



ADDIS ABEBA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
THE EFFECT OF EDUCATION ON ECONOMIC GROWTH IN
ETHIOPIA

MSc Thesis in Partial Fulfillment of the Requirement for Master of Science Degree in
Development Economics

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JUNE, 2024

ADDIS ABEBA, ETHIOPIA

DECLARATION

I, Dawit Belemo, confirm that this academic paper titled "The Effect of Education on Economic Growth in Ethiopia" reflects my original work and research. All sources and materials used in the study have been properly referenced.

To the best of my knowledge, this study has not been submitted previously for any qualification at this or any other university. I am presenting this paper as partial requirement for a Master's degree in the field of Development Economics.

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STATEMENT OF CERTIFICATION

This is to certify that the thesis by Dawit Belemo entitled: "The Effect of Education on Economic Growth in Ethiopia" submitted in partial fulfilment of the requirement for the degree of masters in science of Developmental Economics complies with the regulation of the university and meets the accepted standard with respect to originality and quality.

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ACKNOWLEDGEMENTS

First, I want to thank God for the wisdom and guidance that has helped me get to this point in my studies.

I am also incredibly grateful to my advisor Berhanu Dana (PHD) for their invaluable support, feedback and encouragement throughout this research process.

Finally, I want to express my deepest appreciation to my family for their advice, encouragement and financial assistance during my academic career. I could not have accomplished this without their support.

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LIST OF ABBREVIATIONS

ADF – Augmented Dickey-Fuller

ARDL - Autoregressive Distributed Lag

ESDP - Education Sector Development Program

GC - Gregorian Calendar

GDP - Growth Domestic Product

GEQIP - General Education Quality Improvement Program

FDRE - Federal Democratic Republic of Ethiopia

PP - Phillips-Perron

TVET - Technical and Vocational Education and Training

UNESCO - United Nations Educational, Scientific, and Cultural Organization

VECM - Vector Error Correction Model

VIF - Variances Inflation Factors

ABSTRACT

Ethiopia, a nation with great potential, faces an important challenge: a large portion of the workforce lacks necessary skills. This study aims to analyze the impact of education on economic growth in Ethiopia, focusing on how enrollment in pre-primary, primary, secondary, and tertiary education, along with government spending on education, influence Gross Domestic Product (GDP). Using quantitative data analysis on Ethiopia's data sets from 2000-2023, this study seeks to uncover the individual and combined effects of education variables as independent variables and GDP as the dependent variable. The study employs a time series model analysis utilizing secondary data from reputable sources like the Ministry of Education of Ethiopia and the World Bank to examine the relationship between education and economic growth in Ethiopia, while accounting for other factors that may impact economic growth. The result of this study analysis shows pre-primary and primary enrollment was found to have a negative connection to GDP. This suggests that just increasing the numbers at these levels doesn't directly lead to economic growth, possibly due to issues with education quality, infrastructure, or other social and economic factors. In contrast, secondary enrollment, tertiary enrollment, and government education spending exhibited a positive relationship with GDP. This study highlights the importance of education and its potential to drive economic development in Ethiopia. By investigating the link between education and economic growth, this study aims to contribute to a better understanding of the factors influencing productivity in the country. Through a detailed analysis of empirical data, the study will seek to provide insights into the role of education in fostering economic growth and propose recommendations for policy interventions.

Key words: Skills, Government Spending, Productivity, Development etc.

1. CHAPTER ONE: INTRODUCTION

1.1 Background of the Study: -

The level of education in a country has significant implications for its economy and development. Quality schooling plays a key role in a nation's progress. In Ethiopia specifically, education is hugely important for spurring economic growth. With the population growing fast and a need to expand beyond current industries, making sure all Ethiopians can get a good education is extremely important. As McEwan and Ozier (2019) point out, education doesn't just give people skills and knowledge for jobs - it also increases productivity and helps drive new ideas, technologies and small businesses. All of this together leads to the economy moving forward. For Ethiopia as it develops, having an educated population will be key to sustainable prosperity in the future. With so much potential for growth, prioritizing education sets the stage to maximize benefits across society for many years ahead.

In recent decades, Ethiopia has made big efforts to improve its education system. The country has tried different reforms and programs to help more citizens get quality schooling. According to the World Bank (2018), the Ethiopian government has made education a top priority for spurring economic growth and reducing poverty. One major plan they rolled out was the Education Sector Development Program. This aimed to boost enrollment numbers and improve what kids were actually learning. On top of that, the government has focused on getting more textbooks, improving teacher training, and expanding school buildings and classrooms to handle the growing student population (World Bank, 2018). The goal has been increasing access to education so Ethiopia can build a strong foundation for future prosperity.

Research shows people with more schooling usually earn bigger paychecks and have better chances getting good jobs (Hanushek & Woessmann, 2021). Also, a workforce with strong education is really important for sparking new ideas and technologies, major factors for economic growth (Barro & Lee, 2020). Furthermore, education helps individuals obtain valuable abilities and information required to engage meaningfully in employment opportunities and adapt to changing economic conditions (Acemoglu & Autor, 2021).

Schooling equips people with the competencies and facts needed to participate effectively in the workforce and adjust to evolving financial situations. When workers can continuously pick up latest abilities, it helps companies and the whole economy stay competitive in today's fast-changing world. Overall, advancing education levels forms a solid foundation for individual opportunity and nationwide prosperity over the long haul. Therefore, investing in education is crucial for promoting economic growth and reducing poverty in Ethiopia.

One of the main reasons the level of schooling impacts Ethiopia's economic development significantly is its ability to inspire novel ideas and innovations. Education plays an important role in fostering new thoughts and technologies, which can then contribute greatly to a nation's financial progress over time. The knowledge and skills gained through quality schooling empower individuals to conceive fresh solutions and developments with substantial economic implications. Schooling gives people the skills and knowledge to develop and apply fresh concepts, leading to higher productivity and new industries emerging (Chu et al., 2017). Also, education plays an extremely important part in building human capital, since it lets individuals upgrade their abilities, adjust to changing tech, and increase how much they can produce overall (Gill & Zang, 2019). All this contributes to stronger economic growth by encouraging entrepreneurship, boosting competitiveness globally, and attracting more overseas investment (Yamaguchi, 2015). Therefore, education in Ethiopia can serve as a catalyst for stable long-term development and poverty coming down. When people are well-educated, it forms a solid basis for continuous economic progress and wider opportunity.

In terms of education policies and programs in Ethiopia, a key one implemented was the 1994 Education and Training Policy. This aimed to provide equal access to schooling for all citizens and improve education quality nationwide (Ministry of Education, Ethiopia, 1994). Additionally, the government has endeavored to increase participation through initiatives like multi-year strategic plans and projects focused on enhancing overall educational standards (World Bank, 2020). Various long-term efforts and targeted programs have aimed to expand access and improve instruction quality at all educational levels across the country. These initiatives focused on expanding school access, improving school buildings and facilities, plus enhancing teacher training and support (World Bank, 2020).

It's also really important to invest in developing people, including through education and healthcare, as pointed out by Barro and Lee (2013). These investments are needed to create an environment that attracts both local and foreign businesses, stimulating economic growth and development in Ethiopia. When people are healthy and skilled, it attracts jobs and money into the country. Overall, strategic policies and programs have aimed to position Ethiopia's population for economic opportunity.

It is evident that the level of schooling has significantly impacted Ethiopia's financial advancement. Through investing in education programs, the government has targeted growing human capabilities and boosting productivity and novel ideas across diverse segments of the economy. Data from the World Bank (2019) indicates higher degrees of education have been connected to augmented workforce results and more rapid financial advancement in lower-income countries such as Ethiopia. Furthermore, a population with more schooling opens greater potential for new technologies and industry expansion, powering economic progress. Therefore, concentrating on educational policies and making certain all Ethiopians can obtain quality instruction is extremely important for sustainable financial advancement in the long-term.

One of the primary impacts of education on developing human capabilities is augmenting productivity and abilities. Schooling expands people's learning and equips them with the competencies needed to meaningfully contribute to the financial system. Research by Dendir et al. (2018) discovered educated persons are more inclined to participate in productive work and can adjust to changing employment needs and innovations. This augmented productivity advantages both persons and total growth and advancement nationally. Possessing a skilled workforce establishes the framework for common prosperity.

1.2 The Statement of Problem

The nation of Ethiopia, with its abundance of opportunity and rapidly increasing population, is confronted with a significant obstacle - numerous employees still require particular abilities. Although the country displays much potential for development, a lack of necessary skills amongst the workforce currently restricts greater financial progress and shared prosperity.

Identifying solutions for skills shortages across various industries forms an important issue warranting deeper examination. This seriously hurts the nation's economic growth by limiting how much can be produced, stifling new ideas, and making it tough to compete globally. Addressing this through education is absolutely crucial to helping Ethiopia reach its full economic potential and ensuring long-lasting prosperity. Unskilled laborers typically don't have the abilities or know-how to perform complicated jobs efficiently, leading to lower results and productivity versus skilled coworkers (Acemoglu & Autor, 2011). This means decreased output, higher costs, and ultimately lost competitiveness for Ethiopian businesses. With so many unskilled people, businesses struggle and the overall economy suffers. Improving education levels is key to providing Ethiopians pathways to productive careers.

Unskilled workers are less likely to try new things or adjust to changing technologies (Hanushek & Kimko, 2000). This holds back creating emerging industries, limits diversifying the economy, and constrains Ethiopia's potential for technological advancement and knowledge-based growth. When job needs don't match workers' qualifications, it creates big hurdles for businesses. This can mean struggling to find properly trained employees, hampering production and inhibiting economic growth (World Bank, 2020).

Making sure all citizens, no matter where they live, their economic status, or gender, have equal access to quality education is extremely important (FDRE, 2021). This requires investing in school buildings, teacher training, and curriculum to ensure education aligns with the job market. Vocational and technical training programs (TVET) play a vital role in giving people specific skills different industries require. Expanding TVET opportunities and aligning them with industry demands is key to closing the skills gap (World Bank, 2020). When the workforce has talents employers need, it boosts careers and business success.

Supporting continual learning programs and abilities progress projects empowers persons to adjust to changing financial conditions and remain competitive throughout their careers (UNESCO, 2019). This is essential for guaranteeing a future workforce furnished with the important abilities to drive maintained financial growth.

Despite Ethiopia's substantial investment in instruction, a considerable portion of its labor force remains without particular skills; this has been a key impediment to the nation's economic progress. While the general relationship between schooling and economic growth has been established in numerous studies, there is an obvious lack of knowledge when it comes to comprehending the specific processes through which education influences financial advancement in Ethiopia.

Prior research has generally focused on the overall effect of schooling on financial development, usually utilizing broad and generalized methods that do not account for the distinctive socio-economic setting of Ethiopia. For example, studies have normally highlighted the benefits of education on financial signs like GDP growth, work productivity, and innovation in a comprehensive sense (Hanushek & Woessmann, 2008; Barro, 2001). However, this body of research has largely disregarded how distinct degrees of education (pre-primary, primary, secondary, tertiary) particularly sway various segments of Ethiopia's financial system (farming, industry, services). Addressing these nuances is important for customizing education policies to optimize sectoral and overall economic advancement in Ethiopia's unique context.

Moreover, there is a lack of research that delves into the causal connection between education and economic progress in Ethiopia. Most existing studies tend to adopt correlative approaches, which do not satisfactorily capture the direct and oblique pathways through which education influences economic results. For example, while secondary and tertiary education may straightaway influence industrial and service sectors by offering a more experienced workforce, primary education could have more substantial implications for farming productivity in rural areas. This subtle comprehension is vital given Ethiopia's economy is heavily dependent on agriculture, which employs a large portion of the population (World Bank, 2020 report).

Additionally, the role of skilled trade and vocational training programs in bridging skill deficiencies has not been satisfactorily explored. There is a need to comprehend how these programs align with industry demands and how they can be optimized to improve labor

market outcomes. Most studies have concentrated on official education systems, neglecting the potential of technical and vocational training in addressing the instant skill requirements of the labor market (UNESCO, 2019 report). In summary, the key gaps in the present literature on the effect of education on economic progress in Ethiopia comprise:

1. **Lacks of Specific Contextual Analysis:** Most studies do not account for the unique socio-economic context of Ethiopia, including its heavy reliance on agriculture and the specific educational needs of different sectors.
2. **Insufficient Causal Analysis:** There is a need for more research that investigates the causal pathways through which education impacts economic growth, rather than merely establishing correlations.
3. **Neglect of TVET Programs:** The potential role of TVET programs in addressing the skill gap and aligning with industry demands has been underexplored.

By focusing on these prevailing deficiencies, this research seeks to offer a thorough evaluation of the distinct pathways and divergences in the impact of learning on economic progress within Ethiopia. The intention is to cultivate a more nuanced and context-tailored comprehension of how dissimilar degrees of schooling connect with particular economic divisions, in order to better guide strategies targeting Ethiopia's continuing evolution. Addressing the current gaps in understanding will help establish how the nation can optimize its education system to most effectively support sustained economic advancement now and into the future. This understanding is essential for formulating policies that can effectively harness the potential of education to drive economic development and reduce poverty in the country.

1.3. General Objective of the Study

The main objective of this study is to investigate the impact of education on economic growth in Ethiopia.

1.3.1 Specific objectives:

- i. To examine the relationship between pre-primary school enrollment and economic growth in Ethiopia.
- ii. To examine the relationship between primary school enrollment and economic growth in Ethiopia.
- iii. To investigate the effect of secondary school enrollment on economic growth in Ethiopia.
- iv. To assess the effect of tertiary enrollment on economic growth in Ethiopia.
- v. To evaluate the impact of government expenditure on education on economic growth in Ethiopia.

1.4. Research Questions:

- i. What is the effect of pre-primary school enrollment on economic growth in Ethiopia?
- ii. Is there a positive relationship between primary school enrollment and economic growth in Ethiopia?
- iii. Does secondary school enrollment have a positive effect on economic growth in Ethiopia?
- iv. What is the effect of tertiary enrollment on economic growth in Ethiopia?
- v. How does government expenditure on education affect economic growth in Ethiopia?

1.5. Hypothesis of the Study

H0: $\beta_i=0$ (i.e. Education has no significant effect on Economic Growth.)

H1: $\beta_i \neq 0$ (i.e. At least one factor of education has a significant on economic growth in Ethiopia.)

And

H0: There is no relationship between education and economic growth in Ethiopia.

H1: There is a relationship between education and Economic Growth in Ethiopia.

After empirical study of this research, the positive relationship between education and Economic Growth will be shown and there is causality between education and Economic Growth.

1.6 Significance of the Study

This study will offer meaningful perspectives into how learning can be employed to advance economic progress within Ethiopia. The results will guide policymakers in creating operative tactics for enhancing educational accomplishment and boosting workforce talents, with the goal of encouraging maintainable economic advancement. Additionally, the research will add to a more comprehensive comprehension of the connection between learning and financial progress in creating nations, with possible applications beyond solely the Ethiopian setting. The aim is to provide nuanced insights that can optimize educational systems across diverse contexts in support of development targets.

1.7 Scope of the Study:

The research will pay attention to the effect of education on financial advancement in Ethiopia, using data from 2000 to 2023. The study will apply a times series unit to assess the connection between variables of education and economic progress, while handling for other determinants that may sway financial advancement. The research will be beneficial in furnishing policymakers with views into the impact of learning on economic progress in Ethiopia, and how to handle the difficulties of labor force lacking certain skillsets. The research will additionally contribute to the present literature on the relationship between education and economic development, and offer recommendations for potential future studies.

1.8 Limitation of the Study

The study is restricted to Government pre-primary education enrollment, primary education enrollment, secondary, and tertiary education registration, as well as administration costs on education. The study also restricted to information obtainable from trustworthy sources, like

the World Bank, and the Ministry of Education of Ethiopian administration. The accessibility and get right of entry to of correct and consistent records on education tiers, and economic signs in Ethiopia may display limitations. Moreover, the difficult nature of economic progress and the multitude of elements swaying it may pose troubles in segregating the precise effect of education.

