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POPULATION, INCOME AND OLYMPIC MEDALS: KAZAKHSTAN AND UZBEKISTAN AT THE 2016, 2020 AND 2024 SUMMER OLYMPIC GAMES

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Abstract: In 2024 Kazakhstan's GDP per person was more than four times Uzbekistan's, while Uzbekistan had almost twice as many people, and at the Paris 2024 Olympic Games Uzbekistan won 13 medals and Kazakhstan 7. This study asks what a country's Olympic medal count depends on: its population, its income per person, the total size of its economy, or the sports in which it is strong. Medal tables of the 2016, 2020 and 2024 Summer Olympic Games were combined with World Bank data for every medal-winning country with available data (83 to 91 countries per Games). Before any calculation, the author predicted that medals depend mainly on strong sports, athletes' preparation, funding and population. Population alone and income per person alone each explained only a small part of the differences between countries, but together, or as total GDP, they explained 36% to 51% of the variation, and the hypothesis that both have equal weight could not be rejected. Compared with the typical number of medals for a country of its GDP, Uzbekistan won about three times as many in 2016 and 2024 (8th of 87 countries in 2024), while Kazakhstan moved from 3.7 times in 2016 (6th of 83) to 1.2 times in 2024 (41st of 87). Most medals of both countries came from boxing, judo, wrestling and weightlifting (26 of 32 for Kazakhstan and 28 of 31 for Uzbekistan), and boxing was the largest difference: 9 Olympic titles for Uzbekistan against 1 for Kazakhstan over the three Games. Kazakhstan's fall after 2016 was concentrated in weightlifting and boxing; in Tokyo, Kazakhstan was limited to two weightlifters because of its record of doping violations. The author's own explanation of the fall, weaker preparation of young athletes and less state money in 2016, the year of the EXPO construction, could not be tested with these data and is reported as a hypothesis.

Keywords: Olympic Games; medal count; GDP; population; Kazakhstan; Uzbekistan; boxing; sports economics

1. Introduction

At the Paris 2024 Olympic Games, Uzbekistan won 13 medals, 8 of them gold, and Kazakhstan won 7 medals with one gold [1]. In the same year Kazakhstan's GDP per person was 14,155 US dollars and Uzbekistan's 3,337 dollars, more than four times less, while Uzbekistan had almost twice as many people, 36.4 million against 20.6 million [2]. This raises a simple question: what does the number of Olympic medals of a country depend on, the number of people, how rich they are, or the sports in which the country is strong?

Economists have studied this question for decades. Bernard and Busse studied medal totals from 1960 to 1996. In their results an increase in population and an increase in income per person changed medal totals by a similar amount, which means that a country needs to be both large and rich to win many medals [3]. Johnson and Ali, who studied all post-war Summer and Winter Games, also found that economic and political variables explain participation and medal success remarkably well, and that single-party and communist regimes win more medals [4]. Hoffmann,

Ging and Ramasamy found that, besides economic and political factors, geographical, demographic and cultural characteristics of a country have a significant impact, and concluded that there is still room for public sports policy [5]. De Bosscher and co-authors reviewed the determinants of international sporting success: more than half of them are macro-level variables beyond the control of politicians, while factors at the meso level can be influenced by sports policy, which they grouped into nine policy areas [6].

Kazakhstan and Uzbekistan are neighbours with a shared Soviet past, and both won many medals in Rio de Janeiro in 2016, but at Paris 2024 their results diverged. This paper applies the simplest version of the economic comparisons above to the two countries. It uses the medal tables of three Summer Games, Rio de Janeiro 2016, Tokyo 2020 and Paris 2024, and World Bank data to answer three questions. How well do population, income per person and the size of the economy predict a country's medal count? How far are Kazakhstan and Uzbekistan from the typical number of medals for their economies? And in which sports are the differences between them?

Before the data were analysed, on 1 November 2026, the author was asked by his mentor whether a country's medals depend most of all on money, on the number of people or on strong sports, and why Uzbekistan wins more medals than Kazakhstan. He answered (translated from Russian): "I think that Olympic medals depend most of all on the development of strong sports, the quality of athletes' preparation and funding. Uzbekistan may win more medals than Kazakhstan because it develops some Olympic sports better, for example boxing and judo, and pays more attention to them, or because in Kazakhstan finances may not be distributed properly. Uzbekistan distributes its budget more efficiently, and in Kazakhstan there is no proper monitoring system. Also because of population: Kazakhstan has more than 20 million people and Uzbekistan 39 million, and this changes everything, because more talents can be born in Uzbekistan than here." According to the World Bank, Uzbekistan's population in 2024 was 36.4 million [2].

