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DEMOGRAPHIC DIVIDEND IN CENTRAL ASIA

Doctoral dissertation

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Budapest, 2024

Table of Contents

List of Figures

List of Tables

Acknowledgments

My journey through the PhD program has been a mix of joys and challenges. I am immensely grateful for the unwavering support and guidance provided by my supervisor, Professor Berde Éva. Her encouragement, valuable advice, expertise, and adept research skills have been instrumental in overcoming obstacles and making this journey possible.

I express sincere gratitude to the Stipendium Hungarium Scholarship for affording me the chance to pursue and successfully complete my studies. A special thank you goes to Corvinus University of Budapest, including the professors and staff, the Doctoral School of Economics, Business, and Informatics, Head of doctoral school and program, who consistently offered assistance whenever needed. The Department of Economics, under the leadership of its head and the guidance of professors, played a crucial role in expanding my knowledge, and I am grateful for their contributions. The Doctoral Office was always supportive during these years that I am so grateful.

I reserve deep gratitude for my husband, whose unwavering support and patience have been my pillars of strength. To my beloved father, to whom I dedicate this thesis, your desire for your children's education and constant encouragement to pursue studies have left an enduring impact. Though you are not physically with us, you reside forever in my heart.

To my family—my loving mother, brother, and sister—your support and encouragement have been instrumental in bringing me to this point. I am profoundly thankful. And to my cherished son, your presence has given me the fortitude and resilience to navigate this journey.

Thank you to everyone who has played a part in my academic and personal journey. Your contributions are deeply appreciated.

1. Introduction

1.1. Importance of the topic

Over the past five decades, almost all countries of the world have undergone significant demographic transitions characterized by declining fertility and mortality rates. These transitions have had varying effects on economies, with developed countries facing aging populations, while less developed nations stand to benefit from demographic tailwinds, marked by an increasing share of the working-age population. The age structure, reflecting the relationship between the working-age population and dependents, is a robust indicator of future economic prospects (Gentile, 2007). In fact, the World Bank reported that in developed countries, human resources comprise 68% to 76% of total national wealth, highlighting their crucial role in economic development (World Bank, 2018b).

The period when the working-age population outnumbers dependents is commonly referred to as the "demographic window of opportunity" (Lee & Mason, 2010). This window signifies potential economic benefits that can be harnessed when a large proportion of the population is of working age, the so-called "demographic dividend" (Bloom et al., 2003; Bloom & Williamson, 1998), resulting in greater income generation than consumption (Gentile, 2007; Gribble & Bremner, 2012; Kelley & Schmidt, 2005).

It is important to define certain terms that will be used frequently throughout this thesis. Although these terms do not have universally accepted definitions, we will summarize how they are generally understood in the literature. The term "demographic dividend" typically refers to the economic growth potential that emerges when the share of the working-age population (typically defined as those aged 15 to 64) increases within the total population. As the share of the working-age population (WAP) grows, there is a corresponding decrease in the child dependency ratio (the ratio of people aged 0-14 to the working-age population) and the old-age dependency ratio (the ratio of people aged 65+ to the working-age population).

On the other hand, the term "demographic bonus" is generally broader than the demographic dividend, often highlighting the extra advantages of having a larger workforce. It suggests benefits such as higher economic productivity and an improved system of social security that can boost the economy.

During the demographic dividend, one can expect higher female labor force participation rates (Bloom et al., 2009), improved health and longevity, enhanced labor force productivity, and, in the optimal case, reduced poverty and inequality (Barros et al., 2000; Cruz & Ahmed, 2016; Kelley & Schmidt, 2005; Merrick, 2002). This may also lead to increased physical capital per worker expenditure (Mason et al., 2016), and greater investments in human capital—key components of the demographic dividend (Bloom & Williamson, 1998).

Central Asian countries, including Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, like many other parts of the world, are undergoing changes in their age distributions, with a rising proportion of their populations entering the working-age cohort. How these countries capitalize on this demographic shift, leverage their youthful populations, and navigate the accompanying socio-economic challenges will significantly shape their future trajectories.

This region, characterized by diverse cultures, ethnicities, and socio-economic contexts, is experiencing both the challenges and opportunities that come with changing population structures. "Despite having a similar demographic background for economic growth, these countries differ from each other by their level of socio-economic development. Kazakhstan has the largest area and the least population density, accounting for approximately 51% of the total regional GDP, most of which the country receives from oil. Uzbekistan has the largest population, accounting for 45% of the total population of the region. Kyrgyzstan and Turkmenistan have almost the same population. However, Turkmenistan is a desert country with large energy reserves, especially natural gas, which accounts for 16% of the regional GDP. Kyrgyzstan, on the other hand, is a small mountainous country with few natural resources except water, hydropower, and some gold, which account for 5% of regional GDP. Tajikistan is similar to Kyrgyzstan in terms of resources and size but is even poorer and more isolated (Aytmagambetova, 2009)."[1]

The region's countries are not just blessed with natural resources but also have a favourable population age structure. The initial phase of the demographic dividend has commenced in each country, with a rise in the proportion of working-age individuals offering macroeconomic advantages. However, the demographic opportunity could turn into a negative factor for economic growth once these relatively large cohorts of the population retire from the labour market, even if this will happen only a few generations later. Experiences from other countries undergoing this transition suggest that this demographic bonus will not last

[1] The paragraph is based on Kurbanova (2022)

indefinitely. Rising life expectancies and declining fertility rates will eventually lead to aging challenges, causing these countries to converge quickly with European countries in terms of the share of older people. For instance, advanced economies took a longer length of time to transition into hyper-aged societies[2], with examples including Japan (11 years), Canada (14 years), the United States (16 years), France (29 years), Germany (37 years), and the United Kingdom (51 years) (Huang et al., 2019). In contrast, developing countries are undergoing these demographic shifts at an accelerated pace, as seen with the Republic of Korea and the People's Republic of China, which will become hyper-aged societies in just 10 years (Chu & Yeh, 2021).

Signs of aging have already become apparent in Central Asian countries. In 2020, the median age of the population in Central Asia was 27.6 years old (Worldometer, 2021), and this is expected to increase in the coming decades. Additionally, the emigration of younger generations accelerates the ageing process more rapidly (Bussolo et al., 2015). For example, Kazakhstan's age structure is about to enter a new phase of development. The structure of the dependency ratio will undergo a significant shift, with the child dependency ratio dropping from 79.2% to 62.2% and the old-age dependency ratio increasing from 20.8% in 2019 to 37.8% in 2050 (UNFPA, 2019).

Nevertheless, Central Asian countries can still benefit from the positive trends of the first demographic dividend. “Fertility rates are falling, and if these rates permanently approach the level of Japan, China, or the Republic of Korea in the distant future, the situation is expected to worsen. Due to the extremely low fertility rate and rising life expectancy in Japan, China, and Korea, the first demographic dividend's window of opportunity has closed”[3]. For instance, in Japan, economic growth almost stagnated from 1992 to 2012, with GDP growth of 0.22% due to the 20% increase in the elderly population (Jafrin et al., 2021). Therefore, addressing the challenges posed by an older population and slower economic growth due to a higher relative number of older individuals requires timely action during the demographic window of opportunity (UNFPA, 2019).

Looking at the experience of the East Asian countries (Hong Kong, Singapore, South Korea, and Thailand), one can see valuable lessons learned from the demographic dividend (Mason & Kinugasa, 2008). The demographic transition transpired from the 1950s to the 1970s and had a shorter duration compared to other regions. From 1965 to 1990, the GDP per capita

[2] The World Health Organization (WHO) classified societies as aging, aged, or hyper-aged if more than 7%, 14%, or 20% of the population is 65 years of age or older, respectively.
[3] This part is based on Berde and Kurbanova (2020)

of the East Asian countries rose by an average of 6.1% yearly (Eastwood & Lipton, 2011), with 1.37% to 1.87% attributed to changes in the age structure (Bloom & Williamson, 1998). Other estimates suggest that the demographic dividend contributed from 25% to 40% to overall growth in the so-called East Asian Tiger economies. South Korea, in particular, transformed its economic landscape during the demographic shift. In the early 1960s, Korea had low economic development, with a per capita income of around $100 and a population growth rate of 3% annually. This caused problems such as unemployment, job shortages, and widespread poverty, affecting nearly 40% of the population (Kim, 1991). During the demographic shift, the fertility rate declined to 2 children per woman in 1983, significantly below replacement level, and the labor force increased by 2.7%, accounting for roughly one-third of the economic growth (Bloom et al., 2003). Through proper economic planning, the country raised its per capita GDP to $33719 by 2022 (adjusted to constant 2015 price levels, US$ (World Bank, 2023)), which is more than 30 times higher than in 1960 (World Bank, 2023), and shifted from a poor agrarian country to an industrial high-income country (Lee & Lee, 2013).

However, if countries fail to harness this demographic opportunity and face challenges, the situation can worsen during the transition, potentially leading to fiscal problems for governments unable to meet older generations' obligations. This challenge is currently affecting the economies of Latin America and the Caribbean, where rapid population aging is occurring alongside insufficient preparations to ensure sustainable growth. Despite progress in gender equality, health, education, poverty reduction, increased GDP per capita, and the provision of basic services, high levels of inequality persist in the region. As the demographic dividend wanes in the context of rapidly aging populations, Latin America and the Caribbean are poised to confront budgetary and economic issues along with additional challenges, including heightened inequality, slower economic progress, and a faster pace of population aging (Turra & Fernandes, 2020).

Indeed, the process of demographic transition, along with its benefits, presents challenges. It may worsen the structural weakness of some regions, mainly Central Asia, where the unemployment rate is high, followed by the highest level of poverty (Jha & Dang, 2009). Particularly after the collapse of the Soviet Union, these countries went through a difficult path toward achieving independence and faced challenges and difficulties. The transition process of transforming socialist-oriented and centrally planned economic policies toward market-oriented policies has accelerated poverty (Jha & Dang, 2009; Keller & Heller, 2011), making it one of the poorest regions around the world. It is noteworthy to mention that a decade ago, one-third of the population in Central Asia was living at the absolute poverty level (Hayes, 2014).

Although rapid economic growth has lifted the majority of the population out of poverty in Central Asia, some countries in the region are still struggling to alleviate it (Khitakhunov, 2020a; Seitz, 2019). Among other Central Asian countries, only Kazakhstan has achieved a significant reduction in poverty after its independence; the extreme poverty rate ($1.90 a day) is almost zero. However, the country is vulnerable to economic shocks as it depends on commodity prices and loans from international organizations, which make progress in reducing poverty more challenging. In addition, the economies of Tajikistan, Kyrgyzstan, and Uzbekistan also largely depend on the recipients of remittances.

Thus, it is extremely important to know what socio-economic and demographic factors contribute to or hinder economic growth and poverty reduction in these countries, particularly during the demographic window of opportunity (Nansadiqa et al., 2019; Zhang, 2021). The concept of a demographic dividend seems reasonable and simple to comprehend at first. Additionally, the idea appears to be a perfect fit for development policy. Planning and harvesting a demographic dividend, however, based on target-oriented (political) acts is significantly more complex than it first appears. Moreover, contrary to what the basic idea might imply, the potentially significant variables for a demographic dividend are less susceptible and more complicated (Hilbig et al., 2022).

Despite the challenges associated with demographic transitions, Central Asian countries have a rare window of opportunity to achieve their long-term goal of becoming upper-middle-income nations. The region presents a unique backdrop to explore these complexities, and if successful, these economies could mirror the success stories of East Asian nations that capitalized on similar demographic windows of opportunity (IMF, 2018). Indeed, the region has favourable circumstances to translate today’s demographic realities into tomorrow’s economic prosperity.

While demographic changes in the former USSR's member states have been extensively covered in literature (Sidorenko, 2019), post-Soviet Central Asia has not received nearly as much attention. Several recent studies have explored fertility behaviour, productivity growth, and human capital (Isaeva et al., 2021; Nedoluzhko, 2021; Yormirzoev, 2021), with a focus on economic growth of Central Asian countries. However, the impact of changing age structures on economic growth, poverty, and inequality has been absent from studies conducted in the area.

Regardless of the importance of the topic, almost none of the literature on Central Asian demography has been appropriately examined especially with empirical rigour, and the region

is highly understudied in the literature. Thus, providing further information could be a very useful contribution.

Besides, we can contribute to the existing literature by expanding the geographical area of demographic dividend by including Central Asia. "This topic is well documented in the cases of East Asian, European, and African countries (Bloom & Williamson, 1998; Eastwood & Lipton, 2011; Kelley & Schmidt, 2005; Misra, 2015). Thus, our initial goal in the current research is to test whether this positive relationship is also valid in the case of Central Asia and provide the direction of policy implications to achieve maximum growth during this potential period.

Additionally, the effect of the governance effectiveness indicator during an age-structure transition has received less attention. Although there is a lot of literature mentioning the importance of its contribution to economic growth, work on an empirical estimation is still relatively rare, particularly regarding this area. Therefore, the second goal of this thesis is to present a more comprehensive economic growth, poverty, and inequality model that includes demographic, economic, human capital, and governance indicators at a regional level. By adding the governance effectiveness indicators, the paper provides a practical test of the hypothesis of whether governance factors matter for economic growth in Central Asia (Coppedge et al., 2021; Lindberg, 2015). Through analysis, we intend to investigate how the phenomenon known as "the demographic window of opportunity" plays out differently in Central Asian countries. Moreover, our aim is to discover what reasons lie behind the demographic dividend's differing results in these countries".[4]

To fill the research gap and achieve our objectives, in this thesis, we will examine the effects of the demographic window of opportunity in different directions: economic growth, poverty, and inequality. Initially, we will examine how the shifting demographic composition affects economic growth. The same phase of the first demographic dividend allows us to identify the main drivers of economic growth by examining data from the five Central Asian states in single panel estimation through appropriate methods.

The next direction of the research is to analyze the impact of the demographic transition on the reduction of poverty and inequality in Central Asia. Poverty in the context of ageing poses serious challenges. While the economies of all countries in the region are growing, the fight against poverty has stagnated. The central question revolves around whether this stagnation is attributed to the rising number of working-age individuals or if the region can

[4] This part is based on Berde and Kurbanova (2023).

harness this demographic change to effectively diminish poverty. Also, we will explore what challenges are hindering efforts to alleviate poverty and inequality.

Our thesis includes a published chapter in the “Post-Communist Economies”[5] journal.

The global COVID-19 pandemic during my PhD journey prompted an exploration of ageism in the regional context, particularly the worsening situation of the older generation. This led to a focus on ageism issues, closely connected to the demographic dividend and intergenerational relationships. The coexistence of a youthful demographic dividend and ageism raised questions about their interplay and potential impacts on socio-economic well-being in Central Asia. To explore further, we conducted research on intergenerational relationships in Central Asian countries, comparing ageism levels during critical times like the pandemic. Collaborating with a peer, our joint research resulted in the publication of our first article in the "Regional Science Policy & Practice"[6] journal. Subsequently, my interest extended to ageism in other Central Asian countries, leading to the preparation of our next article[7]. The findings of these ageism papers revealed its existence in Central Asia, primarily linked to financial problems.

Indeed, maximizing the benefits of the demographic window of opportunity helps to improve the overall well-being of people and, at the same time, their interactions with each other, especially with older people. This approach can help mitigate ageism issues and prepare societies for future ageing challenges. Working on ageism topics allows us to prove how the demographic dividend topic is crucial for Central Asia. Through our thesis, we will endeavor to identify potential policy interventions and societal strategies that could help Central Asian countries harness their demographic dividends more effectively while promoting intergenerational understanding and respect. By addressing ageism and optimizing the demographic dividend, these nations can aspire to inclusive and prosperous futures, fostering solidarity among generations.

[5] Berde, É., & Kurbanova, M. (2023). Does the demographic dividend with human capital development yield an economic dividend? Evidence from Central Asia. *Post-Communist Economies*, *35*(2), 154-178.
[6] Berde, É., Kovács, E., & Kurbanova, M. (2023). The two-sided paradox of ageism during the COVID-19 pandemic: The cases of Hungary, Tunisia and Uzbekistan. *Regional Science Policy & Practice*, *15*(3), 606-625.
[7] Kurbanova, M., & Berde, É. (2024). Intergenerational Interaction, Financial Well-Being, and Ageism in Kazakhstan During Covid Pandemic. Journal of Intergenerational Relationships, 1-17.

1.2. Research questions and hypotheses

As previously mentioned, the phenomenon of the "demographic dividend" manifests uniquely across countries, even those within the same geographical area or continent. This raises a crucial practical question: Can these countries, with diverse economic structures and ethnic compositions, effectively harness the benefits of the demographic dividend?

To unravel the complexities surrounding the impact of demographic dividends in Central Asia, this thesis poses several key research questions:

- How do shifts in population structures influence economic growth patterns in Central Asian countries?
- What role does demographic change play in shaping poverty reduction initiatives within the region?

These questions serve as guiding pillars for an in-depth exploration of the intricate relationships between demography, economics, and social dynamics. Consequently, the following hypotheses have been developed to address the research questions. A detailed description of the hypotheses provided in the fifth and sixth parts of the thesis.

For the first empirical part:

Hypothesis 1: The same demographic and economic variables that have influenced the first demographic dividend in other countries are also crucial in Central Asia.

Hypothesis 2: In the Central Asian countries where there are many contradictory economic forces, other variables like the level of democracy and the level of corruption also play a vital role in determining whether the first demographic dividend can exert its effect.

For the second empirical part:

Hypothesis 1: A higher share of the working-age population will lead to a reduction in poverty rates.

Hypothesis 2: An increasing share of the working-age individuals will initially reduce income inequality.

Hypothesis 3: Bribery will be positively correlated with higher poverty rates and income inequality.

Hypothesis 4: Poverty and inequality can be decreased with good governance.

These hypotheses are formulated to guide the empirical analysis, aiming to provide insights into the specific dynamics of demographic dividends in Central Asia. Through systematic examination, the thesis endeavours to contribute valuable knowledge that can inform policy interventions and strategic approaches for these countries, considering their unique economic and demographic landscapes.

1.3. Overview methodology of research

This research employs a comprehensive and multi-disciplinary methodology to address the identified research questions using data from international organizations. After providing a historical overview of Central Asian countries through graphs and tables since the dissolution of the Soviet Union, we employ econometric tools to analyse the situation in more detail. Utilizing a panel fixed-effects model with Driscoll-Kraay-corrected robust standard errors, the study seeks to provide a nuanced understanding of the intricate relationships between demographic dividends, economic growth, poverty reduction, and inequality. The choice of method depends on the characteristics of the panel data.

Prior to selecting this econometric technique, several tests were conducted, including Hausman's (1978) specification test to determine whether fixed or random effects are appropriate for the estimation. Additionally, preliminary diagnostic checks were performed, such as Pesaran's (2004) CD test and Breusch-Pagan Lagrange Multiplier test for cross-sectional dependence, the Heteroscedasticity Modified Wald test for groupwise heteroskedasticity in fixed effect regression model, the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity, and Wooldridge's (2002) test for autocorrelation. Based on the test results and panel data features, the recommended method is the panel fixed-effects model with Driscoll-Kraay standard errors.

Driscoll and Kraay (1998) provide a non-parametric covariance matrix estimator that yields standard errors. This method has many advantages, such as being resistant to a variety of spatial and temporal dependency patterns, consistent with heteroskedasticity and autocorrelation, and effective in handling missing data. Unlike the original covariance matrix estimator of Driscoll and Kraay's (1998), the current tool deals with balanced and unbalanced panels. Additionally, it is appropriate for studies with a long time period and fewer countries,

aligning with the characteristics of our study, ultimately enhancing the precision of inference and improving the statistical validity of the estimates (Hoechle, 2007).

1.4. Contribution of the thesis to the existing body of knowledge

This thesis contributes to the existing knowledge base by illuminating the often-overlooked interplay between demographic dividends, economic growth, and poverty in Central Asia.

As highlighted earlier, despite the significance of the subject, the literature on Central Asian demography lacks thorough examination with empirical rigor, resulting in a considerable gap in scholarly understanding. Therefore, providing additional information on this topic is a valuable contribution in itself.

"Our empirical research has the following distinct features: First, we show that the macroeconomic effect of a changing age structure does not depend only on human capital and utilizing labour force capabilities, but also on institutional factors. Second, despite having similar demographic transition processes, the countries differ in terms of their capacities to harness the demographic dividend. Therefore, we show which factors are creating obstacles to attaining the demographic dividend in Central Asian countries by conducting a cross-country comparison. This allows us to understand the conspicuous causes of challenges in the area"[8].

Moreover, there is limited existing evidence exploring and elucidating the dynamic nexus between the demographic dividend, "good governance," and corruption and bribery in these emerging nations using panel data. The novelty of this study lies in integrating bribery into the research framework of the Poverty-Growth-Inequality triangle, considering the enhancement of good governance in realizing a demographic dividend. This expansion of the research scope in institutional economics introduces the Poverty-Growth-Inequality-Bribery quadrangle.

Finally, beyond delivering new insights into the viable factors that have capitalized on the demographic window of opportunity in Central Asian countries, this study can provide actionable insights for policymakers, researchers, and practitioners. The findings can be

[8] This part is based on Berde and Kurbanova (2023).

instrumental in shaping demographic policies within the region, fostering informed decision-making, and contributing to the overall socio-economic development of Central Asia.

1.5. Structure of the thesis

The thesis is organized into distinct sections to ensure a cohesive exploration of the research questions.

Chapter 1 of the thesis provides an overview of demographic transition, its impact on economic growth and poverty, and insights from well-managed countries. Additionally, it outlines the significance of the research, introduces research questions and hypotheses, and provides a brief overview of the methodology.

The next chapter covers a comprehensive review of existing theories, empirical studies, and key concepts related to demographic dividends, economic growth, and poverty. It establishes the conceptual framework for demographic dividends and identifies their components. The chapter also reviews relevant studies on demography and poverty, with a specific focus on identifying research gaps in Central Asian countries.

Chapter 3 offers preliminary insights into Central Asian countries, including their history, demographic trends, economic background, and development path. It compares the development levels of economic and human capital indicators, addressing the main challenges for each country separately.

Chapter 4 outlines the research methodology, detailing the nature of the data, the econometric methods, and the analytical tools used to evaluate the data. It also describes preliminary diagnostic tests, including the Hausman test for model specification, Cross-Sectional Dependence tests to check for interdependencies among cross-sections, tests for serial correlation, and tests for detecting heteroskedasticity. Based on the results of these tests, the selected methodology is thoroughly described. Additionally, the chapter explores alternative methods used to verify the reliability of the results.

Subsequent chapter focuses on the empirical analysis, examining the impact of demographic dividends on economic growth. The methodological framework, hypotheses, and data description are introduced. This is followed by the introduction of the estimated model, the results, and a discussion of these findings in light of previous research.

In Chapter 6, we examine the impact of the demographic dividend, with a specific focus on its relationship with poverty and inequality. The theoretical framework and hypothesis development are introduced, followed by the data description. We outline the model formulation and the chosen estimation strategy. After that, we provide the estimated model's outcomes and a detailed discussion. Also, the reliability of the results will be checked by alternative methods.

The final chapter is the conclusion, which involves a concise summary of the research discoveries and their theoretical and practical ramifications. It makes recommendations for policy, highlights the significance of the study, admits its shortcomings, and identifies possible directions for further investigation.

2. Literature review

2.1. Demographic transition and its stages

Numerous scholarly works have been written about the demographic transition. “One of the most cited, and probably the first example, is Thompson (1929), which provided a foundational definition of the demographic transition. Later, those ideas were used in Notestein's (1945) articles and subsequently reintroduced with some modifications by Kirk (1996). A shift in mortality and fertility rates from high to low is known as the demographic transition. As a result, the age distribution of the population changes, and life expectancy increases (Caldwell, 2006; Lee, 2003). This phenomenon can occur at different times for each country. Developed countries experienced it before the rest of the world, while in developing and low-income countries, this process began only in the second half of the twentieth century (Lee, 2003)”[9].

Typically, the demographic transition is elucidated using the Demographic Transition Model, a conceptual framework delineating historical and anticipated shifts in population patterns during the progression from pre-industrial to industrialized economic systems. Researchers frequently utilize this model to investigate economic and social policies within and across countries. It serves as a valuable tool for analysing a nation's current population dynamics across various stages. Theoretically, the demographic transition is divided into five stages, based on the interplay between birth and death rates (Cole, 2019; Notestein, 1945).

The initial stage, which is the so-called pre-industrial or “high stationary”[10] phase, is characterized by high birth and death rates, very low life expectancy, and very slow population growth due to illness, hunger, and war. The agricultural sector is dominant in society. The United States and Western European countries in the 1800s could be examples of this, but currently, no country belongs to this stage.

The "early expanding" level, which is the second stage, is distinguished by a falling death rate but still high birth rates that cause a large increase in the population. A fall in mortality, especially in infancy, is thanks to the development of sanitation and health care, which also caused a decline in diseases and increased average life expectancy. In addition,

[9] This part is based on Berde and Kurbanova (2023).
[10] This term was used by Blacker (1947)

agricultural methods and food supply have improved, and the transportation industry has progressed. Afghanistan and some of the sub-Saharan countries might be examples of this stage.

In stage three, birth rates decline gradually due to widespread access to contraception and urbanization. The quality of medical care has increased thanks to technological advances, which have decreased the death rate. Furthermore, women's advanced education and increased participation in the labour market influenced family size. And especially in developed countries, the cost of raising a child has become so high that it has caused a decrease in fertility (Popli, 2021). Population growth is starting to decrease. Most of the developing countries are in this stage.

Low birth and death rates are a defining feature of the fourth stage. As a result, society begins to age, and this poses a threat to some industries that are in need of a labor force. Countries at this stage have a better education system, healthcare, and a greater proportion of women engaged in earning activities. The United States, Iran, Turkey, and newly industrialized countries are currently in this stage.

The last stage is based on the fact that the fertility rate is falling further, and the share of older people is extending from the young population. In some countries, like Germany, Hungary, Japan, and Italy, the birth rate falls even below the replacement level and the total population shrinks.

The Demographic Transition Model, as discussed above, delineates stages based on fertility and mortality rates. Practically, the reason behind infant survival is medical and economic progress. Most of the time, the fall in the mortality rate is considered a twin transition to a decline in fertility and an increase in economic growth. However, some researchers reject the decrease in infant mortality from demographic transition stimulators. For instance, Barro and Becker (1989) as well as Becker and Barro (1988) standard models, Aksan and Chakraborty (2014), Clark and Cummins (2009, 2015), Doepke (2005), Fernandez-Villaverde (2001), and Galor (2012) theoretical research works are among them. Also, Caldwell (2006) highlights in his empirical study that it is impossible to explain declining fertility through mortality because theoretically its effects are unclear and contradictory practically. Mühlhoff (2022) showed that the effect of infant mortality on fertility is an implausible assumption by incorporating the life history theory and an endogenous growth model.

"On the other hand, there is evidence that the above-mentioned stages can affect economic growth through an inverted U-shaped relationship, and it is known as a demographic

U-hypothesis. The initial three stages contribute positively to economic growth as labor supply and savings increase continuously, creating a so-called window of opportunity; however, the last stages lead to an aging society through less labor supply and a decreasing saving rate (Mehmood et al., 2012). In some other literature, the relationship between fertility and economic growth is considered an algebraic relationship of a quadratic function, which means the initial effect of fertility reduction encourages economic growth, but later it reduces (Cai, 2010)"[11].

Throughout history, humans have observed structural transitions, which are characterized by shifting labor from agriculture to manufacturing and services, have had an impact on population transitions (Kuznets, 1957; Lewis, 1954). Scholars have extensively explored the impact of structural transformation on declines in both fertility and mortality rates (Chatterjee & Vogl, 2018; Greenwood & Seshadri, 2002; Lucas Jr, 2018). On the other hand, there is little empirical support for the vice-versa scenario (Barham et al., 2022). Due to medical technologies, birth rates are falling, and this process is faster than it has happened in industrialized countries (Delventhal et al., 2021). Moreover, a demographic transition may outpace structural transformation. Thus, understanding its impact on economic growth is crucial, which we will highlight in the coming section.

Furthermore, demographic transition plays a relevant role in magnifying international migration flows. The world is experiencing enormous migration flows from less developing countries to developed countries, which are linked to an increasing working-age population in source countries and a decline in host countries (Martin, 2009).

An intriguing aspect lies in the demographic transition of Central Asia, which unfolds uniquely due to its historical ties to the Soviet Union and subsequent transition to independent states. These distinct circumstances have shaped demographic shifts in Central Asia and influenced its economic development. We will provide further information regarding this in the following section.

2.2. Demographic dividend

Empirical evidence on the impact of demographic transitions on the economy presents a mixed picture. For instance, "several studies have argued that population change can magnify, reduce, or not affect economic growth at all. Classical economics claims that population growth negatively impacts per capita income due to capital dilution, which is known as a pessimist

[11] The part is based on Kurbanova (2022)

view (Ahituv, 2001; Ahmed & Ahmad, 2016; Birdsall, 1988; Brander & Dowrick, 1994; Ehrlich & Lui, 1997; Herzer et al., 2012; Hirchman, 1958; Kelley & Schmidt, 1994; Li & Zhang, 2007). On the other hand, optimists believe that population growth can accelerate economic growth (Boserup, 1981; Darrat & Al-Yousif, 1999; Kuznets, 1967; Ogunleye et al., 2018; Peter & Bakari, 2018), while neutralists opine that economic growth is independent of population size (Kapuria-Foreman, 1995; Kelley & Schmidt, 1994). Furthermore, a revisionist perspective posits that population growth has a detrimental impact on economic growth. This could be due to a lack of favourable economic policies and governance effectiveness, an unequal distribution of resources, a high level of corruption, or the low social and economic status of women (Merrick, 2002; Todaro & Smith, 2006)"[12].

Children born in the early stages of demographic transition eventually join the labor force. When the growth rate of the labor force surpasses that of the dependent population, it becomes feasible to allocate more resources to economic development. As a consequence, it may result in rapid economic growth, which has been highlighted in empirical studies. "For instance, Bloom and Williamson (1998) showed that as a result of shifts in fertility and mortality, the age structure changes, which can accelerate economic growth. This phenomenon is known as a "demographic dividend", and it occurs when the number of working-age people increases faster than the number of dependents. This process accelerates economic growth by increasing per capita output (Bloom et al., 2001; Mason, 2001)"[13].

Demographic dividends often come with the terms "demographic gift" or "window of opportunity". The time period of occurrence of the window of opportunity is defined differently by various researchers based on the total dependency ratio[14] (Ogawa et al., 2021). For example, Cheung et al. (2004) highlighted that when the dependency ratio is less than 0.5, then the country will be in a stage of demographic bonus. Similarly, Komine and Kabe (2009) also proposed the criterion that when the dependency ratio is continuously falling with the passage of time, the country is experiencing a demographic bonus. In contrast, Golini (2004) uses a somewhat different definition of the overall reliance ratio[15] and for those in the demographic bonus stage, this ratio should be below 0.66. Additionally, the United Nations defines the period for the "demographic window" for countries. This stage occurs when the proportion of the

[12] This part is based on Berde and Kurbanova (2023).
[13] The same
[14] Note: the age dependency ratio is defined as: [(those aged 0–14) + (those aged 65+)]/(those aged 15–64)
[15] Note: the age dependency ratio is defined as: [(those aged 0–14) + (those aged 60+)]/(those aged 15–59)

population aged under 15 years old is below 30% and people aged 65 and over are below 15% (UN, 2004).

In the next chapter, we will employ these methodologies to pinpoint the time frame of the demographic bonus in Central Asian countries. However, Ogawa et al. (2021) argue that traditional total dependency ratios and their variations, which treat all individuals equally regardless of age, are relatively imprecise indicators for measuring how age-related structural shifts impact economic growth. It was proposed to employ the National Transfer Accounts (NTA) system database to determine the "first demographic dividend" more accurately as opposed to the "demographic bonus". Unfortunately, due to the unavailability of NTA data for Central Asian countries, we are unable to adopt this proposed method.

Looking back to history, during the 1950s and 1960s in several East Asian countries, the total fertility rate fell and there were fewer dependents, resulting in unprecedented economic growth. For instance, per capita gross domestic product increased nearly 2,200 percent in the Republic of Korea, and 970 percent growth was observed in Thailand's GDP from 1950 to 2008. Currently, about 60 countries are experiencing demographic shifts, which creates a window of opportunity to reap economic growth if the right social and economic policies are applied (UNFPA, 2020). Central Asian countries are also among those countries that require investigation in order to implement precise actions.

There have been numerous empirical studies that have investigated the link between population age structure and economic growth. Following the pioneering work of Bloom and Williamson (1998), the empirical studies in this area became relatively wide. It is noteworthy that the majority of these studies support the claim that there is a positive effect of an increasing working-age share of the population on economic growth (Eastwood & Lipton, 2011; Kelley & Schmidt, 2005; Misra, 2015). In the section that follows, a comprehensive list of researchers studying how the demographic dividend affects economic growth will be provided.

