

Assessing Growth Convergence in the Post-Soviet Space: A Comparative Analysis of CIS Economies, 1990–2024

Mohammad Orfan Abdullah

School of Economics, University of Hyderabad, India

Ramana Murthy Rupakula

School of Economics, University of Hyderabad, India

ABSTRACT

The post-Soviet era did not provide equitable growth opportunities for all its constituent countries. The group of Central Asian countries has experienced slower growth than Western cohorts of ex-Soviet countries, which have grown faster over the last 35 years (1990-2024). The Central Asian countries experienced a growth shock, with negative growth rates during 1990-95, and later recovered to positive growth. The Western bloc countries also suffered a similar initial growth shock during (1990-95) but recovered on a faster growth trajectory. The Central Asian countries began with lower per capita income, a lower level of industrialization, and primary exports. The study estimated β and σ -convergence between the two cohorts and found evidence for conditional Convergence within and between the two cohorts. The study also estimates rates of conditional Convergence. The study highlights the greater potential for CAS countries to grow faster through investments in human and physical infrastructure. The study also fills a gap in the international literature on convergence studies.

Keywords: economic growth, convergence, Central Asian region, Sigma convergence, conditional convergence

DOI: <http://dx.doi.org/10.15549/jeecar.v12i2.2155>

INTRODUCTION

Growth Dynamics of CIS Countries

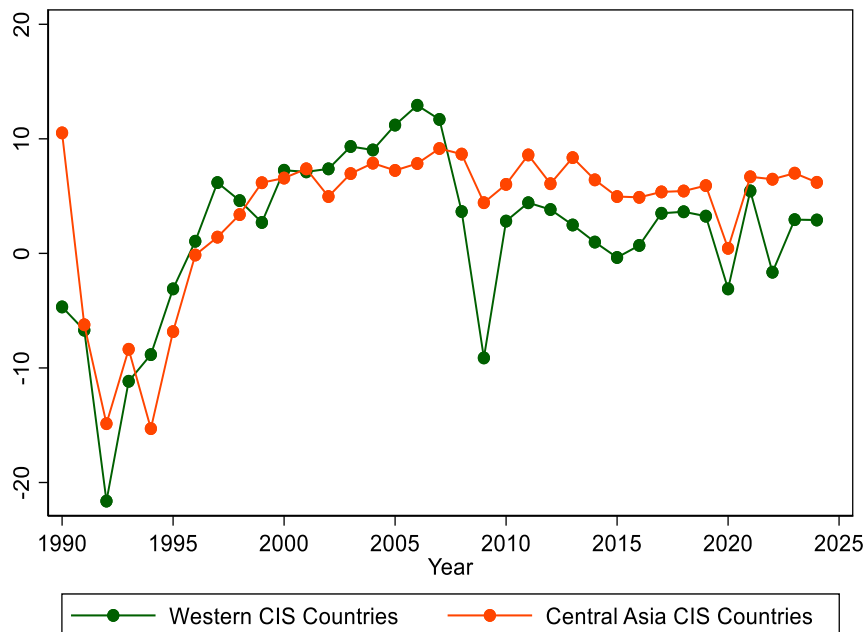
After the dissolution of the USSR, some of the former Soviet Union countries formed the Commonwealth of Independent States (CIS) in 1991 for economic and defence cooperation. CIS countries can be divided into two groups: the Central Asian States (CAS), comprising Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, and Kyrgyzstan, with an average per capita income of \$2688. The second group is the Western bloc of CIS (WCIS) countries, comprising Russia, Belarus, Ukraine, Armenia, Georgia, Moldova, and Azerbaijan, which had an average per capita income of \$5511 in 1990. All the CIS

group of countries initially suffered the effects of the collapse of old arrangements, resulting in their GDP taking a nose dive during 1990-96 by -24.3 percent, but recovered to a remarkably higher growth path during 1991-2009, until were hit by the Global Financial Crisis in 2009, and recovered to 9 percent again during 2010-19, before being hit by the Covid19 crisis. Even though both regions suffered negative growth during 1991-96, the CAS countries shrank by an average of 30 percent, while the WCIS countries' growth declined by an average of 15 percent (See Graph 1). Both groups recovered towards positive growth in the next 24 years from 1996 to 2024, except for the years of the global

financial crisis in 2009 and the COVID-19 crisis in 2020. Given the higher per capita income levels of WCIS, twice those of the CAS region, the CAS region began experiencing higher growth rates than its counterpart. This paper seeks to determine whether there is any evidence of Convergence in per capita income within the canonical Solonian framework (Solow, 1956).