2. Data and methods

2.1. Medal tables

The number of gold, silver and bronze medals of every country at the 2016, 2020 and 2024 Summer Olympic Games was taken from the medal tables published on English Wikipedia, in the versions of 10 November 2026 [1]. These versions include changes made after the Games because of doping cases. For Kazakhstan's 2016 team there were two such changes: the weightlifter Nijat Rahimov was disqualified in 2022 and his gold medal in the men's 77 kg was removed (according to the same source, the IOC has not yet given it to another athlete), and the weightlifter Denis Ulanov was moved up to bronze in the men's 85 kg. Kazakhstan's 2016 result is therefore counted as 2 gold, 5 silver and 10 bronze medals, 17 in total [1]. The medal counts of Kazakhstan and Uzbekistan at all three Games were checked against the independent Olympedia database and were identical [7]; the medal counts of the other countries were not checked against a second source. The medal tables of four sports, boxing, judo, wrestling and weightlifting, the number of events and athletes in them, the number of athletes each country entered and the rules for weightlifting quotas were taken from the Wikipedia pages of these sports at each Games [8].

2.2. Economic data

GDP in current US dollars and population were taken from the World Bank's World Development Indicators [2], and GDP per person was calculated as GDP divided by population. For each Games, the values of the year in which the Games took place were used: 2016 for Rio de Janeiro, 2021 for Tokyo (the Games were postponed by one year and held in 2021) and 2024 for Paris.

2.3. Countries included

The analysis includes every country that won at least one medal and for which the World Bank reports both GDP and population for that year. Teams that are not countries (the Independent Olympic Athletes in 2016, the Individual Neutral Athletes and the Refugee Olympic Team in 2024) were excluded, as were Chinese Taipei, which has no World Bank data, North Korea in 2016 and 2024 and Cuba in 2020 and 2024, for which GDP is not reported. The team of the Russian Olympic Committee in Tokyo was counted as Russia. This left 83 countries for 2016, 91 for 2020 and 87 for

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2024. Countries without a medal were not included, because the logarithm of zero does not exist; this choice is discussed in Section 5.

2.4. Typical number of medals for a country's GDP

For each Games, the logarithm of each country's total number of medals was compared, using linear regression, with the logarithm of its population, the logarithm of its GDP per person, both of them together, and the logarithm of its total GDP. Total GDP equals population multiplied by GDP per person, so a regression on total GDP is the special case in which both have the same weight. Logarithms are used because the countries differ enormously in size: in 2024 the GDP of the United States was about a hundred times that of Kazakhstan. R^2 shows the share of the variation in the logarithm of medal counts that a regression explains, from 0 (none) to 1 (all).

The regression on total GDP gives, for every country, the typical number of medals for a country of its GDP (the value on the regression line). Because the regression works with logarithms, this is a typical value rather than an average: the mean ratio of actual to typical medals was between 1.38 and 1.56, and about half of the countries were above 1. Dividing a country's actual number of medals by this typical number shows how it performed relative to its economy, and the countries were ranked by this ratio. The rank is the fairer comparison, because it does not depend on whether the typical number is taken as a geometric or an arithmetic average.

All statistics were calculated with one analysis script from the public data described above; the numbers of events and athletes in each sport and the quota rules are taken from the cited pages. To check whether population and income per person have the same weight, the regression on total GDP was compared with the regression on both variables using an F-test.

3. Results

3.1. Population and income per person both matter

On its own, population explained 21% to 24% of the variation in the logarithm of medal counts, and GDP per person only 8% to 18% (Table 1). Together they explained 36% to 51%, with slopes between 0.38 and 0.53, all significant ($p < 0.001$). The F-test did not reject equal weights for population and income per person at the 5% level ($p = 0.88$ in 2016, 0.20 in 2020 and 0.08 in 2024). Total GDP, which combines them with equal weight, explained almost as much, 36% to 50%: a country with ten times the GDP of another typically won about 2.6 to 2.7 times as many medals. Figure 1 shows this relation for Paris 2024. A large population or a high income alone is therefore not enough; the countries with many medals usually have both.