2.2.1. First and second demographic dividends

First demographic dividend. "The process of impacting the demographic transition on economic growth is related to the first and second "demographic dividend" (Lee & Mason, 2006). The first demographic dividend (DD) is used when the share of the working-age population (which covers people aged 15 to 64) is increasing in the total population and, as a result, production exceeds consumption. An increase in the working-age population (WAP)

results in a decrease in child dependency (the ratio of people aged 0-14 and the working-age population) and the old-age dependency ratios (the ratio of people aged 65+ and the working-age population), which is considered a transitory bonus (Abío et al., 2017)"[16]. More precisely, the demographic change is a period in each country when fertility and mortality rates fall from high to low levels. However, the speed and duration of this period vary across countries (Ogawa et al., 2021). "Countries with the greatest demographic opportunity for development are those entering a period in which the working-age population has good health, access to quality education, decent opportunities for employment, and a lower proportion of young dependents (Bloom & Canning, 2004; Bloom et al., 2004).

Second demographic dividend. The second demographic dividend provides a further source of growth for a country once the first demographic dividend has already been exploited, especially through effective demographic and economic policies. During the second demographic dividend period, fertility continues to decline but life expectancy increases, thus the working-age share of the population begins to decline. A smaller number of children per household generally leads to larger investments per child (Joshi & Schultz, 2007; Turbat, 2017), and family welfare provides more freedom for women to enter the formal workforce (Bailey, 2006), which later leads to increased income (Lee & Mason, 2006), higher labor supply per capita (Bloom et al., 2009), and more household savings for old age (UNFPA, Gupta, 2014). The latter is known as one of the components of the so-called second demographic dividend (Cruz & Ahmed, 2018; Lee & Mason, 2006)"[17].

An increase in the saving behaviour of younger generations and the exploitation of assets accumulated by older adults lead to per capita income growth and, overall, a rise in the economy's saving rate (Mason & Lee, 2006). As the country has a high saving rate, it can be leveraged to raise investments per worker in both human and physical capital. As a result, the second demographic dividend leads to improved production growth and sustainable development, which have long-term advantages (Apella, 2021). Moreover, as a result of increased longevity, seniors tend to live longer and are healthier, which allows them to work longer than the usual retirement age, raising the number of people in the labor force and, in turn, reducing the demographic load of older people (Sidorenko, 2019). According to the European Commission et al. (2018), another possibility of benefiting from an aging society is

[16] This part is based on Berde and Kurbanova (2020)
[17] The same

to focus on the so-called “silver economy”, which produces goods and services for an increasing segment of older people.

The country will experience an aging issue and see fewer economic advantages if the second demographic dividend is not effectively handled and the proportion of the working-age population begins to decline (Lee et al., 2009). In countries experiencing the second demographic dividend, efforts must be made to address the situation where the share of the working-age population decreases. This is crucial to prevent the risk of the country stagnating in a middle-income trap equilibrium due to demographic dynamics (Apella, 2021).

In a nutshell, the first demographic dividend influences the availability of workers, creating circumstances that encourage economic growth during the demographic bonus era. On the other hand, the economy's ability to save and invest money, build up physical and human capital, and increase overall factor productivity are all indirectly impacted by the second demographic dividend (Apella, 2021).

Policy implications also differ at each demographic dividend stage. For instance, in the first demographic dividend, economic policies should be focused on expanding demand for labor, while in the second dividend, economic policies should be directed to expanding savings (e.g., pensions, financial markets) (World Bank, 2019).

2.2.2. Typology of demographic dividend

In 2016, the World Bank (World Bank & International Monetary Fund, 2016) and various scholars (Ahmed, Cruz, Quillan, et al., 2016) categorized countries based on their demographic characteristics, specifically the share of the working-age population and the fertility rate, with a focus on the first and second demographic dividends (Lee & Mason, 2006). This typology captures the ability of countries to harness the demographic dividend. And the world can be split into four sorts of countries based on this typology.

- Pre-dividend countries. When the fertility rates are more or equal to four babies per woman, then these countries have not yet entered the first demographic dividend stage. They still experience high population growth and a high child dependency ratio, and their human development indicators are low. Low-income countries are in this stage. When the current babies reach working age, then these countries can experience the first demographic dividend.

- Early-dividend countries. The fertility rate falls below four births per woman, and the share of the working-age population starts to increase slowly. The opportunity for the first demographic dividend has recently happened or will occur in the near future following a reduction in youth population share. Lower-middle-income countries are experiencing a current demographic shift where they have to focus on capturing the emerging demographic dividend.
- Late-dividend countries. Even though fertility rates are normally higher than replacement levels (2.1 children per woman), they are on the decline. Their overall age structures are still advantageous for the first demographic dividend despite decreasing working-age individuals' proportions. Due to their rapid ageing, these countries are about to enter the final phase of the demographic transition, so reaping the second demographic dividend is needed. Currently, upper-middle countries are in this stage.
- Post-dividend countries. The fertility rate is below the replacement rate, and the share of the working-age population is continuously declining while the share of older people is increasing. They have passed the first demographic dividend but still have some chance to benefit from the second demographic dividend through savings and investment.

In order to benefit the existing demographic transition at each step, different policy actions are needed (World Bank, 2019). In Table 1, we highlight the characteristics of each step and summarize the main policy priorities to guide countries in maximizing their demographic dividends.

Table 1: The main characteristics and policy action of each demographic transition step

	Pre-dividend countries	Early-dividend countries	Late-dividend countries	Post-dividend countries
Main characteristics	TFR≥4	TFR<4	TFR≥2.1	TFR<2.1
Policy actions	triggering the demographic shift: enhancing human development that creates a favorable age structure with fewer children and a larger working-age population	Job creation: to harness the first demographic dividend, the creation of jobs is required for the increasing working-age population.	Sustainable productivity growth: creating an enabling environment to benefit from the second demographic dividend and starting to plan for aging	Adjusting for ageing: adapting the welfare state for an ageing society*
Countries in this stage	Low-income countries	lower-middle-income countries	upper-middle countries	Most of the industrialized countries

Source: own research

*A recent study by demographic researchers (Ogawa et al., 2021) argues that ageing countries can still benefit from demographic transition through an increasing retirement age, which can cope with the shortage of human capital. This stage leads to what is termed the "silver demographic dividend" or the "third demographic dividend", where the unrealized potential of healthy seniors will be utilized through employment.

2.3. Economic growth and demographic dividend

2.3.1. Mathematical modelling of the demographic dividend

Over time, academics have developed a methodical evaluation of the demographic dividend based on the concept of the first and second dividends, mainly relies on a country's demographic transition stage. This chapter provides a comprehensive overview of several approaches and strategies employed in this context. While various approaches exist, this chapter specifically highlights commonly used methods that assess how changes in population age structure influence the increase in per capita income.

The relationship between the working-age structure and economic growth is represented as follows (Bloom et al., 2007; Bloom & Williamson, 1998).

$$\frac{Y_t}{N_t} = \frac{Y_t}{WAP_t}\frac{WAP_t}{N_t} \quad (1)$$

Where Y – income, N – total population, and WAP – number of working age population; respectively, $\frac{Y_t}{N_t}$ denotes income per capita, $\frac{Y_t}{WAP_t}$ output per worker, or labor productivity, $\frac{WAP_t}{N_t}$ support ratio.

To further analyse these relationships, we take the logarithm of the equation (1), which can be expressed as follows:

$\log\left(\frac{Y_t}{N_t}\right) = \log\left(\frac{Y_t}{WAP_t}\right) + \log\left(\frac{WAP_t}{N_t}\right)$ this can be rewritten as follows: y=z+w – growth rate of income per capita.

The steady-state level of income per capita can be expressed as follows:

$$y^* = z^* + w \quad (2)$$

Where, z^* - the steady-state level of income per working-age population, which could be indicated as $z^* = \beta x$, where x – vector consists of a set of variables that determine steady-state income per working age population.

Then, the equation (2) can be rewritten as: $y^* = \beta x + w$ (3)

As we know Barro and Sala-i-Martin's (2003) economic growth formula is based on that each nation experiences economic growth as it converges from its initial position to its steady state and is expressed as follows:

$$\Delta y = \lambda(y^* - y_{-1}) \quad (4)$$

If we apply equation (3) to equation (4), we will get:

$$\Delta y = \lambda(\beta x + w - y_{-1}) \quad (5)$$

Later on Bloom and Canning (2004) modified the equation (1) by adding the labor force participation rate. Thus, the new equation is as follows:

$$\frac{Y_t}{N_t} = \frac{Y_t}{L_t}\frac{WAP_t}{N_t}\frac{L_t}{WAP_t} \quad (6)$$

This means output per worker times the percentage of people who are working age to the total population times the participation rate adds up to income per capita. After taking the logarithm of the equation (6) and representing it in terms of growth, we have:

$$g_y = g_z + g_w + g_l \quad (7)$$

Where, g_y income per capita growth, g_z productivity growth per worker, g_w growth of share WAP, and g_l growth in labor force participation rate.

Supposing that labor force participation rate growth is constant ($g_{l=a_1}$) and X factors impact productivity growth per worker, that $g_z = a_2 + bf(X)$, and $a = a_1 + a_2$. Then we get the following equation:

$$g_y = a + bf(X) + g_w + \varepsilon \quad (8)$$

This refers to the demographic dividend term that which a rise in the working-age population shares results in GDP per capita growth when all other factors remain constant.

Cruz and Ahmed (2018) revised equation (8) by changing the share of the working-age population with the child-dependency (g_{CDR}) and aged-dependency ratios (g_{ADR}) in functional form (9). They claimed that using dependency ratios helps represent the dependant young and old population more symmetrically, as the total population is not used in the denominator.

$$g_y = a + bf(X) + g_{CDR} + g_{ADR} + \varepsilon \quad (9)$$

Several studies have attempted to estimate the effect of changing age structure on economic growth employing various methodologies grounded in the formulas described above. In recognition of potential endogeneity concerns, these studies have made efforts to mitigate such issues. A comprehensive review of these empirical studies will be presented in the following section.

Growth model: long-run Cobb–Douglas production function

In this section, we review various studies that have analyzed the effects of demographic transitions using the Cobb-Douglas production function as part of their theoretical framework (Crespo Cuaresma et al., 2014; Rizk, 2019). The empirical exercises will be detailed in the next session.

The classical Cobb-Douglas production function is given by the following:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{1-\alpha} \qquad (10)$$

Where Y –Total output or aggregate income (GDP); A – technological change or total factor productivity; K – capital stock; L – labor force or total labor input; t – time period; i – country index

Dividing equation (10) by the labor force, we get the output per worker or GDP per worker:

$$\frac{Y_{it}}{L_{it}} = A\left(\frac{K_{it}}{L_{it}}\right)^{\alpha} \Rightarrow y_{it} = A_{it} k_{it}^{\alpha} \qquad (11)$$

To capture equation (11) in growth rate, we get:

$$\Delta ln y_{it} = \Delta ln A_{it} + \alpha \Delta ln k_{it} \qquad (12)$$

Since in most growth regression, the income per capita is used instead of income per worker, thus considering the relationship between total population, labor force, and working-age population is needed. For this, we can use the following GDP per worker equation, where $\tilde{y}$ – output per capita (income per capita) and N denotes the total population:

$$y_{it} = \frac{Y_{it}}{L_{it}} = \frac{Y_{it}}{N_{it}} \frac{N_{it}}{L_{it}} = \tilde{y}_{it} \frac{N_{it}}{L_{it}} \qquad (13)$$

Combining equation (12) and (13), we get:

$$\Delta ln \tilde{y}_{it} = \Delta ln y_{it} + \Delta ln L_{it} - \Delta ln N_{it} = \Delta ln A_{it} + \alpha \Delta ln k_{it} + \Delta ln L_{it} - \Delta ln N_{it} \qquad (14)$$

The empirical application of equation (14) requires regressing the growth rate of income per capita on the growth rates of capital per worker, labor force growth, and population growth rate, considering that total factor productivity (TFP) growth remains constant throughout time. If changes in the labor force share have no effect on productivity and only influence income per capita through the accounting mechanism presented in equation (13), then the parameters associated with the labor force growth and population growth variables should equal 1 and −1, respectively.

If we suppose that due to the dynamics of technology adaptation, total factor productivity is dependent on the distance to the leading technology frontier the equation (14) will be:

$$\Delta ln\tilde{y}_{it} = \delta + \mu lny_{it-1} + \alpha \Delta lnk_{it} + \Delta lnL_{it} - \Delta lnN_{it} \qquad (15)$$

The equation (15) implies that total factor productivity growth is captured by parameter δ and it depends on the (lagged) income per worker of the country.

To make it more precise we will use the equation of GDP per worker, where WAP refers to working age population:

$$lny_{it} = ln\tilde{y}_{it} + ln\left(\frac{N_{it}}{WAP_{it}}\right) + ln\left(\frac{WAP_{it}}{L_{it}}\right) = ln\tilde{y}_{it} - ln\left(\frac{WAP_{it}}{N_{it}}\right) - ln\left(\frac{L_{it}}{WAP_{it}}\right) \qquad (16)$$

Combing equations (15) and (16) yields:

$$ln\tilde{y}_{it} = \delta + \mu ln\tilde{y}_{it-1} - \mu ln\left(\frac{WAP_{it-1}}{N_{it-1}}\right) - \mu ln\left(\frac{L_{it-1}}{WAP_{it-1}}\right) + \alpha \Delta lnk_{it} + \Delta lnL_{it} - \Delta lnN_{it} \quad (17)$$

According to this specification, in addition to the labor force and population growth rates, the share of the working-age and the participation rate should also be included in the economic growth model. If the parameter estimates for these two variables are of the same magnitude but opposite in sign to that of the baseline income level, it indicates that changes in the participation rate and the working-age share have an exclusive impact on economic development through the previously mentioned accounting channel.

Later on, the demographic researchers have realized that demographic dividends can be reaped if human capital is successfully accumulated. However, in the production function equation (10) human capital is missing, which is one of the crucial components for realizing demographic dividends. To address this gap, Crespo Cuaresma et al. (2014) expanded the equation (10) by adding human capital variables, following the theoretical framework proposed

by various scholars (Benhabib & Spiegel, 2002, 1994; Ding & Knight, 2009; Hall & Jones, 1999; Mankiw et al., 1992). They assumed that GDP per worker can be impacted by the human capital level, using education as a proxy for human capital. Thus, the modified version of equation (10) became:

$$Y_{it} = A_{it}K_{it}^{\alpha}H_{it}^{1-\alpha} \qquad (18)$$

Where $H_{it} = h_{it}L_{it}$ derived from human capital per worker - h_{it}

Human per worker is defined as $h_{it} = exp\theta s_{it}$, while θ – refers to returns to schooling and s_{it} – the average year of schooling of the labor force.

As we previously did, by dividing expression (18) by working age population, taking logs, and differencing it, we get the model for per worker form:

$$\Delta lny_{it} = \Delta lnA_{it} + \alpha\Delta lnk_{it} + (1-\alpha)\theta\Delta s_{it} \qquad (19)$$

Where y_{it} is GDP per worker and $k_{it}$is the physical capital perworker. Since we have equation (13), which considers the relationship between total population, labor force, and working-age population to capture the effect of demographic dividend, we can substitute it into equation (19). By doing so we can get the equation of GDP per capita with demographic dividend and human capital effect. Thus, our new form of equation is:

$$\Delta ln\tilde{y}_{it} = \Delta lnA_{it} + \alpha lnk_{it} + \Delta lnL_{it} - \Delta lnN_{it} + (1-\alpha)\theta\Delta s_{it} \qquad (20)$$

As previously, we assume that Total Factor Productivity depends on the distance of the global technology frontier, and it is given by:

$$\Delta ln\tilde{y}_{it} = \delta + \mu lny_{it-1} + \alpha\Delta lnk_{it} + (1-\alpha)\theta\Delta s_{it} - \Delta\ln N_{it} + \Delta lnL_{it} \qquad (21)$$

Where $\Delta lnA_{it} = \delta + \mu lny_{it-1}$, δ – is the secular trend parameter, $\mu$is the coefficient of initial GDP per worker. Usually, human capital, or as here we are considering average years of schooling (human capital) is accounted as a determinant of technology creation and adoration which impacts the growth of TFP (Benhabib & Spiegel, 1994, 2005). By considering this, besides the average years of schooling change (change in human capital), the education (human capital) level is added to capture the TFP growth (Crespo Cuaresma et al., 2014a).

$$\Delta lnA_{it} = \delta + \rho s_{it-1} + \mu ln\tilde{y}_{it-1} - \mu ln\frac{L_{it}}{W_{it}} - \mu ln\frac{W_{it}}{N_{it}} \qquad (22)$$

For getting the growth rate of GDP per capita, we substitute equation (22) into equation (20) for getting econometric specification:

$$\Delta ln\tilde{y}_{it} = \delta + \rho s_{it-1} + \mu ln\tilde{y}_{it} - \mu ln\frac{L_{it-1}}{WAP_{it-1}} - \mu ln\frac{WAP_{it-1}}{N_{it-1}} + \alpha\Delta lnk_{it} + \Delta lnL_{it} - \Delta lnN_{it} + (1-\alpha)\theta\Delta s_{it} \quad (23)$$

Where, $\Delta ln\tilde{y}_{it}$ - the growth rate of GDP per-capita, s_{it-1} - the lagged level of human capital and Δs_{it} - change in human capital, Δlnk_{it} - growth rate of physical capital per-worker, ΔlnN_{it} - growth rate of total population, ΔlnL_{it} - the growth rate of total labor force, $\frac{L_{it-1}}{WAP_{it-1}}$ - lagged labor force participation ratio, $\frac{WAP_{it}-1}{N_{it-1}}$ - lagged working-age population share of total population.

According to this model, GDP per capita for a given country or region i at time t is influenced by several factors. These include the growth rate of capital per worker, the growth rate of the labor force and population growth. Notably, a positive sign for the labor force growth rate and a negative sign for population growth suggest that changes in the labor force share affect income per capita only through the accounting mechanism, without influencing productivity.

To explore the effects of the demographic dividend, the model incorporates the share of the working-age population and the participation rate, whose parameters are of the same magnitude but opposite in sign to the initial income level. This implies that changes in the participation rate and working age share impact economic development exclusively through the accounting channel.

Human capital also significantly influences economic growth. The model includes the lagged level of human capital, with a coefficient ρ that reflects the impact of prior human capital levels—such as education and skills—on current economic growth. This highlights the delayed effects of investments in human capital on the economy. Additionally, economic growth is affected by changes in human capital, adjusted by coefficients (1-α) and θ, emphasizing the continuous influence of evolving human capital levels, such as improvements in education and workforce skillsets.

It is common to estimate the effect of demographic change, coupled with human capital, on economic growth by deriving a regression equation using the above-described model. We will review those empirical studies in the "Dimensions of demographic dividend" section.

2.3.2. Demographic-growth relationship in empirical studies

Growth in GDP per capita is positively correlated with the growing proportion of the working-age population, according to empirical estimates from various research studies

(Eastwood & Lipton, 2011; Kelley & Schmidt, 2005; Misra, 2015). These studies can be categorized into two groups: those that analyse this relationship on a regional and global level, and those that focus on a single-country case. In Table 2, we provide a summary of selected papers addressing this relationship through econometric models. The table is organized as follows: The first column lists the references for the papers; the second column contains the most important demographic variable in the model influencing GDP growth; the third column shows the level of GDP growth; and the last column contains the geographic area and time period for which the calculations were conducted (Berde & Kurbanova, 2020).

As Table 2 shows, the demographic transition has played an important and positive role in economic development, as evidenced by various studies (Bloom et al., 2010; Cruz & Ahmed, 2018; Lee & Mason, 2010a; Mason & Lee, 2007). However, the degree of success between national population dynamics and global economic growth has varied by country and has depended heavily on the demographic and economic policies implemented (Berde & Kurbanova, 2020).

Table 2: Impact of demographic shifts on development outcomes

Study	The main demographic variable in the model influencing GDP growth	Actual growth in GDP	Geographic area and time frame
Regional and global level			
Bloom and Williamson (1998)	the share of the working-age population	an increase of 1.4–2 percentage points in the GDP growth rate	East Asian countries (1965-1990 years)
Bloom and Canning (2004)	the share of the working-age population	an increase of 1.4 percentage points in income per capita growth	A panel of countries observed every 10 years over 1960–90
Kelley and Schmidt (2005)	youth dependency ratio	an increase of 20 percentage points in per capita output growth	South America, Europe, and Asian countries (1960-1995 years)
Kinugasa and Mason (2007)	the contribution of the first demographic dividend	explains between 9.2 and 15.5 percent of per capita economic growth over the	A wide sample of countries for the 1960–2000 period
Bloom and Finlay (2009)	A 1% higher growth rate of the labor force	is associated with an increase of 1.665% in the growth rate of GDP per capita	World (1965-2005 years)
Song (2013)	growth rates of working-age population	an increase of 1.26 percentage points in GDP per capita growth	13 Asian countries (1965-2009 with a 5-year interval)
Manyika et al. (2015)	the declining working-age population share	could reduce the global average income per capita by 20 percent	over 2015-65
Maliszewska et al. (2016)	the share of the working-age population	an increase of 0.5-0.8 percentage points in annual GDP per capita growth	In pre- and early-dividend countries over 2015–2030, given the right enabling conditions
Cruz and Ahmed (2016)	a 1 percentage point change in the working-age population share	- An increase of 1.5 percentage points in GDP per capita growth - An increase of 0.8 percentage points in the savings share of GDP - A reduce by 0.76 percentage points the poverty headcount	180 countries using five-year averages for the 1950-2010 period
Ahmed, Cruz, Go, et al. (2016)	the demographic dividend	could account for 11– 15% of gross domestic product (GDP) volume growth by 2030	for Sub-Saharan Africa as a whole for the 2011-2030 years
Cruz and Ahmed (2018)	the share of the working-age population	an increase of 1.6 percentage points in GDP per capita growth	180 countries (1950- 2010 years)

Ahmad and Khan (2019)	the share of the working-age population	Has a positive contribution to economic growth with varying magnitudes in different model specifications	67 developing counties (1960-2014 with a 5-year interval)
Jafrin et al. (2021)	1% increase in the share of the working-age population	improves the economic growth of the selected countries by 0.176%	five selected South Asia Association for Regional Cooperation (SAARC) countries for the 1990–2017 period
Apella (2021)	Support ratio	1.06% increase in GDP per capita	16 Latin American countries (1970-2014)
Country level			
Choudhry and Elhorst (2010)	Demographic variables: child dependency ratio, the growth differential between the working-age population and the total population, and old-age dependency ratio	The combined positive effect of demographic variables on annual GDP growth: In China 46%, In India 39% In Pakistan 25%	China, India and Pakistan (1963–2003)
Aiyar and Mody (2013)	The share of the working-age population	2 percentage points per annum to India's per capita GDP growth over the next two decades	22 states of India, with data at ten-year intervals from 1961 to 2001
Liu and Hu (2013)	decrease in the birth rate	The annual per capita GDP growth rate increased to 1.19	China provincial panel data (1983-2008)
	the increase in the share of the working-age population	The annual per capita GDP growth rate increased by 0.73	
Oliveira (2022)	The share of the working-age population	Positively correlated with GDP	Portugal regions (2001-2011)

Source: The author's collection from the cited papers

A wide range of empirical studies have used cross-section analysis to investigate the demographic-growth relationship. For instance, while investigating the panel data, Ahmad and Khan (2018) found that the share of the working-age population and also human capital development indicators have a beneficial impact on economic growth, although their magnitude differs across countries. Sánchez-Romero et al. (2018) analysed the contribution of demographic indicators to economic growth in the case of Western European countries for the 1850-2000 years. Using a model of overlapping generations with households that vary in their educational attainment, they found that 17% of the increase in per-capita income was due to the demographic shift. Similarly, Misra (2015), through analysing BRICS countries during 1990-2015, concluded that in these countries there is a positive relationship between GDP growth and demographic transition. However, the pace of ageing is faster in some countries.

Interestingly, the study of Butt et al. (2019) reveals that the share of the working-age population has an insignificant effect on GDP per capita growth after controlling for endogeneity in a sample of the ten most populated countries for the period 1960-2017. However, they concluded that the share of working-age individuals can be productive in cases where they are engaged in the labor market. It's worth noting that the study's outcomes might be influenced by the inclusion of countries like Japan and Russia, which are not in the demographic dividend stage but rather in an aging phase.

Single-country evidence has also been explored in prior studies. For example, the study by Jain and Goli (2022) assessed the potential demographic dividend of India from 2001 to 2061 by constructing a macro-simulation model. According to the study results, a window of opportunity opened during 2011-2041 in this country, and it can be reaped through the right demographic and socio-economic policies, such as investment in human capital and decent job opportunities. The study used two scenarios: the “demographic-emphasis scenario” and the “demographic-as-usual scenario”. Real GDP per capita would expand nine times between 2001 and 2061 under the Demographic-As-Usual Scenario, which assumes the same demographic environment as in the base year of 2001 and ongoing investment in socioeconomic programs. The Demographic-Emphasis Scenario says that the real GDP per capita would grow by 12.8 times between 2001 and 2061. This is based on the idea that the population will grow according to UN (2019) medium variation fertility projections and that the perfect social and economic conditions will be in place by that year. The study confirms that an additional value to GDP per capita could be added through the right policy implications.

Farid and Mostari (2022) focused on the case of Bangladesh, conducted similar research. According to their estimation, the window of demographic opportunity for Bangladesh is

available from 1984 to 2037. Their findings suggest that during this period, the country should effectively accumulate human capital, reduce gender disparities in education and employment, address unemployment, and increase savings.

Zobeiri (2021) examined the impact of demographic shifts on GDP per capita in resource-rich countries, using Iran as an example from 1978 to 2017. The results suggest that rising oil prices restrict the economy's capacity to efficiently consolidate young people's transition into the labor force. They explained that it may be caused by the "Dutch disease" effect, in which resource rents crowd out the more active manufacturing sector and leave young people with low-paying jobs or unemployment. In the same vein, Polyzos et al. (2022) analyzed how natural resources influence the relationship between the working-age population and economic growth by investigating 19 countries in the MENA (Middle East and North Africa) region from 1992 to 2014. They determined the threshold (16% of resource rents as a share of total GDP) of resource rent at which a unit addition of the working-age population has a negative impact on economic growth. The major factors contributing to the adverse impact of population change can be a decreasing labor force participation rate, inadequate private sector growth, and poor labor market policy, which, on the other hand, are challenges of the "Dutch disease".

The most recent studies also focus on the impact of COVID-19 on the demographic dividend. For instance, Alam and Tonny (2022) analysed the sudden shocks, such as COVID-19's impact, on the possibility of reaping the demographic dividend using the example of Bangladesh. The authors chose three main categories of youth: final-year tertiary students, recent graduates, and job seekers, and investigated how the pandemic impacted their potential employee sector. The results highlighted that the high level of depression due to COVID-19 caused being inactive in the job market, especially for recent graduates. In addition, most of the employees lost their jobs due to the coronavirus and are still struggling to get one. Thus, this situation creates great challenges for not accumulating the potential of youth and active age groups into economic growth, which is the crucial point of harnessing the demographic dividend. The abovementioned studies highlight that changes in age structure alone cannot ensure inclusive gains. In the next section, we will focus on the factors that contribute to stimulating the demographic dividend.

2.3.3. Dimensions of the demographic dividend

In fact, population change is a powerful developmental element that affects society in a number of ways. There are a wide range of mediators that convert this bonus into economic growth. Figure 1 outlines the key contributors to the demographic dividend as perceived from our standpoint.

Figure 1: Components of demographic dividend

Source: own research

Countries at a stage of demographic transition should establish a demographic dividend model capable of quantifying the impact of specific policy issues on the model's output. Researchers have incorporated several variables into their estimations to derive appropriate policy implications. It is very important that a "bridge" between the policy issue and that variable be "constructed" in order to comprehend how it might affect the demographic dividend. In particular, the government is responsible for implementing effective policies that provide the large and youthful population with quality healthcare, appropriate education, effective governance, and other economic possibilities that will significantly impact the nature of the dividend (Zaman & Sarker, 2021).

In Table 3, we compile studies that empirically demonstrate the essential nature of specific variables in accelerating economic growth amid demographic transitions through various channels. We categorize the variables into groups, including human capital, the labor market, women's empowerment, institutions, savings, migration, and environmental sustainability.

Table 3: Channels of Demographic Dividends Impacting Economic Growth: Representative Variables in Empirical Studies

Groups	Subgroups	Variables and the studies that used them
Human capital	Education	***Mean years of schooling*** (Bloom et al., 2021; Cohen & Soto, 2007; Cruz & Ahmed, 2018; de la Fuente & Doménech, 2006; Hanushek & Woessmann, 2012; Lutz et al., 2008)[18];
		Pre-primary education (Lomborg, 2018)
		Primary education (Lin, 2006; Luy & Köppen, 2018; Petrakis & Stamatakis, 2002);
		Post-primary education (Lutz et al., 2019)
		Secondary education (Babatunde & Adefabi, 2005; Bawazir et al., 2020; Bidisha et al., 2020; Dufrénot, 2018; Gebrehiwot, 2014; Mejía et al., 2008; Song, 2013);
		Tertiary education (Berde & Kurbanova, 2020; Butt et al., 2019; Choudhry & Elhorst, 2010; Pasara et al., 2020; Rizk, 2019; Zivengwa et al., 2013);
		PISA test score (Hanushek & Woessmann, 2012)[19]
		Literacy rate (Dufrénot, 2018; Iqbal et al., 2015; Joe et al., 2018)
		Education expenditure (Bawazir et al., 2020; Bidisha et al., 2020; Wako, 2012)
	Health	***Life expectancy*** (Aghion et al., 2011; Ahmad & Khan, 2018; Avcı & Çalışkan, 2022; Bloom et al., 2014; Bloom et al., 2004, 2021; Cervellati & Sunde, 2011; Osobase et al., 2021; Pasara et al., 2020)[20]
		Adult survival rates (Bloom et al., 2018; Mason & Kinugasa, 2008; Well, 2007)[21]
		Health expenditure (Atems, 2019; Chen et al., 2022; Dufrénot, 2018; Esen & Celik Kecili, 2022; Piabuo & Tieguhong, 2017; Qingyuan et al., 2020; Wu et al., 2021; Yang, 2020)
Labor market		***Labor force participation rate*** (Dufrénot, 2018; Kazbekova, 2018; Saleh & Yusuf, 2022; Sarker et al., 2016; Wako, 2012);
		Unemployment (Clydesdale, 2018; De Beer et al., 2011)
Women empowerment		***Female labor force participation rate*** (Dufrénot, 2018; Harkat & Driouchi, 2017);
		Women's education (Abu-Ghaida & Klasen, 2004; Angrisani et al., 2020; Klasen, 2002, 2018)
		Women's health: such as iodine supplementation and HPV vaccination (Bloom et al., 2015; Field et al., 2009)
		Women unemployment (Harkat & Driouchi, 2017)
Institutions		***Bureaucratic quality*** (Bloom, 2010)
		Quality of institutions (Song, 2013)
		Rule of law (Bawazir et al., 2020)
		Regulatory quality (Bawazir et al., 2020)

[18] Each additional year of schooling increase: the annual GDP per capita growth (ranges from 0.2 to 12.5%) by: 0.574 - 1.151% (de la Fuente & Doménech, 2006); 1.05 - 1.26% (Cohen & Soto, 2007), 0.2-12.5% (Lutz et al., 2008); personal income growth by 10% (Bloom et al., 2021).

[19] A 25-point improvement in PISA score rises annual GDP per capita growth by 0.5% (Hanushek & Woessmann, 2012)

[20] A 1-year increase in life expectancy increases per capita income (ranges from 1.9 to 15%) by: 5-15% (Bloom et al., 2014); 4% (Bloom et al., 2004); 2.88-9.46% (Aghion et al., 2011); 1.94-4.14% (Cervellati & Sunde, 2011);

[21] A 10% increase in adult survival rates raises labor productivity (ranges from 6.7 to 9.1%) by: 9.1% (Bloom et al., 2018); 6.7% (Well, 2007)

	Being under colony (Cruz & Ahmed, 2018)
Savings	***Gross savings*** (Aidi et al., 2016; Butt et al., 2019; Choudhry & Elhorst, 2010; Iqbal et al., 2015; Kim & Lee, 2008; Mehmood et al., 2012; Rizk, 2019)
Migration	***Net migration*** (Aidi et al., 2016; Ghassan et al., 2022; Jain & Goli, 2022; Luy & Köppen, 2018)
Environment	***CO_2 emissions*** (Hosan et al., 2022; Okijie & Effiong, 2021)

Source: Author's collection from the cited papers

Previous empirical studies have shown that the countries successfully capitalizing on the benefits of demographic window of opportunity have achieved this through several key factors. These include maintaining a proper level of education (Lutz et al., 2019), increasing the employment rate to absorb the capability of youth entering the labor market (Ahmad & Khan, 2019), improving the health care system (Crespo Cuaresma et al., 2014), establishing supportive policies and institutional environments for domestic entrepreneurs and encouraging foreign capital inflows (Eastwood & Lipton, 2011), and formulating and implementing state-led macroeconomic and social policies (Berde & Kurbanova, 2020; Groth et al., 2019). All of these contribute to development. Human capital development, in particular, is regarded as a crucial driver of both demographic dividends and economic growth.

