



HAL
open science

Essays on economic growth diagnostic and demographics in Sub-Saharan Africa

Gbedia Gomez Agou

► **To cite this version:**

Gbedia Gomez Agou. Essays on economic growth diagnostic and demographics in Sub-Saharan Africa. Economics and Finance. Université Panthéon-Sorbonne - Paris I, 2020. English. NNT : 2020PA01E024 . tel-03022180

HAL Id: tel-03022180

<https://theses.hal.science/tel-03022180>

Submitted on 24 Nov 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Ecole Doctorale d'Économie

THESE Présentée par
Gbedia Gomez Agou
Défendue le 01 octobre 2020

Pour l'obtention le titre de Docteur par **l'Université de Paris I Sorbonne-Panthéon**

Discipline : **Sciences Economiques**

ESSAIS SUR LA CROISSANCE ECONOMIQUE ET LA DEMOGRAPHIE EN AFRIQUE SUB-SAHARIENNE

Directeur de thèse : Professeur Emérite Jean-Claude Berthelemy

Rapporteurs

Dr. Patrick Plane, Directeur de la recherche, CNRS, CERDI, Université de Auvergne

Dr. Dramane Coulibaly, Maître de Conférence, Université de Paris-Nanterre

Présidente du jury : Dr. Maurel, Directrice du Centre d'économie de la Sorbonne

Jury Members

Dr. Berthelemy, Professeur Emérite

Dr. Patrick Plane, Directeur de la recherche, CNRS, CERDI, Université de Auvergne

Dr. Dramane Coulibaly, Maître de Conférence, Université de Paris-Nanterre

Dr. Joaquim Oliveira, Directeur adjoint, OCDE

"Big and sudden changes come from small and consistent actions." Gomez Agou

Acknowledgments

A PHD thesis is like any other journey except that this one is about exploring the uncharted world of knowledge. Each journey has crew members playing various roles: some spark the idea of having the journey, some support during the journey, some guide through the journey and the last lead the journey. This thesis has been no different. And, these crew members deserve to be acknowledged.

I would like to start with my parents, Mr. and Mrs. Agou. They have been at the beginning of my education starting in primary school. With their limited means, my father—a primary school teacher—and my mother—a housewife—have never ceased to push me to cross uncharted lands of knowledge that they have never visited. My father is the one who, unsatisfied with my graduation from Harvard, planted in my mind the idea of a PHD in economics. I have now put my foot in the world of PHDs because of them. I say thank you to them!

Thanks to my special supporters: Edith, Ivana, and David. Edith, my wife has been an incredible support in times of excitement at the beginning of the journey but more importantly in times of doubt during the journey. She has been there, repeating daily that I could become a Doctor of Philosophy in economics until I believed it and made it happen. To be fair, Edith has been a coach for me, bringing the best out of me, since Cambridge on Harvard campus! To Ivana and David, I am grateful to them that they have ignored all my calls to be left alone when I was struggling with the thesis. Without their persistence, I could have missed the joy of being a father during these three years of thesis. I also would like to say thanks to my two brothers (Franck and Ange) for their continued encouragement.

I would like to say a special thanks to a friend who has been an incredible help during this Journey: Dr. Desire Kanga. Dr. Kanga has convinced me that I could do a PHD in three years if I was committed. He had one proof: He had just done it before! Further, he decided to join me in the journey. He has not only co-authored two chapters with me but has been an incredible source of knowledge and wisdom when I needed technical guidance. To be fair, I was not surprised by his support; Desire has been a friend for 15 years!

Big things are usually achieved, standing on the shoulders of giants: Professor Jean-Claude Berthelemy is on them. I would have never joined the community of PHD holders without him. Professor Berthelemy has shown flexibility by supervising a PHD thesis written from Washington. This thesis journey was supposed to last six years, it only lasted three years, thanks to his responsiveness even after being on retirement. During that support effort, he has brought to the Journey Dr. Maurel, an incredible mind! Professor Berthelemy has relentlessly pushed my intellectual limits. I hope to honor his empowerment by contributing to the world of economics.

I cannot forget the metro drivers of Washington DC and the airline pilots of my mission flights. I wrote more than 75 percent of this thesis in trains and airplanes. Every business day in DC, I wrote the thesis in the train during the 30-minute commute on my way in and out from work. And, when I was on mission, I wrote the thesis in the air during my long-hour flights.

Finally, I would like to say thank you my Lord, Jesus Christ. He has kept me alive, prevented fateful events, and given me the courage to push myself. Throughout this journey, he has been at the beginning and the very end. He has put these wonderful people mentioned above in my journey. My God deserves the praise and the glory! He has made me Dr. Agou!

Table of content

List of figures.....	8
List of tables.....	10
Abbreviations.....	12
General introduction.....	16
I- HRV constraints diagnostic to high growth in cote d'ivoire	30
I.1 Introduction.....	30
I.2 Recent African growth: A literature review.....	32
I.3 Cote d'Ivoire: Growth History	37
I.4 Data and Methodology for HRV Diagnostic.....	52
I.5 A story of corruption, finance, and fear to diversify.....	56
I.6 Conclusion.....	76
I.7 Annex.....	78
II- Demographics and Economic Growth in Sub Saharan Africa	83
II.1 Introduction.....	83
II.2 Key Facts of Demography in Sub-Saharan Africa	85
II.3 Demographic impacts on Growth: a literature Review	96
II.4 Revisiting Demography Impact on Economic Growth in SSA.....	107
II.5 Conclusion.....	134
II.6 Annex.....	136
III- Drivers of fertility and life expectancy in Sub Saharan Africa.....	152
III-1 Introduction.....	152
III.2 Trends of fertility and life expectancy in SSA.....	155
III.3 Literature on Fertility, mortality and life expectancy in SSA.....	167
III.4 Empirical Analysis.....	180
III.5 Conclusion.....	196
III.6 Annex.....	198
General conclusion.....	204
Bibliography.....	226

LIST OF FIGURES

Figure 0-1:GDP Growth episodes in the SSA region.....	18
Figure 0-2: A growth diagnostic decision tree.....	22
Figure I-1. Côte d'Ivoire : social indicators performance	43
Figure I-2. Côte d'Ivoire: per capita GDP growth.....	47
Figure I-3. GDP per capita growth in post conflict period.....	47
Figure I-4. Côte d'Ivoire: Growth accountability.....	48
Figure I-5. Côte d'Ivoire: Public Investment (percent of GDP).....	50
Figure I-6: Côte d'Ivoire. exports and GDP per capita.....	51
Figure I-7. HRV diagnostic tree.....	54
Figure I-8 Infrastructure quality.....	57
Figure I-9. Côte d'Ivoire: comparison of enrollment rates.....	58
Figure I-10: Human capital index and components, Higher =worse	59
Figure I-11: Macroeconomic stability indicators, 2017	60
Figure I-12. Governance indicators.....	62
Figure I-13. Corruption control, comparison with peers.....	63
Figure I-14: Corruption as major constraint to business (percent of total firms)	64
Figure I-15. Rules of law indicators, comparison with peers	65
Figure I-16. Court system as a major constraint to business (percent of firms)	65
Figure I-17. Comparison of real interest and lending rates,	66
Figure I-18. Côte d'Ivoire: national savings with peers	66
Figure I-19. Côte d'Ivoire: corruption perception and credit access by sector	69
Figure I-20. Côte d'Ivoire: Non-Performing loans, comparison with peers.....	70
Figure I-21. Côte d'Ivoire : economic complexity.....	71
Figure I-22. Economic complexity.....	73
Figure I-23. Côte d'Ivoire : exports composition (1995).....	74
Figure I-24. Côte d'Ivoire : exports composition (2005).....	75
Figure I-25. Côte d'Ivoire : exports composition (2016).....	75
Figure I-26. Corruption perception rankings.....	78
Figure I-27. Côte d'Ivoire: Credit access by firms' size	80
Figure II-1: Population size and growth in selected world regions.....	85
Figure II-2: Projections of population trends in selected world regions.....	87
Figure II-3: Dependency in selected world regions (1950-2015).....	89
Figure II-4: Fertility and mortality of children under five in SSA.....	91
Figure II-5: Age group population: actual and projected trends.....	92
Figure II-6: Migration in selected world regions.....	95

Figure II-7: Changes in governance scores in SSA (2000-17).....	121
Figure II-8: GDP growth and governance in SSA.....	122
Figure II-9: Population density in selected world regions	136
Figure II-10: Total population by five-year age group, selected world regions.....	137
Figure II-11: Crude birth and fertility rates in world and SSA regions.....	138
Figure II-12: Fertility rate by age group in selected world regions	139
Figure II-13: Fertility rate by age group in SSA regions.....	140
Figure II-14: Infant mortality rates in selected world and SSA regions.....	141
Figure II-15: Life expectancy and crude deaths in world and SSA regions	142
Figure II-16: Total deaths by age group (per 100 group population)	143
Figure II-17: Total deaths per 100 age group population in SSA regions.....	144
Figure II-18: Sex ratio (males per 100 females) in selected world regions.....	145
Figure II-19: Sex ratio (males for 100 females), SSA regions	146
Figure III-1: Population growth rates in the SSA and other regions of the world	156
Figure III-2: Total fertility rates in the SSA and other world regions.....	158
Figure III-3: Top 5 countries with highest fertility rates	158
Figure III-4: Death rate in the SSA and other world regions.....	160
Figure III-5: Infant mortality rates in the SSA and other world regions	161
Figure III-6: Correlation of births and infant mortality rates in the SSA region	162
Figure III-7: Life expectancy in the SSA and other world regions.....	164
Figure III-8: Preston curve for the SSA region (1960-2015).....	164
Figure III-9: Migration trends in the SSA and other world regions	165
Figure IV-1: Life expectancy in Côte d'Ivoire and its peers.....	215
Figure IV-2: Elderly dependency ratio (percent of working age population).....	216
Figure IV-3: Working-age population (percent of total population).....	216

LIST OF TABLES

Table I-1. Correlation between access to credit and finance.....	68
Table I-2. Côte d'Ivoire : corruption perception as obstacle.....	78
Table I-3 : Cote d'Ivoire: firms and access to credit.....	78
Table I-4. Côte d'Ivoire: constraint to access credit.....	79
Table I-5. Côte d'Ivoire : finance perception as obstacle.....	79
Table I-6 : Côte d'Ivoire: decomposition of credit by lender.....	79
Table I-7. Côte d'Ivoire: correlation of access to finance and corruption.....	80
Table I-8. Cote d'Ivoire: firms' size and access to financing.....	80
Table I-9: Côte d'Ivoire: access to credit by sector.....	81
Table I-10. Côte d'Ivoire : firms' size and perception of finance as constraint.....	81
Table II-1: Convergence model for SSA countries (1985-2015).....	120
Table II-2: Governance in SSA regions (2000-17).....	122
Table II-3: Convergence model for resource-rich countries in SSA (1985-2015).....	127
Table II-4: Contributions to changes in per worker income growth (1985-2015)....	132
Table II-5: Contributions to changes in per worker income growth (1985-2000)....	132
Table II-6: Contributions to changes in per worker income growth (2000-2015)....	133
Table II-7: Statistics of regression variables.....	147
Table II-8: Hausman test.....	148
Table II-9: Test for robustness: panel regression excluding child dependency.....	149
Table III-1: Regression results: Fertility and life expectancy in the SSA region.....	194
Table III-2: Descriptive statistics of variables.....	198
Table III-3: OLS regression life expectancy without instrumenting income.....	199
Table III-4: Hausman test for the fertility regression.....	200
Table III-5: Robustness test of the variable marginal intensity.....	201
Table IV-1: simulation of policy changes on population growth and income growth per capita.....	224

ABBREVIATIONS

2SLS: Two Stage Least Square

ACBF: Africa Capacity Building Foundation

AFDB: African Development Bank

AGEROUTE: Agence de Gestion des Routes (State Agency for Road in Cote d'Ivoire).

AIDS: Acquired Immune Deficiency Syndrome

CFA: Community of francophone Africa

CID: Center for International Development

COMTRADE: Common format for Transient Data Exchange for power systems

COVID_19: Coronavirus Disease 2019

CPI: Corruption Perception Index

DHS: Demographic and Health Survey

ECI: Economic Complexity Index

GDP: Gross Domestic Product

HIPC: Heavily Indebted Poor Countries

HIV: Human Immunodeficiency Virus

HRV: Hausmann Rodrik Velasco

ICRG: International Country Risk Guide

IDA: International Development Association

ILO : International Labor Organization

IMF: International Monetary Fund

LIC: Low Income Country

MDRI: Multilateral Debt Relief Initiative

MIT: Massachusetts Institute of Technology

OLS: Ordinary Least Square

SME: Small Medium Enterprises

SODESUCRE : Société De Sucre (Ivorian State Owned Sugar Company)

SOE: State Owned Enterprise

SSA: Sub Saharan Africa

STIC: Scientific and Technical Information Center

TFP: Total Factor Productivity

USAID: United States Agency for International Development

WAEMU: West Africa Economic and Monetary Union

WEO: World Economic Outlook

WGI: World Governance Indicators

GENERAL INTRODUCTION

GENERAL INTRODUCTION

I. Findings of the thesis

Our thesis shows that population growth and structure are significant determinants of economic growth in Sub Saharan Africa (SSA). Therefore, we suggest that the Hausmann Rodrik and Velasco (HRV) diagnostic framework should include explicitly an analysis of population composition and growth when performing a growth diagnostic for the SSA countries. In other terms, the HRV tree should be augmented with demographic branches.

On the impact of population composition on economic growth, we contradict a common belief that a growing active population benefits necessarily economic growth per worker. On the contrary, in the SSA, we find that working age population growth hurts economic growth per worker. Rapid growth of working age population is not what is needed. What is needed is an active population growth that is consistent with the capacity of the labor market to absorb the new entrants of the active population. Also, rising elderly dependency in the SSA countries negatively affects income growth per worker. Life expectancy has a positive impact for economic growth in the SSA region. Longevity is primarily driven by income, HIV prevalence, and democracy and to a lesser extent education intrinsic contribution.

On population growth in the SSA region, we find that the most influential factors to control fertility in SSA are age at first marriage and women participation to labor market and surprisingly not contraceptive use and education. Also, we discover that reducing infant mortality would be as efficient as promoting the use of contraceptive methods to reduce fertility.

II. Context

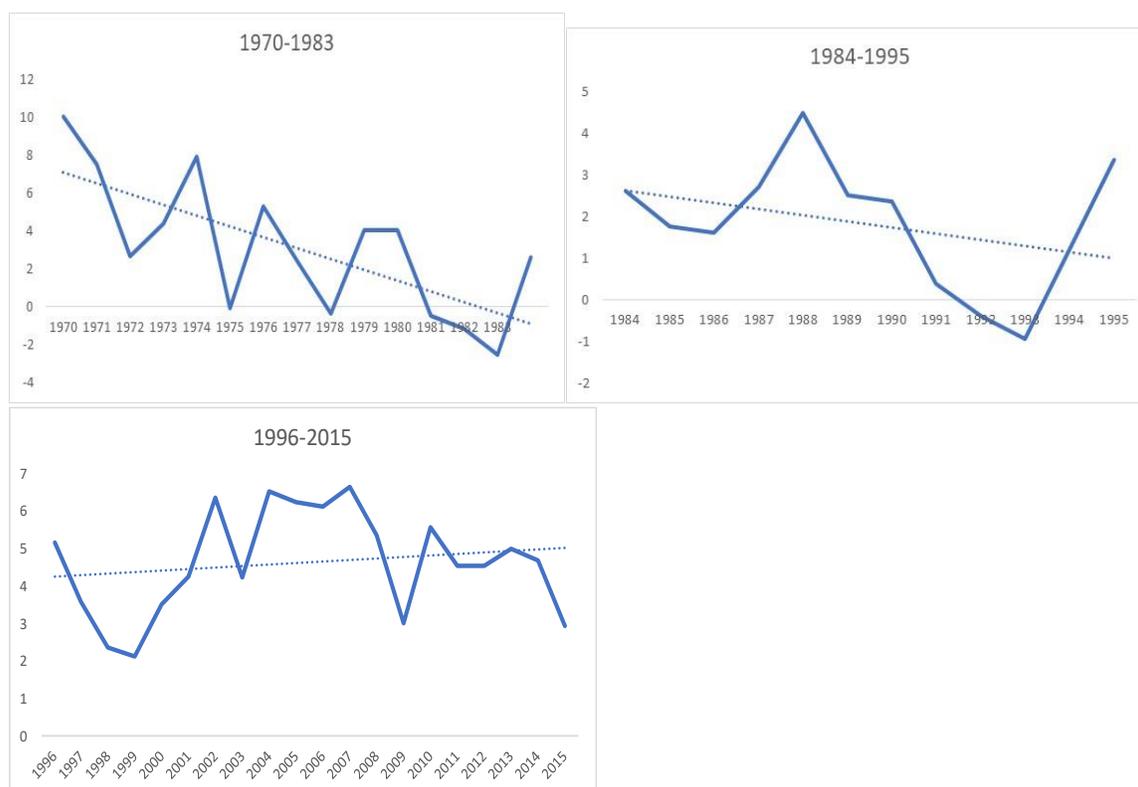
In 2017, the French President Macron reignited a growing and unsettled debate on the impact of demography on economic development in sub-Saharan Africa. He claimed that economic development would nearly be impossible if fertility remained high. This statement fueled the public debate between pessimists, neutralists and optimists of demography. Supporting the French President's view, the pessimists claim that demography in the SSA is a drag on economic growth. The neutralists claim that demography has no impact on economic growth. And, the optimists believe that the SSA demographics could be a driver of economic growth in the SSA.

This demographic debate reemerged after almost 15 years of unprecedented growth: the so called "Africa rising"¹. Since the late 1990s, the SSA region has moved from the "lost decade continent"² to "Africa rising". Sub Saharan Africa has three main episodes of growth (Figure 0-1). The first period spans from 1970 to 1984, the second one from 1985 to 1995, and the third one spans from 1995 to 2015. During the first period, GDP growth trended down with an average of 3 percent with a high volatility. During the second episode, the downward trend of GDP growth continued with a lower average of 2.4 percent. These two episodes of growth sparked the so called "lost decades". In the third period, growth trend reversed; GDP rose by 4.6 percent.

¹ Franks, Suzanne. "[Stereotyping Africa: from impoverishment to 'Africa Rising'](#)". *city.ac.uk*. City, University of London. Retrieved 20 February 2016

² (The Economist, 2000) or the continent of lost decades from failing Washington consensus policies (Easterly, 2001).

Figure 0-1: GDP Growth episodes in the SSA region



Source: World Development Indicators.

Yet, this high growth did not translate into high per capita growth, eaten up by population growth. Since late 1990s, income per inhabitant in the SSA countries grew only by less than 2 percent, halving the increase in GDP. The other half of the GDP rise disappeared with population growth. As a benchmark, over the same period, China's GDP rose by 9.5 percent on average, each resident of China experienced an income growth of more than 8 percent on average. The European Union grew 50 percent less than the SSA region in GDP growth terms. But the income of the European Union inhabitant grew as fast as the income per capita in the SSA region.

III. Research question and contribution to literature

This thesis answers the following questions. Do demographics play any role in economic growth in the SSA region? If so, how?

Economic research has mainly produced three methodologies to pinpoint the drivers to economic growth: growth accounting, cross country regression and Hausmann Rodrik Velasco (HRV) growth diagnostic tree; each successor trying to overcome the limits of its predecessor.

Solow (1957) introduced growth accounting to decompose economic growth of a country into three contributions: physical capital, labor and a residual—which reflects the contribution of other factors apart from the first two ones. That residual, known as the Solow residual or Total Factor Productivity (TFP), measures the productivity of an economy. This residual is known also as the level of our ignorance because it includes factors that are not accounted for in human and physical capital.

Yet, growth accounting presents some limitations due to some of its assumptions³. Growth accounting assumes a production function with constant return to scale. Yet, Barro (1998) shows that a return to scale can be increasing based on endogenous growth theory. Applying growth accounting leads to challenging physical capital measurement regarding the size and quality of capital (Pritchett, 2000). Failing to properly measure physical capital can lead to misappropriation of factor contribution to growth. Finally, growth accounting remains a pure accounting exercise which does not give insights on underlying determinants.

³ This section heavily draws diagnostic methods weaknesses from the Mindbook of Ricardo and al (2008)

The second methodology is the cross-country regression. The approach estimates the contribution of underlying factors to economic growth, using a sample of country data. Economists in the literature have tried all sorts of regressions to explain economic growth. The most famous of these papers running multiple regressions is from Sala I Martin (1997).

However, key weaknesses emerge from the cross-country regression. Hausmann and al (2008) summarize the main ones as follow. First, regressions look at average behavior of the sample while country characteristics do not necessarily fit that behavior. Second, significant regression variables might not be under the direct controls of the policy makers, leading to limited policy prescription. The significant variables in the regression do not indicate whether the level of a given variable reflect a demand or supply side issue. More importantly, regression fails with the substitution assumption while lacking comparability and focus. It assumes that causal factors can be substitute of each other to compensate for an insufficient factor provision. Also, regressions with many of significant causal factors might lead to a laundry list of policies in countries facing scarce implementation resources.

Against this background, Hausmann, Rodrik and Velasco (2005) propose the HRV growth diagnostic. Using the neoclassical rational, the diagnostic focuses on constraints to private investment as it considers that growth is ultimately determined by private investment. It assumes that the level of private investment in an economy reflects the supply of investment (finance) and the demand for investment (the expected returns on economic activity). At any point of time, low level of private investment is either due to low demand for investment or low supply of finance. For

each possibility, the authors identify potential binding constraints to be tested (figure 0-2)⁴.

The HRV framework defines a binding constraint as a growth determinant that is not substitutable and which effect on growth is among the most significant. To identify a binding constraint, there is a set of tests run on all potential growth constraints; constraints which do not meet the tests are ruled out until the binding constraints are identified in an iterative process.

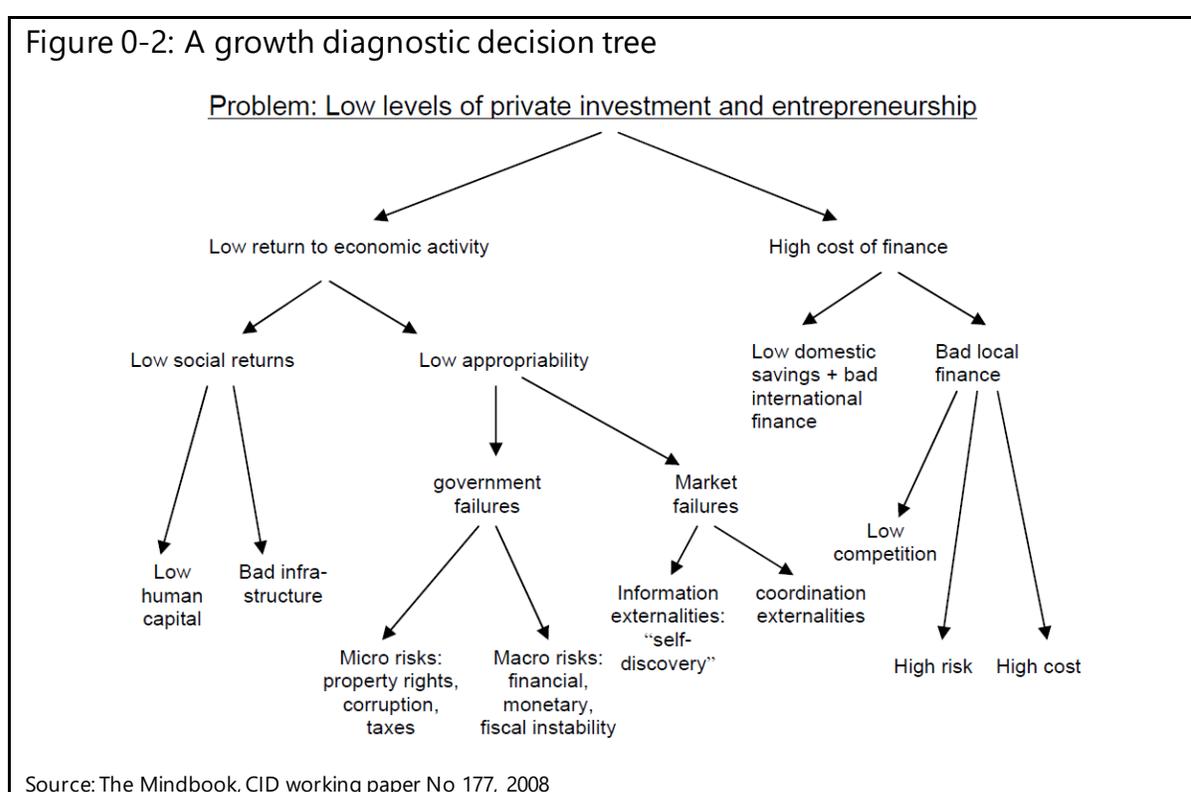
The HRV framework has become the main tool for country or region-specific growth diagnostic. Scholars including leading development institutions like the International Monetary Fund, the World Bank, and the United States Agency for International Development (USAID) have used since late 2000s.

If in the thesis, we were to use the HRV framework as it stands now to answer our research question, we would face a challenge. In fact, looking at the HRV tree, one notices that the tree does not explicitly include demographic factors as initial hypothesis (branches of the HRV tree). Hence, making impossible to include whether demographic variables—neither population composition or growth—constrain growth.

The fact that the latest framework of growth diagnostic does not explicitly include the demographic factors reflects, to a large extent, how research has overlooked demographic impact on economic growth over the last two decades. Only limited papers (e.g. Barro, 1997; Bloom and Sachs, 1998; Kelley and Schmidt,

⁴ This diagnostic tree comes from the Mindbook (Ricardo and al, 2008).

1999; Radelet and al, 2001; Kelley and Schmidt, 2004) in the literature investigate the causal relationship of demographics on economic growth in the SSA region. More importantly, these existing studies have not focused on sub-Saharan Africa alone in their evaluation of demographic impacts, thus making the findings not specific to sub-Saharan Africa. Also, the most recent period under study is 1990s. Also, no study looks at the impact of the population on economic growth in the SSA region over periods including 2000-2015.



Against this existing gap in the literature, the thesis contribution is threefold. First, the thesis looks at the impact of demographic factors on economic growth focusing only on the Sub Saharan Africa (SSA) region, thus providing SSA specific findings for future research and policy making. Second, our research shed light on the role of demographics on economic growth episodes experienced by the SSA region

including from 2000 to 2015. Third, the thesis identifies the drivers of population growth from 1995 to 2015, specific to the SSA region.

IV. Objective of the thesis and methodologies

The goal of this thesis is to show that demographic factors are potential constraints to economic growth in the SSA region. Therefore, demographic factors should be explicitly considered in any HRV growth diagnostic exercise.

To achieve this objective, we adopt a three-stage methodology. The first stage is to show the importance of the HRV framework to assess growth constraints in any SSA economy. The second stage is to show the impact of population characteristics on income growth per working age individual. The third stage is to identify the drivers of population growth which translate the income growth per working age individual into an income growth at the per capita level.

At the first stage, we show that the HRV diagnostic tree is a valuable tool which should be used to pinpoint the growth constraints for the SSA economies. We illustrate that by applying the HRV framework on Côte d'Ivoire, one of the fastest growing economy of the SSA of the last decade.

The second and third stage approach is based on the following logic. We consider that economic growth is measured by the change in GDP per capita. The change in GDP per capita results from two factors: the change in production per active labor (proxied as working age population) and the change in total population size.

Therefore, at the second stage, we assess the impact of population factors on GDP growth per working age population in the SSA region. To do so, we use a convergence model inspired from previous work by Barro (1997) and Kelley and al. (2004). We run a panel regression with GDP growth per worker as the dependent

variable and explanatory variables. The explanatory variables include not only demographic but also economic and institutional variables. We use data from 1985-2015 on 29 SSA countries. We do not include all SSA countries due the lack of data.

At the third stage, we identify the drivers of population growth. To better assess the drivers of population, we focus on the drivers of the population growth components. In fact, population change through three components: i) the number of births or fertility, ii) the number of deaths reflecting how long people live on average (life expectancy), and iii) the net number of people migrating from the population. Based on that logic, our focus is to investigate the drivers of each of these population change components, namely fertility, life expectancy and immigration in the SSA countries. We focus on life expectancy as is calculated from the mortality rate, thus sharing the same drivers. Immigration plays on average a marginal role in population change, about 5 percent of change in population. Therefore, we limit our analysis to fertility and life expectancy. We use data on 29 SSA countries from 1995 to 2015 to conduct a panel regression for fertility equation and a for life expectancy regression.

V. Plan of the thesis

Our thesis has three chapters. Chapter 1 aims at illustrating the importance of the latest growth diagnostic framework to identify binding constraints for future economic growth: the Hausmann, Rodrik, Velasco (HRV) growth diagnostic. We do so by applying the HRV framework on Côte d'Ivoire. This exercise identifies potential constraints to sustain higher private investment in the short and medium term.

We find that corruption, access to finance and weak exports sophistication could hamper high growth over the medium term. It is worth noting that due to the current HRV framework, our findings overlook demographic factors as potential constraints to economic growth.

Chapter 2 aims to show that population structure impacts economic growth in SSA countries. To that end, we use a convergence model comprising economic, institutional, and demographic variables to uncover the drivers of per worker income growth of the last three decades (1985-2015) on 29 countries of the SSA region. We find that working age population, children and elderly dependency are significant determinants of per worker income growth in Sub Saharan Africa. To be clear, increase of these variables negatively impact income growth per worker. We also find that human capital and institutions are positively associated to per worker income growth.

Chapter 3 identifies the drivers of population in the SSA countries. We do so by focusing on the determinants of fertility and life expectancy which are the main components of population change in the SSA region.

Our results shed light on overlooked factors in the literature. For fertility, we find that the age at first marriage is the most important determinant of fertility in the SSA region. Labor participation of women is the second most important factor. Reducing infant mortality is as much impactful as contraception use in the SSA region. On life expectancy, income is the most important driver of longevity in the SSA region, more important than education. Also, HIV prevalence has more impact on life expectancy than education in the SSA countries. Democracy contributes to reduce violence and improve institutions which lead to better public policy outcomes, hence supporting longer life expectancy.

Chapter 1

HRV Constraints Diagnostic to high growth in Côte d'Ivoire⁵

⁵ This chapter has been co-authored by Kanga Desire, PHD.

I- HRV CONSTRAINTS DIAGNOSTIC TO HIGH GROWTH IN COTE D'IVOIRE

I.1 Introduction

Africa went from a status of “hopeless continent” in early 1990s to one of “Africa rising” starting in early 2000s. Research investigated drivers of this change using mainly aggregative approach such as growth accounting, time series, and panel data. These methods come with shortcomings including lack of country specific findings, lack of clarity on future obstacle to growth, and fallacious assumption of substitution of growth factors.

This chapter aims at illustrating the importance of the latest growth diagnostic framework to identify binding constraints for future economic growth in the Sub Saharan Africa (SSA) economies: the Hausmann, Rodrik, Velasco (HRV) growth diagnostic. We do so by applying the HRV framework on one of the fastest growing economies in SSA: Côte d'Ivoire. This exercise identifies potential constraints to sustain higher private investment in the short and medium term. It does not intend to identify sector or industry related obstacles to private investment. We argue that regardless of the specific investment, if major obstacles (first order obstacles) to private investment are not removed, there will not be enough incentives for a rational agent to go into a sector facing its specific obstacles (second order) in sectors or industries. Identifying obstacles to specific private investment including structural transformation could be topic for future research.

The HRV framework is the main tool to determine binding constraints to future growth at country specific level. Applying the HRV framework on Côte d'Ivoire, we find that corruption, access to finance and weak exports sophistication are the binding constraints to sustained high growth in Côte d'Ivoire.

This chapter has 5 sections. After the introduction (section 1), section 2 reviews the findings on drivers and sustainability of recent economic growth in Africa. Section 3 revisits economic performance history of Côte d'Ivoire from independence to 2018. Section 4 focuses on identifying binding constraints to sustain high economic growth in Côte d'Ivoire. Section 5 concludes.

I.2 Recent African growth: A literature review

Determining constraints which could prevent Africa from repeating its recent performance has become a key question as favorable conditions have changed. External conditions are now made of lower commodities prices and weaker demand from emerging economies compared to the 2000s. International financing conditions have tightened following the end of unconventional monetary policies in Europe and USA. Borrowing capacity of most African countries have diminished as most of them have used fiscal space created following debt relief initiatives (HIPC and MDRI). 40 percent of African countries are classified as in debt distress or as high debt risk of debt distress. More recently, with the surge of the COVID-19 crisis, the world entered in economic recession. African countries are not spared. That triggered a debt Service Suspension Initiative to alleviate the pressures on most SSA countries.

Africa was considered as “hopeless Africa” (The Economist, 2000) or the continent of “the lost decade” from the failing Washington consensus policies (Easterly, 2001). This narrative reflected persistent weak economic performance from the independence up to late 1990s.

Using mainly regressions at aggregate levels on African countries, scholars point to six factors explaining this growth episode: lack of good institutions and trust in rules (Collier 1998; Collier and Gunning 1999; Easterly and Levine 1997) ; lack of trade (Dollar 1992; Sachs and Warner 1997; Easterly and Levine 1997); insufficient and ineffective public services (Jonathan Isham and Daniel Kaufman 1999; Isham, Kaufman and Pritchett 1995); challenging geography including related diseases (Sachs and Warner 1997; John Gallup and Sachs 1998); lack of financial depth (Easterly and Levine 1997); counterproductive aid dependence (Burnside and Dollar

1997). Collier and Gunning (1999) argue that policy makers tried to correct this performance without success due to weak response from private sector. In fact, Collier argue that attempt to correct bad macroeconomic policies resulted in temporary burst in economic outcomes. But the bounce did not last due to a lack of private investment response, becoming then the main constraint to long run growth.

Starting in late 1990s, the narrative shifted from “hopeless Africa” to “Africa rise”. This new narrative has generated several important questions (Jones and al, 2015) of which: Did the rapid growth really happened? what are the drivers of this rapid economic growth? Is this economic growth sustainable over the medium term?

There is a broad consensus that Africa’s economic output increased rapidly over the last two decades starting in 1997. According to international standard data, real GDP and income per capita in Sub-Saharan Africa grew respectively by around 4.5 percent and 1.7 percent on average. Over the period, GDP more than doubled while income per capita increased by more than a third compared to its 1997 level. Using Demographic and health Survey (DHS) data on households over 29 countries, Young (2012) argues that income per capita is underestimated by international standard data. His growth estimates are three times higher compared to international standard estimate at the aggregate level. Even sticking to the international standard data, Sub Saharan Africa had the fastest GDP growth in the world while income per capita was second—hampered by rapid demographic growth—after East Asian region.

On drivers of Africa’s performance, scholars identified five key drivers: resource boom, increased borrowing capacity, good policy management, institutions, and improved business climate.

The argument of natural resources meets the largest consensus among researchers (IMF 2016, Rodrik, 2016, Jensen, 2014, Benny 2009). Unprecedented growth in China led to increased world demand for commodities, leading to a surge in commodities prices; exports revenue and government. That boosted growth in income across the board.

Stotsky and al (2013) shows that public and private investment were instrumental in pushing growth in Africa. ACBF (2017) supports these findings using a sample of 54 countries in a fixed effect panel. Increase in public investment benefited from enhanced borrowing capacity following debt relief initiatives led by the IMF and the World Bank starting in late 1990s. Increased borrowing capacity coupled with cheap money on international in late 2000s (IMF 2016) helped financing of government expenditures, including public investment.

Apart from these external factors, positive domestic changes contributed to rapid growth. Using an OLS difference in difference over data from 1960 to 2005, Benney and al (2009) conclude that productive government spending had a greater impact on growth than resource boom cycles in Africa. Further, improvements in government spending was coupled with better macroeconomic policies (Stosky, 2013; Rodrik, 2016) creating a stable environment for capital investment.

Leeke and al (2010) analyze 54 African countries and support the same findings. Further, they add that greater political stability and improved business environment have been conducive of faster growth. But Page and al (2009) argue through a panel regression from 1975 to 2005 that growth in Africa was not strongly associated with better governance.

Using a more recent data from 1995 to 2011 over 38 African countries, and controlling for natural resources and initial GDP per capita, Jensen and al (2014) find that institutions betterment as a key driver of recent growth in Africa. They undertake further econometric testing to ascertain the robustness of the findings to alternative regressions (OLS, Least Absolute Deviation, and 2 SLS).

Rodrik (2016) concurs and finds that institutions betterment has increased economic stability while reducing crisis severity. Africa, to say the least, has seen a significant improvement of its power transition through fair and peaceful elections, reducing wars, increasing the rule of law at a broader level (IMF, 2016).

On the sustainability of recent growth in Africa, skepticism is prevailing among researchers due mainly to the lack of structural transformation over the growth period. Structural transformation is the process whereby resources (labor and capital) are shifted from less productive sectors (traditional/agriculture) to higher productive ones (modern sectors).

In an empirical exercise, McMillan (2014) uses a Demographic and Health Survey (DHS) data and runs country specific regression for different types of occupational activities for 31 countries. The author supports that labor productivity increase in agricultural was a key driver of growth. However, Barrett and al (2017) find that labor productivity has remained low in agriculture despite the rapid growth. This finding could underestimate labor productivity in agriculture if sectoral data are used (MCCullough and al, 2016).

Further, McMillan and al (2014) adds that agriculture sector experienced a decline of employment but that did not translate into increase in employment in manufacturing

but rather in unskilled jobs and services. Rodrik and al (2016) support this argument. They note that a classic structural transformation did not occur in African growth process. Using a three-channel growth model displaying conditional convergence, they argue that resource allocation happened from agriculture to services and informal sectors.

This finding is also supported by Diao and al (2017). Using a growth decomposition regression over panel data of 30 African countries, these researchers conclude, like other researchers (page 2012), that Africa's rise cannot be sustained without a structural change. They caution against the fragility of the current growth rise in SSA.

Our contribution to the literature is to provide a country specific of growth drivers in SSA countries. We show by applying the HRV framework on one of the fastest growing SSA economies: Côte d'Ivoire.

Conducting a country-specific growth diagnostic is critical for three main reasons⁶. First, findings from aggregative methodologies cannot be applied at country level for growth policy making. Aggregative approaches through various regressions were used to assess growth drivers. The findings are valid for the average country, not for a specific country (Rodrik and al 2005). Therefore, it becomes spurious to infer the validity of these findings for a given country. In addition, most empirical models are not based on a specific theoretical model, instead the empirical specifications are somewhat ad hoc, with motivations for the variables included being taken from a wide range of sources (Rogers 2003).

⁶ These reasons are extensively discussed in the HRV instrumental paper the Mind Book (2005)

Second, even one was to take for granted findings on identified drivers, drivers of past growth are not necessarily going to be drivers for future growth. As pointed by Rodrik and al (2005), every time a set of constraints to growth is removed, a new set of different constraints are to be removed to sustain growth in the future.

Third, regressions encompass an unrealistic assumption about growth process. Regressions assume that the shortcomings from one factor of growth can be compensated by providing more of another factor. That assumption has strong limit in the real world (Rodrik and al 2005). For growth to occur, a set of ingredients need to put be together at the same time; the principle of complementarity supported by Rodrik and al (2005).

The recent literature tries to tackle this issue by using interaction terms (e. g., Burnside and Dollar 2000). However, this literature faces somewhat a problem of parameter identification leading to misleading inferences (Chatelain and Ralf 2014). Finally, there are data and interpretation issues related to empirical growth analysis (Rogers 2003). In most cases, it is difficult to obtain data on the real variables of interest. Moreover, the results depend on the sample (countries, years) and can be driven by influential observations. Empirical models can only take a limited number of explanatory variables.

I.3 Côte d'Ivoire: Growth History⁷

Growth had five phases in Côte d'Ivoire: a miracle period from 1960 to 1979, an economic crisis from 1980 to 1994, a short-lived economic revival from 1994 to 1999,

⁷ In addition of IMF database, this section uses IMF and World Bank country reports, Berthelemy and al (1996) on 'Growth and Crisis'

a timid economic recovery plagued with political instability from 2000 to 2011, and an economic catch up since 2012.

The first growth period in Côte d'Ivoire is the so-called Ivorian miracle. This miracle was underpinned by heavy public investment, private sector promotion backed by foreign capital and workers migration openness. Private sector development was driven by agriculture export helped by cheap labor from the hinterland countries (Burkina Faso and Mali). In fact, international migration from the hinterland countries accounted, on average, for 1 percent out of 4 percent annual population growth over this period. Immigrant workers from these countries stayed mainly in the southern and western regions of Côte d'Ivoire where are most fertile lands for agriculture.

During this period, GDP per capita grew by 3.9 percent on average from 1961 to 1978. The rapid GDP growth was driven by exports and investment. In fact, agriculture became the main driver of private sector development due to initial natural endowments, including fertile lands and favorable climate.

Agriculture supported rapid export growth. Agriculture exports accounted for 80 percent of total exports during the period. Agriculture accounted for around 33 percent of total GDP during that period. Agriculture leading role stemmed primarily from Cocoa and coffee production. In fact, Côte d'Ivoire became one of the world largest producers of cocoa and coffee with production doubling from 1958 to 1963.

The second leg of Côte d'Ivoire growth success was government's intervention through public investment. Infrastructure—to attract private investment and meet social needs—and public enterprises—to boost industrialization through import substitution programs—were the main pillars of public investment. Massive public

investment was also part of government's attempt to bridge regional disparities between the southern and northern regions through the so called "programme du Nord". In fact, during mid-1980s, average per capita expenditures in the southern regions, excluding Abidjan, was three times of the northern regions.

In this context, public capital spending went from 4 percent of GDP in 1963 to 22.9 percent of GDP in 1978. Investment from public enterprises accounted for 90 percent of total investment in modern sector by 1980. The import substitution strategy led to establishing more than 30 State-Owned Enterprises (SOEs) and banks. The northern region hosted a significant share of these SOEs including the biggest one: SODESUCRE in charge of sugar manufacturing.

These public enterprises rested on government support, including subsidies. Direct financing of the government accounted for 35 percent of their financing while government backed guaranteed loans accounted for 40 percent of the financing.

These public enterprises contributed to speed up know-how accumulation in Côte d'Ivoire's economic from early 1960s to late 1980s. The state-owned enterprises launched a series of economic activities to modernize agriculture and build an industrial base from scratch. Public enterprises were present in almost all sectors of the economy, accounting for 56 percent of all firms in the modern sector by 1982.

In the same period, Côte d'Ivoire was building its administrative and social infrastructure, including in education and healthcare. That translated not only in massive schools and hospitals building but also massive recruitments of teachers and medical personnel with competitive pay, attracting workers from neighboring

countries. As result, wage bill quickly grew from 38 percent of total expenditures in 1963 to 51 percent of total expenditures in 1978.

These government spending were financed not only by export revenues—thanks to Cocoa and coffee boom—but also massive external debt. Exports duties, mainly made of cocoa and coffee, accounted for 24 percent of government revenues. External public debt grew to 52 percent of GDP in 1978 from 10 percent of GDP in 1963. Debt services reached 38 percent of government revenues in 1978 from less than 0.1 percent of GDP⁸ in 1963.

With tightening external conditions and unsustainable debt, the Ivorian miracle gave way to an economic crisis starting from 1979. Income per capita dropped by 3.9 percent on average per year from 1979 to 1993. Current account balance fell into negative territory, standing at around -10 percent of GDP in 1978 and continued throughout 1980s. Public debt remained above 120 percent of GDP in early 1990s. Know how—measured by the Economic Complexity Index (ECI)—sharply dropped, reaching its lowest level around 1994 since independence.

This economic crisis coincided with banking crisis. Non-Performing Loans (NPLs) soared to around 60 percent of total loans⁹ and around 30 banks out 79 banks filed for bankruptcy in the monetary union¹⁰ (WAEMU), mainly public entities. As result, credit to private sector shrank by around 2 percent y-o-y starting in 1989.

⁸ Using the IMF own terms of debt service less than 1 percent of GDP.

⁹ Powo (2000), les déterminants des faillites bancaires dans les pays en voie de développement : le cas de l'Union Monétaire Ouest Africaine (UEMOA) », Montréal University

¹⁰ Côte d'Ivoire is a country member of the West Africa Monetary Union

This economic crisis started with world economic recession, falling prices of cocoa and coffee, and unsustainable debt. The second oil price shock led the world economy into a recession in late 1970s. This recession resulted into lower global demand for commodities, including cocoa and coffee. As a result, commodities prices fell; cocoa prices dropping by 45¹¹ percent from 1977 to 1980.

The worsening of the external environment coincided with domestic challenges. The expected growth sources did not materialize. Heavy public investment proved to be mostly inefficient along with underperforming and indebted public enterprises.

Coupled with an increased external debt service, this situation resulted in external imbalance and a debt service crisis. First, current account balance went from 1.4 of GDP in 1969 into a deficit of -16 percent of GDP in 1980 before shrinking to -10 percent of GDP in 1991. Second, government revenues fell, reducing debt repayment capacity—measured as debt service over revenues. Further, failing SOEs, unable to service their debt, triggered government public guarantees to service SOEs' debt, increasing an already sizeable public debt. This large external debt service dented international reserves non-replenished by official creditors facing themselves a recession.

Against this background, Côte d'Ivoire initiated a structural adjustment program under the International Monetary Fund (IMF) and the World Bank in late 1970s. The structural adjustment mainly aimed at reducing public debt to sustainable levels. Reducing government spending was expected to improve Côte d'Ivoire

¹¹ Cocoa Handbook: International Cocoa Organization (ICCO), average daily price, New York and London.

competitiveness with large drop in domestic prices compared to trading partners without resorting to exchange rate devaluation.