Table 1. How well population, income per person and total GDP predict the number of medals

Games	Countries	R^2, population	R^2, GDP per person	R^2, both together	R^2, total GDP
Rio de Janeiro 2016	83	0.21	0.08	0.36	0.36
Tokyo 2020	91	0.24	0.13	0.51	0.50
Paris 2024	87	0.23	0.18	0.50	0.48

Note: regressions of the logarithm of total medals on the logarithms of the variables, among medal-winning countries with World Bank data. In the regression with both variables, the slopes on population and on GDP per person were 0.41 and 0.40 (2016), 0.41 and 0.51 (2020), 0.38 and 0.53 (2024). All slopes are significant at $p < 0.05$, and all except GDP per person alone in 2016 ($p = 0.011$) at $p < 0.001$.

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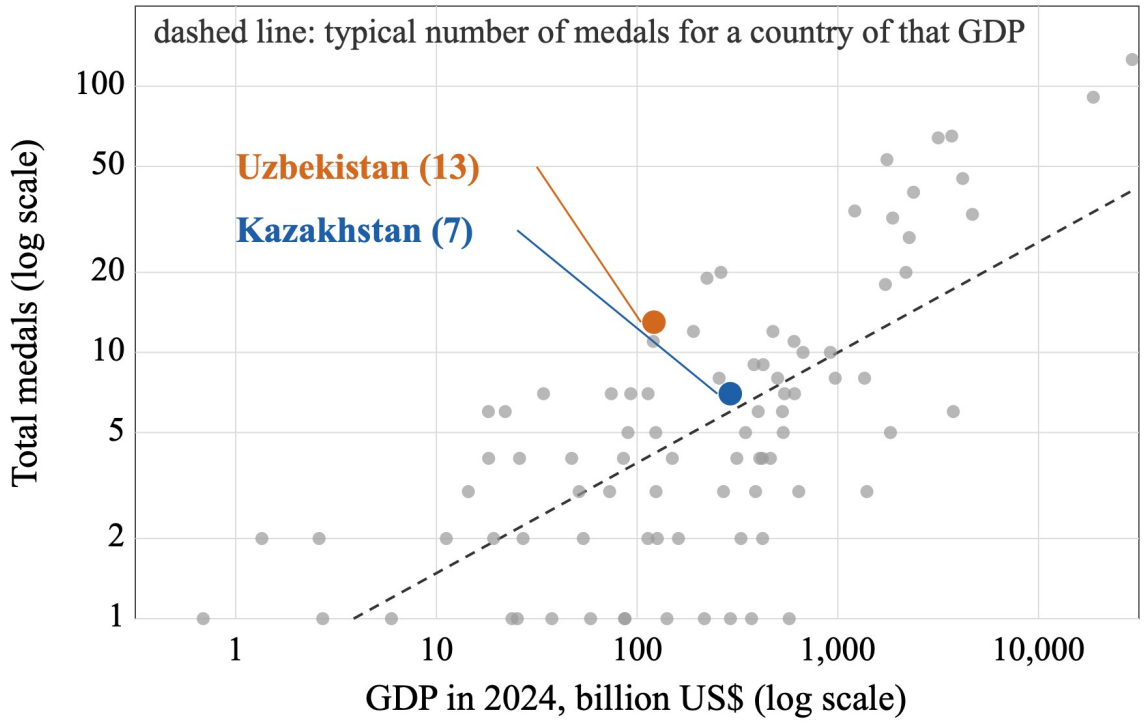

Figure 1. GDP and total medals of 87 medal-winning countries at the Paris 2024 Olympic Games (both axes on a logarithmic scale). The dashed line shows the typical number of medals for a country of a given GDP. Uzbekistan is far above the line, Kazakhstan slightly above it.

3.2. Kazakhstan and Uzbekistan compared with their typical number of medals

Table 2 compares the two countries with the typical number of medals for their GDP. At Rio de Janeiro 2016 both were among the strongest performers: Kazakhstan won 17 medals against a typical 4.6, 3.7 times as many and 6th of 83 countries by this ratio, and Uzbekistan 13 against 4.0, 3.3 times and 11th. At Tokyo 2020 both countries won far fewer medals, Kazakhstan 8 and Uzbekistan 5, and both were in the middle of the ranking (35th and 37th of 91), close to the average ratio of all countries (1.4). At Paris 2024 the two countries separated. Uzbekistan again won 13 medals against a typical 4.2, 3.1 times as many and 8th of 87 countries. Kazakhstan won 7 against a typical 6.0, 1.2 times as many, 41st of 87, slightly below the average ratio of all countries in that year (1.38) (Figure 2).