"Undoubtedly, maximizing human capital increases the productivity assets of nations, enabling the labour force more flexible, and innovative, and more likely to create profitable and successful businesses (Bloom et al., 2021; Cummins, 2019; World Bank, 2018b; Young, 2019)"[22]. However, there are significant differences in investment in human capital between nations. Comparisons of school attendance rates and the highest grade attained by the working-age population reveal gaps that are easily seen. Moreover, when expanded indicators of human capital investments, such as test scores or health inputs and outcomes, are assessed, the gaps across nations are significantly wider than initially assumed. Children from poorer countries enter the labor market with less education and worse health compared to their counterparts in industrialized countries (Collin & Weil, 2020).

Investing in human capital is time-consuming. The study by Ahmad and Khan (2019) evidenced that accumulating human capital in the past affects economic growth in the current period. Young (2019), by analysing the case of Nigeria in 1970-2017, found that education impacts the demographic dividend through two channels: reducing fertility and increasing productivity. In the same vein, Apella (2021), through investigating 16 Latin American

[22] This part is based on Berde and Kurbanova (2023).

countries, concluded that the demographic shift could bring a bonus in the case of investment, not only in physical capital but in human capital as well, as it provides an opportunity to boost productivity in the medium and long term.

By doing further research in this area, Kotschy et al. (2020) noted that existing studies are unable to fully explore the connections between human capital and age structure because they are limited by a rigid structural framework. Thus, the authors reassessed the impact of age transition on development using an age-structured human capital endowment model in a sample of 159 countries during 1950-2015 based on. Their findings highlighted that human capital has a favourable impact on the demographic dividend if incorporated with an advantageous age structure. Thus, policy implications should be directly related to the relevance of education in order to avoid suboptimal results.

Looking at the experience of East Asian countries, we can observe that investing in human capital has made the potential of a demographic dividend a reality. An illustrative case is China, which, by implementing mandatory restrictions on having numerous children and prioritizing investments in human capital, likely accelerated its economic growth through the demographic dividend from 1980 to 2010 (Wei & Hao, 2010). However, there are a few pitfalls that China will face with challenges such as a shrinking share of the working-age population and ageing, which can pose serious challenges. Similarly, Korea, another rapidly ageing country, managed to make the benefits of its demographic window of opportunity more inclusive by investing in human capital. Kwack and Lee (2006) employed neoclassical growth models to examine the development of Korea between 1971 and 2002. They found that R&D and the development of human capital were two major drivers of the country's growth.

Obviously, one of the facilitators of human capital development is education. Without adequate education, a fall in fertility rates may cause the worsening social-economic condition of the country (Lutz et al., 2019). Empirical studies have consistently found that educational variables are always statistically significant and positively correlated with economic growth (Abío et al., 2017; Baerlocher et al., 2019; Bloom et al., 2001; Lee & Mason, 2010; Lutz et al., 2019). Different approaches are used as a measurement of education, such as, mean years of schooling, literacy rate, school enrollment rate, etc. However, the studies claim that returns on investment in education vary by stage. While reviewing the literature Psacharopoulos and Patrinos (2018), identified that investments in primary education often yield larger returns compared to secondary and tertiary education. Even in very low-income environments, investing in good pre-primary education generates a significant impact.

Health, another determinant of human capital, has been widely studied for its role in economic growth, coupled with the demographic dividend. Several variables have been used as proxies for health, with life expectancy being a commonly used metric (see Table 3). However, regression analyses have yielded contradicting results. While Hansen and Lønstrup (2015) found in their studies that life expectancy decreased the GDP per capita in the past 20th century, contrasting results were discovered in Osobase et al.'s (2021) study.

There is a direct link between human capital and the labor market. The study of Idrees et al. (2022) found by analysing selected provinces of Pakistan the ways of utilization of the working-age population. The results of regression analyses showed that labor force participation is significantly impacted by human capital formation and there is a high chance for skilled laborers to integrate into the labor market, which, in turn, increases socio-economic development. According to the study by Groth et al. (2019), it is suggested that an effective employment approach should be directed at youth before they enter the labor market with adequate skills.

Another group of researchers focuses on how to deploy women to sustain economic growth in the face of an increasing working-age population. One of the dominant drivers of the demographic dividend, as well as the economic growth of developed countries, is providing equal opportunities for self-improvement for both genders, whereas it is provided mostly for men in transition countries (Knowles et al., 2002).

In the literature, the nexus between the role of women and economic growth has been discussed from various perspectives, such as education, health, equal employment opportunities, and participation in decision-making processes. Using all the above-mentioned indicators in a single panel of data from developing countries between 1990-2017 Altuzarra et al. (2021) found that the gender gap in education hampers economic growth, while women´s participation in the political arena magnifies economic growth; however, there is no evidence of a significant nexus between the female–male ratio of labor force participation and growth. The same conclusion was made in the Cabeza-García et al. (2018) study. Dohmen and Yelubayeva (2019) studied the role of human capital (adult education), mainly disaggregated by gender, on the macroeconomic growth of European countries. They concluded that female human capital is a significant predictor of GDP per capita: thus, in the case of women being inactive in the labor market, the country will face a significant social loss. In addition, Fink and Peet (2016) detected that payoffs on investment for girls' education are larger than boys', and in addition, its spillover impact could be seen in reduced fertility and healthier families.

Cabeza-García et al. (2018) first introduced the term “inclusive economic growth”, which means that to advance a country’s growth and development, all individuals of active age should contribute without excluding anyone, particularly women. They found different factors related to women’s empowerment to explain economic growth. In the same vein, Khan (2016) investigated the contribution of female human capital to economic growth in Pakistan during the period from 1972 and 2012, applying the error correction method (ECM). The results suggest that although female human capital has minimal immediate effects on economic growth, its impact becomes more significant over a prolonged period. However, Sehravat and Giri (2017) found that female human capital has a significant and positive impact on economic growth in both the long and short terms in developing countries.

The Republic of Korea's development is a prominent example of both the social development repercussions with a gender component that may arise during the demographic transition and the significant correlation between economic growth and the demographic transition. Particularly, the rise in women’s labor force participation from 28% to 54% between 1960 and 2015 was a key factor in the country's significant economic growth (Hyeok, 2021). Subsequently, this indicator continued to show improvement.

“It is not surprising that the government must be socially responsible for fulfilling the needs of their population and establishing an enabling democratic environment for improving human development, gender equity, and employment opportunities (Emara & Chiu, 2016). Moreover, it is argued that the economic outcome of the demographic dividend depends on government policy (Mason, 2005). Without a complementary economic policy, it is hard to gain economic benefits from the increasing working-age population. Governments that came up with the best policies to exploit the first dividend decided to invest in infrastructure and promote the participation of the female labor force, all of which led to significant economic growth”[23]. According to Bloom et al. (2007), institutional and organizational improvements in the areas of healthcare, education, roads, and transportation are crucial for fostering human development, which can then be used to sustain higher economic growth.

The importance of institutions is highlighted in the majority of research in the field of demographic dividends. However, using variables as a governmental proxy in their empirical estimations is relatively thin. On the other hand, plenty of studies have investigated the relationship between economic development and effective governance (Chauvet & Collier, 2004; Emara & Chiu, 2016; Emara & Jhonsa, 2014; Mehanna et al., 2010). For instance,

[23] This part is based on Berde and Kurbanova (2023) and Berde and Kurbanova (2020).

Chauvet and Collier (2004) found that poor governance quality will lead to less economic development in developing countries.

There is a new direction of research regarding the link between digitization, demographic dividend, sustainable economic growth, and energy intensity. Analysing thirty emerging economies during 1995–2018, Hosan et al. (2022) found that demographic dividends, digitalization, and energy intensity could boost economic growth. According to their results, the authors suggested that utilizing technological innovation in the energy industry contributes to economic growth and, at the same time, helps realize the demographic dividend potential.

In the same direction, some researchers focused on how the change in age structure could affect the use of energy. For instance, families with a higher proportion of children or senior citizens use more energy than those with younger ones, which can influence environmental quality (Dalton et al., 2007; Yu et al., 2018; Zhang et al., 2018).

Unlike other empirical studies, Amornkitvikai et al. (2022) investigated the effect of changes in age structure on economic growth in an Asian sample during the period 1960–2020. They went beyond traditional variables by incorporating additional factors such as migration and CO2 emissions. The findings substantiate that a growing proportion of working-age individuals contribute positively to economic expansion. Furthermore, they discovered an inverted U-shaped correlation between economic growth and human capital. Also, their findings revealed a positive association between environmental degradation and economic growth, suggesting that countries should transition to low-carbon technologies to reduce CO2 emissions.

2.4. Central Asia countries in demographic dividend literature

It is notable that the demography of Central Asian countries is unique in terms of rapid population growth in the post-communist world, and this region remains poorly studied (Spoorenberg, 2017). Due to the lack of data spread over the years and the inaccuracy of some existing statistics, these countries have been neglected from analysis to date, whereas some other countries in Asia and developing countries have been described in a detailed way as we have seen in the previous sections (Ahmad & Khan, 2019; Bloom & Finlay, 2009; Ha & Lee, 2016). However, some literature has still emerged that has leaned on scarce demographic data, drawn from before and after the collapse of the Soviet Union (Berde & Kurbanova, 2023).

For instance, Sidorenko (2019) analysed how the demographic transition affects the national security of post-Soviet countries. In addition, according to demographic characteristics, he divided these countries into two groups: demographically “younger” or “in

the earlier stages of demographic transition" and demographically "older" or "in the later stages of demographic transition" countries, and all Central Asian countries are included in the first group. In the long and short terms, the increase in population and real GDP per capita have a positive and substantial link, according to Savaş (2008), who also discovered that Granger causality is bidirectional in Central Asia.

Other groups of researchers focused on single data points. Rakhmetova and Abenova (2013) divided Kazakhstan's demographic development into six stages for the last hundred years and identified the distinctive qualities of each stage in relation to the original nation. In addition, they conducted a correlation analysis to ascertain the causal linkages between the birth rate and several characteristics, such as population below the poverty rate, employed men, and men's salaries. The findings demonstrated that the average male salary and the rate of poverty have an impact on the birth rate. In the same vein, Rakhmetova and Kaliyeva (2022) clustered the regions of Kazakhstan according to their demographic development. Using multivariate statistical and mathematical methods, they divided cities into three clusters by total mortality, infant mortality, demographic load, proportion of triplets, nuptiality, and frequency of abortions. The results showed that all clusters except the last one will experience depopulation. Work by Zhankubayev et al. (2021) documented the sources of demographic decline in Kazakhstan, such as the high mortality rate of the male working-age population and infants. Therefore, they suggested that to achieve the demographic development goals, efforts needed to be made to not only promote fertility but also increase the general happiness and optimism of the population.

Analyzing the demographic stages of countries, Jasku\la (2019) reported that Uzbekistan and Kazakhstan are in between the 2nd and 3rd stages, which are defined by reduced death rates and considerable decline in birth rates. It indicates that the governments of the countries have already made important advancements in infrastructure for food and sanitation, healthcare, and education. However, the fertility rate is dropping in both nations, resulting in slower population growth projected until 2035. According to the outcome of the research, it is suggested to sustain the global economy in order to address the demographic challenges. On the other hand, Nyoni et al. (2021) attempted to predict the TFR of Turkmenistan for the period of 2019 - 30 using an Artificial Neural Network (ANN) approach. Their findings indicate that the country will still enjoy a medium-rate fertility rate (3.2-3.0) during the analysed period, and they recommended that policies be directed to enhance resources and slow population growth.

It is widely acknowledged that reaping the benefits of the first demographic dividend becomes challenging, if not impossible, without a sufficiently skilled young population

(Ustavshchikova, 2017). Gender inequality also poses a significant hurdle (Chen & Yip, 2018; Khitarishvili, 2016; Pignatti, 2020), as does the emigration of skilled workers from the country, a current issue for Central Asian nations (Ustavshchikova, 2017). If improved education is also a part of the demographic transition, Osotimehin and Director (2015) claim that it can increase per capita GDP in Eastern Europe and Central Asia. The same results can be found in Isaeva et al.'s (2021) research, which investigated the connection between economic progress, innovation, and the knowledge economy in Central Asia. The results revealed that human capital is one of the main contributors to GDP in the region. Therefore, investing in human capital is essential, especially considering the high share of youth in the region. The authors suggested promoting the popularization of science and information technology in schools and universities. In a related study, Yormirzoev (2021) analysed total productivity growth in Central Asian countries from 1990 to 2017 and the influence of the labour force on it. He pointed to the very important role of labour in the development of the region, except for Uzbekistan. He explained this difference by treating the labour force as a homogeneous unit. Ultimately, he came to the conclusion that a highly educated workforce is primarily responsible for economic growth in all of the region's countries (Berde & Kurbanova, 2023).

Focusing on the case of Tajikistan, O'Brien (2020) determined the consequences of the civil war (1992-1997) on gendered human capital and compared whether school-aged children in a period of transition to independence and war had a lower education level compared to their peers in the Soviet Union and after transition. The results suggest that an unpeaceful condition negatively affects educational attainment, with the boys' education being most affected.

Jia et al. (2021) investigated the relationship between economic growth, demography, and environmental sustainability in the region. Their findings revealed that CO2 emissions increased with rising economic output and population growth. In a similar vein, research by Batmunkh et al. (2022) showed how traditional agricultural technologies harm the environment (Berde & Kurbanova, 2023). The same direction of study has been explored in Chi et al.'s (2020) research, which examined the relationship between agricultural production (crops and livestock) and climate change and rapid demographic changes in Kyrgyzstan during 1990-2014 using the OLS technique. The results indicate that demographic factors, especially TFR, have a negative association with livestock production. However, strong linkages between socioeconomic, climatic, and demographic factors made it difficult to distinguish how each one contributed to changes in agricultural production. The study also highlighted that approximately one-third of the employable population in Kyrgyzstan emigrates, diminishing the local labor supply. This exodus could potentially be channelled to either increase agricultural production

or reduce the demand for agricultural labor. However, the infusion of remittances further complicated agricultural operations.

As we highlighted above, one of the main causes of demographic transition is migration. There is a wide range of research on this topic. For instance, according to Djoldasheva (2018), emigration from Central Asia was pushed by the region's rising working-age population share as well as high unemployment rates, particularly among the young. In addition, Morozova et al. (2021) found that the main causes of immigration are increased population, inappropriate economic growth and income, and unmatched job vacancies compared to the working-age population in Uzbekistan and Tajikistan. The same thoughts can be found in the Topolin (2000) studies, while Abduraxmanov (2020) mentioned the growing demographic pressure on the labor market.

Djoldosheva (2019) conducted a statistical analysis of population changes and the demographic dividend in the Kyrgyz Republic and the Russian Federation between 1950 and 2015. She mentioned that in both countries, the share of the working-age population increased during the analyzed period; in Russia, it started to decrease, but Kyrgyzstan is still enjoying a favourable age structure. However, due to the scarcity of employment opportunities, the number of labor immigrants from Kyrgyzstan to Russia increased so that both countries could benefit. On the other hand, emigrating educated and working-age people to Russia makes a particular economic contribution to the host nation. In the same vein, Nurzhanova et al. (2020) examined the role of demographic and migration processes on the labor potential of rural areas in Kazakhstan using linear trend models. The findings show that both domestic and international migration are to blame for the country's declining labor force, but practically speaking, village labor force productivity is unaffected. In addition, according to their estimation, the country will not experience a significant change in internal and external migration as well as the size of the urban and rural populations. However, from my point of view, the results could be different if was used an appropriate methodology.

Some other studies have also attempted to analyze the demographic transition of Central Asian countries, but some of their results are not convincing. For example, Bekturganova et al. (2022) analyzed the nexus between demographic transition and demographic dividend factors in Kazakhstan from 2007 to 2020. They developed four hypotheses based on rural and urban areas, and the results highlight that the death rate in the rural area and the fertility rate in the urban area have a significant impact on the working-age population. Moreover, the lower share of men in the working-age population in rural areas harms the labor force. In fact, the unemployment rate of men in rural areas remained unchanged over the years, while the

employment rate of urban men increased. On the other hand, the women's share of the working-age population does not affect the labor force. The authors explained these results by pointing out that most of the women are self-employed. The research findings could give better results with a longer time period and a more sophisticated empirical method.

A closer look at the literature on demography reveals a number of questions regarding the demographic dividend and its impact on economic growth that remain to be addressed. Furthermore, to the best of our knowledge, no earlier research has used empirical estimating to investigate the region as a whole. Thus, in our study, we aim to expand the scarce literature on the relationship between demography and economic growth, poverty, and inequality in Central Asia. We wish to show that, despite the problems affecting the labour market, there is a positive relationship between demographic transition and economic growth in Central Asia.

2.5. Poverty and demographic dividend

As we have discussed above, the demographic transition provides socio-economic opportunities as well as challenges (Bloom & Williamson, 1998; Gómez & De Cos, 2008; Navaneetham & Dharmalingam, 2012; Pool, 2004). Therefore, it is crucial to prioritize an understanding of demographic challenges. A significant challenge arises when an expanding labor force encounters a lack of job opportunities, potentially leading to increased poverty and inequality in society. "Inequality could be observed in a country at a stage of demographic transition, having different economic lifecycle schedules among various age groups (De La Croix & Doepke, 2003; Orbeta Jr, 2005). Consequently, for people living below the poverty line, it is difficult to get loans from formal lending centers to invest in their education and health. Moreover, parents' illiteracy makes it harder for their children to study in a better environment (Banerjee & Duflo, 2007; Khitakhunov, 2020b). This condition makes it difficult to harness the demographic dividend, as this opportunity could be beneficial in a condition of investing in human capital (Abrigo et al., 2016)"[24]. In addition, the demographic dividend requires an urgent need to escape the "poverty trap", as its consequences are quite challenging, especially for developing economies.

Narayana (2022) studied the nexus between inequality and the NTA-based First Demographic Dividend Model in India during the period of 2005-2050. The results showed that for the realization of the first demographic dividend, economic inequality plays an important

[24] This part is based on Kurbanova (2022)

role, especially income inequality, which has a greater impact on reducing the demographic dividend than consumption inequality. On the other hand, Andrianarison et al. (2022) pointed out in their research that, in order to harness the demographic dividend in Cameroon, inequality should be addressed and poverty reduced through structural transformation of the economy.

However, the demographic bonus might serve as a catalyst to reduce poverty. In this section, we will discuss in-depth the studies that focused on investigating the channels of the demographic dividend for reducing poverty.

2.5.1. Poverty-growth-inequality triangle

From the previous sections, it is clear that the demographic dividend has an encouraging effect on economic growth. Hence, growth is considered one of the main determinants of poverty, establishing a direct connection between poverty, economic growth, and demography. In the literature addressing poverty and growth, inequality is commonly intertwined with these factors, encapsulated in the well-known "poverty–growth–inequality triangle" (PGI). This phenomenon is often explored in research. The PGI was originally developed by Bourguignon (2003) and is based on the arithmetic relationship between poverty, growth, and inequality. The argument emphasizes that if growth and inequality reduction go hand in hand, poverty alleviation will happen more quickly (Wietzke, 2020). Additionally, a wide range of empirical studies could prove this point of view (Bluhm et al., 2018; Fosu, 2017; Kalwij & Verschoor, 2007; Kraay, 2006; Lopez & Servén, 2006). These publications yield comparable conclusions despite the diverse specifications employed to approach the relationship. The main factor in reducing poverty has been an increase in mean incomes, while decreased inequality has a significant role in the direct impact on poverty as well as the indirect impact on the growth elasticity of poverty reduction (Bergstrom, 2022). However, other groups of researchers argue that there is no link between increasing economic growth and reducing poverty (Deininger & Squire, 1998; Fosu, 2009), while others highlight that inequality is one of the main intermediation factors in the PGI triangle (Agyemang, 2014; Kalwij & Verschoor, 2007). To represent this relationship, various models have been utilized. One technique involves determining poverty separately for various Gini coefficients (Adams, 2004) so that a model incorporates the combination of growth with initial inequality (Easterly, 2001; Fosu, 2009). Other models to capture the elasticity of income and inequality apply the logarithmic form of income and the Gini coefficient (Fosu, 2010a, 2010b).

Recent studies have focused on the poverty–growth–inequality (PGI) triangle, examining it across diverse country groups. For instance, Bergstrom (2022) re-examined the role of income inequality in poverty reduction using data from 135 countries during 1974-2018. The results showed that a 1% decrease in inequality—as determined by the standard deviation of log income - causes a greater eradication of poverty than a 1% rise in mean income. The same results were obtained while forecasting headcount poverty from 2020 to 2030 under several speculative scenarios. Thus, they concluded that a decrease in inequality can be a significant factor in lowering future poverty, even though recent poverty reductions have largely been a result of economic growth. In addition, the author suggested adding an additional "Policy" channel to the "PGI triangle" that helps to create the most effective anti-poverty measures.

Lakner et al. (2022) also estimated how inequality and income affect poverty. Their results reveal that a 1% reduction in the Gini index will reduce poverty by 6.3% in 2030, and its impact is greater than the 1% annual increase in income growth.

Despite research efforts to predict outcomes, unforeseen events, such as the global pandemic that began in 2019, can disrupt expectations. Government measures aimed at safeguarding citizens during the pandemic have contributed to the deterioration of socio-economic conditions for the population. Scholars have explored the consequences of the pandemic, particularly its impact on increased inequality and poverty. For instance, Alfani (2022) highlighted that COVID might affect the poor negatively in two ways: by ruining their health and by causing them to suffer more immediate economic harm, like large salary reductions or unemployment.

Lakner et al. (2022) investigated the impact of COVID-19 on poverty and found out that the pandemic may have caused 60 million people to live in extreme poverty in 2020. Additionally, over 90 million people may have fallen into extreme poverty in 2020 if the epidemic had raised the Gini index by 2% globally.

2.5.2. Multiple dimensions of poverty

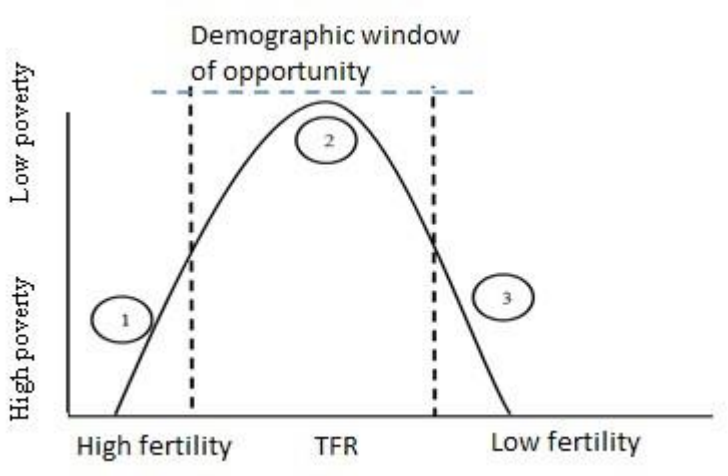
A variety of factors affect and complicate poverty dimensions. The most significant variables that could affect poverty will be highlighted in this part, with an emphasis on the interconnection between demographic changes and economic growth.

Theoretically, population, economic growth, poverty, and inequality are connected to each other in such a way that changes in one indicator affect others, as discussed in the previous section (Imimole, 2021). Malthusians believed that high fertility was one of the causes of

poverty. However, later on, a group of researchers found out that declining fertility follows an increase in the working-age population and leads to economic growth and poverty reduction (Cruz & Ahmed, 2018).

The link between fertility and poverty is the Kuznets-type effect, or the so-called inverted U-shape of the relationship. The impact of declining fertility on poverty through the growth channel is described in Figure 2. The initial step (1) of the relationship is characterized by high fertility, leading to low-income growth and a high rate of poverty, which is known as the "Malthusian trap". Later on, in the demographic transition stage, where birth rates start to decrease slowly, increasing the share of the working-age population leads to higher economic growth and reduces poverty (2). The next step indicates when the fertility rate falls below the replacement level (2.1 children per woman) and the population starts to age (3), which leads to a decreasing effect of fertility on poverty alleviation. It is evident in imperial estimation by having a significant positive coefficient for fertility and a negative coefficient for squared fertility (Wietzke, 2020).

Figure 2: The effect of fertility on poverty reduction



Source: based on Wietzke (2020), p.75

The nexus between demography and poverty is an old debate focusing on population growth: however, analyzing poverty by age structure is relatively new, and only a few studies have focused on this relationship so far (Ahmed, Cruz, Go, et al., 2016; Ahmed et al., 2014; Mason & Lee, 2004). "In the literature, it is suggested that there are several mechanisms by which demographic transition will lead to poverty alleviation. Initial findings show that there is a direct connection between perceptions of poverty and major economic factors (Gallie & Paugam, 2003; Sidorenko-Stephenson et al., 1999), especially the demographic dividend,

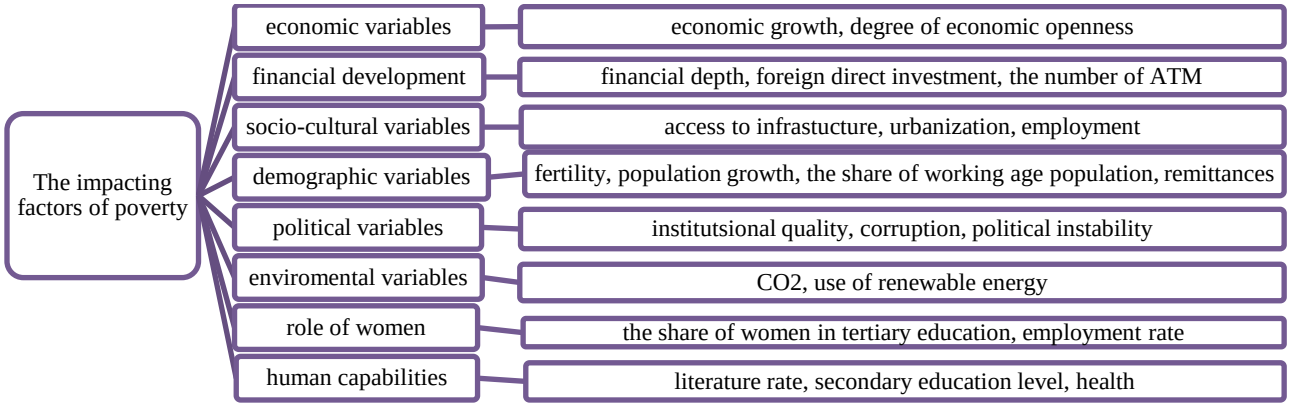
which is expected to improve the economy and alleviate poverty (Dollar et al., 2015; Dollar & Kraay, 2002; Kua & Piyachart, 2016). Moreover, as a result of the reduction of non-earning members, the consumption per capita of the household will decrease, which will cause a lower poverty rate (Cruz & Ahmed, 2018). The next steps related to the second demographic dividend are that demographic transition in a dimension of education reduces poverty, especially in a condition of lower fertility rates, where families invest more in children's education (Kua & Piyachart, 2016), and when females become more educated and have fewer children, they will be active in the job market (Bloom et al., 2009; Klepinger et al., 1999), which leads to more income-earners in the household and increased living standards. Moreover, increasing the number of workers will contribute more to the economy, and the government will devote additional resources to low-income families (Cruz & Ahmed, 2018)"[25].

Taking into account that poverty is a multidimensional approach, the "PGI triangle" was augmented by adding additional drivers of poverty reduction aside from the above-mentioned ones. They could be institutional, macroeconomic, household-specific, or environmental factors. The quality of human capital, population density, and unemployment are among the macroeconomic dimensions. Institutional factors, such as effective governance, corruption, the rule of law, and terrorism, play a pivotal role in translating economic growth into poverty reduction by addressing inequalities (Bourguignon, 2003; Klasen & Nowak-Lehmann, 2008; Ravallion, 2006). Household-specific drivers involve family size, education, and age, while environmental factors encompass carbon emissions, the use of renewable energy, and more.

In fact, the empirical literature on the link between poverty alleviation and its impact channels is very broad. Researchers have employed various indicators to their poverty estimators, such as economic variables (Dollar & Kraay, 2002), financial development variables (Dewi et al., 2018; Majid et al., 2019), sociocultural variables (Menezes-Filho & Vasconcellos, 2007; Muhammad et al., 2011; Ravallion, 2002), and demographic variables (Wietzke, 2020), All of these have been shown to help reduce poverty. Numerous other variables also contribute to poverty alleviation, though in Figure 3, we have highlighted one of the main factors based on our perspective.

[25] This part is based on Kurbanova (2022)

Figure 3: Factors influencing poverty



Source: Own research

Scholars have become interested in the causes of poverty and have identified that one of the key elements influencing it is economic-related indicators. Economic growth is considered among the major factors that has been discussed above. Moreover, economic openness is also related to poverty. It's interesting to note that opinions on trade openness and poverty vary throughout the literature. It is argued that due to the lack of good governance and widespread corruption in the region (Neaime & Gaysset, 2018), poor households are less likely to get benefits from trade (El Ghak, 2018).

Numerous authors have discussed the connection between financial development and poverty reduction in the literature. However, the results are controversial. Neaime and Gaysset (2018), for example, calculated how financial inclusion affected poverty and income disparity in a sample of eight MENA nations. Their empirical results highlight that financial inclusion has a positive effect on reducing income inequality but has no effect on alleviating poverty. Similar results could be found in Quinonez et al.'s (2018) study, which discovered foreign direct investment (FDI) is not strongly linked to the eradication of poverty in Latin America, while on the contrary, human capital development, macroeconomic stability, infrastructure, and financial development show significant impacts on poverty reduction. Their findings are in line with those of other scholars (Bharadwaj, 2014; Dhrifi et al., 2020; Jalilian & Weiss, 2002; Sarisoy & Selcuk, 2012). On the other hand, a group of researchers has found that FDI contributes positively to poverty reduction (Calvo & Hernandez, 2006; Fowowe & Shuaibu, 2014).

Poverty is strongly tied to many aspects of a person's life, despite the common assumption that it only refers to a lack of material resources. Reducing poverty is positively impacted by the urbanization process. Results support the claim of Chen et al. (2019) that increasing the share of the urban population decreases the poverty rate. Indeed, properly

managed urbanization can eradicate poverty and inequality by improving the quality of life, providing job opportunities, and improving access to health and education services (UN-Habitat, 2016). Interestingly, while investigating the factors behind youth poverty in Morocco, Yassine and Bakass (2022) found that access to a job can ensure a satisfactory level of well-being. However, they highlighted that urbanization matters for reducing poverty.

As discussed above, there is a strong link between poverty reduction and demography. Also, the large body of literature highlights the role of international migration and remittances. However, the empirical findings are controversial. The majority of the research came to the conclusion that there is a statistically significant and negative correlation between remittances and poverty. For instance, Adams Jr and Page (2005) found that when the share of remittances in a country's GDP rises by 10%, it results in a 1.6% decrease in the number of people living in poverty. Similar results could be found in a number of other studies (Azam, Shahbaz, et al., 2016; López Córdova, 2018; Taylor et al., 2005). On the other hand, remittances also increase inequality in the country (Adams Jr, 2011; Lubambu, 2014).

Political factors play a central role in explaining poverty. Thus, the majority of empirical studies could prove that the quality of institutions and complementary policies do matter for poverty alleviation through many channels (Duncan & Quang, 2003; Kakwani & Silber, 2008; Majeed, 2017; Mitra, 2016; Perera & Lee, 2013). Ullah and Majeed (2022) investigated the impacts of institutional quality on multidimensional poverty and human development in Pakistan's districts. The results confirm that institutional quality, tertiary education, and demographic factors influence multidimensional poverty, both directly and indirectly.

Tackling poverty may have negative consequences, such as harming the environment. Thus, another group of researchers investigated whether millions of people could be lifted out of poverty while controlling carbon emissions. For instance, Bruckner et al. (2022) investigated 116 countries' cases and found that moving more than a billion people out of poverty could cause only modest relative gains in global carbon emissions, of 1.6-2.1% or less. However, poverty reduction could cause double damage in sub-Saharan Africa's low- and lower-middle-income countries. Thus, the authors suggest that high-emitting countries should decrease their emissions for poverty eradication in order to exceed climate targets.