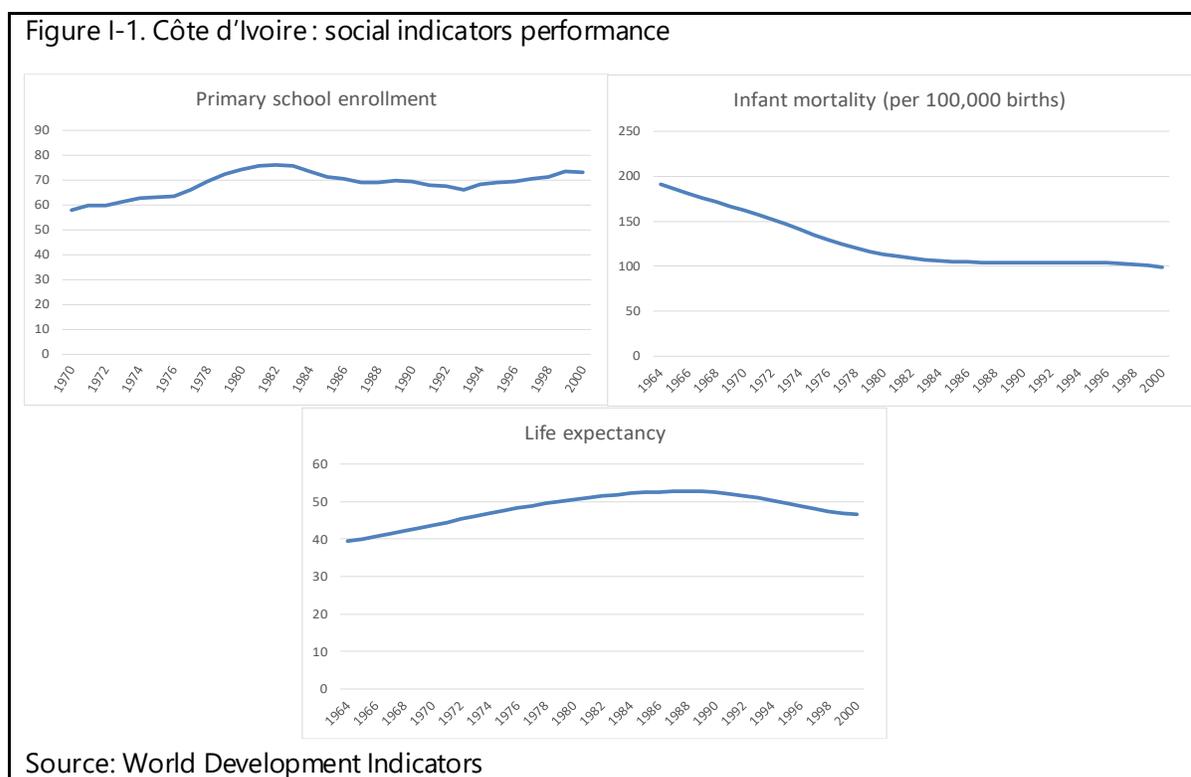
Therefore, government pushed to reduce its spending. The reduction of expenses rested mainly on massive cuts in education, healthcare, infrastructure expenditures coupled with public enterprises privatization. Public wages and promotions were frozen while new teachers' salaries cut by half. Generous conditions of schools were cut, including reduction scholarship and stipends for students. School construction was slowed down; school tuitions were introduced. Similarly, hospital fees increased. Construction of new hospitals in remote areas halted. Massive recruitments of teachers and doctors ended. Public capital expenditure fell from 12 percent of GDP in 1978 to 2.8 percent of GDP in 1993.

In 1991, government initiated massive privatizations, with the World bank' support, of dozen State Owned Enterprises (SOEs) operating in all strategic sectors such as water, electricity production and distribution, export agriculture, and industrial transformation of raw materials, etc. The harshness of the public enterprises restructuring is recounted by Berthelemy and al (1996): "... in June 1980, ten of the thirty-two state enterprises were dismantled, four were privatized, and eleven (in particular, all firms involved in agricultural assistance) were placed under more direct government control and supervision as public agencies (*établissements publics*) rather than decentralized entities".

The public enterprises restructuring was carried out along with massive layoff of its employees coupled with reduction of salaries. Also, the privatization was coupled with a rapid liberalization of economic sectors and enhanced structural reforms for

free trade to attract private sector and shift engine of growth away from public sector.

This structural adjustment contributed to a deterioration in social living conditions (Figure I-1). Employment fell by around 25 percent from around 1980 to 1985¹². Gross school enrollment dropped from its peak of 76.3 percent in 1976 to 66 percent in 1987. Gross secondary school enrollment went from 19.1 percent in 1981 down to 18.4 percent in 1987. Also, infant mortality sharply stagnated from early 1980s to 2000. Overall life expectancy fell from 52 years in late 1980s to 47 years in late 1990s, though this drop also reflected rising public health challenge such AIDS.



¹² Berthelemy and al (1996), Growth and crisis, page 76

The dismantling of public enterprises halted the accumulation of know how in agriculture and industry sectors. Know how—measured by the ECI index—fell by almost 60 percent from 1984 to 1988.

Despite this stringent adjustment, currency devaluation could not be avoided. After several political opposition led by member countries of the franc zone like as Côte d'Ivoire and France, authorities conceded a currency devaluation in 1994.

Devaluation happened as macroeconomic imbalances persisted. Growth was negative around -0.1 percent in 1993 with per capita GDP growth at -3.9 percent dragged down by a shrinking credit to private down by -20.9 percent (y-o-y). Current account remained in deficit at -10.8 percent of GDP. Debt stood at 158 percent of GDP. External arrears reached 61.8 percent of GDP.

This reform fatigue happened along with growing demand for democracy. Under tense political and social environment, the death of the first president opened the last door to the CFA devaluation by 50 percent, supported by the IMF and the World Bank.

After 1994 CFA devaluation, a new era of economic growth started but ended with a military coup in 1999. During that period, growth bounced back to around 5.4 percent per year up to 1998. Current account deficit shrank to about -4.5 percent of GDP on the back of regained competitiveness and increasing cocoa and coffee prices. Investment soared to 18.2 percent of GDP in 1998 from around 10 percent of GDP before devaluation. Momentum in private investment and capital expenditure led the bounce back. Yet, public debt remained high with external public debt at 98 percent of GDP.

Against this background, a debt relief by donors under the Heavily Indebted Countries Initiative (HIPC) was initiated in 1998. Côte d'Ivoire was exceptionally¹³ granted eligibility under the HIPC after a protracted process of review because it did not meet the NPV of debt to exports ratio needed to qualify under the HIPC. The debt relief for Côte d'Ivoire was expected to reduce its debt service, create fiscal space for more growth enhancing expenditures. But, a military coup in 1999 stopped the HIPC initiative along with nascent growth recovery.

The year 2000 opened a decade of political instability. The 1999 military coup gave way to a political transition through general elections. Yet, the power transition was violent with dozens of civilians killed. This new era of democratic governance was short lived as several military coup attempts followed the election of the new president. The last attempt failed to turn into a rebellion in September 2002, with the southern part controlled by the government and northern part held by the insurgents. Despite a peace agreement, the rebellion grew into a civil war in 2011 following a post electoral crisis.

During this period of political instability, real GDP growth remained around 0.8 percent per year from 2000 to 2010. Income per capita growth remained negative - 1.2 percent of GDP. Côte d'Ivoire went through structural adjustment to cope with weak economic activities, limited revenues collection and excessive debt.

Public spending deteriorated, reflecting the instable political environment. Current spending soared from 14.1 percent of GDP in 1998 to 15.2 percent of GDP in 2004 to meet military spending needs and growing social demands in a lackluster economy.

¹³ IMF and IDA (1998), final document on Initiative for Heavily Indebted Poor Countries (HIPC), page 3.

The current spending slightly fell to 12.5 percent of GDP in 2010 reflecting IMF adjustment program. Meanwhile, public capital spending, critical for growth, dropped from 5.6 percent of GDP in 1998 to 3.5 percent of GDP in 2010.

Similarly, private investment declined from 9 percent of GDP in 1998 to 5.6 percent of GDP in 2003, reflecting challenging business climate made of growing insecurity and political uncertainty. During that period, many multinationals and international organizations moved their headquarters away from Abidjan, including the African Development Bank.

A peace agreement between the government and the rebellion was signed in 2007 to create a stable political environment. In this context, elections were organized in 2010. But, disputes over the electoral outcomes led to a crisis. That crisis resulted into an armed conflict which left more than 3,000 deaths. The conflict lasted six months.

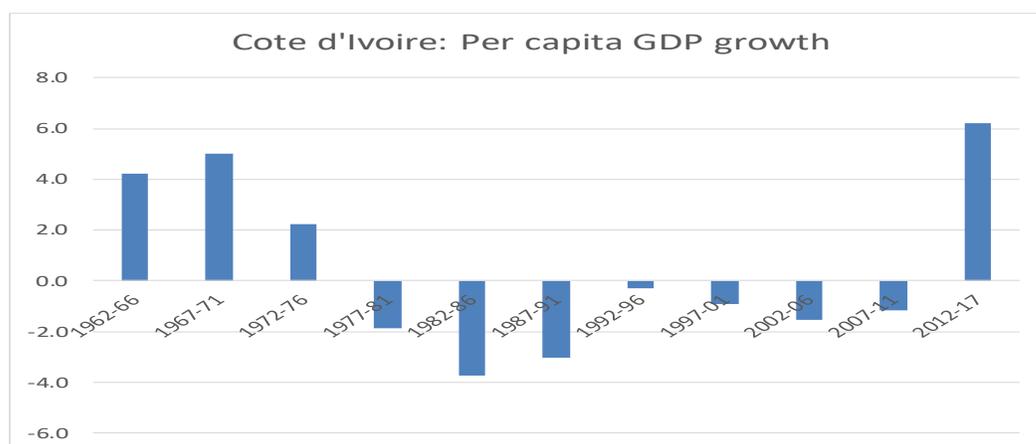
Since 2012, the end of the post crisis conflict, growth performance has rebounded. Annual growth has been around 6 percent¹⁴, above Sub Saharan Africa average. Côte d'Ivoire became the second fastest growing economies after Ethiopia. This current performance is the best performance of five-year growth average since 1962 (Figure I-2).

This post crisis growth partly reflected a catch-up effects of post crisis growth. Countries in Africa like Rwanda, Angola, Liberia and Mozambique experienced that post crisis growth (Figure I-3). In fact, research shows that post conflict periods are characterized by rapid growth due to several factors, including aid flows, foreign

¹⁴ World Bank Development indicators

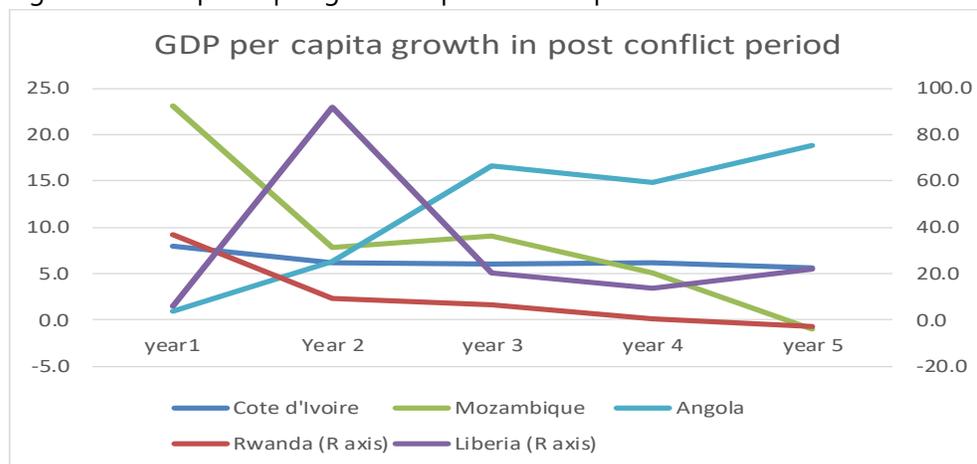
direct investment, use of existing unused production capacity, new political leadership etc.¹⁵. This rapid growth in post conflict periods is called the catch-up effects. Interestingly, research finds that the catch-up effects growth tends to slow down in the medium term, unless new sources of growth emerged.

Figure I-2. Côte d'Ivoire: per capita GDP growth



Source: World Development Indicators

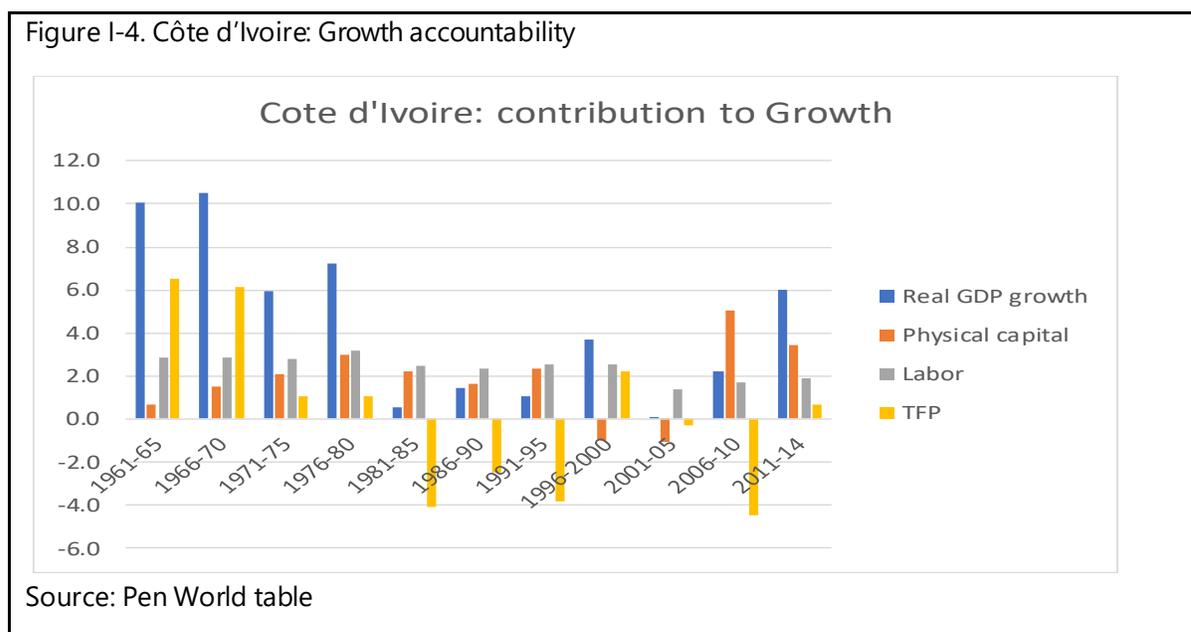
Figure I-3. GDP per capita growth in post conflict period



Source: World Development Indicators

¹⁵ Edbadawi and al (2008), Post-Conflict Aid, Real Exchange Rate Adjustment, and Catch-up Growth

Growth performance in Côte d'Ivoire has mainly been associated with rapid increase in capital accumulation. In fact, growth decomposition shows that physical capital accumulation has been the main driver of growth (Figure I-4). In fact, investment grew from 8.9 percent of GDP in 2011 to 19.5 percent of GDP in 2017. Public investment led the surge, increasing by 170 percent (4.8 points of GDP) supported by private investment which grew by 93 percent (5.8 point of GDP).



Public investment has been partly fueled by public debt. The end of conflict coincided with debt relief of \$ 4.4 billion under the Heavily Indebted Poor Countries (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI) in 2012. Under the HIPC, \$ 3.1 billion was reduced of the debt burden of which 23 percent from multilateral creditors, 43 percent from Paris club bilateral creditors, and the rest from other bilateral and commercial creditors. The MDRI allowed a debt reduction of 1.3 billion of which \$1.1 billion from the World Bank (IDA fund) and 0.2 billion from the African Development Bank (AFDB). As a result, borrowing capacity increased as debt ratio dropped to 45.7 percent of GDP in 2013 from 71.2 percent of GDP in 2011.

Additional factors expanded borrowing options for Côte d'Ivoire. Debt relief occurred amid high commodities prices which boosted commodity related government revenues. In addition, cheap money from unconventional monetary policy in European and US markets broadened access to international borrowing for many developing countries, including Côte d'Ivoire.

As a result, total public debt ratio has stagnated around 46 percent of GDP despite a cumulative nominal GDP growth of 50 percent from 2012 to 2017. IMF report¹⁶ in 2013 projected the public debt ratio falling to 36 percent of GDP in 2018 assuming an average real GDP growth of 8 percent. In 2018, public debt ratio remains above 46 percent of GDP despite GDP growth in line with initial projections. Côte d'Ivoire's debt accumulation is not unique; other HIPC beneficiary countries which are now facing increased risks of debt overhang (IMF, 2017)¹⁷. In the context of the COVID-19 crisis, most HIPC beneficiaries have benefitted from additional debt service relief. In addition, repayment capacity of Côte d'Ivoire has diminished—debt service to government revenues ratio has increased from 5.2 percent in 2012 to 13 percent in 2018.

Against this background, private investment needs to step up to sustain growth momentum. To be clear, growth has subsided in the context of the global COVID-19 crisis. Financing conditions have tightened in emerging markets in turmoil. Commodities prices have dropped and projected to remain low in the medium term¹⁸. Borrowing capacity has dropped—debt service in percent of GDP increased,

¹⁶ IMF country report 13/171 (2013)

¹⁷ IMF AFR Regional Economic Outlook (2017)

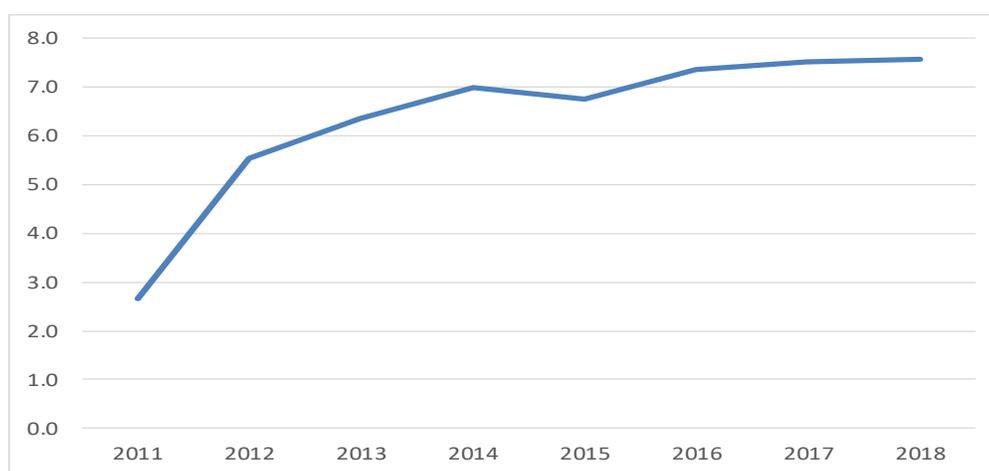
¹⁸ World Economic Outlook (2018)

weakening public investment financing.¹⁹ Subsequently, public investment has started slowing down (Figure I-5).

More worrisome, exports have played a limited role in the rapid growth of Côte d'Ivoire. That contributed to hamper higher and sustainable income growth. In fact, exports earnings per capita growth has been lagging. After five years of rapid GDP growth, export earnings per capita still hover around its pre-crisis level, and far below its 1996 level (Figure I-6).

From this section, we see a major challenges for sustaining high growth: How to boost private investment, including for exports activities? This challenge has now become more prominent in a context of the world in global recession including Côte d'Ivoire. In the next section, we will investigate binding constraints to private investment.

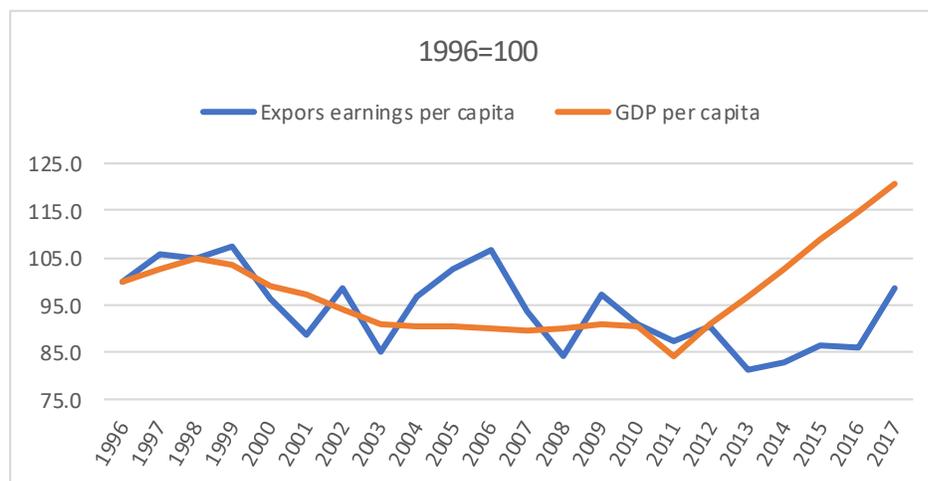
Figure I-5. Côte d'Ivoire: Public Investment (percent of GDP)



Source: IMF staff database

¹⁹ IMF country report Staff Report 18/182 (2018), table 7

Figure I-6: Côte d'Ivoire. exports and GDP per capita



Source: IMF database

I.4 Data and Methodology for HRV Diagnostic

1. Data

We use eight databases for our analysis: Doing Business Indicators, World Development Indicators, World Governance Indicators, Global Competitiveness Index, Enterprise survey, Transparency International, World Economic Outlook (WEO) of the IMF, and IMF internal databases.

We select a group of 9 countries as peer countries in Africa for Côte d'Ivoire. We pick six countries that are middle income countries²⁰ as Côte d'Ivoire' status but also that have achieved the fastest per capita income growth (higher than 2 percent per annum) from 2012 to 2017. The selected countries are Botswana, Cameroun, Ghana, Kenya, Lesotho, Mauritius. To this group, we add Ethiopia and Rwanda. We do so because these two countries are the two Low-Income²¹ Countries (LICs) which had highest GDP per capita growth among LICs that are higher than all Côte d'Ivoire's peers mentioned above. Finally, we add Nigeria, the largest economy of Sub Saharan Africa, though a LIC, that is also in the West Africa region as Côte d'Ivoire. Though meeting the criteria mentioned above to qualify as peer, we exclude Sudan and Sao Tome and Principe because the former faces severe civil war that could blur our analysis and the latter has a too small demographic size (less than 500,000).

²⁰ According to the World Bank ranking, a middle-income country has a gross net income per capita between \$1026 and \$12475; Except Mauritius which is an upper middle-income economy, all the other peers are lower middle income with gross net income lower than \$4035.

²¹ According to the World Bank ranking, a low-income country has a gross net income per capita less than \$1026.

2. HRV Methodology

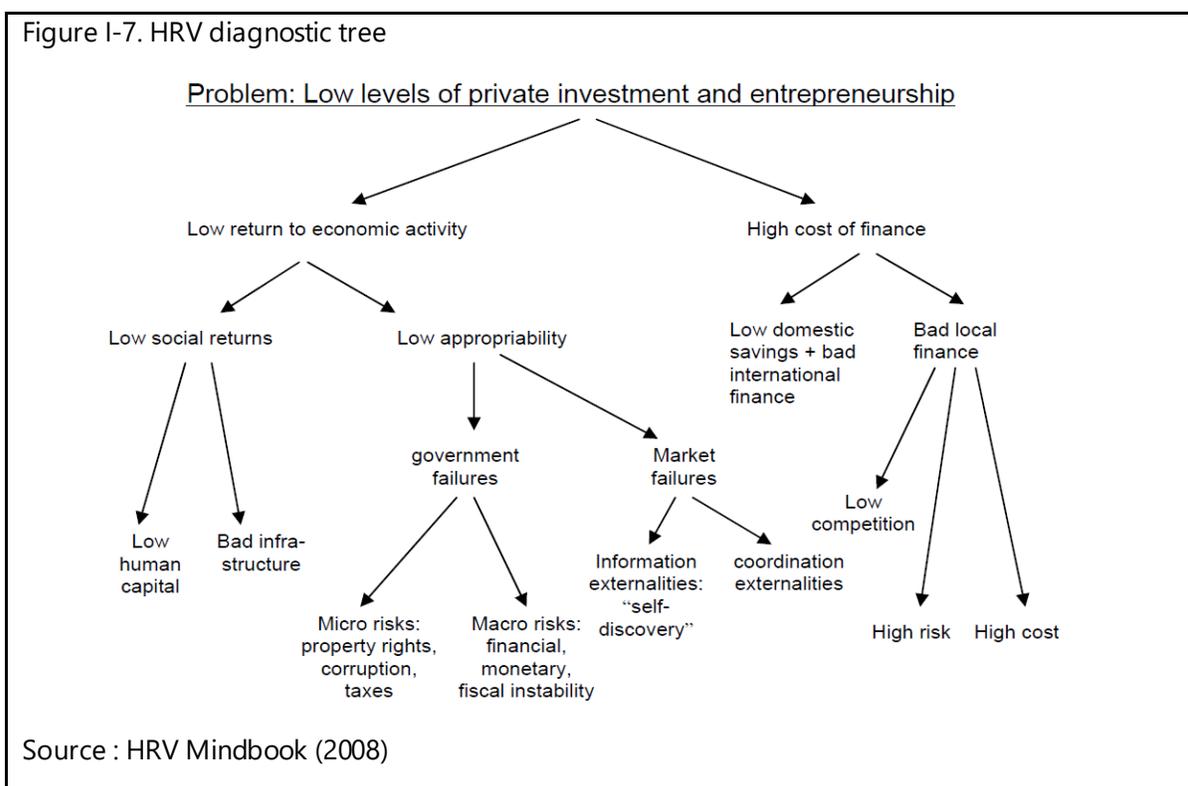
In this section, we briefly explain the methodology of the HRV diagnostic.

Using neoclassical rational, HRV diagnostic focuses on constraints to private investment which ultimately determines economic growth. In fact, from a demand side, GDP is composed of consumption, investment and exports. Yet, consumption and exports activities require investment, thus becoming central to economic growth.

The HRV model assumes that the level of private investment in an economy reflects supply of investment (finance) and demand for investment (the expected returns on economic activity). At any point of time, low level of private investment is either due to low demand for investment or low supply of finance. For each possibility, the authors identify potential binding constraints to be tested (Figure I-7)²².

The HRV framework makes key assumptions. First, it assumes that growth determinants are complementary and not substitutes. An insufficient provision of key growth inputs cannot be substituted by excessive provision of other ingredients. Second, it considers that many determinants of growth even though all insufficiently provided but do not have the same potential in boosting growth. The ones with the largest boosting effect are considered as binding constraints.

²² This diagnostic tree comes from the Mindbook (Hausmann and al, 2008).



The HRV diagnostic has four tests to identify a binding constraint. First, the (shadow) price of a binding constraint is high. For instance, if finance is a binding constraint, one would expect interest rate or collaterals to be excessive compared to a given standard. Second, changes in constraint should lead to significant changes in the objective function, private investment in this case. Third, economic agents facing that constraint actively try to bypass it. Fourth, agents in less need of the binding constraint are more likely to grow faster compared to those in greater needs of that constraint. While performing these tests, one should use a Bayesian mindset whereby further proofs should update initial prior about a constraint.

The HRV framework has key strengths. First, it reflects the real-world interactions of drivers of economic growth by supporting the principle of complementarity between growth factors. Second, the HRV approach is less data consuming compared to the

traditional cross-country regression. It is so because it focuses on an analysis period that is shorter than the observation period which would be required for a cross country regression such as a panel. Third, the HRV method ensures a comparison between comparable countries. It allows to put the findings always in perspective compared to the peers. Fourth, the HRV allows to focus on a small set of constraints to be addressed as opposed to a regression which can show dozens of significant variables leading to a laundry list of measures. Fifth, the iterative approach of the HRV implies a continued search for constraints which change once the previously identified constraints have been addressed within a short period. The regression results do not vary over a short period of time. Thus, misleading on the growth drivers over a short period of time.

The HRV approach has two key weaknesses which do not outweigh its benefits. The major weakness of the HRV is the use of judgment that it gives to the policy analyst to conclude on the binding constraints. The regression approach determines mathematically the variables that influence the economic growth. In fact, after the results, using the P-value, significant variables—meaning the ones which coefficients are statistically different from zero—are identified. All analysts would conclude on the same significant variables. However, under the HRV framework, it is possible for two analysts to conclude on different binding constraints even using the same data. That underlines the possibility of misdiagnosis which could stem from a limited understanding of the HRV approach. The second weakness is the inability of the HRV to provide the key constraints of set of countries without proceeding to a country by country diagnosis. This limitation can really be constraining for policies makers working on large set of countries where decision need to be made quickly and across the board.

I.5 A story of corruption, finance, and fear to diversify

1. The non-binding constraints

We carry out a detailed HRV diagnostic to identify key constraints to sustain high economic growth per capita in Cote d'Ivoire. Here, we rule out non-binding constraints based on their implicit shadow price measured mainly with international benchmarking indicators.

We start our diagnostic by analyzing low social returns as potential binding constraint. We look at its two key components: infrastructure and human capital which are not binding.

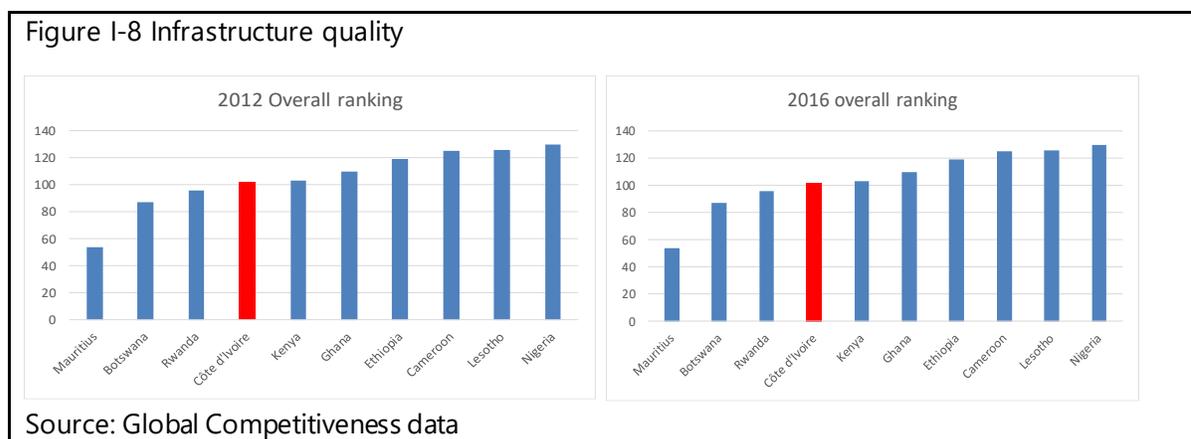
Infrastructure is ranked 5th out of 16 as constraint to doing business by investors in Côte d'Ivoire²³; thus, signaling that infrastructure is not a big obstacle to private investment. Also, Côte d'Ivoire ranks above its peers 'average on infrastructure (Figure I-8). It has maintained its ranking since 2012. Côte d'Ivoire performs particularly well on critical infrastructures for economic activity: port, airport, railroad and electricity²⁴. This infrastructure quality will be upgraded with the upcoming construction of a metro line.

Road infrastructure is one of its weakest point, but it has improved. The main highway to hinterland countries, necessary for regional and international trade, has

²³ 2016-2017 Global Competitiveness report

²⁴ Global competitiveness data

been extended by around 85 kilometers in 2017²⁵, crossing half of the country from Abidjan. This highway is now being extended to the neighboring northern countries.



Quality of human capital does not appear to be binding even though Côte d'Ivoire lags on education enrollment²⁶ compared to its peers. In fact, though enrollment rates at all levels have improved²⁷ thanks to free primary schooling since 2000, rates remain below average compared to its peers (Figure I-9). This underperformance is confirmed by the global competitiveness index ranking on human capital skills. The weak ranking of Côte d'Ivoire compared to its peers is mainly influenced by its underperformance on the subcomponent: enrollment rates.

However, when it comes to providing needed skilled labor to firms, Côte d'Ivoire is the second best, after Kenya, compared its peers (Figure I-9). This performance is

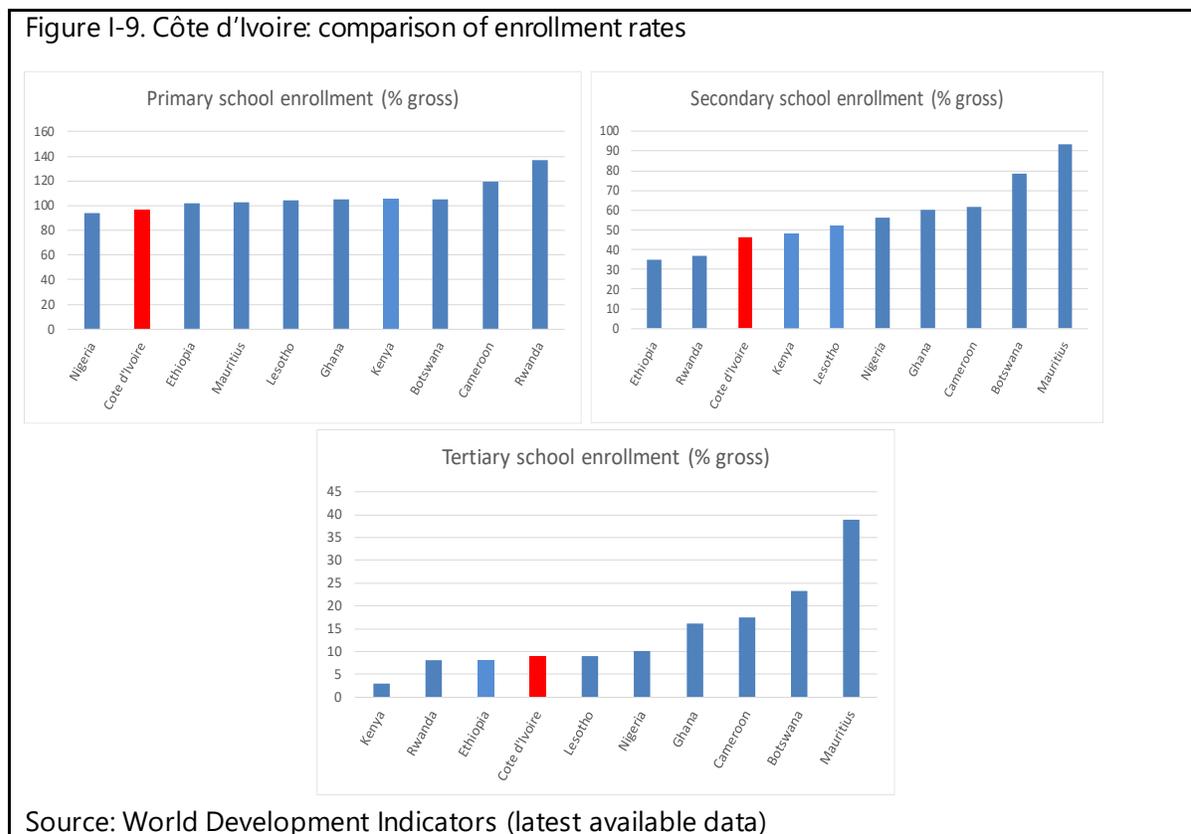
²⁵ Côte d'Ivoire National Roads Agency (AGEROUTE):

<https://www.ageroute.ci/ageroute/realisations/94-prolongement-de-l-autoroute-du-nord>

²⁶ Most of the data date from 2016. Scarcity of data on education enrollment led us to use to latest available data from the same source; World Development Indicators

²⁷ Gross primary school enrollment has increased from 73 percent in 2000 to 96 percent in 2016. Similarly, gross secondary school enrollment went from 18 percent in early 2000s to 46 percent in 2016. Tertiary enrollment stagnated around 9 percent. In fact, based on the latest available data

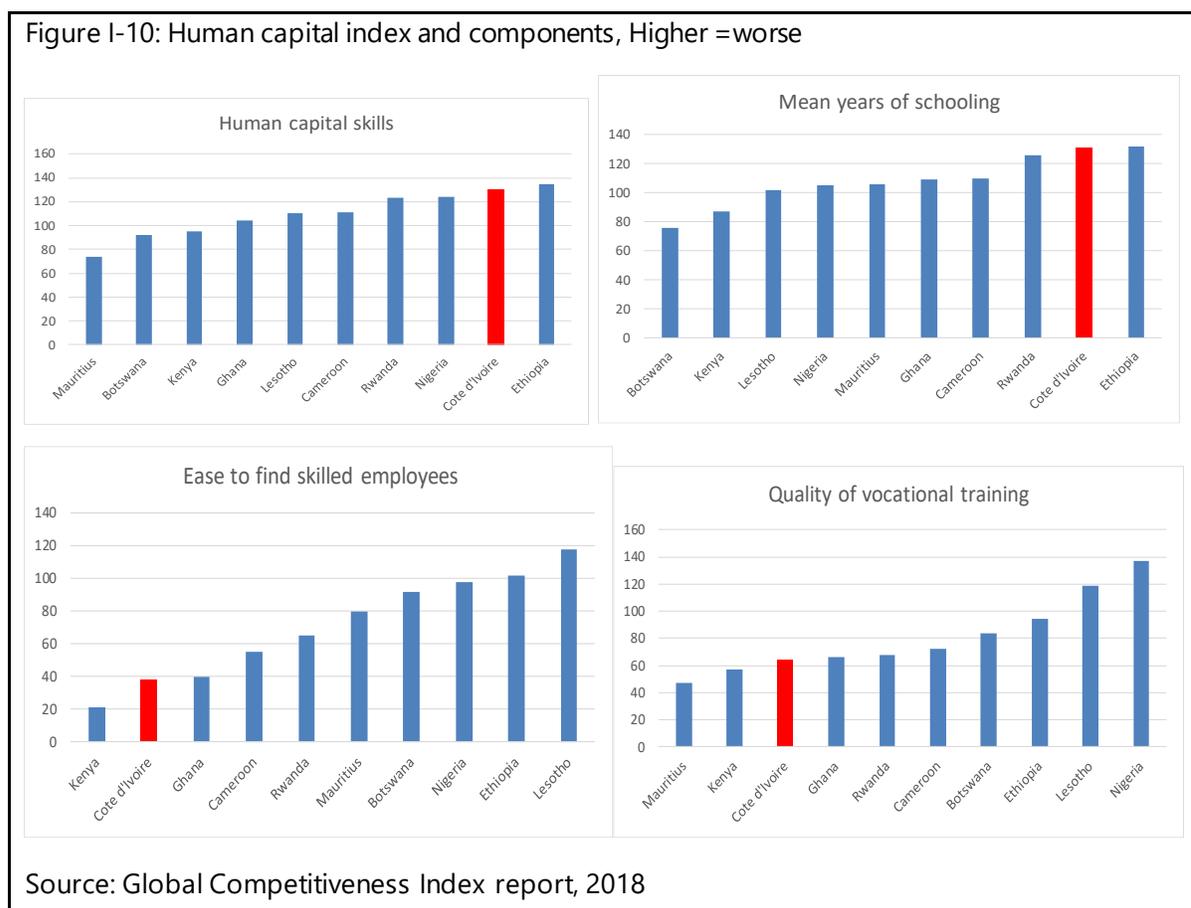
partly explained by the quality of vocational and graduate training of which the most prestigious institutions are the Polytechnic Institute and the National of Statistics and Economics (Figure I-10). In addition, of good supply of skilled labor force, Côte d’Ivoire continues to face high underemployment, standing at 50 percent of active population²⁸, signaling an excess supply of qualified labor force.



We now look at the second node: low appropriability of private returns. We start to examine potential government failures through two possible constraints: macro and micro risks.

²⁸ African development Bank report (March 2018) : West Africa Regional outlook

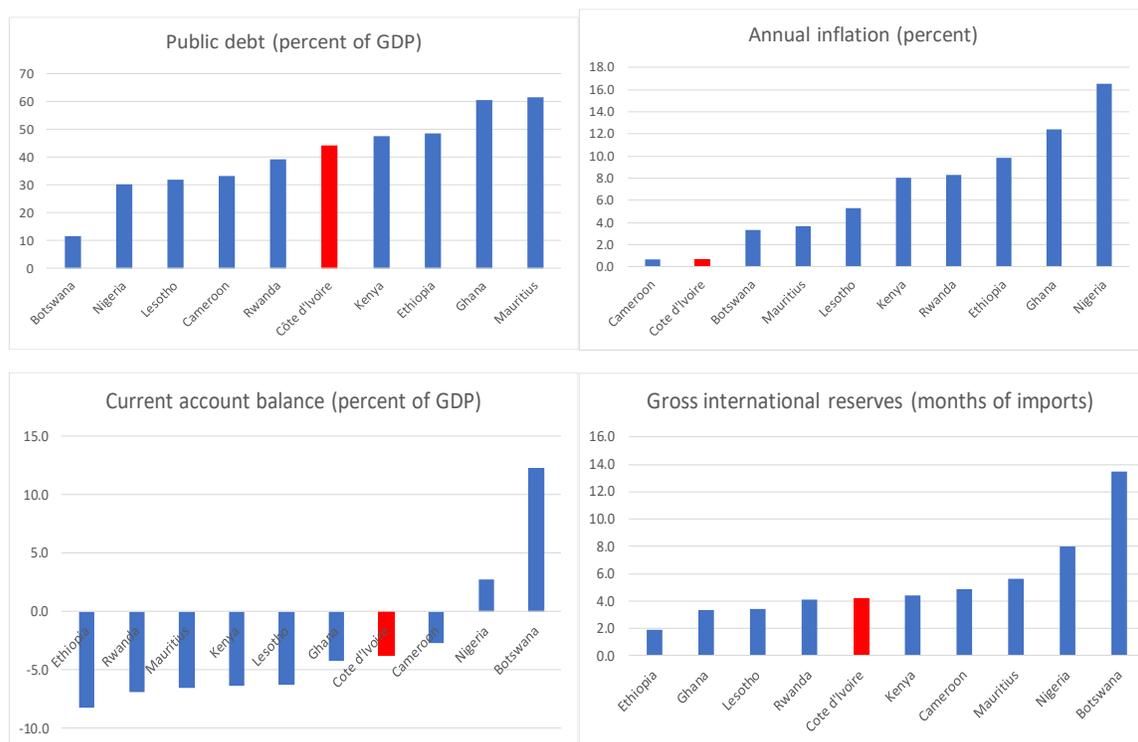
On macro risks, macroeconomic and financial stability have been preserved²⁹ partly reflecting constraints imposed by the convergence criteria of its monetary zone (WAEMU) and IMF programs. Côte d'Ivoire fares well on key macroeconomic indicators compared to its peers (Figure I-11). Public debt remains sustainable, below Sub-Saharan average. Debt ratio is around 46 percent of GDP. Inflation remains stable around below 3 percent. Current account deficit is contained to 3 percent of GDP in 2018. Negative current account balance reflects capital imports to meet rising investment needs in post conflict period. Exchange rate continues to be in line with fundamentals, if not undervalued.³⁰



²⁹ IMF country report 18/182

³⁰ IMF report and Article IV 18/182

Figure I-11: Macroeconomic stability indicators, 2017



Source World Development Indicators and IMF WEO database

2. Binding constraints for high GDP growth

The first screening stage leaves three key potential constraints: i) micro risks, ii) coordination and market failures, and iii) limited access to finance. We examine each of these constraints by turn. We start with micro risks.

Côte d'Ivoire has a mix performance on micro risks. Progress was on voice and accountability, government effectiveness, and regulations quality (Figure I-12). Voice and accountability³¹ score has improved due mainly to two cycles of elections held from 2011 to 2018 as opposed one cycle of elections over the period from 2001 to 2011. Another layer of political representation has been added with the establishment of a senate.

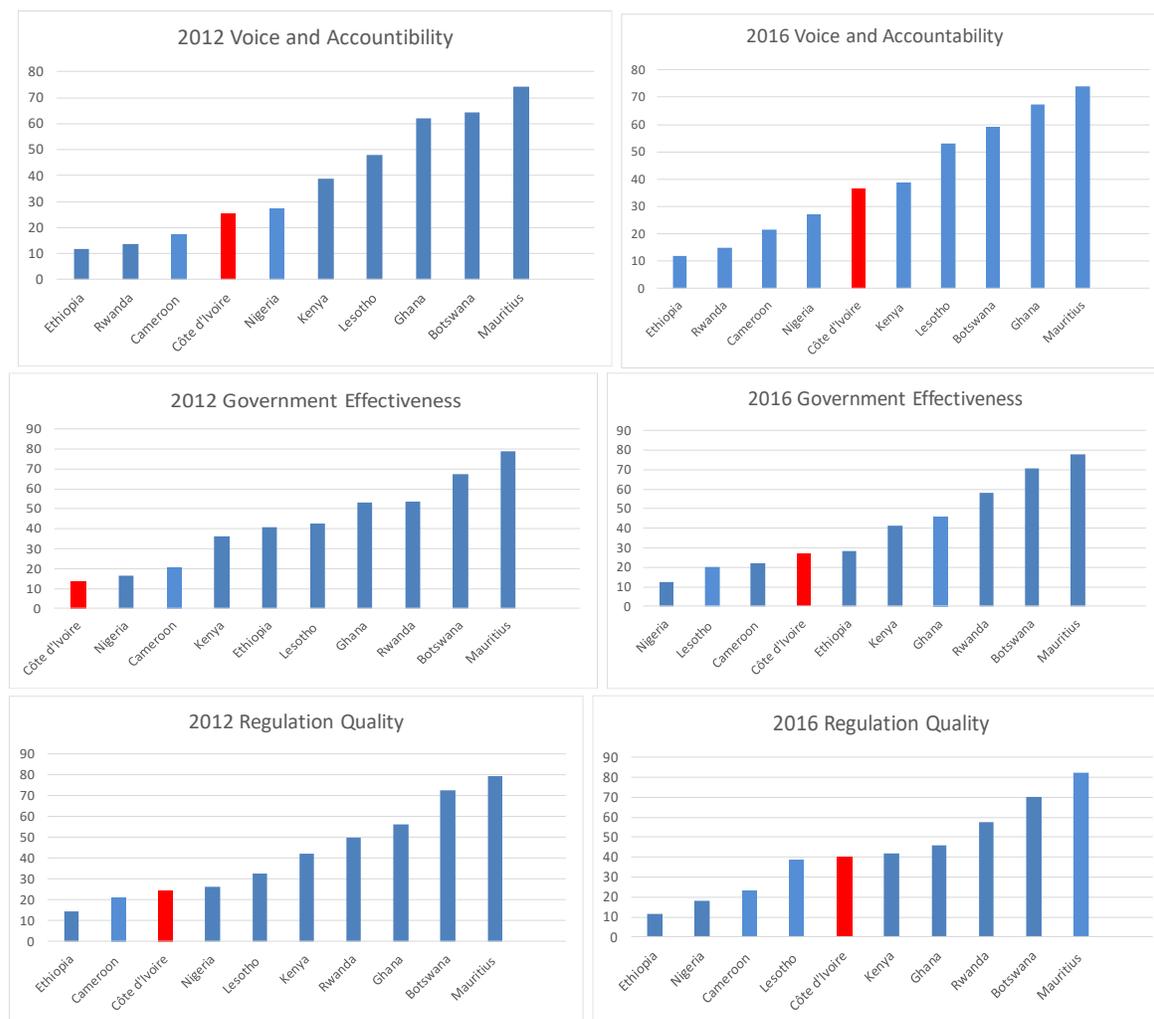
Government effectiveness and regulations quality have improved. The design and implementation of development plans (2011;2015) have contributed to improve perception of government effectiveness and accountability. Establishing a one stop shop for investors which streamlined red tape and wait time for business opening, improved regulation efficiency. A new ministry in charge of private sector development has been established, signaling the government's willingness to streamline obstacles to doing business.