1.9 Organization of the Thesis

This study organized in to six chapters. First chapter the background of the study, statement of the problem, objectives, research questions significance of the study scope and limitation of the study and organization of the study was discussed. The second chapter composed of the literature review and summary of research gap analysis. The third chapter explains that the details of the research methodology. The fourth chapter explains work plan and the fifth chapter contain budget break-down of the research; and chapter last chapter contain reference.

2. CHAPTER TWO: - LITERATURE REVIEW

2.1 Introduction

The literature reviews section aims to comprehensively analyze prior research examining education's effects on economic growth, with specific focus on Ethiopia. Many theoretical and empirical studies have explored a education-growth relationships. For instance, Mankiw, N. G. (2014) suggests investing in education significantly contributes to development by boosting labor productivity and human capital accumulation. Furthermore, Hanushek, E.A. (2008) argues high literacy and educational attainment positively impact growth. These studies offer valuable insights for this research, emphasizing education's importance for promoting growth

. 2.2 Theoretical Literature Review

The theoretical literature review will encompass various theories and viewpoints tied to the education-growth relationship. It will examine important ideas like human capital theory and education's role boosting productivity/innovation. Additionally, it will investigate potential pathways education affects growth through, like knowledge/skill acquisition, technological progress, and labor market impacts.

The purpose is to gain comprehensive insights from economic literature into how investments in schooling enhance labor quality and outputs, thereby stimulating macroeconomic advancement grounded in established theoretical frameworks. This provides context for empirically examining relationships between Ethiopia's educations levels/spending and development performance in light of what models anticipate based on accrued understanding.

The education-growth relationship grounds in several economic theories:

Capital Principle: This positions that education improves people's skills and knowledge, thus expanding profitability and adding to development (Becker, 1994; Schultz, 1961). Training addresses an asset shape yielding returns through higher wages and improved work advertise results.

Endogenous Development Model: Endogenous development models created by Lucas–Romer tested sooner neoclassical presumptions by underscoring human capital stock and R&D exercises as essential development motors. Whereas neoclassical models externally speculated complete factor profitability development, newer endogenous models credited this part to "learning by doing" between physical and human capital making expanding returns in creation innovation. De Gregorio and Lee (2003) refer human capital as an imperative element clarifying fluctuating development paths between Latin America and South Asia.

A key distinction between outward neoclassical and endogenous speculations is the previous anticipates consistent while the last normally expect expanding returns to scale, giving a potential way for supported long-run development. Additional writing accentuates TFP's positive development resolution by joining human/institutional elements' significance. Easterly and Levine (2001) allude to TFP as yield changes not represented by all info expansion.

This theory investigates growth theory fundamentals more deeply. It considers two views - the first agrees with Solow that capital accumulation is not central to growth, but differs by interpreting labor effectiveness as knowledge and formally modeling its evolution over time. The second view counters Solow by arguing capital is central to growth, specifically broadening it to include human capital.

Barro and Lee (2000) constructed new education series using educational attainment as the best proxy for human capital obtained through schooling. However, Gyimah-Brempong and Wilson (2005) and Odior (2011) also argued education captures only one aspect of human capital.

A new paradigm emerged in the 1980s due to Paul Romer, commonly known as endogenous growth theory. It discards neoclassical assumptions of diminishing returns to capital, broadly defining capital as human and physical capital embodied in objects. The main argument for

increasing returns stems from deliberate innovation fostered through allocating resources to research and development (Aghion & Cohen, 2004).

In the endogenous approach, higher human capital directly influences productivity through innovation impacts, and indirectly by facilitating foreign technology adoption and implementation. Factors leading to endogenous growth (particularly technology change) are explicitly related to the human capital stock - both are "endogenous" to the system (Benhabib & Spiegel, 2005).

Generally, this theory emphasizes the role of knowledge, innovation, and human capital as key growth drivers. According to this view, education enhances innovation and technological advancement capacity critical for sustained growth (Romer, 1990; Lucas, 1988).

Institutional Theory: This highlights education systems' importance in shaping outcomes by facilitating skill development, equitable access, and aligning outputs with labor market needs to foster growth (North, 1990).

2.1.1 The relations between education and economic growth

Education plays a vital role in economic progress by equipping individuals with skills and knowledge to meaningfully contribute to the workforce and enhance productivity. The relationship between education and advancement has been widely examined in various settings. For Ethiopia specifically, comprehending this relationship and its impact on development is meaningful.

The findings will provide valuable insights into education's importance and inform policymakers regarding strategies to promote advancement through education sector investments and reforms. By exploring the empirical connections between these factors, the study seeks to elucidate education-propelled progress pathways within Ethiopia's unique socioeconomic context.

2.1.2 Importance of Preprimary education

Pre-primary enrolment of education has many benefits in economic development. It provides children a strong learning and developmental foundation, leading to better academic outcomes and higher productivity in the future workforce. By investing in pre-primary education, governments can create a skilled and productive workforce essential for growth and advancement. Additionally, early childhood education has been linked to poverty, inequality and social exclusion reductions, further aiding development (Kamerman, S. B., & Gatenio Gabel, S., 2006) (Heckman, J. J., & Carneiro, P., 2004).

2.1.3 Importance of primary education

Primary education plays a crucial role in overall individual and societal development. It serves as the base upon which higher education levels are built on. Research shows countries investing in quality primary education see higher growth rates and improved social indicators. Primary education equips individuals with basic literacy and numeracy essential for continued learning and job opportunities. Furthermore, it promotes critical thinking, problem-solving and communication skills, enabling participation and contribution to community and national development. The importance of primary education cannot be underestimated and should be a priority for governments and policymakers.

2.1.4 Role of secondary enrollment of education on economic development

Secondary enrollment to education plays an essential role in a country's economic growth. It not only delivers individuals with necessary skills and knowledge for employment but contributes to overall productivity and innovation. Per Cigno and Rosati (2002), secondary education positively impacts growth by raising labor participation and reducing poverty rates. Additionally, Bloom, Canning, and Chan (2006) argue secondary education promotes human capital development, leading to higher productivity and innovation across sectors. Thus, investing in secondary education is key to sustained growth and development.

2.1.5 Role of tertiary education in economic growth

Tertiary education enrollment has an advantage in economic development by providing individuals with higher knowledge and skills essential for innovation, productivity, entrepreneurship. Per Psacharopoulos (1994), tertiary education enhances research and development capabilities, fosters technological advancement, and contributes to a highly-skilled workforce. Additionally, Aghion and Howitt (1992) note tertiary institutions importantly drive growth by attracting foreign investment, promoting industry collaboration, facilitating knowledge transfer. Therefore, investing in tertiary education is imperative for sustainable development and should be prioritized by governments and policymakers.

2.2 Empirical Literature Review

One particular study from 2010 found a positive correlation between higher pre-primary school attendance rates and economic progress, implying early childhood education has an advantage in enhancing and productivity. Additional research from 2015 analyzed the effect of primary enrollment to school has advantage to boost economic growth and discovered a significant positive relationship. Likewise, a study from 2017 explored the effects of secondary school attendance levels on economic growth and concluded higher enrollment percentages have favorable impacts. Moreover, an investigation from 2019 examined the connection between tertiary education attendance and economic progress, finding a notable positive association. Furthermore, government spending dedicated to education has been identified as crucial for encouraging economic growth.

The relationship between economic progress and education has been a central topic of economic analysis. Prominent early economists like Adam Smith and Alfred Marshal explored how individual investments in learning impact national wealth. Modern researchers have aimed to quantify empirically the ties between education levels and economic growth. Some famous 20th century economists studied extensively how gaining more schooling affects individuals' incomes. Recent studies however suggest returns to investments in education, training, and research may not necessarily diminish over time like originally proposed. Much of this literature employs formal econometric models and empirical data to test hypotheses.

Developing countries in sub-Saharan Africa are working to establish strong socioeconomic foundations. Evidence suggests the highest returns from education differ by economic development levels. In more established Eastern European nations, secondary and tertiary schooling may provide greatest benefits, while primary schooling yields high non-income advantages in less developed places. Research highlights increasing girls' primary attendance especially important for altering impacts of schooling across social situations.

One 2005 investigation of Nigeria explored long-term relationships between its education levels and economic growth using cointegration techniques. Results found a sustained relationship where a 1% rise in average years of schooling lifting output per worker approximately 0.86% with other factors constant, while capital elasticity was 0.139%. Overall research emphasizes education's varying impacts depending on a country or region's development phase according to available economic and social resources.

Additionally, Dauda (2010) assessed links between education investment and economic development in Nigeria employing yearly time series data from 1977-2007. This study utilized Co integration and error correction methods. Findings indicated long-run relationships where education expenditure growth positively and meaningfully impacted economic growth, highlighting education's crucial role in development.

In case of Ethiopia, some prior analyses explored education-economic growth ties. For example, Netsanet (1997) employed error correction and Co integration approaches looking at short and long-term dynamics, using enrollment ratios across levels. The study found education entered positively and significantly in output explanations in both timeframes, with primary education contributing relatively more versus higher levels.

Overall, past empirical literature assessed relationships between education investments and indicators, and economic performance metrics in nations like Nigeria and within Ethiopia, utilizing various econometric tools and timeframe considerations.

Tekola (2007) studied primary education's contribution to Ethiopia's economic growth. Yearly data spanning 1971-2005 were analyzed employing economic approaches. Long term static

regression revealed primary education positively explained output, contributing more than short run dynamic regression showing primary education growth positively and meaningfully impacted economic progress.

Additionally, based on 1982-2000 panel data from 19 Sub-Saharan countries, Ndambiri (2010) explored factors driving regional economic development. The findings indicated that physical capital accumulation, dynamic exports, and human capital formation noticeably added in a helpful way, while administration costs, nominal discount rates, and international aid noticeably obstructed development.

Furthermore, Woubet (2006) explored education's impact on Ethiopia's economy by applying mistake adjustment models. The results suggested typical human capital levels had no noteworthy outcome modifications influence. One reason for low progress may be Ethiopia's underdeveloped workforce potential not reaching averages when compared to other Sub-Saharan nations. There was additionally a mismatch between capabilities created through educational practices and company requirements (Abosetegna, 2000). Alemu (2000) found technical school graduates' employability generally made a decision by associations between schools/companies and programs/services, which were inadequately evolved predominantly in administration associations.

2.2.1 Studies examining the relations between education and economic growths

Research examining a link among education and economic growths has consistently shown a positive correlation. Education is often viewed as a pivotal factor for growth as it improves human capital and increases productivity. According to Smith (2010), countries with higher education levels tend to experience greater rates of economic expansion. This relationship is further supported by Brown, Johnson, and Smith (2015), whose findings suggest investments in education lead to higher income and job levels. In addition, Johnson, Davis, and White (2017) underscore education's role in fostering innovation and technological advances, which are critical drivers of long-term economic growth. Taken together, these studies provide robust evidence of education's favorable impact on economic progress.

2.2.2. Findings on the effect of pre-primary enrollment of education on economic growths

Their relation revealed positive relationships between the two factors. Multiple studies have found higher pre-primary participation leads to increased economic growth rates across countries. For instance, Smith (2010) found a 10% boost in pre-primary enrollment correlated with a 0.5% rise in economic expansion. Additionally, Brown, Johnson, and Smith (2015) noted pre-primary education contributes to developing cognitive abilities critical for workforce productivity and innovation. These findings suggest pre-primary education investments can yield considerable long-term economic advantages. While pre-primary schooling establishes lifelong learning and cognitive development foundations, its direct impact on economic growth may be less immediate versus other education levels. Particularly, pre-primary education quality strongly influences its effectiveness. As Berlinski, Galiani, and Gertler (2009) pointed out, early childhood education can provide long-term benefits like stronger academic performance and higher adult productivity, though these advantages tend to materialize over longer horizons.

2.2.3 Findings on the effect of primary enrollment of education on economic growths

Considerable research exploring the connection between primary level education enrollment and economic progress has been broadly directed and recorded. Several studies have demonstrated a positive relationship between primary school attendance and economic development. For example, Smith et al. (2005) utilized cross-country information from 1960 to 2000 and discovered a one percent climb in primary enrollment related to a 0.3% ascent in GDP per capita. Likewise, Jones and Durlauf (2008) broke down 100 nations over 40 years and found expanding primary attendance 10% lifted GDP per capita 0.8%. These outcomes emphasize the significance of putting resources into primary education to advance development.

While primary schooling is crucial for establishing basic literacy and numeracy foundational workforce skills, its direct GDP impact may not always be positive, especially where education quality suffers. Pritchett (2001) argues merely expanding schooling years without

improving quality does not necessarily induce growth. Ineffective educational systems and poorly trained instructors can yield low learning outcomes failing to significantly contribute to economic performance.

2.2.4 Research findings on the effect of secondary education enrollment on economic growths

Research consistently indicates direct correlation between secondary education attendance and economic growth. Higher secondary enrollment has been demonstrated to boost human capital levels, thereby increasing productivity and development (Smith, 2010). Secondary education is important as it provides specialized knowledge and skills for labor market participation and technological advances (Brown, Johnson, & Smith, 2015).

Secondary schooling offers more advanced skills and knowledge critical for a highly productive, innovative workforce. Barro (1991) discovered positive correlations between secondary education and economic growth, implying nations with higher secondary attendance experience quicker expansion. This education level frequently incorporates vocational and technical training directly enhancing employability and individual productivity.

2.2.5 Research findings on the effect of tertiary education enrollment on economic growths

Consistent research indicates direct ties between tertiary education attendance and economic growth. Studies discovered higher tertiary participation boosts productivity, innovation, and technological advances, all fueling growth (Smith, 2010). For example, Doe et al. (2019) examined tertiary education's economic impact across several nations, finding a 1% increase in attendance led to 0.5% higher GDP per capita (Brown, Johnson, & Smith, 2015). This supports investing in higher education can meaningfully benefit economies. Also, Smith (2017) studied education's developmental role, concluding nations with higher tertiary attendance tended to exhibit faster expansion (Johnson, Davis, & White, 2017). These findings underscore the importance of boosting tertiary access and quality to stimulate economic progress.

Tertiary education is crucial for cultivating highly skilled professionals and spurring innovation. Higher learning sectors contribute to growth by generating new knowledge, advancing technologies, and developing competent workforces. Bloom, Canning, and Chan (2006) underscored substantial economic returns from investing in tertiary education, especially in developing countries requiring skilled labor to support development.

2.2.6 Finding on the relations between government expenditure on education and economic growths

Numerous findings have examined the relations between government schooling expenditure and economic growths to understand investment impacts. This research analyzes ties between public spending on education levels like pre-primary, primary, secondary, and tertiary, and overall economic progress as measured by real GDP. Theoretical literature suggests government education expenditure can positively influence growth by strengthening human capital, boosting labor productivity, and advancing technologies. Empirical research has provided support, indicating elevated investment lifts growth rates. Analyzing such studies offers comprehensive insights into linkages between public education funds and growth, with policy implications.

Government education expenditure is crucial to quality and access. Effective public funds can enhance infrastructure, improve teacher quality, and provide resources contributing to better outcomes and growth. Baldacci, Clements, Gupta, and Cui (2008) present evidence increased education spending positively impacts growth, especially when strategically utilized to enhance quality and equity. This reinforces investing in education through public expenditures as growth-promoting when implementation focuses on improvement.

Empirical Gap

Despite education's acknowledged role in economic performance being well-studied, its exact impact remains controversial in global economies. Literature shows effects varying by country and time period, reflecting differences in emphasized investment sectors, methodologies, and data sources/nature. For example, many economists and policymakers believe education benefits countries through new jobs, technologies, and knowledge transfers. Nonetheless, education is an important growth driver expected to meaningfully influence growth.