Investing in human capital is intricately tied to income per person, and the poor health and education of workers contribute significantly to the poverty of many nations, resulting in lower labor input (Alkire et al., 2017; Duclos et al., 2006). Therefore, Rashid et al. (2022)

analyzed the nexus between poverty alleviation and human capital, in particular, health, in the short and long run for Pakistan from 1985 to 2021. Their findings demonstrated that a rise in GDP per capita (taken as proxy of poverty), which in turn could have an impact on increased longevity and lower infant mortality, could reduce poverty. In addition, health indicators impact positively on education. However, from our point of view, considering only GDP per capita as a proxy of poverty reduction could be spurious, as it is a weak representative of poverty.

On the other hand, Collin and Weil (2020) investigated quantitatively how income and poverty dynamically responded to such increased investment in human capital. To do this, they examined different scenarios to see the role of human capital in poverty reduction. They compared a baseline scenario where investment in human capital remains unchanged with a "typical" scenario where the country experiences a growth rate in human capital investment. According to the findings, the usual scenario's worldwide poverty rate of $1.90 is 0.7 percentage points lower than the baseline scenarios. However, it was highlighted that the time dimension is crucial due to the extremely long reproductive cycles associated with the effects of increased human capital investment. Other imperial research has produced similar findings (Amar & Aimon, 2021; Li & Bai, 2022; Olopade et al., 2019). Bloom et al. (2021) also pointed out that investment in physical capital alone is not able to tackle poverty, while investment in human capital is more promising.

Women's empowerment needs to be a focus as a matter of urgency, as it is one of the dominant drivers of boosting economic growth, reducing poverty and inequality (Ngom, 2021). For example, Awan and Malik (2020) measured the effect of women's education on poverty in Pakistan, and the results showed there is a positive relationship between female education and poverty alleviation.

2.5.3. Poverty measurement

Usually, two approaches to measuring poverty are commonly used in empirical analysis: direct and indirect. The direct approach lies in the standard of living, such as having clean water or access to electricity. Income is considered an indirect approach, which is most commonly used to measure poverty (Jha & Dang, 2009; Kua & Piyachart, 2016). Traditionally, poverty is measured by the number of people living below the international poverty threshold. Indeed, internationally comparable estimates of poverty are provided by the World Bank, which uses a uniform standard to determine the extent of extreme poverty and sets a poverty threshold that

reflects the same real quality of living in each country to differentiate levels of poverty across nations. Poverty is considered the dollar-a-day line, which was set at $1.25 in 2005 but changed to $1.90 a day in 2011 (World Bank, 2020). Since 2017, the World Bank has begun to monitor the poverty level of $3.20 per day for lower-middle-income countries and $5.50 per day for upper-middle-income countries (World Bank, 2018a).

Countries also use their own national poverty line, which are financial thresholds that indicate the lowest amount of money required to satisfy fundamental necessities. These cutoff points establish the minimum amount that people are considered incapable of meeting their most basic needs. The national poverty line varies by country, as it is based on the unique economic and social conditions of each nation, reflecting what is considered appropriate to be classified as not poor locally (World Bank, 2018a). Making comparisons of poverty across borders is difficult conceptually and practically because poverty is defined and assessed differently between nations.

There are also poverty indexes that are provided by international organizations. Usually, empirical papers use the global MPI index as a measurement of poverty, which is calculated on a household basis. However, Burchi et al. (2022), unlike other scholars, used two new indices of multidimensional poverty: the Global Correlation Sensitive Poverty Index (G-CSPI) and the Global M0 (called G-M0). These indicators incorporate three different types of deprivations: decent work, education, and health, and are computed at the individual level, focusing on the 15-65 age group. Moreover, G-M0 is sensitive to poverty incidence and intensity, while G-CSPI takes account of inequality among the poor as well. The authors examined the evolution of multidimensional poverty in a sample of 54 low- and middle-income countries. As health indicators, they used access to safe, drinkable water and basic sanitation: the number of years spent in school served as a proxy for education. Decent work was calculated based on labor (whether an individual is unemployed, employed, or not in the labor force) and employment status (paid employee, non-paid employee, employer, self-employed, and other types of workers). The results highlight that all three dimensions of poverty improved, while employment had the least improvement among them. Therefore, they suggest paying attention to the functioning of the labor market. In addition, they found that in comparison to multidimensional poverty, income poverty has greatly decreased, meaning it has been two to six times lower compared to income poverty. Thus, the conclusion was that the non-monetary dimensions of poverty reduction are not as remarkable as they seem and that additional efforts are needed to combat the various forms of poverty.

2.6. Poverty in Central Asia

"From a regional perspective, evidence from Central Asia shows that these countries are still challenged by poverty (Jha & Dang, 2009). During the Soviet Union, income inequality was limited by a high level of social expenditure and low wage differentials (Atkinson & Micklewright, 1992). However, after the Soviet Union, the transition from centrally planned to market economies increased poverty and changed its nature (Alam et al., 2005; Habibov, 2011; Habibov & Fan, 2007; Klugman, 1997; Klugman et al., 2002; Milanovic & Ersado, 2008). In the Soviet era, only selected categories like single mothers, the disabled, and old-age pensioners were vulnerable to poverty, which changed after independence in post-communist countries (Habibov et al., 2016). Moreover, a higher poverty rate is observed in the more densely populated areas of each region's countries (Seitz, 2019)"[26].

Some authors provided information about the background of the problem by studying poverty, its factors, and its vulnerability to poverty in the context of Central Asia. For instance, Hasselman (2021) estimated the effect of trade liberalization on poverty alleviation in 43 countries, including Central Asia, during the period 1992-2018. Interestingly, the findings showed that trade liberalization increases poverty in Central and South Asia. Bierbaum and Gassmann (2012) identified that low levels of human capital and a lack of job opportunities are the main factors contributing to chronic poverty in Kyrgyzstan, while Howie et al. (2021) highlighted that poverty in Kazakhstan is due to corruption, low wages, inefficient governance, and inefficient market labor policies. Kudebayeva (2018) recommended through her analysis, that investment in human capital is needed to tackle poverty in Kazakh society. Another thing that is thought to be a factor in the region's poverty is gender disparity. Applying the multinominal logit models, Strokova and Ajwad (2017) found that, compared to males, women are around 23 percentage points less likely to have a job and 12 percentage points less likely than males to be wage workers in the private sector.

The channels for reducing poverty in Central Asia were analyzed by Seitz (2019), who found that labor migrants significantly contribute to the poorest areas through remittances and investment. According to their survey, about 19 percent of families have at least one migrant abroad in Central Asia. Murodova (2018), using unique household survey data from the Kyrgyz Republic, Tajikistan, and Uzbekistan, investigated the effect of international migration and remittances on poverty reduction. The findings showed that it has a significant positive impact on alleviating poverty in these countries except in Kyrgyzstan, where the magnitude is small.

[26] This part is based on Kurbanova (2022)

However, in Tajikistan, having remittances could reduce the poverty headcount by 38%. In the same vein, a number of studies have also found that it does matter for poverty (Azam, Haseeb, et al., 2016; Batsaikhan & Dabrowski, 2017; Ulrika, 2020). On the other hand, Kayani (2021) found through his empirical estimation that remittances do not have any impact on poverty alleviation in Kyrgyzstan.

Another channel for reducing poverty in the region was analyzed by Falkingham (2005), who mentioned that priority should be given to the youth education system and providing the labor market with the demanded skills. Moreover, effective governance, especially strengthening the public administration system and involving the community in the decision-making process, will be guaranteed to improve material conditions and the capabilities of the poor (Falkingham, 2005). Besides, an increase in GDP significantly reduces the structural attribution of poverty in Central Asia (Habibov et al., 2016).

In essence, previous studies have focused on poverty at individual and country levels, exploring its factors and impact within Central Asia (Kurbanova, 2022). However, no previous studies have emphasized the effect of changes in age structure on poverty, particularly through empirical estimation. Therefore, some questions regarding the importance of demographic factors for alleviating poverty remain to be addressed in the case of Central Asia. Addressing these questions requires a more systematic and empirical approach, focusing on the multidimensional nature of poverty at the regional level, especially considering that these countries are currently positioned to benefit from demographic tailwinds that may not last indefinitely. The increasing proportion of older individuals and the impending aging of the population in the region further underline the importance of this topic. Thus, our dissertation focuses on the examination of how changes in age structure, among other determinants, could influence poverty alleviation at a regional level (see Section 6). By exploring this effect, we aim to inform appropriate policies, specifically in terms of enhancing the share of the working-age population and contributing to filling the gaps in the existing literature.

3. Overview of the Central Asian countries

3.1. Brief history of Central Asian countries

In the literature review part, we explored studies related to Central Asian countries. However, it is worth highlighting information in connection with their history, background, and development paths before proceeding with the empirical estimation of our empiric models, which will be discussed in the following sections. We wish to provide some preliminary insights about these countries and ease the interpretation of the results that will be given in the next sections of this research.

"The term "Central Asia" represents five landlocked countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. These countries have struggled in the past due to being conquered by various empires, divided politically, and debilitated by conflict and internal discord. For a long time, the area was in decline following the bright era of the Timurid Empire in the 14th century. During this period, several empires tried to conquer parts of Central Asian territory, and from the 18th century onwards, Russian influence became the most prevalent (Zhussipbek, 2017). Meanwhile, much of the area was inhabited by nomadic peoples, with virtually no country borders. The identity of the population was belonging to different tribes. Despite this nomadic lifestyle, one of the defining elements of the economy was vibrant trade and being part of the Great Silk Road. The area was constantly characterized by warfare, with different ethnic groups initiating numerous attempts at self-realization and independence (Christoph, 2018).

The Bolshevik Revolution of 1917 radically altered the area's life. Those various ethnic groups were coerced into forming the five Soviet republics, which are now the five independent nation-states"[27]. Previously, these countries had never achieved statehood (Utomo, 2017). Soviet power brought about a level of economic development in the region, allocated huge financial resources, helped in the construction of factories, significantly increased the education of the population, and formally introduced equality for women by substituting the contemporary state for the region's traditional khanate system (Dagiev, 2013; O'Brien, 2020). Especially targeting women was part of the Soviet objective of developing the ideal "socialist person" through standardized education and removing conventional Islamic madrasas (Deyoung, 2006; Edgar, 2006; O'Brien, 2020). The Soviet educational system had a strong focus on maintaining

[27] This part is based on Berde and Kurbanova (2023)

Soviet dominance while at the same time increasing the literacy rate of Central Asia to 90% by 1965 (Froese, 2008; Niyozov & Bahry, 2006; O'Brien, 2020). The Soviet Union governed these countries by establishing relevant social policies and unified languages, such as Russian, which is still commonly spoken today (Delanty & Kumar, 2006; Utomo, 2017).

The Central Asian republics played a secondary role in comparison with the primary republics of the Soviet Union, and their economic life was fundamentally characterized by dependence on those other republics (Zhussipbek, 2017). These republics were directed to specialize in a narrow range of products, functioning as suppliers of raw materials to the industrial centers of the Soviet Union. For example, Tajikistan for supplying aluminium, Uzbekistan for cotton, and Kazakhstan for producing wheat. As a result, after the collapse of the union, these countries found themselves unprepared to navigate the transition from authoritarian to democratic societies. Lacking experience in self-governance and enduring the challenges of achieving independence, they became some of the poorest countries in Asia (VOA, 2009). However, over the past 20 years, there have been tremendous changes, and each country has followed a different pathway of economic, political, and institutional development. Despite significant industrialization processes, agriculture continued to play a major role in the economic lives of the five republics. In terms of political stability, Kazakhstan has maintained a relatively stable government, while Kyrgyzstan and Tajikistan have faced challenges. Kyrgyzstan, for instance, experienced three revolutions (in 2005, 2010, and 2020) and transitioned to a presidential system of government in 2021 (Frost, 2018; Lee-Jones, 2021; Omelicheva, 2021). Unlike other Central Asian countries, Tajikistan had to overcome two difficulties: first, it had to establish itself as a sovereign nation following the dissolution of the Soviet Union in 1991, and then there was the civil war from 1992 to 1997. This disorder distorted people's lives and economic development, as well as being reflected in other aspects of life, such as dropping the amount of GDP almost 70% below its 1991 level, growing the unemployment rate, and increasing immigration (Amir & Berry, 2013; O'Brien, 2020). In contrast, Turkmenistan's government is widely regarded as one of the world's last remaining totalitarian autocracies (VOA, 2009). Uzbekistan has witnessed some reforms, referred to as the Uzbek Spring, starting in 2016 (Frost, 2018).

Generally speaking, these countries differ from one another in terms of population size, geographical characteristics, and ethnic diversity. Uzbekistan boasts the largest population in the region, constituting 45% of the total population, and possesses the highest population density (Aytmagambetova, 2009). Kyrgyzstan and Tajikistan are less populous countries, and

only 10% of their territories are appropriate for agricultural and human settlement due to the presence of mountains. Kazakhstan has the largest area compared to other Central Asian countries, the second largest population, but the lowest population density. Turkmenistan is considered an unpopulated country because of its low population. The region's ethnic variety is reflected in its linguistic and religious heterogeneity. All the countries' languages belong to the Turkic group, while only Tajik is Persian. Islam is the most common religion in Central Asia, but other religions are also practiced there, such as Russian Orthodox Christianity and others (Nedoluzhko, 2021).

In addition, these countries also vary through nationalism. Turkmenistan is classified as one of the most autocratic nations in the world, which it achieved through its homogeneous demographic composition. This homogeneity of the population (Turkmen represent 73% of the population) allowed Turkmenistan to be a stable country. On the contrary, multi-ethnic Kyrgyzstanis is considered the representatives of a "hybrid regime" that has displayed a comparatively higher level of plurality compared to its neighbours, especially in its initial year of independence (Economist, 2015; Utomo, 2017). Only 52% of the population was Kyrgyz, compared to 22% and 13% for Russians and Uzbeks in 1995, respectively (Utomo, 2017). In the same vein, the population of Kazakhstan is also considered multi-ethnic, and its demographic policy has its own features, such as promoting fertility. In contrast, Uzbekistan, has worked to slow population growth (Nedoluzhko, 2021). These various policies have reflected their development. In the next chapter, we will discuss the different demographic and economic potential of these countries, the degree of stability and efficiency of the state, and the size and structure of national economies.

3.2. Recent demographic trends

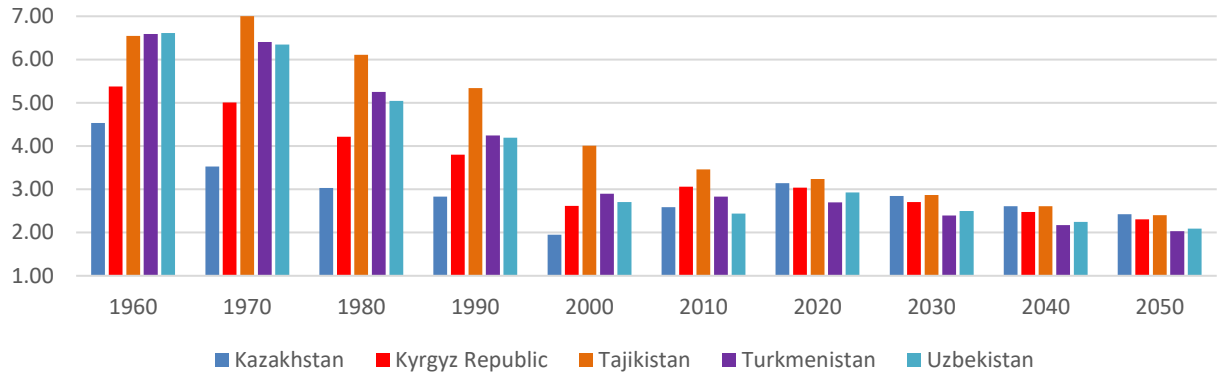
Demographically, the area was characterized by high fertility rates and falling death rates. Migration from other Soviet republics, mainly Russia, also plays an important role in increasing the population. "During and immediately after World War II, large numbers of deportees of other nationalities arrived in the Central Asian region (Islamov, 2000).

In the last years of the Soviet Union, the fertility rate of the Central Asian republics had already fallen sharply but was still around 4.0 in 1990 (Worldometer, 2021). For the first time in their histories, the five republics embarked on an independent development path in 1991 after the break-up of the Soviet Union. They were allowed to realize their national identity

(Connors, 1998). This seems to have been achieved so far, with varying degrees of success. After an initial economic downturn, all five countries embarked on a path of economic growth, but their growth rates are quite different (Stark & Ahrens, 2012). The region is a heterogeneous group with natural resource-exporting countries (Kazakhstan and Turkmenistan), agriculturally-based small countries (Kyrgyzstan and Tajikistan), and more industrialized countries (such as Uzbekistan) (Asian Development Bank, 2010; ESCAP, 2019).

The demographic backgrounds of economic growth in the five independent countries have been very similar, despite the different economic characteristics of these countries. Although there had been an increase in the region's population over the last half-century, starting in the last few years, the growth has slowed down. In the middle of the 21st century, demographic transitions began with a decline in the total fertility rate (TFR) in all the countries following 1960 (Figure 4). It is noteworthy that, despite increases in the TFR in some years, it may, upon projection, quickly realign with the replacement level"[28].

Figure 4: Total fertility in Central Asian countries, 1960-2050 (live births per woman)

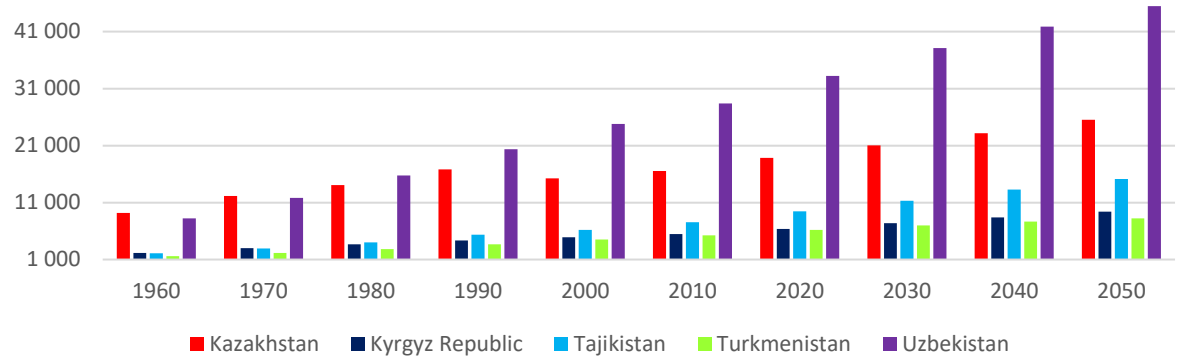


Source: Department of Economic and Social Affairs database, UN (Medium projections)[29]

Even though the TFR is decreasing, the population of the region is predicted to grow to 88.6 million by 2050 (UN, 2015). In 1950, Kazakhstan was the leader of the region in terms of population, slightly outstripping Uzbekistan (Figure 5). The highest rates of population growth and birth rates are noted in the Republic of Tajikistan. On the whole territory, except for Kazakhstan, there is an outflow of population. The rapid increase in population might cause a shortage of living space due to its unique geographical features, especially in Tajikistan and Kyrgyzstan. On the other hand, it will also negatively affect the environment (UNFPA, 2021a).

[28] This part is based on Berde and Kurbanova (2023)
[29] https://population.un.org/wpp/Download/Standard/MostUsed/ assessed 17.11.2023

Figure 5: Total population in Central Asian countries, 1960-2050 *(thousands)*



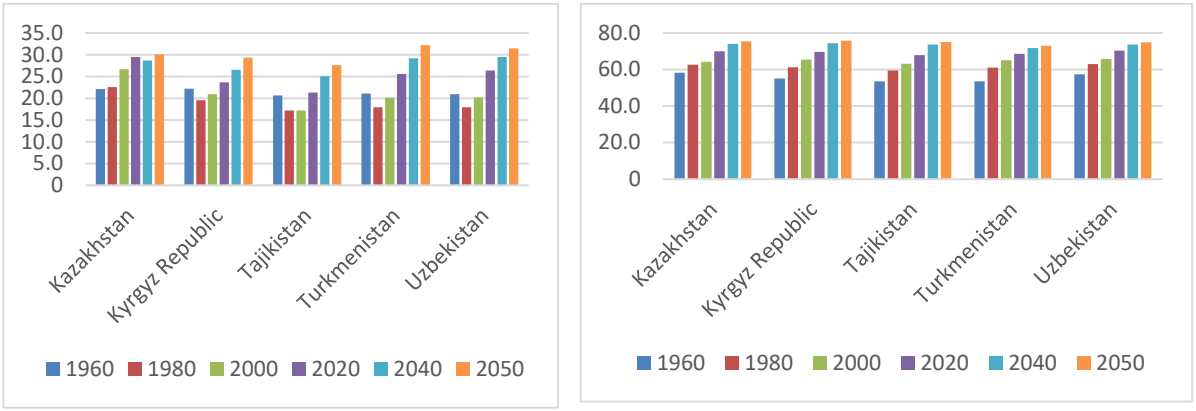
Source: Department of Economic and Social Affairs database, UN (Medium projections)[30]

The demographic conditions across these countries exhibit similarities, characterized by a generally low average old-dependency ratio, predominantly below 7%, except for Kazakhstan. The overall trend indicates a decreasing young-dependency ratio for the entire sample. The decline in the fertility rate, accompanied by demographic aging, is evident through a slight increase in the share of the population of retirement age in these countries, coupled with a significant rise in life expectancy, particularly post-independence (refer to Figure 6b). However, this ageing trend is more prominent in Kazakhstan, positioning the country to parallel Western nations with a growing proportion of older citizens. The dependency ratio in Kazakhstan is projected to rise from 11.3% in 2010 to 20.8% in 2040, marking a transition to an aging nation (Izekenova et al., 2015).

In response to this demographic shift, Kazakhstan initiated preparations for an aging population in 2018 by incrementally raising the official retirement age for women (UNFPA, 2019). As per the updated regulations, the retirement age will increase by six months annually, aligning with the age for men, set to be 63 years by 2027 (UNFPA, 2021b). As of 2023, women in Kazakhstan can retire at the age of 61. Conversely, other Central Asian countries have different retirement age policies. Uzbekistan maintains the lowest retirement age, with men retiring at 60 and women at 55, unchanged since the Soviet Union's dissolution. In Turkmenistan, men retire at 62 and women at 57. Kyrgyzstan and Tajikistan have retirement ages set at 63 for men and 58 for women (Makhanov, 2023). On the contrary, Tajikistan will still enjoy a relatively low proportion of older people, and their share will only grow to 5.3% by 2030 (Strokova & Ajwad, 2017). The median age is also expected to increase further, though it is still considered low compared with industrialized countries (Figure 6a).

[30] https://population.un.org/wpp/Download/Standard/MostUsed/ assessed 17.11.2023

Figure 6: Median age and life expectancy in Central Asian countries



a) 'Median Age, as of 1 July (years) b) Life Expectancy at Birth, both sexes (years)

Source: Department of Economic and Social Affairs database, UN (Medium projections)[31]

These nations exhibit a more advantageous demographic balance than the situation in 1991, characterized by a decreased share of dependents, thanks to a favorable age distribution. Throughout the examined period, approximately 60% of the population falls within the active age group (15–64 years old), around 30% are below the age of 14, and 10% are above the age of 65 (Figure 7). Projecting forward over the next two decades, particularly from 2023 to 2036, a notably high percentage of the population will theoretically be eligible for employment (IMF, 2018), with a subsequent gradual decline expected in Kazakhstan (UNFPA, 2019).

Figure 7: Age distribution in Central Asian countries

Source: World development indicators, 2023

[31] https://population.un.org/wpp/Download/Standard/MostUsed/ accessed 17.11.2023

Consequently, the first demographic dividend window has opened in each country, presenting an opportunity for economic growth through an increased share of the working-age population. We categorized Central Asian countries based on the Demographic Transition Theory, summarizing their demographic conditions in Table 4 to highlight their current demographic states. In our literature review, we initially adopted the World Bank's four-level categorization of demographic dividends (World Bank & International Monetary Fund, 2016). However, for our analysis, we found UNICEF's five-level categorization more suitable, incorporating a mid-dividend level aligned with the five stages of demographic transition (UNICEF, 2019b), and thus, we employed it.

Table 4: Central Asian countries in the phase of demographic transition and demographic dividend

Demographic transition	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Birth rate	High	High	Rapid fall	Low	Very low
Death rate	High	Rapid fall	Slow fall	Low	Low
Population	Stable	Rapid growth	Slow increase	Slow increase	Stabilizing
Central Asian countries					
		Tajikistan* Turkmenistan* Uzbekistan*		**Kazakhstan* Kyrgyz Republic***	
Demographic dividend	**Pre-dividend**	**Early-dividend**	**Mid-dividend**	**Late-dividend**	**Post-dividend**
	Many children, few elderly people. High rates of mortality and fertility.	Increasing share of workers. Decreasing child and youth mortality rates. Opens a demographic window of opportunity.	The fertility rate starts to decrease.	Decreasing share of workers. Falling mortality and fertility rates. The demographic window of opportunity closes.	Few children, many elderly people. The Fertility rate is below the replacement level.

***Classified by the World Bank**[32]

Source: Made by author based on UNICEF (2018)

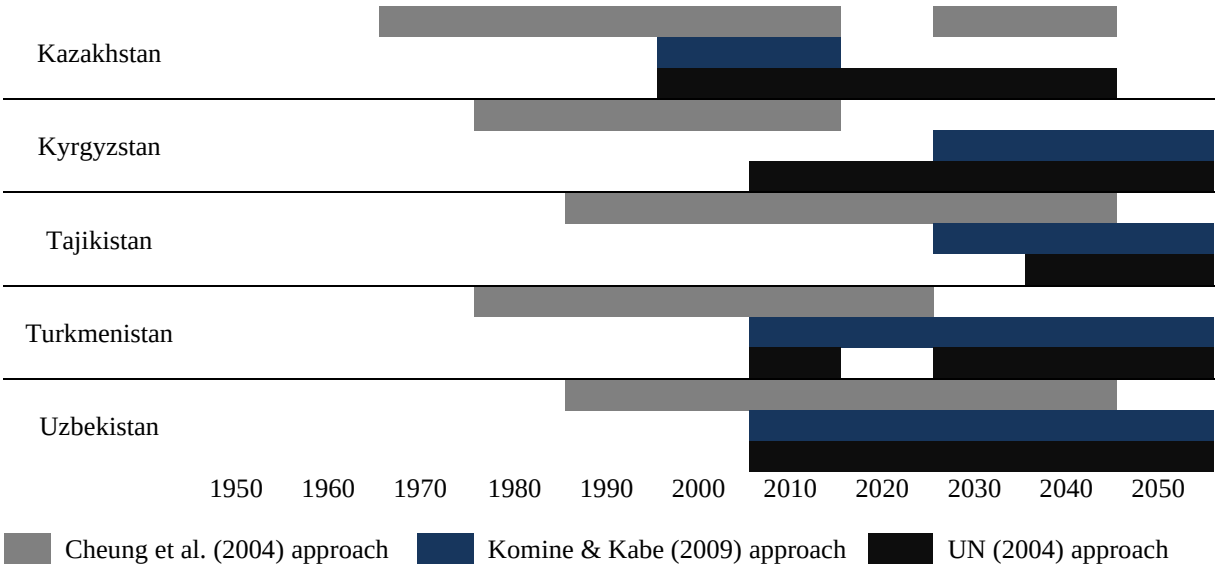
Key factors for stage two, or the early dividend, include an increasing total population, a high birth rate, and a decreasing death rate, indicating the presence of an open demographic window of opportunity. Presently, the region exhibits a declining fertility rate and a slow decrease in the death rate, positioning it between the second and third stages of demographic transition, equivalent to the early and mid-dividend stages. This situation provides a favorable

[32] https://data.worldbank.org/country/early-demographic-dividend and https://data.worldbank.org/country/late-demographic-dividend

backdrop for leveraging the demographic bonus. Contrary to this, the World Bank classifies Kazakhstan and the Kyrgyz Republic as late-dividend countries, characterized by decreasing trends in the share of the working-age population, mortality, and fertility rates. However, these countries do not fully align with the characteristics of late-dividend nations. Hence, we believe they still have an opportunity to reap the benefits, albeit within a relatively short timeframe.

The demographic window of opportunity is transitional, so identifying the time of its occurrence is essential. As we discussed in the literature review part, there are different typologies to define it. We applied them to determine the time period for the Central Asian countries (Figure 8).

Figure 8: The period of Demographic Bonus in Central Asian countries based on different approaches



Source: calculated by author based on WPP, 2017 estimation

These estimated findings highlight variations in the time frame and duration of the demographic advantage across these countries. Moreover, the outcomes differ significantly depending on the calculations applied. According to our calculations, it can be asserted that most of these countries are currently experiencing this demographic bonus, although, in Kazakhstan, it is expected to end in the next decade. As emphasized in the literature review section, these methodologies come with certain implications; nonetheless, they provide insights into the time frame during which Central Asian countries need to take immediate action. The direction of these actions will be discerned after the empirical estimation of our model, which will be presented in the fifth and sixth chapters. However, before focusing on that, it is crucial to spotlight the current socio-economic conditions of these countries.

3.3. Background to economic development

"As highlighted in the introduction, our objective is to identify variables contributing to economic growth and poverty reduction in the context of the demographic transition in Central Asian countries. An essential question arises concerning whether these countries can equally harness the demographic dividend and foster an environment conducive to human capital development. In many countries, the underdevelopment of socio-economic and institutional indicators often hinders the realization of the demographic dividend. We intend to discover whether this statement is true in the case of Central Asian countries. Our focus revolves around education, female labor force participation rates, and institutional indicators, considering them key contributors to economic growth"[33].

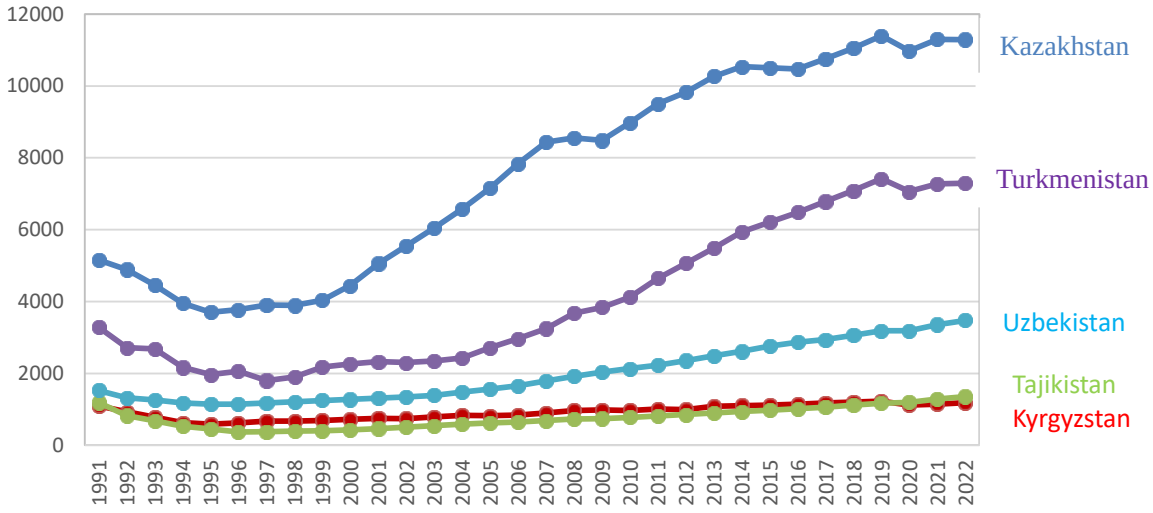
To comprehend the demographic drivers in Central Asian countries, a deeper understanding of their economic background and demographic development is crucial. Examining their development path reveals that, after the collapse of the Soviet Union, these countries experienced a significant decline in their economies and overall living conditions (Batmunkh et al., 2022; Nedoluzhko, 2021). Consequently, they exhibit significant heterogeneity in socio-economic processes, with a widening development gap over the years. Additionally, natural wealth distribution differs across these nations. With the highest GDP per capita density, Kazakhstan is the wealthiest country in the area, making up over 51% of the total GDP, the majority of which comes from oil. With significant energy reserves, particularly in natural gas, Turkmenistan is a desert country that accounts for 16% of the region's GDP. These countries could mitigate the transition challenges due to their hydrocarbon exports (Nedoluzhko, 2021; Vakulchuk & Overland, 2021). However, Kyrgyzstan and Tajikistan do not have it, and Uzbekistan does not have enough of this natural resource. Tajikistan, less developed, follows an agrarian-transit model, while Kyrgyzstan, a small mountainous country, relies on water, hydropower, and some gold, constituting 5% of the regional economy (Aytmagambetova, 2009).