But, Corruption persists. It stalled from 2012 to 2016 compared to peers (Figure I-13). Corruption is ranked second as most problematic constraint to doing business by investors in the 2016-2017 global competitiveness report. Transparency international index on corruption (CPI) supports this finding as well (Annex, Figure I-

³¹ The World Governance index defines voice and accountability as "perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media."

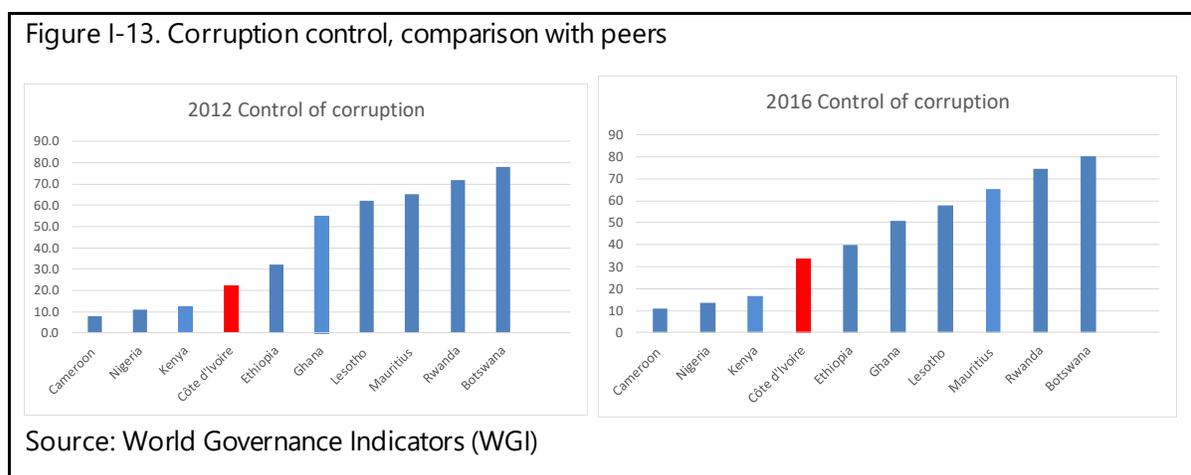
26). Though Côte d'Ivoire has gained ranks compared to all countries, it has not translated into improved rankings compared to its peers (Annex, Figure I-28).

Figure I-12. Governance indicators



Source: World Governance indicators (WGI)

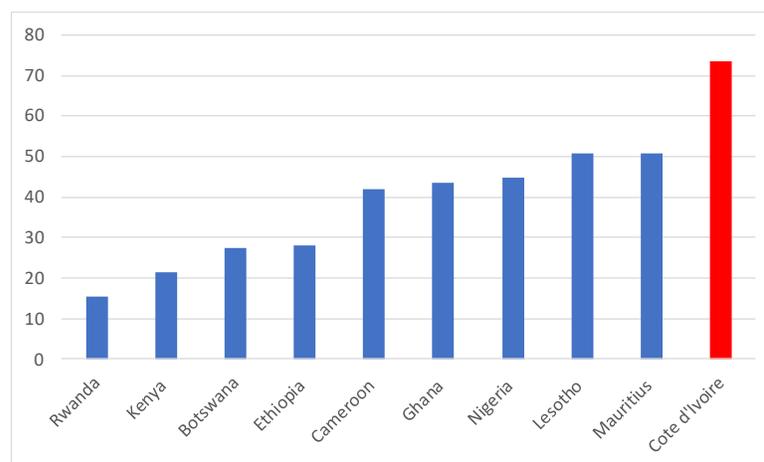
This perception is supported by the World Bank enterprise survey. The survey shows that 71 percent of firms find corruption as a major constraint to doing business in Côte d'Ivoire (Annex, Table I-2). This ratio is the highest among Côte d'Ivoire's peers (Figure I-14). Several corruption scandals occurred from 2011 to 2018, including in the vehicles licensing and custom clearance³². The establishment of an additional institutions tasked to fight corruption points to rampant corruption. Yet, this new institution has no prosecution power. In addition, the head of this institution is not independent from executive power. Opportunities for rent seeking and corruption have also increased with considerable number of noncompetitive public procurements³³.



³² <http://www.linfodrome.com/economie/39335-scandale-au-guichet-unique-automobile-concession-de-cote-d-ivoire-logistique-implication-des-personnalites-le-ministre-amadou-kone-fait-le-grand-deballage>

³³ This situation has been officially acknowledged by the government's spoke person: <http://news.abidjan.net/h/576861.html>

Figure I-14: Corruption as major constraint to business (percent of total firms)



Source; World Bank Enterprise Survey, latest data available

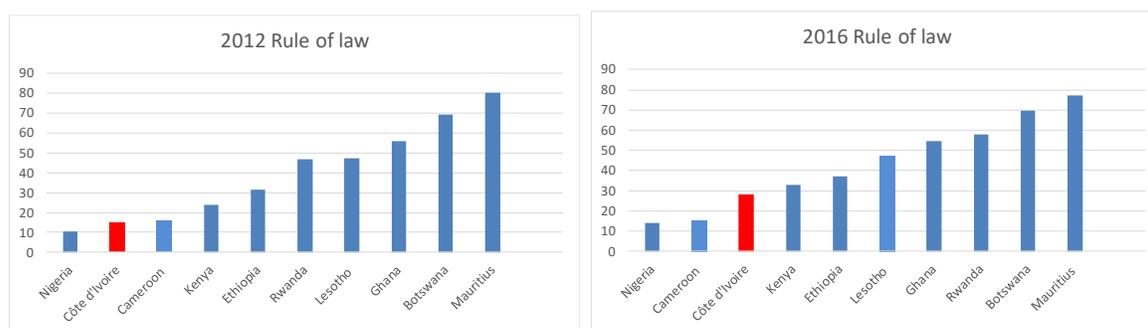
Rule of law is also weak (Figure I-15). Investors rank inefficient bureaucracy, which include quality of institutions, as the third biggest obstacle to doing business³⁴. Judicial independence has one of worst ranking as subcomponent of institutions. Côte d'Ivoire has the highest share of firms perceiving the court system as a major obstacle to doing business compared to its peers (Figure I-16).

The post electoral crisis has used the judicial system as a battle ground for stakeholders, weakening its independence. In the aftermath of the crisis, the judicial system has remained affected by executive power. Human rights organizations, including Human Rights watch, have denounced lacking judicial independence in Côte d'Ivoire³⁵.

³⁴ Global competitiveness report 2016-2017

³⁵ Human Rights Watch Report (March 2016)

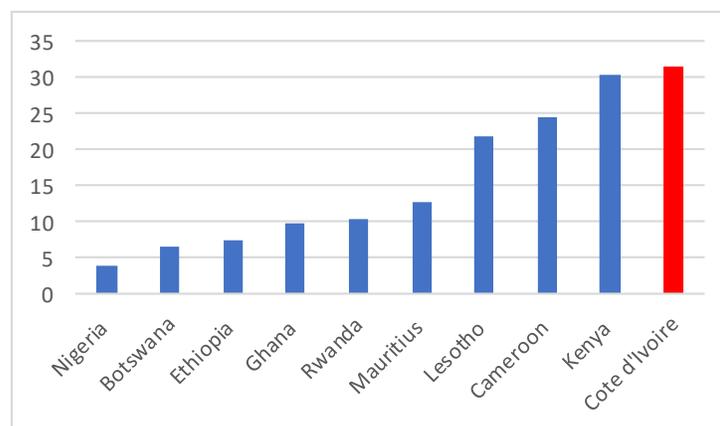
Figure I-15. Rules of law indicators, comparison with peers



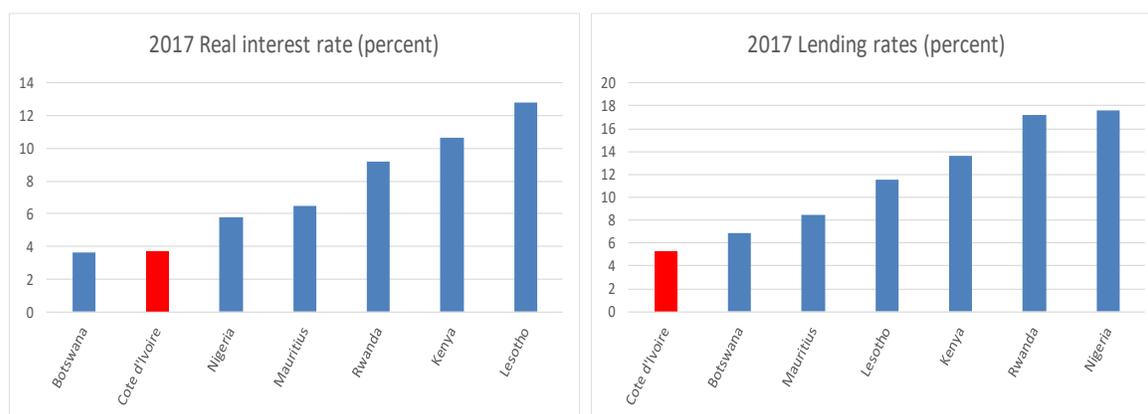
Source: World Governance Indicators

We now examine access to finance as potential binding constraint. We find that finance is cheaper in Côte d'Ivoire than most of its peers (Figure I-17). In fact, policy rate and lending rate in Côte d'Ivoire are among the lowest compared to its peers.

Figure I-16. Court system as a major constraint to business (percent of firms)



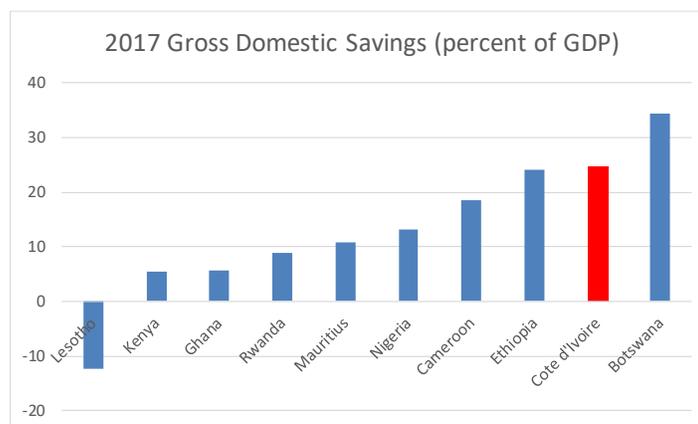
Source: World Bank Enterprise Survey

Figure I-17. Comparison of real interest and lending rates,³⁶

Source: World Development Indicators

This finding is consistent with sizeable level of national savings in Côte d'Ivoire (Figure I-18). The current account balance of Côte d'Ivoire is among the top performing its peers due to large exports, including cocoa, coffee and oil. Only 10 percent of firms in Côte d'Ivoire see interest rates as constrained to financing³⁷.

Figure I-18. Côte d'Ivoire: national savings with peers



Source: World Development Indicators

³⁶ Cameroon, Ghana, and Ethiopia have missing data

³⁷ World Bank Enterprise data survey

Yet, access to finance remains limited. Entrepreneurs rank access to finance as the first constraint to doing business³⁸ (Annex, Table I-3). 64 percent of firms see access to finance at least as a major constraint to doing business (Annex, Table I-4); more than half of them perceive it as a “very severe constraint” (Annex, Table I-5). In fact, 80 percent of firms in Côte d’Ivoire have a banking account—high compared to its peers. However, 78 percent of firms do not have access to credit. 75 percent of these firms, though in need, do not have access to credit. The most affected sectors are respectively retail and other services (Figure I-19).

Based on the preceding findings on corruption, rule of law and access to credit, we assume the following: perception of considerable risks by banking system rationing credit provision to investors reflects rampant corruption and limited independence of justice. Corruption is rampant and present in the judicial system, constraining the rule of law. Therefore, banks find challenging to recoup collateral in case of loans repayment failures. To avoid such challenge, the banking system ration credit through non-price elements.

Data shows a strong correlation between limited access to credit and corruption (Table I-1). Data support this assumption above. In fact, the banking sector is the largest provider of credit in Côte d’Ivoire, accounting for 90 percent of total credit provision (Annex, Table I-6). Around 79 percent of investors who perceive corruption as a major constraint to doing business do not have access to credit (Annex, Table I-7). Similarly, sectors perceiving corruption as a severe constraint also have the lowest access to finance (Figure I-19).

³⁸ Global competitiveness report 2016-2017

Table I-1. Correlation between access to credit and finance

Association between the two obstacles: access to finance and corruption

The table displays the number of respondents

		How much is access to finance an obstacle?					Total
		No obstacle	Minor obstacle	Moderate obstacle	Major obstacle	Very severe obstacle	
How much is corruption an obstacle?	No obstacle	9	16	8	18	14	65
	Minor obstacle	4	17	12	23	28	84
	Moderate obstacle	6	8	24	36	29	103
	Major obstacle	16	22	35	100	78	251
	Very severe obstacle	41	23	39	94	132	329
	Total	76	86	118	271	281	832

Independence test

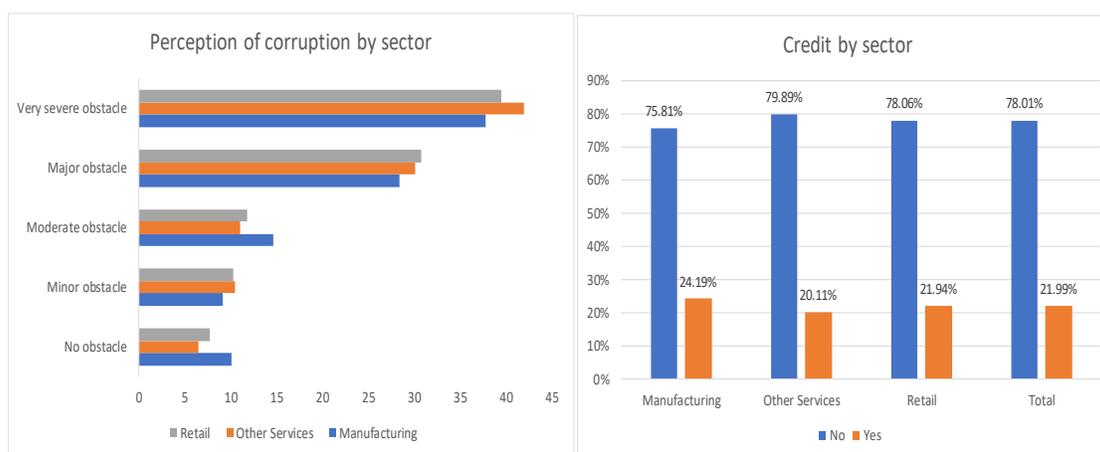
	Stat	P-value
Pearson chi2(16)	59.0822	0
likelihood-ratio chi2(1)	53.6736	0
Cramér's V	0.1332	

Test statistics evaluate association between access to finance and corruption. The association is significant though not very strong; the Cramer's V is at 13%.

Source: World Bank Enterprise Survey

On average, collateral value accounts for 150 percent of backed loan. Collaterals are required for 64 percent of loans. SMEs, characterized by limited assets for collaterals, have the least access to credit (Annex, Table I-8, Annex Figure I-27). Also, not surprising, manufacturing sector has the largest share of credit and the easiest access to credit (Annex, Table I-9), reflecting their assets usable as collaterals compared other sectors (Figure I-19). Similarly, SMEs, typically, with limited assets, are the largest share of companies perceiving finance as a constraint (Annex, Table I-10).

Figure I-19. Côte d'Ivoire: corruption perception and credit access by sector



Source: World Bank Enterprise Survey

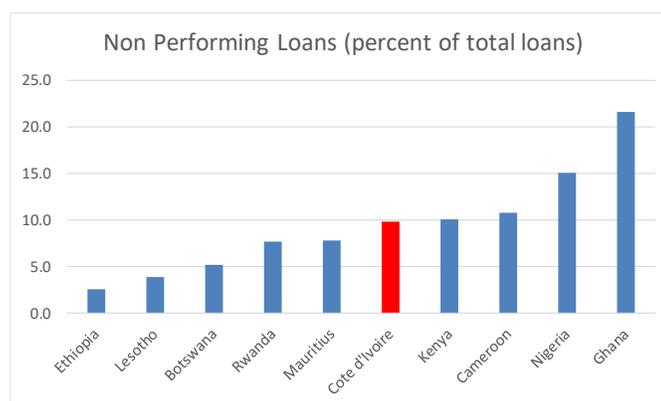
In fact, though non-performing loans in Côte d'Ivoire is above average compared to peers (Figure I-20). Banks lend mainly to existing and well-known clients, even in case of available collaterals from new investors, to avoid risk of litigation for unpaid loans. In fact, in case of litigation, banks claim to face corruption, red tape and a limited independence of judicial system. The latest case is the nonpayment of sizeable loans by a bankrupt firm in the cocoa sector. Creditor banks tried to recoup collaterals before court. The judicial decision did not support them, leaving the banking sector with non-recoverable loans of around \$ 320 billion; the banking association warned that if implemented banks would be more reluctant to lend to private sector³⁹.

We also see camels and hippo behavior. We note that thriving firms in Côte d'Ivoire both public enterprises and private firms have strong connections with executive's power. These connections allow them to benefit from the rent seeking system or not being hampered by petit corruption. Also, SMEs, lacking connections, tend to

³⁹ Jeune Afrique (Septembre 2018), édition 3009, page 60

stagnate; other SMEs born along with new regime go bankrupt as political regime changes.

Figure I-20. Côte d'Ivoire: Non-Performing loans, comparison with peers



Source: World Development Indicators and IMF data base

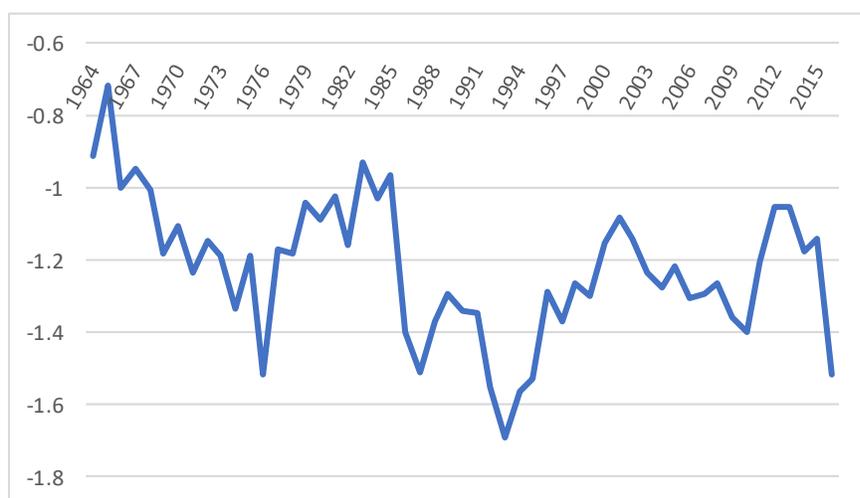
Finally, the government has tried to help entrepreneurs to circumvent corruption by establishing a one stop shop for investors which allows to isolate firms at their creation stage. But once created through the stop shop, many firms face challenges to continue their daily operations as they must interact with other public entities rigged with corruption.

We now turn to coordination and market failures as potential binding constraints. We look first know how accumulation that we consider as good symptom of existing market failures. In fact, theory⁴⁰ explains that coordination and market failures deter investors to venture into new high productive activities presenting both positive externalities and substantial risk related discovery process. These activities require the acquisition of new know how.

⁴⁰ Rodrik and al (2008): Growth Diagnostic: The Mindbook

Know how measured by Economic Complexity Index (ECI)—box 1 for concept definition—fell from 2011 to 2016, below its pre-crisis level in 2010. From 1996 to 2016, it has been on a downward trend with a weak rebound attempt between 2011 and 2013 (Figure I-21). Further, Côte d'Ivoire is now lagging compared to its peers (Figure I-22). Accumulation of know how is strongly associated with future income growth⁴¹. Weak know how accumulation in Côte d'Ivoire could hamper GDP growth in the coming years, if no action is taken. Therefore, coordination and market failures hampering know how accumulation is a key constraint to rapid and sustainable growth in the medium term.

Figure I-21. Côte d'Ivoire : economic complexity



Source: World Economic Complexity Atlas, MIT

⁴¹ Ricardo Hausmann and al (2009)

Box 1. Economic Complexity Index: definition and methodology⁴²

The Economic Complexity Index (ECI) measures capabilities of economic production at a country level. Simply put, it measures the level of know-how of a country.

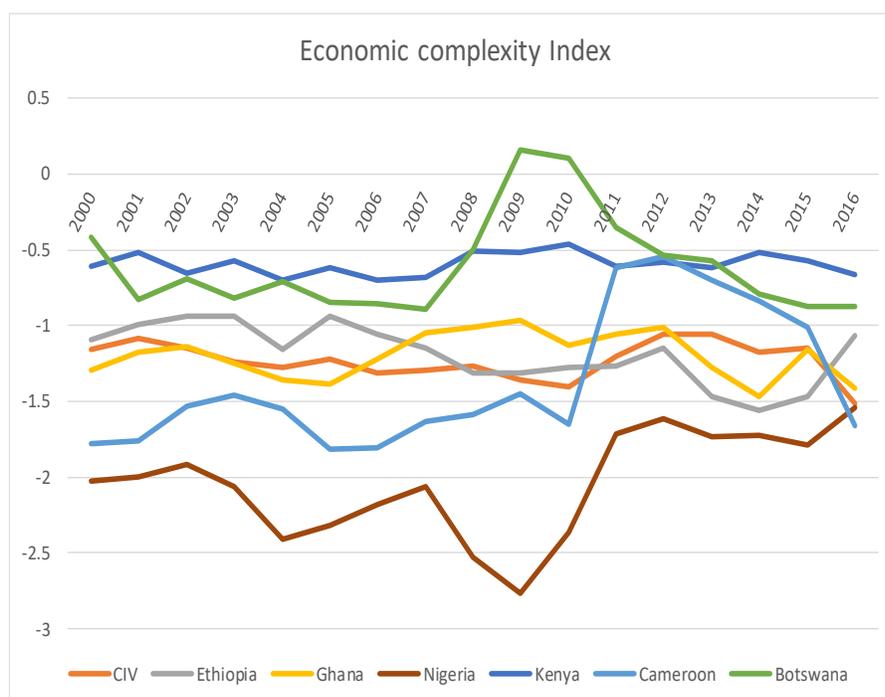
The ECI is built from two indexes: country diversity and product ubiquity. Country diversity reflects the number of goods exported by a country, using the three alternative sources of trade data: the Standard International Trade Classification (SITC), the COMTRADE system, and the North American Industry Classification.

A country with high economic complexity is diversified and produces products with a low average ubiquity. A higher number of good types exported, the more diverse would a country be. Product ubiquity counts the number of countries producing a given product. Using a model of reflection, Hausmann and al (2009) find that the less ubiquitous is a product, the more capabilities it requires to be produced. The average ubiquity of country's products is negatively correlated with its level of diversification. Countries with more capabilities are more diversified as they can produce a larger variety of products. These capabilities allow them to produce products that very few countries are capable to produce.

To be sure, the Economic Complexity Index does not incorporate prices of products. Therefore, fluctuations in product prices would not affect the change in ECI.

⁴² This box summarizes a paper by Hausmann and al (2009) titled "the building blocks of economic complexity"

Figure I-22. Economic complexity



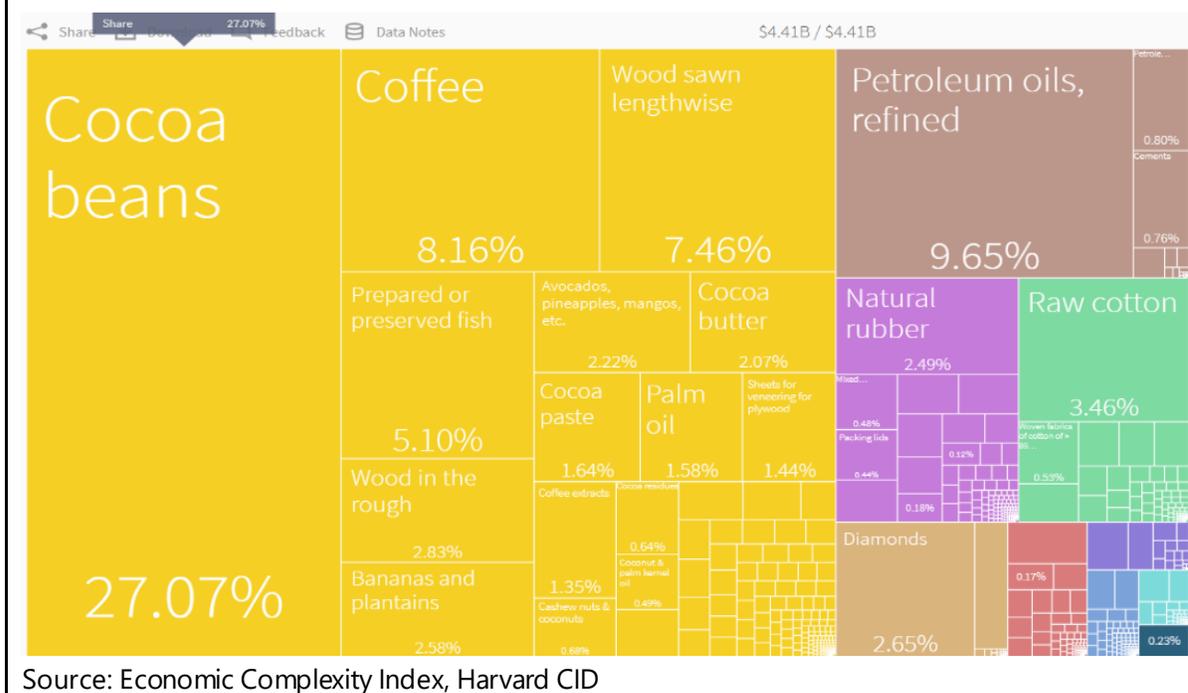
Source: World Economic Complexity Atlas, MIT

Limited know how accumulation reflects persistent preferences of investors into primary sector export activities. This preference has not changed over time.

Diversification has been limited over the last two decades (Figure I-23; Figure I-24; Figure I-25). Cocoa continues to lead exports, followed by refined petroleum products, crude oil and coffee. Cocoa export share has grown from 25 percent of total exports in 1995 to 31 percent in 2016.

Limited know how accumulation could result from two factors: i) corruption, ii) limited access to finance, and insufficient infrastructure and institutional framework to encourage risk taking into new productive activities. In fact, with rampant corruption, investors might fear that lose return from new activities as those activities could easily be taken from them due to the lack of rule of law.

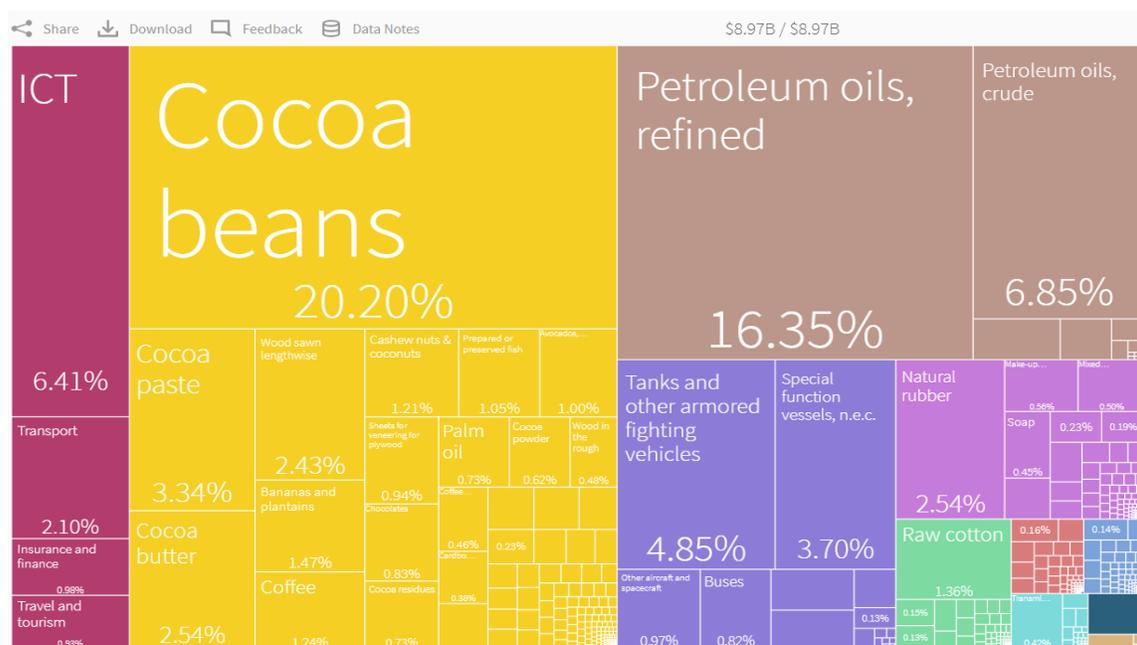
Figure I-23. Côte d'Ivoire : exports composition (1995)



Also, venturing into new and high productivity activities involves elevated risk taking related to learning costs. With a banking system that is risk averse, it is likely that investors willing to take risks into new activities will face finance access as a major constraint.

Côte d'Ivoire does not have enough incentive mechanism to support entrepreneurs into new activities. The new investment code does not provide ex ante support to new activities discovery. In fact, the code grants tax exemptions related to new activities. But it does not provide line credit to initiate financing of these new activities. That is even more important in a risk averse banking system. The new code does not link tax support with tangible results. Thus, it does not create incentives for entrepreneurs to continuously challenge existing space of know-how and seek for more diversification and product sophistication.

Figure I-24. Côte d'Ivoire : exports composition (2005)



Source: Economic complexity Index, Harvard CID

Figure I-25. Côte d'Ivoire : exports composition (2016)



Source: Economic Complexity Index, Harvard CID

I.6 Conclusion

This chapter aims at understanding potential binding constraints for Côte d'Ivoire in 2018. To that end, we use Hausman, Rodrik, and Velasco (HRV) growth diagnostic framework. More specifically, we identify constraints to shift growth engine to private investment.

After ruling out non-binding constraints, we find that corruption, access to finance and lack of institutional framework to incentivize entrepreneurs into new productive activities could be the binding constraint higher growth in Côte d'Ivoire.

Feasible options exist to tackle these constraints. On corruption, Côte d'Ivoire has several institutions in charge of good governance, including fighting against corruption. All these institutions lack independence and judicial power to take up corruption issues and tackle them. These two weaknesses should be addressed.

To increase access to finance, two measures would be critical. First, a judicial system, free from corruption, and competent to swiftly render judgements on commercial matters. Second, a credit bureau to keep record of borrowers, capable of providing enough data on new investors to help banks discriminating between good and bad borrowers.

On increasing exports sophistication, government would need to partner with private sector in engaging into active industrial policies which reward risk takers into high productivity activities and sanction weak performers. Corruption and rent seeking would need to be addressed before implementing the risk reward mechanism. In addition, institutional mechanism should be established between government and private sector to facilitate information sharing on challenges with coordination and

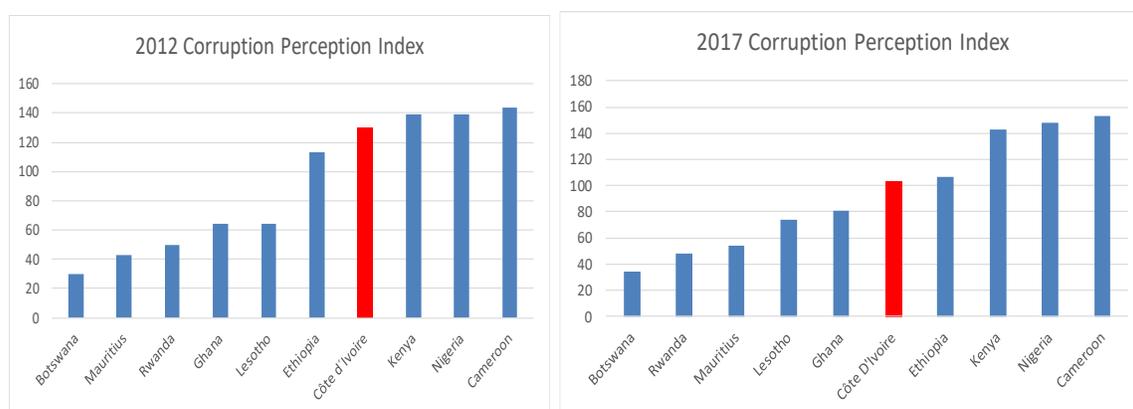
market failures.. In that vein, it will be critical to revisit the investment code to focus on giving incentives to move into sector with higher economic complexity and increasing returns. Also, providing a well-managed government backed guarantee could encourage banks to finance new sophisticated activities. Currently, there is a state-owned bank (BNI) which initially was established to support new economic activities but has in practice been more into the traditional lending activities. BNI could be redesigned and granted additional roles to play as a development bank to boost venture into new sophisticated activities from investors.

The paper identifies major obstacles to private investment. It does not address sector specific obstacles to private investment including industrialization. This gap could be addressed by future research. Furthermore, bridging this gap could be first applied to the agricultural and non-agricultural sectors. In fact, do corruption, limited access to finance, and market failures constrain both low productivity (agricultural) and high productivity (non-agricultural) sectors? Or do these constraints differ from one sector to the other? This question is crucial as many developing economies face economic dualism. Achieving faster and inclusive growth requires removing constraints in both modern and traditional sectors.

The other issue is demographic dynamics on growth. Population in Africa is growing at a faster pace than the rest of the world. This population composition differs from the one in the rest of World. So far, it is unclear what would be the impact of these two features of demographics in Africa on its GDP growth.

I.7 Annex

Figure I-26. Corruption perception rankings



Source: Transparency International

Table I-2. Côte d'Ivoire : corruption perception as obstacle

	Freq.	Proportion	
		Wit missing	Without missing
No obstacle	69	7.78%	8.05%
Minor obstacle	85	9.58%	9.92%
Moderate obstacle	107	12.06%	12.49%
Major obstacle	254	28.64%	29.64%
Very severe obstacle	342	38.56%	39.91%
No response	30	3.38%	
Total	887	100.00%	100.00%

Source: World Bank, enterprise survey

Table I-3 : Cote d'Ivoire: firms and access to credit

A firm has **access to credit** if (1) it has a line of credit or loan from a financial institution; or (2) its working capital is partially or fully financed by a bank loan

		Number	Proportions	
			Wit missing	Without missing
Access to credit	No	674	76.0%	78.0%
	Yes	190	21.4%	22.0%
	No response (don't know)	23	2.6%	
		887	100%	100%

Source: World Bank, enterprise survey

Table I-4. Côte d'Ivoire: constraint to access credit

A firm is financially constrained if it did not apply for new loans/lines of credit in last fiscal year because (1) Application procedures were complex, (2) Interest rates were not favorable, (3) Collateral requirements were too high, or (4) Size of loan and maturity were insufficient

	Obs.	Percent
Non-Constrained	324	46.22
Constrained	377	53.78
Total	701	100

Source: World Bank, enterprise survey

Table I-5. Côte d'Ivoire : finance perception as obstacle

How much is access to finance an obstacle?

	Freq.	Proportion	
		With missing	Without missing
No obstacle	78	8.79%	9.07%
Minor obstacle	89	10.03%	10.35%
Moderate obstacle	121	13.64%	14.07%
Major obstacle	276	31.12%	32.09%
Very severe obstacle	296	33.37%	34.42%
No response	27	3.04%	
Total	887	100.00%	100.00%

Source: World Bank, enterprise survey

Table I-6 : Côte d'Ivoire: decomposition of credit by lender

Which institutions finance credit to firms?

	Observations	Proportion	
		With missing	Without missing
Bank	171	90.00%	90.96%
Non-bank financial ins	14	7.37%	7.45%
Other	3	1.58%	1.60%
No response (don't kn	2	1.05%	
Total	190	100%	100%

Source: World Bank, enterprise survey

Table I-7. Côte d'Ivoire: correlation of access to finance and corruption

Association between access to finance and corruption as obstacle
The table displays the percentage of respondents (rows)

		Access to credit		
		No	Yes	Total
How much is corruption an obstacle?	No obstacle	75.76	24.24	100
	Minor obstacle	78.57	21.43	100
	Moderate obstacle	77.88	22.12	100
	Major obstacle	76.89	23.11	100
	Very severe obstacle	78.25	21.75	100
	Total	77.63	22.37	100

Independence test

	Stat	P-value
Pearson chi2(16)	0.3314	0.988
likelihood-ratio chi2(1)	0.3292	0.988
Cramér's V	0.0199	

Test statistics indicate no association between access to finance and corruption as obstacle. Corruption affects every single firm.

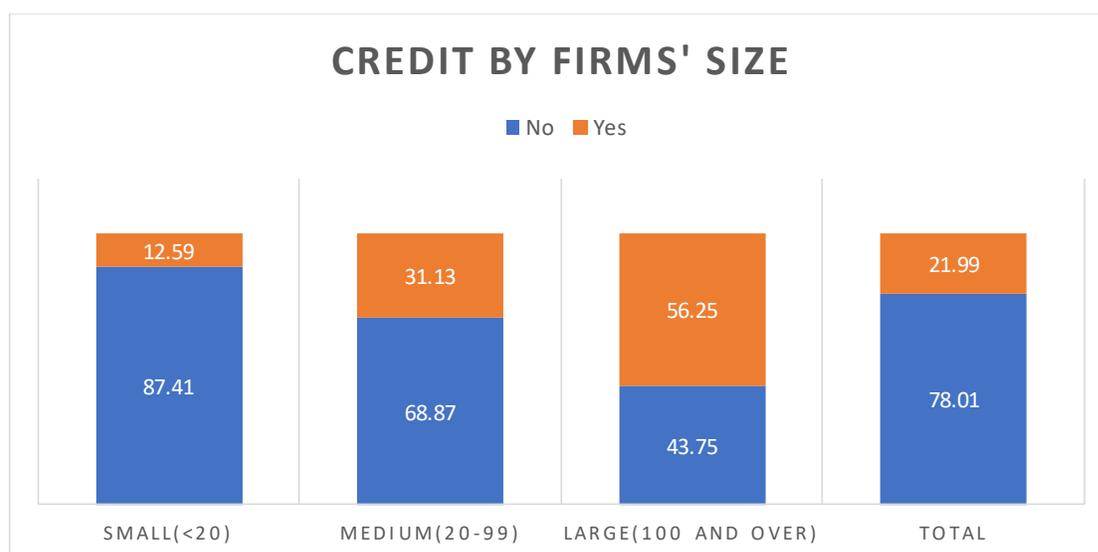
Source: World Bank, enterprise survey

Table I-8. Cote d'Ivoire: firms' size and access to financing

	Access to credit		Total
	No	Yes	
Small(<20)	87.41	12.59	100
Medium(20-99)	68.87	31.13	100
Large(100 And Over)	43.75	56.25	100
Total	78.01	21.99	100

Source: World Bank, enterprise survey

Figure I-27. Côte d'Ivoire: Credit access by firms' size



Source: World Bank, enterprise survey

Table I-9: Côte d'Ivoire: access to credit by sector

	Access to credit		
	No	Yes	
Manufacturing	75.81%	24.19%	100
Other Services	79.89%	20.11%	100
Retail	78.06%	21.94%	100
Total	78.01%	21.99%	100

Source: World Bank, enterprise survey

Table I-10. Côte d'Ivoire : firms' size and perception of finance as constraint

Finance perceived as constraint by firms' size				
	Non-Constrained	Constrained	Total	
Small(<20)		40.16	59.84	100
Medium(20-99)		54.37	45.63	100
Large(100 And Over)		77.36	22.64	100
Total		46.22	53.78	100

Source: World Bank, enterprise survey

Chapter 2

Demographics and Economic Growth in Sub- Saharan Africa⁴³

⁴³ Co-authored by Desire Kanga, PHD.

II- DEMOGRAPHICS AND ECONOMIC GROWTH IN SUB SAHARAN AFRICA

II.1 Introduction

In 2017, the French President reignited a growing and unsettled debate on the impact of demography on economic in Sub-Saharan Africa. He claimed that economic development would nearly be impossible if fertility remained high. This statement fueled the public debate between pessimists, neutralists and optimists of demography. This demographic debate reemerged amid a slowdown of the GDP per capita growth in Sub Saharan after almost 15 years of unprecedented growth, the so called "Africa rising".

Most analysts agree that low growth rates and aging of population in high-income countries will likely slow economic growth in these countries in the coming years (Baker and al, 2005)⁴⁴. But the reverse does not seem to find the consensus. There is no strong support for the adverse effect of population growth on economic growth in developing countries (Heady and Hodge, 2009)⁴⁵.

Very few studies have been conducted over the last two decades to shed light on the role of demography on income growth in Sub Saharan Africa. More importantly, existing studies have not focused on Sub Saharan Africa alone in their evaluation of demographic impacts. Also, the most recent period under these studies is 1990s.

⁴⁴ Baker, D., De Long, J. B., & Krugman, P. R. (2005). Asset returns and economic growth. *Brookings Papers on Economic Activity*, 2005(1), 289-330.

⁴⁵ Headey, D. D., & Hodge, A. (2009). The effect of population growth on economic growth: A meta-regression analysis of the macroeconomic literature. *Population and Development Review*, 35(2), 221-248.

Such research gap is problematic, especially at times where Sub Saharan Africa continues to face a peculiar demographic trend compared to other regions of the world.

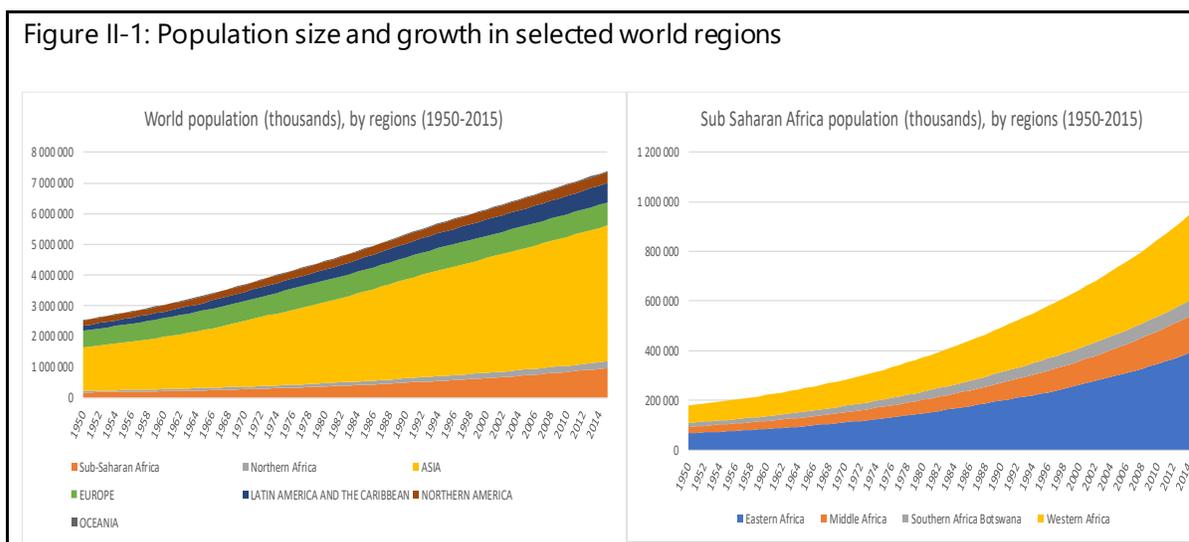
In this paper, we attempt to bridge this research gap. To that end, we use a convergence model comprising economic, institutional, and demographic variables to uncover the drivers of income growth per worker during the last three decades (1985-2015). We find that working age population and elderly dependency are significant determinants of per worker income growth in Sub Saharan Africa. We also find that human capital and institutions are significant contributors to per worker income growth.

This paper has six sections. After the introduction (section I), Section II highlights economic facts characterizing growth episodes from 1970 to 2015 in Sub Saharan Africa. Section III looks at demographic developments in Sub Saharan African over the last six decades (1955-2015). Section IV reviews the literature to underline methodologies used to assess demographic impact on income growth as well the findings. Section V presents the findings of our conditional convergence model assessing the impacts of demography on income growth from 1985 to 2015 in Sub - Saharan Africa. Finally, we conclude (section VI).