The paper estimates coefficients of unconditional and conditional Convergence between two groups and within the two groups of countries, for the period 1990–2024, by drawing data from World Bank statistics, using the standard methodology of Convergence developed by Barro and Sala-i-Martin (1992) and Romer (1986,1991)

Graph 1: Comparison of Growth in CAS and WCIS countries



The Received Theory

Robert Solow, the growth economist, proposed that, assuming population and technology remain the same across countries, all countries will ultimately converge to the same level of per capita income (Solow, 1956). This is known as the absolute or ‘Unconditional Convergence’ (also known as β -convergence) in technical terms. On the contrary, later studies found a divergence in per capita income between poor and rich countries, which led Paul Romer to revise the convergence hypothesis into conditional Convergence. Further, the literature in the area introduced the concept of ‘sigma convergence’ into the discourse on the dispersion of growth rates across groups of countries, which is a measure of weaker Convergence. Romer (1991) showed in his endogenous growth model that the divergence between the poor and the rich is due to differences in human capital; hence, greater

investment in human capital will close the technology and productivity gaps to attain the Solowian Convergence.

LITERATURE REVIEW

Barro and Sala-i-Martin (1991) provided strong evidence of absolute Convergence among U.S. states between 1960 and 1985, indicating that economically weaker states experienced higher growth rates than wealthier states. However, there was no evidence of Convergence when comparing rich countries (OECD) to a group of 98 poor countries in the same period. Nayyar (2013), in his book *The Catch Up*, revisited the debate on the possibility of Convergence between rich and poor countries over a longer period, into the globalization era of the post-1990s, and found that a group of sixteen developing countries showed remarkable economic Convergence with industrialized

nations during 1995-2008. Convergence is mediated by an industrial transformation led by the manufacturing sector and an encouraging world GDP growth. Varblane and Vahter (2005) studied economic Convergence in transition economies from 1995 to 2004. Their research shows that there is both absolute and sigma Convergence throughout this period. Ismail, N. W. (2008) study on ASEAN countries also confirmed Convergence during 1960-2004, both in absolute and conditional terms. Unal (2014) studied Convergence among the 31 Organisation of Islamic Cooperation (OIC) countries; conditional sigma convergence occurred from 1980 to 2009, while a smaller group of oil-producing OIC countries showed absolute Convergence with the rich countries. Their research provided strong evidence of conditional Convergence across 31 OIC countries. Thus, the literature has addressed convergence questions at the aggregate level and only in select regions, leaving scope for further study. This paper seeks to address the convergence issue among CIS countries.

Central Asia's Infrastructure and Resources

The Central Asian countries were historically less industrialized than their other CIS cousins. However, the infrastructure in Central Asian countries has gradually improved since around 2007-08, but the progress has been uneven across the region. Kazakhstan and Uzbekistan are the leaders in infrastructure development, far ahead of the other Central Asian countries. Turkmenistan falls in the middle; Tajikistan and Kyrgyzstan are still catching up with the others in terms of infrastructure quality. The Global Competitiveness Index, published by the World Economic Forum, ranked the CAS countries lower than many other countries with more difficult terrain, in addition to being landlocked. However, there are serious initiatives in these to develop infrastructure. The Belt and Road Initiative is believed to hold the promise of boosting the region's connectivity and economic growth (Abbas, 2021).