This economic divergence has led to substantial disparities in GDP per capita between the two subgroups of Central Asian countries (Batsaikhan & Dabrowski, 2017). "The first subgroup comprises Kazakhstan and Turkmenistan, where hydrocarbons contribute over 15% to GDP and more than 50% to exports, rendering them less dependent on remittances. In contrast, Uzbekistan, with an eclectic export portfolio but insufficient oil and gas resources, relies on remittances, constituting 10-20% of its GDP. Kyrgyzstan and Tajikistan, in the second

[33] This part is based on Berde and Kurbanova (2023)

group, heavily depend on remittances, which account for over 20% of their GDP (Vercueil, 2018)"[34]. Figure 9 clearly illustrates that Tajikistan and Kyrgyzstan have experienced minimal growth in GDP per capita since 1990, despite the boost from expanding natural gas resources. In contrast, Uzbekistan has seen moderate growth; however, this trend was impacted by the pandemic in recent years and is anticipated to decline further due to the consequences of the Russia-Ukraine war.

Figure 9: GDP per capita (constant 2015 US$) in Central Asian countries



Source: World development indicators by the World Bank, 2023

"All five Central Asian countries have unfavourable geographical locations because they are landlocked. Landlocking challenges and underdeveloped transport infrastructure cause problems for their integration into the world economy (Batsaikhan & Dabrowski, 2017). However, their location is favourable for agriculture. Turkmenistan and Kyrgyzstan were the main "agricultural baskets" for the Soviet Union (Abazov, 1999). The agricultural sector was restructured from state-owned farms to small-scale individuals (Batmunkh et al., 2022). The most important agricultural products of Central Asia are wheat, barley, maize, potatoes, oilseeds, and a range of vegetable and fruit crops, as well as animal husbandry, including sheep, goats, cows, and horses (Batmunkh et al., 2022). The world's major cotton exporters are Uzbekistan and Turkmenistan (Mukhitidinova, 2015)"[35].

Kyrgyzstan, Tajikistan, and Uzbekistan have tried to make their industrial and service sectors more efficient, but they have not been really successful (Batsaikhan & Dabrowski,

[34] This part is based on Berde and Kurbanova (2023)
[35] The same

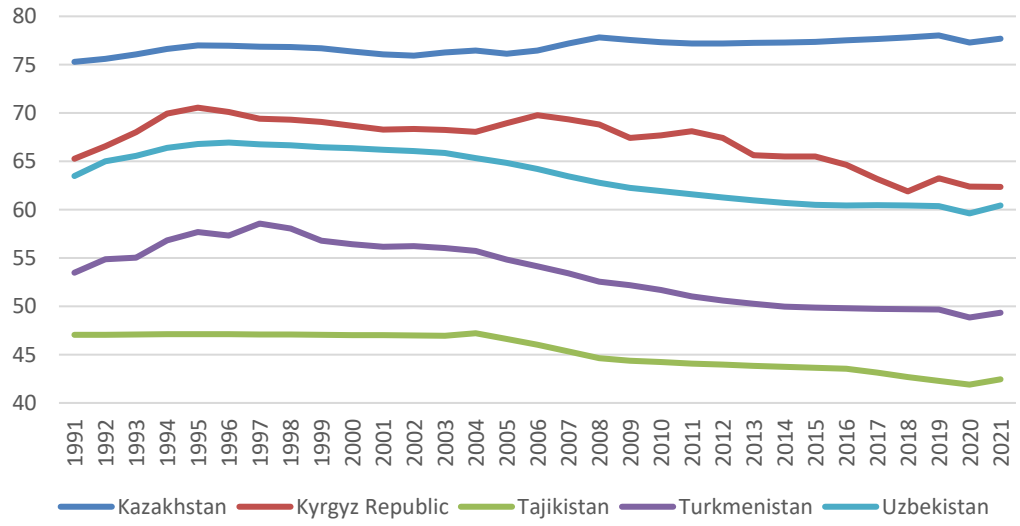
2017). Agriculture also has a serious environmental impact due to its high water use, which is almost 60% of the region's total water consumption (Aminova & Abdullayev, 2009; Batmunkh et al., 2022; Qin et al., 2022).

All five Central Asian countries are rich in gold. Uzbekistan and Kazakhstan are the main gold exporters in the region (Mukhitidinova, 2015). In addition, the Central Asian countries have significant amounts of other valuable mineral resources, like manganese, chromium, lead, zinc, titanium, aluminium, copper, cobalt, and molybdenum (Vakulchuk & Overland, 2021).

3.4. Social development and public policy

In this section, we will analyse the social developments, such as employment, education, the role of women in society, immigration, and the quality of institutional performances, that are all crucial to reaping the demographic dividend. We will also use some of these indicators in our empirical analysis.

Figure 10: Labor force participation rate in Central Asian countries, total (% of total population ages 15-64)



Source: World development indicators by the World Bank, 2023

The employment policy situation in Central Asian countries is unfavorable. Since gaining independence, these nations have struggled to create sufficient jobs to absorb their growing working-age population. Previous initiatives had limited success in generating enough

jobs or boosting living conditions to meet the national objectives (IMF, 2018). This condition leads to the underutilization of human capital for economic growth and poverty reduction. In some Central Asian countries, including Kyrgyzstan, Turkmenistan, and Uzbekistan, almost half of the active population is not employed. In Tajikistan, this number is even lower (Figure 10). Additionally, there is a noticeable challenge of unemployment among recent graduates, attributed to a skills gap between market demands and the available workforce.

The employment situation is particularly dire among the region's youth (aged 15-24), constituting a substantial portion of the population. Of particular concern are those not engaged in employment, education, or training (as indicated by the NEET indicator), posing a significant challenge for the country. The prevalence of such youth is conspicuous in Central Asian countries, particularly in Tajikistan and Kyrgyzstan, where 40% and 21% of the youth, respectively, fall into this category (World Bank, 2021). This figure might be higher due to a substantial portion of unemployed youth not being registered, categorization as seasonal workers or self-employed individuals, and engagement in illegal labor migration abroad. Recent studies suggest that such youths impede a nation from fully capitalizing on the demographic window of opportunity, contribute to the perpetuation of intergenerational inequality, and elevate crime and violence rates (De Hoyos et al., 2016). Urgent attention is needed to address this issue.

Table 5: The share of workers in economic sectors (% of total employment)

	Agriculture				Industry				Services			
	1991	2000	2010	2021	1991	2000	2010	2021	1991	2000	2010	2021
Kazakhstan	36	36	28	15	18	16	19	21	46	48	53	64
Kyrgyzstan	35	53	32	17	27	11	21	26	38	36	47	57
Tajikistan	55	60	52	43	23	16	16	20	22	24	32	37
Turkmenistan	37	36	32	23	29	27	28	34	34	37	40	43
Uzbekistan	40	38	27	24	23	20	23	25	37	42	50	51

Source: World development indicators by the World Bank, 2023

Another impediment hindering the development of the country's social sphere is low labor productivity. In Central Asian countries, labor productivity is insufficient, and structural reform is progressing too slowly, notably in the agricultural and service sectors. This issue is especially pronounced in Tajikistan, where nearly half of the workforce is involved in agriculture (Table 5), and improvements have been minimal due to a lack of economic structural transformation (Strokova & Ajwad, 2017). Additionally, the increase in labor productivity has been negatively impacted by the inefficient relocation of workers between industries.

Another reason for these countries' low labor productivity is an inefficient urban population, where there is little opportunity to invest in human capital. The human development gap is reflected in the level of social processes in these countries, which are rapidly fragmenting in terms of living standards, quality of social services, education, and access to infrastructure. The urbanization of these countries is extremely unbalanced. Kazakhstan has a substantial urban population, whereas Kyrgyzstan and Tajikistan are characterized by a prevalence of rural communities, with nearly two-thirds of their populations residing in rural areas (Table 6). The urbanization tendency has not improved much since independence, even though the majority of people from rural areas have migrated abroad (Strokova & Ajwad, 2017).

Table 6: The share of urban population in Central Asian countries

Countries	1991	1995	2000	2005	2010	2015	2021
Kazakhstan	56	55.9	56.0	56.4	56.8	57.1	58
Kyrgyzstan	37	36.3	35.2	35.2	35.3	35.7	37
Tajikistan	31	28.8	26.5	26.5	26.5	26.7	28
Turkmenistan	45	44.7	45.9	47.0	48.4	50.3	53
Uzbekistan	42	43.7	46.1	48.5	50.9	50.7	50

Source: World development indicators by the World Bank, 2023

Inadequate levels of urbanization, limited access to basic necessities, and a lack of jobs compelled the majority of the active population to seek employment abroad. Therefore, it has become common for some young people to take up temporary or permanent jobs abroad for better pay, especially in Russia. Since dual citizenship is not permitted in the majority of the region's countries, most people who work permanently in Russia are still citizens of their home countries. Therefore, it is very difficult to determine the exact number of people from the region who have migrated from their country. The majority of these emigrants are from rural areas and are relatively young married men with only a secondary education who work in agriculture, maintenance, housing, and trade (Ajwad, Abdulloev, et al., 2014; Ajwad, de Laat, et al., 2014; Ajwad, Hut, et al., 2014; Strokova & Ajwad, 2017).

Remittances sent home significantly support the economy. Moreover, it is well known that the country reduces unemployment by exporting its excess workforce and benefiting from remittance inflows, both of which contribute to GDP and alleviate poverty (World Migration Report, 2020). This process has helped to exploit at least some of the potential of the first demographic dividend. For instance, in Tajikistan, poverty has dramatically decreased from 65 percent in 2003 to 23.5 percent in 2009 due to rising remittances (Strokova & Ajwad, 2017).

Over the past ten years, the significance of labor migration has increased, making some Central Asian countries (Tajikistan, Kyrgyzstan, and in some extant Uzbekistan) the most remittance-dependent nations across the globe, with remittances making up 27%, 31%, and 12% of GDP, respectively, in 2020 (World Bank, 2020a) (Table 7). As a result, the economy is vulnerable to external shocks, particularly changes in the Russian Federation, and has a limited export base.

For instance, the ongoing pandemic and the conflict in Ukraine have exacerbated matters. The region's remittance-dependent countries experienced a significant decline in remittance inflows in 2020. The pandemic forced Russia to restrict movement and introduce lockdowns. As a result, many emigrants were forced to take unpaid leave, thereby incurring significant cuts in salary or, even worse, losing their jobs (World Migration Report, 2020). While these countries are still working on mitigating the consequences of the pandemic in general, the latest conflict between Russia and Ukraine may further worsen the situation and represent an obstacle to materializing the first demographic dividend of Central Asian countries, which instead could face a demographic disaster.

Table 7: Remittance Data for Central Asian Countries

Country	Remittance inflows, 2020 (current, $ mn)	Remittance inflows, % of GDP, 2020	Remittance inflows, % of exports and services, 2020	Share of remittances from Russia (of the total remittance receipts), 2021 Q1-Q3	Originally projected growth rate, 2022	Revised projection of the growth rate for 2022
Kazakhstan	374	0.2%	0.7%	51%	7%	-17%
Kyrgyzstan	2,423	31.3%	99.5%	83%	3%	-33%
Tajikistan	2,187	26.7%	155.2%	58%	2%	-22%
Uzbekistan	6,980	11.6%	48.0%	55%	3%	-21%

Source: based on Ratha and Kim (2022)

First of all, the situation has initially impacted emigrants' chances of earning and transferring money home. Thus, the financial inflow of remittances from Russia was expected to decrease dramatically. For example, due to the economic situation in Russia, the volume of remittances to Uzbekistan from labor migrants in 2022 may decrease by 21% instead of growing at the expected 3% rate, according to the predictions of World Bank experts (Ratha & Kim, 2022) (Table 7). Moreover, Russia's disconnection from SWIFT has further complicated the transfer of remittances.

Second, as the rouble depreciates, many families in Central Asian countries that depend economically on remittances from Russia are already feeling the adverse effects. A weaker

rouble means smaller transfers. According to the surveys, a significant amount of this money was spent on children's education, which has become impossible in the present circumstances (Seitz, 2019a; UNICEF, 2019a). Thus, a lack of remittances directly decreases investment in human capital. During demographic transition, sustained investment in human capital is needed. However, the recent situation clearly indicates that these countries will suffer and maybe unable to benefit from demographic tailwinds due to a lower level of human capital.

Skills and education are crucial factors in determining job outcomes, and studies have also found that there is a positive correlation between employment rates and educational achievement (Strokova & Ajwad, 2017). Education is considered one of the main accelerators for enhancing human capital. There are many proxy measures used to measure education. In our research, we represent education by the mean length of years of schooling. "The region's countries have about 11 years of schooling. People from Kazakhstan and Uzbekistan studied for more than 11.5 years, as is almost true in Kyrgyzstan, while in the remaining two countries of the region, it is 11.3 years (Table 8). The relatively high numbers come from universal intermediate education as a result of the Soviet era, but higher education enrolment is still low"[36].

Table 8: Education indicators in Central Asian countries

Country	Mean years of schooling			Education enrolment rate (% gross)					
				General secondary (15-18 years)			Tertiary (19-24 years)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Kazakhstan	9.7	11.1	12.3	91	N/A	94	32	47	65
Kyrgyzstan	10.3	11.0	11.4	81	87	93	35	41	46
Tajikistan	10.8	11.2	11.3	72	85	N/A	17	23	31*
Turkmenistan	8.5	11.0	11.3	N/A	N/A	88	N/A	N/A	14
Uzbekistan	10.0	11.0	11.9	87	91	91	13	9	16

*2017

Source: the data about mean years of schooling is sourced from the UNDP, Human development index database, the remainder from the World Bank database.

Note: N/A – not available

"The region's countries are facing problems related to higher education level and the insufficient quality of human capital. The majority of the population has access to general secondary education, which is guaranteed in the legal framework of all countries. However, due to limited access to tertiary education, employers face challenges such as an acute shortage of qualified specialists, especially among the young. In general, the higher education systems of Central Asian countries are at different stages of development, with notable variations in

[36] This part is based on Berde and Kurbanova (2023)

enrolment and completion rates. The enrolment rate in tertiary education differs across the region, from 65% in Kazakhstan to 14% in Turkmenistan (Table 8ftgvb). This variation is even more noticeable in the gender imbalance, both in accessing and completing higher education. The most significant gender inequality gap is in Tajikistan, where the completion rate is more than two times higher for men than for women (29% vs. 13%) (UNESCO, 2021). Access to higher education for women is much lower in Turkmenistan and Uzbekistan than in Kazakhstan and Kyrgyzstan (Table 9). According to studies, the primary cause of this disparity is that most families prioritize the education of their sons over that of their daughters. They believe that the benefits of a son's education are generally higher than a daughter's since sons are expected to support their parents financially while daughters are expected to support the families of their husbands (World Bank, 2021)"[37].

Table 9: Female development indicators in Central Asian countries

Country	Completion rate, upper secondary education, female (%)			School enrolment, tertiary, female (%, gross)			Female labour force participation ratio (% of female population ages 15+)		
	2000	2019	2020	2000	2019	2020	2000	2019	2020
Kazakhstan	82.1	96.1	96.5	34.6	68.4	78	65.71	64.01	63.62
Kyrgyzstan	71.8	84.7	85.3	35.8	47.4	52	55.72	43.97	41.56
Tajikistan	50.06	59.9	60.7	11.1	26.9*	n/a	31.27	30.8	30.39
Turkmenistan	93.6	95.7	95.8	N/A	12.8	15	44.5	37.44	36.84
Uzbekistan	72.51	90.4	91	11.9	11.4	15	56.24	46.66	44.84

*2017

Source: the data about secondary education is sourced from the UNESCO Institute for Statistics (UIS) database, the tertiary education from the World Development Indicators of the World Bank and labor force participation rate from the global economy database[38].

"There are several reasons behind gender inequality at the national level. The most significant is a lack of legislative commitment and insufficient policy implementation to ensure equal rights (UNESCO, 2021). The effects of these factors, combined with gender stereotyping, manifest as unequal acceptance of women in the labour market. Notably the gender employment gap in Central Asia is wide, and women still face problems integrating into the labour market (Gebel, 2020). The female labour force participation rate has tended to decline over the last two decades in all the region's countries. The latest trend indicates that almost half of working-age women are not engaged in income-related activities. The situation is most worrying in Tajikistan, where more than two-thirds of women are not joining the workforce (Table 9).

[37] This part is based on Berde and Kurbanova (2023)
[38] https://www.theglobaleconomy.com/rankings/female_labor_force_participation/Asia/

The reasons behind a fall in the employment rate among women could be personal, cultural, social, religious, or marriage-related factors (Brück et al., 2014). Notably, the fertility rate is still high in Central Asia compared with developed countries (in Tajikistan and Kyrgyzstan, the TFR is 3.6 and 3.3, respectively). Furthermore, the absence of appropriate institutions for child daycare and insufficient early childhood education creates barriers for women to be active in the labour market"[39]. Like many other nations, gender stereotypes and attitudes that demand women be in charge of childcare and housework chores put an unequal burden on women (World Bank, 2021). Male migration is another cause of the low level of female employment. On the one hand, the influx of remittances discourages women from seeking employment and engaging in money-making activities. On the other hand, they have to shoulder additional obligations outside of their own, which ban them from working even after completing their education (World Bank, 2021).

Additionally, employers are less likely to hire women who have a dual responsibility between work and family, making it more difficult for women to enter the labour market (Spierings et al., 2009). On the other hand, ESCAP (2019) emphasized that women in Central Asia are more inclined to work in the informal agriculture sector. This sector typically does not demand extensive educational qualifications and tends to offer lower wages. The informal sector is particularly large in rural areas and in agriculture, where unpaid family workers are very common (Strokova & Ajwad, 2017). On the other hand, there is a significant gender wage gap in these countries. The chronic gender wage gap and occupational segregation are caused by gender inequalities in the disciplines of study. Sectors with a higher proportion of women, like education, typically pay less than those with a higher proportion of men, including finance, business, construction, and transportation. For example, in Tajikistan, women's earned income is 4.5 times lower than men's (World Bank, 2021). Also, a greater gender gap could be noticed in government and political decision-making, where due to cultural norms and gender stereotypes, women are less likely to be involved in these activities (UNFPA, 2019; World Bank, 2021).

"Women have many legal rights in Central Asia; however, upon closer examination of family institutions, education, and the labor market, it becomes evident that, in practice, these rights are often constrained by traditional mindsets (Moniruzzaman & Farzana, 2019). The question of how much attention policymakers have paid to women remains crucial. It

[39] This part is based on Berde and Kurbanova (2023)

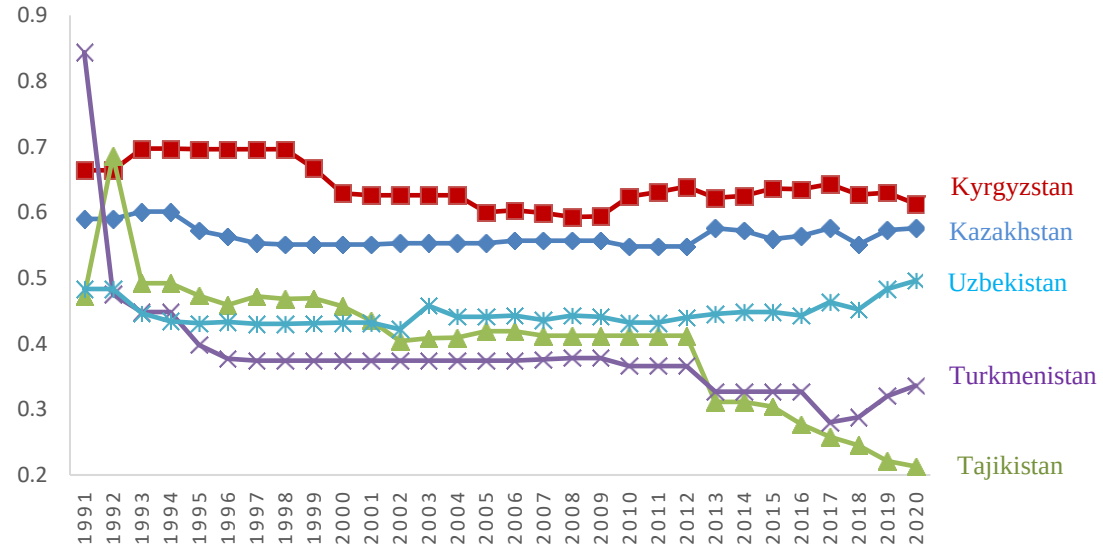
encourages us to emphasise the importance of ensuring that women-related policies work and are implemented more effectively, where institutional factors play a relevant role.

The development level of institutional factors also varies between countries. For analysis, we take the Political Corruption Index and Egalitarian Democracy Index, which are composite measurements of governance effectiveness. The Political Corruption Index covers different areas and levels of corruption in the political realm. It is derived from four scale indicators: the executive corruption index, the public sector corruption index, the indicator for judicial corruption, and the indicator for legislative corruption. The index is measured as the sum of the average level of each indicator. It ranges from less corrupt (zero) to more corrupt (one) (Coppedge et al., 2021).

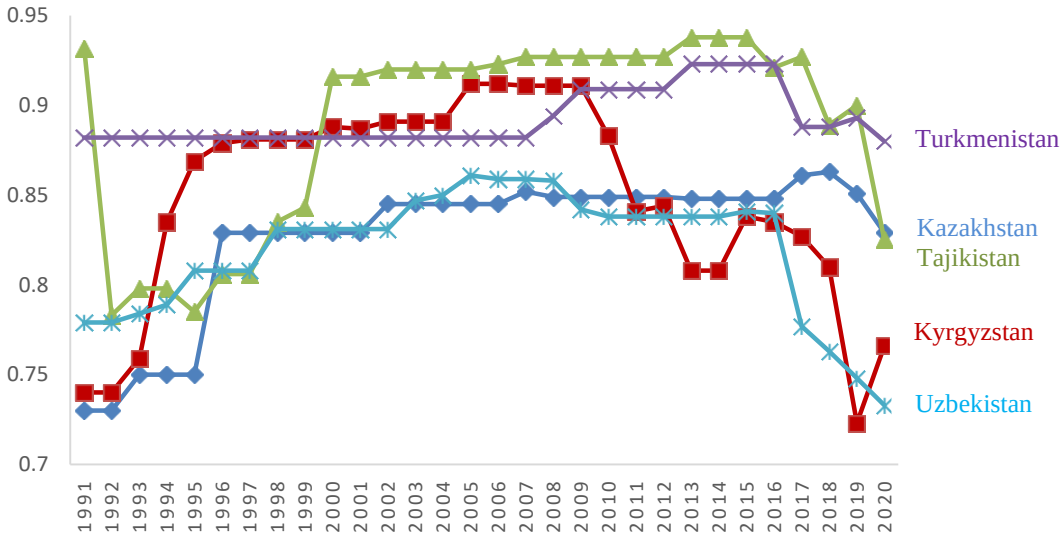
The Egalitarian Democracy Index is generated from sub-component indicators such as "equal protection" and "equal distribution of resources" among citizens. "Equal protection" will be achieved when the government grants and assures individuals' rights and freedom. On the other hand, an equal distribution of resources means that residents have all the basic necessities, such as equal education and health. The sum of these indicators demonstrates how individuals in a particular country have equal political rights and freedoms and the ability to influence political processes (Lindberg, 2015). It ranks from less democracy (zero) to high democracy (one) (see these indices in Coppedge et al., 2021). In terms of the Egalitarian Democracy Index, all five countries are experiencing fluctuations. Immediately following the collapse of the Soviet Union, the index scores were better, as everything was distributed equally and the rate of inequality among citizens was low (Figure 11a). However, the score has deteriorated as the countries have gained independence and built their own models. The development of the Egalitarian Democracy Index shows that Kazakhstan and Kyrgyzstan are performing better concerning democratisation compared with the other Central Asian countries, although they are still lagging behind developed countries. Theoretically, this indicates that political decisions are being reached through a deliberative process in these countries, and the people have more influence over political and governing processes. In the past, the situation has been better, but on the surface, it seems people are still more equal in these two countries than in other Central Asian countries. Paradoxically, this could be the cause of recent strikes in Kazakhstan: people know what they stand to lose if strict regulation is introduced[40].

[40] The recent situation of massive anti-government protests in Kazakhstan in January 2022 started with a spike in fuel prices and developed into serious political unrest after a long period of stability in the country. Some experts accuse protestors of being part of a foreign terrorist plot and assume 'outside power' is behind the unrest (Human

Figure 11: Egalitarian Democracy Index and Political Corruption Index in Central Asian countries*



a) Egalitarian Democracy Index



b) Political Corruption Index

* **Source**: University of Gothenburg database

The Egalitarian Democracy Index in Uzbekistan is at the Central Asian average, scoring 0.4. This means efforts still need to be made to improve the protection of individuals under the law and their influence over policymaking across different groups. The situation is critical in Tajikistan and Turkmenistan. Both of these countries still have much progress in achieving

Rights Watch, 2021; Turak, 2022). These situations can illustrate that improvement in democracy is still needed in the country, even though the Egalitarian Democracy Index highlights relatively better results.

democracy, scoring around 0.2 points (Figure 11a). Low political empowerment, restrictions on civil liberties, poor quality healthcare and education, and the low social status of women are some of the obstacles to achieving democracy in these countries"[41]. Especially, in Tajikistan, the situation is very problematic. The country trails many of its regional neighbours in terms of institutional reforms due to the civil and political turmoil in the early years of independence, as well as the slow pace of reform implementation (Strokova & Ajwad, 2017). Thus, the country is categorized as a "late modernizer" country (Arias et al., 2014).

"The situation concerning corruption is also not favourable for the entire region. The Political Corruption Index is above 0.7 in all countries (Figure 11b). The higher value indicates that access to public service and political power depends on bribery and corrupt methods. As a result, these become the norm rather than disallowed practices. The situation is not helpful for development: hence, policymakers need to combat corruption as a matter of urgency to use their human resources more efficiently and achieve rapid growth.

In a nutshell, insufficient development of human capital, underutilisation of women, low levels of democratisation, and high levels of corruption are some of the major contributors to Central Asian countries' low GDP. Conversely, in the case of Kazakhstan, it can be observed that the country has a relatively enabling environment in terms of materialising the demographic dividend. If the issues behind the above-analysed indicators are addressed, they could be a catalyst for reaping a demographic benefit in these countries"[42].

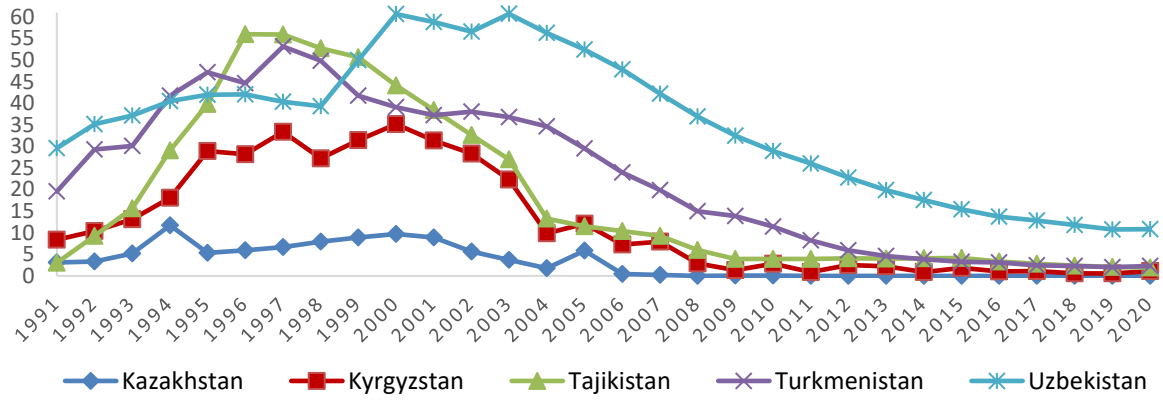
3.5. Trends in poverty and inequality in Central Asia

In the literature review, we explored claims by researchers that a rise in the active population's share and limited job opportunities could potentially lead to increased poverty and inequality in a country. Conversely, with effective policies, this scenario could be transformed into a means of poverty alleviation. We plan to empirically assess this in the context of Central Asian countries in the sixth chapter of our dissertation. However, we believe it is essential to first highlight the present state of poverty and inequality in Central Asia before moving to the calculations. This preliminary examination may offer initial insights into the poverty and inequality conditions in these countries.

[41] This part is based on Berde and Kurbanova (2023)
[42] The same

Poverty is one of the major economic problems in Central Asian countries. Following the attainment of independence in 1991, poverty has increased (Jha & Dang, 2009a; Keller & Heller, 2011). Only since the 2000s have these nations witnessed a substantial decline in poverty rates, primarily attributed to remittance-driven prosperity. Despite this improvement, poverty levels still remain high. Strong economic growth over the past ten years has not been the consequence of structural changes that can sustainably raise living standards. Jobs have been generated, but they tend to be in low-productivity occupations that are frequently in the informal sector. Additionally, there are different socio-economic outcomes in the job market among areas and population groups (Strokova & Ajwad, 2017). The trends in poverty reduction also vary between these countries; some of them have succeed in lifting the majority of people out of poverty, while others are still struggling to catch up (Khitakhunov, 2020a; Seitz, 2019).

Figure 12: Poverty line (1.90$/day) in Central Asian countries, headcount (%)



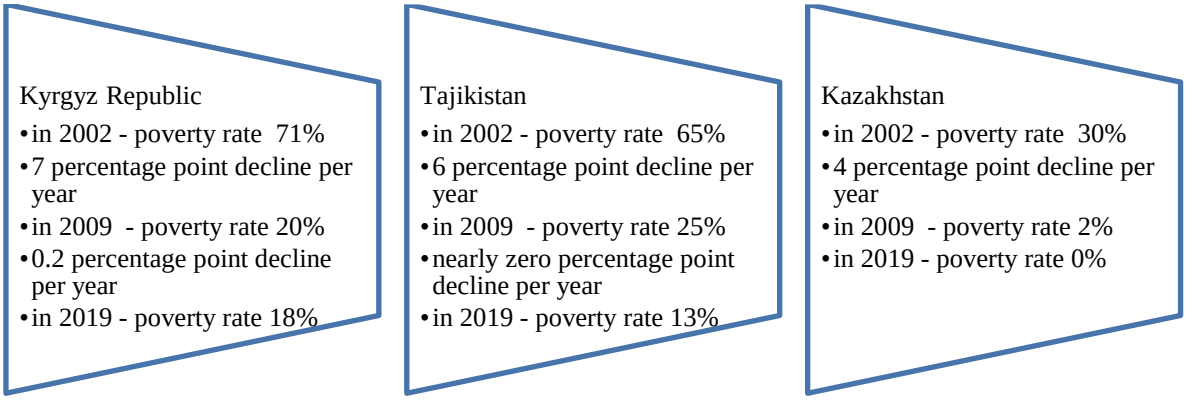
Source: Poverty and Inequality Platform, World Bank

The most noticeable reduction was observed in Kazakhstan through macroeconomic reforms and anti-inflation policies (Jha & Dang, 2009). The country's extreme poverty rate is almost zero. On the other hand, extreme poverty is still high in Uzbekistan, even though there was a precipitous reduction, which fell from 60% in 2000 to 10% in 2019 (Figure 12).

There is clear evidence that poverty declined over the years (Figure 12). However, the tendency to alleviate poverty varies across countries. The poverty reduction rate was significant until 2009, with an average 7 percentage point decline annually from 2002 to 2009, in both the Kyrgyz Republic and Tajikistan. However, after that period, the rate of poverty reduction has

fallen more slowly. Among Central Asian countries, only Kazakhstan could eliminate poverty, which is measured by 3.20 USD of income per day (Figure 13).

Figure 13: Poverty reduction rates in Central Asian countries (3.2 $ per day)



Source: World Bank, 2020

It is noteworthy to mention that a high level of poverty remains in remote and rural areas, where there is a lack of employment opportunities and close integration with urban growth centers (World Bank, 2020a). In remote areas of Tajikistan and the Kyrgyz Republic, where 73% and 64% of people live, the poverty rate is above 40%. This indicates that poverty in Central Asia is largely a rural phenomenon.

Another indicator of poverty in the region is the proportion of employed people who are poor, also known as the working poor. This indicator identifies the proportion of the employed population who are poor because, despite having a job, their income is insufficient to cover basic living expenses. Surprisingly, countries' international poverty rates and the working poor indicators do not vary significantly from each other (Gammarano, 2019).

