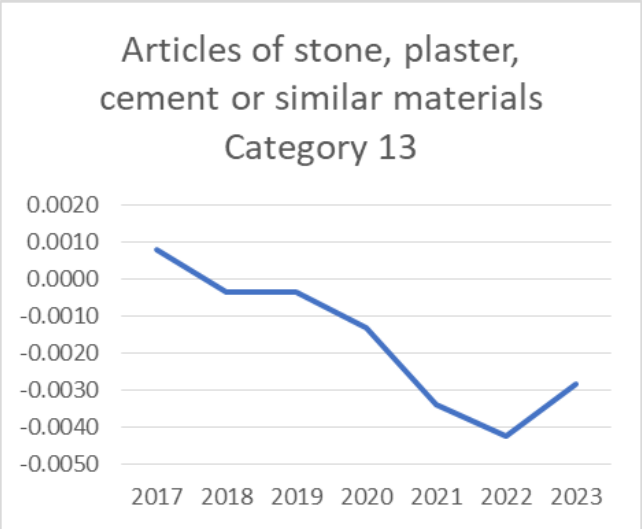


Fig 15: PCI of Articles of Stone, Plaster, Cement, or Similar Materials

8. Economic Implications

Enhancing the Product Complexity Index in Uzbekistan

The Product Complexity Index is a crucial economic indicator that reflects the technological and knowledge intensity of a country's industries. Enhancing the PCI can drive technological advancement and increase the value added to exported products. To improve the overall PCI, Uzbekistan needs to boost the production capacity of high-PCI products while reducing the export of low-PCI raw materials.

Currently, the leading export industries in Uzbekistan are precious stones and metals, and textile products. However, these sectors predominantly export raw materials, such as gold and cotton yarn, which significantly lower the country's PCI. Gold, with an export share of 33.4% in total export of goods and services, has a PCI of -2.5, and cotton yarn, with a 4.9% export share, has a PCI of -1.86. These low PCI values indicate minimal processing and technological input, highlighting the need for a strategic shift towards producing and exporting more complex, high-value-added goods. This transition is essential for fostering sustainable economic growth, enhancing global competitiveness, and achieving long-term development objectives. More precisely, the following economic implications are derived from the study.

8 **Increased product complexity**: The growth in the overall PCI from -1.57 in 2017 to -1.2 in 2023 indicates an improvement in the sophistication and diversification of Uzbekistan's export products. This growth reflects the country's shift towards producing more complex and higher-value goods, such as "Bodies for motor vehicles," "Spark-ignition or rotary engines," "Copper tubes and pipes," and "Telephone sets." These products require advanced processing techniques and significant know-how, suggesting that the industry is moving up the value chain.

9 **Export diversification**: The shift from raw materials to more semi-finished and finished goods in sectors like textile, non-ferrous metals, and machines and equipment industries has diversified the export base. This diversification reduces the country's economic vulnerability to fluctuations in raw material prices and

global demand, contributing to more stable economic growth.

10 **Sectoral growth and decline**: While sectors like mineral products, chemical products, textile products, non-ferrous metals, and machines and equipment have experienced significant growth in their PCI, sectors like precious and semi-precious stones and plastic and rubber products have seen declines. This mixed performance highlights the need for targeted interventions to support lagging sectors.

11 **Raw materials dependency**: The continued high export share of low PCI products like gold (33.4%) and cotton yarn (4.9%) suggests a reliance on raw material exports. These products have low value addition and do not contribute significantly to economic complexity. Reducing this dependency is crucial for long-term economic development.

12 **Enhanced job creation**: Increasing Uzbekistan's PCI by shifting from low-PCI raw materials to high-PCI products can significantly boost job creation. As the country produces more sophisticated goods, the demand for skilled labor will rise, leading to new industries and expanded existing ones. This will create numerous employment opportunities in sectors like advanced manufacturing and information technology, resulting in higher wages and better living standards. Increased employment in high-PCI industries will also stimulate domestic consumption, creating a positive feedback loop for further job creation.

13 **Boosted GDP growth**: Transitioning to high-PCI products will significantly enhance Uzbekistan's GDP growth. High-PCI goods generate higher revenue due to their greater value-added components, directly contributing to GDP growth. Additionally, developing high-PCI industries will attract foreign direct investment (FDI), bringing in capital, technology, and expertise to boost productivity and innovation. Diversifying the industrial base and increasing export complexity will reduce economic vulnerability to commodity price fluctuations, leading to a more resilient and competitive economy capable of sustaining long-term growth.