Human Development in Central Asian Countries:

The CAS countries had robust health and education systems in the Soviet era. The initial

crisis during 1991-95 affected investments in human capital; however, there has been considerable improvement thereafter. While some countries, like Kazakhstan and Uzbekistan, maintained or increased education spending, others, like Kyrgyzstan, saw declines. As poverty increased, families struggled to afford the costs of education, including books, uniforms, and fees. Changes in the economies and job markets also affected education provision. Industries declined, resulting in job losses and labour underutilization. This created challenges for aligning education with new workforce needs. Between 1989 and 1999, it found improvements in infant mortality and abortion rates across the region. However, other indicators like youth mortality, life expectancy, sexually transmitted diseases, and tuberculosis worsened in most countries. Preschool and tertiary (university-level) enrolment rates dropped significantly, especially in Kazakhstan, Kyrgyzstan, Turkmenistan, and Uzbekistan.

The reasons for the relative backwardness in CAS countries, according to critics like Shagdar (2006), included reduced education spending, rising poverty that made it harder for families to afford costs, and cultural shifts emphasizing family-based childcare over preschool. Turkmenistan is facing several challenges, including a decrease in primary education from 10 to 9 years, entry restrictions to universities, isolation from outside influence, and an increase in drug use and infectious diseases. The core issue is that skills learned under the Soviet system became obsolete in market economies. Curriculum reforms, teacher training, and improved learning environments were priorities to enhance education quality and align it with market needs, recognizing the need for new skills. However, in some countries, like Kyrgyzstan, formal education lost prestige as poverty, marginalization, and early marriage traditions re-emerged after independence. Failure to invest in human capital would adversely impact current and future generations' health, education, and productivity. Restoring dwindling human capital stocks would also result in higher future costs (Shagdar, 2006).

Table 1: Comparative analysis of economic growth and social trends between CAS and the WCIS countries.

	1990-95	1996-2000	2001-05	2006-10	2011-15	2016-20	2021-24	Total Average
CAS regions								
G.D.P. (current US\$)	-3.60	-2.50	25.00	15.00	-4.70	3.50	8.04	5.80
Gross capital formation (current US\$).	24.00	-3.90	24.00	13.70	-1.80	7.40	10.59	10.57
Exports of goods and services (current US\$).	17.50	6.00	28.00	10.70	-18.30	2.20	14.22	8.61
H.D. I	0.64	0.59	0.61	0.66	0.69	0.71	0.72	0.66
General government final consumption (current US\$).	23.00	-3.40	21.60	13.70	-2.00	8.70	7.19	9.82
Population, total.	0.92	0.74	1.10	1.90	1.70	1.80	1.45	1.37
Labor force, total.	1.50	1.30	1.70	1.80	1.00	0.95	1.56	1.40
WCIS countries								
G.D.P. (current US\$)	-4.80	-5.30	26.00	7.00	-15.00	3.00	-0.20	1.52
Gross capital formation (current US\$).	-13.15	-4.20	27.60	4.50	-17.03	2.24	4.45	0.63
Exports of goods and services (current US\$).	2.50	4.00	25.0	6.00	-14.0	4.00	-5.74	3.10
H.D. I	0.70	0.67	0.71	0.76	0.78	0.81	81	0.75
General government final consumption (current US\$).	0.20	-12.00	24.0	7.21	-15.00	3.0	4.6	1.71
Population, total.	-0.10	-0.46	-0.40	-0.06	0.15	-0.17	-0.03	-0.15
Labor force, total	-1.00	0.80	0.20	0.09	-0.10	-0.49	-0.53	-0.14

Source: World Bank data

Note: The data are calculated using the compound growth rate.

Comparison of Development Indicators

It is useful to make a quick comparison of the broad developmental indicators (see Table 1). CAS countries experienced consistently higher GDP growth, with an average CAGR of 9.10 percent from 2001 to 2010. On the other hand, WCIS regions experienced greater instability in GDP growth, with a lower average CAGR of 1.52 percent than the CAS region. The CAS regions maintain a positive average gross capital formation CAGR of 10.57 percent, indicating ongoing investment activity. WCIS countries struggled with gross capital formation,

suggesting a weaker investment environment than in the CAS. Region, with an average growth of 0.63 percent during 1990-2024 and a significant decline of -17.03 percent in mid-2010. Regarding export growth, CAS shows steady growth with an average CAGR of 8.61 percent, compared to 3.10 percent in WCIS.