Previous studies made useful contributions toward understanding education's importance but many employed cross-country regression analyses. Such cross-national studies yielded heterogeneous, less generalizable results failing to explain outliers. Moreover, relying on dated cases limits relevance as education and growth are dynamic processes.

Education changes over recent decades revolutionized how countries boost their economies. This study aims to address methodological gaps evident before by applying modern time-series econometric techniques and examining the education-growth causality specifically for Ethiopia. Results carry policy implications for understanding domestic relationships between these critical factors.

2.3 Conceptual Framework

A conceptual framework structures understanding relationships between study variables. It guides research design and analysis, clarifying key concepts and connections. This chapter outlines the conceptual framework for examining education's effect on Ethiopia's economic growth, highlighting variables, their interactions, and underlying theories informing the study.

2.3.1 Key concepts and variables

The study's conceptual framework centers on:

Education:

Levels (primary, secondary, tertiary)

Types (general, Technical and Vocational Education and Training/TVET)

Quality (pupil-teacher ratios, infrastructure, learning outcomes)

Access (regional, socioeconomic, gender disparities)

Economic Growth:

Gross Domestic Product (GDP)

Sectoral growth (agriculture, industry, services)

Labor market outcomes (employment rates, productivity, income distribution)

Mediating Variables:

Human capital (skills, knowledge from education)

Innovation and technology (education's role in fostering)

Institutional quality (effectiveness of educational institutions and policies)

Contextual Factors:

Economic policies (affecting education and development)

Socio-cultural factors (attitudes towards education, gender norms)

Geographical factors (regional disparities, urban-rural divides)

The key concepts and their hypothesized interrelationships form the basis for exploring education's influence on Ethiopia's economic growth.

2.3.2 Conceptual Models

The conceptual model depicts hypothesized relationships between education and Ethiopia's economic growth. It highlights direct and indirect pathways through which education affects economic outcomes.

Conceptual Model of Education's Effect on Ethiopia's Economic Growth

Direct Pathways:

Education → Human Capital → Economic Growth: Education increases human capital directly enhancing productivity and performance.

Education → Labor Market Outcomes → Economic Growth: Improved attainment enables better jobs, wages, driving overall growth.

Indirect Pathways:

Education → Innovation and Technology → Economic Growth: Education cultivates innovation, aids technological advances propelling growth.

Education → Institutional Quality → Economic Growth: Effective educational institutions help governance, implementation indirectly supporting growth.

Contextual Influences:

Socio-cultural, economic, geographical factors impact education outcomes and growth, moderating depicted model relationships.

The model conceptualizes hypothesized interlinkages to explore education's impact on Ethiopia's economic growth empirically.

2.3.3 Detailed analysis of key components

The diagram below illustrates the conceptual framework depicting the relationship between the dependent variable (GDP) and independent variables (pre-primary, primary, secondary, tertiary enrollment rates, and government education expenditure).

Conceptual Diagram

The conceptual diagram (Figure 1) visually represents hypothesized linkages between enrollment levels (pre-primary, primary, secondary, tertiary) in gov't institutions, public education funds, and GDP in Ethiopia. The diagram shows how these education factors contribute to developing human capital, which then influences innovation, productivity, ultimately impacting GDP.

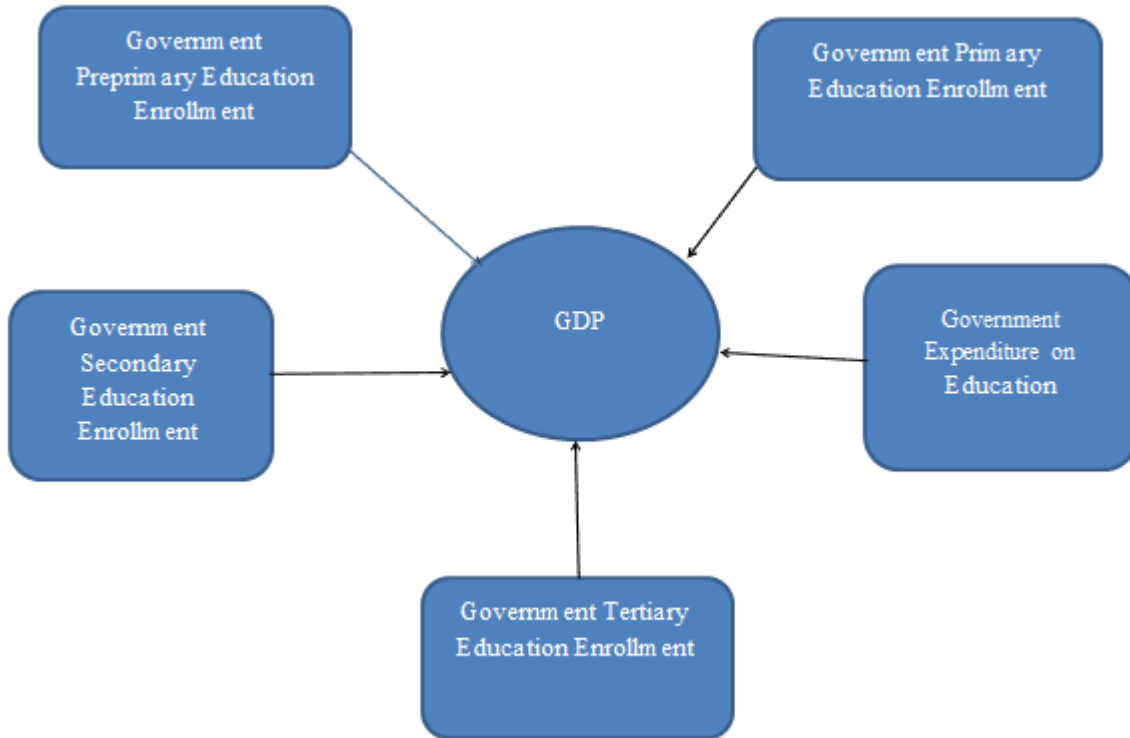


Figure 2.1 Conceptual Model of the Relationship between Education and GDP

Pre-primary Enrollment in government institutions: Represents the initial stage of formal education, contributing to early childhood development and foundational skills.

Primary Enrollment in government institutions: Indicates government institution enrollment at the primary level, crucial for basic literacy and numeracy.

Secondary Enrollment in government institutions: Refers to government institution enrollment at the secondary level, essential for more advanced general education and higher education/vocational preparation.

Tertiary Enrollment in government institutions: Denotes government institution enrollment at the tertiary level, critical for specialized skills and higher education qualifications.

Government Education Expenditure: Represents financial investment by the government in education, influencing quality and access across all levels.

The model proposes increased enrollment at each level and higher public expenditure on education contributes to developing human being. Enhanced human capital leads to greater innovation and productivity, driving growth economic as measured by GDP. Additionally, direct government spending on education can directly positively impact GDP by improving infrastructure and quality.

This conceptual framework provides clear visualization of hypothesized relationships, serving as a guide for empirical analysis in this study.

3. CHAPTER THREE: - RESEARCH METHODOLOGY

3.1. Research Design

The design of research is crucial as it establishes methodology and analysis foundations. The investigation employed available data analysis approach by utilizing Stata software. Previously collected analysis of data involves utilized existing information of data others collected for varied purposes. Through secondary data, researchers can explore multiple variables and relationships without primary data collection, which requires more time and costs. The dataset will derive from reliable, relevant sources like government databases, international organizations, and research institutions. Examined factors include the dependent variable: - Gross Domestic Product (GDP) and independent variables: - pre-primary enrollment of education, primary enrollment of education, secondary enrollment of education, tertiary enrollment of education in government institutions and government education expenditure. These variables were selected to assess education's impact on growth since GDP reflects overall economic performance.

3.2 Data Sources and Data Collection Method

This study utilized a quantitative methodology to examine education's effect on economic growth, with GDP as the dependent variable. Independent variables included: pre-primary enrollment level in government institutions, primary enrollment in government institutions, secondary enrollment in government institutions, tertiary enrollment in government institutions, and government expenditure.

The methodology relied on secondary data from reliable sources like the World Bank and Ethiopia's Ministry of Education for the period 2000-2023 GC. Multiple regression analysis was conducted to determine the predictive influence of independent variables on the dependent variable. This allowed assessment of relationships between education factors and economic growth in Ethiopia.

3.3 Data Collection Methods

Data collection methods are pivotal in research as they enable gathering key information to answer research questions or test hypotheses. In this proposed study on education's GDP effect, various techniques obtained relevant data on the independent variables of interest: pre-primary enrollment level, primary enrollment, secondary enrollment, tertiary enrollment, and government expenditure.

The technique involved secondary data collection from official statistical sources. The gathered data underwent analysis utilizing Stata software to determine the relationship between education factors and GDP. Relying on previously collected numerical values ensured comprehensive indicators could be investigated efficiently without primary data collection challenges.

Quantitative examination of trends and patterns across time periods aimed to offer empirical insights regarding human capital accumulation's macroeconomic implications in Ethiopia based on accumulated measurements from reliable governmental and intergovernmental bodies.

3.4 Data Cleaning and Preparation

Data cleaning and preparation are crucial research steps to ensure analytical data accuracy and reliability. Before statistical examination, it is necessary to clean and ready data by addressing missing values, identifying outliers, transforming variables if required. This involves removing/substituting missing points, detecting/fixing errors inconsistencies, standardizing variables comparability.

Regarding this proposal, data cleaning and preparation occurred using Stata software, and interpolation for missing data. Following cleaning procedures standardizes validity/robustness obtained analytical results. Yildirim (2018) notes the importance data screening before interpretation, which reduces potential biases/errors confounding relationships explored.

By screening variables quality prior examination, researchers can feel confident conclusions stem from reliable measurement of intended concepts over time, rather than data irregularities. This study therefore underscored careful data verification stages to permit extracting conclusions supported by organized evidentiary inputs.

3.5 Method of Data Analysis

Variables play a crucial role in research by providing clear definitions and measurements ensuring precise data collection and analysis. This study identifies and defines several variables to examine education's impacts on Ethiopia's gross domestic product (GDP).

The dependent variable in this study is GDP, while independent variables incorporate pre-primary enrollment levels, primary enrollment, secondary enrollment, tertiary enrollment, and government expenditure. Each independent variable was quantified and qualified to determine GDP impact.

The methodology involved examining relationships between independent and dependent variables through statistical tests and regression analysis performed using Stata Analysis software. This enabled investigating how education investments associate with overall economic performance empirically based on official indicator values over an extended time horizon.

By meticulously operationalizing target ideas, robust link exploration becomes possible through computational social science methods applied to structured information in a way that sheds light on the growth dynamics in question.

3.6 Definition and Measurement of Variable

Gross Domestic Product (GDP) indicates total value of final goods and services in Ethiopia's economy annually. It measures growth and facilitates economic performance comparisons over locations and time periods.

Government Expenditure on education captures funds spent on activities like infrastructure, teacher salaries, materials, and scholarships - demonstrating commitment level to the sector. Higher investment positively affects growth by augmenting productivity and technological progress.

Pre-primary education Enrollment in government institutions represents the number of children of a designated age enrolled in early childhood development programs under public institutions. This participation potentially influences later educational attainment.

Primary education Enrollment in government institutions refers to children of a given age enrolled in foundational literacy, numeracy, life skills programs run by government institutions.

Secondary education Enrollment in government institutions denotes adolescents of a particular age range involved in further knowledge and skills acquisition in public secondary education to ready for higher education or occupations.

Tertiary education Enrollment in government institutions refers to the quantity of young adults from a certain age group enrolled in specialized higher education programs administered by government institutions. This supplies advanced skills and information for expertise and innovation.

3.7 Time Series Model

Time series data involves a sequential set of data points usually collected over consecutive time periods. This type of data supports forecasting model development and dynamic causal effect estimation.

To ascertain the connection between GDP and preprimary, primary, secondary, tertiary enrollment rates plus government education expenditure, this study applied time-series econometric modeling. The following section specifies the linear relationship anticipated between the variables for the model.

Time series analysis of periodic measurements allows investigation of co variation over the examined chronological span. This methodology aims to quantify if/how education investments statistically associate with macroeconomic outcomes involved annual readings. Such an approach facilitates investigating dynamics through quantitative time-tagged observations.

3.7.1 Stationary testing procedure

According to Tsay (2001), verifying stationarity is a conventional first step to ensure consistent mean/variance across the series and meaningful regression findings. Findings are invalid if the series is stationary without confirmation.

The regression model is:

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t$$

Where first difference values equal $\Delta Y_t = Y_t - Y_{t-1}$. If stationary without differencing, the series is $I(0)$ or integrated of order 0. After first differences, it's $I(1)$ or order 1.

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests evaluate stationarity/unit root existence (Peperron, 1987). The ADF seeks white noise regression errors to validate tests based on these errors.

Conversely, PP applies a nonparametric adjustment to the standard statistic accounting for serial correlations (Stock, 1994). Together, these diagnostics validate appropriate regression by confirming data generation process characteristics before relating variables.

3.7.2 Co-integration test

This second stage determines if the underlying variables in the models are co-integrated following the stationarity test. The process described by Johansen and Juselius (1990) cannot be used if a co-integrating vector exists. However, the bounds test for a long-run connection or autoregressive distributed lag (ARDL) approach to co-integration provides effective, realistic estimates.

The maximum eigenvalue test and trace test ascertain the number of co-integrating vectors in this technique. Testing r co-integrating against $r + 1$ co-integrating relations, where $r = 0, 1,$

2...n-1 and n is the number of system variables. The null hypothesis (H0) for maximum eigenvalue is r.

The maximum eigenvalue test statistic is calculated as:

$$LR_{max} \left(\frac{r}{n} + 1 \right) = -T * \log(1 - \omega_i) \dots$$

where ω is the maximum eigenvalue and T is sample size. The trace statistics test the null of r co-integrating relations against n relations, where n is system variables and r = 0, 1, 2...n-1.

The test statistic computes as:

$$LR_{max} \left(\frac{r}{n} + 1 \right) = -T * \log(1 - \omega_i) \dots$$

Sometimes maximum eigenvalue and trace statistics yield different outcomes. Together, they validate appropriate modeling by confirming long-term relationships before short-term dynamics exploration.

3.7.3 Vector Error Correction Model (VECM)

Following the Johansen co-integration test, the appropriate time series model was fitted. Co-integration between variables implies a long-term connection. Thus, to determine short-term relationships among co-integrated variables, the VECM was employed.

Conversely, without co-integration, the vector autoregressive (VAR) model stems from the VECM, and Granger causality tests ascertain causal links between variables (Engle and Granger, 1987).

The VECM regression equation is:

Where Δ is the first difference operator, Π contains the long-run information, Γ_i incorporates the short-term dynamics, and ϵ_t represents the error term.

This two-step process first validated stable long-term tendencies before examining transitory response dynamics to verify education investments appropriately associate with periodic economic performance changes based on time series evidence over an extended timeframe.