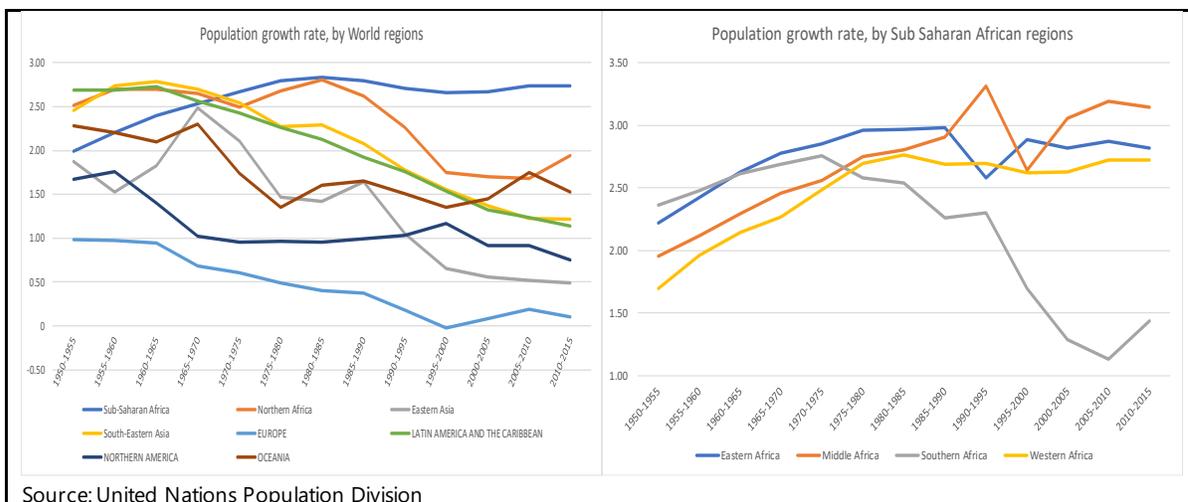
II.2 Key Facts of Demography in Sub-Saharan Africa⁴⁶

Sub Saharan Africa has the second largest population after Asia in the World (Figure II-1). Sub Saharan Africa took over Europe's ranking as second since 2005. Eastern Africa has the largest population in sub-Saharan Africa since 1963, followed by West Africa.

Sub Saharan Africa has the fastest growing population in the world led by its middle region. South Eastern Asia is the most densely populated region followed by Eastern Asia, and Sub Saharan Africa (Annex, figure II-9). Sub Saharan Africa holds the third rank since 2005, previously held by Europe. Eastern Africa has the highest density in Sub Saharan Africa.



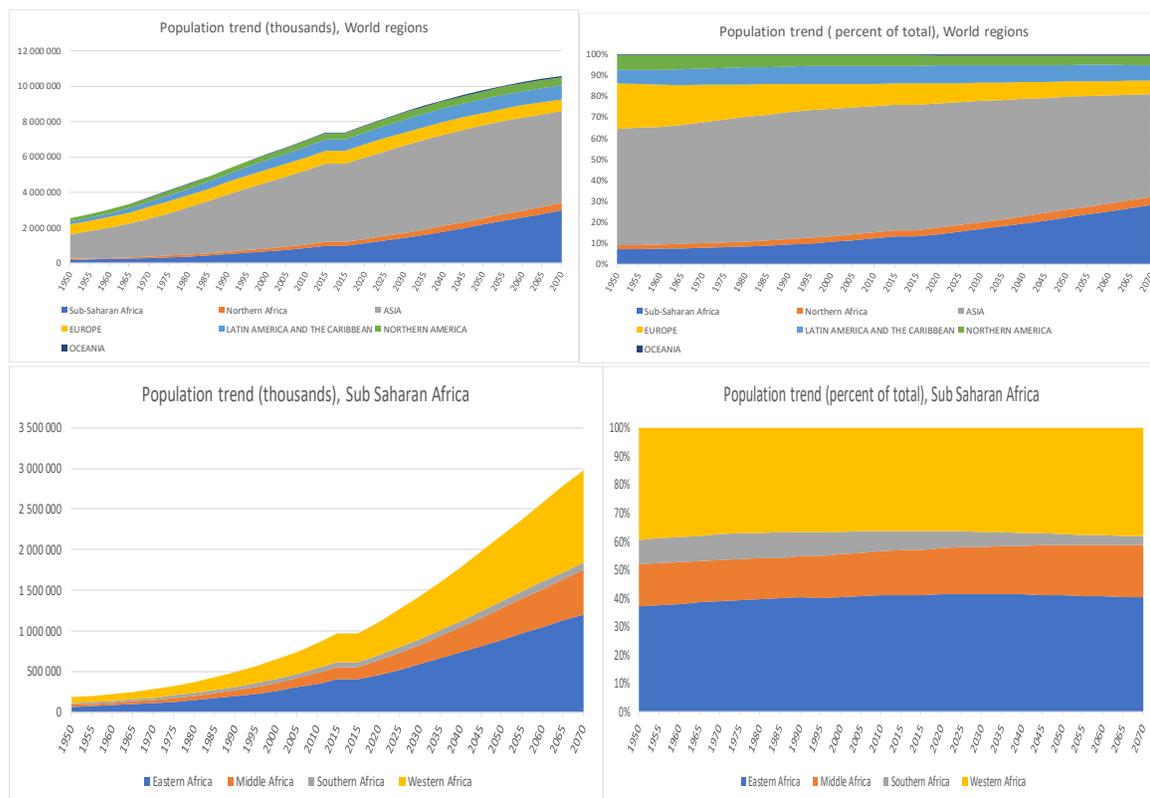
⁴⁶ Database for key demographic facts is the United Nations Population Division



Sub Saharan Africa (SSA) will have 3 billion inhabitants in 2070, reflecting a general upward trend in the world. World population is expected to reach 10.5 billion in 2070 from 7.3 billion in 2015 (Figure II-2). Asia and Sub Saharan Africa will remain the most populated regions in the world. Asia's share in world's population is projected to shrink from 60 percent in 2015 to 49 percent in 2070. On contrast, SSA population is expected to increase from around 13 percent of world population in 2015 to 28 percent of world population by 2070, reaching almost 3 billion inhabitants from around 1 billion in 2015.

Western and Eastern regions in Sub Saharan Africa will remain the two largest populated areas, each counting for 35 percent of the population in SSA. Middle Africa will remain the fastest growing region in Sub Saharan Africa

Figure II-2: Projections of population trends in selected world regions



Source: United Nations Population Division

SSA Population composition has not changed. The composition of population has changed since 1950 in the world (Annex, figure II-10). The largest group shifted from population of 0-14 years old in 1950 to working population of 15-64 in 2015. This shift has occurred in most world regions with the Eastern Asia achieving the most spectacular shift. Yet, SSA region has not achieved such shift; its 0-14 years old population remains the largest share of population. Only Southern Africa has shown a shift similar to other world regions.

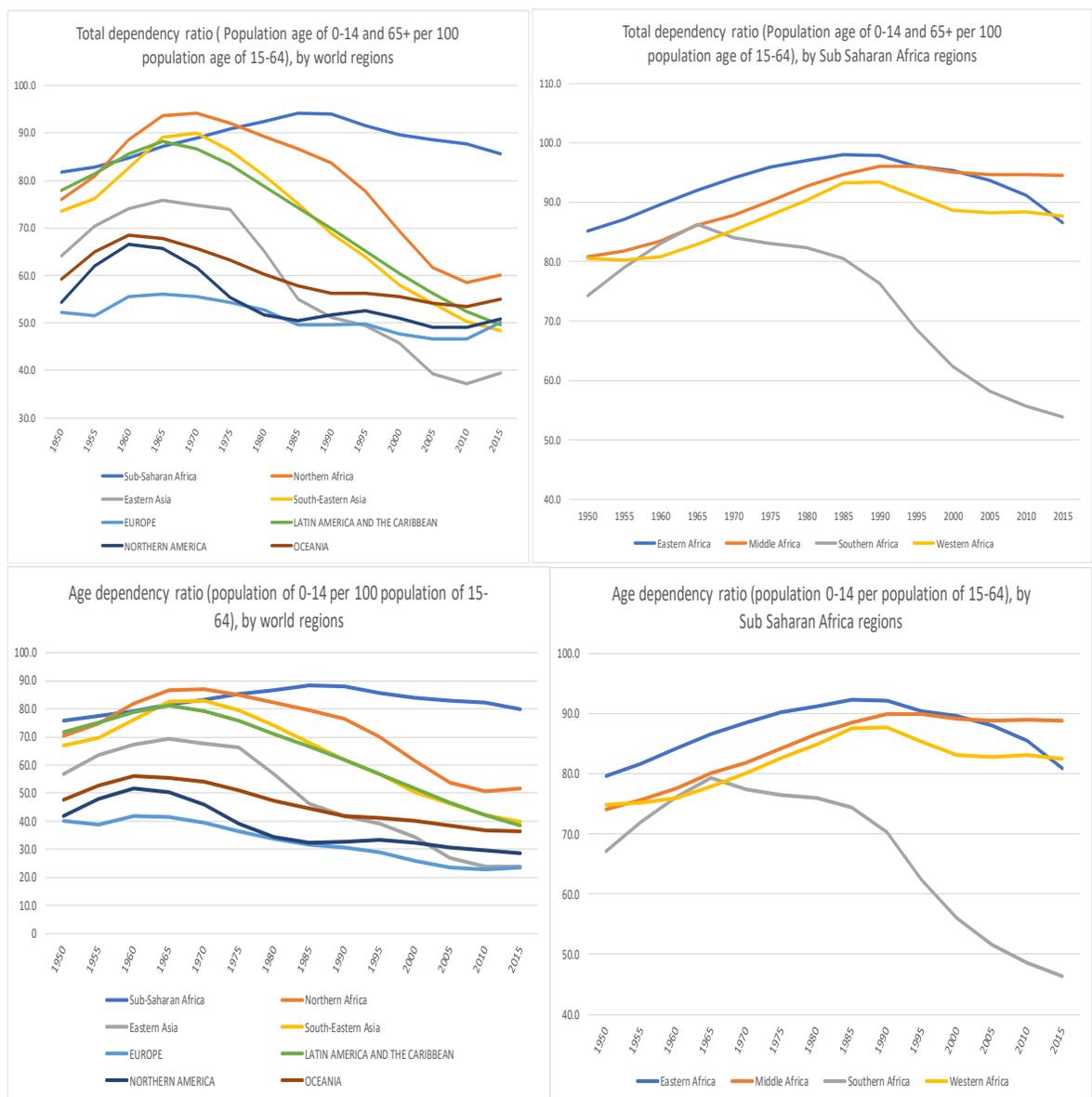
The slow shift of population composition toward working age population in sub Saharan Africa reflects high fertility which continues to fuel dependency ratio. Sub Saharan Africa has the highest dependency ratios in 2015 in the world for both population of 0-14 and 15-64 (Figure II-3). Dependency ratios have increased since

1950, even though they have slightly declined over the last two decades from their peaks in mid-1980s. Middle Africa has the highest and most stable dependency ratios in Sub Saharan Africa.

Crude birth rate has significantly dropped in sub Saharan Africa compared to other regions. while crude birth rate has dropped in other regions in the world. Crude birth rate has rapidly dropped over the last half century in world from 36 births per inhabitants in early 1950s to 19 births per 1,000 population in mid 2010s (Annex, figure II-11).

But the birth rate in Sub Saharan Africa in 2015 is still higher than the world average rate in 1950s. Middle Africa has seen the slowest decline in births rate while southern Africa achieved the fastest drop in births rate. Birth rate in Sub Saharan Africa reflects its fertility rate which remains the highest in the world (Annex, figure II-12). Most fertile groups in Sub Saharan Africa are population of 20-30 years old, like other world regions. Middle Africa has the highest fertility rate since early 1990s (Annex, figure II-13).

Figure II-3: Dependency in selected world regions (1950-2015)



Source: United Nations Population Division

High crude birth rate Sub Saharan Africa could reflect high infant mortality. In fact, sub Saharan Africa has the highest infant mortality rate in the World (Annex, figure II-14). North Africa had an infant mortality rate of 201 per 1,000 live births, higher than Sub Saharan Africa in early 1950s. In 2015, infant mortality rate in North Africa

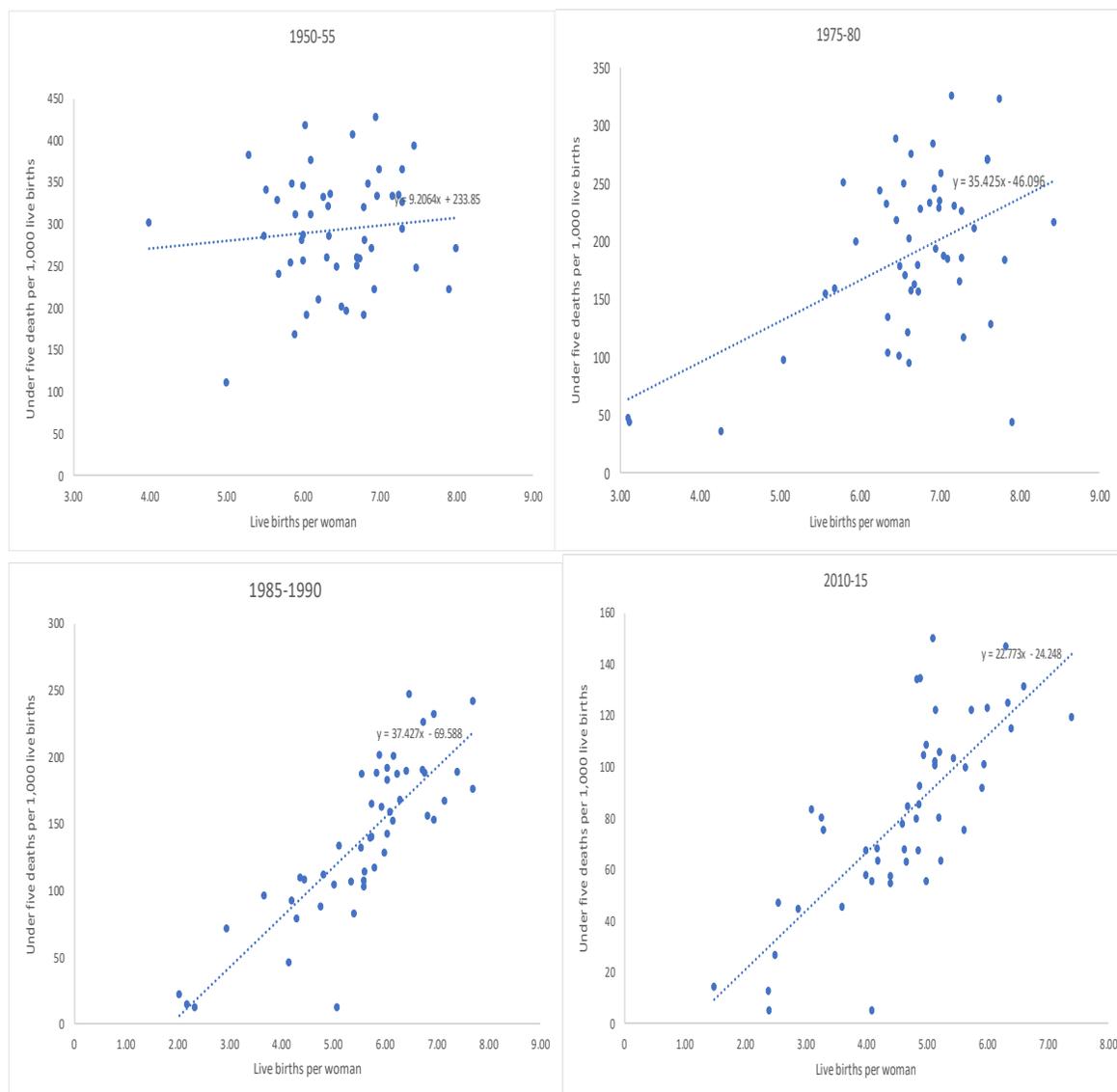
dropped to 28 per 1,000 live births while Sub Saharan Africa has twice this rate. Middle Africa has the highest mortality rate in Sub Saharan Africa.

Furthermore, fertility rate and mortality rate of children under five seem to be highly correlated since early 1960s up to 2015. This correlation was at its highest level between 1985 and 1990 (Figure II-4). That reflects typical stylized fact of high mortality rate encouraging women to have more children in anticipation of high deaths among future children (World bank, 2015).

This current population composition is to change in the coming decades in sub Saharan Africa. In fact, the working age population in Sub Saharan Africa is expected to be the fastest growing in the world from 2020 and onward. Working age population is expected to be the main driver of Sub Saharan Africa's population growth.

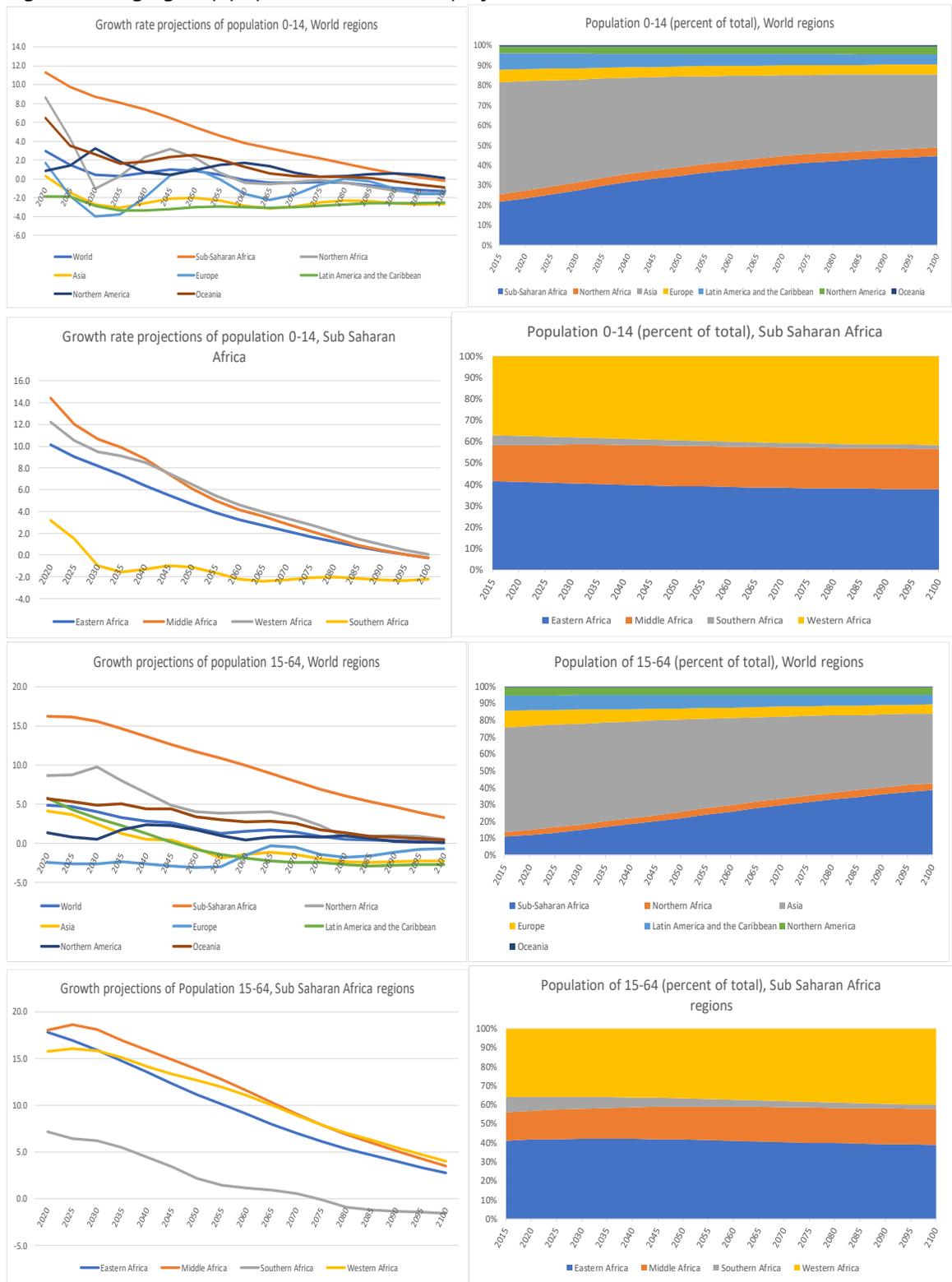
Sub-Saharan Africa trend will reflect a global dynamic. World population will be driven by working age population (15-64) expected to increase at an annual average rate of 2.7 percent over 2020-2070 (Figure II-5). Population under 15 is expected to slow down from an annual rate of 3 percent in late 2010s to 0.7 percent on average over 2020-2070.

Figure II-4: Fertility and mortality of children under five in SSA



Source: United Nations Population Division

Figure II-5: Age group population: actual and projected trends



Source: United Nations Population Division

Sub Saharan Africa has the shortest life expectancy in the world. Life expectancy has increased from 37 years old in early 1950s to 58 years old in 2015 in Sub Saharan Africa (Annex, figure II-15). The life expectancy gap has widened on average between Sub Saharan Africa and the rest of the world. Eastern Africa has achieved the most rapid life expectancy increase in Sub Saharan, going from 37 years old to 61 years old.

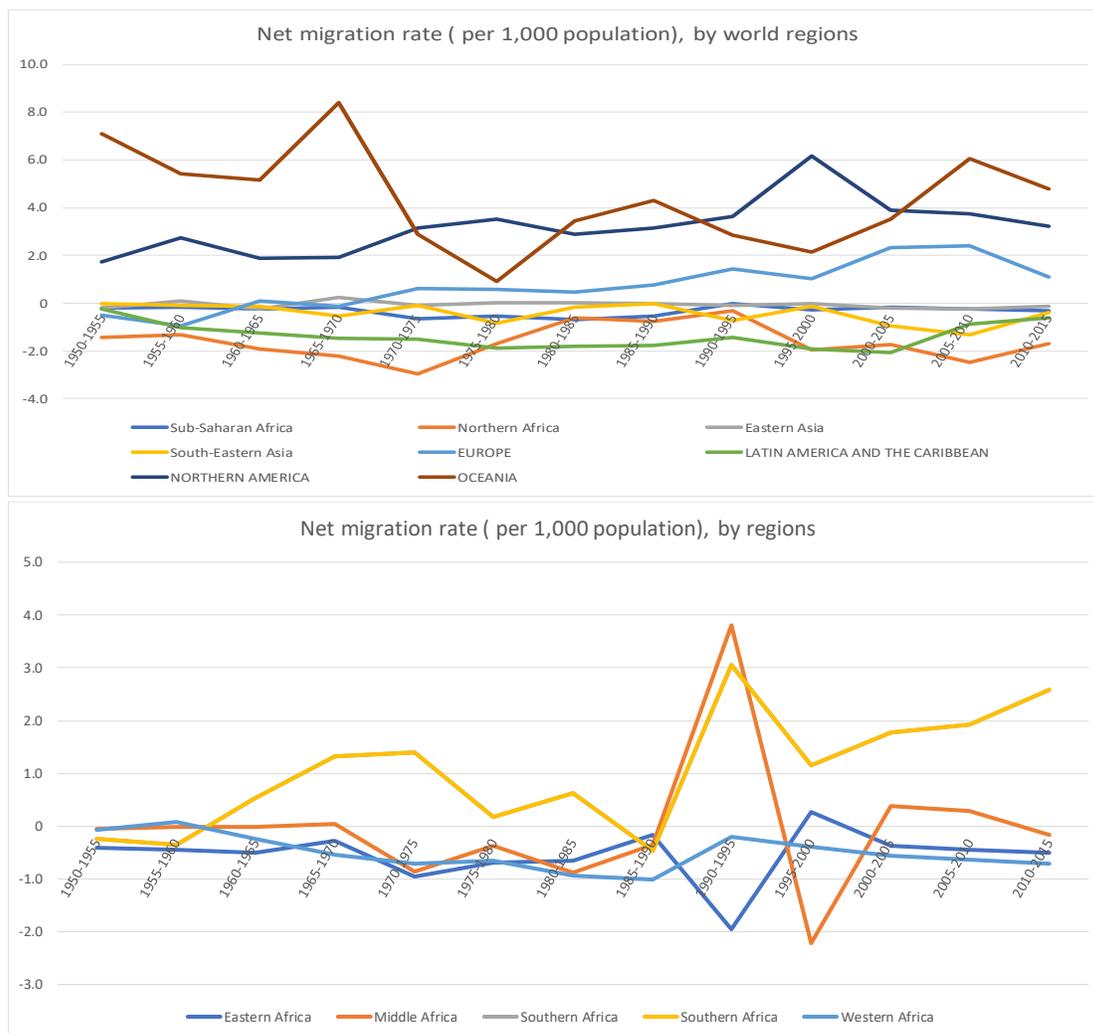
Also, in sub Saharan Africa, high death rate has shifted from infant group to the working age population (15-64). Most world regions, except SSA, have seen a shift of highest death rate from infant group (0-4) in 1950 to senior group (65 and up) in 2015 (Annex, figure II-16).

Death rate has almost doubled from 1950 to 2015 in SSA. This could reflect new pandemics, including AIDS and Ebola. More specifically, the death rate has shifted from infant to working age population in the southern and eastern African regions while it still the highest among infant in the central and west African regions (Annex, figure II-17).

As opposed the rest of the world, the sex ratio has not significantly changed in Sub-saharan Africa. On average, the world has seen an increase of the sex ratio from 1950 to 2015 (Annex, figure II-18). That means that the number of males have increased faster than the number of females. Also, there are more males in the world than females, except for the group of 65 years old and beyond. This composition is mainly driven by Asia which has the highest sex ratios. West Africa has the highest ratios in SSA on average (Annex, figure II-19).

Sub Saharan Africa has more people migrating towards other regions than it receives (Figure II-6). But Sub Saharan Africa has the lowest rate (number of migrants per 1,000 people) of net negative migration regions in the world.

Figure II-6: Migration in selected world regions



Source: United Nations Population Division

II.3 Demographic impacts on Growth: a literature Review

The effect of demography on economic growth is controversial (Heady and Hodge, 2009), and may vary depending on the econometric techniques used, the definition of demographic variables and the addition of other control variables in the regression. This is the main reason why in this section, we first look at the three main methodologies used to assess the impact of demography on economic growth. Then, we review key studies which evaluated the impact of demography on economic growth in world regions including African countries. We finally explain the contribution of this paper to the literature review.

1. Quantitative assessment of demography impact on economic growth

Three methodologies have been widely used in previous studies to assess relationships between demography and economic growth: i) simple correlation, ii) production function and iii) convergence patterns⁴⁷.

Simple correlation considers an association between economic growth and demographic variables. Many studies used unconditional correlations between economic income per capita and variables such as population growth, age structure, fertility rate, mortality rate on different groups of countries during different periods. This methodology has been criticized by many authors⁴⁸ for its simplistic approach. This methodology overlooks nonlinear relationship, possible reverse causation, and dynamic relationships between demography and economic growth. This approach also suffers from weak data quality, result sensitivity to countries sample selection.

⁴⁷ This section draws on the paper synthesizing economic-demographic modeling by Kelley and Schmidt (1999), Barro (1997), Radelet and al (2001), and Kelley and Schmidt (2004).

⁴⁸ (Kelley, 1988; National Council, 1986, and Blancet, 1991) questioned the simple correlation approach.

Due to these weaknesses, studies using pure correlation found controversial results. For instance, some studies suggest no correlation between economic output and demography. These results contradict debated prior on demographic impact on growth, lead to more sophisticated methodology to provide a comprehensive account of demography and economic growth relationship.

The production function methodology was suggested to overcome the weaknesses of the simple correlation approach. The basic idea of this methodology is to consider an output produced by the stocks of several elements: physical capital, labor (the number of workers), human capital (education and health), natural resources (land, minerals, environment), and technological progress. To avoid known challenges coming with estimating stocks, and possible reverse causation, variables were used in terms of growth rates.

Yet, using this methodology appear challenging due to several statistical issues such as estimation of physical capital depreciation, natural resources depletion and human capital changes. Similarly, collection of data on technology and scale seem impossible. To overcome this challenge, many studies recourse to the concept of "residual", known as the level of ignorance to account for ill-measured variables and missing data. Kelley (1999) and others⁴⁹ find this "solution" as "obscuring many of the most important linkages between demography and the economy."

The Convergence model is the third methodology which has gained better and lasting ground. It has been widely used over the last two decades due to both its reasonable foundational theory and less challenging empirical application. This

⁴⁹ Brander and Dowrick (1994)

model⁵⁰ considers the neoclassical growth theory. The model establishes a relationship between the economic growth and the level of economic development composed of both economic productivity and demographic variables. To that end, it defines a gap which is the difference between the long run level or steady state level⁵¹ of labor productivity and the current level of labor productivity. The convergence theory tries to explain the speed at which a country moves to close this gap.

In principle, all countries should have the same long run level of labor productivity, hence economic growth would essentially be different from zero until the gap is closed (unconditional convergence). But this long run level of labor productivity differs from one country to another one due specific country characteristics (conditional convergence). From that standpoint, the characteristics specific to a given country become key determinants of economic growth in its attempt to reach the steady state.

The characteristics defining economic growth rate are of three types: initial condition, economic, and demographic variables. Throughout studies, chosen variables are those assumed to influenced long run level of labor productivity. These models⁵² have evolved to add demographic transition component which explain the transition from per worker economic growth into a per capita economic growth. The convergence models will be formalized in the section 4.

⁵⁰ Ramsey (1928), Solow (1956), Cass (1965), and Koopmans (1965). This section builds from Kelley (1999) written using other studies Barro (1997) and Barro and Lee (1993).

⁵¹ From that paragraph, we will be using the word "long run" or steady state to designate indistinctively both steady state and long run.

⁵² See Bloom and Williamson (1998), Radelet, Sachs, and Lee (1997)

2. Demographic impact assessment on economic growth in SSA

The convergence model has been mainly used in studies to evaluate the impact of demography on economic growth in Africa. The paper of Barro (1997) is one of the foundational pieces specifying in great details the convergence model with a list of core variables which continue to be a reference in convergence models. He defines as economic determinants: schooling, life expectancy, government consumption, rule of law, terms of trade, democracy and inflation.

His study looks at a panel data of 100 countries from world regions including sub Saharan African countries spanning from 1960 to 1990. Using a two Stage Least Square (2 SLS), he confirms the neoclassical notion of convergence whereby lower initial income is associated with faster economic growth to catch up the steady state level. He also finds that schooling, life expectancy, better terms of trade, lower government consumption and inflation positively impact economic growth per capita.

Also, his study supports that rule of law and democracy are important for growth. The author suggests that too much democracy (measured by the squared index of democracy) can have a deleterious effect on economic growth.

The results of Barro's study confirm the pessimistic theory on demographics as fertility rate is negatively associated with economic growth per capita. These results are robust as tested through an Ordinary Least Square (OLS) with fixed effect. Though enlightening, his study which uses the fertility rate looks only at demographics from the size perspective, thus overlooking the possible demographic structure effects as suggested by many researchers, including Kelley (1999).

Bloom and Sachs (1998) shed more light on the issue of population structure impact on economic growth. To that end, the authors use the same convergence model while including a more refined measurement of demographics. In their attempt to explain economic growth relationship with geography and demography, the authors use a convergence model through a cross country regression on a panel of 77 countries including some SSA countries. The study uses similar economic variables as Barro (1997) but adds share of working age population, population growth, coastal population density.

Bloom's study confirms Barro's findings on the impact of economic variables on economic growth. But, it does not find strong relationship between schooling and economic growth; this finding supports earlier result by Pritchett (1996). Also, Bloom and al (1998) find more mitigated results on demographic impact on income growth. For example, population growth is negatively associated with economic growth per capita while working age population share and coastal population density are positively associated with economic growth.

Kelley and Schmidt (1999) support this mitigated view about demography. They conduct a cross country regression on a panel data of 86 countries of which some sub Saharan African countries. The period under study is from 1960 to 1995—longer period than previous studies.

This study looks at two specifications: one where the dependent variable is the per worker income growth and the other where the per capita income growth. In addition of fertility rate, they introduce population structure variables: population growth rate, working age population growth rate, share of working age population

over total population, population density, and population size. The authors find an overall net positive effect of demographic on economic growth from 1960 to 1995. Radelet and al (2001) find similar results. They conduct a cross country regression on a panel data on 78 countries including Sub Saharan African countries over the period 1960 to 1990.

Despite their contribution, these studies (Bloom and al, 1998; Kelley and al, 1999; Radelet and al, 2001) overlook critical demographic components. In fact, these papers improve the unidimensional perspective of demographic impact a la Barro. Yet, they fail to include key demographic components such as dependency costs impacting economic growth through savings and investment.

Leff (1969) concurs that high dependency ratios account for the large disparity in savings rate between advanced economies and developing ones. His paper is built on 74 countries including SSA countries. He finds that dependency ratio negatively and significantly influences savings rate.

Kelley and Schmidt (2004) attempt to overcome these shortfalls of the previous studies through an enriched model compared to Radelet⁵³'s specification. In that vein, they apply a convergence model using a two Stage Least Square (2SLS) on a panel data of 86 countries including 23 Sub Saharan African countries.

They introduce two key variables: children dependency and elderly dependency. Also, they test the demographic transition through five specifications; two specifications have income growth per capita as dependent variable and three

⁵³ Radelet and al (2001) specification is called the Harvard model in Kelley and al (2004).

specifications have income growth per working age as dependent variable. These specifications are well specified with an R square above 50 percent.

Results support earlier findings and shed more light on demographic impacts. More importantly, they find that population growth has a negative impact on income growth for per capita. They find that working age population growth has a negative impact on income growth per worker. This result supports the idea that the net effect of working age on growth depends on the combined effect of labor productivity of the new entrants and the growth of the overall working age population. Labor productivity of the new entrants can be lower than existing labor productivity if new entrants have lower skills and experience than the average labor. This hypothesis is further confirmed by Fox and al (2008).

Another critical variable used in convergence models by Kelley is the dependency ratio impact. Dependency rate is understood in the literature mainly through four channels. The first channel considers the individuals as production inputs. Therefore, a large ratio of dependency means a lower proportion of individual contributing to production of income.

The second channel assumes that individuals determine aggregate consumption. That assumes that a children consumes less than an older individual or an adult (Cain, 1971). That means a higher proportion of children in a population implies lower aggregate consumption compared to a same population size with a lower proportion of children.

The third lens for dependency ratio is the composition of consumption for children and elderly persons. Children and elderly persons lead to demands for education and medical facilities which are considered as less productive investment compared to

capital goods. So, a higher proportion of dependency ratio leads to more spending on education and medical facilities, hampering growth to some extent.

Finally, the dependency ratio is associated with savings behavior. This concept embodies the net effect of the first two channels of dependency impact. Savings behavior reflects the combination of income generation and consumption level of an individual. Therefore, higher proportion of children and elderly persons lead, on one hand, to lower income by the non-dependents and on the other hand to more spending by the non-income producers (dependents).

Also, Kelley and al (2004) support that the negative relationship between dependency ratio and income growth. The authors find that children dependency and elderly dependency have a negative effect on income growth on average with impact from child dependency being larger.

These findings further the concept of dependency by introducing the idea of demographic transition. Demographic transition happens when total fertility falls following lower infant mortality. That leads to more working age population growing faster than the children and elder population. As more working age individuals enter the labor market, if there is enough absorption in the labor market, then economic growth rises. This phenomenon is known as the demographic dividend (Bloom and al, 2003).

Using a total dependency ratio variable in a conditional convergence model on a panel data, Wei and Hao (2010) find that dependency negatively affects economic growth. They show that a drop of the dependency ratio by 15 percent leads in an increase in growth of GDP per capita of 1 percent.

Kelley (1973) nuances such findings by explaining that a drop in dependency rate might lead to further negative impact on growth by distinguishing dependency rate for those who have not entered the labor force (the children) and those who have left the labor force (the elderly).

The author supports that dissaving rate from child dependency is lower than the one from elderly dependency. Thus, the fall in dependency rate for children due to lower fertility can result in lower savings rates for elderly living longer. Simply put, the author supports that elderly dependency rate is more hurtful to income growth than child dependency rate.

In an accounting exercise, Kelley and al (2004) conclude that demography has been positive on average on economic growth in world regions from 1960 to 1995.

Changes in demography have accounted approximately for 20 percent of per capita output in the world, with larger contributions in Europe and Asia. Specifically, apart from the period 1960 to 1970 where demography has negatively contributed to income growth in Africa, it has been positive for economic growth from 1970 to 1995. Feyrer (2004) nuances to some extent this positive view by suggesting that poorer countries could have caught up faster with richer countries if their working population was less young.

In Africa, the potential to benefit from these types of demographic changes is conditioned by a policy and institutional environment that are supportive to economic growth and demographic changes (bloom and al, 2007). These critical conditions are often overlooked in many public discourses calling for lower fertility and high share of working age population which are believed to benefit economic

growth systematically. Significant reproductive behaviors including weak family planning remains a key challenge to lowering fertility (Bongaart and al, 2013).

Turbat and al (2017) argue that demographic transition could be beneficial for Africa if the dependency ratios improve. To that end, they mention necessary conditions including policies on education, health, gender equity and good governance.

Canning and al (2015) support this view. The authors point to the lower fertility as critical to benefit from the demographic transition burden by high dependency ratio. They suggest that policies helping families to access family planning methods, reducing child mortality and empowering women could lead to lower fertility. They mention education, labor market opportunities, and health benefits information as possible channels to achieve these goals.

Bloom and al (2016) put a more optimistic tone to the discussion. The authors argue that progress witnessed on fertility in Africa, if maintained, could result in further decline. This decline would be possible if the ratio of working age population over dependent could be greater than in Asia, Europe and Norther America. Yet, they caution that achieving such "success" allowing Africa to reap its demographic transition would require sustained and complementary policies focusing on macroeconomic management, human capital, trade, governance, labor markets and capital markets.

Against this background the contribution of our paper is threefold. First, it is the first paper that uses the enriched convergence model on a panel data only made of sub Saharan African countries. Though previous studies which looked at the demographic impact on economic growth have included some Sub Saharan African countries in the panel set, regression coefficients remain the sample average. So, de

facto these results are not sub Saharan Africa specific. Having an exclusive account of demography impact on economic growth on Sub Saharan African countries is critical as the region is the only with a very different demographic trends compared to other world regions (as highlighted in section 3).

Focusing on African countries alone come with some challenges. African countries are all at the very early stage of development, particularly from a demographic and income perspective. Therefore, it becomes challenging to meet the steady state assumption as done under previous studies in which countries were from all regions, with small sample from Africa, allowing to presumably assume a long run or steady state. We attempt to meet the steady state assumption through a careful choice of variables. The variable selection rules will be explained in the next section.

Second, the paper uses most recent data up to 2015 compared to previous studies. Our paper covers the period of the so-called Africa rise which has been seldom discussed in the literature through the demographic lens. It is essential to shed light on the role of demography during the fastest economic growth period of sub Saharan Africa.

Third, this research is the first paper to perform a growth accounting exercise for sub Saharan Africa alone and that recounts the contributions of demographic factors to economic growth. To be clear, this paper gives an answer to the world of research and policy to whether demographic trends in sub Saharan Africa have been positive to economic growth.

II.4 Revisiting Demography Impact on Economic Growth in SSA

This section presents the data, the econometric strategy to estimate the impacts of demography on economic growth in sub-Saharan Africa since 1985, and the empirical results. The main model for our empirical exercise is the enriched Harvard convergence model (Kelley and al, 2005).

1. Data

We focus only on sub-Saharan African countries. We collect data of these 45 countries but consider only 29 countries due to large data gap in the series. We choose to collect the data from 1985 to 2015 to provide an account of the demography role on economic growth during two very important periods: the period of the “lost decades” and the period of “Africa rise”. Also, we are limited by the lack of data on institutional quality prior to 1985. Yet, the data size after counting for the missing data is enough to run our regressions. We collect this data from various databases including the World Development Indicator (World Bank), the World Economic Outlook (IMF), and International Country Risk Guide (ICRG). We use five-year period data for our regressions to correct for possible fluctuations and reflect the medium and long term approach of the convergence model. There is a fuller description of the list of countries, variables, data characteristics, and database (Annex, table II-7).

2. Econometric strategy⁵⁴

2.1 The convergence framework

The conditional convergence model assumes the speed at which a country tries to close the gap between its long run or steady state equilibrium of labor productivity and its current level of labor productivity expressed as the following:

$$Y/L_{grit} = c \left[\ln \left(\frac{Y}{L_{it}} \right)^* - \ln \left(\frac{Y}{L_{it}} \right) \right] \quad (1)$$

Where Y/L_{grit} is the labor productivity growth of country i at time t . This rate is proportional to the gap between the logarithms of the long run or steady state equilibrium of labor productivity $\left(\frac{Y}{L_{it}} \right)^*$ and the current level of labor productivity $\frac{Y}{L_{it}}$. Going forward, please note that we will not repeat that (i) means country and (t) means time in describing equations.

All countries would converge to the same level of long run labor productivity (unconditional convergence) given key assumptions such as perfect factor mobility, identical attitudes toward work, similar economic and government structures. Under such assumption equating long run productivity for all countries, one expects poorer countries with larger gap to grow faster to catch up. In other words, the lower the initial income, the faster income growth is expected to be.

But empirics tell us that countries differ in great and many ways. For that reason, scholars do not assume that long run labor productivity should be the same for all

⁵⁴ This section draws on the methodology used by Barro (1997), Kelley and al (1999), Radelet and al (2001), Kelley and Schmidt (2004) as it is one the foundational paper used latter research mid -2000s.

countries but rather each country has its own long run productivity given its specific characteristics. The idea is expressed as follows:

$$\ln\left(\frac{Y}{L_{it}}\right)^* = \alpha + \beta Z_{it} \quad (2)$$

Z is the matrix of long run determinants which could differ from one study to the other even though a core set of variables has regularly used in the literature; we provide more details on that in latter in that section.

A key insight from equation 2 is that the long run level of labor productivity can change in time depending on the changes in Zs. Better provision of Zs can lead to higher long run level of labor productivity or in the opposite case to a lower level of long run labor productivity.

Combining equations (1) and (2) yield the following:

$$Y/L_{grit} = \alpha' + \beta' Z_{it} - c \ln\left(\frac{Y}{L_{it}}\right) \quad (3)$$

With $\alpha' = \alpha c$ and $\beta' = \beta c$

The Z variables (called also the economic productivity) have been widely discussed in the literature starting with the summary work of Levine and Renelt (1992), followed by foundational papers by Barro (1997), Higgins and al (1997), Kelley (1994) and Radelet (2001). The literature suggests three key categories of Z variables which should include in any convergence model specification: economic, human capital, and demographic variables.

The assumption of a steady state is difficult to be met with a sample countries only from Africa. Variables determining the steady state labor productivity from African countries are at levels which could hardly be considered as in long run levels as

African countries are at very early stage of development. This challenge was not completely resolved in previous studies⁵⁵, even though authors tried to address it by using a panel of countries including developed countries⁵⁶. To address this challenge, we will depart from the standard convergence model specification. We only include variables from the literature which could reasonably be assumed to have limited level fluctuations over the long run.

Along that logic, we exclude macroeconomic variables (such as terms of trade) and education variables used in the literature from our specification because these variables show significant fluctuations over the period of observation and are expected to significantly change in the future as these African countries are in economic developing stage from both economic structure and educational achievements.

Though excluding these variables reduces some insights on income growth story in African countries, it is critical to note that the focus of our research is to determine the role of demographics on economic growth per worker. Hence, we rely mainly on demographic determinants as explanatory variables in our regression. We still include some human capital variables.

⁵⁵ Barro (1997); Kelley and al (2004)

⁵⁶ Countries from Europe, America and Asia were part of the sample.

2.2 The role of demography in the convergence model

We now turn into a discussion on the role of demography (part of Z variables) in the convergence process expressed in equation as it is a key objective of this paper.

First, we decompose the per capita output growth (Y/N_{gr}) into the generation pace of income per worker (Y/L_{gr}) and a translation component ($L_{gr} - N_{gr}$) which explains how the per worker output growth translates into per capita output growth in equation (4):

$$Y/N_{gr} \cong \left(\frac{Y}{L}\right)_{gr} + L_{gr} - N_{gr} \quad (4)$$

Where L_{gr} is the growth rate of labor, N_{gr} is the growth of the population.

Kelley and Schmidt (2004) suggest three forms that the translation component can take among others:

The first form (Translation A) reflects the neoclassical theory at the steady state where everyone is employed, thus expressed as:

$$(L_{gr} - N_{gr}) = 0 \quad (5)$$

This formulation, mainly expressing the steady state shows that population growth does not affect economic growth in a different way compared to labor growth.

A more realistic translation (Translation B) is suggested, reflecting changes in labor:

$$(L_{gr} - N_{gr}) = \left(\frac{L}{LF}\right)_{gr} + \left(\frac{LF}{WA}\right)_{gr} + WA_{gr} - N_{gr} \quad (6)$$

Where L_{gr} is the growth rate of labor, N_{gr} is the growth of the population, L is the total hours of labor, LF is the total labor available for work, WA is the working age population (assumed to be between 15 and 64 years old). The first two terms are mainly

influenced by economic, labor market conditions and household choices while the last two terms reflect demographic changes including fertility, mortality, and migration.

From equation (6), we use a more practical formulation suggested, by Radelet and (2001), Translation C, known as the Harvard scholars' model:

$$(L_{gr} - N_{gr}) = WA_{gr} - N_{gr} \quad (7)$$

This formulation removes the first two terms of equation (6) namely labor force participation and employment to reflect age distribution. We find this simplification also practical as data on labor participation and employment rate in many low-income countries are difficult to collect.