The human development index trend reveals a substantial difference between CAS and WCIS. CAS countries experienced a lower average growth of 0.66 percent, indicating improvement in social development, with a peak of 0.72 percent in 2024. In contrast, the WCIS regions

had a higher average HDI of 0.75 percent, peaking at 0.81 percent in 2024. This high HDI rate reflects more stable improvement in social indicators than in the CAS region. Furthermore, government expenditures in both regions grew at almost the same average rates, with a 1% higher difference in the CAS region; however, the CAS region saw a significant increase in government expenditure after the global financial crisis of 2009. Population growth in CAS was relatively stable, with an average CAGR of 1.37 percent, while WCIS regions experienced a minor decline, with an average CAGR of -0.15 percent. When considering the labor force, both regions faced challenges. CAS had a moderate labor force CAGR of 1.40 percent, whereas the WCIS regions experienced a slight negative trend, with an average CAGR of -0.14 percent. Overall, the CAS regions show steady economic growth and moderate social progress, while WCIS experienced a slowdown in growth and social progress. However, there are significant differences in the absolute levels of GDP per capita between the two regions; one should keep this in mind (See Graph 1.1).

Absolute Convergence in CIS countries

We estimate unconditional β -convergence (unconditional Convergence) and sigma-convergence (income dispersion) for CIS countries as a bloc.

Convergence:

Absolute Convergence, a key concept in the

study of economic growth, suggests that poorer countries tend to grow faster than wealthier ones, ultimately leading to a convergence in per capita income levels across nations. We use a panel data regression model to examine the presence of absolute Convergence:

$$GR = \alpha_0 + \alpha_1 \log y_{i0} + \varepsilon_{it}$$

In this equation, GR represents the country's growth rate, $\log y_{i0}$ represents the initial GDP per capita income level, and ε_{it} is the error term. For absolute Convergence to hold, the coefficient α_1 , It must be significantly negative. A negative coefficient implies that countries with lower initial income levels experience higher growth rates, thus closing the gap with wealthier nations over time. For the panel data, we used fixed-effect estimation. The regression results, presented in Table No. 1.1, reveal that the coefficient of the initial level of GDP per capita is positive and statistically significant; this finding indicates no absolute convergence between WCIS and CAS during the study period. The lack of absolute Convergence between WCIS and CAS countries suggests that the steady-state level of income, or the long-run equilibrium level towards which economies converge, is not uniform across these nations. These results align with Barro's (1991) findings, which also showed an absence of absolute Convergence in a broader cross-country analysis. The scatter plot of GDP per capita of CAS and WCIS is given in Figure 1.2. The figure indicates a slight positive relationship between the rate of GDP growth and the initial GDP level.

Graph 1.1: Absolute convergence trend between CAS and WCIS

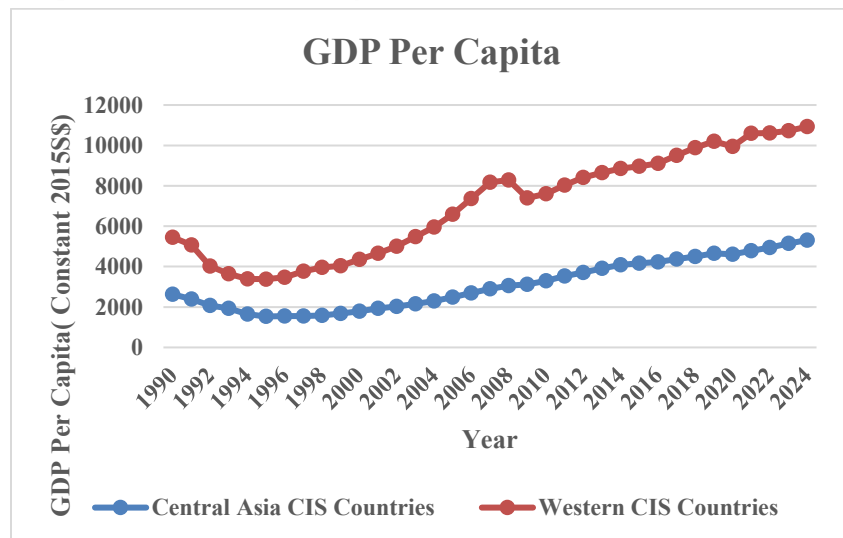
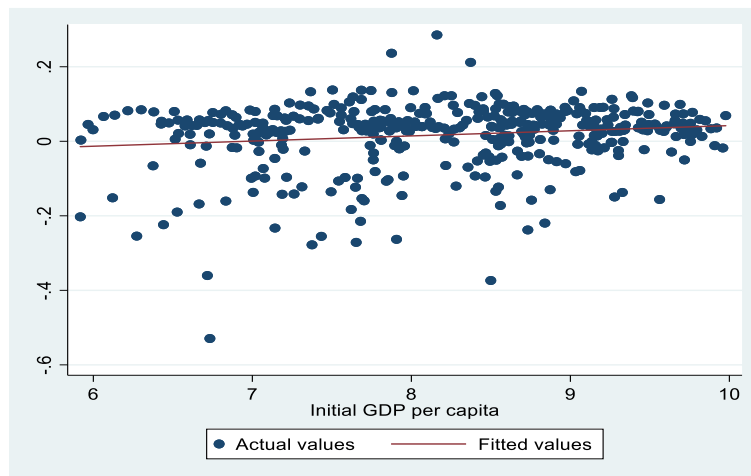