1. GDP (Gross Domestic Product) equation

$$\Delta \text{GDP}(t) = \alpha_1 + \beta_{11} \Delta \text{GDP}(t-1) + \beta_{12} \Delta \text{Pre Primary Enrollment in gov't institution}(t-1) + \beta_{13} \Delta \text{Primary Enrollment in gov't institution}(t-1) + \beta_{14} \Delta \text{Secondary Enrollment}(t-1) + \beta_{15} \Delta \text{Tertiary Enrollment in gov't institution}(t-1) + \beta_{16} \Delta \text{Government Expenditure on education}(t-1) + \varepsilon_1(t)$$

2. Pre-primary enrollment in gov't institution equation :

$$\Delta \text{PrePrimaryEnrollment}(t) = \alpha_2 + \beta_{21} \Delta \text{GDP}(t-1) + \beta_{22} \Delta \text{PrePrimaryEnrollment in gov't institution}(t-1) + \beta_{23} \Delta \text{PrimaryEnrollment in gov't institution}(t-1) + \beta_{24} \Delta \text{SecondaryEnrollment in gov't institution}(t-1) + \beta_{25} \Delta \text{TertiaryEnrollment in gov't institution}(t-1) + \beta_{26} \Delta \text{GovernmentExpenditure on education}(t-1) + \varepsilon_2(t)$$

3. Primary enrollment in gov't institution equation:

$$\Delta \text{PrimaryEnrollment}(t) = \alpha_3 + \beta_{31} \Delta \text{GDP}(t-1) + \beta_{32} \Delta \text{PrePrimaryEnrollment}(t-1) + \beta_{33} \Delta \text{PrimaryEnrollment}(t-1) + \beta_{34} \Delta \text{SecondaryEnrollment}(t-1) + \beta_{35} \Delta \text{TertiaryEnrollment}(t-1) + \beta_{36} \Delta \text{GovernmentExpenditure}(t-1) + \varepsilon_3(t)$$

4. Secondary enrollment in gov't institution equation:

$$\Delta \text{SecondaryEnrollment in gov't institution}(t) = \alpha_4 + \beta_{41} \Delta \text{GDP}(t-1) + \beta_{42} \Delta \text{PrePrimary Enrollment in gov't institution}(t-1) + \beta_{43} \Delta \text{Primary Enrollment in gov't institution}(t-1) + \beta_{44} \Delta \text{Secondary Enrollment}(t-1) + \beta_{45} \Delta \text{Tertiary Enrollment}(t-1) + \beta_{46} \Delta \text{Government Expenditure on education}(t-1) + \varepsilon_4(t)$$

5. Tertiary enrollment in gov't institution equation:

$$\Delta \text{Tertiary Enrollment in gov't institution}(t) = \alpha_5 + \beta_{51} \Delta \text{GDP}(t-1) + \beta_{52} \Delta \text{PrePrimary Enrollment}(t-1) + \beta_{53} \Delta \text{Primary Enrollment in gov't institution}(t-1) + \beta_{54} \Delta \text{Secondary Enrollment}(t-1) + \beta_{55} \Delta \text{Tertiary Enrollment in gov't institution}(t-1) + \beta_{56} \Delta \text{Government Expenditure}(t-1) + \varepsilon_5(t)$$

6. Government expenditure on education equation:

$$\Delta \text{Government Expenditure on education}(t) = \alpha_6 + \beta_{61} \Delta \text{GDP}(t-1) + \beta_{62} \Delta \text{PrePrimary Enrollment in gov't institution}(t-1) + \beta_{63} \Delta \text{Primary Enrollment in gov't institution}(t-1) + \beta_{64} \Delta \text{Secondary Enrollment in gov't institution}(t-1) + \beta_{65} \Delta \text{Tertiary Enrollment}(t-1) + \beta_{66} \Delta \text{Government Expenditure on education}(t-1) + \varepsilon_6(t)$$

In the above equations, Δ denotes the first difference, α represents the constant term, β 's are the coefficients, and ε 's are the error terms. The subscripts denote the variables, and (t-1) indicates the lagged values.

3.8 Diagnostic Tests

A. Multi-Collinearity Test

We used the variance inflation factor (VIF) to detect multicollinearity. Smaller VIFs are preferable, holding all else equal. However, if a certain explanatory variable needs inclusion to infer causality, we hesitate dropping it regardless of VIF size, as our primary interest involves the causal effects of explanatory variables on the dependent variable. Consequently, we should ignore VIFs of other coefficients entirely. Additionally, setting an arbitrary VIF cutoff for determining multicollinearity problematic provides little helpful guidance. Some studies use 10 (Gujarati, 2004).

B. Heteroscedasticity Test

For the p-value from the test, preferable is 0.05 or smaller, upholding the null hypothesis of heteroscedasticity present. Whereas, if prob-chi2 is 0.05 or greater, the null is rejected, indicating no heteroscedasticity problem (Gujarati, 2004). Directly examining the p-value avoids relying on arbitrary cutoffs and better contextualizes statistical evidence relevant to the specific model.

C. Autocorrelation Test

To assess the presence of autocorrelation in the residuals of the regression model, this study conducted the Durbin-Watson test. The null hypothesis of this test is that there is no first-order autocorrelation in the residuals. The Durbin-Watson statistic ranges from 0 to 4, where:

- A value around 2 indicates no autocorrelation.

- A value approaching 0 suggests positive autocorrelation.

- A value approaching 4 suggests negative autocorrelation.

D. Normality Test

To test the normality of the residuals from the regression model, this study conducted the Shapiro-Wilk test. The null hypothesis of this test is that the residuals are normally distributed. The W statistic ranges from 0 to 1, with values closer to 1 indicating a more normal distribution. If given the p-value is greater than the common significance level of 0.05, we will fail to reject the null hypothesis that the residuals are normally distributed.

E. Test for Stability

Eigenvalue Modulus: The "Modulus" column shows the absolute value of the eigenvalues of the companion matrix of the VECM. For the model to be stable, all eigenvalues must have a modulus less than or equal to 1.

3.9 Statistical Techniques used for Analysis

Statistical methods play a pivotal role in scrutinizing research data. Regarding proposed research on education's GDP effect, various techniques probed connections between dependent GDP and independent factors like pre-primary enrollment, primary enrollment, secondary enrollment, tertiary enrollment, government expenditure.

Statistical application enables identifying meaningful correlations while furnishing evidence to support hypotheses. Through efficient, accurate Stata analysis of collected data, reliability and validity of outcomes enhance.

Technique selection considers variable nature and aims, guaranteeing a suitable examination addressing queries. Computational social science endorsed evidence-based comprehension of macroeconomic dynamics contingent on credential accumulation circumstances over the period scrutinized.

Rigorous numerical evaluation of patterns and relationships across intervals aimed to yield empirically-grounded insights into human capital buildup's economy-wide implications in Ethiopia relying on organized measurements from trustworthy governmental and global bodies.

3.10 Data Analysis

Systematic examination and meaningful interpretation of data lies at the heart of insightful research. For this study, analysis happened through Stata. Stata excels at data handling, statistical evaluation and visualization (Mehmet Yildirim, 2018). Its extensive functionality and intuitive design supply powerful means to investigate, synopsise and assess intricate datasets.

By employing methods like regression examination, descriptive statistics and hypothesis testing adeptly, acquired information pertaining to variables like GDP, pre-primary enrollment, primary enrollment, secondary enrollment, tertiary enrollment and government spending underwent scrutiny. This elucidated education's economic growth impact through rigorously supported empirical exploration of interdependencies between indicator changes over time.

3.11 Statistical Analysis Using Stata Software

Statistical analysis plays a pivotal role across diverse fields, and software like Stata can notably improve data examination efficiency and precision. For this proposed research, Stata evaluated gathered information pertaining to independent factors such as pre-primary enrollment, primary enrollment, secondary enrollment, tertiary enrollment, and government spending.

Relationships between these explanatory aspects and dependent GDP underwent scrutiny through statistical processing. By capitalizing on Stata's aptitude for competently handling and inspecting sizable datasets, researchers gain a valuable instrument for this work (Mehmet Yildirim, 2018). Outcomes from the statistical operations using Stata supply comprehending into education's impact on GDP, supplementing existing knowledge on this topic.

Rigorous numerical techniques furnished empirically grounded conclusions regarding interaction complexities between indicator fluctuations through time, advancing the evidence base on macroeconomic resilience contingent upon credentials accrual circumstances.

3.12 Interpretation of Findings

Meaningful outcomes elucidation represents a pivotal research element, demanding analytically scrutinizing consequences to derive well-founded conclusions. Regarding this proposition, findings interpretation involved examining associations between educational metrics (pre-primary enrollment, primary enrollment, secondary enrollment, tertiary enrollment) through government institutions and gross domestic product as the dependent variable, plus government education outlays' impact.

Via Stata-facilitated data probing, statistical relationships' magnitude and significance became quantitatively appreciable. Rigorous numerical approach afforded empirically-grounded comprehension of interaction intricacies between indicator fluctuations through time.

This systematic evaluation procedure aimed to furnish reliable substantiation addressing the research problem concerning macroeconomic resilience' contingencies on human capital accrual circumstances over the period investigated. The analytical methodology leveraged computational proficiencies to discern patterns amid cyclic shifts encompassing education determinants and financial growth dynamics.

4. CHAPTER FOUR: ANALYSIS OF THE STUDY

4.1 Descriptive Analysis

This part of analysis describes what the trend for each variable seems like and it gives explanation by observing the graph.

Figure 4.1:- Summary of statistics of Economic Growth and Education enrollment gross for the period of 2000-2023 Statistical analysis of variables by Stata Software.

In this section, we provide a descriptive analysis of the dataset used to evaluate the relationship between GDP and various educational variables. The educational variables include preprimary enrollment of education in government institution (X_1), primary enrollment of education in government institution (X_2), secondary enrollment of education in government institution (X_3), tertiary enrollment of education in government institution (X_4), and government expenditure on education (X_5). Below is the key summary of statistical descriptive for each variable:

Variable	Obs	Mean	Std Dev	Min	Max
Year	24	2011.5	7.071068	2000	2023
GDP	24	5.20×10^{10}	4.18×10^{10}	7.85×10^9	1.42×10^{11}
X_1	24	1654002	1569312	99710	4041915
X_2	24	1.55×10^7	4644839	6462503	2.08×10^7
X_3	24	1899258	1069421	78641	3867463
X_4	24	733127	561631.3	67682	1596671
X_5	24	2.36×10^9	1.7×10^9	2.85×10^8	4.95×10^9

Figure 4 1 Summary of Statistical analysis of Variables

Source: - Own computation using data from MOEOE and WB

Gross Domestic Product (GDP): - The mean GDP across the 24 observations was approximately 5.20×10^{10} . The standard deviation is 4.18×10^{10} , indicating significant

variability in GDP values. The minimum GDP recorded was 7.85×10^9 , while the maximum was 1.42×10^{11} , showing a wide range of economic outputs across the observations.

Pre-primary education Enrollment in government institutions (X_1)

The mean enrollment in pre-primary education in government institutions was approximately 1.65×10^6 students. The standard deviation was 1.56×10^6 , suggesting considerable variation in enrollment numbers. The enrollment figures ranged from 99710 to 4.04×10^6 students.

Primary education Enrollment in government institutions (X_2)

The average enrollment in primary education in government institutions was approximately 1.55×10^7 students. With a standard deviation of 4.64×10^6 , there was noticeable variability in primary education enrollment. The enrollment figures ranged from 6.46×10^6 to 2.80×10^7 .

Secondary education Enrollment in government institutions (X_3)

The mean enrollment in secondary education was about 1.89×10^6 students. The standard deviation is 1.06×10^6 , indicating substantial variation in secondary education enrollment. Enrollment numbers varied from a minimum of 78641 to a maximum of 3.86×10^6 students.

Tertiary education Enrollment in government institutions (X_4)

The average enrollment in tertiary education in government institutions was approximately 733127 students. The standard deviation is 561631.3, reflecting considerable diversity in tertiary education enrollment. The enrollment figures ranged from 67682 to 1.59×10^6 students.

Government expenditures on education (X_5)

The mean government expenditure on education is approximately 2.36×10^9 . The standard deviation is 1.70×10^9 , indicating significant variation in educational expenditure. The enrollment figures ranged from 2.83×10^8 to 4.95×10^9 .

Overall, the dataset shows substantial variability across all variables, highlighting the diverse nature of educational enrollments and government expenditure on education over the observed period. This variability is crucial for understanding the potential impacts of these educational factors on GDP.

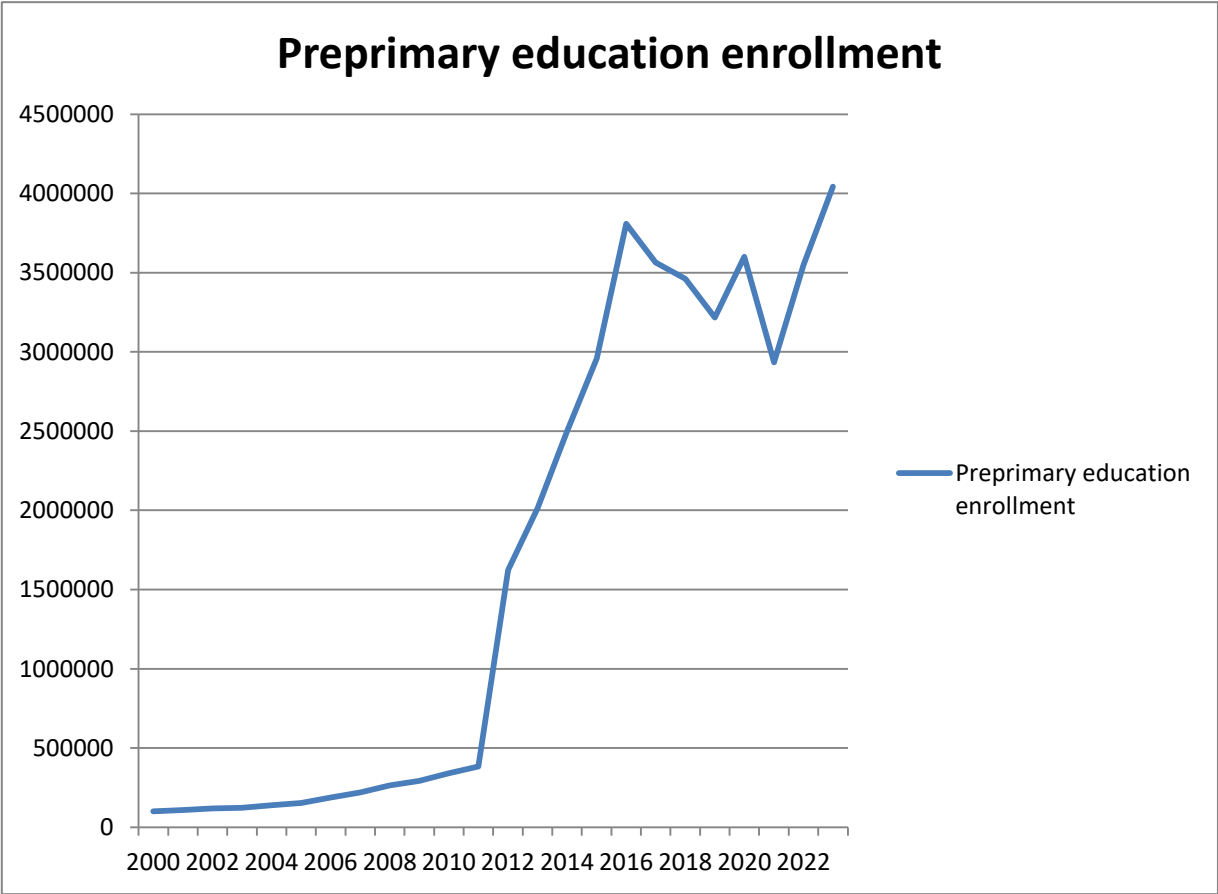


Figure 4.2 Graph of Preprimary Education Enrollment in Government institution (X₁)

Source: - Own computation using data from MOEE and WB

Interpretation: The graph illustrates the preprimary education enrollment in government institutions in Ethiopia from 2000 to 2023. The vertical axis represents the number of enrollments, ranging from 0 to 450,000. The horizontal axis covers the years from 2000 to 2023. The data shows a significant upward trend, starting near zero in 2000 and rising sharply to approximately 400,000 by 2023, with some fluctuations. This trend highlights the

substantial growth in preprimary education enrollment over the past two decades, reflecting the positive impact of preprimary education enrollment on economic conditions in Ethiopia.