14 **WTO accession:** Uzbekistan's active preparation for accession to the WTO is a significant component of its strategy to enhance economic complexity and competitiveness. The country has signed four bilateral agreements with the Dominican Republic, Israel, Japan, and Uruguay and has engaged in bilateral negotiations with 33 members since the seventh Working Party meeting [9]. This engagement demonstrates Uzbekistan's commitment to aligning its trade policies with global standards and leveraging WTO membership to boost its economic growth and integration into the global economy. By harmonizing national legislation with WTO rules, Uzbekistan aims to improve market access, reduce trade barriers, and attract foreign investment. The establishment of a special department within the Ministry of Justice to ensure compliance with WTO rules and the creation of WTO divisions in 20 ministries and agencies underscore the country's dedication to this process.

Overall, Uzbekistan's efforts to enhance the PCI, diversify exports, and integrate into the global economy through WTO accession are expected to drive sustainable economic growth, increase job creation, and boost GDP, ultimately improving the country's global competitiveness and economic resilience.

9. Policy Recommendations

To speed up Uzbekistan's accession to the WTO and strengthen its position in the global market, it is essential to align its trade policies with WTO standards. At the same time, to improve the Product Complexity Index and enhance the competitiveness of its products, the government should reduce the export of low-PCI raw materials like gold and cotton yarn and instead use these resources domestically to produce high-value-added goods, such as high-quality clothing and home accessories. This transition would raise the PCI level, reflecting greater technological advancement and knowledge intensity, and significantly increase the export value of Uzbek products. By encouraging local industries to move up the value chain, Uzbekistan can enhance its product complexity, improve its global competitiveness, and drive sustainable economic growth.

- **Harmonize trade policy:** trade-related laws to ensure compliance with WTO standards should be revised and harmonized, thereby enhancing transparency, reducing non-tariff barriers, and strengthening intellectual property rights protection. Uzbekistan should undertake comprehensive legal reforms to align with WTO requirements. After resuming WTO accession processes in 2020, Uzbekistan has made significant progress in trade policy adjustments. Notable reforms include property rights protection under PF-198, which encompasses measures to ensure the inviolability of property rights, prevent unwarranted interference in property relations, and increase the capitalization of private property.

Additionally, Uzbekistan should review and adjust trade policies to promote the export of high PCI products. This could involve negotiating trade agreements that provide favorable market access for these products and implementing measures to protect nascent industries from unfair competition. In 2021, Uzbekistan was accepted as a beneficiary country under the European Union's GSP+ (Generalized System of Preferences Plus) scheme. This provides tariff preferences for the export of 6,200 types of products, which has already shown significant benefits. Building on this success, Uzbekistan should negotiate additional trade agreements, such as Preferential Trade Agreements, to further enhance market access and support the export of high-PCI products.

- **Improve logistics and transportation infrastructure: It is imperative to** invest in modernizing transportation infrastructure, including roads and railways, to reduce logistics costs and improve export efficiency. A key focus should be on upgrading strategic areas such as the Navoi Free Economic Zone (FEZ). Established in 2008 and expanded by Presidential Decree in 2019, the Navoi FEZ offers significant benefits including a rich raw material base, preferential treatment, and strategic

[9] Source: WTO | 2024 News items - Uzbekistan continues to make progress towards WTO accession

location at the crossroads of major transport routes connecting Central Asia, Russia, and China. These factors make it ideal for high-tech, export-oriented enterprises.

The Navoi FEZ aims to attract direct investments to create innovative and high-value-added products, supported by a skilled labor force and reliable infrastructure. This development aligns with the Uzbekistan-2030 Strategy, which seeks to expand relations with countries in South Asia, the Middle East, and Africa, and establish transport-logistics corridors to access to global markets. Enhancing this infrastructure will boost Uzbekistan's logistics sector and export potential, connecting it more efficiently to global supply chains and markets.

- **Develop human capital:** It is important to invest in education and training programs to build a skilled workforce capable of supporting advanced manufacturing and high-tech industries. Partnerships with international educational institutions and the private sector can help bridge the skills gap. For instance, presidential decree PF-2 from January 2023 mandated the Tashkent Institute of Textile and Light Industry to develop and implement joint education programs with higher education institutions from Turkey, Germany, and other countries. These programs aim to train highly demanded specialists in the textile industry, such as engineers, technologists, designers, and marketers. Expanding and updating such initiatives is necessary to meet industry needs.