Table 1.1: Estimates of Convergence between CAS and WCIS

Dep var: Growth rate of PCGDP				
Ind Var: PCGDP	Coef.	Std. Err.	T	P> t
α_0	-0.31	0.08	-3.87	0.000
α_1	0.04***	0.01	4.19	0.000

Source: Estimated

Figure 1.2: Convergence between CAS and WCIS



σ (Sigma) Convergence

Sigma convergence, a closely related concept to absolute Convergence, focuses on the income dispersion across countries over time. While absolute Convergence examines the relationship between initial income levels and subsequent growth rates, sigma convergence examines whether the cross-sectional variance of income decreases over time. The literature has widely adopted Grier and Grier's (2007) and Streissler's (1979) linear regression approach to study sigma convergence. To evaluate the presence of sigma convergence, we employ a linear trend equation that takes the following form:

$$\sigma_{st} = \gamma_0 + \gamma_1 T + u_t$$

In this equation, σ_{st} The standard deviation of the logarithm of income across countries at time T measures the income dispersion¹. Table 1.2 presents the results of this analysis, reporting the

estimated coefficients and their corresponding t-statistics based on Newey-West heteroscedasticity- and autocorrelation-consistent standard errors.

The findings in Table 1.2 reveal that the coefficient, γ_1 , Which captures the time trend in income dispersion, is positive and statistically significant. This result provides strong evidence in support of sigma divergence between CAS and WCIS countries. The positive γ_1 Indicates that the dispersion of income, as measured by the standard deviation of the logarithm of income, has increased over the period under study. However, it is essential to note that sigma convergence is a necessary but insufficient condition for absolute Convergence. While sigma convergence indicates that income dispersion is decreasing over time, it does not necessarily imply that poorer countries are growing faster than richer ones. Figure 1.2 presents a graphical

¹ The intercept term, γ_0 , Captures the initial level of income dispersion. At the same time, the coefficient γ_1 presents the trend in dispersion over time: the error term, u_t , accounts for any unexplained variation in the dispersion measure. The critical parameter of interest in this regression is γ_1 , Which indicates the direction and

magnitude of the trend in income dispersion. A negative and statistically significant value of γ_1 provides evidence favouring sigma convergence, implying that income dispersion across countries decreases over time.

representation of sigma convergence, which initially showed an increasing trend but has declined since 2009. There is no sigma