Table 10: Share of employment by economic class (%, ILO modeled estimates, 2022)

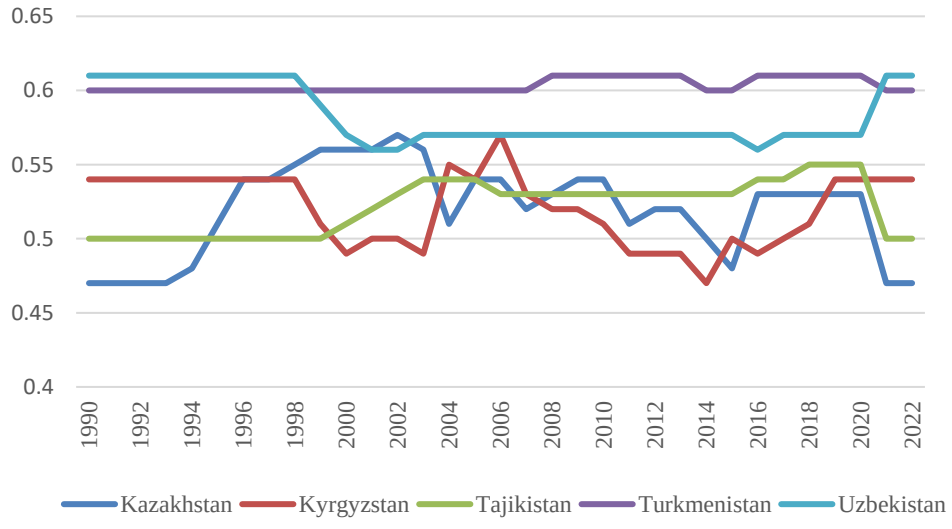
Country	Extremely poor	Moderately poor	Near poor
Kazakhstan	0	0	2
Kyrgyzstan	0	12	45
Tajikistan	2	7	23
Turkmenistan	1	4	19
Uzbekistan	7	22	38

Note: Extremely poor: less than $1.90 a day, moderately poor: $1.90 to $3.20 a day, near poor: $3.20-$5.50 a day (using 2011 PPPs)
Source: ILO modeled estimates, ILOSTAT

According to data on the working poor, the situation in Uzbekistan is also not as favorable as that of other Central Asian countries. As of 2022, the share of the extremely poor in Uzbekistan is 7%, meaning that despite being employed, seven percent of all workers live in extreme poverty (Table 10). The main causes of poverty include unemployed workers, inefficient workers, and the lower wages of rural residents, whose incomes are only half those of the average citizen (UNFPA, 2019).

In addition to poverty, inequality creates a significant challenge for Central Asian countries, contributing to social tension and economic instability. Historically, levels of inequality were lower during the Soviet Union era when access to public services such as healthcare, education, and utilities, as well as a source of income, were promised to every individual. However, gender equality in labor market participation was also mandated (UNESCAP, 2018). After the collapse of the Soviet Union and transition to market economies, income inequality, including variations in earnings and profits, surged (RICA, 2019). In some Central Asian countries, the coefficient of Gini, a measure of income inequality, doubled from pre-transition levels (Bandara et al., 2006). For instance, during the 1987-90 period, income inequality levels were comparable to Scandinavian countries, with a Gini coefficient of 0.25. However, in the first decade of independence, particularly in Turkmenistan and Tajikistan, it soared to 0.5, aligning with global high-income inequality levels (Müller, 2003).

Figure 14: Pre-tax national income (Gini coefficient) in Central Asian countries



Source: World inequality platform - https://wid.world/data/

In the past decade, the Gini coefficient based on pre-tax national income has remained persistently high across Central Asian countries, except for Kazakhstan and Kyrgyzstan. In other countries in the region, it exceeds 0.5 and even reaches 0.6 (see figure 14).

The Gini coefficient based on after-tax income varies. In 2022, Kazakhstan and Kyrgyzstan had an indicator of about 0.29, while in 2023, Uzbekistan's stood at 0.35, indicating moderate inequality (Knight et al., 2024; World Bank, 2023).

The other most widely used measure of income distribution by demographic group is the total income of the richest tenth decile. The wealthiest segments of each nation's population have their incomes concentrated in the tenth decile, which also best captures the characteristics of inequality: the status of elites and their ingrained interests (the "mentality" of high society) (RICA, 2019). Greater income disparity within a population is indicated by a higher income share owned by the top 10% of earners. It implies that a comparatively small percentage of people or families control a substantial part of the nation's income.

Table 11: The share of total income of 10 of the richest*

Countries	1991	1995	2000	2005	2010	2015	2020
Kazakhstan	0.3529	0.3861	0.4321	0.4201	0.4138	0.3730	0.4120
Kyrgyzstan	0.4335	0.4335	0.3791	0.4241	0.4032	0.3968	0.4327
Tajikistan	0.3812	0.3812	0.3915	0.4232	0.4086	0.4072	0.4223
Turkmenistan	0.4799	0.4799	0.4807	0.4838	0.4878	0.4818	0.4889
Uzbekistan	0.4830	0.4830	0.4550	0.4547	0.4547	0.4547	0.4553

*Pre-tax national income

Source: World inequality platform - https://wid.world/data/

Recent trends indicate that in Central Asian countries, the income of the richest 10th decile has increased over the last few years (Table 11). For instance, in Uzbekistan during 2022-2023 the incomes of the bottom 10% increased by 6%, while the incomes of the wealthiest 10% grew by more than 30 % (Knight et al., 2024).

Another interesting point is identifying whether an optimal level of inequality exists for this region, as it provides an opportunity to create a more balanced and sustainable socio-economic environment. However, defining the optimal level of inequality in Central Asia is challenging, as previous scientific works have not calculated it precisely. The literature offers specific solutions rather than a general theory for estimating the optimal level of inequality (Charles-Coll, 2010; Khatun & Saadat, 2022). In the Central Asian context, the optimal level of inequality depends on the specific goal: if the aim is to increase the average GDP per capita, a different level of inequality might be optimal compared to increasing the average educational level. Therefore, establishing a well-founded methodology to estimate it precisely is essential and will be a focus of our future research.

4. Research methodology

4.1. Research design

In this section, we will describe the procedures and strategies for collecting, evaluating, and interpreting our data. It should be noted that this methodology is relevant for the next parts of the thesis (sections five and six), which is why it is included here. However, to avoid confusion the description of the models (growth, poverty and inequality) and the explanation of the data will be provided in their respective empirical sections.

We used secondary time-series panel data from international organizations in this study, indicating a quantitative approach. Our sample comprises yearly data from five Central Asian countries, forming a panel dataset.

In panel data analysis, it is typical to use random effects and fixed effects models. These two models differ in how they treat dummy variables. In a fixed effects model, the parameter estimate of a dummy variable is integrated into the intercept, while in a random effects model, it becomes part of the error term. In both types of models, the slopes remain consistent regardless of the group or time period (Park, 2011). Below, model one and model two represent the functional forms of fixed (1) and random effect (2) models respectively:

$$y_{it} = (a + u_i) + X'_{it}\beta + v_{it} \qquad (1)$$

$$y_{it} = a + X'_{it}\beta + (u_i + v_{it}) \qquad (2)$$

A fixed effects model assumes uniform variance and consistent slopes across all groups in order to investigate the variations in intercepts between individuals. In this model, the individual-specific effect, u_i, can be associated with other variables in the model since each individual's distinct characteristic is constant over time and is integrated into the intercept (Park, 2011).

On the other hand, in random effect model, the error variance is estimated which is unique to each group or times, presuming that heterogeneity is uncorrelated with any of the regressors. Thus, the individual-specific effect, represented by u_i, is either part of the composite error term or a single, particular random heterogeneity. For this reason, an error component model is another name for a random effect model. In this model, the intercept and slopes of the regressors remain consistent across individuals, while the variability between individuals (or

time periods) is due to their unique error components, not differences in their intercepts (Park, 2011).

To determine whether the fixed or random effects method is more appropriate, there is a test designed to help make that choice. This test, known as the Hausman (1978) specification test, compares the two models, with the null hypothesis asserting that individual effects are not correlated with any of the regressors in the model (Park, 2011).

In our case, we used the Hausman (1978) specification test to select the applicable estimation method. Table 12 presents the test results for each model from our two empirical sections. The test results indicated that the null hypothesis of no correlation between the individual-specific effects and the regressors is rejected at a 10% significance level, suggesting that the fixed effects model is more suitable. Thus, we opted to use the fixed effects approach for our regression models.

Table 12: Hausman test results

	Models							
Empirical part 1: Economic growth	1a		1b		2a		2b	
	Statistics	Probability (Prob.)	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
	115.46	0.000***	111.4	0.000***	111.4	0.000***	106.2	0.000***
Empirical part 2: Poverty and inequality	Model 1		Model 2		Model 3		Model 4	
	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
	47.48	0.00***	36.5	0.00***	49.21	0.00***	61.57	0.00***

Source: own estimation

4.2. Diagnostic tests

In regression equations, it is essential to conduct a series of mandatory diagnostic tests to avoid spurious results and ensure the selection of the appropriate method. One important test is to detect cross-sectional dependence. If this issue exists, it can lead to biased results. Various techniques can determine if the issue is relevant. One such technique is the Pesaran (2004) Cross-Sectional Dependence (CD) test, which is a useful method for detecting this problem using the following estimation:

$$CD = \sqrt{\left(\frac{2}{N(N-1)}\right)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{T_{ij}\hat{p}_{ij}}\right) \qquad (3)$$

Where, T represents the time dimension, and N represents the cross-sectional dimensions of the panel. The term $\hat{p}_{ij}$ is the residual coefficient for pairwise cross-sectional correlation.

Table 13: Diagnostic Test Results

	Models							
Empirical part 1: Economic growth	1a		1b		2a		2b	
	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
Pesaran CD	1.43	0.15	1.81	0.07	1.67	0.09	1.76	0.07
Breusch-Pagan LM test (CD)	65.63	0.00***	60.47	0.00***	18.94	0.04**	17.89	0.05**
Serial Correlation	200.9	0.00***	173.9	0.00***	118.2	0.00***	103.1	0.00***
Heteroscedasticity Modified Wald test for groupwise heteroskedasticity in fixed effect regression model	139.98	0.00***	63.58	0.00***	29.94	0.00***	35.64	0.00***
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	8.68	0.00***	5.75	0.02**	0.58	0.4	0.73	0.4
Empirical part 2: Poverty and inequality	Model 1		Model 2		Model 3		Model 4	
	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
Pesaran CD	0.07	0.9383	0.28	0.7750	1.99	0.0466	1.29	0.1957
Breusch-Pagan LM test (CD)	28.48	0.00***	50.67	0.00***	30.02	0.00***	14.30	0.16
Serial Correlation	117.8	0.00***	133.0	0.00***	3.65	0.12	3.51	0.13
Heteroscedasticity Modified Wald test for groupwise heteroskedasticity in fixed effect regression model	4.29	0.5	4.52	0.47	43.63	0.00***	124.5	0.00***
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	0.05**	0.83	0.35	0.55	8.58	0.00***	16.04	0.00***

Source: own estimation

Another technique to detect cross-sectional dependence is the Breusch and Pagan (1980) LM test, which is more appropriate when T is greater than N. However, if N is larger or approximately equal to T, this test may yield biased results. The test calculates through the following equation (4):

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^2 \qquad (4)$$

Where, $\hat{p}_{ij}$ represents the correlation coefficient of residuals between cross-sectional units i and j; T denotes the time dimension.

For our panel data, we applied both the Pesaran (2004) Cross-Sectional Dependence test and Breuch-Pagan LM test to all our sample equations. The results indicate that most of the regression residuals show evidence of cross-sectional dependence (Table 13).

The next step is to address the issue of autocorrelation. Its presence can lead to inefficient estimates and violates the assumption that errors are independent. To ensure the accuracy of the model, detecting autocorrelation is essential. Although several tests have been suggested for serial correlation in panel-data models, Wooldridge (2002) highlighted a novel test that is particularly appealing because it is simple to perform and needs relatively few assumptions (Drukker, 2003; Khosropour, 2017). We performed the Wooldridge (2002) test for autocorrelation on our models, and the results indicated that autocorrelation is a relevant concern across our cases (Table 13).

Detecting heteroscedasticity is also critical. If heteroscedasticity is present, standard errors computed under the assumption of homoscedasticity are likely to be inaccurate, potentially leading to unreliable confidence intervals and hypothesis tests. As a result, incorrect inferences regarding the importance of coefficients may be drawn. To address this, estimating robust standard errors is recommended to account for potential heteroscedasticity.

Various techniques can be used to identify heteroscedasticity, including the Modified Wald test for groupwise heteroscedasticity (Greene, 2002) and the Breusch-Pagan / Cook-Weisberg test. We applied both tests, and the results showed that heteroscedasticity is present in our models (Table 13).

4.3. The chosen methodology

The next crucial step is to choose an appropriate regression technique for our models. In order to tackle above mentioned issues, multiple strategies exist. The choice of method depends on the characteristics of the panel data. As we have mentioned in the introduction, for our case with a long time period (T=28 years) and fewer countries (N=5 countries), it is recommended to use a panel fixed-effects model with DriscolleKraay corrected robust standard errors. Driscoll and Kraay (1998) provide a non-parametric covariance matrix estimator that yields standard errors that are resistant to a variety of spatial and temporal dependency patterns and consistent with heteroskedasticity and autocorrelation (Hoechle, 2007).

Given that the Hausman test indicates that the fixed-effects model is appropriate, the Driscoll-Kraay estimators with fixed effects (DKFE) will be used. The technique works as follows: Initially, all the variables in Equation (5) must be within-transformed, then using the within-transformed variables to perform an Ordinary Least Squares (OLS) estimation on Equation (6) (Hoechle, 2007).

$$\check{z}_{it} = z_{it} - \bar{z}_{it} + \bar{z} \qquad (5)$$

Where, $\bar{z}_i = T_i^{-1} \sum_{t=t_{i1}}^{T_1} Z_{it}$ and $\check{z} = (\sum T_i)^{-1}$

$$\check{y}_{it} = \tilde{x}'_{it}\theta + \check{\epsilon}_{it} \qquad (6)$$

$\check{\epsilon}_{it}$ is covariance-matrix of the Driscoll-Kraay, that is stable regardless of cross-sectional dependencies throughout the panel because it depends on cross-sectional averages.

4.4. Validation and reliability

To ensure the reliability and robustness of the findings, a variety of alternative techniques can be used. It's crucial to ensure that these methods are appropriate for the characteristics of the data.

Table 14: Estimation techniques for addressing issues in linear panel models

	Hetero-scedastic	autocorrelation	contemporaneously cross-sectionally correlated
Fixed or random effects with 'robust' option for standard errors	+		
Fixed or random effects with 'cluster' option for standard errors	+	+	
Fixed- and random-effects linear models with an AR(1) disturbance		+	
Regression with Newey-West standard errors	+	+	
Feasible Generalized Least Squares	+	+	+
Linear Regression with Panel-Corrected Standard Errors	+	+	+

Source: based on Hoechle, (2007).

Our preliminary diagnostic tests revealed certain issues in the dataset, indicating that besides Driscoll-Kraay estimators with fixed effects, other techniques might be necessary. Researchers recommend fixed or random effects with 'robust' or 'cluster' standard errors, regression with Newey-West standard errors, linear regression with panel-corrected standard errors, and Feasible Generalized Least Squares (Hoechle, 2007). Table 14 outlines the methods used to address certain issues.

To validate the results of our hypothesis testing, we applied alternative techniques, such as Feasible Generalized Least Squares (FGLS) and Linear Regression with Panel-Corrected Standard Errors (PCSE), to some sections of our empirical analysis.

5. The impact of demographic transition on economic growth of Central Asia: empirical analysis

This chapter is based on a paper published in the *Post-Communist Economies* journal[43].

5.1. Methodological framework and hypothesis

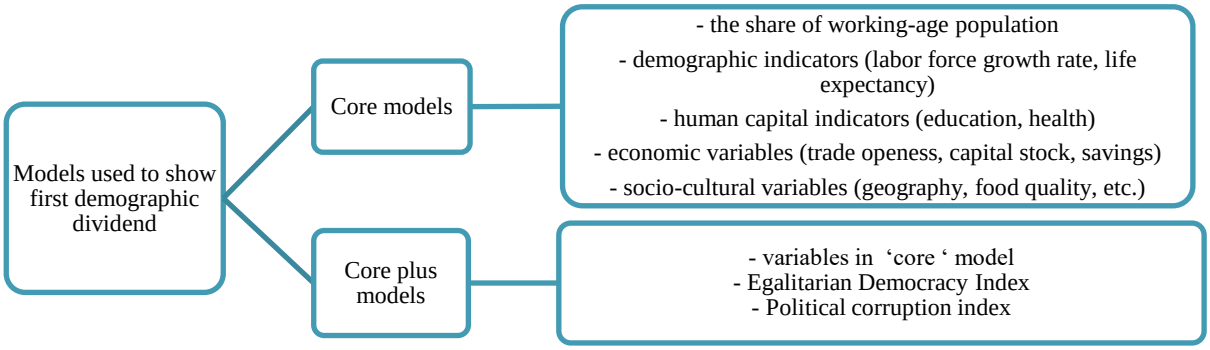
After presenting the main elements of the economic and social situations in the Central Asian countries in the previous section, we will also examine the drivers of development through our growth model. Our modelling tool is based on a version of the post-neoclassical growth model that takes into account demographic developments.

In neoclassical growth models, only population growth took place as a demographic variable. However, the approach has become more differentiated in the literature, where the first demographic dividend is modelled. These models explore the returns to the working-age population and the GDP-increasing effect of the first demographic dividend. In this regard, the idea that an increasing working-age population can boost economic growth and that this potential is dependent on labour policies, macroeconomic management, and education policies is essential (Choudhry & Elhorst, 2010). A detailed explanation of the economic and demographic background was given in the third chapter.

Therefore, in empirical estimations of the demographic dividend, economic growth is explained by the standard explanatory variables, which we will call "core" explanatory variables. These variables are the working-age share of the population, demographic and human development indicators, and economic and socio-cultural variables. With respect to these variables, we refer to these models as "core- models". Figure 15 illustrates the most important variables of the "core-models". We refer to the models where democracy and corruption indicators are also taken as explanatory variables as "Core-plus" models in the present paper. We have used the Egalitarian Democracy Index and the Political Corruption Index to represent these factors.

[43] Berde, É., & Kurbanova, M. (2023). Does the demographic dividend with human capital development yield an economic dividend? Evidence from Central Asia. Post-Communist Economies, 35(2), 154-178.

Figure 15: Model Structure for Describing the First Demographic Dividend



Source: own research

In this research, we have used "Core models" and "Core plus models" to describe how the first demographic dividend evolved. We are testing the following two hypotheses:

Hypothesis 1: The same demographic and economic variables that have influenced the first demographic dividend in other countries are also crucial in Central Asia.

Hypothesis 2: In the Central Asian countries, where there are many contradictory economic forces, other variables like the level of democracy and the level of corruption also play a vital role in determining whether the first demographic dividend can exert its effect.

5.2. Data description

For this study, the data is combined from different data sources covering 1991-2018 for each of the five countries. We have mainly used data from World Development Indicators published by the World Bank. The UNDP's Human Development Report serves as the source for the average year of schooling. The data for the quality of government, the Political Corruption Index, and the Egalitarian Democracy Index are being used from the University of Gothenburg database. The sample selection and the time period are partly based on data availability. Table 15 provides information about the data, including sources and measurement units.

Table 15: Data and sources for economic growth estimation

	Indicator	Source of data
loggdppc	Log of GDP per capita (constant 2010 US$)	World development indicators by the World Bank
WAP	The working-age share of the population (population aged 15-64, % of the total population)	World development indicators by the World Bank
CS	Gross capital formation (% of GDP)	World development indicators by the World Bank
AG	Employment in agriculture (% of total employment) (modelled ILO estimate)	World development indicators by the World Bank
SR	Employment in services (% of total employment) (modelled ILO estimate)	World development indicators by the World Bank
FL	Female labour force participation rate (% of female population ages 15+) (modelled ILO estimate)	World development indicators by the World Bank
ODR	Old dependency ratio (% of working-age population)	World development indicators by the World Bank
YDR	Young dependency ratio (% of working-age population)	World development indicators by the World Bank
$g_{L_{it}}$	Growth of life expectancy	World development indicators by the World Bank
X	Mean years of schooling (years)	Human development report by the UNDP
$g_{U_{it}}$	Growth of urban population	World development indicators by the World Bank
CR	Political corruption index	University of Gothenburg database
GI	Egalitarian Democracy Index	University of Gothenburg database

Source: edited by the author

Most of the variables are standard economic categories and do not need further explanation. The Political Corruption Index and the Egalitarian Democracy Index are taken as proxies for governance effectiveness. The meaning of these two variables has already been explained in Section 3.

The descriptive statistics for all the variables are calculated and provided in Table 16. According to this, the region's average GDP per capita during the analysis period was around $2700. The average share of the working-age population (people aged 15 to 64 as a percentage of the total population) is 61.5%. However, the female labor participation rate is low, accounting for more than half of the working-age women who do not work. In addition, the region's countries have about 10 years of schooling on average. Section 3 contains in-depth analyses of the other variables.

Table 16: Descriptive statistics of economic growth estimation variables

Variable	Mean	Std. dev.	Min.	Max.	Obs.
Gdppc - GDP per-capita	2771.242	2869.541	366.9354	11165.54	140
WAP_{it} The working-age share of the population	61.57	4.71	51.74	69.13	140
CS Gross capital formation	26.10	9.01	9.01	51.93	140
FL_{it} Female labour force participation rate	49.95	11.32	29.17	65.66	140
AG_{it} Employment in agriculture	37.32	11.54	16.26	61.35	140
SR_{it} Employment in services	39.58	9.07	22.8	63.30	140
$g_{L_{it}}$ Growth of life expectancy	0.32	0.60	-1.74	2.33	140
X_{it} Mean year of schooling	10.04	1.03	8.1	11.8	140
$g_{U_{it}}$ Growth of urban population	1.51327	1.17	-1.71	3.77	140
CR_{it} Political corruption index	0.86	0.05	0.72	0.94	140
GI_{it} Egalitarian Democracy Index	0.47	0.13	0.23	0.70	140
ODR_{it} old dependency ratio	7.89	1.76	4.81	11.52	140
YDR_{it} Young dependency ratio	55.49	13.44	34.65	85.73	140

Source: own elaboration

5.3. Model specification

First, we estimate economic growth by the standard explanatory variables ("Core model"), which are given in equation (1a).

$$\text{loggdppc}_{it} = \beta_0 + \beta_1 \text{WAP}_{it} + \beta_2 \text{CS}_{it} + \beta_3 \text{AG}_{it} + \beta_4 \text{FL}_{it} + \varepsilon_{it} \quad (1a)$$

Where, i = 1, 2,… ,5 represents the cross-sectional units and t = 1, 2,…,28 is the time period and ε_{it} is the error term. The description of the data is given in table 16 above.

The alternate (b) version of the first equation, equation (1b), will also be used to examine different age groups' effects.

$$loggdppc_{it} = \beta_0 + \beta_1 ODR_{it} + \beta_2 YDR + \beta_3 CS_{it} + \beta_4 AG_{it} + \beta_5 FL_{it} + \varepsilon_{it} \quad (1b)$$

The working-age share of the population (WAP) has been swapped out for the old-age dependency ratio (ODR) and the young-age dependency ratio (YDR). This makes model (1b)

different from its simpler predecessor (1a). The remaining portion of the equation is identical to that in (1a).

In addition to the first model, we have added a set of relevant indicators that help us to determine other key components of the demographic transition in economic growth estimation (the "Core plus model") in a more general way. These potential contributing indicators contain not only governance effectiveness indicators but also human development indicators. This specification is expressed as follows:

$$\text{loggdppc}_{it} = \beta_0 + \beta_1 \text{WAP}_{it} + \beta_2 \text{AG}_{it} + \beta_3 \text{SR}_{it} + \beta_4 \text{FL}_{it} + \beta_5 g_{L_{it}} + \beta_6 X_{it-2} + \beta_7 g_{U_{it}} + \beta_8 \text{CS}_{it} + \beta_9 \text{CR}_{it} + \beta_{10} \text{GI}_{it} + \varepsilon_{it} \quad (2a)$$

The increasing working-age share of the population embedded in human capital is a crucial component of the demographic dividend. It increases workers' productivity (Cruz & Ahmed, 2018) and is a key channel for transforming unskilled workers into skilled ones (Golley & Tyers, 2012). Therefore, we use the mean years of schooling as a proxy for human capital in our estimation. It is noteworthy that the previous year's capital accumulation affects economic growth in the current year. Hence, adding education with a lag seemed reasonable in our estimation, and the choice of lag in the model (2a) was based on achieving the highest significant delay. Moreover, health as a measure of human capital could be a sensible inclusion in the analysis, as the literature suggests (Ahmad & Khan, 2018; Ogundari & Awokuse, 2018). Therefore, the growth rate of life expectancy has been included in the estimation. It is assumed that having a better healthcare system causes an increase in the population's life expectancy.

Also, urbanisation is considered to be one of the main components of human capital development. In fact, infrastructure is developed in urban areas, and people are more likely to have better access to education and health. This allows them to improve the living standards of the population and increase workers' productivity (Dao, 2012). In addition, in the endogenous growth model, labor plays a significant role in driving growth and transformation; therefore, urbanization must be taken into account in order to draw accurate conclusions (Haldar & Sethi, 2022). Hence, the growth rate of the urban population was added to our estimation as a proxy for living standards. To exploit the demographic dividend fully, well-established institutions are required. Hence, the Political Corruption Index and the Egalitarian Democracy Index were included in our model as proxies for governance effectiveness or institutional indicators.

$$loggdppc_{it} = \beta_0 + \beta_1 AG_{it} + \beta_2 SR_{it} + \beta_3 FL_{it} + \beta_4 g_{L_{it}} + \beta_5 X_{it-2} + \beta_6 g_{U_{it}} + \beta_7 CS_{it} + \beta_8 CR_{it} + \beta_9 GI_{it} + \beta_{10} ODR_{it} + \beta_{11} YDR_{it} + \varepsilon_{it} \quad (2b)$$

In model specification (2b), we focus on how the dependency ratio and additional explanatory variables impact economic growth. The principal difference in the model (2b) from its simpler predecessor (2a) is that it replaces the working-age share of the population with the old-age dependency ratio and young-age dependency ratio (henceforth the old dependency ratio and young dependency ratio, respectively). We have previously used the same practice in models (1a) and (1b). The remaining portion of equation (2b) is the same as that in the model (2a).

5.4. Empirical results and discussion

The common phase of the first demographic dividend in the five Central Asian countries allows us to identify the main drivers of growth by examining data from these countries in a single panel estimate. Panel data estimation has several advantages, such as obtaining better estimates through a larger sample, controlling unobservable variables, accounting for heterogeneity, and tackling the omitted variable bias problem (Ahmad & Khan, 2019). This approach is also useful in our case, as the time-series data that available for the region is not long enough to calculate the relationships separately in each Central Asian country.

To choose an appropriate method, a set of diagnostic tests needs to be implemented. A detailed explanation of each diagnostic test and their results is provided step-by-step in the fourth section, "Research Methodology." Therefore, we will proceed directly to our estimation results.

As mentioned in the methodology section, we classified our models into two groups: “Core models” and “Core models plus”. Here, “Core models” are represented by models (1a) and (1b), and “Core plus” models by (2a) and (2b). For our curiosity, we separately tested the impact of different age groups (young and old dependency ratios) on economic well-being in the ‘b’ version of both models.

The empirical estimation of all four model specifications (1a/b, and 2a/b) is expressed in Table 17. Stata-16 software was used to perform the estimation.

Table 17: Results of fixed effect estimation

Dependent variable: log of GDP per-capita

Variable	Model 1		Model 2	
	a	b	a	b
Constant	5.18 [0.97]***	6.60 [0.60]***	1.98 [1.26]	4.06 [1.17]***
WAP_{it} The working-age share of the population	0.018 [0.01]*		0.020 [0.008]***	
CS Gross capital formation	0.007 [0.002]***	0.008 [0.002]***	0.003 [0.001]*	0.003 [0.001]**
FL_{it} Female labour force participation rate	0.045 [0.01]***	0.043 [0.01]***	0.059 [0.006]***	0.059 [0.006]***
AG_{it} Employment in agriculture	-0.035 [0.004]***	-0.037 [0.003]***	-0.010 [0.011]	-0.015 [0.011]
SR_{it} Employment in services			0.015 [0.014]	0.012 [0.014]
$g_{L_{it}}$ Growth of life expectancy			-0.067 [0.017]***	-0.058 [0.018]***
X_{it-2} Mean year of schooling			0.134 [0.02]***	0.130 [0.025]***
$g_{U_{it}}$ Growth of urban population			0.091 [0.016]***	0.093 [0.018]***
CR_{it} Political corruption index			-1.034 [0.51]**	-1.283 [0.55]**
GI_{it} Egalitarian Democracy Index			0.816 [0.242]***	0.727 [0.231]***
ODR_{it} old dependency ratio		0.036 [0.19]		0.025 [0.018]
YDR_{it} Young dependency ratio		-0.008 [0.004]**		-0.009 [0.003]***
R-squared	0.81	0.82	0.92	0.92

Driscoll-Kraay standard errors are in parenthesis

Note: *, **, *** represents Significance level at 10%,5% and 1% respectively.

According to the results aggregating five countries in both model specifications (1a) and (2a), the coefficient of the working-age share of the population is positive and highly significant. This confirms the theory that demographic transition is a driver of economic growth in transition economies (Aiyar & Mody, 2013; Bloom et al., 2001). It provides evidence that Central Asia still has an opportunity to translate today's demographic realities into tomorrow's economic prosperity, even if they have not applied every possible measure in the past.

Interestingly, even if some economic and political hardships distort the opportunity for GDP growth in some Central Asian countries (Tajikistan and Kyrgyzstan), the contribution of the demographic dividend to economic growth can still be seen in our estimation results. Similar results were shown by Abdulloev et al. (2014) and Denisenko et al. (2020). Besides, the coefficient of the working-age share of the population is larger in the model (2a) compared to (1a) (1.8% and 2.0%, respectively). This supports the claim that the impact of demographic transition will be more powerful in a condition of improved human capital, in well-established government institutions, and corruption-free societies.

The coefficient of capital stock is positive and significant, highlighting that higher capital formation encourages economic growth. This result is consistent with the findings of Ahmad and Khan (2018, 2019).

The magnitude of the demographic benefit is determined by the economy's ability to absorb an additional labour force. It can be maximised by providing job opportunities for the upcoming bulk of the economically active population, particularly the female labour force (Ahmad & Khan, 2019; Aiyar & Mody, 2013; Bloom et al., 2009). All models' results show a positive and significant coefficient for female labour force participation, indicating its importance in the labour market. As a result of increased female labour force participation, living standards rise, economic growth accelerates, and national income rises. In addition, it provides an opportunity for the achievement of the Sustainable Development Goals (SDGs), particularly SDG 5 ("Achieve gender equality and empower all women and girls").

On the other hand, the share of employees in the agriculture sector exhibits a negative effect, which is consistent with the results of Joe, Kumar, and Rajpal (2018). They found that the labour force should be shifted from low-productivity agricultural to high-productivity sectors. Hence, job opportunities for the upcoming young labour force should be created in more appropriate sectors of the economy. Agriculture is still one of the dominant sectors employing people in Central Asia; it ranges from 16% in Kazakhstan to 45% in Tajikistan (World Bank, 2020).

In model specifications (1b) and (2b), we tested whether economic growth can be boosted by reducing the number of dependents according to the demographic dividend hypothesis. As expected, the effect of the young dependency ratio is negative and significant in both the regression results summarised in Table 17. This means that a decrease in the young dependency ratio is one of the biggest drivers of economic growth in Central Asian countries.

The result is consistent with the findings of Cruz and Ahmed (2018), indicating that a decrease in the young dependency ratio leads to economic growth.

The old-age dependency ratio has a positive sign, which seems strange at first thought. This is probably the consequence of the fact that GDP per capita and the share of older people are both increasing. Moreover, the share of older people is still not very high in Central Asian countries. The positive coefficient does not indicate causation and does not represent an important part of equations (1b) and (2b), which can be seen from the fact that it is not statistically significant. These findings are consistent with the studies by Bloom, Canning, and Finlay (2010) and Choudhry and Elhorst (2010). They found that the old-age dependency ratio does not impact economic growth over the interval where it is still not very high. Moreover, Lee and Shin's (2019) findings highlight that the old-age share of the population will be impacted negatively when it reaches a certain level. In our case, the lack of impact can be explained by the fact that none of the countries in question have yet completed their demographic transition. They have a relatively low share of people aged 65 and above compared with countries experiencing ageing populations. In 'aged' countries, the proportion of people aged 65 and up exceeds 20%.

When more control variables were added to the model specifications (2a) and (2b), the results fully confirmed previous researchers' and our hypothesis that human capital, female labour force participation, and governance effectiveness significantly impact the economic growth of the Central Asian region. Human capital formation is considered one of the most important pathways for describing the impact of demographic changes on economic growth. In the current analysis, the education variable is positive and statistically significant. The lagged form of the variable indicates that previously investing in human capital affects economic growth in the current period and increases productivity. Similar results are found in Ahmad and Khan (2019) and Crespo Cuaresma et al. (2014). Conversely, technology adaptation when people have less human capital is shallow. In other words, demographic dividends can turn into economic dividends only in a highly educated society (Lutz et al., 2019).