Investment in education is crucial as human capital is measured by the years of education, including schooling, and the return on education. According to the OECD [10], several educational policies can boost human capital and productivity, such as increasing pre-primary attendance, decreasing student-teacher ratios, increasing school autonomy, and enhancing university autonomy. Germany serves as a clear example of these reforms. For instance, increasing attendance in pre-primary education increased GDP per capita by 0.69%, while decreasing the student-teacher ratio resulted in a 0.91% increase in GDP per capita.
For Uzbekistan, implementing similar reforms and programs can be transformative. By fostering partnerships with key industries and international educational institutions, Uzbekistan can develop its own ecosystem of innovation. This approach will help the country build a skilled workforce, promote the production of high-tech, value-added products, and enhance its competitiveness in global markets. Additionally, focusing on enhancing school attendance, reducing student-teacher ratios, and increasing institutional autonomy will further strengthen Uzbekistan's human capital and productivity. These efforts will collectively drive sustainable economic development by fostering a highly skilled, innovative workforce, supporting long-term economic growth, and enhancing global market competitiveness.

- **Invest in research and development (R&D):** Allocation of funds for R&D should be increased to drive innovation and enhance the production of products with higher PCI. Establishing dedicated R&D centers with strong government backing and fostering partnerships with key industries can help Uzbekistan develop its own innovation ecosystem. This will support the creation of high-tech, value-added products, enhancing competitiveness in global markets.

Building on Presidential decree PQ-4453, which provides material and technical support for scientific work, Uzbekistan should develop new incentives to boost R&D further. Establishing dedicated R&D centers and offering grants or tax incentives for companies investing in new technologies can significantly contribute to this goal.
A standout example of successful R&D investment is South Korea's establishment of the Korea Advanced Institute of Science and Technology (KAIST) [11]. Founded in 1971, KAIST was a government initiative aimed at developing highly skilled scientists and engineers to drive technological innovation and industrial growth. This institution has played a pivotal role in transforming South Korea into a global leader in high-tech industries by fostering close collaborations with leading conglomerates like Samsung, LG, and Hyundai. The synergy between academia and industry accelerated the commercialization of new technologies, significantly enhancing South Korea's competitive edge in global markets.
For Uzbekistan, replicating such a model could be transformative. By creating dedicated R&D centers and fostering partnerships with key industries and international educational institutions, Uzbekistan can develop its own ecosystem of innovation. This approach will help the country build a skilled workforce, promote the production of high-tech, value-added products, and enhance its competitiveness in global markets. Expanding and updating education and training initiatives, inspired by successful models like KAIST, will ensure that Uzbekistan meets the evolving needs of its industries and supports long-term economic growth.

- **Enhance financial support to SMEs: The Uzbek government should** expand access to affordable financing options for businesses, especially small and medium-sized enterprises (SMEs), to invest in production upgrades, technology adoption, and export activities. Uzbekistan can establish financial support mechanisms, such as a national export-import bank, to offer tailored financial products and services for exporters.

Targeted support for SMEs is crucial to help them scale up and integrate into global value chains. The Uzbekistan-2030 Strategy sets key targets, including expanding opportunities for SMEs to enter international markets, developing microfinance, supporting innovation and startups, and introducing new instruments for cooperation with large businesses. However, there is still a need for specialized legislation and strategies for SMEs in Uzbekistan. This can provide additional market control, access to finance, technical assistance, and market access programs, enabling SMEs to contribute more significantly to economic complexity.

- **Encourage value addition:** The government should incentivize the production of high-value, complex products instead of exporting raw materials. For instance, rather than exporting cotton yarn, policies

[10] Source: Productivity, human capital and educational policies - OECD

[11] Source: Research < KAIST

should promote the production of high-quality textiles and home accessories. This can be achieved through subsidies, tax breaks, and support for technology adoption in the textile industry.

A practical example is decree PF-60, which aims to develop a multi-tiered value chain from raw materials to finished products in the copper industry. This decree focuses on creating comprehensive value chains with the assistance of foreign consultants, thereby enhancing the overall economic complexity of the sector. Such an approach should be replicated in other industries to maximize the value addition within Uzbekistan.

Here, it is important to encourage industries to move up the value chain by producing high-value-added goods. Ireland's R&D Tax Credit scheme[12] offers a useful example, providing a 25% tax credit on qualifying R&D expenditures and cash refunds for non-taxable companies. This scheme has successfully attracted major multinationals like Google and Apple, significantly boosting Ireland's economic growth. Implementing a similar program in Uzbekistan could attract investment, spur innovation, and enhance the country's competitive edge in global markets.

By expanding incentives similar to those in decree PF-60 and introducing comparable policies across other sectors, Uzbekistan can encourage industries to add more value to their products. This approach will enhance the global competitiveness of Uzbek products and drive sustainable economic growth. Supporting these efforts through strategic policies will ensure that Uzbekistan moves up the value chain, promoting high-tech, value-added production and strengthening its position in the global market.

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[12] Source: R&D Corporation Tax Credit (revenue.ie)