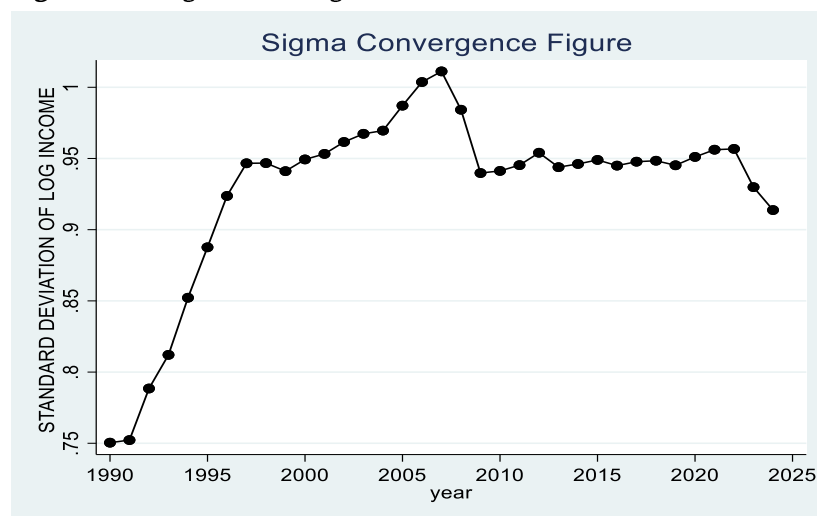
convergence between CAS and WCIS, which supports the earlier result of absolute Convergence.

Table 1.2: Sigma convergence between the CAS and WCIS

Dependent variable: Standard Deviation of PCGDP					
Variable	Coef.	Newey west Std. Err.	T	P> t	95% Conf.
γ_1	0.004	0.001	2.41	0.02	0.000
γ_0	-7.57***	3.55	-2.13	0.04	-14.81

Source: Estimated

Figure 1.2.: Sigma Convergence between CAS and WCIS



β (B-) Convergence within two Groups

Now, we will turn to the issue of Convergence within the two groups, CAS and WCIS countries. The estimated β - Convergence within the two groups shows, again, an absence of absolute

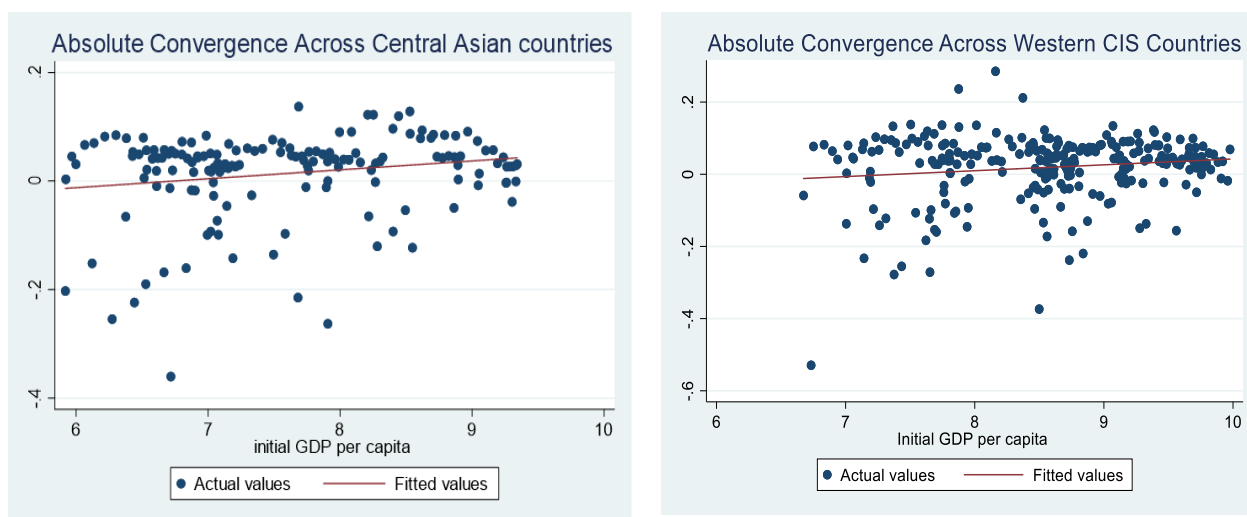
Convergence. Over 1990-2024, the β -coefficient is positive and statistically significant. (see Table 1.3). Figure 1.3. displays the scatter plot showing estimated GDP per capita in both regions. The figure indicates an important positive sign for both CAS and WCIS countries.