Presented as such, translation C limits the role of working age population growth and population growth to only a translation impact. But previous work has argued, and rightly so, to include these two variables into the economic productivity. In fact, working age population and population growth impact also savings and investment, specifically during demographic transition. This impact is known as dependency impact.

Dependency idea looks at the life cycle consumption patterns stemming from workers spending rather than saving or investing to take care of non-working population (children and elderly persons)⁵⁷. One could measure this impact indirectly by including population growth and working age population growth into the economic productivity component of the convergence model. But, as suggested by Kelley, it makes more sense to measure directly the impact through dependency

⁵⁷ Kelley and Schmidt (1996); Higgins and Williamson (1997)

variables available for most countries. Key variables to measure the direct impact of dependency on economic productivity are the children dependency ratio, old age and dependency ratio.

We use translation C for the rest of our modeling exercise. After estimating the determinants of the income per worker, one can deduct the income per capita by subtracting the population growth rate from the estimate. Therefore, one could exclude the working age population and population growths from the equation by assuming solely their translation role.

But we keep the working age population growth variable in our specification for two reasons. First, the entire growth of working age population does not necessarily benefit to income per worker growth. Only a portion of that growth is beneficial, so it is crucial to keep it in the equation to determine that sharing parameter.

Second, keeping the working age population growth variable in our specification would also allow to give an answer to an ongoing debate about the importance of working population growth on income in Africa. In the public debate, it is commonly believed that Africa could have a higher income if it had a higher share of working age population. This assertion assumes that the net effect of the working age population growth is positive on income per worker growth. This assertion would be true if the marginal productivity of the working age individual is at least higher than the average productivity of the working age population. Yet, it is not clear that this assumption is necessarily met in Africa strained with large informal sector with low productivity and high unemployment in the formal sector.

Now, using equation 3 and following Kelley and (2005), we fully explicit the specification distinguishing, as the productivity variables (Z_e), the demographic variables (Z_d), the time invariant variable (f) and time variant one (T).

$$Y/L_{grit} = \alpha' + \beta' Z_{it} - c \ln\left(\frac{Y}{L_{it}}\right) + af_i + bT_t + \varepsilon_{it} \quad (8)$$

$$Y/L_{grit} = \alpha' + \beta' (Z_e + Z_d)_{it} - c \ln\left(\frac{Y}{L_{it}}\right) + L_{grit} + af_i + bT_t + \varepsilon_{it} \quad (9)$$

Where $\left(\frac{Y}{L_{it}}\right)$ is the initial income per worker

Equation (9) is our specification for modeling demographic impact on income growth per worker in Sub Saharan Africa.

2.3 Variables selection

We now turn into the choice of variables for our estimation exercise. We focus on impact of demographic variables on income growth. Therefore, we will slightly depart from the literature (Kelly and al, 2004; Barro, 1997) where larger number of variables were introduced in model specification to reflect economic productivity.

In addition, we choose variables that are not subject to large variation during the transition toward the steady state. In that sense, compared to previous papers including Kelley and al (2005), our paper excludes the following variables: enrollment rate, inflation, government consumption, level of democracy, population density.

- **Economic productivity variables**

- ✓ Convergence

Initial level of income per worker (in log) is proxied by the income per worker in previous period. According to our equation 9, the expected sign is negative. That

means the lower the initial income per worker, the larger is the gap between the current labor productivity and the long run labor productivity, hence the faster is income per capita or per worker growth.

✓ Human capital

Life expectancy (in log) is expected to have a positive relationship with economic growth as higher life expectancy reflects healthy human capital and long use of acquired know how in the production system and better investment and savings decision.

✓ Institutional quality variables

Rule of law is widely discussed for its importance for economic growth as it protects investors and households, providing predictability of economic transactions bounded by rules. We use the index calculated by the ICRG, which looks at the importance of the business environment for growth and investment. This indicator has seven categories from 0 to 6; 0 being the worst ranking for the business environment. A positive coefficient from the regression would imply that rule of law has a good impact on per worker income growth.

- **Demographic variables**

Instead of using the total age dependency ratio used by (Shryock and al, 1973), we follow Kelley and (2004) by disaggregating the total age dependency ratio into two age dependency ratios: i) children age dependency (in log) is the ratio of the population aged of less than 15 years old over the working age population (15-64). This ratio is assumed to negatively impact economic growth, ii) elderly dependency (in log) is the ratio of the population of 64 years old and above over the working age

population (15-64). The variable is expected to have negative impact on economic growth.

Working age population growth (in percent) has an effect is difficult to be prejudged. The direction of the net effect depends on one hand on the changes in productivity due to the new entrants in the labor force who are perceived to have a lower than average skills and experience compared to existing workers and on the other hand the magnitude of the sheer growth of the working age population due to new entrants.

- **Dummy variables for periods**

We introduce dummy variables to catch specific effects from decade periods: 1980s (starting with 1985), 1990s, 2000s.

2.4 Model specifications and estimation procedures⁵⁸

Our specification (equation 9) is a panel regression, built from Kelley and al (2004) and Barro (1997). The model has per worker income growth as the dependent variable and includes all variables mentioned in the previous section., namely initial level of income per worker, life expectancy, rule of law, children dependency, elderly dependency and working age population growth and period dummies.

We test the validity of fixed effects using the Hausmann test.

⁵⁸ See Appendix for fuller description of the specification with variables.

3. Empirical results and interpretation

In this section, we expect to provide a quantitative based view of impact of demography on income growth in Sub-Saharan Africa, including the recent period of Africa rise.

3.1 Overall fitness of the model

Table II-1 reports the results of the estimates. Despite the exclusion of macroeconomic variables (explained in the section above), our convergence model remains well specified to estimate the impact of demographics on income growth per worker in Sub Saharan Africa. In fact, the overall R square for the model with fixed effects is 88 percent and for the model with random effect is 92 percent.

Using the Hausman test, we reject the hypothesis that there is no systematic difference in coefficients, so we keep the fixed effects specification for our data (Annex, table II-7).

3.2 Economic and institutional variables impact on income growth

With the fixed effect specification, all coefficients have the expected signs in line with the literature. All coefficients are significant at either 1 or 5 percent, except the child dependency coefficient (Table II-1).

The significant and negative coefficient of the initial income per worker confirms the conditional convergence principle for sub Saharan African countries. Countries with lower initial income tend to grow faster than richer countries to catch up their long run income level given their economic and demographic characteristics. Holding all other variables constant, the estimated speed of conditional convergence is about 22

percent. That means in practice that a country that has only half of the income of another country tends to grow faster by 0.15 percentage point ($0.22 \cdot \ln(2)$). This conditional catch-up is low compared to Asian economies⁵⁹ while much higher than the world average⁶⁰

The coefficient for life expectancy variable has the expected sign (+) and is significant at 1 percent. The coefficient value is 2.5 implying that economic growth rate would increase by 0.025 percentage point on average if life expectancy increases by one percent.

This impact is quite high compared to the existing literature. Life expectancy proxies the quality of health. But it also underlines the importance of human capital quality which is critical to increase productivity and hence boost income growth per worker.

This coefficient is much higher than the world average (0.042) in Barro (1997) and Asian economies (0.33) in Radelet (2006). This magnitude underscores the crucial need to improve life expectancy in Sub Saharan Africa to boost growth through longer retention of accumulated know how by the human capital.

The prospect of living longer influences investment and savings decisions (Bloom and al. 2003 and Lee and al. 2001). As mentioned by Bloom and al (2003), in a non-steady state of population growth, longevity has a substantial impact on savings decision, leading to higher growth. Similarly, many studies (Lee and al, 2001; Mason and al, 2004; Lee and al, 2006) found that incentive to increase retirement savings rises with longer life expectancy and smaller family sizes.

⁵⁹ Radelet (2006) found a conditional convergence rate of around 1.97 for Asian economies

⁶⁰ Barro (1997) found a conditional convergence rate of 0.025 for its world sample

Sachs and al. (1997) find a positive slope between life expectancy and income per capita in a long run growth equation. The authors conclude that that higher life expectancy, proxying human capital quality, raises growth, and when not has a zero impact at very high level of income.

The rule of law has the expected positive impact on growth and is significant at 1 percent. Its coefficient equals to 0.1 is higher than many previous studies by Barro (1997) and Radelet (2003), signaling a stronger impact on economic growth in Sub Saharan Africa. Our finding is in line with many studies that have shown the beneficial impact of governance on income growth (Fosu 1992; Diop and al. 2010; Fayissa and al. 2013).

Yet, Progress on governance, and rule of law has stagnated in Sub Saharan Africa during the highest growth period spanning from 2000 to 2017, the so-called Africa rise (Figure II-7). On average less than half of the Sub Saharan African countries have improved their governance and institutions from 2000 to 2017. In fact, 55 percent of countries have seen improvement on their voice and accountability institutions. But political stability and rule of law have worsened in more than half of Sub Saharan African countries. More importantly, corruption has worsened in 62 percent of these countries (Figure II-7).

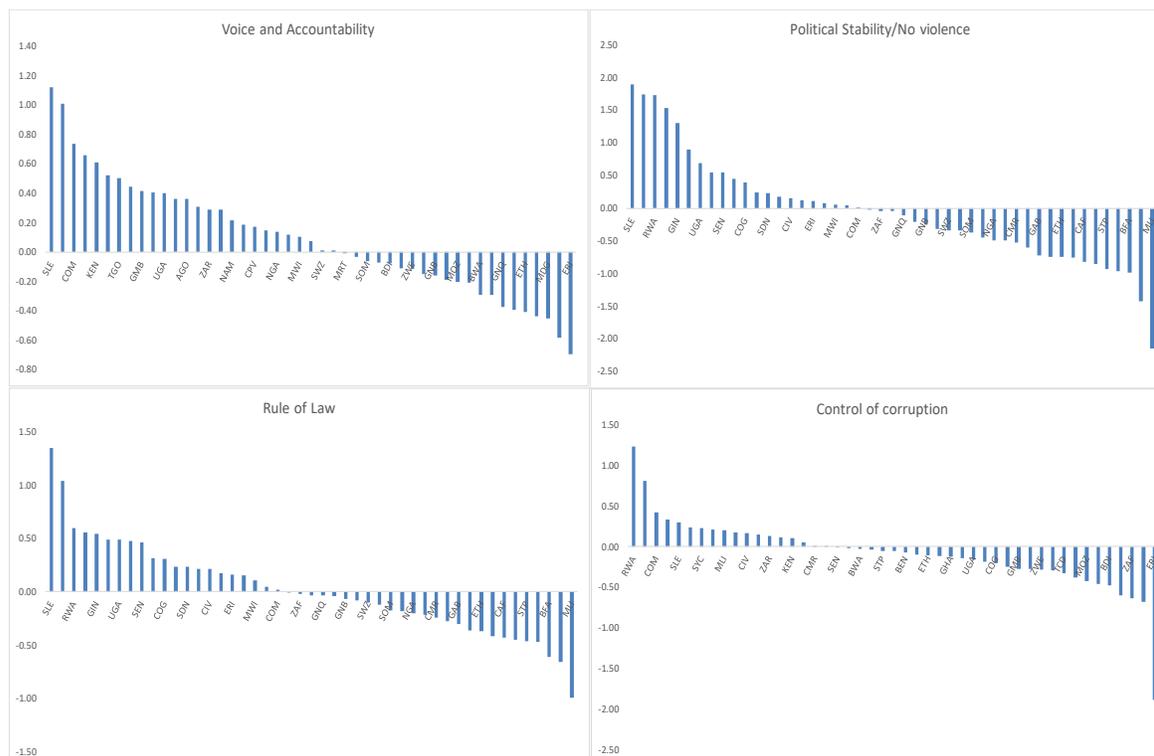
Table II-1: Convergence model for SSA countries (1985-2015)

Model	(1)
Dependent variables	Income growth per worker
Independent variables	
Initial income per worker	-0.225**
	(0.106)
Life expectancy	2.468***
	(0.350)
Rule of law	0.104***
	(0.0312)
Working age population growth rate	-0.0737***
	(0.00183)
Elder dependency ratio	-0.781***
	(0.261)
Children dependency ratio	-0.0666
	(0.355)
Dummy for 1980s	0.245**
	(0.107)
Dummy for 1990s	0.263***
	(0.0882)
Dummy for 2000s	0.112
	(0.0703)
Constant	-8.601***
	(1.685)
Observations	191
R-squared	0.925

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

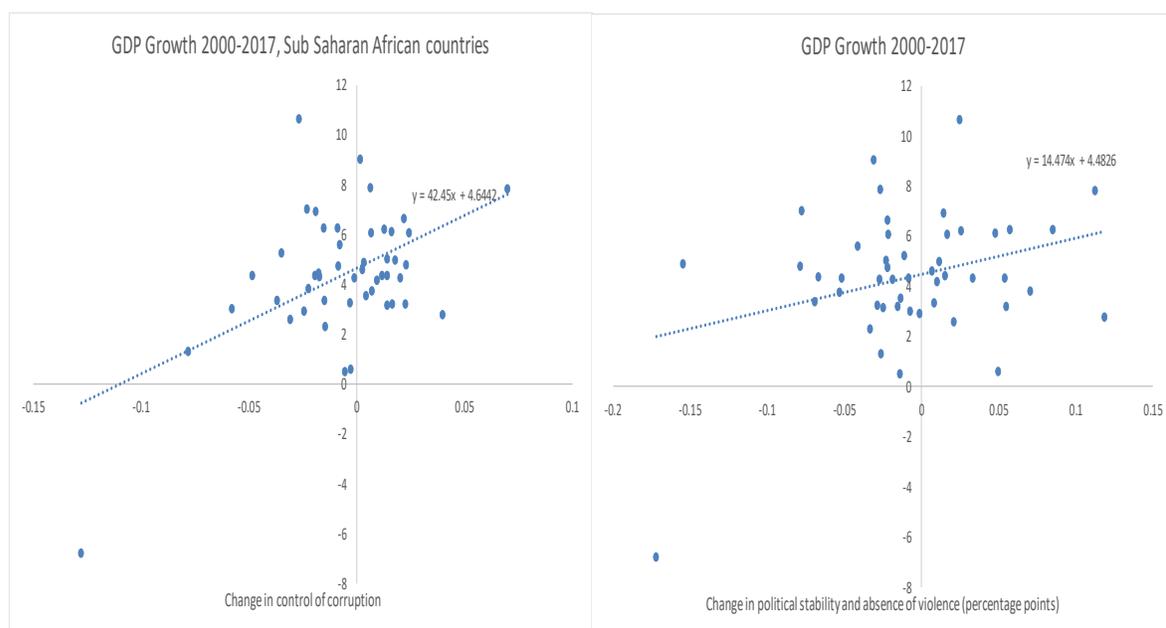
Figure II-7: Changes in governance scores in SSA (2000-17)



Source: World Governance indicators, World Bank

These results are problematic as GDP growth have been strongly associated with governance from 2000 to 2017 (Figure II-8). This performance is also supported by Heritage foundation index measuring political rights and civil liberty. In fact, in sub Saharan Africa, political rights have worsened in a third of countries, improved for another third of them and remained unchanged for the rest. Furthermore, civil liberties have only improved for 23 percent of countries. At a regional level, central Africa region has seen a downward trend in governance from 2000 to 2017. West Africa region has been the best performer in Sub Saharan Africa. Rule of law has deteriorated in all Sub Saharan Africa regions (Table II-2).

Figure II-8: GDP growth and governance in SSA



Source: World Development indicators and World Governance Indicators

Table II-2: Governance in SSA regions (2000-17)

Regions	<u>Voice and accountability</u>		<u>Political stability</u>		<u>Rule of law</u>		<u>Corruption control</u>	
	+	-	+	-	+	-	+	-
Central	44	56	33	67	45	55	45	55
East	47	53	65	35	47	53	35	65
West	69	31	38	62	44	56	50	50
South	60	40	20	80	40	60	0	100

(+): improvement; (-): deterioration

Source: World Governance Indicators

3.3 Demographic impacts on income growth per worker

Results show that all demographic variables have the expected impact on income growth per worker. Coefficients of demographic variables in the model have all the expected signs in the fixed effects specification (our best specification).

Coefficients for dependency for children and elderly are both negative. This finding is consistent with the literature as discussed in the literature review section. The coefficient for elderly dependency is significant while the one for children dependency is not significant. We estimate a model without the child dependency variable. The results for the other variables remain very similar (Annex, table II-8).

This result suggests that elderly dependency is a more serious challenge faced by the working age population. Elderly dependency has stronger negative impact on savings and investment. In fact, the lack of social protection in many countries for the elderly forcing working age population to spend a portion of their income on the senior persons. A large proportion of elderly population is expected to be without any social protection or retirement system because a large portion of them were employed in the informal sector. Sub Saharan Africa has one of the largest informal sectors in the world ranging from 20 percent of GDP to 65 percent of GDP in some countries⁶¹.

Furthermore, the magnitude of the support cost to the senior persons is compounded by a cultural perception whereby working age persons have a moral and social obligation to take care of their aged parents and relatives. The cultural norm of respect and obligation to the elderly persons who the moral guarantor of the extended family is held throughout all African, embodied through concepts such

Ubuntu and Harambee (Marzi 1994). This norm leads to more care from the working member of the family to the elderly persons (Chawala, 1996; Apt, 2001)

The coefficient of working population growth is significant and negative as expected in the literature. This negative relationship between working age population growth and income growth per worker argues that rapid working age population growth can have a negative effect on labor force quality (Bloom, 2001) as workers with lower than average skills and experience are hired.

Such relationship is not surprising. The large share of the new entrants to the labor force is likely to be hired in the large informal sector, including agriculture characterized by lower productivity. This negative impact on labor quality is not compensated by the productivity of the existing workers in the modern sector where productivity remains lower compared to than in other world regions. That finding nuances to some extent the rhetoric of "Africa needs a large working population to achieve prosperity". It shows that Africa needs indeed large working population that has a high productivity rate higher than the growth rate of that population.

Furthermore, these findings also support the idea of the economic dependency ratio (Turbat and al 2017). Turbat and his co-authors argue the costs of the dependency is not sufficiently captured by the child dependency and elderly dependency ratios. They suggest the demographic dependency which factor the costs of supporting three groups of people: people who are over 15 years but continue to be dependent on working age population, working population who do not work and receive support from other working age population and working age people who are underemployed. This description fits the African context strained with high unemployment and underemployment.

3.4 Exogenous influences on income growth

All temporal variables have positive signs and significant except for the 2000s period. These results are a bit surprising particularly for the periods (1980s and 1990s) which come out period specific positive for the region. One would have thought that some decades which experience weak economic growth performance were particularly negative Sub Saharan Africa. However, it is worth noting that this period was also marked by a massive cooperation between Bretton Woods institutions and the SSA region.

3.5 Robustness of our specification

In our main regression, we did not distinguish the countries with natural resource which could potentially have an impact on income per capita. We show that natural resources endowment has not medium term and long-term impact on impact per worker.

In fact, we estimate the same equation on a sub sample of our data, focusing only on 19 countries which are resource rich. The regression results show not only a regression with a R square similar our main regression but more importantly the coefficients and signs of the variables are similar to our main regression (Table II-2). This result was expected based on the literature which argue that benefits of natural resources in economic growth is sometimes either exaggerated or non-existent known also the natural resource curse (Winter-Nelson, 1995; Papyrakis and Gerlagh, 2006).

We remove the child dependency variable has not been found significant to see whether our estimate remains valid. The results confirm the robustness of our regression (Annex, Table II-9).

Finally, to ensure that our specification does not suffer from the terms of trade and education variables exclusion, we conduct the same specification while including these two variables. The terms of trade and education variables are non-significant in the regression showing that we do not lose any critical information by focusing only less fluctuating variables.

Table II-3: Convergence model for resource-rich countries in SSA (1985-2015)

Dependent variable	Income growth per worker
Independent variables	
Initial income per worker	-0.361*** (0.109)
Life expectancy	2.866*** (0.401)
Rule of law	0.116*** (0.0393)
Working age population growth rate	-0.0751*** (0.00244)
Elder dependency ratio	-0.756** (0.289)
Children dependency ratio	-0.426 (0.397)
Dummy for 1980s	0.298** (0.117)
Dummy for 1990s	0.294*** (0.0971)
Dummy for 2000s	0.157** (0.0787)
Constant	-9.354*** (1.742)
Observations	128
	20
R-squared	0.919

4. An accounting exercise for Sub Saharan African growth since 1985

In this section, we estimate the contribution of each variable in our regression to changes in per worker income growth from 1985 to 2015, and during its sub periods (1985-2000; 2000-2015). We do this exercise for the entire sub Saharan Africa region but also for the sub regions (western, eastern, central and southern regions). To do such exercise, we estimate the contributions of the regression variables to changes in per worker income growth for each country in our sample for each period under consideration in our exercise. Then, we take the average—weighted by the population size of each country—for each sub region and for the entire sub Saharan Africa region. The results are below.

4.1 Economic and demographic Insights from 1985-2015

From 1985 to 2015, demographic factors have positively benefitted per worker income growth in Sub Saharan Africa (Table II-4). Decelerating working age population growth had the largest and positive impact on per worker income growth changes.

This result underlines that Sub-Saharan Africa will not automatically reap a demographic dividend as working population increases. On contrary, the SSA region would need to achieve higher economic productivity and faster job creation to benefit from the demographic transition. In other words, the SSA needs a growing working age population, but that growth needs to be consistent with growth of jobs creation and of economic productivity. A fall of the children dependency supported per worker income growth acceleration.

At the regional level, demographic factors led acceleration in per worker income growth in Eastern Africa due to the slowdown of its working age population growth. Central and Western Africa regions suffered the most of its demographic factors, particularly from rapid working age population growth. That highlights the inability of the labor markets in these regions to catch up with the growth rate and low economic productivity of the new entrants.

Improvement in human capital, measured by life expectancy, had the second largest contribution to per worker income growth acceleration. Interestingly, human capital positively impacted income growth changes in all regions over the period under consideration. Human capital had the highest impact in East Africa.

Limited progress in institutions hampered per worker income growth acceleration from 1985 to 2015 in sub-Saharan Africa. Institutions had a positive impact on income growth only in East and West Africa. Contribution of institutions in other regions were negative over the period to per work income growth changes. This underlines the critical challenge that governance poses to economic growth in Africa.

Now we dive into more details to assess the contributions of our variables under consideration by dividing the 30 years of observation (1985-2015) into two periods: 1985-2000 (the so-called lost decades) and 2000-2015 (the so-called Africa rise). The findings are below:

4.2 Economic and demographic Insights from 1985-2000

Demographic factors had a negative impact on per worker income growth over the period (Table II-5). Acceleration in working age population growth rate was the main driver, followed by the child dependence. This result supports a common belief that

demography was an impediment to growth during the “lost decade” period which was characterized by rapid population growth triggering birth control programs in the post-independence periods in Africa.

At a regional level, Western and Central regions suffered the most of their demography. Only South Africa region experienced a positive impact of demography on per worker income growth. Demography contribution on per worker income growth change in eastern region was nearly zero during that period.

Improvements in institutions, with many African countries under IMF and World Bank programs coupled with the era of democratization, had the largest and positive contribution on income growth. All regions experienced a positive contribution of their institutions on income growth. Eastern Africa experienced the largest contribution of institutions to income growth per worker.

Human capital supported per worker income growth. The Western, and to a lesser extent, Central Africa benefitted the most from its human capital regarding economic growth. The other regions, economic growth suffered from its human capital.

4.3 Economic and demographic Insights from 2000-2015

Since 2000, demography positively impacted income growth witnessed in sub Saharan Africa (Table II-6). In fact, demographic factors had the largest and positive contribution to income growth of per worker income. This marked a change in direction compared to the previous period (1985-2000) where demography was a burden to income growth.

This positive shift reflects a slowdown of working population growth and falling child dependency ratio. This nuances two commonly beliefs about demography in Africa. First, demography has become a positive factor for economic growth and not a burden as in pre-2000s period. Second, though children dependency ratio is still high compared to the rest of the world, the ratio has dropped and supported income growth acceleration.

Elderly dependency had almost no impact on income growth per worker. That continues to reflect rising elderly dependency ratio as people live longer in SSA which costs are still magnified by the persistent social norms of caring for the elderly persons and weak social security systems in many countries in Sub Saharan Africa. The western region suffered the most from its elderly population.

Human capital had the second largest and positive contribution to growth acceleration in per worker income. Interestingly, it is the first time since 1985 that human capital impact has been positive in all regions.

Institutions have been problematic to per work income growth acceleration during the famous " Africa rising". It has negatively affected the income growth over this period of Africa rise. For the first time, contribution of institutions to income growth has been negative for all regions as opposed to the previous period (1985-2000).

Table II-4: Contributions to changes in per worker income growth (1985-2015)

SSA regions	1985-2015				
	All	West	Central	East	South
Per Worker income growth	1.25	0.25	0.00	3.01	0.02
Initial income level	-0.05	-0.05	-0.10	-0.05	-0.06
Human capital	0.44	0.39	0.50	0.57	0.00
Institutions	0.04	0.03	-0.11	0.11	-0.07
Demographic factors	0.83	-0.12	-0.30	2.37	0.16
Working age population growth	0.83	-0.15	-0.25	2.36	0.39
Child dependency	0.01	0.03	0.04	0.01	-0.22
Elderly dependency	-0.01	-0.01	-0.09	0.00	-0.02

Source: World bank, UN population division and our calculations

Table II-5: Contributions to changes in per worker income growth (1985-2000)

SSA regions	1985-2000				
	All	West	Central	East	South
Per Worker income growth	0.03	0.07	-0.07	-0.01	-0.01
Initial income level	0.02	0.02	0.01	0.02	0.00
Human capital	0.03	0.07	0.02	-0.01	-0.01
Institutions	0.07	0.10	0.00	0.07	-0.01
Demographic factors	-0.10	-0.12	-0.10	-0.09	0.01
Working age population growth	-0.07	-0.14	-0.08	-0.02	0.08
Child dependency	-0.01	0.02	0.02	-0.03	-0.06
Elderly dependency	0.00	-0.04	-0.04	-0.04	-0.01

Source: World bank, UN population division and our calculations

Table II-6: Contributions to changes in per worker income growth (2000-2015)

SSA regions	2000-2015				
	All	West	Central	East	South
Per Worker income growth	1.17	0.16	0.04	2.90	0.03
Initial income level	-0.07	-0.08	-0.05	-0.05	-0.07
Human capital	0.40	0.30	0.55	0.60	0.01
Institutions	-0.06	-0.08	-0.04	-0.03	-0.07
Demographic factors	0.90	0.01	-0.01	2.38	0.15
Working age population growth	0.89	0.02	-0.11	2.32	0.31
Child dependency	0.01	0.01	0.08	0.04	-0.16
Elderly dependency	0.00	-0.02	0.02	0.02	-0.01

Source: World bank, UN population division and our calculations

II.5 Conclusion

Using a conditional convergence model, we assess the impact of human capital, institutions, and demography on per worker income growth in Sub Saharan Africa from 1985 to 2015 over 29 countries. To that end, we use a specification drawn from previous work including Kelley and al (2004) and Barro (1997).

Our regression shows that working age population and elderly dependency are significant determinants of per worker income growth. Life expectancy and rule of law are also significant determinants for per worker income growth.

Using the regression results, we recount the story of per worker income growth from 1985 to 2015. First, Sub Saharan Africa's demographics has turned around from being a curse from 1985 to 2000 to become an opportunity for higher growth since 2000. Second, growing working age population remains the most determinant demographic variable for income growth since 1985. Specifically, our results show that Sub Saharan Africa does not need just a larger share of working age population. Instead, for Africa to benefit from its working age population, the growth of working age population should be consistent with labor market absorption capacity and average productivity of existing workers for Africa. Such changes require policies beyond demographic policies.

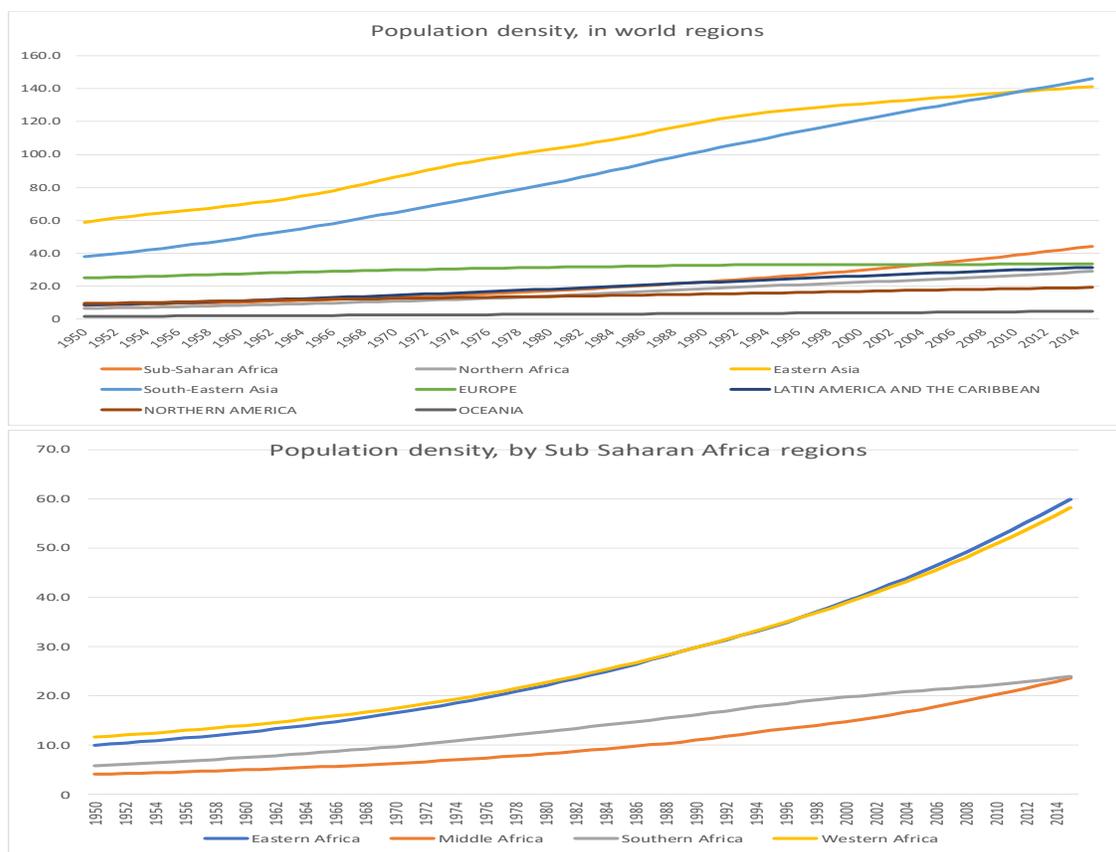
Third, as opposed to pre-conceived idea, children dependency has not negatively contributed to per worker income growth. Children dependency ratio in Sub-Saharan Africa is the highest in the world, but the ratio has been trending down. Africa needs to continue down that path. It remains true that a much lower children dependency ratio close to the world ratio would have been more beneficial.

Fourth, the roles of human capital and institutions are confirmed through our accounting exercise.

Now, we know the determinants of per worker income growth. From the growth of the per worker income to per capita income growth, population growth will be the only determinant. Controlling population growth becomes therefore critical. The next chapter will focus on understanding the determinants of population growth.

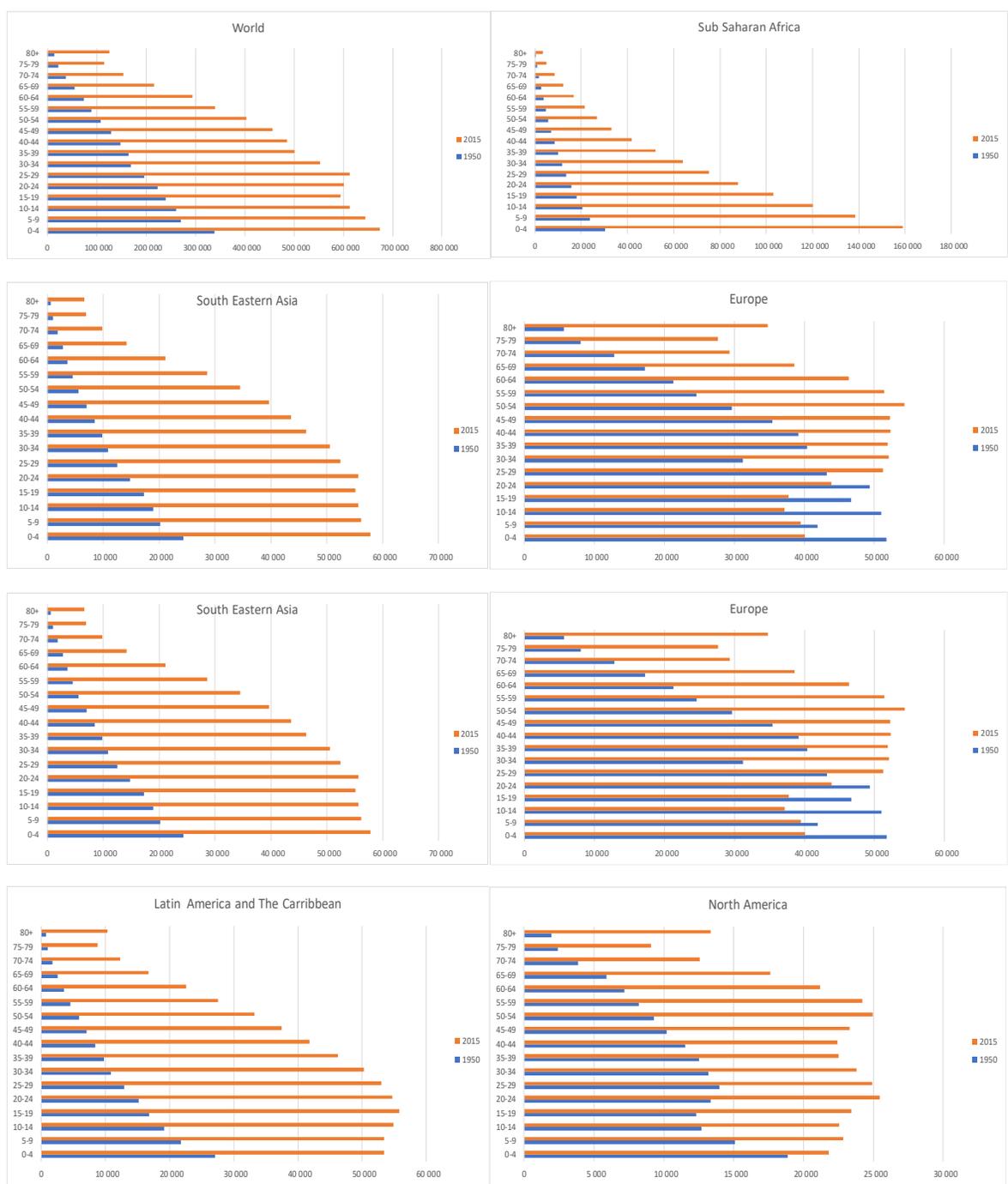
II.6 Annex

Figure II-9: Population density in selected world regions



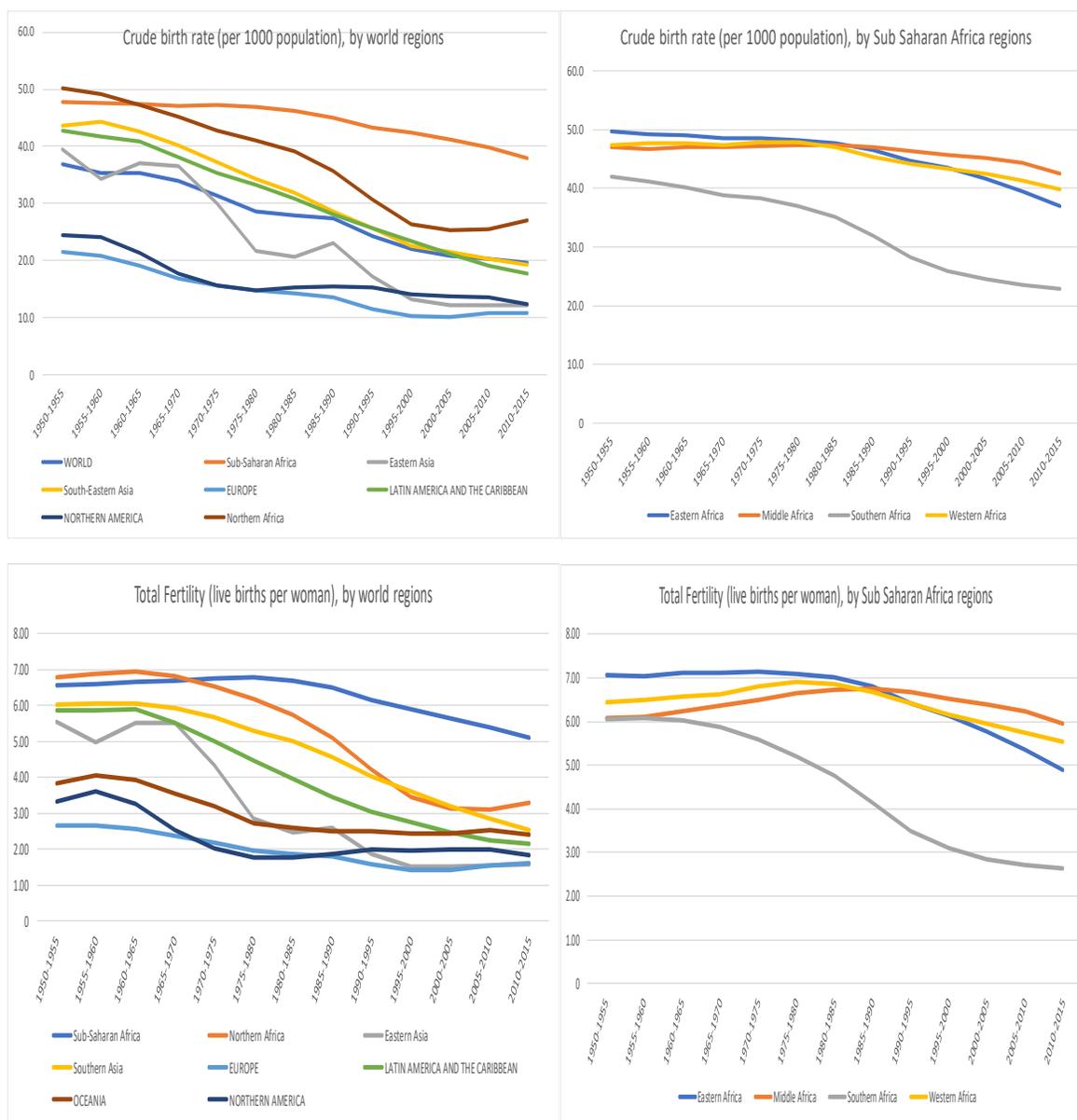
Source: United Nations Population Division

Figure II-10: Total population by five-year age group, selected world regions



Source: United Nations Population Division

Figure II-11: Crude birth and fertility rates in world and SSA regions



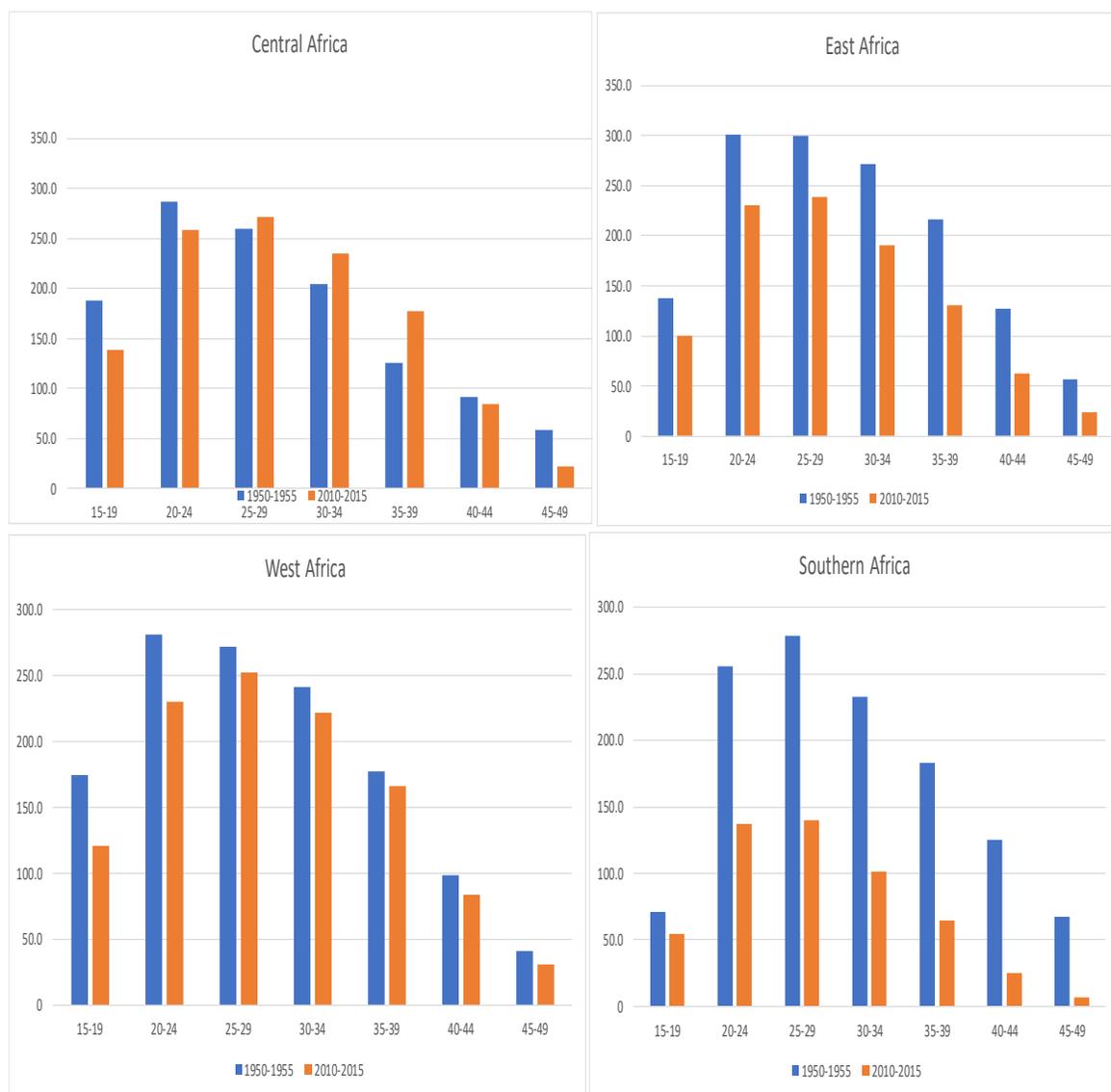
Source: United Nations Population Division

Figure II-12: Fertility rate by age group in selected world regions



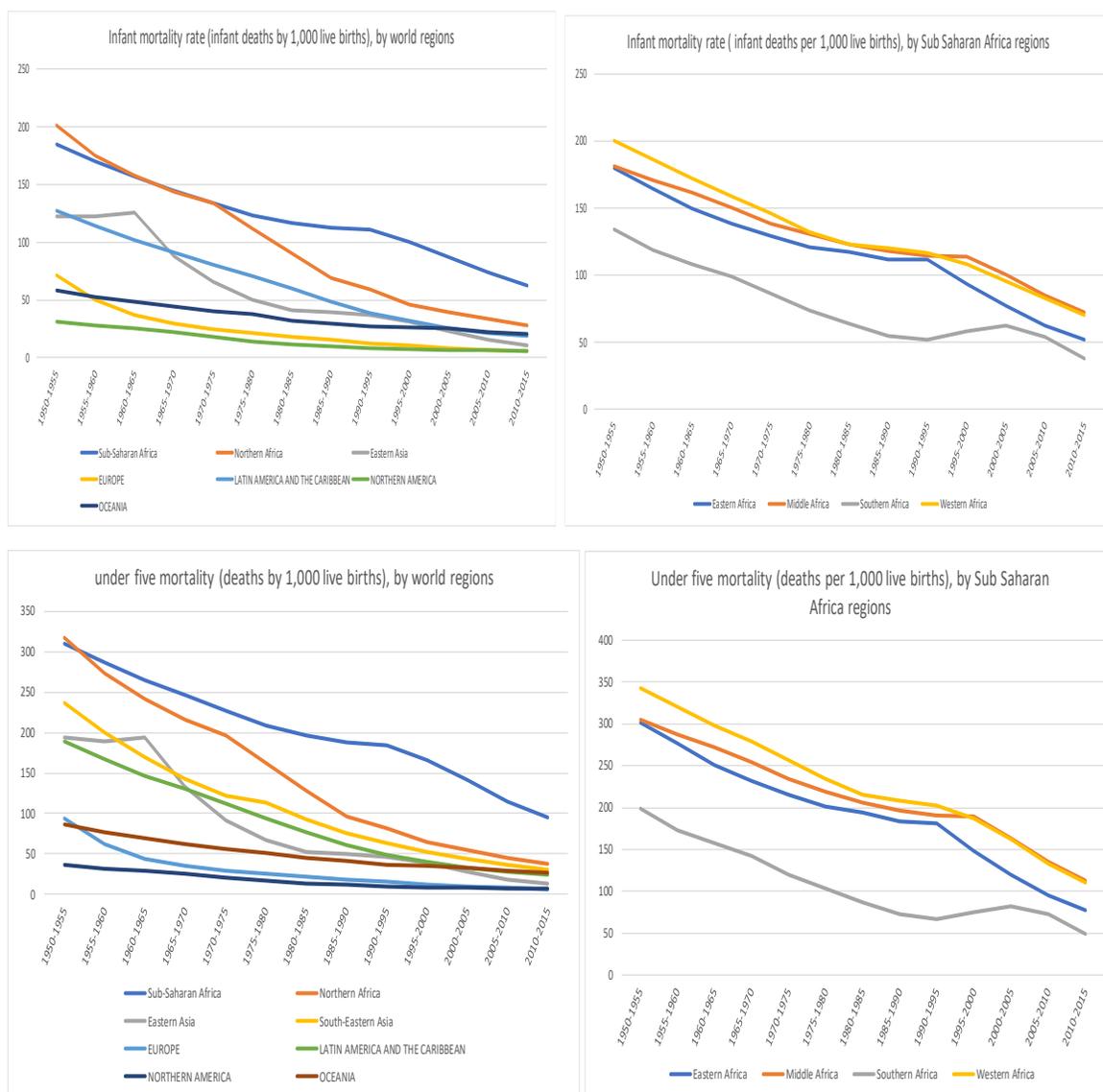
Source: United Nations Population Division