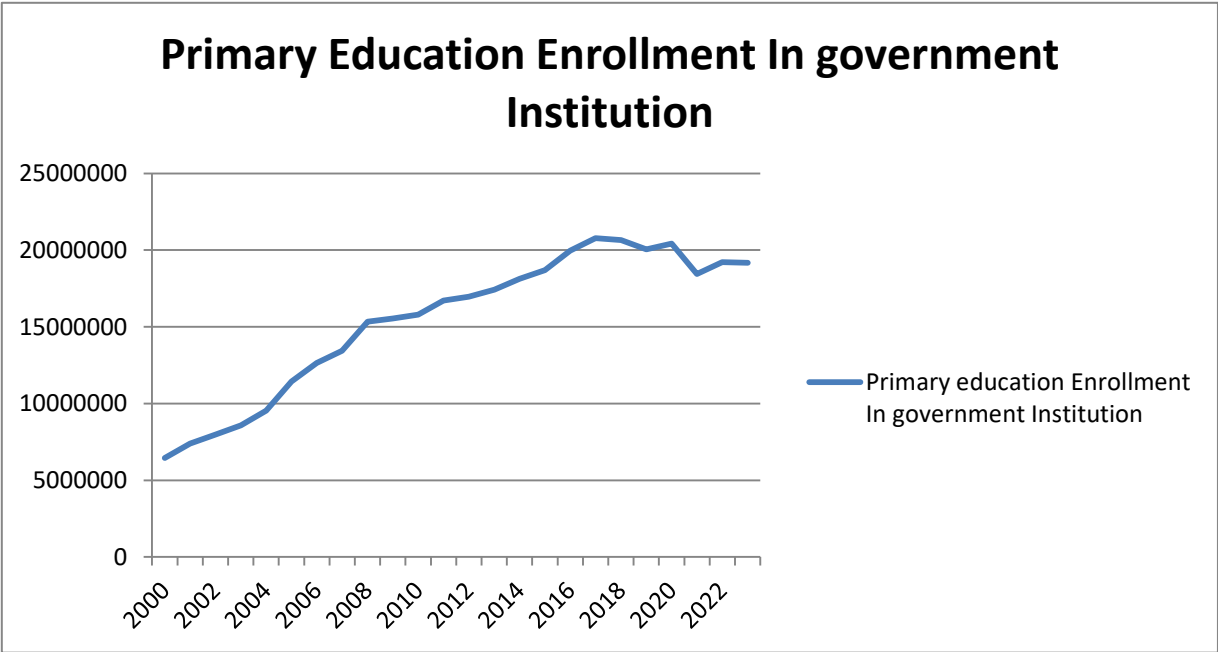


Figure 4.3 Graph of Primary Education Enrollment in gov't institution (X₂)

Source: - Own computation using data from MOEE and WB

Primary Education Enrollment in gov't institution (X₃)

Interpretation of Figure 4.3: The graph illustrates the primary education enrollment in government institutions in Ethiopia from 2000 to 2023. The vertical axis represents the number of enrollments, ranging from 0 to 2,500,000. The horizontal axis covers the years from 2000 to 2023. The data shows an overall increasing trend, with some fluctuations and a plateau towards the end. This trend highlights the substantial growth in primary education enrollment over the past two decades, reflecting the positive impact of primary education enrollment on economic conditions in Ethiopia.

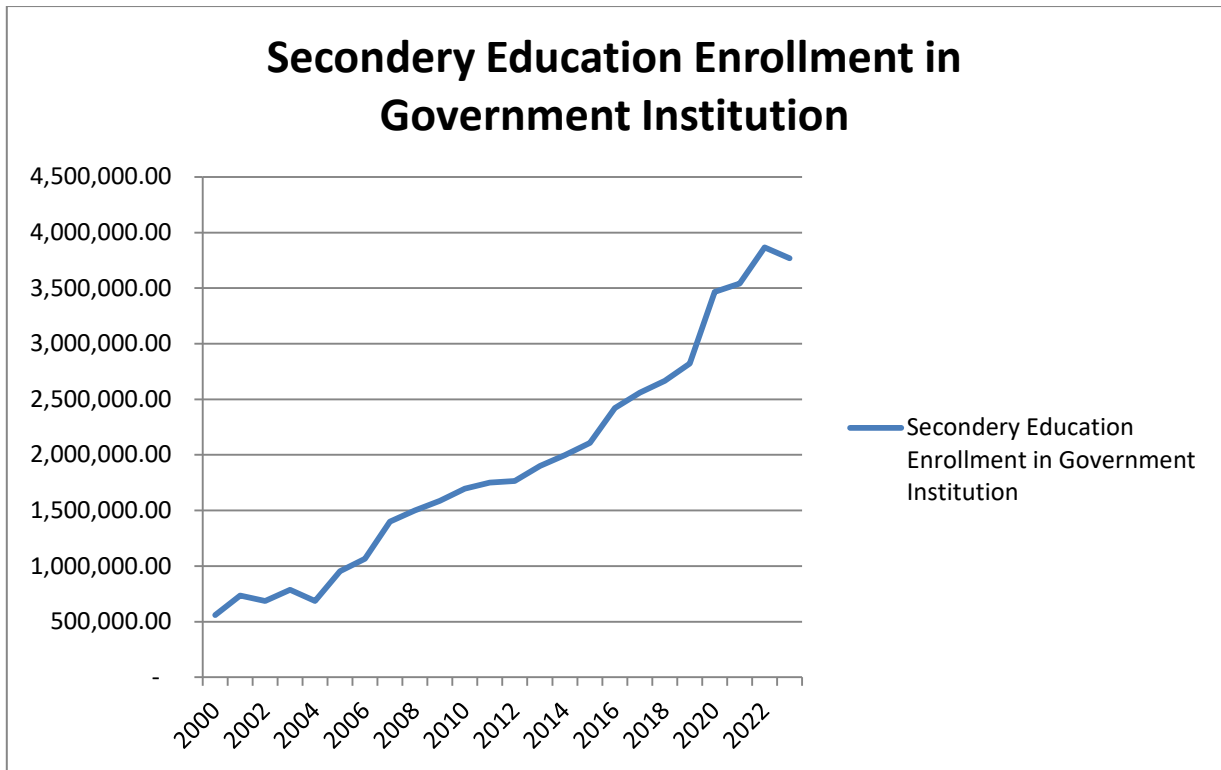


Figure 4.4 Graph of Secondary Education Enrollment in gov’t institution (X_3)

Source: - Own computation using data from MOEE and WB

The above Figure 4.4 The graph illustrates the secondary education enrollment in government institutions in Ethiopia from 2000 to 2023. The vertical axis represents the number of enrollments, ranging from 0 to 4,500,000. The horizontal axis covers the years from 2000 to 2023. The data shows a generally increasing trend, starting just above 500,000 enrollments in 2000 and rising steadily to nearly 4,500,000 enrollments by 2023, with some fluctuations. This trend highlights the substantial growth in secondary education enrollment over the past two decades, reflecting the positive impact of secondary education enrollment on economic conditions in Ethiopia.

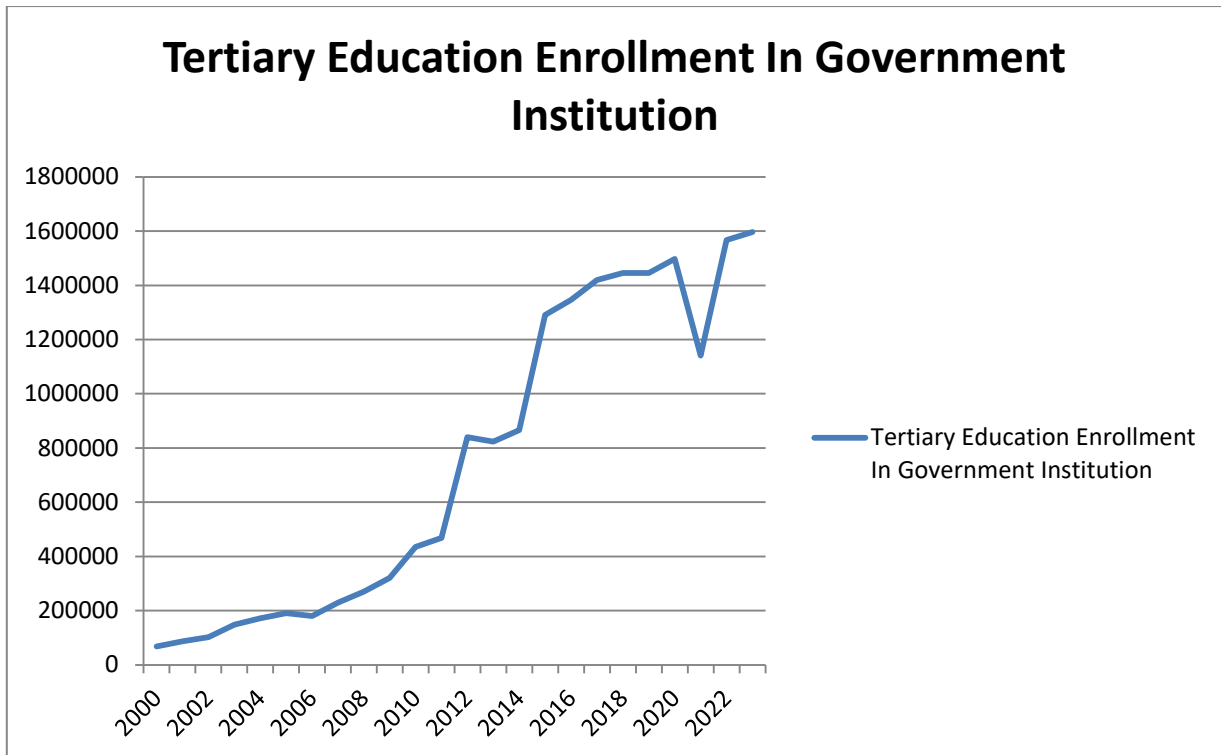


Figure 4.5 Graph of Tertiary Education Enrollment in gov’t institution (X₄)

Source: - Own computation using data from MOEE and WB

Figure 4.5: The graph illustrates the tertiary education enrollment in government institutions in Ethiopia from 2000 to 2023. The vertical axis represents the number of enrollments, ranging from 0 to 1,800,000. The horizontal axis covers the years from 2000 to 2023. The data shows a general upward trend, starting just above 200,000 enrollments in 2000 and rising sharply to approximately 1,600,000 enrollments by 2023, with some fluctuations. This trend highlights the substantial growth in tertiary education enrollment over the past two decades, reflecting the positive impact of tertiary education enrollment on economic conditions in Ethiopia.

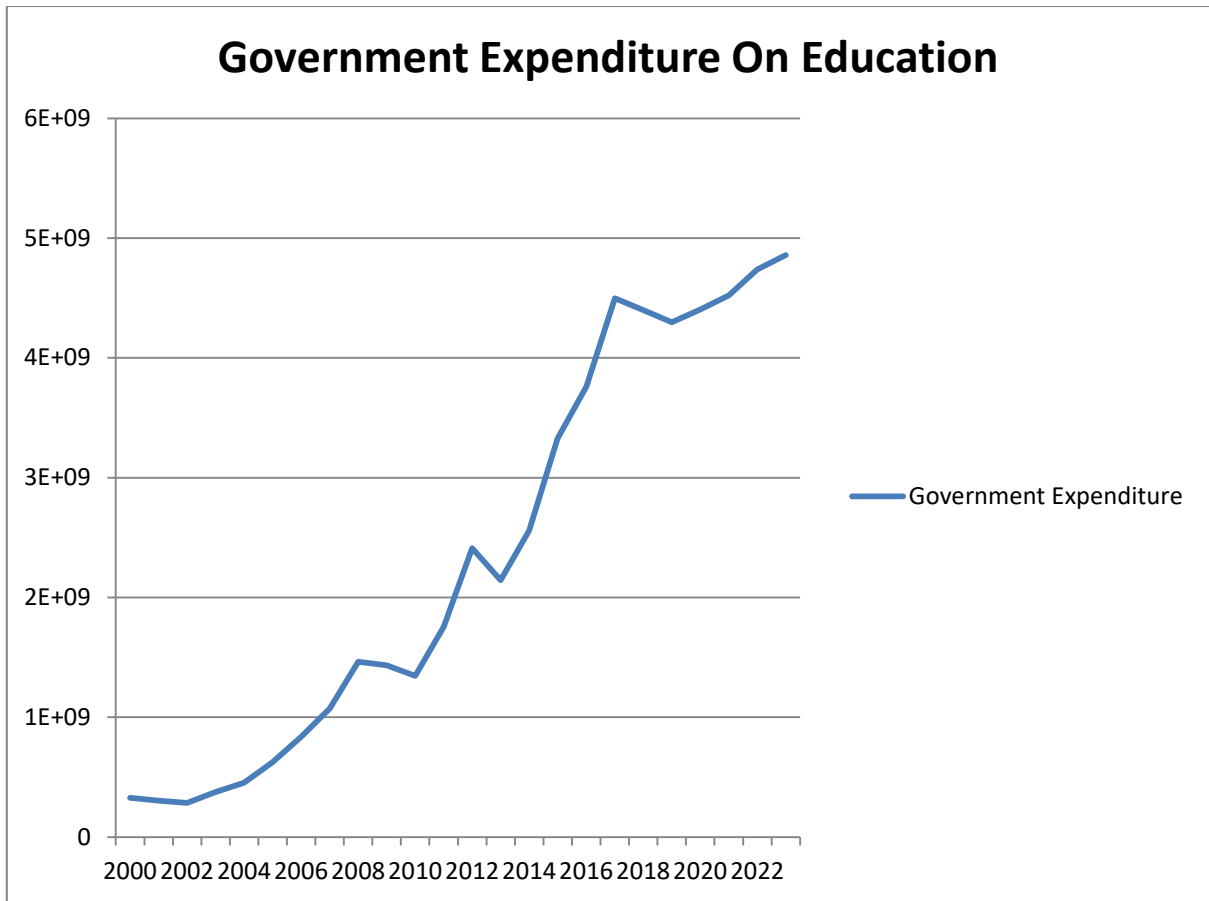


Figure 4.6 Graph of Government Education Expenditure (X_5)

Source: - Own computation using data from MOEE and WB

Figure 4.6: The graph illustrates the government expenditure on education in Ethiopia from 2000 to 2023. The vertical axis represents the expenditure in Ethiopian currency, ranging from 0 to 6 $\times 10^9$. The horizontal axis covers the years from 2000 to 2023. The data shows a generally increasing trend, starting below 1 $\times 10^9$ in 2000 and rising gradually until around 2010, after which the expenditure sharply increases, reaching just above 5 $\times 10^9$ between 2018 and 2023. This trend highlights the significant increase in government investment in education over the past two decades, reflecting changes in educational policies or economic conditions in Ethiopia.