Table 1.3:- Convergence within CAS & WCIS

WCIS				
Variable	Coef.	Std. Err.	T	P> t
α_0	-0.34	0.11	-3.0	0.002
α_1	0.04	0.01	2.93	0.001
CAS				
α_0	-0.34	0.12	-2.8	0.006
α_1	0.04	0.1	2.93	0.004

Source: Estimated

Figure 1.3: Absolute Convergence: CAS and WCIS countries



Sigma Convergence Within the Groups

The estimates of Sigma convergence are given in Table 1.4. The estimates of the coefficient of γ_1 is positive and statistically significant, indicating the absence of sigma convergence within the CAS countries. However, the coefficient for WCIS is

negative but statistically not significant; therefore, sigma convergence did not hold within the WCIS countries either. This indicates that the income dispersion has increased across these countries over time.

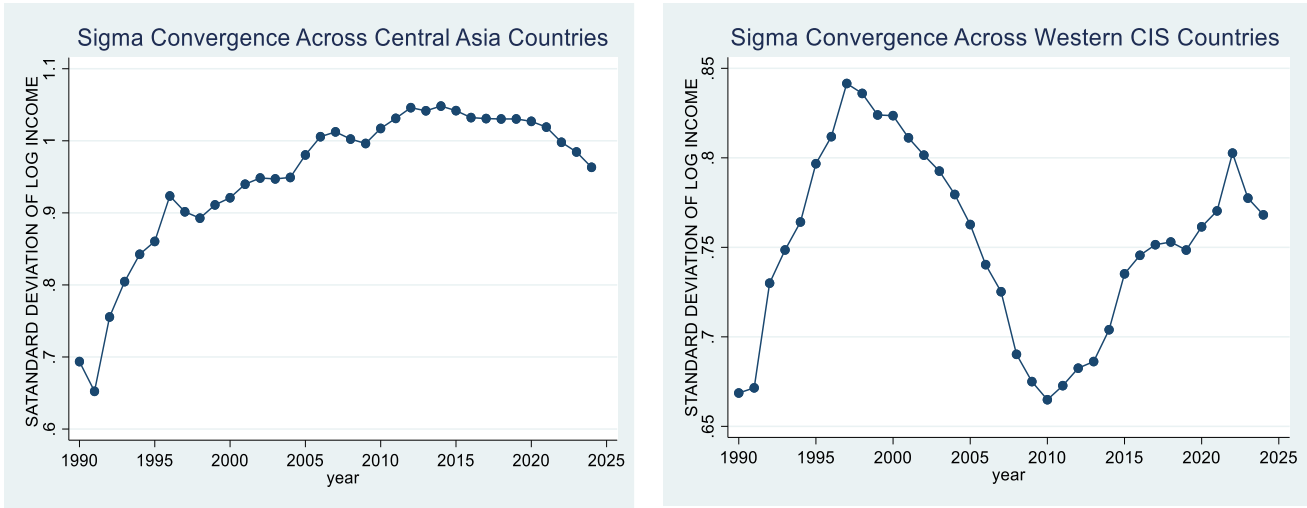
Table 1.4: Result of Sigma within the CAS and WCIS countries.

CAS				
Variable	Coef.	Newey west Std. Err.	T	P> t
γ_1	0.001	0.001	5.30	0.000
γ_0	-17.4	3.48	-5.0	0.000
WCIS				
γ_1	-0.00	0.001	-0.7	0.47
γ_0	2.66	2.67	1.00	0.32

Source: Estimated

The plot of estimated sigma convergence is given in Graph 1.4, which shows a continuous divergence in per capita GDP across CAS countries, more pronounced than in WCIS countries.

Figure 1.4. Sigma Convergence: CAS and WCIS (1990-2024)



Conditional β Convergence Between CAS and WCIS Regions

Now, we estimate the conditional Convergence between the two regions from 1990 to 2024. We use the Solow and extended Solow models of conditional Convergence, with fixed-effects estimation, developed by Bassanini, Scarpetta, and Hemmings (2001). We added additional variables to capture the effects of various factors on economic growth and the conditional convergence process. The GDP per capita growth rate, gross capital formation (investment), Trade, HDI, general government expenditure, labor force, and population growth are used. The specification of our estimated model is :

$$\begin{aligned} \log y_t - \log y_0 = & v_i \\ & - \beta_1 \log y_0 \\ & + \beta_2 \log S_k \\ & + \beta_3 \log X + \beta_4 \log H + \\ & \beta_5 \log G_c + \beta_6 \log l_f + \beta_7 \log P_g + \theta_t \end{aligned}$$

In this equation, S_k represents Investment gross capital formation, X is Trade, H is the human development index, G_c is General government consumption expenditure, l_f is labour force, and P_g is population. The direction of the coefficients for per capita GDP and population is expected to be negative, while those for trade, investment, and HDI are expected to be positive; while those for government expenditure and labour force could be ambiguous.