Figure II-13: Fertility rate by age group in SSA regions



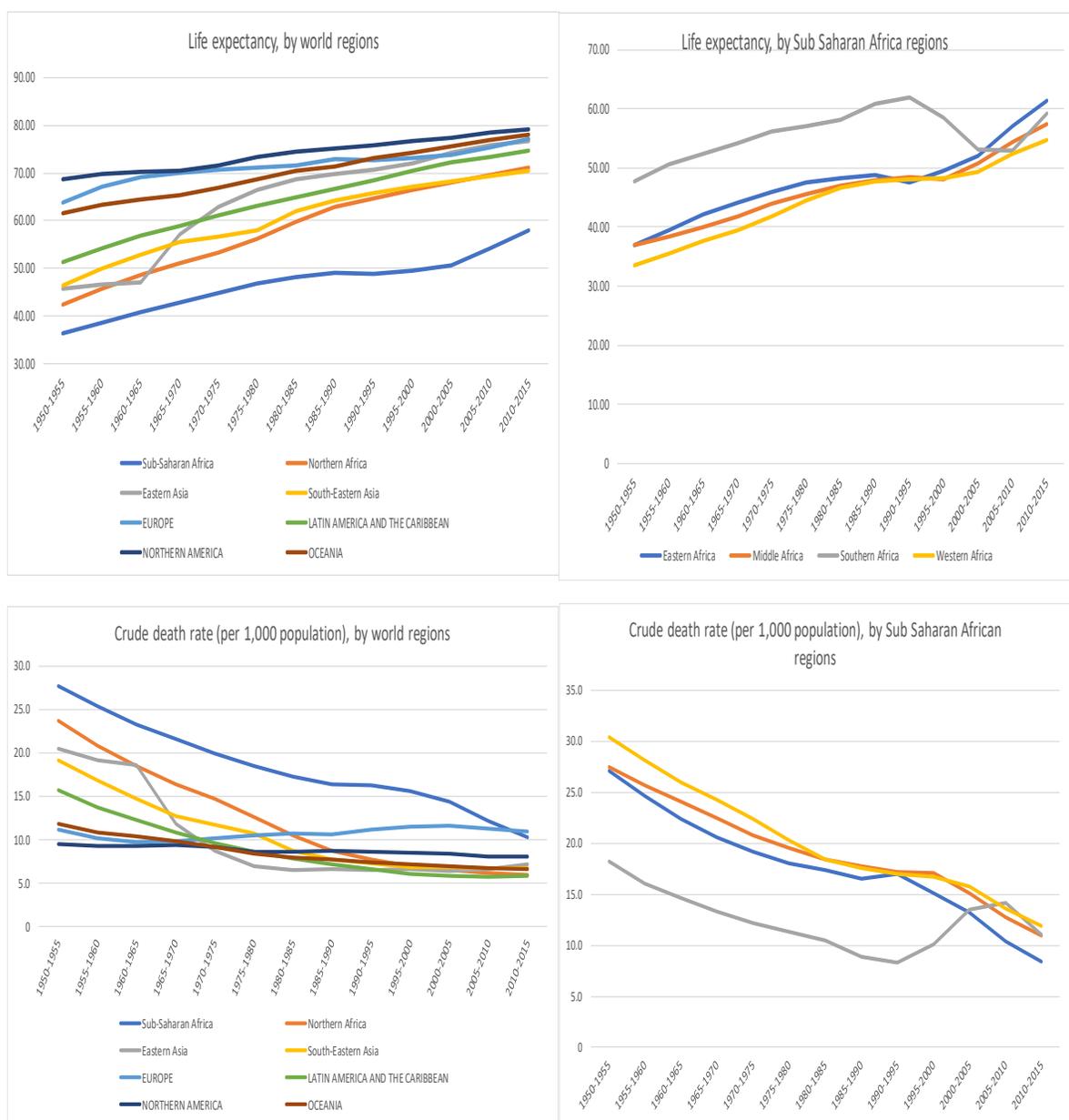
Source: United Nations Population Division

Figure II-14: Infant mortality rates in selected world and SSA regions



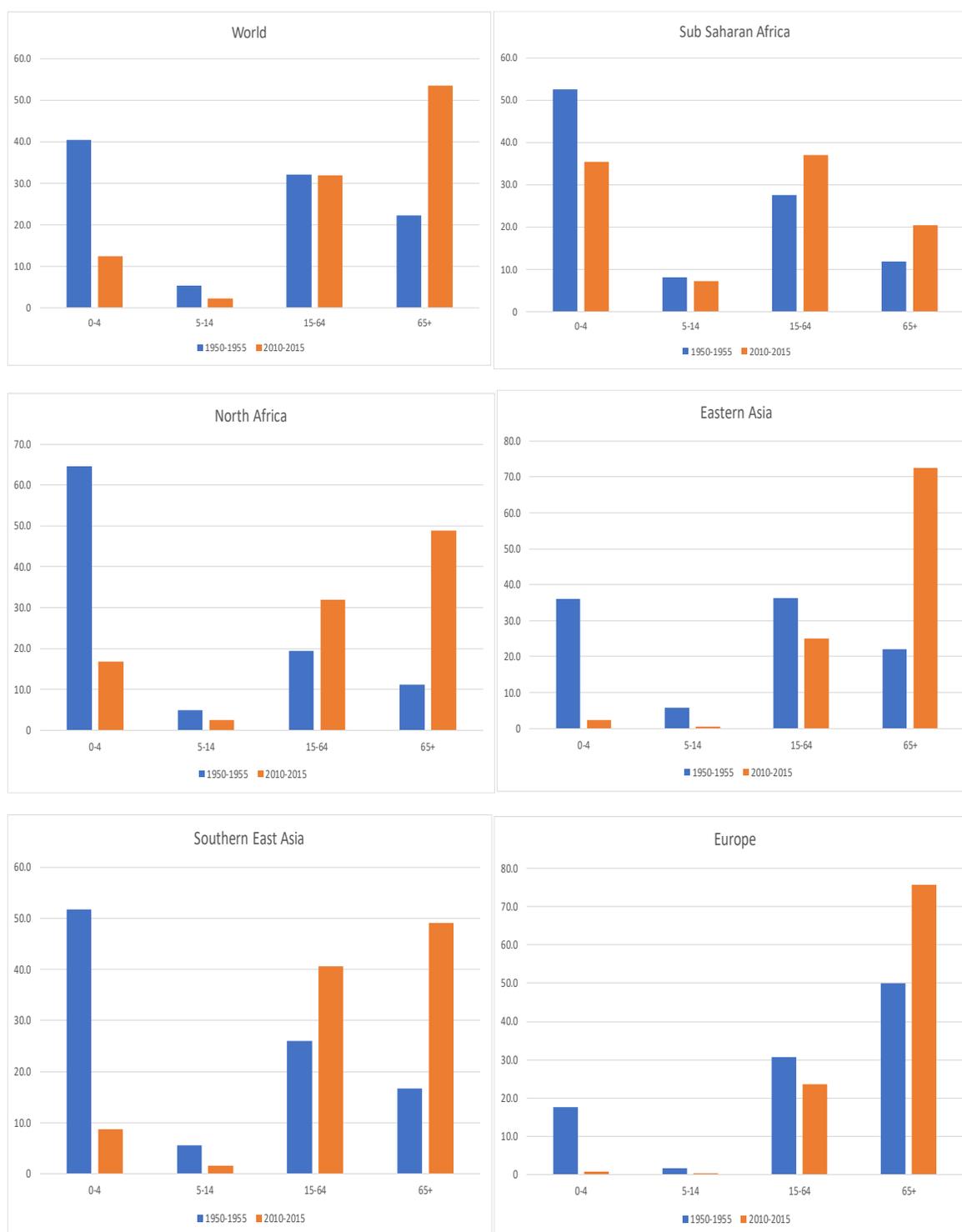
Source: United Nations Population Division

Figure II-15: Life expectancy and crude deaths in world and SSA regions



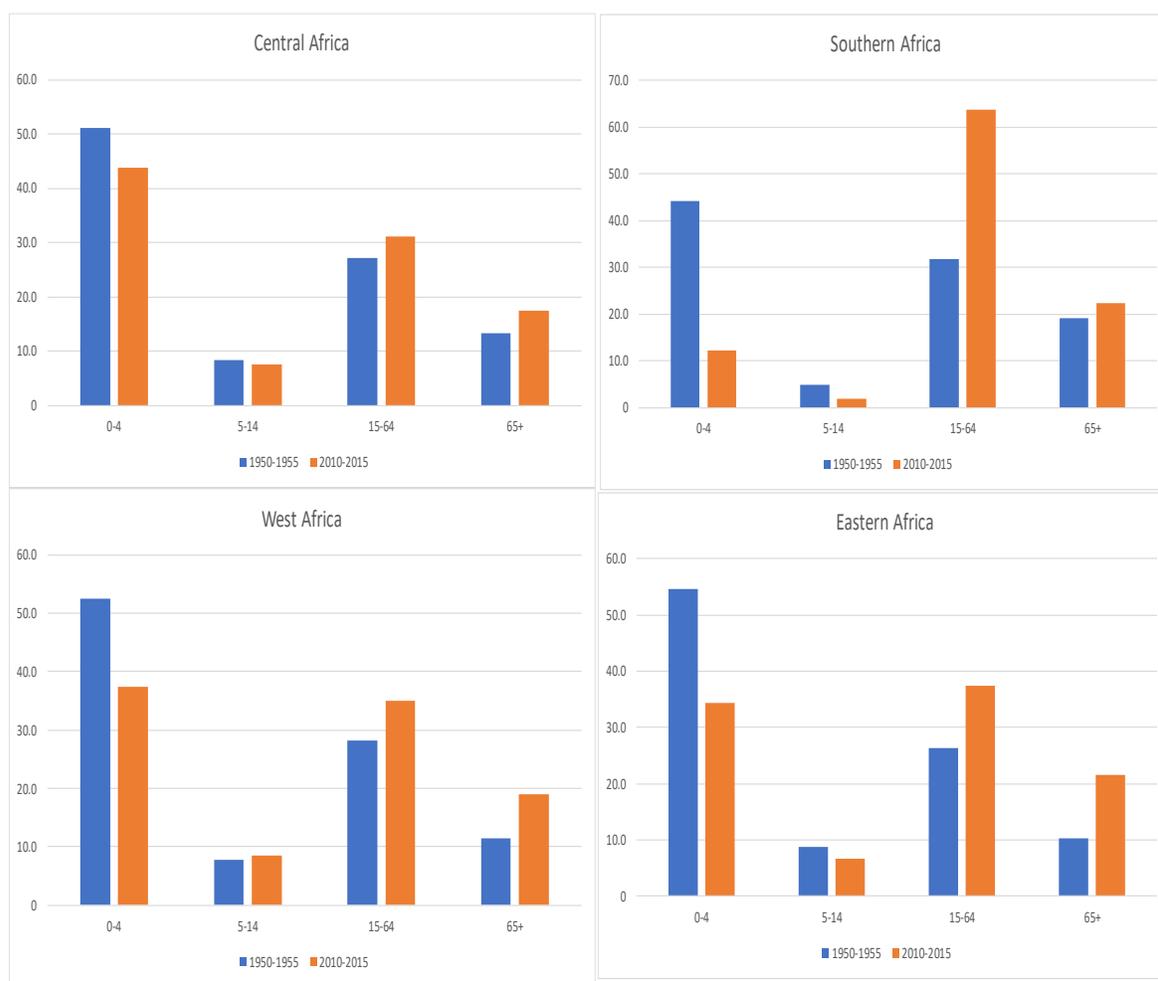
Source: United Nations Population Division

Figure II-16: Total deaths by age group (per 100 group population)



Source: United Nations Population Division

Figure II-17: Total deaths per 100 age group population in SSA regions



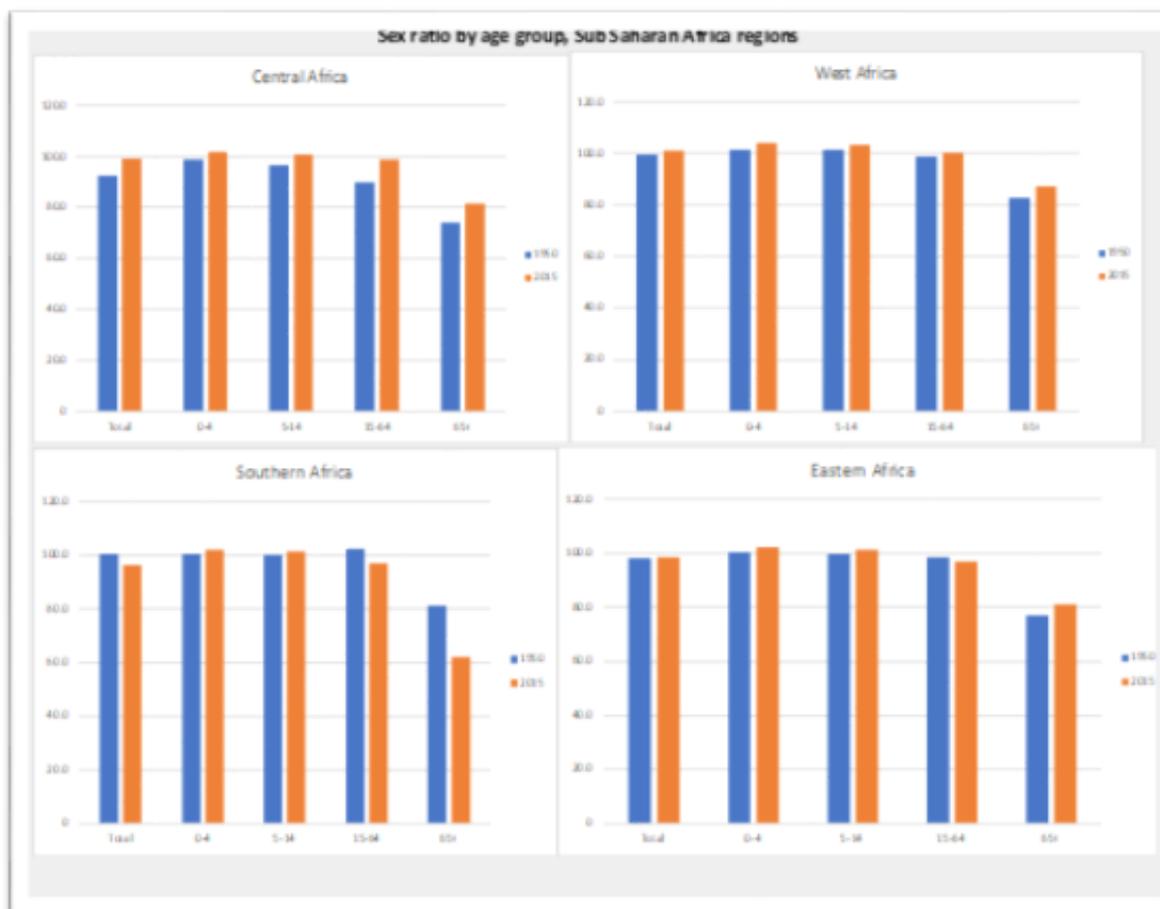
Source: United Nations Population Division

Figure II-18: Sex ratio (males per 100 females) in selected world regions



Source: United Nations Population Division

Figure II-19: Sex ratio (males for 100 females), SSA regions



Source: United Nations Population Division

Table II-7: Statistics of regression variables

Variables	Variable description	Source	Obs	Mean	Std. Dev.	Min	Max
gdpwa_rr	Per working age GDP growth rate (PPP)	World Bank Development Indicators	298	0.15	0.87	-0.47	8.65
lgdpwalg	Per working age GDP in PPP (lagged log)	World Bank Development Indicators	298	-5.57	0.86	-7.36	-2.87
llifexpc	Life expectancy (log)	World Population, United Nations	315	3.98	0.14	3.17	4.31
rule	Rule of law index	International Country Risk Group	202	3	1	1	6
wapop_r	Working age population growth rate (percent); working age population is total population of people aged between 15 and 65.	World Population, United Nations	315	13.97	12.31	-86.02	41.02
lolddp	Old age dependency ratio (log), total population over 64 divided by total working age population.	World Population, United Nations	315	1.80	0.21	1.37	2.65
lchddp	Children dependency ratio (log), total population under 15 divided by working age population	World Population, United Nations	315	4.39	0.21	3.31	4.67

Our sample had initially 45 countries, all from Sub Saharan Africa. But we had to reduce the sample to 29 countries because of missing data for some countries. We used the following 29 countries for our panel data: Angola, Botswana, Burkina Faso, Cameroon, Congo, Congo Democratic Republic, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

The panel data span from 1985 to 2015 constrained by missing data for years before 1985.

Table II-8: Hausman test

	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	S.E.
lgdpwalg	-0.22	-0.01	-0.21	0.10
llifexpc	2.47	1.84	0.63	0.26
rule	0.10	0.07	0.03	0.02
wapop_r	-0.07	-0.07	0.00	0.00
loldddep	-0.78	-0.55	-0.23	0.20
lchddep	-0.07	0.82	-0.89	0.28
t1980	0.24	0.01	0.23	0.07
t1990	0.26	0.07	0.19	0.06
t2000	0.11	0.01	0.11	0.04

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$\chi^2(9) = (b-B)'[(V_b - V_B)^{-1}](b-B) = 14.85$
 Prob> $\chi^2 = (V_b - V_B \text{ is not positive definite}) = 0.0952$

Table II-9: Test for robustness: panel regression excluding child dependency

Model	(1)
Dependent variables	Income growth per worker
Independent variables	
Initial income per capita	
Initial income per worker	-0.220**
	(0.103)
Life expectancy	2.441***
	(0.317)
Rule of law	0.103***
	(0.0306)
Working age population growth rate	-0.0737***
	(0.00182)
Elder dependency ratio	-0.776***
	(0.259)
Children dependency ratio	-0.0666
	(0.355)
Dummy for 1980s	0.232***
	(0.0799)
Dummy for 1990s	0.252***
	(0.0657)
Dummy for 2000s	0.106*
	(0.0618)
Constant	-8.759***
	(1.455)
Observations	191
R-squared	0.925

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

CHAPTER 3

DRIVERS OF FERTILITY AND LIFE EXPECTANCY IN SUB-SAHARAN AFRICA

III- DRIVERS OF FERTILITY AND LIFE EXPECTANCY IN SUB SAHARAN AFRICA

III-1 Introduction

Over the last two decades, sub-Saharan Africa has managed to break the cliché of the continent with no economic growth⁶². But there is another key challenge: its fast-growing population. That has posed a new challenge to the “Africa rising” narrative. From 2000-2018, Sub Saharan economies have growth at an average pace of 4.4 percent per year. Yet, income per inhabitant on the continent grew only by less than 2 percent, half of the increase in GDP. The other half of the GDP rise disappeared with population growth.

As a reference, over the same period, China’s GDP rose by 9.5 percent on average. On average, each resident of China experienced an income growth of more than 8 percent. The European Union’s GDP grew 50 percent less than the SSA region. Yet, the income of the European Union inhabitant grew as fast as the income per capita in the SSA region. Regardless of how fast an economy grows, if its population growth is not under control, the distribution of income at the per capita level is compromised.

Understanding the drivers of population growth should be a priority. This topic has received a lot of attention around the world. Yet, limited papers have focused on the entire sub-Saharan Africa (Junh and al, 2008; Ezeh and al, 2009; Shapiro and al, 2017;

⁶² Data used in this paragraph comes from the World Development Indicators database of the World Bank.

Bongaart, 2017). Moreover, research that focuses only the entire SSA region and at the same time on the period of growth (1990s-2015) are even fewer.

Our paper intends to close these two gaps: diving into the drivers of population growth focusing only on the entire SSA region and on the period (1995-2015). We do so by focusing on the determinants of fertility and life expectancy.

Population change is determined by three variables from a pure demographic accounting: fertility, mortality or life expectancy, and immigration⁶³ (Pew Research, 2015). Fertility increases population size, mortality or short life expectancy reduces population, and positive immigration increases population size. We do not look at the drivers of immigration because immigration accounts for only 5 percent of the annual population change in the SSA region⁶⁴.

Our results are in line with the literature findings but shed additional light on overlooked factors. For fertility, we find that age at first marriage is the most important determinant of fertility in the SSA region. Labor participation of women is the second most important factor. Reducing infant mortality is as much impactful as contraception use in the SSA region. On life expectancy, income is the most important driver of longevity in Africa, more important than education in the strict sense. Also, HIV prevalence has more impact on life expectancy than education. Democracy contributes to reduce violence, hence supporting longer life expectancy.

⁶³ For further details on the accounting concept, see Pew Research Center, The Future of world religions: population growth, 2010-2015.

⁶⁴ We use the data from the United Nations Population Division. This estimate is an average of the immigration rate from 1955 to 2015.

The paper has 5 sections. After the introduction (section 1), the section 2 looks at the trends in population growth and its components. The section 3 reviews the existing research work on fertility, mortality and life expectancy on data including the SSA region. Section 4 describes the empirical analysis to understand the drivers of fertility and life expectancy in the SSA region. Section 5 concludes.

III.2 Trends of fertility and life expectancy in SSA

In this section, we quickly review the growth of population growth and its components (fertility, mortality, life expectancy and immigration) in the SSA region from 1960 to 2015 in sub-Saharan African region.

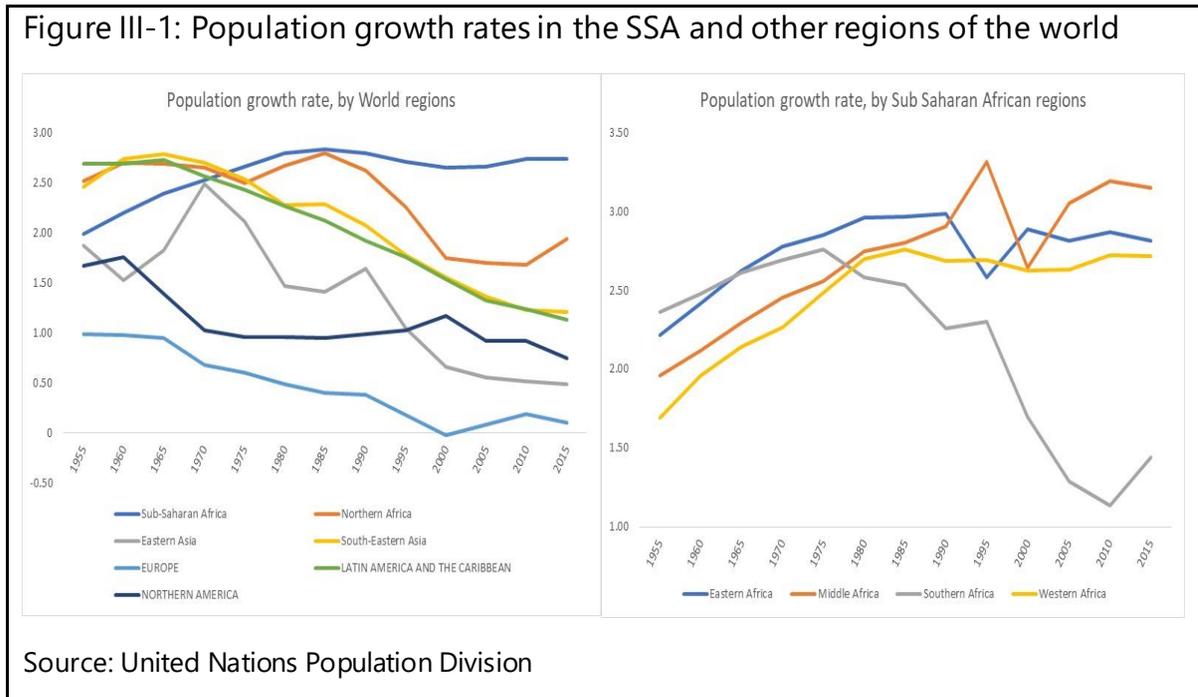
1. Population growth

Population growth in the SSA region is the highest in the world and has continuously increased since 1960 (Figure III-1). The annual population growth rate in the SSA region stood at 2.7 percent in 2015. This growth rate is higher the average population growth rate of the world which hovers around 1.2 percent.

The SSA population growth rate has trended up since 1960. Interestingly, the SSA region rate was lower compared to many regions such as Eastern Asia, Northern Africa and Latin America in 1960s. Since 1960, all regions of the world have continuously seen their rates falling, except for the SSA region. As a result, the population growth rate of the SSA region which was only 20 percent higher than the world average in 1960, is more than twice the world average rate in 2015.

The rising population growth rate happened in all SSA sub-regions, except the southern region (Figure III-1). In fact, the eastern, western and middle regions have experienced a sustained increase of their population growth rates since 1960. From 1960 to 2015, population growth rate soared from 2.4 percent to 2.8 percent in the eastern region, from about 2 percent to 2.7 percent in the western region, and from

2.1 percent to 3.2 percent in the middle region. Conversely, the southern region's rate fell from 2.5 percent to 1.4 percent over the same period.



2. Evolution of population components

2.1 Fertility

Fertility in SSA region continues to remain high and failed to catch up the general trend in fertility in the world. The gap between the rate in the SSA and the rest of the world widened since 1960. In 2015, fertility in SSA regions stood at 5.1 children per woman while the world's average rate hovered around 2.5 children per woman (Figure III-2). Yet, in 1960 the fertility rate in SSA region was 6.6 children per woman while the world's rate was 4.9 children per woman on average. Moreover,

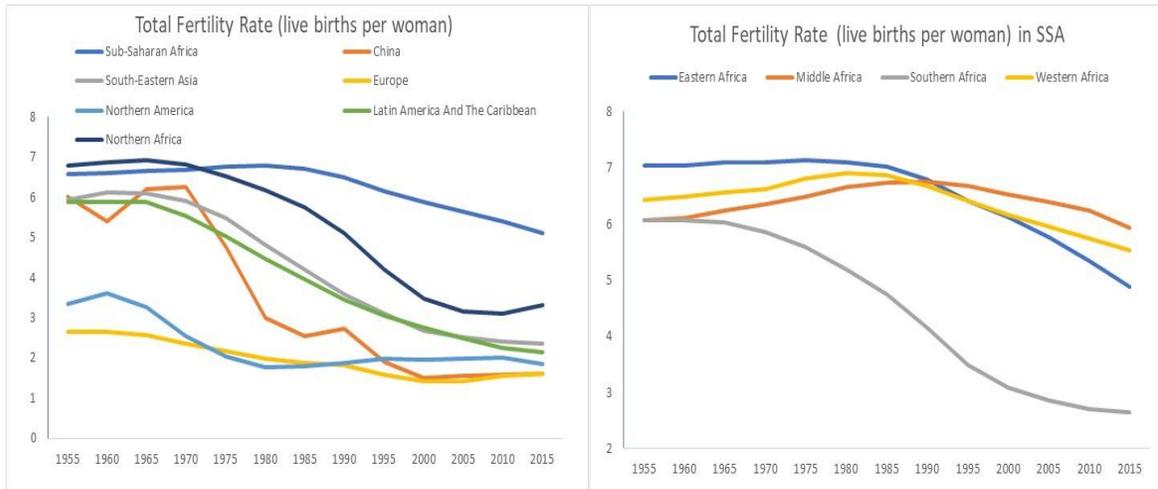
fertility rate in SSA region soared to 6.8 children per woman in 1980 before slowly falling to remain above 5 children per woman.

To be clear, the SSA region had almost the same fertility rate as China and Taiwan in 1955. But five decades later, the SSA region' fertility rate is almost five times the ones of China and Taiwan with China 's rate standing at 1.6 children per woman and Taiwan at 1.1 children per woman.

The middle and western regions in SSA are the most fertile in SSA (Figure III-2). Fertility rate stood at 5.9 children per woman and 5.5 children per woman respectively in the middle and western regions in 2015 above the average of the entire SSA region. The middle region has seen sustained fertility rate mostly throughout the last five decades since 1960. In 2010, the fertility in the middle region was still higher than its level in 1960. That rate peaked at almost 7 children per woman in 1990. Similarly, the western region experienced a rise in its fertility rate peaking to 7 children per woman in 1980 before falling in early 2000s.

Southern region in SSA has achieved the strongest performance in fertility reduction. Its rate fell continuously from 6 children per woman in 1960 to 2.6 children per woman in 2015. The eastern region has achieved substantial fall in fertility.

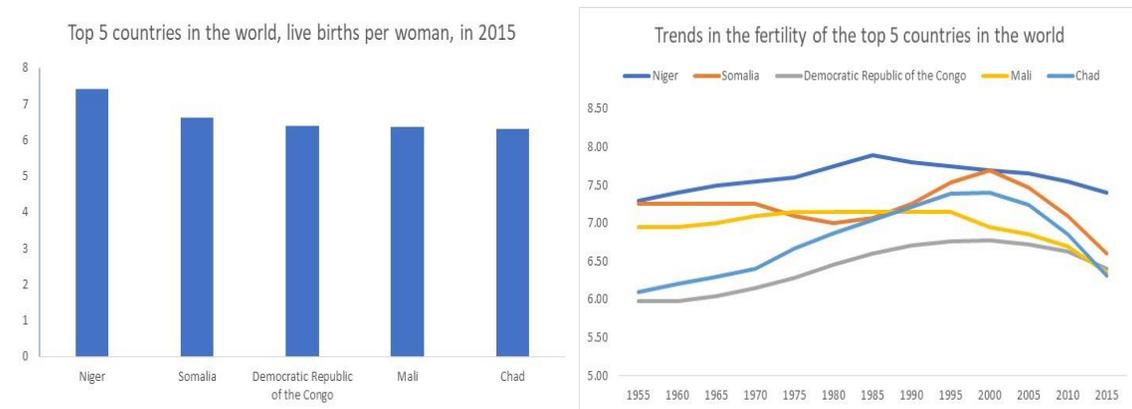
Figure III-2: Total fertility rates in the SSA and other world regions



Source: United Nations Population Division

In 2015, the top five countries with the highest fertility rate in world are from the SSA region (Figure III-3). These countries are Niger, Somalia, Mali, Democratic Republic of Congo, and Chad. Out of these high fertility countries, two countries are from the middle region, two from the western region and the last one from the eastern region. In 2015, Niger has the same level of fertility of 7.4 children per woman as in 1960. This level is the lowest level of fertility rate in Niger over the last five decades.

Figure III-3: Top 5 countries with highest fertility rates



Source: United Nations Population Division

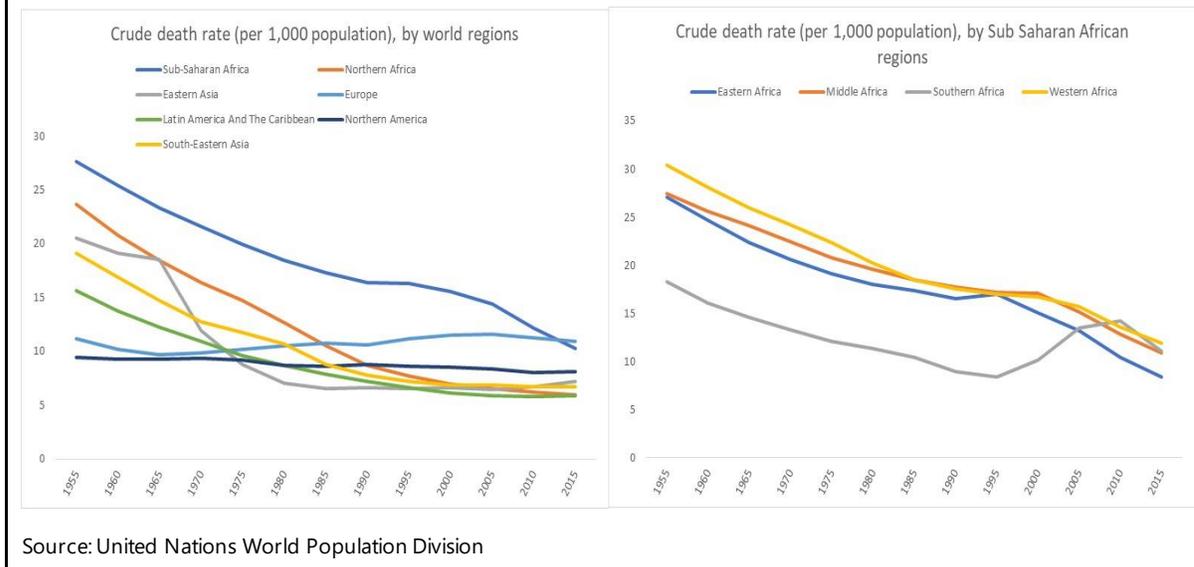
2.2 Mortality

The SSA region has made significant progress in reducing mortality over the last two decades, catching up with other world regions such as Europe (Figure III-4). In 1960, the SSA region faced a high mortality rate of 170 deaths per 1,000 population compared to a world average of 130 deaths per 1,000 population. In the following decades, while the world average dropped to 67 deaths per 1,000 population in 1990, the rate in the SSA region stood at 112 deaths per 1,000 population. But, since the early 2000s, the SSA death rate fell sharply to 62 per 1,000 population, reducing the gap with the world average of 35 per 1,000 population in 2015.

The significant fall in mortality in the SSA region has been primarily driven by the eastern region (Figure III-4). In fact, from 1960 to 2015, the eastern region rate dropped by 66 percent to 8.4 per 1,000 population. This performance was seconded by the middle and western regions achieving a decline of about 57 percent from 1960 to 2015. In 2015, mortality rate stood at 70 deaths per 1,000 population and 72 deaths per 1,000 population respectively for the western and middle region.

The southern region started with a mortality rate of about 118 deaths per 1,000 population lower compared to other sub regions in 1960. After a decline in the rate to 52 deaths per 1,000 population in 1995, the mortality rate picked up to 62 deaths per 1,000 in 2005 likely reflecting the AIDS pandemic severely affecting the region.

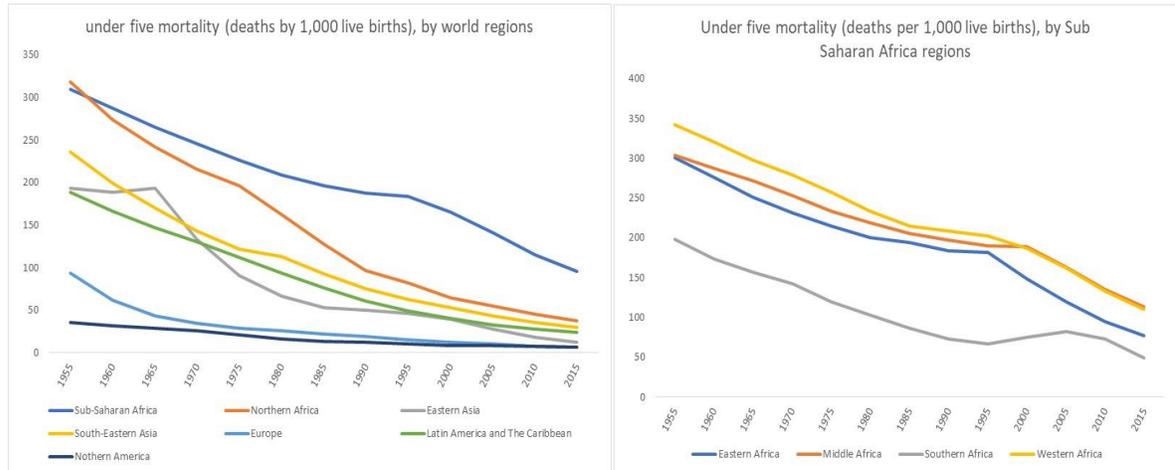
Figure III-4: Death rate in the SSA and other world regions



While the SSA region has managed to reduced mortality rate gap with the rest of world, the gap for the infant mortality rate has widened (Figure III-5). In 1960, infant mortality rate in the SSA region hovered around 287 per 1,000 live births while the average rate in the world was at 196 per 1,000 live births. Five decades later in 2015, the mortality rate stood at 95 per 1,000 live births in the SSA region against a world average of 48 per 1,000 live births.

Slow infant mortality decline in the SSA region reflects mainly limited progress in the middle and western regions (Figure III-5). These regions have seen infant mortality falling only by 65 percent at most in 2015. In the middle region, mortality went from 287 per 1,000 live births in 1960 to 113 per 1,000 live births in 2015. Similarly, in the western region, the rate fell from 320 per 1,000 live births to 111 per 1,000 live births over the same period. The eastern and southern regions performed better over the same period with their rates falling by 72 percent on average.

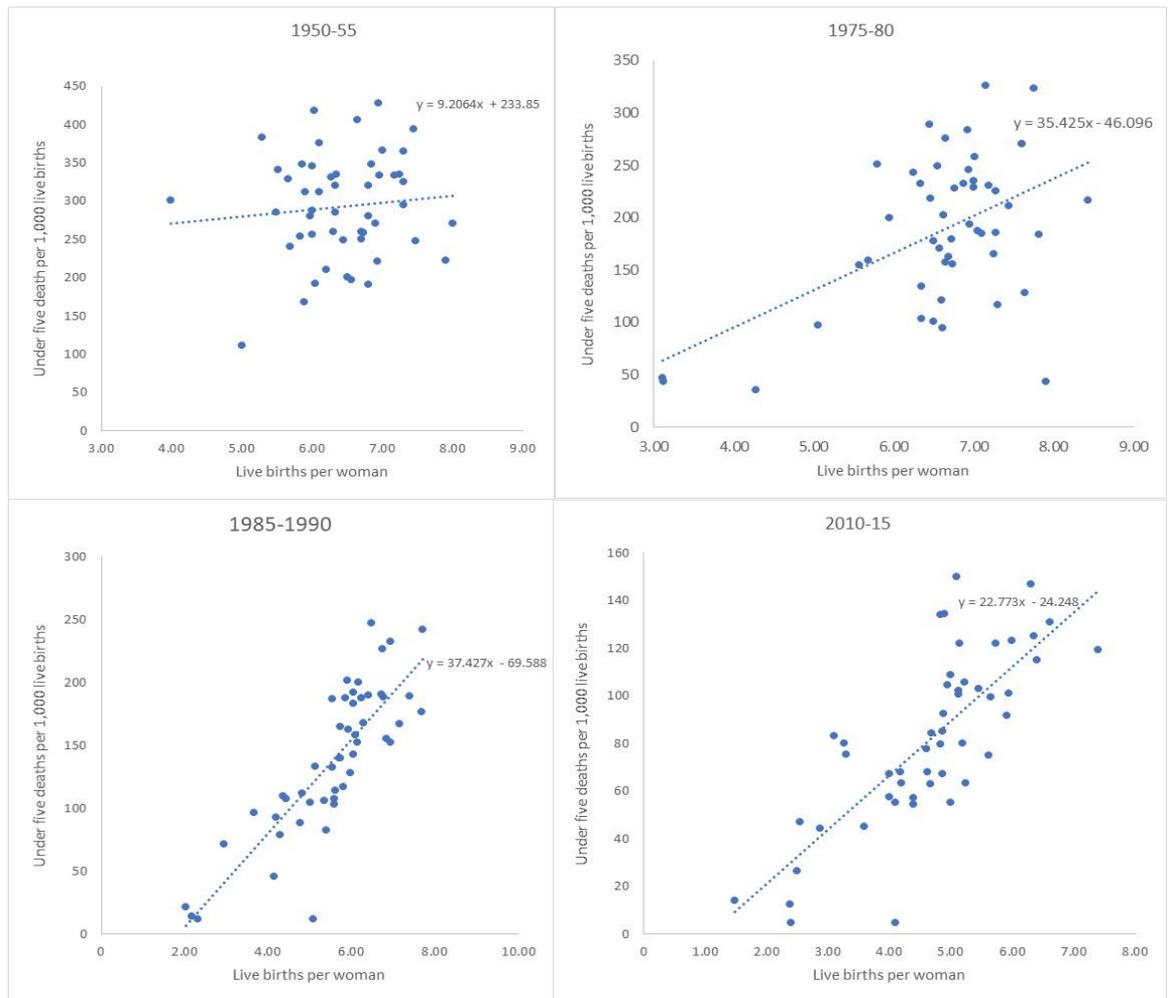
Figure III-5: Infant mortality rates in the SSA and other world regions



Source: United Nations Population Division

Infant mortality seems positively correlated with fertility. That is higher infant mortality is associated with higher fertility. This relationship holds throughout the last five decades (Figure III-6). The correlation coefficient was at its highest between 1985-1995, period during which fertility increased or stagnated in many SSA countries. This positive association could underline possible causations. We answer this question during the empirical exercise.

Figure III-6: Correlation of births and infant mortality rates in the SSA region



Source: United Nations Population Division

2.3 Life expectancy

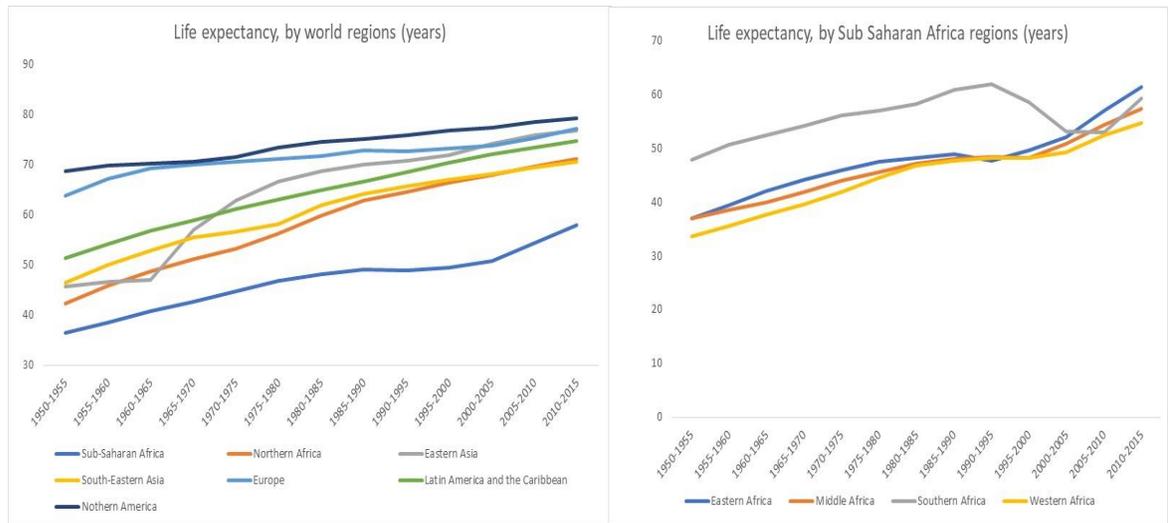
Life expectancy in the SSA region has increased but at a slower pace compared to the rest of world (Figure III-7). Population in the SSA region lives longer today than five decades ago. In 1960, the life expectancy in the SSA region stood at 38.5 years. In 2015, life expectancy was 57 years in the SSA region.

Yet, this progress has been slow compared to the rest of the world. The gap of life expectancy between the world and the SSA region was of about 10 years in 1960, then picked to almost 16.5 years in 2005 before falling at about 13 years. In 1960, northern Africa 's life expectancy was higher to the SSA region's one by only 7 years; in 2015, the gap stood at almost 15 years.

The southern region has been a major drag on life expectancy improvement in the SSA region (Figure III-7). It is the only region that has achieved an improvement below the SSA average. Though the region started in 1960 with a higher life expectancy compared to other regions in the SSA, life expectancy over the last five decades (1960-2015) has increased by 8 years in the southern region. The eastern region has achieved the fastest improvement in life expectancy, soaring by 22 years from 1960 to 2015, seconded by the western and the middle regions respectively increasing life by 19 years and 18 years respectively.

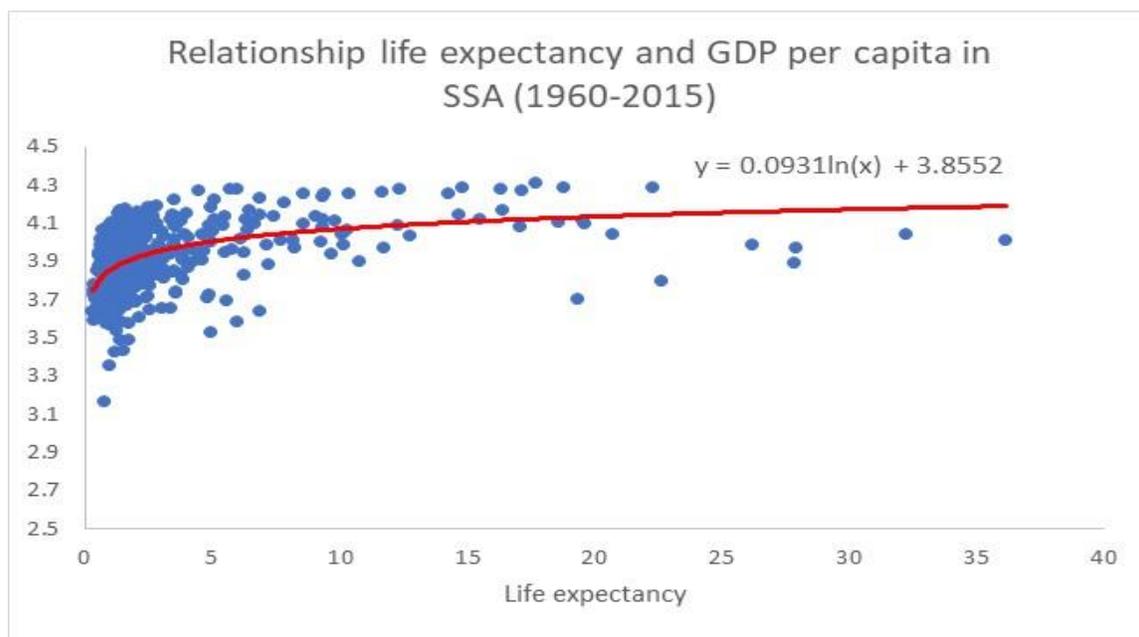
We look at the association between life expectancy and income per capita, assessing the assumption of a Preston curve (Preston, 1975). The SSA countries graphically fit the Preston curve (Figure III-8). That means life expectancy is positive associated with income per capita. The scatter plot displays a logarithm trend, implying that the association of income and life expectancy gets weaker as income increases. We suggest to empirically assess this relationship in the empirical analysis section.