The coefficient of the growing share of the urban population is positive and statistically significant, verifying the empirical findings of Fox and Dyson (2008) and Dao (2012). The urbanisation process is considered one of the main factors in human capital development. Thus, compared to their rural counterparts, urban societies benefit more from high-quality education, healthcare, and sanitation and have a higher life expectancy (Dao, 2012).

The growth in life expectancy has a significant negative impact on GDP per capita, which confirms the findings of previous scholars (Acemoglu & Johnson, 2007; Barro et al., 2010; Kunze, 2014; Sunde & Cervellati, 2012). The negative impact can be explained by the fact that increasing life expectancy requires additional resources for social care and pensions. This leads to a decrease in investment in children's education and other necessities (Kunze, 2014).

As has been argued, the demographic dividend is policy-dependent, meaning that the government plays an important role. A government that is socially accountable in delivering services and responsive to the needs of its citizens will ultimately create a democratic environment conducive to inclusive growth and human development (Emara & Chiu, 2016).

Our second hypothesis is based on testing the vital role of "other variables", such as the level of democracy and corruption. Our hypothesis is fully confirmed by our estimation results. Turning to our main variables of interest, the results of the (2a) and (2b) models have shown that the coefficient of the Egalitarian Democracy Index is significant. This demonstrates that governance effectiveness is an important determinant of the economic growth of developing economies. The positive sign of the coefficient shows that without effective governance and policies, the demographic gains will not be as powerful. In general, the importance of institutional factors in stimulating economic growth has been confirmed in the empirical literature and also proven in our model (Emara & Chiu, 2016; Emara & Jhonsa, 2014; Mehanna et al., 2010).

Regarding the other political variable, our results reveal a negative relationship between the Political Corruption Index and economic growth. Therefore, economic growth would be affected by the high level of corruption in the country. Corruption prevents efficient production and innovation and leads to decreased economic growth. The empirical evidence suggests that corruption reduces economic growth, especially in countries with low investment rates and low-quality governance (Aidt et al., 2008; Gründler & Potrafke, 2019; Tsanana et al., 2016). Since the Political Corruption Index is high among all Central Asian countries, they face many more difficulties in terms of economic development. Thus, this issue needs to be addressed urgently.

5.5. Conclusion

In this section, we have investigated the effect of changes in age structure on economic growth using the econometric model. We employed two models for our analysis. The first model included the standard demographic variables commonly used by scholars, while the second model, extended by us, incorporated additional variables that could influence the realization of the demographic dividend.

The results from both models affirm our hypotheses that the increasing share of the working-age population serves as a catalyst for accelerating economic growth. However, it is important to note that this demographic factor alone cannot guarantee sustained growth. Additional measures are required, such as providing adequate education to the active population, creating job opportunities, and empowering women. Moreover, as previously mentioned, the realization of the demographic dividend is contingent upon well-established policy frameworks. Effective governance can ensure that the gains from demographic changes are more inclusive, whereas corruption may undermine these gains.

6. Determinants of Socio Economic and Demographic Characteristics of Poverty and inequality in Central Asian countries

6.1. Theoretical framework and hypothesis development

In the previous section, we discussed the potential of Central Asian countries to harness the demographic window of opportunity for economic growth. In this section, we focus on the impact of the demographic dividend, with a specific emphasis on its relationship with poverty and inequality. While some scholars have attempted to analyse the effects of demographic changes, particularly changes in age structure, on poverty (Cruz & Ahmed, 2018; Kua & Piyachart, 2016), this area of research remains relatively limited in recent debates. However, for our study, the Poverty-Growth-Inequality (P-G-I) trilemma, which has been extensively studied by Bourguignon (2003), Breunig and Majeed (2020), Labidi et al. (2023), and Wietzke (2020), provides a theoretical framework that highlights these dynamics.

According to this trilemma, when a country experiences economic growth, it often leads to poverty reduction by increasing income levels, generating employment opportunities, and improving access to essential services. However, the inclusion of income inequality complicates the situation. High-income inequality can lead to social tensions and, importantly, can limit overall economic progress by concentrating wealth among a select few. This, in turn, can exacerbate poverty as it hampers marginalized and vulnerable groups' access to resources and opportunities (Bourguignon, 2003; Cerra et al., 2021).

However, due to the complexity of this trilemma, previous studies have indicated that the dynamics of this trilemma can vary significantly among different income groups and regional contexts (Adeleye et al., 2020; Gründler & Scheuermeyer, 2018; Labidi et al., 2023). Given the lack of prior analyses specific to the Central Asian context, this presents a unique opportunity and motivation for our study to investigate these dynamics.

The intriguing question pertains to the current state of the relationship within this trilemma in Central Asia. As we have previously mentioned, these countries, particularly Uzbekistan, Kazakhstan, and Turkmenistan, have witnessed substantial economic growth, primarily driven by natural resource exports such as oil, gas, and minerals. Theoretically, this economic growth should have contributed to poverty reduction. However, despite economic

expansion, income inequality remains a significant challenge in Central Asian countries. High-income inequality prevents the equitable distribution of the benefits of economic growth to all segments of the population, ultimately exacerbating poverty, particularly in rural areas, as observed in Tajikistan and Kyrgyzstan (Haquette, 2022; Seitz, 2019b).

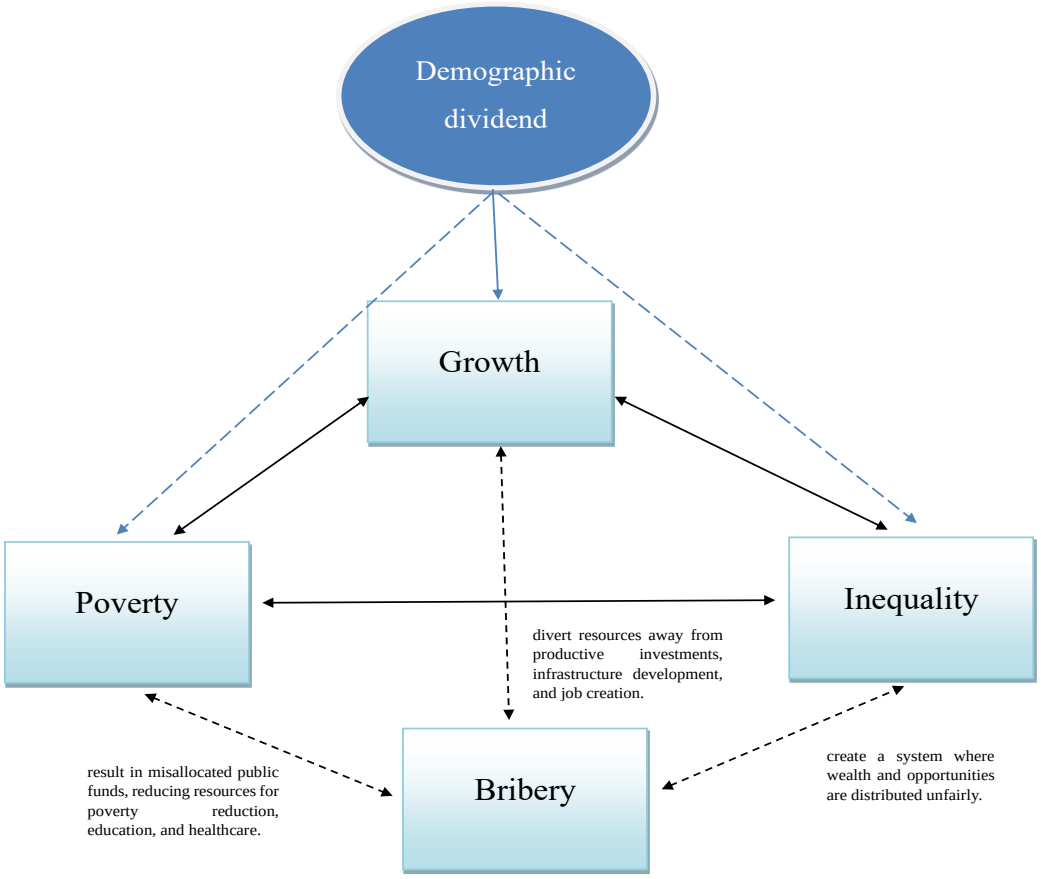
Then the question arises: why is this trilemma not working as expected? Some scholars argue that there should be other factors that ensure this relationship works effectively. For instance, Labidi et al. (2023) highlighted that while growth is typically required to raise the population's standard of living, it cannot guarantee the intended improvement in everyone's well-being or the eradication of poverty on its own. Even though a variety of policies and programs are introduced to address poverty and inequality issues, their efficiency often falls short (Negin et al., 2010). A contributing factor to this is the prevalence of bribery and corruption within a country. The concept of corruption is widely defined as when elected officials utilize their position of power to further their own interests by stealing and bribing money from public coffers (Kaufmann et al., 2010).

For instance, corruption is considered a major contributor to the low rate of African economic growth and the poorest region in the world (Jain et al., 2014; Usenata, 2022). Scholars argue that the economic potential of Africa can be unlocked only by finishing the cancer of corruption (Acemoglu & Robinson, 2015). Latin American countries are also suffering from high rates of corruption (Borja, 2020). Theoretically, higher growth rates are expected to reduce poverty, but bribery impedes the reduction of poverty by slowing down economic growth (Nel, 2020), decreasing wealth and national income, and raising government costs (Chaudhry et al., 2006). Furthermore, it has been demonstrated that growth is negatively impacted by income inequality, and if corruption exacerbates this issue, growth will be hindered as well, creating a barrier to the elimination of poverty (Maeda & Ziegfeld, 2015). Therefore, corruption contributes to poverty's self-reinforcing nature, particularly in low-income nations. Moreover, it limits the nation's political stability (Slijepčević et al., 2020). Hence, we can assert that bribery is a key element within this trilemma problem.

One may wonder how the bribery is linked to the demographic dividend. We assume that bribery has a particular effect on demographic dividend-related factors related to the demographic dividend. It can hinder the effects of demographic changes on poverty, growth, and inequality. Thus, the widely accepted theory of corruption in the economic literature forms the foundation for this study. There are many forms of corruption, such as theft, nepotism, embezzlement, and wastage of public money (UNODC, 2020), but bribery is a widespread form

of corruption that has an everyday impact on the lives of millions of people (Nel, 2020). Therefore, we extend the Poverty-Growth-Inequality framework by introducing the dimension of bribery within the context of demographic dividends and propose the Poverty-Growth-Inequality-Bribery (P-G-I-B) Quadrangle (Figure 16).

Figure 16: Proposed P-G-I-B Quadrangle framework



Source: made by author

Proven relationship in the literature, ---------- Proposed relationship

We assume that the relationships within the quadrangle are as follows: Bribery has a direct effect on growth as it deters foreign investments, infrastructure development, and job creation. As a result, it hinders the effective utilization of the working-age population for economic growth, thereby affecting the demographic dividend's potential. Moreover, bribery can divert resources away from investments in education and healthcare, which are the main components of the demographic dividend, hindering human capital formation and limiting potential poverty reduction (Usenata, 2022). Additionally, bribery can contribute to income inequality by creating unequal access to opportunities, meaning that the benefits arising from

the demographic dividend may not reach all segments of the population equally, exacerbating income disparities.

Following our theoretical framework, we have developed the following hypotheses:

Hypothesis 1: A higher share of the working-age population will lead to a reduction in poverty rates.

Hypothesis 2: An increasing share of the working-age population will initially reduce income inequality.

Hypothesis 3: Bribery will be positively correlated with higher poverty rates and income inequality.

It's important to note that, as highlighted by Acemoglu and Robinson (2015), “corruption is a symptom and not the main disease”. To effectively address this issue, strong institutions and effective governance are needed to ensure that the benefits of the demographic dividend reach those who need them most. Thus, effective government plays a crucial role in mediating the relationship within the P-G-I-B framework in the context of the demographic dividend (Girishankar et al., 2001; Sittha, 2012).

Thus, through our study, we also aim to investigate whether good governance can enable the reduction of poverty and inequality, and we have developed the following hypothesis:

Hypothesis 4: Good governance can reduce poverty and inequality.

All of our hypotheses will be examined within the Central Asian context. In our empirical analysis, we mainly focus on poverty and inequality. Details regarding our methodology and data description will be provided in the following section.

6.2. Data selection and description

Our study employs a panel of five heterogeneous Central Asian countries during the period from 1991 to 2020.

To gain a greater insight into the effects of demographic dividends on two crucial issues—poverty and inequality—our study uses two dependent variables. The selection of suitable variables to represent these two indicators is particularly challenging, especially given

the scarcity of longitudinal data in the context of Central Asian countries. Consequently, our choice of indicators is driven by data availability as well as previous studies.

In this study, poverty is used as a dependent variable. Empirical analyses commonly employ two approaches to measure poverty: direct and indirect. Income is considered an indirect approach and is the most widely used to measure poverty (Jha & Dang, 2009b; Kua & Piyachart, 2016). Traditionally, poverty is measured by the number of people living below international poverty threshold. The World Bank provides internationally comparable estimates of poverty, with the poverty line set at $1.25 in 2005 and adjusted to $1.90 a day in 2011 (World Bank, 2020b). Moreover, the international practice uses income-class-specific poverty lines, defined at $3.2 for lower-middle-income countries and $5.5 for upper-middle-income countries. Conversely, the direct approach lies in the standard of living, such as having clean water or access to electricity (Kurbanova, 2022). In our study, we adopt an indirect approach, specifically the absolute poverty rate. This rate is calculated as the percentage of people residing in families whose consumption or income falls below the international poverty level of 1.9 dollars per day at 2011 international prices.

For the measurement of inequality, we utilize the Gini index, a widely employed metric in the literature (Wan et al., 2021; Wietzke, 2020). A higher Gini index value signifies a more unequal income distribution within society.

As a growth variable, the log of Gross Domestic Product (GDP) per capita (in constant 2015 prices) was taken to examine how poverty and inequality are influenced by the level of economic development.

To model the Poverty-Growth-Inequality-Bribery nexus, it is essential to include a variable representing bribery. To address this, we employed executive bribery and corrupt exchange data sourced from the Varieties of Democracy (V-Dem) project. It is a comprehensive international initiative known for its country-year ratings generated from firsthand information provided by at least five experts in respective countries (Wong, 2023). These estimates are derived from multiple evaluations submitted by experts in each country, with considerations made for discrepancies and measurement errors in the data (Teorell et al., 2019). The executive bribery and corrupt exchanges data measures the frequency with which executive branch officials, including heads of state, government leaders, and cabinet ministers, or their representatives, engage in favoritism in exchange for bribes, kickbacks, or other tangible incentives (Coppedge et al., 2021). The indicator is based on the survey where respondents

answered the question on a scale ranging from zero to four. A score of zero signified frequent or consistent executive corruption, while a score of four indicated an absence or near absence of executive corruption (Fish et al., 2015). This indicator has been employed in recent studies due to its disaggregated corruption measures (Lindberg et al., 2022; Martins et al., 2023; Wong, 2023; Zhang, 2023).

To gain a comprehensive understanding of poverty, it is advisable to explore the interrelationships among poverty and other socio-economic indicators in multidimensional poverty analysis (Kakwani & Silber, 2008). This approach provides a broader perspective on poverty (Gammarano, 2019) and informs more targeted policy interventions. Therefore, in alignment with previous research, we have introduced a set of variables into our estimation.

As we are particularly interested in the effect of demographic dividends, we include the share of the population aged 15-64 in our model. This variable serves as an indicator of demographic transition and enables us to assess whether a connection exists between demographic dividend, poverty, and inequality. We also consider population growth as an important demographic indicator.

Additionally, we incorporate data on population characteristics related to education and health variables. The body of research indicates that improving health and education can help one escape poverty. (Barro & Sala-i-Martin, 2003). As we have mentioned above, due to the scarcity of data, we were only able to obtain mean years of education and life expectancy at birth for these countries, which we have used as a proxy of education and health variables.

Most countries in the region heavily rely on remittances, making data regarding their characteristics crucial for the poverty-inequality model. For instance, in 2022, remittance receipts as a share of GDP for Tajikistan, Kyrgyzstan, and Uzbekistan were 51.1%, 31.3%, and 20.8%, respectively (Kim, 2023). Usually, in empirical studies of the nexus between poverty, inequality, and migration, most scholars use remittance inflow, its share in GDP, and per capita remittance as key indicators (Arapi-Gjini et al., 2020; Azizi, 2021; Vacaflores, 2018). However, this specific data is unavailable for each year of the considered time period in our sample. Consequently, we opted to use the net migration rate, which also reflects the trend of outmigration, in our estimation. This data is calculated by deducting out-migrants from in-migrants.

Also, we added people outside the labor force to our model. This category encompasses all persons of working age who, during the specified reference period, were neither employed

nor unemployed (ILO, 2023). This variable helps us to capture a more comprehensive understanding of labor market dynamics and the extent to which individuals are economically inactive, focusing on the hidden complexities of poverty and inequality within the population. Also, it accommodates individuals typically omitted from employment statistics, offering insights into their roles in shaping the economic landscape, including informal work, caregiving responsibilities, and unique circumstances influencing their vulnerability to poverty and inequality.

Women comprise half of the Central Asian population, and converting this resource into poverty reduction is encouraged as it can lead to women's economic empowerment. This can be achieved through various channels, such as improving women's access to employment opportunities, enhancing their participation in politics, addressing gender disparities, and so on (Altuzarra et al., 2021; Jamil et al., 2022; Khanie, 2019; Opoku et al., 2021). Surprisingly, many previous studies investigating poverty and inequality in the region have overlooked the role of women in parliamentary representation. Yet, increasing women's representation in parliament is often seen as a measure to promote gender equality and empower women. When women have a stronger presence in decision-making bodies, there is a better chance of policies and legislation being developed to address gender-based disparities, which can contribute to reducing poverty and inequality, particularly among women (Baskaran & Hessami, 2022; Lerch et al., 2022; Opoku et al., 2021). Given the significance of women's involvement in political decision-making, our study aims to investigate the potential impact of increasing the proportion of women in political roles on poverty and inequality within the Central Asian context.

One of the main concerns among scholars is how to manage environmental degradation in addition to poverty and income disparity. Environmental degradation, poverty, and income inequality have all been subjects of extensive debate and research. Empirical evidence on the same topic is mixed. Scholars have proposed various perspectives on their interrelationship: some argue that poverty and income inequality are significant contributors to environmental pollution (Khan et al., 2022), others find a mixed relationship (Masud et al., 2020), and still others suggest a positive link between them (Islam & Abdul Ghani, 2018).

Moreover, environmental degradation may affect poverty through the growth channel. In the literature, it is argued that economic growth and environmental pollution may follow the same trajectory, signifying that increased growth leads to higher pollution. This phenomenon is termed the "pollution dividend", and is especially prevalent in middle- and low-income countries (Ansari, 2022; Berde & Mengesha, 2023). As a result, it may reduce poverty.

However, the relationship between these factors is complex and multifaceted. This complexity becomes particularly crucial as the share of the working-age population increases, leading to greater demands for manufacturing and resource consumption to meet their needs.

As our primary emphasis lies on the demographic aspects of poverty and inequality, we will only concentrate on one of the tiny facets of the environmental issue. We acknowledge the broad scope of the topic, recognizing the need for a more comprehensive investigation.

While previous studies have explored the relationship between poverty, inequality, and environmental pollution using variables such as carbon emissions (CO2), our study takes a different approach by incorporating material footprint per capita into our estimations. Material footprint per capita goes beyond just carbon emissions and considers various environmental impacts associated with the extraction and utilization of natural resources. This approach provides a more comprehensive understanding of the environmental consequences of economic activities (Baloch et al., 2020; Khan et al., 2022). Essentially, material footprint per capita measures the quantity of natural resources consumed by individuals or groups of people. High material use can lead to resource depletion, a critical concern in a world with finite natural resources. By including material footprint per capita in our poverty and inequality estimations, policymakers gain valuable insights into how resource scarcity affects vulnerable populations, particularly in regions where resource shortages are a significant issue.

Most of the literature argues that to achieve the demographic dividend, well-established governance is required, and improving governance practices is an essential component of any comprehensive poverty reduction strategy, growth, and development. This encompasses facets like fostering access to high-quality employment and education opportunities, as well as fostering collaboration among civil societies, governments, and communities to establish laws promoting transparency and accountability across executive and administrative operations (Martin, 2006). This becomes particularly pertinent for Central Asian countries, which, having spent decades under Soviet rule, may face challenges in independently establishing robust governance practices. Hence, we investigate the potential impact of effective governance on our poverty and inequality estimation.

We use the governance indicators in two distinct ways: as individual variables and in constructing composite indexes. While composite indexes are not without their limitations and inherent subjectivity, they serve to condense various dimensions of governance into a single metric, thus helping to mitigate multicollinearity issues and align with the multidimensional

nature of governance (Datta & Singh, 2019; Polloni-Silva et al., 2021). Following the definition of the World Bank's Worldwide Governance Indicators, we select the component indicators (the appendix provides the list of component indicators) and source data from the University of Gothenburg's Quality of Governance database[44].

To streamline our good governance composite index and minimize information loss, we employ principal component analysis (PCA) (Jolliffe & Cadima, 2016; Spada et al., 2023). PCA transforms a set of correlated variables into a set of uncorrelated variables, or Principal Components (PC), preserving only common factors with eigenvalues exceeding one or the mean (Ceopedia, 2024; Jollife, 2002; Kaiser, 1974). To create the index, we initially standardize all variables. This step is crucial because PCA aims to maximize variance and is sensitive to the relative scales of the original variables. Normalization prevents any single variable from dominating the others, ensuring that the data analysis method treats all variables equitably (Akande et al., 2019). Then we constructed a Good Governance index through a varimax rotation of the principal components. The principal components (PCs) are linear combinations of the original variables and are ordered by their importance or influence on the dataset. Each principal component is associated with an eigenvalue derived from the correlation matrix of the dataset. The first principal component displayed in the table signifies the most influential one, determined by the eigenvector linked to the largest eigenvalue of the correlation matrix. This pattern holds true for the subsequent components as well (Zhong & Enke, 2017).

Our newly constructed Good Governance Index effectively encapsulates the majority of the information present in the original dataset, which comprises six governance indicators. Conducting a PCA yields a total of six components. Table 18 provides insight into the proportion of variance attributed to each principal component. The first principal component accounts for the largest share of the total variance in our data. As we move further from the first principal component, PC1, the subsequent components explain progressively less of the total variance. For instance, the first principal component factor accounts for 72% of the standardized variance, while the second, third, fourth, fifth, and sixth factors of the principal component contribute 15.8%, 5.0%, 3.7%, 2.2%, and 1.5%, respectively. However, our focus is primarily on the first principal component, as it possesses eigenvalues exceeding one, following Kaiser's

[44] Varieties of Democracy (V-Dem) is a novel approach to conceptualizing and measuring democracy. It provides a multidimensional and disaggregated dataset that reflects the complexity of the concept of democracy as a system of rule that goes beyond the simple presence of elections. The V-Dem project distinguishes between five high-level principles of democracy: electoral, liberal, participatory, deliberative, and egalitarian, and collects data to measure these principles.

criterion (1960). Also, this factor accounts for approximately 72% of the variability, representing the most substantial portion among all the factors. This implies that the first principal component offers superior explanatory power for the variations and is, therefore, the more robust measure of good governance in this particular context.

Table 18: Principal component analysis: factor loading, eigenvalue, and variance explained

Variables	PC1	PC2	PC3	PC4	PC5	PC6
DCI*	0.4514	0.0654	-0.2898	-0.0974	0.8035	0.2299
ECI*	0.4403	0.0240	-0.2857	0.7236	-0.3459	0.2841
EgCI*	0.4190	-0.1343	0.8580	-0.0120	0.0078	0.2647
LCI*	0.4624	0.0917	0.0596	0.0901	0.0155	-0.8751
PCI*	0.4031	0.4282	-0.1879	-0.6187	-0.4538	0.1734
PcorrI*	-0.2244	0.8862	0.2437	0.2754	0.1689	0.0223
Eigenvalue	4.2959	0.9482	0.3016	0.2257	0.1365	0.0919
Proporsion (% of variance)	0.7160	0.1580	0.0503	0.0376	0.228	0.0153
Cumulative	0.7160	0.8740	0.9243	0.9619	0.9847	1.0000

*DCI- Deliberative component index, ECI-Electoral component index, EgCI-Egalitarian component index, LCI-Liberal component index, PCI-Participatory component index, PCorrI-Political corruption index

Source: own elaboration

Another group of researchers analysed the effect of governance on poverty estimation by including the variables separately in the analysis (Jamil et al., 2022; Marrero & Servén, 2022). Following the previous studies, we have also tested one of the governance indicators separately. Thus, as a proxy for good governance, we use the Liberal Democracy Index. It sums up the essential liberal component of democracy and assesses the safeguarding of individual and minority rights (Ruth-Lovell et al., 2019). It considers factors like constitutional protection of civil freedoms, the strength of the legal system, the independence of the judiciary, and effective checks and balances (Coppedge et al., 2021). Incorporating an additional variable alongside the principal component introduces the need to compare the outcomes derived from these two approaches. It prompts an exploration of both the similarities and differences in the results, leading to an examination of the implications stemming from these disparities.

For our study, the data were obtained from secondary sources and databases. Poverty metrics, mean income, and inequality (presented in US$ using 2011 PPPs) are derived from the Poverty and Inequality Platform, an online poverty measurement tool developed by the Development Research Group of the World Bank. This platform draws from an extensive compilation of household surveys, making it a widely utilized resource among researchers.

While the majority of the data originates from the World Bank, governance indicators were sourced from the University of Gothenburg's database. The source of each data point is reported in Table 19.

Table 19: Data and sources for poverty and inequality estimation

Symbol*	variable	Unit	Source
poverty	Poverty headcount ratio	(% of population) (2011 PPP)	Poverty and Inequality Platform
Gini	GINI index	(% of population) (2011 PPP)	
NM	Net migration rate	per 1000 population	Macrotrends-the premier research platform
X	Mean years of schooling	years	Human development report by the UNDP
MF	Material footprint per capita	tonnes	
PF	Share of seats in parliament, female	% held by women	
GDPpc	GDP per capita	Constant 2015 US $	World Bank
WAP	The share of working-age population	population aged 15-64, % of the total population	
gP	Population growth	Annual %	
LE	Life expectancy at birth	years	
OLF	Persons outside the labour force	thousands, Age: 25+	International Labor Organization
Lib	Liberal component index	ranges from 0 (not at all democratic) to 1 (fully democratic)	University of Gothenburg database
Bribe	Executive bribery and corrupt exchanges	scale ranging from zero to four. A score of zero signified frequent or consistent executive corruption, while a score of four indicated an absence or near absence of executive corruption	
GG	"Good governance" Composite index	Composite index for effective governance was created using principal component analysis. The components are given in Apendix1	Own estimation

***** Variables with natural log transformations are GDP per capita, Persons outside the labour force and mean years of schooling.

Source: edited by the author

The summary statistics are given in Table 20. In 2020, Uzbekistan had the highest absolute poverty rate (10.8%) among the region's countries. In contrast, Kazakhstan demonstrated better performance in reducing poverty, with an almost zero rate. The Gini index, which represents income inequality, is different in these countries. Turkmenistan holds the highest value (0.408), highlighting that income is not distributed equally. On the other hand, in Kyrgyzstan and Kazakhstan, the situation is better, indicating that people's incomes are somehow equal among these regions' countries. With regard to demographic indicators, the share of WAP is almost the same across all countries, with an average of 62%, while population growth is the highest in Tajikistan, with 2.2% in 2020.

Table 20: Descriptive statistics of poverty and inequality estimation variables

Variable	Mean	Std. dev.	Min.	Max.	Obs.
Poverty	0.183	0.180	0.0002	0.606	150
Gini	0.352	0.057	0.267	0.463	150
GDP per capita	2967.388	2916.322	383.539	11402.76	150
WAP-share of working age population	61.694	4.612	51.744	69.134	150
X-mean years of schooling	10.717	0.826	7.619	12.347	150
PF- Share of seats in parliament, female	48.548	12	28.697	66.667	150
gP – population growth	1.426	0.849	-2.062	2.822	150
NM - net migration rate	-2.897	4.085	-17.868	2.212	150
LE- life expectancy	66.587	3.146	52.866	71.567	150
MF- material foot	9.745	9.358	1.47	44.26	150
Lib- Liberal component index	0.227	0.172	0.045	0.674	150
Bribe- Executive bribery and corrupt exchanges	0.423	0.303	0.146	1.661	150
Composite index "Good governance"	-0.007	2.071	-2.872	5.309	150

Source: own elaboration

6.3. Model formulation and estimation strategy

To test our hypothesis related to the influence of changes in age structure, socio-economic, and demographic factors, as well as good governance indicators, on poverty and inequality reduction, we conducted regression analyses using the aforementioned indicators. Given that our analysis accounts for both regional and time effects, the models were structured as follows: Initially, we estimated the Poverty-Growth-Inequality-Bribery (P-G-I-B) Quadrangle, with a primary focus on poverty and inequality estimation, as we have mentioned

above. The first poverty estimation model, as part of the quadrangle, is presented as follows (the abbreviation of all variables and their measurement are given in Table 20):

$$poverty_{it} = \beta_0 + \beta_1 logGDPpc_{it} + \beta_2 logGDPpc_{it}^2 + \beta_3 WAP_{it} + \beta_4 logOLF_{it} + \beta_5 logX_{it} + \beta_6 PF_{it} + \beta_7 g_{P_{it}} + \beta_8 NM_{it} + \beta_9 LE_{it} + \beta_{10} MF_{it} + \beta_{11} Gini_{it} + \beta_{12} logLib_{it} + \beta_{13} logBribe_{it} + \beta_{14}(logMeanIncome * logGini_{it}) + \varepsilon_{it} \quad (1)$$

In the subsequent estimations, we will repeat the same procedure but replace two governance indicators, such as the liberal component index and the executive bribery and corrupt exchanges index, with a newly constructed composite index, which we named «Good Governance».

$$poverty_{it} = \beta_0 + \beta_1 logGDPpc_{it} + \beta_2 logGDPpc_{it}^2 + \beta_3 WAP_{it} + \beta_4 logOLF_{it} + \beta_5 logX_{it} + \beta_6 PF_{it} + \beta_7 g_{P_{it}} + \beta_8 NM_{it} + \beta_9 LE_{it} + \beta_{10} MF_{it} + \beta_{11} Gini_{it} + \beta_{12} GG_{it} + \beta_{13}(logMeanIncome * logGini_{it}) + \varepsilon_{it} \quad (2)$$

Next, we will estimate the inequality model using the same technique as the poverty estimation.

$$Gini_{it} = \beta_0 + \beta_1 logGDPpc_{it} + \beta_2 logGDPpc_{it}^2 + \beta_3 WAP_{it} + \beta_4 logOLF_{it} + \beta_5 logX_{it} + \beta_6 PF_{it} + \beta_7 g_{P_{it}} + \beta_8 NM_{it} + \beta_9 LE_{it} + \beta_{10} MF_{it} + \beta_{11} Gini_{it} + \beta_{12} logLib_{it} + \beta_{13} logBribe_{it} + \varepsilon_{it} \quad (3)$$

$$Gini_{it} = \beta_0 + \beta_1 logGDPpc_{it} + \beta_2 logGDPpc_{it}^2 + \beta_3 WAP_{it} + \beta_4 logOLF_{it} + \beta_5 logX_{it} + \beta_6 PF_{it} + \beta_7 g_{P_{it}} + \beta_8 NM_{it} + \beta_9 LE_{it} + \beta_{10} MF_{it} + \beta_{11} Gini_{it} + \beta_{12} GG_{it} + \varepsilon_{it} \quad (4)$$

In the four above-mentioned equations, i denotes countries, while t represents time, β_0 is the intercept, β_1 to β_{14} denote the estimated coefficients for each variable, and ε is the error term.

In our estimations, besides economic growth, we included its square to capture non-linear relationships between economic growth (as measured by GDP per capita) and poverty and inequality, following previous scholars (Blanco & Ram, 2019; Jovanovic, 2018; Wan et al., 2021). According to economic growth theory, the nexus between income and poverty is not

strictly linear. In the beginning, as income increases, the reduction in poverty or inequality may be more significant, but at higher income levels, the impact may diminish. Including the squared term helps account for this non-linearity.

Additionally, we included the interaction term between income and the Gini coefficient in poverty estimation to represent that the poor in high-inequality countries benefit less from economic growth. The aim of adding this variable is to indicate the effect of domestic inequalities in income distribution on poverty (Bourguignon, 2003; Ravallion, 2006; Wietzke, 2020)

Before proceeding with our model estimation, we need to specify the appropriate panel-data estimation strategy. Detailed clarifications and steps are provided in the fourth section, "Research methodology".