Table 2. Actual medals of Kazakhstan and Uzbekistan and the typical number for their GDP

Games and country	Medals (gold-silver-bronze)	GDP, billion US$	Population, million	Typical for its GDP	Actual / typical (rank)
2016 Kazakhstan	17 (2-5-10)	137.3	18.4	4.6	3.7 (6 of 83)
2016 Uzbekistan	13 (4-2-7)	97.9	31.3	4.0	3.3 (11 of 83)
2020 Kazakhstan	8 (0-0-8)	197.1	19.7	5.4	1.5 (35 of 91)
2020 Uzbekistan	5 (3-0-2)	81.2	34.2	3.6	1.4 (37 of 91)
2024 Kazakhstan	7 (1-3-3)	291.5	20.6	6.0	1.2 (41 of 87)
2024 Uzbekistan	13 (8-2-3)	121.4	36.4	4.2	3.1 (8 of 87)

Note: GDP and population for 2016, 2021 and 2024. The typical number comes from the regression on total GDP for the same Games. The average ratio of all medal-winning countries was 1.56 (2016), 1.40 (2020) and 1.38 (2024).

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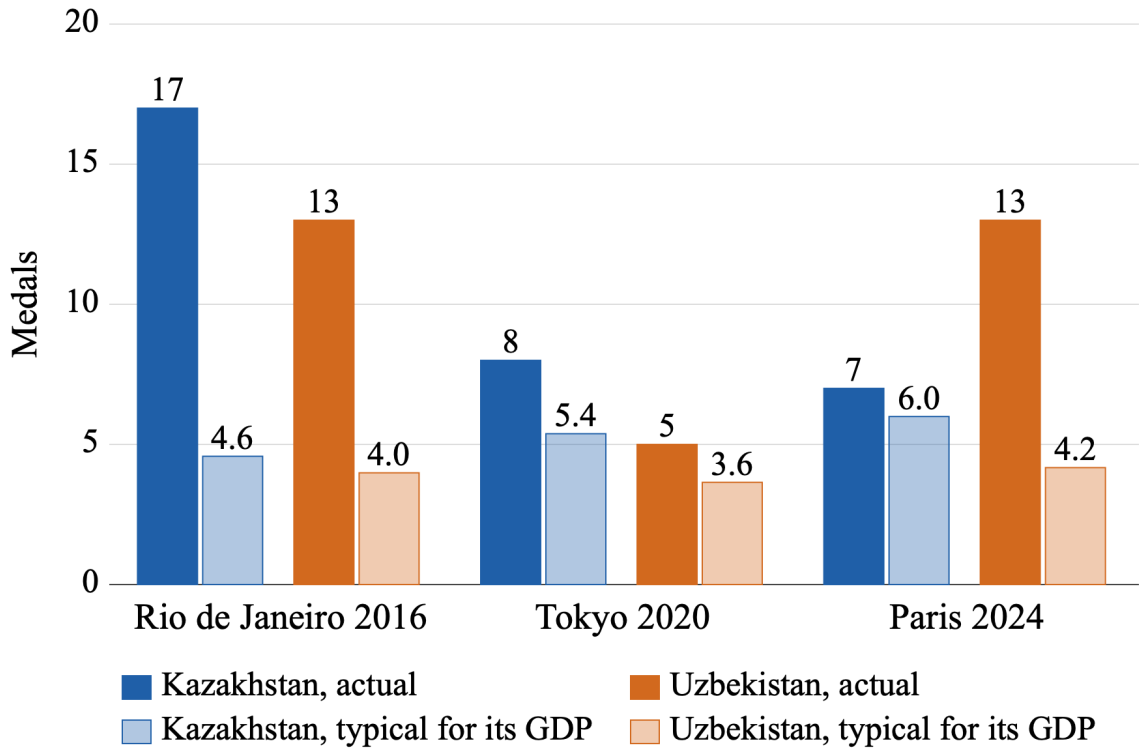

Figure 2. Actual medals of Kazakhstan and Uzbekistan and the typical number of medals for their GDP at three Olympic Games.

Population alone explains Uzbekistan's result only partly. The regression on population gives a typical number of about 7 medals for Uzbekistan in 2024 (6.9) and about 6 for Kazakhstan (5.8). Uzbekistan's 13 medals are 1.9 times its typical number for its population, somewhat above the mean ratio of all countries in this model (1.69), and 22nd of 87, compared with 8th of 87 when measured against GDP.