Figure III-7: Life expectancy in the SSA and other world regions



Source: United Nations Population Division

Figure III-8: Preston curve for the SSA region (1960-2015)

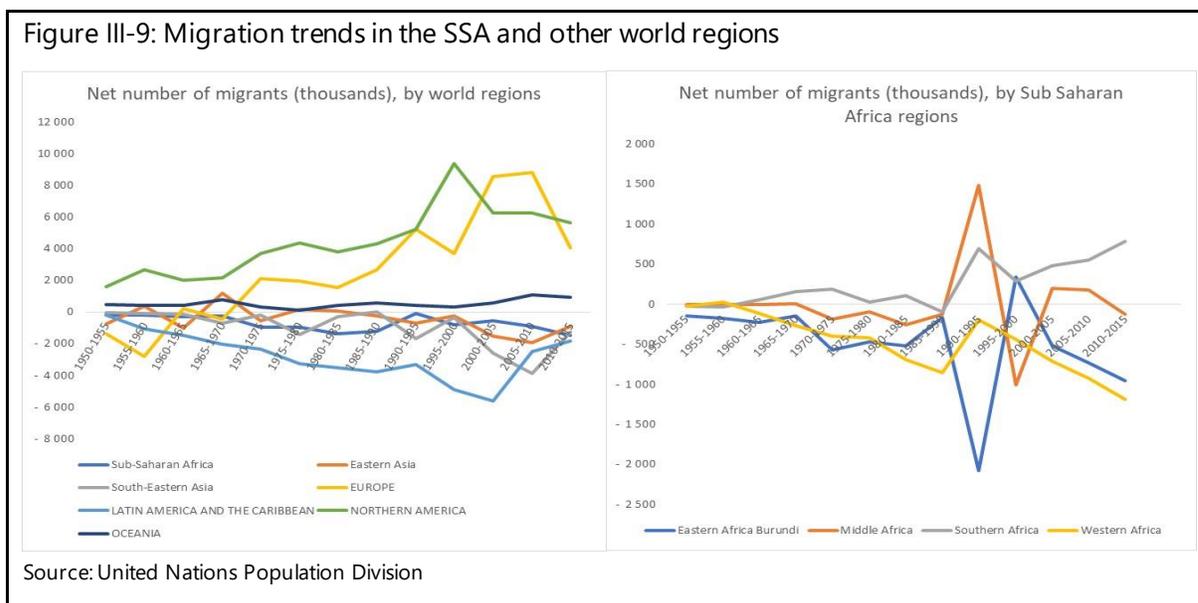


Source: World Development Indicators and United Nations Population Division

2.4 Immigration

Immigration rate in the SSA region has been negative and lower in absolute value compared to the average of other world regions (Figure III-9). Immigration rate in the SSA was at -180,000 migrants in 1960 and then multiplied by almost ten-fold to reach -1.4 million in 2015. However, the SSA migration rate is one of the lowest relative to its population compared to the other world regions. This result is interesting as it invalidates common belief about Africa being the biggest exporter of immigrants in the world.

The negative migration rate of the SSA region is driven by the eastern, middle and western regions (Figure III-9). The southern region has a positive migration rate, meaning that more people come in that region compared to the number of people emigrating from the region. This trend is driven by Southern Africa. The western region has fastest growing immigration rate since 1960.



For the rest of this chapter, we will focus on the determinants of fertility and mortality or life expectancy. Data shows that immigration accounts on average only 5 percent of population size change in the SSA region⁶⁵. The rest of the population change is determined by fertility and mortality or life expectancy. Having a good understanding of their determinants suffice to understand the drivers of population growth.

⁶⁵ United Nation Population data.

III.3 Literature on Fertility, mortality and life expectancy in SSA

This section is a literature review focusing on fertility, mortality and life expectancy which includes the SSA countries.

1. Drivers of fertility

This section focuses on key determinants of fertility but more importantly looks at the findings regarding the sub-Saharan Africa. Understanding fertility drivers has been the focus of a large research body since the 1950s. Pioneers like Davis and Blake (1956), Henry (1972), Sheps and Menken (1973), and Bongaarts (1982, 1983) helped to identify two types of main determinants of fertility: proximate and background or intermediate variables. The research on these types of variables have been extensively reviewed (Leridon, 1977; Bongaarts, 1982, 1983; Gray, 1983; and Menken, 1987).

A proximate variable, as defined by Bongaart (1984), is a factor that directly has an influence on fertility. Key variables have been considered as proximate variables in the literature. The variables and their definition below are drawn from the work of Bongaart (1984) and Menken (1987).

Proportion of married or in sexual unions measures the risk of conception for women in each population.

Frequency of intercourse focus on the probability of a woman to conception. Women who are frequently separate from their spouses would likely have lower fertility.

Postpartum abstinence is the absence of sexual intercourse in a period of a woman breastfeed a newborn. This is a widespread practice in many societies based on moral, religious, social motives.

Lactational amenorrhea is the impossible conception period for a woman following a pregnancy or during a breastfeeding period.

Contraception is a known practice by women in age of conception to willingly prevent a pregnancy using both traditional and modern methods to limit the number of children. Conception differs from lactational amenorrhea or postpartum abstinence because the latter focus to protect the mother and newborn health rather than limiting the number of children.

Induced abortion captures any method with deliberately stops pregnancies for various reasons.

Spontaneous intrauterine mortality is the proportion of pregnancies which naturally do not result in live births through miscarriage or dead births.

Sterility is the ratio of women in reproductive age who cannot conceive a pregnancy and give birth due to disease or not.

Background or indirect variables which positively or negatively on fertility only through the proximate variables. Background variables are economic, social and environmental characteristics of women in reproductive age which impact proximate variables to ultimately determine the level of fertility.

Many studies investigated fertility trends and drivers in Sub Saharan Africa. Young (2005) finds that HIV epidemic in South Africa increases, in net, future per capita consumption. He comes to this conclusion by looking at the effect of AIDS in increasing orphans and the effect of AIDS prevalence in lowering fertility through reluctance to have unprotected sexual intercourse and increased labor opportunities.

Juhn and al (2008) put some nuances on Young's findings. Using the data from the Demographic and Health Surveys (DHS) from 13 African countries through a linear regression, the authors show HIV infected women have lower fertility due psychological factors but do not find significant impact of HIV prevalence on non-infected women's fertility.

Women schooling is found to be fertility reducer. Ezeh and al (2009) use the DHS to examine the stylized facts of fertility trends in Eastern Africa. They find a correlation between fertility decline and women with advanced education. Shapiro and Tenikue (2017) support this finding, using larger DHS data on African countries. They find that in urban areas, improvements in women schooling contributes for 54 percent to fertility decline. In rural areas, increased education of women impacted the fertility decline by 30 percent.

They find these results using a decomposition equation of linear regression model which basically expresses the change in means of the dependent variables over two

periods as a function of the means variation of independent variables over the same two periods.

Using the DHS data over different periods, Bongaarts (2017) finds that the desired family size in sub-Saharan Africa is around 5 children per women much higher than the world average of desired family hovering around 3. The author argues that with such high desired family size, one should expect fertility in Africa to remain relatively high. Yet, using an ordinary least square regression, he shows effort for family planning contributes to lower desired family size, hence decline in fertility.

Towriss and Timaeus (2018) explores the impact of contraceptive on the lengthening of birth intervals. They conduct this analysis on Eastern Africa data, particularly in Ethiopia, Kenya, Tanzania, and Zimbabwe. Using DHS data in a Poisson regression, they conclude that birth intervals have lengthened due in part to contraceptive. The time between two births is longer in urban areas than in rural areas.

The ability of the woman in Africa to use contraceptive is related to her socio-economic characteristics. Based on data survey in Kenya, Mburu and al (2011) find that contraceptive use is determined among other factors by partner's approval, quality of services, women's knowledge about the family planning, and women's income level.

Another factor boosting the use of contraceptive is schooling of women (Ezeh and al, 2009). More generally, schooling of females helps to lower fertility. Hallman and Grant (2008) use data from South Africa, through a series of regression including logit regression. They show that dropout or discontinued enrollment are strongly associated with early fertility among young women. They suggest that increasing

female participation in school is critical to avoid such early fertility among females. They also find that young early caregivers are likely to drop out from school to take care of children.

Using the data from 57 countries including African countries, Channon and al (2018) argue that underachieved stated fertility is higher among women from sub-Saharan African countries. This difference is significantly explained by the education level. They conclude that increasing education of women in Africa would decrease fertility.

Beyond individual education of women, education can affect fertility from a community level. Kraydal (2002) considers education from community perspective and fertility. He finds that the average education level of a village or community has an aggregate effect in reducing fertility. He conducts this analysis over 22 countries in sub-Saharan Africa. This finding supports the need to spread education at all level to impact fertility over the long term.

Urbanization is another reducer of fertility. White and al (2005) examine the impact of urbanization on fertility looking at the rural to urban migration data in Ghana. They find that migrants from rural areas settling in urban areas quickly adapt their fertility. Though these migrants display a fertility rate that remains on average higher than urban residents, the migrants still have a lower fertility compared to the average households with similar characteristics living in rural areas.

Similar conclusion was formed earlier by Brockerhoff and al (1994) using DHS data for countries in sub Saharan Africa. They conclude that fertility decline has partly been driven by rapid urbanization and rural to urban migration. Their logit analyses show that migrant women from rural areas had higher fertility before the migration.

Once in cities, their fertility rapidly declines over the long run, influenced by living standard improvements and separation with spouse.

High mortality pushes fertility. Harrington JA (1974) looks at the impact of high infant and childhood mortality on fertility in west Africa. He concludes that high mortality results in higher fertility for three main reasons: the need to replace the dead child, the death of the previous child reduces the lactation period which triggers an ovulation period for the woman, and early weaning of the child sometimes leads to death due to weak nutrition, resulting in a need for a pregnancy.

In the SSA region, women face a tradeoff between having children and working to earn income. Takyi (1993) examines the impact of women's employment on fertility in Africa, using a national probability data of about 6125 women in Ghana. He finds that though on average employment does not significantly impact fertility, the impact of employment varies according to the type of occupation. When women are employed in non-family settings, they display a lower fertility.

Jong and al (2017) examine the effect of young children bearing on women's participation to the labor force in Africa. Using the event of having twins as instrumental variables for children bearing, they find that children bearing has a negative effect on women's participation in the labor force. That effect is even more negative for more educated women. That implies that women would rather work if they did not have children.

Using a linear regression on DHS data, Obiyan and al (2019) assess the impact of socio-economic status of Nigerian women on their fertility measured by the number of total children ever born. The measurement of socio-economic status includes

education attainment, work status, and income of the woman's household. They find that a negative relationship between socioeconomic status of women and fertility.

Age at marriage has direct impact on woman's fertility. Early marriage leads to higher fertility. Lejeune (2001) examines the effect of rising marriage age on fertility in South Eastern Africa. He finds that higher age at marriage lowers fertility.

Shapiro and al (2014) expand this conclusion across sub-Saharan African countries. They look at the impact of marriage trends over more than a dozen countries in SSA. They find that rising age at first marriage has helped curbing fertility rate and pushing fertility transition. As shown by Koski and al (2017), age at first marriage has been rising, thus one would expect positive contribution to fertility decline.

Hertrich (2017) comes up with a stronger conclusion. She suggests that fertility transition has not been possible in sub-Saharan Africa without decline in early age marriage. Moreover, decline in early age marriage has preceded fertility rate drop by 10 percent from its historical peak.

Mace and al (1997) analyze the impact of sex preferences and birth spacing over dozens of countries in sub Saharan Africa. They find that when the birth is a boy, birth spacing is longer. Also, women with no boys have much shorter birth intervals compared to women with at least one son. This finding implies that in a population with higher total sex ratio (at birth) would tend to have a lower fertility compared a similar population with lower sex ratio.

This view is shared by Beyeza-Kashesya and al (2010) through their qualitative study on Ugandan young couple. For them, high fertility in Uganda is partly explained by the desire to have a boy to sustain “the men’s blood”.

2. Drivers of life expectancy

Grosse and Perry (1982) investigate the determinants of life expectancy from 1950s to 1970s focusing only on developing countries. They find literacy rate and income per capita are positively associated with life expectancy. Yet overtime, literacy started playing a greater role on life expectancy than income in the early 1970s.

Further, Grosse and Auffrey (1989) review studies showing the positive impact of literacy on lower mortality, longer life expectancy in developing countries including sub-Saharan African countries supported by several reasearchers (Preston, 1979; Caldwell, 1979; Cochrane 1979; Caldwell and McDonald, 1982). These studies argue that this association between literacy and life expectancy holds irrespective of the culture or the economic development level.

Barlow and Vissandjee (1999) come to a similar conclusion. They run a cross national analysis to uncover the determinants of life expectancy in the developing world (Africa, Carribean, and Latin America). They conclude that literacy along with per capita income, and access to clean water positively contribute to longer life expectancy.

Education impact on life expectancy holds true for even poor countries. Vogl (2005) underlines the role of education on life expectancy and mortality. Through a panel data regression over 20 years (1982-2002) across poor countries, including African

ones, he shows that education plays a positive role on life expectancy and mortality. More recent data has reconfirmed the role of education on life expectancy for developing countries (Lin and al, 2012). The specific role of women education on life expectancy has not been widely tested for the SSA countries.

Kabir (2008) looks 91 developing countries data and runs multiple regressions including probit models. He creates three groups (low, medium and high life expectancy) and carries out the analysis on each group. He finds that income per capita, education, urbanization, and access to water are not the strongest determinants of life expectancy. He suggests that literacy of adult and nutrition have stronger impact on life expectancy.

The role of income on life expectancy has been extensively discussed in the literature. Scholars find that income plays a positive role on life expectancy and reduces mortality including in Africa.

Pritchett and Summers (1993) assess the impact of income on the infant mortality and life expectancy in developing and developed countries. Using panel data from 1960 to 1980, they regress infant mortality and life expectancy on income and other variables. First, they instrument income with investment rate, terms of trade, black market premium to isolate the intrinsic effect of income on life expectancy and infant mortality. They found a strong and significant impact of income on life expectancy and mortality of infant.

Though income has a strong impact on life expectancy. The relationship is not linear. Preston (1975) made a critical contribution known as the Preston Curve. He shows

that life expectancy significantly improves following income rise. But that income effect has a decreasing marginal effect on life expectancy.

Several scholars have provided further support to Preston's finding. Hanmer and al (2003) run over 420 000 equations using cross national data, to pinpoint robust determinants of mortality for infant. Income comes out as the most robust determinants. They also argue that income does not systematically translate into better health outcomes.

Noumba (2004) draws similar conclusion of income and life expectancy. He looks at the importance of countries' income on health outcomes (infant mortality rate, crude death, total fertility, and total expectancy at birth). Using a panel data regression, he finds that income positively contributes to improve health outcomes. Yet, the relationship is not linear. In fact, wealthier nations do not systematically have better health outcomes compared less wealthier nations. This finding confirms the Preston curve principle for African countries (Kuhn, 2010).

McCarthy and Wolf (2001) also prove that Preston curve principle is also valid for sub-Saharan African countries. Using a group of 20 African countries, the authors find that life expectancy is positively correlated with income in Africa.

But they warn that the link is not uniform across countries. Some poor countries display similar life expectancy to countries with higher income. This lack of uniformity is partly explained by health expenditure which is not a good predictor of health outcomes including life expectancy.

This lack of uniformity points to imperfect proxy of well-being measured by income (Canning and al, 2006; Deaton, 2006). They argue that income is an imperfect proxy of human well-being. Further they suggest that the Preston curve principle should not only focus on income but could be extended to other socio-economic indicators. Also, higher income does not reflect necessarily better well-being, thus higher life expectancy, particularly for countries which income increase due to natural resource discovery (Edwards, 2016).

More recently, Jetter and al (2016) examine the role of income on life expectancy for 197 countries over 213 years. In their analysis, they also test the Preston curve by introducing quadratic form of income (square and cubic) to measure the marginal effect of income. Their results confirm the important role of income on life expectancy. Income explains 64 percent of life expectancy changes over time.

Disease has a negative impact on life expectancy. AIDS epidemic in Africa has proven this point. Vogl (2005) proves that AIDS disease contributed to reduce life expectancy in Africa. Addressing HIV epidemic has helped supporting life expectancy. Bor and al (2015) analyze the change in life expectancy following mass treatment of HIV in South Africa. They find that life expectancy increases significantly while mortality falls due lower HIV infection.

Quality of political institutions impact life expectancy in mortality in a sense that it contributes to reduce violence, source of deaths, and improve public policy making leading to better social outcomes. Plumper and Newmayer (2006) draw attention of conflict impact on life expectancy, particularly of women. Specifically, using a panel data including African countries, they show that life expectancy gap between female

and male falls during civil war. Women life expectancy drops through direct impact of killings but more importantly through drop in socio-economic conditions.

Lin and al (2012) assess the impact of socio-political variables on life expectancy between 1970 and 2004 over national country data of 119 Less Developed Countries (LDCs). They find similar conclusion as Mackenbach and al (2013) did on European countries during the democratization waves in Europe. Lin and al point to democracy as a source of life expectancy improvement. In fact, they use as independent variables: income per capita, literacy, nutritional status, and political regime. They find that all these independent variables have significant impact on life expectancy. More important, democratic regime has positive rising impact on life expectancy over time while other social indicators show decreasing effects.

Against this wealth of research on fertility and life expectancy, our paper contributes to the literature in three ways. First, it focuses solely on sub Saharan African countries. Many papers have included the SSA region in analyzing the determinants of fertility and life expectancy. Yet, only very few ones have only focus on the SSA region. That contrast is surprising because the SSA region remains the region with highest fertility rate and lowest life expectancy. So, more studies should focus on the SSA countries to uncover the SSA region-specific determinants for fertility and life expectancy.

Second, our paper would be the unique paper that looks at only sub Saharan African countries using the most recent data up to 2015. This feature is quite important to understand the drivers of the improvements in fertility and life expectancy witnessed on the region during the famous period of Africa rising.

Third, the paper would assess the validity of the Preston curve for African countries using only data from only SSA region using dummy variable (variable intensity effect) rather than quadratic form of income.

III.4 Empirical Analysis

1. Data

We focus only on sub-Saharan African countries. We collect data of these 45 countries but consider only 29 countries due to large data gap in some key series such as women labor participation. We choose to collect the data from 1960 to 2015 to assess the determinants of fertility and life expectancy. Due to the missing data, our data can only be used from 1995 to 2015. We use a five-year data for our regression. We collect this data from various databases: the World Development Indicators (World Bank), the International Labor Organization (ILO), the World Economic Outlook (IMF), and International Country Risk Guide (ICRG), the World Marriage data (United Nations) and the Population division (United Nations).

There is a fuller description of the list of countries, variables, data characteristics, and database (Annex, table III-2).

2. Econometric strategy for fertility

2.1 Specification

We start this section with the specification for fertility. Our goal is to understand the drivers of fertility in Africa. Our specification will be based on existing literature and methodologies (Shapiro and al, 2014; Channon and al, 2018)) discussed in the previous section. We support from the assumption widely admitted in the literature that fertility is determined by both proximate variables but also “background” variables as specified in equation 1.

$$Fertility_{tj} = \sum_{i=1}^n \beta_i prox_{it,j} + \sum_{i=1}^n \alpha_i bckg_{it,j} + \varepsilon_{jt} \quad (1)$$

With $Fertility_{tj}$ is measured by the total fertility rate at time t of country j , $prox_{it,j}$ value of proximate variable i at time t for country j and $bckg_{it}$ a value background (socio-economic) variable i at time t , for country j , and ε_{jt} the error term for country j at time t .

We use a panel data regression. We also introduce a country fixed effects (to be tested by the Hausman to ensure its validity in the specification). Equation 1 becomes:

$$Fertility_{t,j} = \sum_{i=1}^n \beta_i prox_{it,j} + \sum_{i=1}^n \alpha_i bckg_{it,j} + C_j + \varepsilon_{t,j} \quad (2)$$

With C_j the country time-invariant effect (fixed effect). This specification is what we use for our regression model.

2.2 Variable selection

We use the following variables for our fertility model specification:

As proximate variables, we use:

- **Contraceptive prevalence** measures the use of contraceptive methods (traditional and modern) among women. We use the lagged variable because contraceptive method impacts future fertility of a woman. As shown in the literature section, contraceptive prevalence is expected to negatively impact fertility.

- **Age at marriage** measures the age at first marriage. We use the lagged variable. Marriage age impact is expected to be negative. To be clear, a woman getting married a younger age is likely to have a higher fertility compared to a woman who gets married at a later age.

We could have used more proximate variables, but we are constrained by limited data availability. Also, most studies in the literature use a very small number of proximate variables in their specification.

As background variables, we use the following:

- Education of women measured by the lag of gross **primary school enrollment of women**. A more educated woman is expected to have a lower fertility mainly through increased access to information including about contraception. Also, more education assumes a later marriage age.
- **Female labor market participation** measured by the share of women working or actively seeking a job in the labor market. We use the lagged term of this variable. Literature has shown that women engaged in the labor market, working or seeking for job, constantly tradeoff between pregnancy/childbearing and income. Such constant tradeoff leads to lower fertility as the opportunity costs of pregnancy and childbearing is high. Therefore, a higher female participation in the labor market is associated with lower fertility.
- **Urbanization** measured by the percent of the population living in urban areas over the total population in a country. We use the log variable. The expected

sign of urbanization impact on fertility is negative. Population living in urban areas are expected to have better access to contraceptive methods, healthcare service, and costlier living standard leading to constant tradeoff between childbearing and income.

- **Infant mortality** which is the death rate of infant. We use one of its metric: the neo mortality which measures the death rate of infant younger or aged of 28 days over the number living births in a year. High mortality of infants is expected to incentivize mother to have more children because they aim to achieve the desire family size over the number of survivors' kids. Also, the death of an infant leads to a shorter postpartum period, leading to a period of fertility. We use the lagged term of infant mortality.
- **Total sex ratio** (lagged term) is the ratio of total males over total females in a country. This ratio is expected to have a negative effect on fertility for several reasons as mentioned in the section above. In Africa, the culture of giving an heir who must be a boy remains strong. Thus, women tend to have more children in the pursuit of a male birth or several male births.

3. Econometric strategy for life expectancy

3.1 Specification

We draw our specification from models used in the literature (Pritchett and al, 1993; Jetter and al, 2016). The specification aims at understanding the determinants of life expectancy in sub-Saharan Africa.

Also, we take the opportunity of this specification to shed more light on the literature debate about the competitive roles of income and education on life expectancy.

We consider a panel regression with country fixed effects (to be tested by a Hausman test). Therefore, our specification includes income per capita and education of women variables along with other socio-economic variables as follows:

$$Life_{t,j} = \beta \left(\frac{Y}{L}\right)_{j,t} + \alpha FPE_{t,j} + \sum_{i=1}^n \delta_i X_{it,j} + C_j + \varepsilon_{t,j} \quad (3)$$

With $Life_{t,j}$ is the life expectancy variable of country j at time t , $\left(\frac{Y}{L}\right)_{j,t}$ is the GDP per capita of country j at time t , $FPE_{t,j}$ is the education variable female of country j at time t , $X_{it,j}$ is a socio-economic variable i at time t for country j , C_j is the fixed effect of country j , $\varepsilon_{t,j}$ the error term of country j at time t .

We use then a two Stage Least Square procedure (2SLS) for our regression equation 3. In fact, given the bidirectional relationship between life expectancy and income as largely discussed by Pritchett and al (1993), we first instrument income per capita to avoid the possible reverse causation from life expectancy to income. We do so by using explanatory variables found significant in our chapter 2. In the chapter, our dependent variable is the growth of income per worker with explanatory variables including elderly dependency and working age population growth. As a reminder the equation of chapter was the following:

$$Y/L_{gr_{it}} = \alpha' + \beta' (Z_e + Z_d)_{it} - c \ln \left(\frac{Y}{L_{it}}\right) + L_{gr_{it}} + af_i + bT_t + \varepsilon_{it} \quad (4)$$

With $Y/L_{gr_{it}}$ is the labor productivity growth of country i at time t , Z_e a vector variables of long run economic determinants, Z_d a vector variables of long run demographic determinants, $\frac{Y}{L_{it}}$ initial

income of country i at time t , $L_{gr_{it}}$ the growth rate of labor of country i at time t , f_i the fixed effect of country i , T_t the country invariant effect, and ε_{it} the error term.

During the estimation procedure, we will test whether our instrument choice is valid with overidentification test of Sargan-Hansen. We use then a two stage least regression (2SLS) for our regression.

It is worth mentioning that before proceeding with the 2SLS estimation, we conduct an OLS estimation to be able to underline the possible endogeneity bias stemming from a non-instrumented income variable (annex, table III-3).

We also use this paper to assess the validity of the Preston curve for sub-Saharan African countries. This is an important contribution to the literature. So far, the literature has not estimated a Preston curve equation for only sub-Saharan African countries. Jetter and al (2016) have estimated a Preston curve equation but for 193 countries over 216 years, dating back in times where all African countries were at the early phase of development. Our paper looks at a more recent data spanning from 1995 to 2015.

We depart from Jetter's approach which include quadratic variable of income to assess the marginal effect of income on life expectancy. To avoid possible reverse causation effect from the quadratic variables (square and cubic variables), we use dummy variables to measure the variable intensity as suggested by Mogstad and al (2010). We introduce three dummy variables indexed to the quartiles of income. Specifically, the first dummy variable takes the value of 1 if the income per capita value is greater or equal to the first quartile and take the value of 0 otherwise. The second dummy takes the value of 1 if the income per capita is greater or equal to

the second quartile and take the value of 0 otherwise. The third quartile takes the value of 1 if the income per capita value is greater or equal to the third quartile and take the value of 0 otherwise.

Introducing the dummy variables in equation 3, our Preston curve equation is as follows:

$$LifE_{t,j} = \beta \left(\frac{Y}{L}\right)_{j,t} + \alpha FPE_{t,j} + \sum_{i=1}^n \delta_i X_{it,j} + C_j + \sum_{h=1}^3 d_h + \varepsilon_{t,j} \quad (5)$$

with d_h the variable dummy indexing the h^{th} quartile as described in the previous paragraph.

Finally, we use a three Stage Least Square estimation to test the robustness of our two main equations 4 and 5. That means a simultaneous estimation of equation 4 and equation 5 to assess the robustness of the estimates results for the two equations. In fact, the main equation of the chapter 2 include life expectancy variable. The Simultaneous estimation allows us to assess validity of our regression results (chapter 2 and chapter 3) facing the possible endogeneity risk between life expectancy to income.

Explicitly, equation 4 can be rewrite as follows:

$$Y/L_{gr_{it}} = \alpha' + \beta'(Z_e + Life + Z_d)_{it} - c \ln \left(\frac{Y}{L_{it}}\right) + L_{gr_{it}} + af_i + bT_t + \varepsilon_{it} \quad (6)$$

Equation 6 can be expressed as a function of life expectancy as follows:

$$Y/L_{gr_{it}} = f(Life, X) \quad (7)$$

With X representing the explanatory variables of equation 6, excluding life expectancy variable

Similarly, equation 5 can be rewritten as a function of income as follows:

$$LifE = f(Y, Z) \quad (8)$$

With Z the explanatory variables excluding income variable (Y).

Putting together equation 7 and 8, we get the following system of equations that are interdependent:

$$\begin{cases} Y/L_{grit} = f(LifE, X) \\ LifE = f(Y, Z) \end{cases} \quad (9)$$

We estimate the system of equation (9) through a three Stage Least Square.

3.2 Variable selection

We use the following variable for our life expectancy regressions:

Life expectancy is measured as the life expectancy at birth measures how long on average a newborn live if the current rate of deaths does not change. This is our dependent variable. We use the logarithm of the life expectancy variable.

Income per capita is measured by the Gross Domestic Product (GDP) divided by the total population. The income per capita is expected to have a positive impact on life expectancy.

Female primary school enrollment to measure women's education. We use the lagged term. Women's education is expected to positively influence life expectancy through better pregnancy and care of children thanks to access to health information.

HIV prevalence which is the ratio of infected people per 100,000 population. This variable reduces life expectancy. As mentioned in the literature review section, HIV prevalence has been to be an important impediment to life expectancy in sub-Africa.

Population density measures the number of people living on one kilometer square. We assume that population density is positive as a densely inhabited area provides opportunity for knowledge and information sharing to face threats to life. We include this variable to assess this assumption.

Democracy is measured by the index measuring the respect of political rights. The higher the index, the less democratic is the regime. The index ranges from 1 to 7. Countries with free political rights tends to ensure more stable political environment, less violence in political transition. Hence, free political regime is expected to be positively associated with life expectancy. So, the sign of this political index on life expectancy is expected to be negative.

4. Empirical results for fertility

This section discusses the results of the regressions presented in the previous section. We start with the results for the fertility and then the findings for the life expectancy.

4.1 Overall fitness of the model

Our panel model is well specified (equation 1 in the Table III-1). The R-square is 79.2 percent. The hypothesis of a country fixed effect is validated by the Hausman test which rejects that difference in coefficients between a fixed effect model and random effect model is not systematic (Appendix, Table III-4). Moreover, all coefficients of the variables in the model are all significant at 5 percent threshold and have all the expected signs (equation 1 in Table III-1).

4.2 Impact of proximate variables

The results show that contraceptive methods and age at first marriage contribute to reduce fertility in SSA region. The marriage age has the largest impact compared to contraception prevalence. If marriage age were to increase by five years on average, total fertility rate would drop by 0.2 child per women. That means in simple terms that for each group of 100 women, they would be 20 children less than they would at the current marriage age. The SSA average age at first marriage is about 20 years. Improvement on that front would make a difference in the region's fertility.

4.3 Impact of socio-economic variables

All socio-economic variables have significant impact on fertility. First, women labor participation to the labor market is the most critical socio-economic variable on fertility. This variable has the largest impact on fertility. It is the second most impactful variable of the regression after women's age at first marriage.

Second, infant mortality is as important as contraception. Increase by one point in infant mortality rate results in fertility rise as much as contraceptive prevalence leading to fall by the same magnitude in fertility. To be clear, improving infant mortality would be as beneficial as improving contraception use in the SSA region.

Third, girls schooling has the weakest impact compared to other socio-economic variables. Newborn mortality rate has three times more impact than schooling of girls on fertility. This result is particularly important as donors and governments have

promoted massively the need to send girls to school and use contraceptive. While these policies are important on their own, the finding reminds us the need to focus also more on improving the births and living conditions of the newborns as a mean to slowdown fertility in Africa.

Fourth, similarly, urbanization plays larger role on reducing fertility than girls' schooling and women's participation to the labor market plays. One percent increase in urbanization percent leads to a reduction in fertility of 0.019. This finding suggests than push for urbanization should attract more attention from policy makers.

Finally, the persisting culture of boy preference would continue to be an impediment to fertility drop in Africa. Sex ratio has almost as much impact as women labor participation. Its impact is much larger than girls' schooling and use of contraceptive. To be clear, one could infer that if women give preference to boys in their births, they could be driven to pursue the birth of a boy regardless whether they are educated and use contraceptive methods.

5. Empirical results for life expectancy

5.1 Overall fitness of model

Our model specification is well fitted with an R square of 39.5 percent. We used elderly dependency ratio and growth rate of working age population as instruments for income per capita. The Sargan-Hansen test shows that the instruments are valid. All coefficients of the explanatory variable of our specification have the expected signs and are all significant at the 10 percent level (equation 2 in Table III-1).

5.2 Light on income versus education impact on life expectancy

Our results show that the impact of income is much stronger than education on life expectancy. Both education and income have positive impacts on life expectancy in SSA region. An increase of income per capita by one unit would result in an increase of 1 percent in life expectancy on average. For instance, an average increase of annual income per capita by \$1000 would increase life expectancy by six months. Similarly, an increase of female primary school enrollment by one point would lead in an increase of life expectancy by 0.1 percent on average. From this, we conclude that income per capita has 10 times more impact on life expectancy than education of women.

The impact of income per capita has decreasing marginal impact, thus confirming the principle of the Preston curve for SSA countries. In fact, our specification (equation 3 in Table III-1) testing the Preston Curve is well fitted with a R-square of 42 percent. Also, all coefficients of the explanatory variables are significant and have the expected signs.

Not all the dummy variables are significant. But, the first dummy variable taking 1 for all income per capita values greater than the first quartile (Q1) is significant. This dummy variable has a positive sign, implying the impact of income per capita up and above the first quartile is positive. The coefficients for the two other dummy variables (indexing Q2 and Q3) are negative. The coefficient of the dummy indexing Q3 is much larger, in absolute value, than the coefficient of the second dummy.

This result points to a decreasing effect of income on life expectancy once the income passes over the second quartile, this marginal effect decreases even more for

countries with income per capita higher than the third quartile of income variable. Similar results are found when using decile dummy variables to further test the marginal intensity hypothesis (Annex, table III-5).

5.3 The impact of democracy and AIDS

The most striking result of our regression is the impact of democracy or political liberty on life expectancy (Table III-1). Not only regime with reduced political freedom has a negative impact on life expectancy but that impact is larger than any other variables of our regression.

The democratic nature of political regime in SSA countries is more important than income per capita impact. While this result seems surprising at first, it makes sense. Autocratic regimes have resulted in massive political violence and civil wars in Africa. Conflicts have an immediate consequence on life expectancy as it leads to massive deaths.

Similarly, HIV prevalence turns out to have a larger impact compared to education. An increase in the HIV prevalence by one percentage point reduces life expectancy by 0.6 percent. This result is not surprising either as AIDS has proven to be a major cause of deaths in SSA regions in the past three decades (table III-1).

5.4 Robustness of regressions

We test the robustness of our regression discussed above with simultaneous regression achieved through a 3 Stage Least Square (3SLS). In the chapter 2, we use

the life expectancy variable as an independent variable in the regression of the income per worker as dependent. Under this regression, there could be endogeneity issue with the life expectancy variable as income per worker could contribute to longer life expectancy. To check whether our regression in chapter did not suffer from this endogeneity, we conduct this simultaneous regression. Similar endogeneity challenges could have arisen with our regression of life expectancy in the chapter 3 based on the validity or not of our instruments.

We do so by estimating simultaneously the life expectancy regression and the chapter 2 regression on income per working age population. The results confirm that the regressions in chapter 2 and 3 are robust. The simultaneous support the results not only the impact of all significant variables in both regressions but also the signs (equation 4 and 5 in Table III-1).

Table III-1: Regression results: Fertility and life expectancy in the SSA region

VARIABLES	Preston curve			Simultaneous Estimate	
	1. Panel Total fertility rate	2. 2SLS Life expectancy (log)	3. 2SLS Life expectancy (log)	4. 2SLS Life expectancy (log)	(5) Income per worker growth rate
Contraceptive prevalence (lag)	-0.0146*** (0.00293)				
Marriage age (lag)	-0.0486** (0.0207)				
Primary school enrollment of women (lag)	-0.00386** (0.00170)	0.00138*** (0.000316)	0.00134*** (0.000252)	0.00196*** (0.000257)	
Neo mortality (lag)	0.0139** (0.00609)				
Female labor participation (lag)	-0.0363*** (0.00714)				
Urban population percent (log)	-1.978*** (0.231)				
Sex ratio (lag, total)	-0.0333** (0.0158)				
GDP per capita		0.0109* (0.00558)	0.0111* (0.00672)	0.00333 (0.00230)	
Population density		0.000146** (5.68e-05)	0.000181*** (5.83e-05)	5.57e-05 (0.000167)	
HIV prevalence		-0.00618*** (0.00114)	-0.00529*** (0.00113)	-0.00787*** (0.00140)	
Political liberty regime (lower number means more democracy)		-0.0254*** (0.00386)	-0.0244*** (0.00419)	-0.0254*** (0.00440)	
GDP per capita (dummy first quartile-			0.0506***		

Q1)					
GDP per capita (dummy second quartile-Q2)			(0.0189) -0.00256		
GDP per capita (dummy third quartile-Q3)			(0.0165) -0.0441		
Initial income per worker			(0.0427)		-0.114***
Life expectancy (log)					(0.0327) 2.124***
Rule of law					(0.459) 0.0722***
Working age population growth rate					(0.0216) -0.0737***
Elder dependency ratio					(0.00189) -0.610***
Dummy for 1980s					(0.161) 0.138
Dummy for 1990s					(0.103) 0.194**
Dummy for 2000s					(0.0861) 0.0568
Constant	19.05*** (1.946)	3.957*** (0.0276)	3.922*** (0.0284)	3.954*** (0.0298)	-7.083*** (1.826)
Observations	209	306	306	182	182
R-squared	0.792	0.395	0.420	0.442	0.904

III.5 Conclusion

Since late 2000, the Sub Saharan Africa region has broken, at least temporarily, the curse of “unsustainable economic growth”. The next biggest challenge of the region to control of composition and growth rate of its population.

This research looked at the drivers of demographic growth which has halved the benefits of the GDP rise of the SSA region over the last two decades. We carried this exercise from 1995 to 2015, constrained by data availability. We focused only on the drivers of fertility and life expectancy.

To that end, we used a panel regression to identify the determinants of fertility in SSA. Then, using a 2SLS regression, we uncovered the factors shaping life expectancy in SSA, instrumenting the income per capita. We also assessed the validity of the decreasing marginal effect of income on life expectancy, the so-called Preston curve.

Finally, we tested the robustness of the life expectancy results and the regression of demographic structure impact on income per working age assessed in the chapter 2. We did so through a simultaneous equation performed with a 3SLS regression.

We found critical results which could guide policy making for demographic policies in the years to come. On fertility, marriage age is the most impacting factor of fertility in the SSA region. Increasing the participation of women in labor market would be critical in curbing population growth. Having women to work would kill two birds with one: it would reduce fertility and increase income production. While

education of the girl and use of contraception are confirmed as important, reducing the infant mortality deserves as much attention as infant mortality when it comes to reducing fertility.

On life expectancy, we found that rising income is the primary factor of longevity. Thus, sustaining GDP growth remains critical. Yet, the impact of income on life expectancy is marginally decreasing (validation of the Preston curve for the SSA region). So, income cannot be a panacea to longevity in the SSA Africa.

Other factors matter. Education, particularly of women, remains an important component to increase life expectancy. HIV disease has been a drag on life expectancy, impacting more than education. This is a reminder of the need for African countries to improve their public health system to cope with a world strained with possible pandemics as seen with the COVID-19. Finally, political regime with limited political freedom constrained longevity in the SSA region as such regime leads to violence and deaths during political transition.

Now, the world of research knows the determinants of population growth. The next stage of research should focus incorporating these factors in economic growth policies design. The HRV diagnostic tree has overlooked demographic factors as significant contributors to income rise. The HRV diagnostic needs to be augmented to reflect the findings of this paper particularly for the SSA countries.

III.6 Annex

Table III-2: Descriptive statistics of variables

Five years period	N	Mean	Standard Deviation	Min	Max
Total fertility ratio	540	6.032	1.231	1.49	8.43
Life expectancy (log)	495	3.919	.171	3.166	4.306
Contraceptive prevalence (lag)	484	19.773	16.258	.8	75.8
Marriage age (lag)	495	20.435	2.733	14.4	30.3
Primary school enrollment of women (lag)	351	75.927	33.245	11.843	148.518
Neo mortality (lag)	495	43.553	16.937	8.6	107
Female labor participation (lag)	220	62.676	15.899	29.13	91.948
Urban population percent (log)	539	3.152	.692	.731	4.479
Sex ratio (lag, total)	495	97.842	3.829	85.434	125.404
Population density	495	63.74	95.51	.789	618.36
HIV prevalence	516	3.763	5.326	.1	28.1
Democracy	380	4.988	1.673	1	7
GDP per capita	457	3.406	4.681	.325	36.121
Elderly dependency ratio (log)	540	1.792	.237	.804	2.645
Growth rate of working age population	450	13.482	10.734	-86.016	41.02

Our sample had initially 45 countries, all from Sub Saharan Africa. But we had to reduce the sample to 29 countries because of missing data for some countries. We used the following 29 countries for our panel data: Angola, Botswana, Burkina Faso, Cameroon, Congo, Congo Democratic Republic, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

Table III-3: OLS regression life expectancy without instrumenting income

Variable	(1) Life expectancy
Primary school enrollment of women (lag)	0.00194*** (0.000318)
Population density	0.000679*** (0.000207)
HIV prevalence	-0.00597*** (0.00133)
Political liberty regime (lower number means more democracy)	-0.0202*** (0.00442)
GDP per capita	0.00532** (0.00214)
Constant	3.869*** (0.0335)
Observations	306
R-squared	0.420

Table III-4: Hausman test for the fertility regression

	Coefficients		
	(b) fixed	(B) random	(b-B) difference
Contraceptive prevalence (lag)	-0.01	-0.02	0.01
Marriage age (lag)	-0.05	-0.08	0.03
Primary school enrollment of women (lag)	-0.004	-0.004	0
Neo mortality (lag)	0.01	0.02	-0.01
Female labor participation (lag)	-0.04	-0.01	-0.02
Urban population percent (log	-1.98	-1.11	-0.87
Sex ratio (lag, total)	-0.03	-0.03	0.00

b = consistent under H_0 and H_a ; obtained from xtreg

B = inconsistent under H_a , efficient under H_0 ; obtained from xtreg

Test: H_0 : difference in coefficients not systematic

$$\begin{aligned} \text{chi2}(7) &= (b-B)'[(V_b-V_B)^{-1}](b-B) \\ &= 51.60 \end{aligned}$$

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Table III-5: Robustness test of the variable marginal intensity

VARIABLES	Life expectancy
GDP per capita	0.0262 (0.0366)
Primary school enrollment of women (lag)	0.00130*** (0.000359)
Population density	0.000207*** (6.68e-05)
HIV prevalence	-0.00438** (0.00179)
Political liberty regime (lower number means more democracy)	-0.0330* (0.0175)
Dummy (decile 1)	0.0159 (0.0349)
Dummy (decile 2)	-0.00235 (0.0277)
Dummy (decile 3)	0.0384 (0.0254)
Dummy (decile 4)	0.00329 (0.0259)
Dummy (decile 5)	-0.0385 (0.0330)
Dummy (decile 6)	0.0117 (0.0369)
Dummy (decile 7)	-0.0112 (0.0285)
Dummy (decile 8)	-0.0490 (0.0846)
Dummy (decile 9)	-0.247 (0.401)
Constant	3.945*** (0.0736)
Observations	306
R-squared	0.316

GENERAL CONCLUSION

GENERAL CONCLUSION

This thesis answers two questions that have fueled the debate on economic growth over the last decade in the sub Saharan Africa: Do demographics play any role in economic growth in the SSA region? If so, how?

The thesis answers yes to this first question. The growth episodes of the SSA region have been determined to a large extent by its demographic changes. The answer to the second question is: both population structure and growth in the SSA region determine income growth per capita.

I. Summary of the main findings

The first chapter shows that the HRV model is a valuable tool which allows to diagnose constraints to economic growth, including for an SSA economy. We use the HRV model and identify three main constraints which could prevent Côte d'Ivoire from sustaining the high economic growth experienced since 2012. We find that corruption, access to finance and lack of institutional framework to incentivize entrepreneurs into new productive activities are the binding constraints to higher economic growth in Côte d'Ivoire.

Yet, the diagnostic exercise which led to these findings did not consider demographics as potential constraints to economic growth. Hence the need to assess the connection between economic growth and demographics in the SSA region.

The chapter 2 shows that demographic factors are drivers of economic growth in the SSA countries, hence should be included in the HRV diagnostic exercise. The chapter shows that population structure has played critical role in GDP growth per worker in the SSA region from 1985 to 2015.

We show that working age population and elderly dependency are negatively associated with the per worker income growth. Children dependency is not found significant. Life expectancy and the rule of law are also significant determinants for per worker income growth.

Using the regression results, we recount the story of per worker income growth from 1985 to 2015 through an accounting growth exercise. First, Sub Saharan Africa's demographics has turned around from being a curse from 1985 to 2000 to become an opportunity for higher growth since 2000.

Second, working age population growth has negatively contributed to income growth since 1985. In simple words, compared to the labor market absorption capacity, working age population continues to grow too fast even though it has slowed down. New entrants' productivity is lower on average compared to existing average worker.

Third, as opposed to pre-conceived idea, children dependency has not negatively contributed to per worker income growth. Children dependency ratio in Sub-Saharan Africa is the highest in the world. But the ratio has been trending down.

Fourth, the positive impact of life expectancy and institutions on economic growth are confirmed through our empirical exercise.

The third chapter shows that population growth in the SSA region is strongly determined by the marriage age of women, women's participation in the labor market, infant mortality, income, female schooling, HIV prevalence, and political nature of regime.

Specifically, the regressions show the following results. On fertility, marriage age is the most impacting factor of fertility in the SSA region. Increasing the participation of women in labor market reduces fertility. While education of the girl and use of contraception are confirmed as important, reducing the infant mortality has as much impact as schooling and contraception on fertility.