6.4. Results and discussion

Being part of the same region enables us to explore the primary drivers of poverty and inequality reduction by analyzing data from all five Central Asian states within a unified panel estimation framework. Utilizing panel data estimation offers several advantages, including the ability to control for individual differences, reduce collinearity among variables, provide greater variability, and enhance degrees of freedom (Baltagi, 2008).

Table 21 presents the results of our estimations employing the fixed-effect model with Driscoll-Kraay standard errors. In the initial two models, the dependent variable is poverty, followed by the last two models, where the dependent variable is inequality.

One of the noteworthy aspects of our results is the significance of the coefficient associated with the share of the working-age population in all models. This emphasizes the importance of this demographic factor in understanding poverty and inequality dynamics. An increasing share of the working-age population can serve as a valuable asset for Central Asian countries, as it has the possibility to enhance economic productivity, thus contributing to overall economic growth and poverty reduction. These results align with the findings from prior studies (Ahmed et al., 2014; Cruz & Ahmed, 2018; Kua & Piyachart, 2016; Mason & Lee, 2004). However, it's crucial to ensure that the labor market can effectively absorb this workforce and create an enabling environment for their productive utilization.

Another noteworthy aspect is the coefficient of the share of working-age population. Although the significance of this variable is high in all models, its values vary among them. For instance, the effect of the share of working-age population is more pronounced in the poverty model than in the equality model. Specifically, a one-unit increase in the share of the working-age population is associated with a decrease of around 1.4 to 1.6 percentage points in the poverty headcount ratio, holding other variables constant. In contrast, this decrease is approximately 0.7 to 0.9 units in the equality model. This suggests that the demographic composition of the population plays a particularly influential role in determining poverty levels. This shows the importance of considering demographic factors when designing policies aimed at alleviating poverty.

Table 21: Regression results

variable	Dependent variable: poverty		Dependent variable: inequality	
	Model 1	Model 2	Model 3	Model 4
logGDPpc	-0.932***	-0.599***	-0.585***	-0.331***
$logGDPpc^2$	0.049***	0.028***	0.029***	0.014**
WAP	-0.014***	-0.016***	-0.007***	-0.009***
logOLF	0.033	0.046	0.043	0.061**
X	-0.377***	-0.177*	-0.501***	-0.263***
PF	0.0007	0.0007	-0.0008	-0.0006
gP	-0.021***	-0.016	-0.023**	-0.010
NM	0.011***	0.008***	0.012***	0.006***
LE	0.013***	0.007***	0.007**	0.001
MF	0.003***	0.004***	-0.001	-0.001
logLib	-0.122***		-0.064***	
logBribe	0.029***		0.020**	
Composite index “Good governance”		-0.024***		-0.022***
Interaction logmeanincome*loggini	0.193***	0.204***		
Poverty			-0.393***	-0.337***
Gini	-1.012***	-1.178***		
Constant		4.393***	4.001***	
Number of countries	5	5	5	5
Number of observations	150	150	150	150

Driscoll-Kraay standard errors are in parenthesis.

Note: *, **, *** represents Significance level at 10%,5% and 1% respectively.

As mentioned earlier, our models were constructed with the application of governance indicators through both direct variables and an aggregated "Good Governance" variable. The choice between models using principal components and those employing direct variables of governance in poverty and inequality estimations revolves around the approach to handling

multiple indicators of governance. In models with direct variables, each governance indicator is treated as a separate variable in models with direct variables, enabling a more detailed examination of the precise influence of each indicator on poverty and inequality. This method offers a clear understanding of how different aspects of governance affect the degree of poverty. Bribery is one of these variables.

Our estimation results consistently show that in both poverty and inequality models, the coefficient associated with bribery is positive and significant, with virtually identical values across all models. This indicates that bribery increases poverty and inequality within the context of Central Asian countries undergoing demographic transition. This outcome is consistent with previous research demonstrating the adverse effects of corruption on economic development, social equity, and overall well-being (Wong, 2023). Additionally, the existing literature regarding poverty and inequality can be expanded by confirming the quadrangle relationship of Poverty-Growth-Inequality-Bribery through our results.

It is highly concerning that bribery and poverty have a positive correlation. Our findings show that when bribery is prevalent and accepted in a community, public resources and funds are misallocated, which could otherwise be used for initiatives aimed at reducing poverty and inequality. Bribery has a regressive effect on poverty because it disproportionately impacts those who are already at the lowest end of the income distribution. Forcing individuals or households to pay bribes in order to access vital services or job opportunities increases their financial burden and exacerbates poverty. Marginalized and underprivileged groups often lack the means and connections to navigate corrupt systems, making their situation even more dire.

If we look at the case of Central Asian countries, we can observe that the prevalence of corruption and unfavorable business environments in these countries pose substantial barriers and risks for potential entrepreneurs. Additionally, the public sector may become unwieldy, resulting in limited job creation (World Bank, 2017). In addition, due to bribery, citizens are limited in their access to basic public services. For instance, in the Kyrgyz Republic, around two in five households paid bribes to access public services such as healthcare, education, etc. The situation is unfavourable in Tajikistan that every other household pays bribes. The highest bribery risk is in the police and civil courts (Pring, 2016). Effective anti-corruption measures and effective resource allocation are essential to harnessing the demographic dividend's potential for poverty reduction and economic growth.

The significant coefficient of the liberal component index in our estimation highlights the importance of governance once again. Higher democratization rates are more likely to facilitate the developmental process of governance. An intriguing aspect is the higher value of the variable in the poverty model. This suggests that the impact of liberalization on governance effectiveness may have a more pronounced effect on poverty reduction compared to its effect on inequality mitigation.

Moreover, models employing principal components aggregate information from various governance indicators into a condensed set of uncorrelated variables, termed "Good Governance." This composite measure emerges as a robust factor influencing both poverty and inequality, as its sign and value are consistent across all models, particularly within the demographic window of opportunity. For instance, a one-unit increase in good governance is associated with a decrease of around 2.4 percentage points in the poverty headcount ratio and 2.6 units in inequality, holding other variables constant. Our results indicate that an increasing share of the working-age population can lead to poverty alleviation when effectively integrated into economic growth and productivity through sound governance and strategic implementation that can also tackle bribery.

This is evidenced by the coefficient values. When comparing models that use separate governance indicators with those that use the aggregated "Good Governance" variable, the impact of the working-age population share is more significant under conditions of good governance. Specifically, in the poverty model, the decrease in the poverty headcount ratio is 1.6 percentage points with good governance, compared to 1.4 percentage points with separate indicators, holding other variables constant. This shows once more the importance of good governance in maximizing the demographic dividend and reducing poverty and inequality.

Good governance creates an enabling environment for equitable development by providing sufficient job opportunities and ensuring equitable access to education and healthcare, all of which are important for reducing poverty and inequality. Currently, evidence from Central Asian countries indicates that poor governance and bribery are the main obstacles hindering these countries from fully benefiting from social, political, and economic opportunities (Torres, 2019).

Additionally, GDP per capita exhibits a positive impact on poverty reduction, in line with the notion that as a country develops, the poverty and inequality levels tend to decrease. However, efforts need to be made to use the income properly and distribute it equally among

all individuals. Otherwise, the situation may worsen, as experienced in South American countries, where increased economic growth did not guarantee a reduction in poverty but instead only increased the wealth of the ruling class. This outcome underscores the importance of economic growth as a fundamental driver of poverty reduction and improved income distribution. The experiences of developed countries supports this idea, as they typically have lower poverty levels (Dollar et al., 2015; El Ghak, 2018). According to Roswton's growth theory, an increasing GDP reflects the growth output of goods and services, which generates jobs, increases income, and ultimately leads to poverty alleviation (Ogbeide-Osaretin, 2018). Additionally, countries experiencing higher levels of economic prosperity tend to have more resources available for social safety nets, education, and healthcare, all of which contribute to lower poverty rates and reduced income inequality.

The inclusion of the square of GDP per capita in our models signifies its significant effect on poverty and inequality. It indicates that initially, economic growth decreases the level of poverty and inequality when a country reaches a certain level of development but tends to increase both poverty and inequality with further economic growth. This confirms the existence of a non-linear relationship between these variables, consistent with the previous studies (Labidi et al., 2023; Soava et al., 2020).

Increasing economic growth, which could serve to reduce poverty and inequality, is mostly associated with increasing stress on ecological processes and resources. Our poverty results also show that the significance of the coefficient associated with a material footprint in all models, emphasizing the environmental dimension of poverty and inequality. A higher material footprint per capita is linked to increased poverty rates and income inequality in our model, which is in line with previous studies (Baloch et al., 2020; Khan et al., 2022). This outcome suggests that resource-intensive consumption patterns may exacerbate economic disparities and poverty. It highlights the urgency of adopting sustainable consumption practices and responsible resource management to reduce the environmental footprint while simultaneously addressing poverty and inequality, especially during the demographic transition.

In one of our inequality estimations (table 17, the last column), an increasing number of people outside the labor force correlates with higher poverty rates. Indeed, this result highlights the existing issue in the region, where individuals outside the labor force face limited access to economic opportunities. This lack of economic participation may arise from various factors, including inadequate education, skills, or restricted job market access, all of which contribute to poverty. When individuals struggle to secure employment or engage in economic activities

while entering the labor market, poverty rates tend to rise, particularly in the context of rapidly growing labor forces.

In light of this problem, it's important to recognize that a significant portion of Central Asia's population is forced to seek employment opportunities outside their home countries. As a result, these countries are among the largest recipients of remittances, which significantly impact their economies. This is reflected in our estimation results as well, where there is a positive relation between migration and poverty reduction (please note that the net migration is negative in most cases, so we interpret its sign in reverse). Thus, countries experiencing outmigration can lower poverty rates and income inequality. This finding highlights the potential positive impact of remittances that migrants can send back to their countries of origin. Remittances can act as an important source of income for households, contributing to poverty reduction and improved living standards. However, they also signify a potential brain drain, posing a challenge to long-term development opportunities.

However, there is a special concern regarding the outmigration of Central Asia due to its main destination, which is Russia. The main reasons for choosing Russia as an emigration destination country are familiarity with the language (the majority of the Central Asian population can speak Russian), significantly higher wages than in these countries, better employment opportunities, and the low cost of money transfers. In addition, previously well-established migrants assist with finding affordable accommodation and work for new arrivals (World Migration Report, 2020). As a result of high outmigration, the economies of Central Asian countries are highly reliant on remittances from Russia, with particular significance for Uzbekistan, Tajikistan, and Kyrgyzstan. But the COVID-19 outbreak has altered the circumstances, and the war in Ukraine has made it even worse. Almost all three countries have experienced a significant decline in remittance inflows since 2020. This has impacted emigrants' earning potential and their ability to send money home. Consequently, the financial inflow of remittances from Russia decreased, affecting households' ability to invest in various areas, including human capital (Seitz, 2019a; UNICEF, 2019a). In a demographic transition, sustained investment in human capital is crucial, and the recent situation indicates that these countries may struggle to fully benefit from demographic tailwinds due to lower levels of human capital.

The importance of human capital, particularly education, has shown its importance in our estimation as well. However, education becomes more powerful tool for narrowing income

disparities than for reducing poverty rates alone, as its impact is higher in the equality model compared to the poverty estimation. Several factors may contribute to this difference. While education is important for lowering poverty by providing individuals with the means to support themselves, its greater influence on inequality comes from its ability to create fair opportunities, promote social mobility, and raise productivity across all spheres of society. Enhanced education typically leads to better job opportunities and higher earnings for a wide range of people, not just those living in poverty.

Central Asian countries can optimize the potential of their growing working-age populations and potentially reap the benefits of their skills by addressing educational disparities and paving the way for higher-skilled employment. Education's importance is further supported by research, which shows that higher levels of education are associated with a decreased likelihood of falling into poverty (El Ghak, 2018; Zhang, 2021). Additionally, studies by Kua and Piyachart (2016) and Cruz and Ahmed (2016) have found that demographic transition, coupled with quality education, can alleviate poverty. However, challenges may arise in countries with high outmigration, as the most talented and highly educated individuals may leave, posing a threat that the demographic dividend could be realized more by host countries than the origin country. Therefore, in addition to enhancing educational levels, it is crucial to create suitable job opportunities and an enabling environment.

We also found interesting dynamics regarding life expectancy in the context of inequality and poverty in our investigation. According to our research, rising life expectancy is linked to increasing levels of inequality and poverty. Although this might initially seem counterintuitive, there are a number of factors that can help us understand this phenomenon. One possible explanation is the process of demographic transition. As countries undergo demographic transition, where birth rates decline and life expectancy increases, there is a period during which the population ages. As it is known, older individuals typically have lower earning potential and may rely on limited retirement savings or social safety nets, which can contribute to their vulnerability to poverty. Furthermore, this can strain social welfare systems and put pressure on working-age individuals to support the non-working population, potentially increasing poverty and inequality.

In a nutshell, our findings illuminate the multifaceted dynamics of poverty and inequality in Central Asian countries undergoing demographic transitions. Through our results, we confirmed all of our hypotheses. While the demographic dividend presents an opportunity

for reducing poverty and inequality and fostering economic growth, the significant challenge posed by bribery, coupled with the potential increase in environmental impact, necessitates strategic interventions. Addressing these challenges requires the implementation of "Good Governance," incorporating effective anti-corruption measures, governance reforms, and sustainable resource management. In order to fully realize the demographic dividend in Central Asia, this framework is essential. Furthermore, investments in education and skill development are imperative to ensure that the workforce can meaningfully contribute to economic growth and poverty reduction.

6.5. Robustness check

To ensure the reliability and robustness of our analytical findings, we conducted a comprehensive set of robustness checks to assess the stability of the key coefficients associated with hypotheses H1, H2, H3, and H4. The primary analysis employed a fixed-effects model with Driscoll-Kraay standard errors, and to validate our results, alternative estimators were applied, including Feasible Generalized Least Squares (FGLS) and Linear Regression with Panel-Corrected Standard Errors (PCSE) methods. The rationale for selecting these methods is detailed in the "research design" section.

We replicated the same models described in the model formulation and estimation strategy section of this study. Specifically, poverty and inequality estimations were conducted using governance indicators through both direct variables (columns 2, 4, 6, 8) and an aggregated "Good Governance" variable (columns 3, 5, 7, 9). The results of these alternative estimators are presented in Table 22. We mainly focused on our variable of interest and its connection to our hypotheses.

Consistently, the findings reinforce the significance of the working-age population share in all models of both methods, revealing its substantial impact on poverty and inequality and pushing back the poverty level. The values are also almost the same as those in the main model, lending robust support to our primary analytical framework. This consistency emphasizes the significant role of demographic composition in shaping economic outcomes.

Furthermore, the outcomes consistently highlight the role of controlling bribery in poverty reduction. Lower levels of corruption are consistently associated with diminished poverty and inequality rates, reinforcing the credibility of our primary results. Once again, we

confirm the quadrangle relationship of the Poverty-Growth-Inequality-Bribery through our alternative methods.

The robustness checks also extend to the governance component. The findings pertaining to good governance remain steadfast, accentuating its crucial role in the reduction of poverty and inequality. This consistency across alternative estimators bolsters the robustness and reliability of our primary analytical approach.

Additionally, the sign and significance of education, net migration, and the Liberal component index variables align with the main findings, highlighting the importance of human capital, outmigration, and democracy in the reducing poverty and inequality.

In summary, the outcomes from these robustness checks reaffirm the stability and credibility of our primary analysis, offering robust support for the relationships explored in the context of Central Asian countries undergoing demographic transitions.

Table 22: Robustness check

	FGLS				Linear regression with panel-corrected standard errors			
variable	Dependent variable: poverty		Dependent variable: inequality		Dependent variable: poverty		Dependent variable: inequality	
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
logGDPpc	-0.220***	-0.120**	0.080*	0.214***	-0.270***	-0.069	0.019	0.211***
$logGDPpc^2$	0.013***	0.010**	-0.002	-0.011***	0.016***	0.005	0.0005	-0.011***
WAP	-0.014***	-0.014***	-0.003***	-0.004***	-0.016***	-0.017***	-0.006***	-0.006***
logOLF	0.003	0.001	-0.011***	-0.024***	0.006	0.0007	-0.011**	-0.021**
X	-0.382***	-0.272***	-0.300***	-0.252***	-0.343**	-0.213*	-0.497***	-0.419***
PF	0.001**	0.001**	-0.0004	-0.0006*	0.0009	0.001	-0.001	-0.0008
gP	-0.026***	-0.020***	-0.020***	-0.018***	-0.040***	-0.030***	-0.028***	-0.021***
NM	0.008***	0.008***	0.006***	0.007***	0.009***	0.008***	0.009***	0.009***
LE	0.012***	0.009***	0.003**	0.003***	0.014***	0.013***	0.007***	0.005***
MF	0.011***	0.009***	-0.002***	-0.003***	0.010***	0.009***	-0.002***	-0.002***
logLib	-0.023***		-0.032***		-0.062***		-0.046***	
logBribe	0.008*		0.013***		0.011*		0.014**	
Composite index “Good governance”		-0.010***		-0.010***		-0.012***		-0.011***
Interaction logmeanincome*loggini	0.350***	0.374***			0.335***	0.363***		
poverty			-0.013	0.019			-0.064**	-0.016
Gini	-1.026***	-1.010***			-1.075***	1.116***		
Constant	2.822***	2.578***	0.801***	0.290	2.871***	2.085***	1.406***	0.687*
Number of countries	5	5	5	5	5	5	5	5
Number of observations	150	150	150	150	150	150	150	150

Source: own elaboration

6.6. Conclusion

The following section offers deeper insights into the demographic dividend, particularly its impact on poverty and inequality. We tested our hypotheses within the framework of the "poverty-growth-inequality" triangle and expanded it to include bribery, forming a "poverty-growth-inequality-bribery" quadrangle. Our primary focus was to examine the influence of changing age structures on poverty and inequality.

The estimation results reaffirm the potential of the demographic dividend to bring about macroeconomic benefits. Additionally, the findings underscore the crucial role of good governance in realizing the demographic bonus, while highlighting the detrimental effect of bribery on reaping demographic benefits. Moreover, the study reveals a U-shaped relationship between economic growth and poverty. Also, the results suggest that investing in human capital, particularly in education, can effectively address inequality and poverty.

To ensure the robustness of our estimation results, we conducted checks using alternative methods. The consistency in the signs and significance of the results across different methodologies validates the reliability of our findings.

7. CONCLUSION AND IMPLICATION

7.1. Conclusion

Many developing countries, including those in Central Asia, are currently undergoing a demographic transition, marked by a growing share of the working-age population. The change in the population age structure offers a special chance to gain macroeconomic benefits. However, our literature review highlighted that Central Asian countries are not exempt from the ongoing empirical discourse on the demographic dividend. This thesis aimed to contribute to this discourse by analysing the impact of changing age structures on economic growth and exploring its potential implications for poverty and inequality in the region.

Through a comprehensive historical overview, utilizing graphs and tables, we identified various challenges that impede the realization of the demographic dividend in Central Asia. Notably, shortcomings in employment policies pose a significant hurdle to effectively utilizing the expanding working-age population to drive economic growth and alleviate poverty. This situation has resulted in a notable outmigration trend, particularly in countries like Tajikistan, Kyrgyzstan, and Uzbekistan. Additionally, issues related to education quality and human capital deficiencies persist, as limited access to tertiary education contributes to a shortage of qualified specialists. The gender gap in both education and employment further compounds the challenges, alongside governance inefficiencies that hinder the effective implementation of development strategies.

To empirically investigate the impact of these challenges on economic growth and poverty during the demographic transition, we employed econometric tools. Our initial analysis focused on economic growth, utilizing panel datasets from the five Central Asian countries spanning the period between 1991 and 2018. The choice of the year 1991 was due to data availability, and it aligns with the year these countries obtained independence from the Soviet Union. Given the limited number of countries (5) and years (29) in our dataset, the fixed-effect model with Driscoll-Kraay standard errors emerged as the most suitable method for our analysis.

“Typically, in empirical studies of demographic dividends, economic growth is explained by the standard explanatory variables, which we have entitled “Core models”. In addition, we have assumed that the political environment also influences demographic dividends, so there might be other factors. We selected the Egalitarian Democracy Index and

Political Corruption Index, considering that they also have a significant role in the development of demographic dividends. We referred to the model with these additional factors as the "Core plus model". We have applied both models to our estimations.

Our model results have confirmed all our hypotheses. According to our first hypothesis, a direct link between demography and the economy has been demonstrated by our estimation. This indicates that the increase in the working-age share of the population is a potential source of the accelerating economic growth associated with the demographic dividend. In addition, education, which is taken as a proxy for human capital development, has a significant positive effect on economic growth. This result corroborates the human capital theory, which is based on the skills and knowledge of individuals, strengthened by education, improving their living standards. Investments in human capital increase the labour force engaged in the job market, boost productivity, and accelerate economic development. The female labour force participation rate has also been demonstrated to be one of the main elements of growth. It shows that countries can reap economic benefits from supplementary education and the empowerment of women. Finally, increasing the urban share of the population leads to economic growth.

Our calculations have also shown that the Egalitarian Democracy Index and the Political Corruption Index do matter in the growth model in the demographic transition stage. This result confirms that the demographic dividend is policy dependent, where increasing the level of egalitarian democracy accelerates economic growth, and corruption retards said growth. Thus, the greater the quality of public institutions, the more rapidly the country will develop. Our overall findings suggest and confirm our hypothesis that materialising demographic benefits do not depend only on human capital but that institutional factors also matter in the case of Central Asia"[45].

The second part of our empirical estimation focused on the effect of demographic dividends on poverty and inequality. In this part, we built our models on the "Poverty-Growth-Inequality" triangle. The time period is a bit longer than the first empirical part, precisely from 1991 to 2020. The same estimation technique as the first part was employed, with the robustness of the results validated through the alternative methods.

Our findings once again confirmed the macroeconomic benefits of the changing age structure. Indeed, the share of the working-age population, which represents the demographic dividend, highlights its possibility of reduction of poverty and inequality. However, one of the

[45] This part is based on Berde and Kurbanova (2023)

challenges in converting the demographic dividend into poverty and inequality reduction is the existence of bribery. Thus, the significant impact of bribery allows us to extend the "Poverty-Growth-Inequality" triangle into the "Poverty-Growth-Inequality-Bribery" quadrangle. Moreover, the environmental footprint emerges as another factor that can exacerbate poverty levels, signalling the need for sustainable development practices.

An overarching theme that resonates throughout our findings is the crucial role of good governance, mirroring the observations from the first empirical part. Our analysis consistently emphasizes that effective governance, characterized by anti-corruption measures, institutional reforms, and sustainable resource management, is essential for unlocking the complete benefits of the demographic dividend. It acts as an enabling force, fostering an environment conducive to equitable development, job creation, and access to essential services.

Moreover, the research has followed recent studies by introducing additional and region-specific (Central Asia) variables to capture the multidimensional conceptualization of poverty analysis, especially connecting with the demographic dividend. When we extended our estimation by adding additional human-wellbeing representatives and other socio-economic variables, the results indicated that poverty is a multi-complex problem. The empirical results of our estimation highlight the significant role of GDP per capita, outmigration, and democracy in decreasing poverty and inequality in the region.

Furthermore, education emerges as a crucial factor in the pathway to unlocking the demographic dividend once again. Addressing educational disparities and facilitating pathways to higher-skilled employment are imperative steps for Central Asian countries. Higher levels of education not only equip the workforce with enhanced skills but also act as a deterrent against falling into poverty.

In summary, our thesis has yielded several novel scientific findings. Firstly, we have empirically demonstrated that the positive economic benefits resulting from changes in age structure are applicable to Central Asian countries. This suggests that these nations can leverage demographic shifts to achieve economic growth while also mitigating poverty and inequality.

Furthermore, our research focuses on the complex relationship between the demographic dividend and governance performance in Central Asian nations through a comprehensive analysis. We find that while economic and demographic variables are crucial in realizing the first demographic dividend, factors such as the level of democracy and corruption also significantly influence its effectiveness.

Through cross-country comparisons, our study uncovers the diverse capacities of Central Asian countries to harness the demographic dividend. Despite undergoing similar

demographic transition processes, these nations exhibit varying abilities to capitalize on demographic shifts. We identify the obstacles impeding the realization of demographic dividends and propose policy implications.

Expanding upon existing research on demographic dividends, our study introduces bribery as a crucial institutional factor in the Poverty-Growth-Inequality-Bribery quadrangle. By integrating bribery into the research framework, we highlight its substantial impact on poverty rates and income inequality in Central Asian countries. This approach extends the scope of institutional economics, provides new insights into the dynamics of economic development and governance in emerging nations, and offers strategies for addressing these challenges within the broader context of development.

7.2. Policy implications

As we focus on Central Asia's experience with the demographic dividend, it becomes evident that the region has a unique opportunity to reduce poverty, promote economic growth, and address income inequality. However, realizing these benefits necessitates the implementation of effective measures.

After clarifying the existing challenges, which our estimations have confirmed, we can outline policy implications for realizing the demographic dividend’s potential in the region. To harness the capabilities of the working-age population effectively, there must be a paramount focus on developing and implementing robust employment policies. These policies should accommodate the expanding working-age population and create diverse job opportunities aligned with the skills and aspirations of the workforce. Additionally, investing in educational training programs to bridge skill gaps and enhance employability is crucial. Expanding access to tertiary education ensures a steady supply of qualified specialists, contributing to economic growth and poverty reduction. Targeting the female working-age population and empowering them socially and economically will increase women's participation in the workforce, fully realizing their potential. Efforts must address cultural and societal norms hindering women's career advancement.

Mitigating outmigration challenges requires addressing the root causes, particularly in countries like Tajikistan, Kyrgyzstan, and Uzbekistan. Formulating policies to retain skilled labor by improving local job markets and offering competitive incentives is essential.

Implementing sustainable resource management practices to mitigate environmental challenges provides additional support.

However, these policy implications can only be effective with the establishment of a robust system for monitoring and evaluating implemented policies, achievable through ensuring good governance. It promotes transparency and enforces anti-corruption measures to combat corruption, especially bribery. Strengthening institutional systems to prevent corruption and ensuring transparency and open governance are pivotal. Moreover, efforts should be directed towards increasing democracy by granting more freedom and access to citizens to participate in decision-making processes.

By implementing these policy recommendations, Central Asian countries can position themselves to effectively harness the demographic dividend, fostering sustainable development, reducing poverty, and promoting social inclusion. This proactive approach ensures that the demographic opportunity is not squandered but rather leveraged for the region's advancement, avoiding the transformation of a demographic opportunity into a demographic burden.

However, it’s crucial to recognize that although these policy implications provide a broad framework for inclusive demographic gains, unforeseen shocks can disrupt the prevailing conditions. The COVID-19 pandemic and the conflict between Russia and Ukraine serve as stark reminders of such unpredictability. For instance, the Russian-Ukrainian war introduces further uncertainty about how to navigate the demographic transition. The ongoing conflict has disrupted normal day-to-day relations with Russia, and its future trajectory remains uncertain. Nonetheless, some of the detrimental effects of these uncertainties can be lessened by solving current problems in the area.

7.3. Limitations of the research

While our study contributes insights into the impact of changing age structures on economic growth, poverty, and inequality reduction in Central Asia during the demographic transition, it is essential to acknowledge certain limitations:

Firstly, the existing dataset for these countries constrains our ability to comprehensively consider the impact of socio-economic factors. For instance, due to the absence of time series data for other education variables (such as the share of people with tertiary education, completion rates at different education levels, etc.), we were compelled to use only the mean years of schooling as a proxy for education. Employing more precise variables that better

represent education could offer a more nuanced understanding. Additionally, our analysis relies on existing datasets, and any limitations or inaccuracies in these sources could impact the accuracy of our results.

Another challenge lies in the considered time frame. As these countries recently gained independence, the available data mainly dates back to 1991. However, the demographic transition is a dynamic process, and the effects of changing age structures may continue to evolve beyond our chosen timeframe. Thus, considering a more extended time period would enable a more comprehensive understanding of the ongoing dynamics. Moreover, the lack of recent data did not allow us to capture the effects of shocks such as pandemics.

Central Asian countries exhibit unique economic, social, and political characteristics. Our analysis treats the region as a whole, potentially overlooking country-specific nuances that could affect the relationship between demographic changes and economic outcomes. A more granular examination of individual countries might provide richer insights.

Our analysis primarily focuses on internal factors within Central Asian countries. External influences, such as global economic conditions, international policies, or geopolitical events, may also play a role in shaping economic growth, poverty, and inequality. For instance, the ongoing conflict between Russia and Ukraine introduces a significant external factor that may impact the demographic landscape and economic dynamics in the region. The current analysis does not fully account for the potential implications of this conflict for Central Asia. A more inclusive analysis incorporating external factors could enhance the study's comprehensiveness.

Acknowledging these limitations, our study lays the groundwork for further research in this critical area, emphasizing the need for a nuanced and context-specific understanding of the demographic transition's implications for Central Asian countries.

7.4. Further research

Considering the importance of the topic, several unanswered questions present promising directions for further research. Firstly, an in-depth exploration into the impact of women's empowerment on realizing the demographic dividend could highlight gender-specific aspects. Investigating how empowering women through education, workforce participation,

and leadership roles contributes to economic development and poverty reduction would help identify obstacles hindering the realization of the demographic dividend.

Moreover, the role of youth is a pivotal factor in the demographic window of opportunity. Examining whether Central Asia's expanding young population can be the key to its demographic dividend and addressing the creation of job opportunities for the youth would be essential. Exploring the impact of technological advancements on the demographic dividend in Central Asia could also offer insights into how emerging technologies and digital transformations influence job creation, productivity, and economic growth.

Health is crucial for enhancing human capital, making it imperative to investigate the relationship between healthcare infrastructure and the demographic dividend. Specifically, assessing how a robust healthcare system contributes to a healthier and more productive workforce, positively impacting economic outcomes, could provide valuable insights.

For remittance-dependent Central Asian countries, researching the effects of migration policies on the demographic dividend is another intriguing avenue. Examining how policies encouraging or discouraging migration influence the utilization of human capital and economic outcomes would be crucial, considering the potential threat that a high rate of outmigration poses to Central Asia's demographic dividend to be reaped by host countries.

Additionally, examining the influence of cultural and social factors on the demographic dividend could provide valuable insights. Exploring how cultural norms, family structures, and social attitudes shape individuals' choices regarding education, employment, and family planning could uncover the cultural aspect of the demographic dividend.

Extend the study to consider longer-term demographic trends and their interplay with economic growth, poverty, and inequality in Central Asia post-resolution of the Russia-Ukraine conflict. Additionally, assess the impact of external shocks, such as pandemics, on the demographic dividend and its associated socio-economic dynamics in the region.

By addressing these research areas, scholars and policymakers can gain a more nuanced understanding of the factors influencing the demographic dividend in Central Asia and develop targeted strategies for sustainable development.

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Appendix

Table A1

Component indicators for the "Good governance"

Name of the component	Definition
Deliberative component index	This index is constructed using point estimates obtained from a Bayesian factor analysis model that incorporates indicators such as reasoned justification, common good justification, respect for counterarguments, range of consultation, and engaged society. To assess these aspects within a polity, we seek to gauge the extent to which political elites publicly justify their positions on public policy matters, justify their positions in terms of the public good, acknowledge and respect counterarguments, and determine the breadth of consultation at elite levels.
Electoral component index	The electoral component index is implemented as a chain defined by its weakest link among freedom of association, suffrage, clean elections, and elected executive. Achievement of this index is assumed when suffrage is widespread, political and civil society organizations can operate freely, elections are free from fraud or systematic irregularities, and the chief executive of a country is chosen directly or indirectly through elections.
Egalitarian component index	This index is derived by averaging the following indices: equal protection index and equal distribution of resources. Egalitarian democracy is realized when 1) the rights and freedoms of individuals are equally protected across all social groups; 2) resources are distributed equally across all social groups; and 3) access to power is equally distributed based on gender, socioeconomic class, and social group.
Liberal component index	This index is formed by averaging the following indices: equality before the law and individual liberties, judicial constraints on the executive, and legislative constraints on the executive. Achievement of this index involves constitutionally protected civil liberties, a robust rule of law, an independent judiciary, and effective checks and balances that collectively limit the exercise of executive power.
Participatory component index	This index is created by averaging the following indices: civil society participation, direct popular vote, elected local government power, and elected regional government power. The participatory principle of democracy emphasizes active citizen involvement in all political processes, both electoral and non-electoral.
Political corruption index	The index is determined by averaging the scores of (a) public sector corruption index; (b) executive corruption index; (c) the indicator for legislative corruption; and (d) the indicator for judicial corruption.

Source: (Coppedge et al., 2021)