3.3. Medals by sport

Most medals of both countries were won in four sports: boxing, judo, wrestling and weightlifting (Table 3). For Uzbekistan these sports gave all 13 medals in 2016, 4 of 5 in 2020 and 11 of 13 in 2024, 28 of 31 in total. For Kazakhstan they gave 15 of 17 medals in 2016, 6 of 8 in 2020 and 5 of 7 in 2024, 26 of 32 in total.

The largest difference between the countries is in boxing. Over the three Games, Uzbekistan won 9 Olympic boxing titles (3 in 2016, 1 in 2020 and 5 in 2024) and Kazakhstan won 1 (in 2016). In Paris, 5 of Uzbekistan's 8 gold medals came from boxing, although both countries entered a similar number of boxers (10 from Kazakhstan and 11 from Uzbekistan) [8]. In judo the two countries are close: 6 medals for Uzbekistan and 5 for Kazakhstan over the three Games.

Kazakhstan's fall from 17 medals in 2016 to 7 in 2024 happened entirely in these four sports, whose medals fell from 15 to 5, while the other sports gave 2 medals at each Games. The largest drops were in weightlifting, from 5 medals to 2 and then none, and in boxing, from 5 medals to 2 and 2.

In weightlifting, Kazakhstan entered 8 athletes in 2016, 2 in 2020 and none in 2024. For Tokyo, the International Weightlifting Federation limited each country's team according to its number of doping violations, and Kazakhstan, with 34 violations, was among the countries allowed only one man and one woman; Uzbekistan, with 17, was allowed two men and two women [9]. The Olympic weightlifting competition was also reduced, from 260 athletes and 15 events in 2016 to 196 athletes and 14 events in 2020 and 122 athletes and 10 events in 2024 [8]. Why Kazakhstan had no weightlifters in Paris was not established in this study. In boxing, the total number of events stayed at 13, but men's events fell from 10 in 2016 to 8 in 2020 and 7 in 2024, while women's events grew from 3 to 5 and 6 [8]. Under the same rules, Uzbekistan's boxers won 5 of the 7 men's titles in Paris, so the smaller number of men's events does not by itself explain Kazakhstan's fall in

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boxing. Kazakhstan's whole Olympic team also became smaller, with 101 athletes in 2016, 97 in 2020 and 78 in 2024, while Uzbekistan's went from 70 (2016) and 67 (2020) to 87 (2024) [7].

Uzbekistan's medals also fell sharply from 2016 to 2020, from 13 to 5, before returning to 13 in Paris. A fall at Tokyo 2020 was therefore not unique to Kazakhstan; the difference is that Uzbekistan recovered in 2024 and Kazakhstan did not.

Table 3. Medals of Kazakhstan (KAZ) and Uzbekistan (UZB) in four sports, gold-silver-bronze

Sport	KAZ 2016	KAZ 2020	KAZ 2024	UZB 2016	UZB 2020	UZB 2024
Boxing	1-2-2	0-0-2	0-1-1	3-2-2	1-0-0	5-0-0
Judo	0-1-1	0-0-1	1-0-1	0-0-2	0-0-1	1-0-2
Wrestling	0-1-2	0-0-1	0-1-0	0-0-3	0-0-1	1-0-1
Weightliftin g	0-1-4	0-0-2	0-0-0	1-0-0	1-0-0	0-1-0
Four sports, total	15	6	5	13	4	11
All sports, total	17	8	7	13	5	13

Note: medal tables of each sport at each Games, versions of 10 November 2026; 2016 weightlifting after the later reallocations.

4. Discussion

4.1. What the data say about the author's prediction

The author's prediction named four reasons: strong sports, the quality of athletes' preparation, funding and population. The data used here can check only parts of it.

The data are consistent with the boxing part of the prediction: boxing is the largest difference between the two countries, 9 Olympic titles against 1. They do not support the judo part, because in judo the two countries won almost the same number of medals. The medal tables show only where medals were won; they cannot show whether Uzbekistan develops boxing better, spends more on it or pays it more attention.

The idea about population is partly supported. Across all medal-winning countries population does matter, but on its own it explains less than a quarter of the variation, and in Paris Uzbekistan won somewhat more medals than is typical even for its population. The same is true of income: in Paris, Kazakhstan's much higher GDP per person did not bring it more medals than Uzbekistan, and across countries income per person alone explained even less than population. This agrees with Bernard and Busse's finding for earlier Games that a country needs to be both large and rich to win many medals [3].