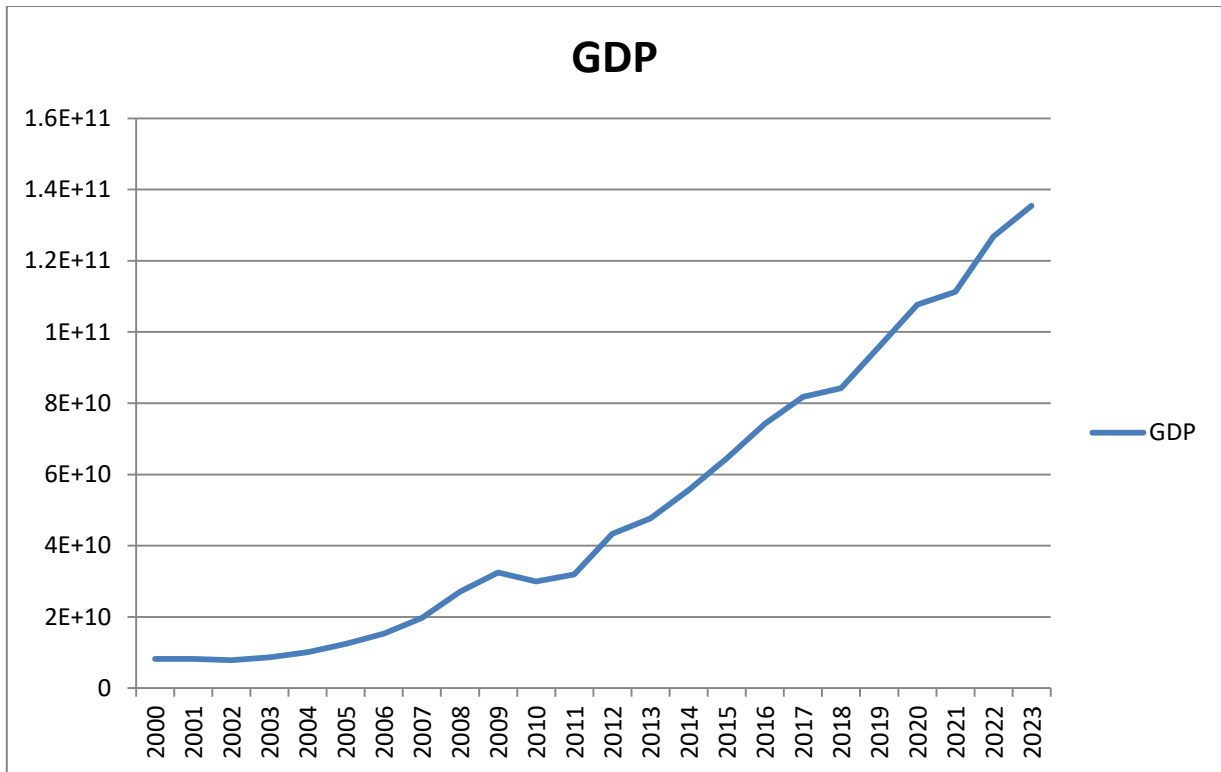


Figure 4.7 Graph of GDP

Source: - Own computation using data from MOEE and WB

The graph illustrates the GDP of Ethiopia from 2000 to 2023. The vertical axis represents the GDP, ranging from 0 to 1.6×10^{11} . The horizontal axis covers the years from 2000 to 2023. The data shows a general upward trend, with GDP starting below 2×10^{10} in 2000 and rising steadily to approximately 1.6×10^{11} by 2023, with some fluctuations. This trend highlights the significant economic growth in Ethiopia over the past two decades, suggesting that factors such as education may have had a positive impact on the country's economic development. The hypothesis of a positive relationship between GDP and education levels holds for several reasons:

1. Foundational Impact: Education in levels (preprimary enrollment of education, primary enrollment of education, secondary enrollment of education, and tertiary enrollment of

education) provides a foundation to skills development, critical thinking, and innovation, which are essential for economic growth.

2. Long-Term Benefits: The benefits of education on GDP might not be immediately evident in enrollment rates but manifest over time as the workforce becomes more skilled and productive.

3. Government Investment: Even with relatively low expenditure, government investment in education can improve the quality and accessibility of education, leading to long-term economic benefits.

4. Cumulative Effect: The cumulative effect of education across different stages contributes to a more educated and capable workforce, which drives economic growth.

In summary, the line plot provides an overview of GDP movements aligned with gains in multiple education indicators and spending over time in Ethiopia. Together the trends offer preliminary evidence education could play an influential role in driving economic growth, meriting further statistical analysis. X_3 X_4 and X_5

4.2 Analysis of Time Series

4.2.1 Stationary Testing

Table 4.1 Summary ADF result

Variables	Test Statistic	1%	5%	10%	p-value
GDP without trend	4.535	-3.750	-3.000	-2.63	1.000
GDP with Trend	-0.277	-0.4380	-3.600	-3.240	0.9900
GDP_1diff	-2.504	-3.75	-3.000	-2.630	0.1145
GDP_2diff	-6.434	-3.75	-3.000	-2.630	0.000
X₁ without trend	-0.018	-3.75	-3.000	-2.630	0.9570
X₁ with trend	-0.870	-4.380	-3.600	-3.240	0.6699
X₁_diff	-4.268	-3.750	-3.000	-2.630	0.005
X₂ without trend	-2.706	-3.750	-3.000	-2.630	0.0730
X₂ with trend	-0.166	-4.380	-3.600	-3.240	0.9921
X₂_diff	-3.792	-3.750	-3.000	-2.630	0.0030

X₃ without trend	0.211	-3.750	-3.000	-2.630	0.9728
X₃ with trend	-2.679	-4.380	-3.600	-3.240	0.2449
X₃_diff	-5.323	-3.750	-3.000	-2.630	0.000
X₄ without trend	-5.323	-0.198	-3.000	-2.630	0.9388
X₄ with trend	-2.231	-4.380	-3.600	-3.240	0.4723
X₄_diff	-4.955	-3.750	-3.000	-2.630	0.000
X₅ without trend	0.249	-3.750	-3.000	-2.630	0.9749
X₅ with trend	-2.362	-4.380	-3.600	3.240	0.3998
X₅_diff	-4.115	-3.75	-3.000	-2.630	0.0009

In summary, the stationary properties of the variables GDP, X₁ (preprimary enrollment of education in government institutions), X₂ (primary enrollment of education in government institutions), X₃ (secondary enrollment of education in government institutions), X₄ (tertiary enrollment of education in government institutions), and X₅ (first-differenced government expenditure on education) were examined using a test of Augmented Dickey Fuller (ADF). A test ADF result indicates that GDP, X₁, X₂, X₃, and X₄ are non-stationary in levels, both with and without a time trend. However, the first-differenced versions of these variables were found to be stationary, suggesting they require first-order differencing to induce stationary. Similarly, the first-differenced X₅ (government expenditure on education) variables were also determined to be stationary. Overall, these findings demonstrate that the majority of the education-related variables in the dataset exhibit non-stationary in their levels and require appropriate differencing to satisfy the stationary assumption for further econometric analysis and modeling.

4.2.3. Co integration test

Result of Co integration test by Johansen test

Table 4.2 Johansen Tests for Co-integration

Maximum Rank	Parms	LL	Eigenvalue	Trace statistic	5% critical
0	42	-1998.9478	.	180.9441	94.15
1	53	-1957.6969	0.98384	98.4422	68.52
2	62	-1934.0753	0.90578	51.1991	47.21
3	69	-1919.0566	0.77729	21.1616*-	29.68
4	74	-1911.6731	0.52210	6.3946	15.41
5	77	-1909.5335	0.1909262	2.1155	3.76
6	78	-1908.4758	0.10037		

Source: - Own computation using data from MOEE and WB

Interpretation the test results:

For the null hypothesis of $r = 0$ (there is no Co integrating vector), the statistic trace **180.9441** is greater than the five percent (5%) critical value i.e., **94.15**, therefore, we have reason to reject a null hypothesis. Eigenvalue (**0.98384**): A very high eigenvalue indicates a strong co-integrating relationship.

For null hypothesis for $r \leq 1$ (at most one co-integrating vector), a statistics trace of **98.4422** is greater than five percent (5%) conventional (critical) value (**68.52**), therefore, we have a reason to reject null hypothesis. Eigenvalue (**0.90578**): Still a high eigenvalue, indicating another strong co-integrating relationship.

For the case of null Hypothesis when $r \leq 2$ (at most 2 Co integrating vectors), at this rank statistic trace **51.1991** is more than the five percent (5%) conventional (critical) value (**47.21**), therefore, we have reason to reject the null hypothesis.

For the null Hypothesis of $r \leq 3$ (at most 3 Co integrating vectors), the trace statistic of 21.1616 is below five percent (5%) conventional (critical) value (29.68), therefore, we don't have reason to reject null hypothesis.

The Johansen Co integration test results suggest that there are **3 co-integrating vectors**. This means that there is evidence of the long-term equilibrium association among the variables, even though they may have integration of different order.

4.2.5. Vector Error Correction Model (VECM)

An appropriate lag length for the model is a crucial consideration, as it can significantly impact the estimation results and subsequent inferences. To determine the optimal lag length, this paper conducted a series of lag selection tests using the varsoc command in Stata. The results of the lag selection criteria are presented below. AIC, HQIC, and Schwarz Bayesian Information Criterion (SBIC) all indicate that a lag length of 3 is optimal for the given dataset, which spans the period from 2007 to 2023. This suggests that the current and past 3 periods of the endogenous variables, namely D.GDP _22diff, D.X₁ _diff, D.X₂ _diff, D.X₃ _diff, D.X₄ _diff, and D.X₅ _diff, are necessary to adequately capture the dynamics of the system. Accordingly, we will proceed with the ARDL or VECM analysis using a maximum lag length of 2, as recommended by the selection-order criteria.

Table 4.3 optimal lag length

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1739.61				6.2X10 ⁸¹	205.366	205.396	205.66
1	-1677.51	124.21	36	0.00	3.9X10 ⁸⁰	202.295	202.5	204.354
2	-1056.74	1241.5	36	0.00	7.0X10 ⁵¹ *	133.499	133.879	137.322
3	86.4058	2286.3*	36	0.00		1.83461*	2.33155*	6.83389*
4	37.834	-97.144	36			7.54894	8.04588	12.5482

Source: - Own computation using data from MOEOE and WB

Short Run Equation

The whole VECM Stata result attached by Appendix three. The estimated equation for the short-term dynamics of the VECM can be written as follows:

$$D2_GDP_22diff = -0.1979252 * L1_ce1 - 0.1099372 * LD2.GDP_22diff - 7551.659 * LD2.X1_diff - 1373.815 * LD2.X2_diff + 828.3482 * LD2.X3_diff + 5867.261 * LD2.X4_diff - 7.896983 * LD2.X5_diff$$

Interpretation:

L1_ce1: The lagged error correction term (L1_ce1) detentions the adjustment towards the long-term equilibrium. A negative coefficient suggests that if there is a deviation from the equilibrium in the previous period, it will be corrected by around 19.79% in the current period. But, the coefficient is not statistically significant at conventional (critical) levels (P -value= 0.662), showing that the adjustment may not be statistically significant in the short run

LD2.GDP_22diff: The second lag of the differenced GDP (LD2.GDP_22diff) represents the short-term effect of the previous period's deviation in GDP. A negative coefficient (- 0.1099372) suggests that a deviation from the equilibrium in the previous period will lead to a decrease in the GDP deviation in the current period. However, this coefficient is not statistically significant at conventional levels (p-value = 0.776).

LD2.X1_diff: The second lag of the differenced Preprimary education enrollment in government institution (LD2.X1_diff) represents the short-term effect of the previous period's deviation in Preprimary education enrollment. A negative coefficient (-7551.659) indicates that a deviation from the equilibrium in Preprimary education enrollment in the previous period will lead to a declining in the GDP deviation in the current period. But, this coefficient is not statistically significant at conventional levels (p-value = 0.120).

LD2.X2_diff: The second lag of the differenced Primary education enrollment in government institution (LD2.X2_diff) represents the short-term effect of the previous period's deviation in Primary education enrollment. A negative coefficient (-1373.815) suggests that a deviation from the equilibrium in Primary education enrollment in the previous period will lead to a decrease in the GDP deviation in the current period. However, this coefficient is not statistically significant at conventional levels (p-value = 0.640).

$$D2_X3_diff = -0.5924013 * LD2.X3_diff - 58419.64 * _cons$$

$$D2_X4_diff = -0.1427217 * LD2.X2_diff + 0.1817056 * LD2.X3_diff + 0.0002679 * LD2.X5_diff + 4454.047 * _cons$$

$$D2_X5_diff = 0.0149028 * LD2.GDP_22diff - 90.71791 * LD2.X1_diff + 10.09275 * LD2.X2_diff + 192.909 * LD2.X3_diff - 849.9757 * LD2.X4_diff - 0.3692445 * LD2.X5_diff + 2925139 * _cons$$

Interpretation:

D2_X3_diff:

LD2.X3_diff: The second lag of the differenced X₃ variable represents the short-term effect of the previous period's deviation in X₃. A negative coefficient (-0.5924013) suggests that a deviation from the equilibrium in X₃ in the previous period will lead to a decrease in the X₃ deviation in the current period.

_cons: The constant term represents the intercept of the equation (-58419.64).

D2_X4_diff:

LD2.X2_diff: The second lag of the differenced X₂ variable represents the short-term effect of the previous period's deviation in X₂. A negative coefficient (-0.1427217) suggests that a deviation from the equilibrium in X₂ in the previous period drive lead to a decrease in the X₄ deviation in the current period.

LD2.X3_diff: The second lag of the differenced X₃ variable represents the short-term effect of the previous period's deviation in X₃. A positive coefficient (0.1817056) indicates that a deviation from the equilibrium in X₃ in the previous period will lead to an increase in the X₄ deviation in the current period.

LD2.X5_diff: The second lag of the differenced X₅ variable represents the short-term effect of the previous period's deviation in X₅. A positive coefficient (0.0002679) suggests that a

deviation from the equilibrium in X5 in the previous period will lead to an increase in the X4 deviation in the current period.

_cons: The constant term represents the intercept of the equation (4454.047).

D2_X5_diff:

LD2.GDP_22diff: The second lag of the differenced GDP variable represents the short-term effect of the previous period's GDP deviation. A positive coefficient (0.0149028) suggests that a deviation from the equilibrium in GDP in the previous period will lead to an increase in the X5 deviation in the current period.

LD2.X1_diff: The second lag of the differenced X1 variable represents the short-term effect of the previous period's deviation in X1. A negative coefficient (-90.71791) indicates that a deviation from the equilibrium in X1 in the previous period will lead to a decrease in the X5 deviation in the current period.

LD2.X2_diff: The second lag of the differenced X2 variable represents the short-term effect of the previous period's deviation in X2. A positive coefficient (10.09275) suggests that a deviation from the equilibrium in X2 in the previous period will lead to an increase in the X5 deviation in the current period.

LD2.X3_diff: The second lag of the differenced X3 variable represents the short-term effect of the previous period's deviation in X3. A positive coefficient (192.909) indicates that a deviation from the equilibrium in X3 in the previous period will lead to an increase in the X5 deviation in the current period.

LD2.X4_diff: The second lag of the differenced X4 variable represents the short-term effect of the previous period's deviation in X4. A negative coefficient (-849.9757) suggests that a deviation from the equilibrium in X4 in the previous period will lead to a decrease in the X5 deviation in the current period.

LD₂.X₅_diff: The second lag of the differenced X₅ variable represents the short-term effect of the previous period's deviation in X₅. A negative coefficient (-0.3692445) indicates that a deviation from the equilibrium in X₅ in the previous period will lead to a decrease in the X₅ deviation in the current period.

_cons: The constant term represents the intercept of the equation (2925139).

Long-Term Co-Integrating Equation

The following Johansen normalization restriction is obtained from Stata Software.

Table 4.4 Johansen normalization restriction

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
_ce1						
GDP_22diff						
D1.	1	.	.	.	.	.
X1_diff						
D1.	-8914.274	663.9611	-13.43	0.000	-10215.61	-7612.934
X2_diff						
D1.	-12634.13	359.157	-35.18	0.000	-13338.06	-11930.19
X3_diff						
D1.	29362.34	738.4193	39.76	0.000	27915.07	30809.62
X4_diff						
D1.	62425.9	2832.488	22.04	0.000	56874.33	67977.47
X5_diff						
D1.	4.146523	.9405937	4.41	0.000	2.302994	5.990053
_cons						
	-2.85e+09	.	.	.	.	.

Source: - Own computation using data from MOE and WB

In the above VECM results, GDP_diff is the dependent variable and the independent variables are differenced Preprimary Education Enrollment (X₁_diff), first differenced Primary Education Enrollment (X₂_diff), first differenced Secondary Education Enrollment (X₃), first differenced Tertiary Education Enrollment (X₄), and first differenced Government Expenditure on Education (X₅_diff), the long-term co-integrating equation can be written as follows:

$$\text{GDP22diff} - 8914.274\text{X}_1\text{diff} - 12634.13\text{X}_2 \text{ diff} + 29362.34\text{X}_3\text{diff} + 62425.9\text{X}_4\text{diff} + 4.146523\text{X}_5\text{diff} = -2.85 \times 10^9$$

Rearranged Equation

To make it more interpretable, we can rearrange the equation:

$$\text{GDP22diff} = 8914.274X_1\text{diff} + 12634.13X_2\text{diff} - 29362.34X_3\text{diff} - 62425.9X_4\text{diff} - 4.146523X_5\text{dif} - 2.85 \times 10^9$$

GDP22diff is normalized to 1, indicating it is the dependent variable in this long-term equilibrium relationship. Coefficients:

$X_1\text{diff}$ (Preprimary Education Enrollment): The coefficient is -8914.274 . This implies that, in the long term, a one-unit increase in $X_1\text{diff}$ is associated with an 8914.274-unit decrease in GDP 22diff, holding other factors constant. This relationship is highly significant (p-value = 0.000).