The Estimates of Conditional Convergence between CIS

The following are estimates of conditional Convergence among the CIS countries. As we found no evidence of unconditional Convergence in the previous exercise, we now find significant evidence of conditional Convergence, as shown in Table 1.5. The β -coefficient is negative and significant at the 1 percent significance level, indicating strong conditional Convergence. The Convergence is supported by investment, trade at a 1 percent significance level, and HDI and labor at a 10 percent significance level. Government expenditure and population had negative signs, which is entirely possible. Government expenditure has a significant negative relationship with per capita growth. The population coefficient has an expected negative relationship with per capita GDP growth and is significant at the 10 percent level. The overall model is statistically significant, shown by the p-value being less than the critical value.

Table 1.5: The conditional Convergence between CIS.

Independent variable:	Dependent variable: PCGDP growth rate
Ln PCGDP	-0.06*** -2.73
Ln Investment	0.06*** 6.02
Ln Trade	0.05*** 4.04
Ln HDI	0.19* 1.49
Ln Labour	0.19* 1.62
Ln Govt Expenditure	-0.09*** -5.19
Ln Population Growth	-0.16* -1.65
F-statistic	23.43
Prob > F	0.001

Source: Estimated

Conditional B- Convergence Between CAS and WCIS Countries

The findings in Table No. 1.6 indicate conditional Convergence among the CAS and WCIS countries. The β -coefficient is negative and significant, indicating condition convergence after controlling for investment, trade, HDI, labour force, government expenditure, and population

growth. Estimates indicate that all coefficients have the expected signs and are statistically significant. The F-test in fixed-effect estimation in the regression model assesses the overall significance of the model in explaining variation in the dependent variable. The estimated model is highly statistically significant.

Table 1.6: The conditional Convergence between CAS and WCIS.

Variable	CAS	WCIS
Ln GDPC	-0.11*** -2.95	-0.04* -1.47
Ln Investment	0.009* 0.73	0.07*** 5.76
Ln Trade	0.09* 0.86	0.03*** 1.97
Ln HDI	1.50*** 6.34	0.06* 0.47
Ln Labour	0.71*** 5.65	-0.32** -2.31
Ln Govt Expenditure	-0.08*** -4.47	-0.07*** -3.28
Ln Population Growth	-0.63*** -5.41	0.16* 1.33
F	23.43	18.55
Prob > F	0.002	0.001

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Source: Estimated

CONCLUSION

The question of economic growth convergence is important for countries. This paper is a contribution to estimating the Convergence in the Commonwealth of Independent States (CIS) of the former USSR. We looked at the issue between the two broad regions of Central Asian Countries and the Western CIS countries, which has been unaddressed so far in the empirical literature. The study estimated the standard Beta and Sigma convergence, as well as the conditional Convergence. The paper, based on its estimations, concludes that there is no evidence of β (absolute) Convergence between the two groups of countries, nor of sigma convergence within the two groups. However, there is statistically significant evidence for conditional Convergence between the two regions. The reasons are that the CAS group of countries has experienced higher per capita GDP growth, backed by increasing trade, investment, labour force, and Human Development Index, than their counterparts. The CAS countries also suffer the disadvantage of being landlocked. It makes a strong case for them to join the Belt and Road Initiative to boost trade. However, the large level effects still make unconditional Convergence distant.

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ABOUT THE AUTHORS

Mohammad Orfan Abdullah, email:

21seph06@uohyd.ac.in

Mohammad Orfan Abdullah is a Ph.D. Research Scholar at the School of Economics, University of Hyderabad, India.

Venkata Ramana Murthy Rupakula is a Senior Professor at the School of Economics, University of Hyderabad, India.