The author's suggestion that Uzbekistan distributes its budget more efficiently could not be checked, because the data used here describe the size of each economy but not how much each country spends on sport or how this money is distributed. De Bosscher and co-authors describe the factors that sports policy can change as separate policy areas [6]; comparing these areas in Kazakhstan and Uzbekistan would be a way to check this idea, but this study does not measure them.

4.2. The author's explanation of Kazakhstan's fall after 2016

After seeing the results, on 9 November 2026, the author wrote his explanation (translated from Russian): "The number of medals depends not only on money but also on the preparation of athletes and coaches and the development of strong sports. In 2016 Kazakhstan won 17 medals, in Tokyo 8 and in Paris only 7. I think that the results fell because of insufficient preparation of young athletes." He added: "Also because in 2016 there was the construction of EXPO, so the state invested less money than before." EXPO here is the international exhibition EXPO 2017, held in Astana.

These are the author's hypotheses, and the data in this study cannot test them. The medal tables and the World Bank data contain no information on how young athletes are trained, on coaches, or on how much the state spent on sport in any year. No source on Kazakhstan's spending

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on sport was examined in this study, so the link between the EXPO construction, less state money and the medal results remains an assumption. The sources used here point to other reasons that also have to be considered. In weightlifting, which gave Kazakhstan 5 medals in 2016, the team at the next Games was limited to two athletes because of the country's doping record, and the Olympic weightlifting competition became smaller. In boxing, the number of men's events was cut, although Uzbekistan's boxers did better under the same rules. Uzbekistan's medals also fell from 2016 to 2020, which shows that a fall at Tokyo was not unique to Kazakhstan. What the data do show is where Kazakhstan's fall happened: in weightlifting and boxing, which had given it 10 of its 17 medals in 2016. A test of the author's explanation would need Kazakhstan's state spending on sport for each year from about 2012 to 2024, data on youth sport and coaches, ideally by sport, and the same data for Uzbekistan.

5. Limitations

The study covers only three Olympic Games and two countries, so its conclusions about these countries are descriptions, not proof of causes. The regressions include only countries that won at least one medal. Leaving out countries without medals tends to make the estimated effects of population and income smaller and the typical number for small economies larger, so the typical numbers here describe medal-winning countries only; studies of all countries use other methods [3]. The regressions do not take into account other factors that earlier studies found important, such as hosting the Games, climate or the political system [4, 5]. GDP measures the size of an economy, not its spending on sport. Medal tables change after the Games when medals are reallocated for doping, and the versions used here are those of 10 November 2026. Only the weightlifting quota rules for Tokyo were examined; the rules for other sports and other Games were not.

6. Conclusion

Across the medal-winning countries of the 2016, 2020 and 2024 Summer Olympic Games, neither population nor income per person alone predicted a country's medal count well, but together, or as total GDP, they explained about a third to a half of the variation in the logarithm of medal counts. Compared with the typical number of medals for its GDP, Uzbekistan was among the strongest performers in 2016 and 2024, while Kazakhstan moved from 6th of 83 countries in 2016 to 41st of 87 in 2024. Both countries win most of their medals in boxing, judo, wrestling and weightlifting, and boxing is the largest difference between them: 9 Olympic titles for Uzbekistan against 1 for Kazakhstan. Kazakhstan's fall after 2016 happened mainly in weightlifting, where its team in Tokyo was limited to two athletes because of its doping record, and in boxing. Whether weaker preparation of young athletes or less state money (which the author links to the EXPO construction) also played a part, as the author suggests, remains a hypothesis that requires data on sports spending and youth sport to test.

Data availability

All data are public: the World Bank World Development Indicators [2], the Olympic medal tables and sport pages on Wikipedia [1, 8] and the Olympedia database [7]. The data files and the analysis script are available from the author or his mentor on request.

Author contributions and use of AI tools

Aituar Kassymov chose this topic from two directions offered by his mentor, Gaziz, wrote his prediction before seeing any calculation, and after seeing the results wrote his own explanation of why Kazakhstan's results fell. Both are quoted above in English translation; the translations were prepared with an AI assistant and checked by his mentor against his Russian messages. The author did not do the calculations. His mentor, working with a generative AI assistant (Claude, Anthropic), chose the method and the literature, downloaded the data, wrote the analysis code, made the figures and wrote the text, including its interpretation of the results. Every statistic in the paper was computed by the analysis script from the public sources, the medal counts of both countries were compared with a second database, and the summary of each cited study was compared with its published abstract. The author and his parent read the final text and confirmed it on 22 November 2026.

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Conflicts of interest

The author declares no conflicts of interest. No funding was received for this study.

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