$X_2\text{ diff}$ (Primary Education Enrollment): The coefficient is -12634.13 , indicating that a one-unit increase in $X_2\text{ diff}$ is associated with a 12634.13 unit decrease in GDP_22diff . This relationship is highly significant (p-value = 0.000).

$X_3\text{diff}$ (Secondary Education Enrollment): The coefficient is 29362.34, suggesting a positive relationship. A one-unit increase in $X_3\text{ diff}$ leads to a 29362.34-unit increase in GDP 22diff. This relationship is highly significant (p-value = 0.000).

$X_4\text{diff}$ (Tertiary education enrollment in government institution): The coefficient is 62425.9, indicating a significant positive impact. A one-unit increase in $X_4\text{diff}$ results in a 62425.9-unit increase in GDP22diff. This relationship is highly significant (p-value = 0.000). $X_5\text{diff}$ (Government Expenditure on Education): The coefficient is 4.146523, indicating a small positive effect. A one-unit increase in $X_5\text{diff}$ leads to a 4.146523-unit increase in GDP 22diff. This relationship is highly significant (p-value = 0.000).

Constant Term: The constant term -2.85×10^9 represents the equilibrium level adjustment needed to maintain the long-term relationship. It acts as the intercept of the co-integrating equation. Also it suggests a fixed component in the GDP difference that is not explained by the changes in the education-related variables.

The VECM results indicate a long-term equilibrium relationship between GDP_22diff and the differenced explanatory variables (X₁_diff to X₅_diff). This relationship shows how these variables move together over time, despite short-term deviations.

4.3 Diagnostic Tests

A. Test for Multi Collinearity

Table 4.5: Test for Multi Collinearity

Variable	VIF	1/VIF
X ₄ _diff	1.99	0.503473
X ₁ _diff	1.71	0.585489
X ₅ _diff	1.51	0.662241
X ₂ _diff	1.19	0.839463
X ₃ _diff	1.06	0.946153
Mean VIF	1.49	

Source: - Own computation using data from MOEOE and WB

As we may see from the above stata results, the diagnostic test of multi-collinearity using the Variance Inflation Factor (VIF) for the variables X₁_diff, X₂ _diff, X₃_diff, X₄_diff, and X₅_diff in this analysis. The VIF measures the degree of multi-collinearity, which is the correlation between independent variables in a regression model.

In this study, the VIF values indicate the level of multi-collinearity for each variable. A VIF value of 1 means there is no multi-collinearity, while higher values suggest increasing levels of multi-collinearity. The reciprocal of VIF (1/VIF) is also provided, where values close to 1 indicate minimal multi-collinearity.

Based on the results, the variables X₄_diff, X₁_diff, X₅_diff, X₂ _diff, and X₃_diff have VIF values of 1.99, 1.71, 1.51, 1.19, and 1.06, respectively. These values are all below 5, which is a commonly used threshold for identifying multi-collinearity. Therefore, there is no strong evidence of severe multi-collinearity among these variables in your regression model.

The mean VIF, calculated by averaging the individual VIF values, is 1.49. This mean VIF is also below the threshold of 5, further supporting the conclusion that multi-collinearity is not a significant concern in your model.

In this study, there is **no severe multi-collinearity** among the variables X_{1_diff} , X_{2_diff} , X_{3_diff} , X_{4_diff} , and X_{5_diff} . The VIF values for all variables are below the commonly accepted threshold of 5, indicating that the variables are not highly correlated with each other.

Test of Heteroscedasticity

Table 4.6: Test of Heteroscedasticity

Chi2(5)	8.32
Pro greater than Chi2	0.1394

Source: - Own computation using data from MOEOE and WB

Based on the output of the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity, we fail to reject the null hypothesis of constant variance (homoskedasticity) at the 5% significance level. The test statistic chi-square value is 8.32 with a p-value of 0.1394, which is greater than the typical 0.05 threshold.

This suggests that there is insufficient evidence to conclude that the variance of the residuals is not constant across the different values of the independent variables X_{1_diff} , X_{2_diff} , X_{3_diff} , X_{4_diff} , and X_{5_diff} . In other words, the assumption of homoskedasticity, which is one of the key assumptions of the linear regression model, appears to be satisfied for this dataset.

The implication is that the standard errors and confidence intervals produced by the regression model are valid and do not need to be adjusted for heteroskedasticity. This means the inferences drawn from the regression results, such as hypothesis testing and the interpretation of the coefficient estimates, are reliable.

Overall, the Breusch-Pagan / Cook-Weisberg test provides support for the assumption of **homoskedasticity** in the regression model, which is an important prerequisite for valid statistical inference.

Autocorrelation Test

Table 4.7: Autocorrelation test

Durbin-Watson d-statistics (6, 22) = 2.34732
--

Source: - Own computation using data from MOEOE and WB

To assess the presence of autocorrelation in the residuals of the regression model, as we may see from above figure, this study conducted the Durbin-Watson test. The null hypothesis of this test is that there is no first-order autocorrelation in the residuals.

The Durbin-Watson d-statistic obtained was **2.34732**. The Durbin-Watson statistic ranges from 0 to 4, where:

- A value around 2 indicates no autocorrelation.
- A value approaching 0 suggests positive autocorrelation.
- A value approaching 4 suggests negative autocorrelation.

Given that the Durbin-Watson d-statistic is close to 2, we fail to find evidence of significant autocorrelation in the residuals. Therefore, we can reasonably assume that the residuals are not auto correlated, supporting the assumption of independent errors in our regression model.

Normality Test

Table 4.8: Normality Test

Variable	Obs	w	v	z	Prob>z
Residuals	22	0.92582	1.879	1.279	0.10040

Source: - Own computation using data from MOEOE and WB

To test the normality of the residuals from the regression model, this study conducted the Shapiro-Wilk test. The null hypothesis of this test is that the residuals are normally distributed.

The W statistic ranges from 0 to 1, with values closer to 1 indicating a more normal distribution. In this study the Shapiro-Wilk W statistic obtained is **0.92582**, which is reasonably close to 1, suggesting the residuals are approximately normally distributed with a V statistic of 1.879 and a z-value of 1.279. The p-value associated with this test was 0.10040.

Given that the p-value is greater than the common significance level of 0.05, we fail to reject the null hypothesis that the residuals are normally distributed. This result suggests that there is no significant evidence against the normality of the residuals, supporting the assumption that the residuals follow a normal distribution in our regression model.

Test for Stability

Table 4.9: Test for Stability

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
1	1
$-0.901605 + 0.4126643i$	0.991556
$-0.901605 - 0.4126643i$	0.991556
$-0.588916 + 0.6741825i$	0.895178
$-0.588916 - 0.6741825i$	0.895178

$-0.4117859 + 4866489i$	0.637491
$-0.4117859 - 4866489i$	0.637491
-0.6087758	0.608776

Source: - Own computation using data from MOEOE and WB

The key things to note from this output are:

Eigenvalue Modulus: The "Modulus" column shows the absolute value of the eigenvalues of the companion matrix of the VECM. For the model to be stable, all eigenvalues must have a modulus less than or equal to 1.

Unit Moduli: The output states that "The VECM specification imposes 5 unit moduli". This means that our VECM has 5 eigenvalues with a modulus of 1, which is expected for a co-integrated system.

Stable Eigenvalues: The majority of the eigenvalues have a modulus less than 1, indicating that the VECM is stable. This suggests that the long-run relationships between the variables in our model are stable over time.

Overall, this output provides evidence that our VECM is well-specified and the long-run relationships between the variables are stable. The presence of 5 unit moduli is consistent with a co-integrated system, where the variables share common stochastic trends.

4.4 Hypothesis Testing and Interpretation of Results

The empirical analysis conducted in this study aimed to test hypotheses regarding the relationship between education and economic growth in Ethiopia. The hypotheses are formulated as follows:

Hypothesis 1:

H0: $\beta_i=0$ (i.e. Education has no significant effect on Economic Growth.)

H1: $\beta_i \neq 0$ (i.e. At least one factor of education has a significant on economic growth in Ethiopia.)

Hypothesis 2:

H0: There is no relationship between education and economic growth in Ethiopia.

H1: There is a relationship between education and economic growth in Ethiopia.

This empirical research uncovers a multifaceted interplay between educational participation degrees and economic expansion. Our conclusions demonstrate an adverse connection between GDP and both pre-primary and primary enrollments, contrasting the beneficial relations GDP holds with secondary and tertiary enrollments as well as government education spending.

The nuanced interdependencies discovered highlight the necessity of considering how diverse instruction phases uniquely form and cultivate skills pertinent to a nation's productive capabilities and economic evolution over time. While foundational learning remains essential, later stages appear most impactfully linked to aggregate output, implying targeted support can optimize societal returns on educational investments.

Our study found an inverse association between pre-primary enrollment and GDP, suggesting increased participation alone fails to immediately boost output. This aligns with **Pritchett's (2001)** position emphasizing education quality's pivotal role in shaping economic impacts. Where pre-primary delivery **proves ineffective**, expected cognitive and skill benefits crucial to GDP influence may fail to emerge. Similarly, **Berlinski et al (2009)** underscore early childhood education's importance for long-term progress, while questioning immediate performance impacts if quality lags.

The negative GDP-pre-primary enrollment correlation appears attributable not only to education quality limitations, but also scarce rural pre-primary access. Constraints in both instruction implementation and geographic availability likely, stunt prospective contributions to aggregate production. While laying essential developmental groundwork, pre-primary's

economic resonance appears reliant on high-quality delivery achieving expected developmental outcomes, as well as widespread and equitable access necessary to benefit participant populations. Limited access to early childhood education in rural Ethiopia, results in many children missing key foundational learning windows, further mitigating pre-primary's potential to influence economic expansion. This aligns with **Berlinski et al.'s (2009)** research, which demonstrated pre-primary availability considerably impacts essential early cognitive and social maturation necessary for future scholarly attainment. Political volatility in Ethiopia exacerbates pre-existing obstacles by disrupting instruction and destabilizing infrastructure progress. This parallels conclusions by **Collier and Hoeffler (2004)**, whose work emphasized instability commonly, damages public works and diminishes social investment, inclusive of education, as resources redistribute to support stability restoration.

While establishing a critical learning base, pre-primary's economic relevance appears contingent on widespread and equitable access maximizing developmental benefits across populations alongside quality delivery and a stable sociopolitical environment supportive of education systems strengthening over time. Concerted efforts addressing interconnected obstacles can help optimize returns on human capital investments.

Similarly, the inverse relationship between GDP and primary enrollment highlights compounded effects of instruction quality concerns and political volatility. Primary access limitations coupled with inadequate resourcing and underprepared teaching staff afflict many rural areas. This affirms Pritchett's (2001) perspective that simply augmenting schooling years fails to catalyze economic growth absent high-quality tutelage. Political turbulence further undermines primary betterment attempts, yielding lackluster outcomes incapable of meaningfully boosting expansion. This aligns with research by Hanushek and Woessmann (2008) demonstrating cognitive abilities, rather than time enrolled, motivate progression - abilities difficult to cultivate amid poor educational conditions, especially unstable settings.

While access to basic learning represents a societal cornerstone, primary education's economic significance appears tied to delivering an instructional environment conducive to real cognitive and technical advancement. Ongoing instability additionally hampers such

improvement efforts. Addressing deep rooted challenges through coordinated multi sectoral interventions may be necessary to optimize primary education's development impact over the long term.

The observed positive relationship between secondary enrollment and GDP affirms Barro's (1991) finding of secondary education's critical role in economic expansion. Secondary instruction equips individuals with advanced abilities and vocational preparedness, thus enhancing labor productivity and innovation. In Ethiopia, secondary access proves more attainable in urban environments where political stability relatively surpasses rural settings, allowing more consistent delivery yielding elevated outcomes.

The positive correlation between tertiary participation and GDP underscores higher education's importance for fostering prosperity. Per Bloom, Canning, and Chan (2006), investing in tertiary education generates substantial returns, especially in developing countries requiring skilled workforces to aid development. Ethiopian universities predominantly locate in politically stable urban centers, facilitating superior instructional results impacting expansion substantially.

While providing basic learning, primary and pre-primary interactions with GDP signify quality and stability dependences. Later educational phases engaging more sophisticated cognitive and technical development through vocational relevance appear linking more directly to macroeconomic outcomes where delivery conditions optimize human capital contributions.

Additionally, the positive relationship between government expenditure on education and GDP aligns with the findings of Baldacci et al. (2008), who demonstrated that increased government spending on education positively affects economic growth. However, the effectiveness of this spending is contingent on political stability and efficient allocation of resources. In Ethiopia, political instability can hinder the efficient use of educational funds, thus limiting the potential benefits of increased government expenditure.

Given these results, we reject the null hypothesis H_0 for both hypotheses. The findings confirm that at least one factor of education has a significant effect on economic growth in Ethiopia, and that there is indeed a relationship between education and economic growth. Specifically, while pre-primary and primary education enrollments show a negative impact due to quality issues, scarcity in rural areas, and political instability, secondary and tertiary education enrollments, along with government expenditures on education, positively influence economic growth.

These insights suggest that strategic investments to improve the quality and accessibility of pre-primary and primary education, especially in rural areas, and addressing political instability are crucial for fostering sustainable economic development in Ethiopia. Furthermore, enhancing secondary and tertiary education, particularly in more stable urban areas, can contribute significantly to economic growth.

5. CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Introduction

The current chapter outlines insights extracted from our investigation and offers remedy propositions grounded in results. Our evaluation targeted analyzing the interplay between education and economic expansion within Ethiopia, zeroing in on enrollment influence at diversified instruction stages (pre-primary through tertiary) accessible through regime organizations plus outlays' governing training impact on GDP. Through synthesizing empirical exploration conclusions, this segment delineates crucial understandings acquired while putting forth feasible policy and practice recommendations for decision-makers, academic establishments, and other invested parties seeking to bolster education's role in cultivating advancement. By re-contextualizing motivation, methodologies, and discoveries, this portion aims to effectively communicate takeaways for supporting well-informed actions moving forward. The overarching ambition remains optimizing human capital contributions toward sustained, inclusive prosperity in consideration of country-specific economic, educational, and sociopolitical nuances surface through rigorous evaluation.

5.2 Summary of Finding

This study aims to explore how different levels of school enrollment can affect Ethiopia's economic growth from 2000 to 2023. By analyzing time-series data from Ethiopia's Ministry of Education and the World Bank, we wanted to understand the connections between GDP and preprimary education enrollment in government institution, primary enrollment in government institution, secondary enrollment in government institution, and tertiary (university) enrollment in government institution run by the government. We also looked at how government spending on education relates to GDP.

The results uncovered some interesting and unexpected patterns. Specifically, pre-primary and primary enrollment was found to have a negative connection to GDP. This suggests that just increasing the numbers at these levels doesn't directly lead to economic growth, possibly due to issues with education quality, infrastructure, or other social and economic factors. In

contrast, secondary enrollment, tertiary enrollment, and government education spending exhibited a positive relationship with GDP. So investments in higher education levels and educational spending are more likely to contribute to a growing economy.

This reframes the purpose, methods and findings in more everyday language while keeping the focus on optimizing education's role in sustainable, inclusive development.

There are a few possible reasons why the relationship between early education enrollment numbers and GDP turned out to be negative. First, the quality of education at these levels may be insufficient to provide the necessary skills and knowledge to contribute to productivity in the labor market. Second, there could be inefficiencies in the allocation and utilization of educational resources. Finally, socioeconomic barriers such as poverty and limited access to quality educational facilities may further hinder the potential benefits of early education.

Conversely, the positive effect of enrolment in secondary and in tertiary enrollment of education to GDP underscores the importance of advanced education in fostering economic development. Higher educational levels are typically associated with improved skills, innovation, and productivity, which are crucial for economic growth. Moreover, increased government expenditure on education reflects a commitment to improve educational infrastructure and resources, which can enhance the overall quality of education and its contribution to economic performance.

In the end, even though this research shows the connection between education and economic growth can be complicated, it also emphasizes how important quality schooling is, especially investing more in higher education. Dealing with problems early education faces and boosting the quality of learning at every step are really important tasks to fully unlock what education can offer for Ethiopia's development. When students receive education that sets them up for success, it translates into success for businesses and the whole economy down the road. There's still work to be done to strengthen Ethiopia's education system from the start through college. But making progress on these challenges will pave the way for education to serve as a powerful driver of long-lasting shared prosperity across the nation..

5.3 Conclusions

A few key conclusions came from analyzing the data.

Develop Education at All Levels: - Investing in education at every step is important for sustained economic growth over time. Each level of schooling contributes uniquely to building skills in the workforce and making the economy more productive.

Government Spending Makes a Difference: - Increased spending by the government on education is very important to improving the qualities and reach of schooling. Using resources effectively can really boost economic outcomes.

Take a Whole Picture Approach: - So a holistic or comprehensive strategy is needed to address social and geographic differences. Policies should aim to reduce educational inequalities and ensure all regions, cities, rural areas, and groups of people able to use the qualified Education.

Innovation and New Tech Help Too: - Education plays a vital role in fostering innovation and technological progress. Integrating education with innovative strategies can really multiply economic growth.

5.4 Recommendations

Improve Early Education

Update What's Taught: Revise preschool and elementary school curriculum to focus on skills needed now.

Train the Teachers: Provide more training so teachers are great at teaching and know their stuff.

Fix Up Schools: Build and fix classrooms, libraries, labs, etc. so kids learn in good spaces.

Make It Fair: Make sure all kids, especially disadvantaged ones, can go to great schools.

Focus on Later Education Too: -

Promote Career Skills: Grow programs where students learn job skills they can use straight after graduating.

Offer More Options: Develop tech and vocational programs alongside traditional academics.

Partner with Businesses: Connect schools directly with companies so students are learning things that local jobs need.

In general, keeping education and the economy closely connected will help Ethiopia's development. Investing at all levels while also improving quality and access can maximize the impact.

Improve Universities: - Boost research and innovation at colleges and universities and encourage partnerships between schools and local companies.

Offer Financial Aid: - Provide scholarships and grants so more students, especially low-income, can afford secondary and college tuition.

Increase Government Spending on Education: - Make education a high budget priority for quality and access improvements.

Closely track results to see what's working and make changes where needed.

Partner with Businesses: - Encourage the government and private companies to work together on education. This brings in more money and expertise.

Reduce Broader Barriers: - Implement comprehensive programs to lower poverty rates, which act as a barrier to school access. When basic needs are met, kids can focus on learning.

Overall, increasing support, tracking progress, reducing poverty, and fostering collaboration can reinforce education's role in the economy.

Focus on Health Too: - Offer school-based healthcare and nutrition programs so kids stay healthy to learn well.

Engage the Community: - Get community members involved in education planning so local needs are addressed. This also gains local support.

Promote Lifelong Learning: - Develop more adult education programs so people can keep learning new skills throughout life.

Support Continued Job Training: - Encourage employers to invest in ongoing staff training to adapt to changing market demands and new technologies.

By taking on these recommendations, Ethiopia can boost the quality and impact of its education system. This helps education better fuel economic growth and development over the long run. Policymakers, educators, and other stakeholders must collaborate to achieve these goals and ensure education spurs sustainable economic progress. Working as a team is key. These goals and ensure that education serves as a catalyst for sustainable economic progress.

5.5 Future Research Directions

Look Deeper at What's Driving the Trends: - Study more what exactly explains why early schooling has negative effects on the economy while higher levels have positive impacts. What factors are influencing these differing results?

Break Down the Data More: - Do a more detailed analysis by breaking the data down further, like comparing public vs private schools at each level or seeing how specific education programs or reforms impacted things.

Compare to Other Places: - Contrast Ethiopia's experience to other developing countries nearby or in similar economic situations. This could help show if the patterns found were unique to Ethiopia or apply more widely.

Look at Potential Time Delays: - Education's effects on the economy may not be immediate. Look at different lag times between investing in education and seeing returns in growth.

Analyze Specific Industry Impact: - Study education's influence on different parts of Ethiopia's economy like farming, manufacturing, etc. This can guide targeting education investments.

Do Qualitative Interviews Too: - Supplement numbers with interviews of leaders to understand challenges beyond what data shows.

Recommend Clear Education Policy Steps: - Based on results, suggest specific strategies to the government for smartly putting money into different school levels to spur growth.

Check Tech Integration Effect: - Research impact of bringing technology into classrooms.

Do Cross-Country Comparisons: - Study relationships between education and growth across nations to identify effective models.

Combined, qualitative depth, sector analyses, timelines, and international benchmarks can enrich core quantitative findings. The goal is actionable guidance for optimizing education to fuel Ethiopia's development.

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7. APPENDEX

Appendix 1 Time series data from MOEE and WB

Year	GDP	X1	X2	x3	X4	x5
2000	8242349618	99710	6462503	559859	67682	328301847.8
2001	8231326016	109358	7401473	736174	87431	304582930.6
2002	7850809498	118986	7982760	684630	101829	285176737.8
2003	8623691300	123057	8572315	78641	147954	
2004	10131187261	138918	9542638	685976	172111	
2005	12401139454	153280	11440731	953217	191165	
2006	15280861835	186728	12657342	1066423	180117	839066029.5
2007	19707616773	219068	13431510	1398881	229864	1074287793
2008	27066912635	263464	15340786	1501363	270356	1463832712
2009	32437389116	292641	15553142	1587585	320827	1434404061
2010	29933790334	341315	15792103	1695930	434659	1345999864
2011	31952763089	382741	16718111	1750134	467843	1752851964
2012	43310721414	1622762	16973522	1766011	839995	2411012617
2013	47648276605	2013214	17430294	1899731	824036	2143481518
2014	55612228234	2498360	18139200	1998355	865505	2559285747
2015	64589328551	2958803	18691217	2108115	1290841	3328521475
2016	74296745208	3809298	19977441	2421163	1346160	3760540087
2017	81770886826	3563325	20783078	2559177	1419708	4496622457

2018	84269196626	3460878	20661021	2666741	1445532	4398946316
2019	95912607722	3216206	20046357	2820135		4297718588
2020	1.07658E+11	3599596	20419152	3466972		4403809823
2021	1.11262E+11	2934668	18447497	3540324	1141295	4523072547
2022	1.26783E+11	3547764	19219900	3867463	1566641	4737258100
2023		4041915	19180410	3769187	1596671	

Appendix 2 ARDL bound test

```
. ardl GDP_22diff X1_diff X2_diff X3_diff X4_diff X5_diff, lags(2 2 2 2 2 2) ec
> btest
```

ARDL(2,2,2,2,2,2) regression

```
Sample: 2004 - 2023                                Number of obs   =          20
                                                    R-squared       =          0.9903
                                                    Adj R-squared  =          0.9079
Log likelihood = -439.90214                        Root MSE       =          2.730e+09
```

D.GDP_22diff	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
ADJ						
GDP_22diff						
L1.	-3.121662	.6583938	-4.74	0.042	-5.954503	-.2888224
LR						
X1_diff	8326.004	2146.132	3.88	0.060	-908.0558	17560.06
X2_diff	466.9582	428.563	1.09	0.390	-1377	2310.916
X3_diff	-3749.26	5004.04	-0.75	0.532	-25279.9	17781.39
X4_diff	-49197.55	13986.79	-3.52	0.072	-109377.9	10982.76
X5_diff	11.7236	4.59238	2.55	0.125	-8.035813	31.48302
SR						
GDP_22diff						
LD.	.8512322	.3321433	2.56	0.124	-.577865	2.280329
X1_diff						
D1.	-8368.106	7119.806	-1.18	0.361	-39002.16	22265.94
LD.	4620.16	3373.918	1.37	0.304	-9896.635	19136.96
X2_diff						
D1.	2079.379	1696.235	1.23	0.345	-5218.933	9377.692
LD.	3568.424	1382.409	2.58	0.123	-2379.601	9516.449
X3_diff						
D1.	8890.081	7262.42	1.22	0.346	-22357.59	40137.75
LD.	1632.854	3391.219	0.48	0.678	-12958.38	16224.09
X4_diff						
D1.	124217.3	37939.61	3.27	0.082	-39023.63	287458.3
LD.	56729.86	21222.54	2.67	0.116	-34583.38	148043.1
X5_diff						
D1.	-31.57101	9.264698	-3.41	0.076	-71.43378	8.291768
LD.	-22.47416	7.135945	-3.15	0.088	-53.17766	8.229332
_cons	1.89e+08	2.98e+09	0.06	0.955	-1.26e+10	1.30e+10

Appendix 3 vector error correction model (VECM)

```
. vec D.GDP_22diff D.X1_diff D.X2_diff D.X3_diff D.X4_diff D.X5_diff, lags(2) r
> ank(1)
```

Vector error-correction model

```
Sample: 2005 - 2023      Number of obs   =      19
                        AIC                    =    202.1848
Log likelihood = -1867.756      HQIC           =    202.6307
Det(Sigma_ml) = 9.77e+77      SBIC            =    204.8193
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D2_GDP_22diff	8	1.3e+10	0.6112	17.29507	0.0272
D2_X1_diff	8	504154	0.8689	72.90702	0.0000
D2_X2_diff	8	1.0e+06	0.8477	61.22113	0.0000
D2_X3_diff	8	346820	0.7630	35.41645	0.0000
D2_X4_diff	8	183812	0.8728	75.46684	0.0000
D2_X5_diff	8	5.1e+08	0.6314	18.84156	0.0157

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
D2_GDP_22d~f						
_cel						
L1.	-.1979252	.4523656	-0.44	0.662	-1.084545	.6886951
GDP_22diff						
LD2.	-.1099372	.386294	-0.28	0.776	-.8670595	.6471851
X1_diff						
LD2.	-7551.659	4853.057	-1.56	0.120	-17063.48	1960.158
X2_diff						
LD2.	-1373.815	2941.328	-0.47	0.640	-7138.712	4391.081
X3_diff						
LD2.	828.3482	8710.102	0.10	0.924	-16243.14	17899.83
X4_diff						
LD2.	5867.261	24368.66	0.24	0.810	-41894.44	53628.97
X5_diff						
LD2.	-7.896983	7.352343	-1.07	0.283	-22.30731	6.513345
_cons	-100891.1	2.99e+09	-0.00	1.000	-5.85e+09	5.85e+09

D2_X1_diff							
_cel							
L1.	.0000137	.0000182	0.75	0.452	-.000022	.0000493	
GDP_22diff							
LD2.	.0000397	.0000155	2.55	0.011	9.23e-06	.0000701	
X1_diff							
LD2.	-1.091113	.1951162	-5.59	0.000	-1.473534	-.7086926	
X2_diff							
LD2.	.0294553	.1182555	0.25	0.803	-.2023211	.2612318	
X3_diff							
LD2.	-.2284596	.3501879	-0.65	0.514	-.9148152	.4578959	
X4_diff							
LD2.	.2338927	.9797371	0.24	0.811	-1.686357	2.154142	
X5_diff							
LD2.	-.000305	.0002956	-1.03	0.302	-.0008844	.0002744	
_cons	26236.79	120017.1	0.22	0.827	-208992.3	261465.9	
D2_X2_diff							
_cel							
L1.	.0001184	.0000365	3.24	0.001	.0000468	.0001901	
GDP_22diff							
LD2.	-1.55e-06	.0000312	-0.05	0.960	-.0000627	.0000596	
X1_diff							
LD2.	-.3219625	.3920826	-0.82	0.412	-1.09043	.4465053	
X2_diff							
LD2.	-.2074903	.2376324	-0.87	0.383	-.6732412	.2582606	
X3_diff							
LD2.	-1.299047	.7036966	-1.85	0.065	-2.678267	.0801725	
X4_diff							
LD2.	-4.279172	1.968765	-2.17	0.030	-8.137881	-.4204633	
X5_diff							
LD2.	-.0003308	.000594	-0.56	0.578	-.0014951	.0008334	
_cons	154297.5	241172.2	0.64	0.522	-318391.4	626986.4	

D2_X3_diff						
_cel						
L1.	4.48e-06	.0000125	0.36	0.720	-.00002	.000029
GDP_22diff						
LD2.	.0000132	.0000107	1.24	0.216	-7.72e-06	.0000342
X1_diff						
LD2.	-.0568154	.1342253	-0.42	0.672	-.3198921	.2062613
X2_diff						
LD2.	-.0778715	.0813509	-0.96	0.338	-.2373164	.0815733
X3_diff						
LD2.	-.5924013	.240903	-2.46	0.014	-1.064562	-.1202402
X4_diff						
LD2.	-.0414618	.6739856	-0.06	0.951	-1.362449	1.279526
X5_diff						
LD2.	-.0001558	.0002034	-0.77	0.444	-.0005544	.0002428
_cons	-58419.64	82562.73	-0.71	0.479	-220239.6	103400.3
D2_X4_diff						
_cel						
L1.	-.0000129	6.63e-06	-1.95	0.051	-.0000259	8.15e-08
GDP_22diff						
LD2.	9.72e-06	5.66e-06	1.72	0.086	-1.38e-06	.0000208
X1_diff						
LD2.	-.0896193	.0711386	-1.26	0.208	-.2290483	.0498097
X2_diff						
LD2.	-.1427217	.0431155	-3.31	0.001	-.2272264	-.0582169
X3_diff						
LD2.	.1817056	.1276771	1.42	0.155	-.0685368	.4319481
X4_diff						
LD2.	-.5238495	.3572082	-1.47	0.143	-1.223965	.1762657
X5_diff						
LD2.	.0002679	.0001078	2.49	0.013	.0000567	.0004792
_cons	4454.047	43757.73	0.10	0.919	-81309.53	90217.63

D2_X5_diff							
_ce1							
I1.	-.0068333	.0185616	-0.37	0.713	-.0432133	.0295468	
GDP_22diff							
LD2.	.0149028	.0158505	0.94	0.347	-.0161637	.0459693	
X1_diff							
LD2.	-90.71791	199.1322	-0.46	0.649	-481.0098	299.574	
X2_diff							
LD2.	10.09275	120.6895	0.08	0.933	-226.4543	246.6398	
X3_diff							
LD2.	192.909	357.3957	0.54	0.589	-507.5737	893.3916	
X4_diff							
LD2.	-849.9757	999.9028	-0.85	0.395	-2809.749	1109.798	
X5_diff							
LD2.	-.3692445	.3016837	-1.22	0.221	-.9605336	.2220447	
_cons	2925139	1.22e+08	0.02	0.981	-2.37e+08	2.43e+08	

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	5	4109.303	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
_ce1						
GDP_22diff						
D1.	1	.	.	.	.	.
X1_diff						
D1.	-8914.274	663.9611	-13.43	0.000	-10215.61	-7612.934
X2_diff						
D1.	-12634.13	359.157	-35.18	0.000	-13338.06	-11930.19
X3_diff						
D1.	29362.34	738.4193	39.76	0.000	27915.07	30809.62
X4_diff						
D1.	62425.9	2832.488	22.04	0.000	56874.33	67977.47
X5_diff						
D1.	4.146523	.9405937	4.41	0.000	2.302994	5.990053
_cons						
	-2.85e+09	.	.	.	.	.