On life expectancy, the empirical analysis shows that rising income is the primary determinant of longevity. Yet, the impact of income on life expectancy is marginally decreasing (validation of the Preston curve for the SSA region). So, income cannot be a panacea to long life expectancy in the SSA region.

Other factors matter for life expectancy. Education, particularly of women, remains an important component to increase life expectancy. HIV disease has been a drag on life expectancy, impacting more than education. Finally, political regime with limited political freedom constrained longevity in the SSA region. Autocratic regime leads to violence and deaths during political transition and uncertainty over good policy making necessary to improve life expectancy such as healthcare policy.

II. Policy implications of the main findings

The main implication of our thesis findings is that economic growth analysis should be carried by explicitly including demographic analysis. The HRV framework as it stands now has a limitation: overlooking demographics factors.

Ignoring demographic factors in economic growth discussion would be partial and incomplete. To be clear, scholars and policy analysts should continue to use the HRV framework to identify constraints to economic growth in the SSA countries. But this diagnostic should be augmented by considering population structure and growth to be comprehensive.

On specific findings of the thesis, below are the following implications. Regarding the findings on Côte d'Ivoire' growth constraints, several policy options should be considered to tackle the identified constraints to sustaining high economic growth in Côte d'Ivoire. Corruption should urgently be tackled; it is the original sin of the country which could prevent sustainable and high growth. Côte d'Ivoire has several institutions in charge of good governance, including fighting against corruption. All these institutions lack independence and judicial power to take up corruption issues and tackle them.

To increase access to finance, two measures would be critical. First, a judicial system, free from corruption, and competent to swiftly render judgements on commercial matters and reassure investors. Second, a credit bureau to keep record of borrowers, capable of providing enough data on new investors to help banks discriminating between good and bad borrowers.

On increasing exports sophistication, government would need to partner with private sector in engaging into active industrial policies which reward risk takers into high productivity activities and sanction weak performers. Such framework would need to be free from corruption and rent seeking and should be result focused. In addition, institutional mechanism should be established between government and private sector to facilitate information sharing on challenges with coordination and market failures. Also, providing a government backed guarantee, if well managed, could encourage banks to finance new sophisticated activities.

Regarding the role of demographics and its drivers in the SSA region, we draw the following implications. First, sub Saharan Africa does not need just a larger share of working age population. Instead, for Africa to benefit from its working age population, the growth of that population should be consistent with labor market absorption capacity and average productivity of existing workers for Africa. Such changes require policies beyond demographic policies.

Revisiting the quality of education and training system of the SSA countries would be critical to that end. Such policy would ensure that the new entrants to the working age population have the appropriate training to increase the average productivity of worker. Also, healthcare policies should support the education policies to ensure healthy entrants in the labor force.

Moreover, structural transformation of economies should be a priority in order to i) increase the job creation to face new entrants in the working age population but also boost average productivity of worker. This calls for government to be proactive to steer away their economies from commodity-driven economy.

Second, the underpinning policies which have led to falling children dependency should be continued. They are working. We know now better the drivers of fertility. Policies should focus on them. Stringent policies should supplement awareness policies against forced girl marriage. The age of marriage is the largest driver of fertility, governments can no longer close their eyes on the issue. Policies need to be enforced: early and forced marriage should be illegal and punished.

Also, government should promote women's participation in the labor force. Having women to work would kill two birds with one stone. It would reduce fertility and increase income or production.

Mortality is still too high in the SSA region. Reducing infant deaths should be a top public health priority. In the 21st century, losing a baby should not be a concern for mothers, including in the SSA region. If infant mortality remains high, contraceptive effectiveness could be elusive.

On elderly dependency, it deserves more public policy attention. It is costly for economic growth per worker as it leads to lower savings. Though elderly dependency remains low in the SSA region compared to the rest of the world, it could quickly become a serious public policy issue in an environment with large informal sector, weak pension and savings systems.

Informal economy is problematic for many reasons in the SSA region. One reason is that it does not provide social protection to its workers who become a financial burden for the economy when they get old and can no longer work.

The government should do two things to address this issue. First, the government should find a tax instrument which could tax the informal sector implicitly including through consumption tax to build fiscal space to support future costs of the elderly dependency. The second is the set of economic policies to structurally transform economies to increase the share of manufacturing which would eventually reduce informal sector. Beyond economic policies, governance should be improved to strengthen trust in governments by individuals to dare formality.

Longevity is good on its own but also for economic growth. And, long life expectancy can be achieved in the SSA region. First advice is any GDP growth will help. This recommendation might seem contradictory as longevity is a driver of growth. But the point here is to say economic growth slowdown should be avoided as it would lead lower life expectancy which in turn will hurt future economic growth, leading to a vicious circle.

Next, the fight against HIV should be intensified. The negative impact of HIV prevalence on life expectancy is a reminder that high disease prevalence is a problem in general. The world including the SSA region is facing the COVID-19, with its toll of deaths. African countries need to improve their public health system to cope with a new world which could be strained with future pandemics as seen with the COVID-19. Unprepared, countries in the SSA could suffer significant reduction in life expectancy.

Strengthening education in general and for females remain relevant for economic growth. It should continue to deserve public policy attention. Education of

female support economic growth, increases likelihood of women to participate to labor market, reduces early age marriage, provides enough awareness to women about contraceptive methods and childcare.

To illustrate the benefits on population growth and income growth per capita from changes in demographic policies. We simulate the impact of four policy changes: increase in female primary school enrollment, reduction of HIV prevalence, increase of marriage age of women, and boost of urbanization ratio. For full details on simulations of policy changes and results (Annex on policy simulations).

We find the following results. On population growth, the simulations show that reducing HIV prevalence would result in higher population growth—the largest effect on population change (0.4 percentage point). This result is sensible as it reflects how deadly this pandemic has been on the SSA population. Reducing HIV prevalence would extend life expectancy.

Increasing marriage age by 2 years (about 10 percent) from about 21 years on average in the countries sample to 23 years would have the second largest effect, reducing population growth by 0.3 percentage point.

Infant mortality rate reduction by 10 percent would reduce population growth by 0.09 percentage point.

An increase by 10 percent of the female enrollment would raise population growth by 0.07 percentage point. This effect is the combined effects from impact of female enrollment on life expectancy and fertility. The former increases life expectancy, hence, pushes up population growth rate while the latter reduces fertility, thus

population growth. The combined effect is positive because the effect on life expectancy is larger than on fertility.

Conducting all four policy changes at once would result in an increase of population growth rate by 0.1 percentage point, thanks the dominating effects of life expectancy.

On the per capita income growth, the impact comes from both population changes but also direct benefit from increase from life expectancy following some policy change simulation.

Assuming the same size of policy change as in the previous paragraph, change in marriage age would boost per capita income growth by 0.3 percentage point through its reduction effect on population change. That impact is about 15 percent of the average annual per capita income growth in Sub Saharan Africa over the last 20 years.

Reducing infant mortality rate by 10 percent would generate 0.09 percentage point of per capita income growth. Infant mortality has the second largest effect on income growth per capita after marriage age.

HIV prevalence is found to have the third largest impact on per capita income through its impact on life expectancy. Reducing HIV prevalence by 10 percent would raise per capita income by 0.08 percentage point.

Increasing female enrollment rate at primary school would boost per capita income growth by about 0.04 percentage point.

If government change all four policy at once, per capita income would soar by about 0.5 percentage point, equivalent to 25 percent of the SSA income per capita growth over the Africa rising period.

III. Future Research

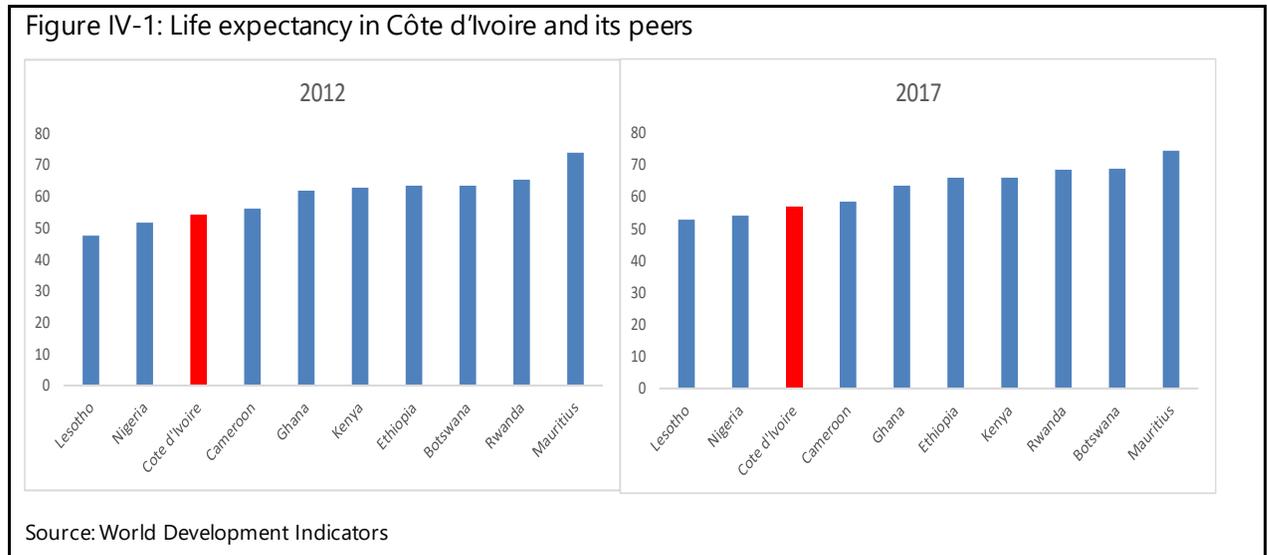
Based on its findings, this thesis leaves a major unknown. That is what should be the structure of the new HRV diagnostic tree. The HRV tree should include characteristics of population structure and growth which determine economic growth. The challenges are twofold. First, it is important to decide which demographic factors to include. Second, once the tree incorporates the demographic factors, are the current tests allowing to consider or rule out potential constraints be appropriate to deal with the demographic factors.

Once the structure of the augmented HRV framework would be suggested, it would critical to apply it to several economies starting to assess how well this new framework would perform compared to the current HRV tree. One could start with Côte d'Ivoire and compare the diagnostic under the augmented tree with the results discussed in this thesis.

To illustrate briefly the importance of such research, we refine the HRV diagnostic done in the chapter 1. We look at three demographic factors found critical in our chapter 2 and 3 and see what additional constraints could be identified. We look at Côte d'Ivoire performance on life expectancy, elderly dependency and population growth rate compared to its peers.

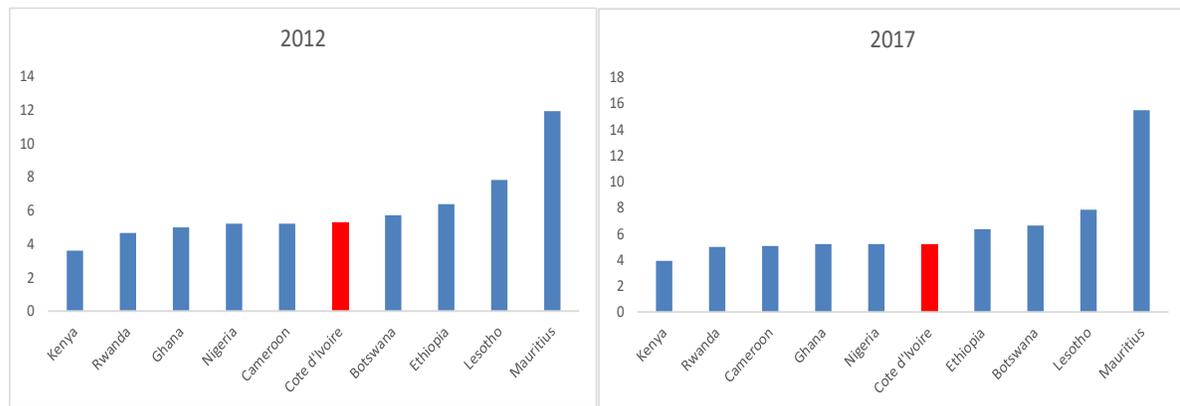
On life expectancy, Côte d'Ivoire lags behind most of its peers (Figure IV-1). It has the third lowest life expectancy of the group. This ranking has not changed over the five years of unprecedented growth unlike Kenya and Botswana which have taken over their immediate competitors at the end of 2017. Short life expectancy is problematic for sustained economic growth. In fact, life expectancy is not only

reflective of the population health but also it is a measure of a country return on its investment in education and health of its population. The longer people live, the more they can contribute to income growth through sustained productivity and human capital quality. In simple terms, Côte d'Ivoire spends its people who die too early preventing the country to reap their expected contribution to income.



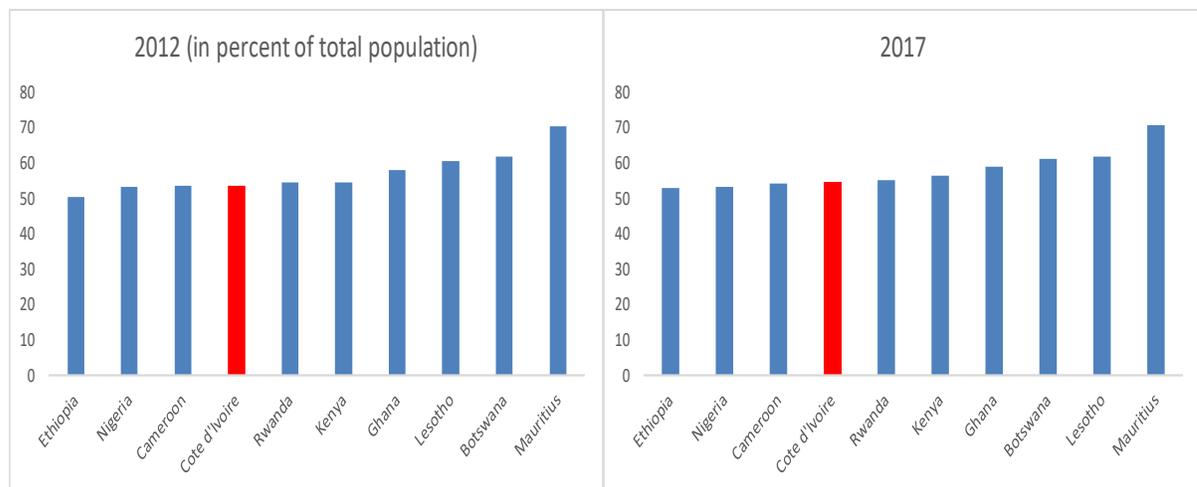
Surprisingly, Côte d'Ivoire has a relatively high elderly dependency ratio compared to its peers (Figure IV-2). Côte d'Ivoire ranks sixth among the comparative group of ten countries on elderly dependency ratio. One would have expected Côte d'Ivoire to be among the lowest on dependency ratio as it has one of the lowest life expectancy. This false paradox is explained by low ratio of working age population in Côte d'Ivoire compared to its peers. The elderly dependency ratio is the elderly population divided by the working age population (Figure IV-3).

Figure IV-2: Elderly dependency ratio (percent of working age population)



Source: World Development Indicators

Figure IV-3: Working-age population (percent of total population)



Source: World Development Indicators

This brief exercise of the HRV tree considering explicitly demographics points to key demographic factors as being a key constraints for medium term economic growth in Côte d'Ivoire. The analysis shows how the conclusion of the traditional HRV analysis could be improved by including demographic factors. It begs therefore for dedicating a new piece of research to propose an augmented HRV tree which would include the main findings of the chapter 2 and 3.

Finally, HRV diagnostic could also on sectoral diagnostic. Our findings in the chapter 1 focus on macro constraints, at the overall level of the economy. The analysis does not shed light on the constraints in sector specific. Yet, it is not proven that constraints are the same for all economic sectors. In case where economy wide constraints differ from sectoral ones, focusing on policies tackling only wide economy constraints would be insufficient to induce overall economic growth. A related research could look at demographic conditions for structural transformation from less productive sectors to more productive ones.

IV. Annex: Policy Simulations

This annex simulates the impact on economic growth per capita and population change of policy change in demographic change.

In the chapter 2, we established the relationship between economic growth per capita, economic growth per worker and population growth as follows:

$$Y/N_{gr} \cong \left(\frac{Y}{L}\right)_{gr} + L_{gr} - N_{gr} \quad (1)$$

With per capita output growth (Y/N_{gr}), income per worker (Y/L_{gr}), L_{gr} the working age population growth and total population growth.

We consider that the change in working age population growth is influenced by the change in mortality rate (M_{gr}). In fact, working age population falls when mortality rises and working population growth rises when mortality falls. Working age population growth is not instantaneously influenced birth rate. Therefore, from a static point of view, we pose the following:

$$L_{gr} = \rho M_{gr} \quad (2)$$

Combining equation (1) and (2), we pose the following:

$$Y/N_{gr} \cong \left(\frac{Y}{L}\right)_{gr} + \rho M_{gr} - N_{gr} \quad (3)$$

The next section explains the impact of demographic policy changes on population growth.

Population change (N_{gr}) is determined by birth rate (B_{gr}), mortality (M_{gr}) and immigration (I_{gr}).

$$N_{gr} = B_{gr} - M_{gr} + I_{gr} \quad (4)$$

We showed that I_{gr} impact is marginal on population change in the SSA in chapter 3 of the thesis, therefore we posit the following:

$$N_{gr} \cong B_{gr} - M_{gr} \quad (5)$$

We posit that the change in birth rate (B_{gr}) is mainly determined by the change in fertility rate ($Fertility_{gr}$); with fertility being number of live births. The relationship is as follows:

$$B_{gr} \cong \beta Fertility_{gr} \quad (6)$$

Similarly, we posit that mortality rate is mainly determined by life expectancy ($LifE$) linked through a coefficient (θ). Mortality reflects the health of a population which measured by life expectancy.

$$M_{gr} \cong \theta LifE_{gr} \quad (7)$$

With $LifE_{gr}$ is the change in the life expectancy.

Using equation (7), we can rewrite equation 3 as follows:

$$Y/N_{gr} \cong \left(\frac{Y}{L}\right)_{gr} + \rho\theta LifE_{gr} - N_{gr} \quad (8)$$

Inputting equations (6) and (7) into equation (5) yields:

$$N_{gr} \cong \beta Fertility_{gr} - \theta LifE_{gr} \quad (9)$$

We use equation 9 to simulate the marginal effect of an explanatory variable of either fertility or life expectancy on population growth rate.

Inputting equation 9 into equation 8, we get the following:

$$Y/N_{gr} \cong \left(\frac{Y}{L}\right)_{gr} + \rho\theta LifE_{gr} - (\beta Fertility_{gr} - \theta LifE_{gr}) \quad (10)$$

$$Y/N_{gr} \cong \left(\frac{Y}{L}\right)_{gr} - \beta Fertility_{gr} + (1 + \rho).\theta LifE_{gr} \quad (11)$$

The specification of our model from the chapter 2 of the thesis establishes a relation between labor productivity and its determinants, including life expectancy. The expression is as follows:

$$Y/L_{grit} = \alpha' + \beta'(Z)_{it} - c \ln\left(\frac{Y}{L_{it}}\right) + L_{grit} + af_i + bT_t + \varepsilon_{it} \quad (12)$$

With Z economic and demographic variables including life expectancy, initial income per worker, f time invariant effect, T country invariant variable.

We rewrite equation 12 as follows:

$$Y/L_{grit} = \alpha' + \partial LifE_{gr} + \beta'(Z_1)_{it} - c \ln\left(\frac{Y}{L_{it}}\right) + L_{grit} + af_i + bT_t + \varepsilon_{it} \quad (13)$$

With Z_1 all other economic and demographic variables excluding life expectancy.

Equation 13 can be rewritten as follows:

$$Y/L_{grit} = \partial LifE_{gr} + \delta X_{it} + \varepsilon_{it} \quad (14)$$

With X_{it} a vector of variables including all other variables and terms excluding life expectancy variable.

Equation 14 is rewritten as:

$$Y/L_{grit} \cong \partial LifE_{gr} + \delta X_{it} \quad (15)$$

Inserting equation 15 into equation 11, we get:

$$Y/N_{gr} \cong \partial LifeE_{gr} + \delta X_{it} - \beta Fertility_{gr} + (1 + \rho) \cdot \theta LifeE_{gr} \quad (16)$$

$$Y/N_{gr} \cong -\beta Fertility_{gr} + (\partial + (1 + \rho) \cdot \theta) LifeE_{gr} + \delta X_{it} \quad (17)$$

We keep equation 17 as our main equation to simulate the marginal effect of an explanatory variable of either fertility or life expectancy on income growth per capita. To simulate the impact of policy change, we would assume some changes in some explanatory variables of fertility or life expectancy model specification established in the chapter 3. These changes would result in changes in fertility and/or life expectancy variables in equations (9) and (17), leading to changes in our variables of interest, namely population change and income per capita growth.

For practical purposes, we estimate ρ , β , θ as follows. For ρ , we divide the working age population rate change by the life expectancy (log) change from 2000 to 2015. For β , we divide the birth rate change with fertility rate change from 2000 to 2015. For θ , we divide the mortality rate change with the life expectancy change from 2000 to 2015. All coefficients are stable throughout the period (2000-2015). So, we use the coefficients values for 2015. All these estimates use the same data sample of chapter 2 and chapter 3. ∂ is already known from chapter 2 regression estimate.

We simulate four policy changes: i) increase on female enrollment, ii) reduction of HIV prevalence, iii) increase of first marriage age, and iv) reduction of infant mortality. We estimate their impact on population growth and income per capita growth (Table Iv-1).

On population growth, the simulations show that reducing HIV prevalence would result in higher population growth—the largest effect on population change (0.4 percentage point). This result is sensible as it reflects how deadly this pandemic has

been on the SSA population. Reducing HIV prevalence would extend life expectancy, hence lower deaths.

Increasing marriage age by 2 years (about 10 percent) from about 21 years on average in the countries sample to 23 years would have the second largest effect, reducing population growth by 0.3 percentage point.

Infant mortality rate reduction by 10 percent would reduce population growth by 0.09 percentage point.

An increase by 10 percent of the female enrollment would raise population growth by 0.07 percentage point. This effect is the combined effects from impact of female enrollment on life expectancy and fertility. The former increases life expectancy, hence, push up population growth rate while the latter reduces fertility, thus population growth. The combined effect is positive because the effect on life expectancy is larger than on fertility.

Conducting all four policy changes at once would result in an increase of population growth rate by 0.1 percentage point, thanks the dominating effects of life expectancy.

On the per capita income growth, the impact comes from both population changes but also direct benefit from increase from life expectancy following some policy change simulation.

Assuming the same size of policy change as in the previous paragraph, change in marriage age would boost per capita income by 0.3 percentage point through its

reduction effect on population change. That impact is about 15 percent of the average per capita income growth in Sub Saharan Africa over the last 20 years.

Reducing infant mortality rate by 10 percent would generate 0.09 percentage point of per capita income growth. Infant mortality has the second largest effect on income growth per capita after marriage age.

HIV prevalence is found to have the third largest impact on per capita income through its impact on life expectancy. Reducing HIV prevalence by 10 percent would raise per capita income by 0.08 percentage point.

Increasing female enrollment rate at primary school would boost per capita income growth by about 0.04 percentage point.

If government change all four policy at once, per capita income would soar by about 0.5 percentage point, equivalent to 25 percent of the SSA income per capita growth over the Africa rising period.

Table IV-1: simulation of policy changes on population growth and income growth per capita

Policy variables	Female schooling	HIV prevalence	Marriage age	Infant mortality	Total effect
Description of the policy change	Increase of female primary school enrollment ratio	Reduction of the prevalence rate	Increase of marriage age by 2 years	Reduction of the infant mortality rate	All policies at once
Size of the change	0.1	-0.1	0.1	-0.1	
Change in Fertility rate	-0.0004		-0.0049	-0.0014	-0.0066
Change in life expectancy (log)	0.0001	0.0006			0.0008
Population growth (change in percentage)	0.07	0.43	-0.30	-0.09	0.12
GDP per capita growth (change in percentage)	0.04	0.08	0.30	0.09	0.50
Memorandum					
ρ	-0.82				
θ	-6.99				
β	0.62				
d	2.47				

BIBLIOGRAPHY

- Andersen, T., & Jensen, P. (2013). *Is Africa's Recent Growth Sustainable* . Discussion Papers on Business and Economics.
- Angora, A., & Tarazi, A. (2011). Banking crises in WAEMU countries: an early warning system based on multinomial logit approach.
- Apt, N. A. (2001). *Rapid Urbanization and Living Arrangements of Older Persons in Africa*. Legon: Center for Social Policy .
- Bank, W. (2008). *Local governance and national crisis in Côte d'Ivoire*.
- Bank, W. (2013). An Analysis of issues shaping Africa's economic future . *Africa's pulse* .
- Bank, W. (2018). *Cote d'Ivoire facing climate change challenges*. Washington DC: World Bank.
- Barlow, R., & Vissandjee, B. (1999). Determinants of National Life Expectancy . *Canadian Journal of Development Studies*, 9-29.
- Barrett, C., & Shimeles, A. (2017). *On the Structural Transformation of Rural Africa*. Oxford: Journal of African Economies.
- Bergh, A., & Nilsson, T. (2009). *Good For Living? On the Relation Between Globalization and Life Expectancy*. Las Vegas.
- Beyeza-Kashesya, J., Neema, S., Ekstrom, A., & Kaharuza, F. (2010). *“Not a Boy, Not a Child”: A Qualitative Study on Young*. Stockholm.
- Bhatti , S. H. (2013). Estimation of the Mincerian Wage Model Addressing its Specification and Different Econometric Issues.
- Bloom , D. E., Canning, D., & Graham, B. (2003). Longevity and Life Cycle Savings. 319-338.
- Bloom , D., & Prettnner , K. (2016). Africa's prospects for Enjoying a Demographic Dividend. *NBER Working paper* .
- Bloom, D., & Canning, D. (2007). Commentary: The Preston curve 30 years on: Still sparking.
- Bongaarts, J. (2008). Fertility Transitions in Developing Countries: Progress or Stagnation. *Studies in family planning*, 105-110.
- Bongaarts, J. (2011). Can family planning programs reduce high desired family size in sub Saharan Africa? *International Perspectives on Sexual and Reproductive Health*, 209-216.
- Bongaarts, J., & Casterline , J. (2012). Fertility Transition: Is Sub Saharan Africa Different? *Population and Development Review*, 153-168.
- Bor, J., Rosen, S., & Chimbind, N. (2015). Mass HIV Treatment and Sex Disparities in Life Expectancy: Demographic Surveillance in Rural South Africa. *PLoS Med*.
- Brockerhoff, M., & Xiushi, Y. (1994). Impact of migration on fertility in su-Saharan Africa. *Social Biology* , 19-43.
- Burkhart, R. (1997). Comparative Democracy and Income Distribution: Shape and Direction of the Causal Arrow. *The Journal of Politics*, 148-164.
- Center, P. R. (2015). *The Future of World Religions : Population growth, 2010-2050*.

- Channon, M., & Harper, S. (2018). *How education mitigates the realisation of fertility intentions: Is sub-Saharan Africa different?* Oxford: Institute of Ageing population.
- Chawala, S. (1996). The eradication of poverty in old age . *United Nations Bulletin on Ageing*, 4-8.
- Collier, P., & Gunning, J. (1999). *Explaining African Economic Performance*. Journal of Economic Literature.
- De Jong, E., Smits, J., & Longwe, A. (2017). Estimating the Causal Effect of Fertility on Women's Employment in Africa Using Twins. *World Development*, 360-368.
- Easterly, W. (2001). *The Lost Decades: Developing Countries' Stagnation in Spite of Policy Reform 1980-1990s*. Washington DC: World Bank.
- EDWARDS, R. (2016). Mining away the Preston curve. *World Development* , 22-36.
- Ezeh, A., Mberu, B., & Emina, J. (2009). Stall in fertility decline in Eastern African countries: regional analysis of patterns, determinants, and implications. *The Royal society* , 2991-3007.
- Fayisaa, B., & Nsiah, C. (2013). The impact of governance on economic growth in Africa. *Journal of Developing Areas*.
- Fink, G., & Peet, E. (2014). Returns on Education in Low and Middle INcome Countries: Evidence from the Living Standards and Measurement Surveys. *Program on the Global Aging (Harvard University)*.
- Forum, W. E. (2007). *The GLocal Competitiveness Report 2006-2007*. Geneva.
- Forum, W. E. (2018). *The Global Competitiveness Report 2017-2018*.
- Fosu, A. K. (1992). Political instability and Economic Growth: Evidence from Sub Saharan Africa . *The University of Chicago Press Journals* , 829-841.
- Fosu, A. K. (2016). The Recent Growth Resurgence in Africa and Poverty Reduction: Assessing the context and Evidence. *CSAE Working Paper*.
- Gelb, A., Meyer, C., & Vijaya, R. (2014). Development as Diffusion: Manufacturing productivity and sub-Saharan Africa's Missing Middle . *Center for Global Development*.
- Ghazanchyan, M., & Stotsky, J. (2013). Drivers of Growth: Evidence from Sub-Saharan African Countries. *IMF, Working paper* .
- Golub, S., & Hayat, F. (2014). Employment, Unemployment , and Underemployment in Africa . *Wider Working paper*.
- Grant , M., & Hallman, K. (2008). Pregnancy-related School Dropout and Prior School Performance in KwaZulu-Natal, South Africa . *Studies in Family Planning* , 369-382.
- Grosse , R., & Auffrey, C. (1989). Literacy and Health Status in Developing Countries . *Annual Review for Public Health* , 281-297.
- Grosse , R., & Perry , B. (1982). Correlates Of Life Expectancy in Less Developed Countries . *Health and Policy Education* , 275-304.
- Group, A. D. (2014). *Tracking Africa's Progress in Figures*.
- Hanmer, L., Lensink , R., & White , H. (2003). Infant and Child Mortality in Developing Countries: Analysing the Data for Robust Determinants . *The Journal of Development Studies* , 101-118.

- Harwood-Lejeune. (2001). Rising Age at Marriage and Fertility in Southern and Eastern Africa. *European Journal of Population* , 261-280.
- Hausmann, R., & Hidalgo , C. (2009). *Supplementary material for : the building blocks of economic complexity*. Cambridge : Center for International Development, Harvard University .
- Hausmann, R., & Hidalgo , C. (2009). *The building blocks of economic complexity* . Center for International Development, Harvard University .
- Hausmann, R., & Hidalgo, C. (2009). *The building blocks of economic complexity*. Cambridge: Center for International Development .
- Hausmann, R., & Klinger , B. (2008). Growth Diagnostic: Peru . *Center For International Development* .
- Hertrich, V. (2017). Trends in Age at Marriage and the Onset of Fertility Transition in sub-Saharan Africa. *Population and Development Review*, 112-137.
- IMF. (1964). *Ivory Coast-- 1963 Article XIV Consultations*.
- IMF. (1973). *Ivory Coast: Staff Report and proposed Decision for the 1973 Article XIV Consultation* .
- IMF. (1978). *Ivory Coast--Staff Report and Proposed decision for the Article XIV Consultation 1978*.
- IMF. (1980). *Ivory Coast: Staff Report for the 1979 Article XIV Consultation*.
- IMF. (1980). *Ivory Coast--Staff Report for the Article IV Consultation* .
- IMF. (1981). *Ivory Coast--Staff Report for the 1980 Article IV Consultations* .
- IMF. (1982). *1982 Article IV Consultation Statistical Annex*.
- IMF. (1983). *Ivory Coast---Staff Report for the 1982 Article IV Consultation and Review of the Extended Arrangement*.
- IMF. (1985). *Ivory Coast--Staff Report for the 1985 Article IV Consultation and Request for a Stand By Arrangement* .
- IMF. (1987). *Cote d'Ivoire--Staff Report for the 1987 Article IV Consultation and Request for a Stand By Arrangement*.
- IMF. (1990). *Cote d'Ivoire--Staff Report for the Second Review of the Stand By Arrangement* .
- IMF. (1991). *Cote d'Ivoire--Staff Report for the 1991 Article IV Consultation and Request for Stand By Arrangement*.
- IMF. (1994). *Cote d'Ivoire--Staff Report for the 1994 Article IV Consultation and Request for Enhanced Structural Adjustment Facility* .
- IMF. (1995). *Cote d'Ivoire--Request for the second Annual Arrangement under the Enhanced Structural Adjustment Facility*.
- IMF. (1995). *Cote d'Ivoire--Staff Report for the 1995 Article IV Consultation and Midterm Review of the Second Annual Arrangement under the Enhanced Structural Adjustment Facility*.
- IMF. (1995). *Cote d'Ivoire--Staff Report for the 1995 Article IV Consultation and Midterm Review under the Second Annual Arrangement under the Enhanced Structural Adjustment Facility*.

- IMF. (1996). *Cote d'Ivoire: Staff Report for the Article IV Consultation and Midterm Review under the Third Annual Arrangement Under the Enhanced Structural Adjustment Facility*.
- IMF. (2013). *Cote d'Ivoire: Third Review Under the Three Year Arrangement under the Extended Credit Facility*.
- IMF. (2017). *Restarting the Growth Engine*. Regional Economic Outlook (Sub Saharan Africa).
- IMF. (2018). *Cote d'Ivoire: 2018 Article IV Consultation and Third Review under the Extended Credit Facility*.
- IMF. (2018). *Domestic Revenue Mobilization and Private Investment*. Regional Economic Outlook (Sub Saharan Africa).
- Ja, H. (1974). The effect of high infant and child mortality on fertility: the west African case. *Concerned Demography*, 22-35.
- Jetter, M., Laudage, S., & Stadelmann, D. (2016). The Intimate Link between Income Levels and Life Expectancy: Global Evidence from 213 Years. *Econstor*.
- Jones, S., Page, J., & Shimeles, A. (2015). *Aid, Growth and Employment in Africa*. African Development Review.
- Juhn, C., Kalemli-Ozcan, S., & Turan, B. (2008). HIV and fertility in Africa: First evidence from population based surveys. *NBER working paper series*.
- Kabir, M. (2009). Determinants of Life Expectancy in Developing Countries. *The Journal of Developing Areas*, 185-204.
- Kelley, A. (1973). Population Growth, the Dependency Rate and the Pace of Economic Development. *Population studies*, 405-414.
- Kone, A. (2018). *Cote d'Ivoire: Use of lands, changes in lands and forest allocation*. World Observatory for Non Governmental Climate Action.
- Koski, A., Clark, S., & Nandi, A. (2017). Has child marriage declined in sub Saharan Africa? An analysis of Trends in 31 countries. *Population and Development Review*, 7-29.
- Kraydal, O. (2002). Education and fertility in sub Saharan Africa: individual and community effects. *Demography*, 233-250.
- Kuhn, R. (2010). Routes to Low Mortality in Poor Countries Revisited. *Population And Development Review*, 655-692.
- Lee, R., Mason, A., & Miller, T. (1998). *Saving, wealth, and Population*.
- Leff, N. H. (1969). Dependency Rates and Savings Rates. *The American Economic Review*, 886-896.
- Lin, R.-T., Chen, Y.-M., Chien, L.-C., & Chan, C.-C. (2012). Political and social determinants of life expectancy in less developed countries: a longitudinal study. *Bio Med Central*, 1471-2458.
- Mace, R., & Sear, R. (1997). Birth interval and the sex of children in traditional African population: an evolutionary analysis. *Journal of biosocial science*, 499-507.
- Mackenbach, J., Hu, Y., & Looman, C. (2013). Democratization and Life Expectancy in Europe, 1960-2008. *Social Science and Medicine*, 1-10.

- McCarthy, D., & Wolf, H. (2001). Comparative Life Expectancy. *Policy Research Working paper*.
- McCullough, E. (2017). *Labor productivity and employment gaps in Sub Saharan Africa*. Elsevier.
- Mogstad, M., & Wiswall, M. (2010). Linearity in instrumental variables estimation: Problems and solutions. *IZA Discussion Papers*.
- Mogstad, M., & Wiswall, M. (2010). Linearity in instrumental variables estimation: Problems and solutions. *IZA Discussion Papers*.
- Noumba, I. (2004). *Are wealthier Nations Healthier Nations? A Panel Data Approach to the Determinants of Human Development in Africa*. Somerset West: Forum Paper.
- Obiyan, M., Akinlo, A., & Ogunjuyigbe, P. (2019). Maternal Socioeconomic Status and Fertility behaviour in Nigeria: Evidence from Cross Sectional Nationally Representative Survey. *European Scientific Journal*.
- Okech, T., Wawire, N., & Mburu, T. (2011). Contraceptive Use among Women of Reproductive Age in Kenya's City Slums. *International Journal of Business and Social Science*.
- Page, J. (2012). *Can Africa industrialise?* Oxford: Journal of African Economies.
- Parliament, E. (2016). Africa's economic growth: take off or slowing down?
- Pritchett, L., & Summers, L. (1993). *Wealthier is Healthier*. Washington DC: World Bank.
- Radelet, S. (2016). Africa's Rise-Interrupted? *Finance and Development*.
- Robinson, P. M. (1991). Best Nonlinear Three-Stage Least Squares Estimation of Certain Econometric Models. *Econometrica*, 755-786.
- Rodrik, D. (2016). An African Growth Miracle? *Journal of African Economies*, 1-18.
- Rodrik, D. (2017). The Recent Growth Boom in Developing Economies: A structural change perspective.
- Sachs, J., & Warner, A. (1997). Fundamental sources of long run growth. *The American Economic Review*.
- Shapiro, D., & Gebreselassie, T. (2014). Marriage in Sub-Saharan Africa: Trends, Determinants, and Consequences. *Popul Res Policy Rev*, 229-255.
- Shapiro, D., & Tenikue, M. (2017). Women's education, infant and child mortality and fertility decline in urban and rural sub-Saharan Africa. *Demographic Research*, 669-708.
- Siegel, J., & Shryock, H. (1973). *The methods and materials of demography*. Washington: Bureau of Census, US Dept of Commerce.
- Takyi, B. (1993). *The Status of Women and Fertility Behavior in Sub Saharan Africa: The effects of Female Labor Force Participation and Gender Preferences on Fertility in Ghana*. State University of New York.
- The African Capacity Building Foundation. (2017). Drivers of Economic Growth In Africa. *Occasional Paper*.
- Towriss, C., & Timaeus, I. (2018). Contraceptive use and lengthening birth intervals in rural and urban Eastern Africa. *Demographic Research*, 2027-2052.

- Turbat, V., May, J., & Groth, H. (2017). Policies Needed to Capture a Demographic Dividend in sub Saharan Africa. *International Population Conference*. Cape Town: African Population and Health Research Center.
- Verdeaux, F. (1998). The paradox and rationality of deforestation in Ivory Coast. *LSS*, 26-35.
- Vogl, T. (2005). New Routes to Low in Poor Countries? Crossover in the Roles of Income and Female Education. *Undergraduate Economic Review*.
- Wei, Z., & Hao, R. (2010). Demographic structure and economic growth: Evidence from China. *Journal of Comparative Economics*, 472-491.
- White, M., Tagoe, E., Stiff, C., Kubaje, A., & Smith, D. (2005). Urbanization and the fertility transition in Ghana. *Population Research and Policy Review*, 59-83.
- Young, A. (2004). The Gift of the Dying: the Tragedy of AIDS and the Welfare of Future African Generations. *NBER Working Paper Series*.



Ecole Doctorale d'Économie

THESE (version résumée en français) Présentée par

Gbedia Gomez Agou

Défendue le 08 octobre 2020

Pour l'obtention le titre de Docteur par **l'Université de Paris I Sorbonne-Panthéon**

Discipline : **Sciences Economiques**

ESSAIS SUR LA CROISSANCE ECONOMIQUE ET LA DEMOGRAPHIE EN AFRIQUE SUB-SAHARIENNE

Directeur de thèse : Professeur Emérite Jean-Claude Berthelemy

Rapporteurs

Dr. Patrick Plane, Directeur de la recherche, CNRS, CERDI, Université de Auvergne

Dr. Dramane Coulibaly, Maître de Conférence, Université de Paris-Nanterre

Présidente du jury : Dr. Maurel, Directrice du Centre d'économie de la Sorbonne

Jury Members

Dr. Berthelemy, Professeur Emérite

Dr. Patrick Plane, Directeur de la recherche, CNRS, CERDI, Université de Auvergne

Dr. Dramane Coulibaly, Maître de Conférence, Université de Paris-Nanterre

Dr. Joaquim Oliveira, Directeur adjoint, OCDE

Contents

I. Contexte.....	235
II. Problématiques de la recherche et contribution à la littérature.....	237
III. Objectives et méthodologies de la recherche	241
IV. Plan de la thèse.....	243
V. Principaux résultats de la thèse	245
Bibliography.....	247

I. CONTEXTE

En 2017, le Président Français a ravivé le débat sur le rôle de la démographie sur le développement économique en Afrique Sub-Saharienne (ASS). Il a affirmé que le développement sur le continent serait quasiment impossible si la fertilité restait élevée.

Cette déclaration a relancé le débat entre les courants de pensée démographique : les pessimistes, les neutres et les optimistes. Les pessimistes soutiennent le point de vue du Président Macron. Les neutres soutiennent que la démographie ne joue pas de rôle sur la croissance économique. Le courant des optimistes considère que la démographie a un impact positif sur la croissance économique en ASS.

Le débat sur la démographie a refait surface après 20 ans de croissance économique sans précédent en ASS. La région ASS a connu trois principales périodes de croissance économique : 1970-1984 ; 1985-1995 ; 1995-2015. La première période fut marquée par une croissance baissière annuelle d'environ 3 pour cent avec une forte volatilité. La seconde période a connu une croissance annuelle plus faible de 2.4 pour cent. La troisième période a inversé la tendance baissière de la croissance avec une croissance moyenne de 4.6 pour cent par an.

Cependant, cette croissance économique ne s'est pas traduite en une augmentation proportionnelle du revenu par habitant en raison de la croissance démographique. Depuis la fin des années 1990, le revenu par tête s'est accru seulement par moins de deux pour cent, la moitié de la croissance moyenne du PIB sur la même période. Au cours de la même période, l'Union Européenne (UE) a connu une croissance du PIB de moitié comparée à celle de la région ASS. Et pourtant la croissance du revenu par habitant dans l'UE est comparable à celle de l'ASS.

II. PROBLEMATIQUES DE LA RECHERCHE ET CONTRIBUTION A LA LITTERATURE

La thèse apporte des éléments de réponses à la question suivante : la démographie joue-t-elle un rôle dans la croissance économique de la région ASS ? Si oui, comment ?

La littérature a produit trois méthodologies pour identifier les déterminants de la croissance économique : la comptabilité de la croissance, les régressions de données transversales et l'arbre de diagnostic de la croissance (HRV) de Hausman, Rodrik et Velasco. Chaque nouvelle méthode tentant de combler les limites de la méthode précédente.

Solow (1957) a introduit la comptabilité de la croissance permettant de décomposer la croissance économique d'un pays en trois facteurs contributifs : le capital physique, capital humain et le résidu—qui reflète la contribution des autres facteurs en dehors des deux susmentionnés. Le résidu, connu sous l'appellation de « résidu de Solow » ou Productivité Total des Facteurs, mesure la productivité d'une économie.

Toutefois la comptabilité de la croissance présente de limites. La méthode suppose une fonction de production à rendement d'échelle constant. Barro (1998) montre que les rendements d'échelle d'une fonction de production peuvent être croissants. Par ailleurs, l'application de la comptabilité de la croissance peut être difficile avec les défis de mesure statistique du niveau et de la qualité du capital physique (Pritchett, 2000). Une mauvaise mesure du capital peut conduire à une estimation erronée de sa contribution à la croissance économique. Enfin, la comptabilité de la

croissance ne donne pas d'information sur les facteurs sous-jacents des facteurs contributifs.

La seconde méthodologie, la régression transversale sur pays, permet d'estimer la contribution des déterminants de la croissance économique en utilisant des données sur un échantillon de pays. Les chercheurs ont expérimenté de nombreuses régressions de croissance économique. Le plus célèbre des travaux sur ces régressions est celui de Sala I Martin (1997).

Cependant, la régression transversale sur les pays a présenté des limites. Hausmann and al (2008) notent les limites majeures suivantes. Primo, la régression s'intéresse à la tendance moyenne de l'échantillon et non au comportement individuel des pays. Ainsi, les déterminants provenant de la régression ne sont pas nécessairement ceux tirant le comportement individuel d'un pays donné. Secundo, les variables significatives de la régression ne sont pas souvent des variables sous le contrôle direct des décideurs politiques, limitant les possibilités de changement. Aussi, la régression fait-elle l'hypothèse de la substitution de l'élasticité des variables indépendantes. Enfin, la régression n'établit pas un ordre de priorités des variables à adresser, conduisant à une longue liste de solutions.

Pour pallier les insuffisances de la régression, Hausmann, Rodrik et Velasco (2005) propose le diagnostic de croissance HRV. Cette méthodologie considère que l'investissement privé, le principal moteur de la croissance économique, fait face à un ensemble de contraintes dont certaines sont plus contraignantes que d'autres au niveau d'une économie donnée. Ces contraintes peuvent être soit du côté de la demande d'investissement privé ou de l'offre d'investissement privé (finance).

L'exercice de diagnostic HRV se focalise donc à identifier ses obstacles les plus contraignantes à la croissance afin de les adresser en priorité pour le pays individuel. La méthodologie HRV considère que les déterminants de la croissance économique sont complémentaires et non substituables. Pour identifier ces obstacles contraignants, les auteurs ont développé un ensemble de tests. La conduite de ses tests se fait de façon itérative.

Dans le cadre de notre recherche, utiliser la méthode HRV pour répondre à notre problématique serait difficile en raison du fait que les contraintes potentielles suggérées par la méthode HRV n'inclut pas explicitement des contraintes démographiques.

Le fait que la dernière méthodologie de diagnostic de la croissance économique n'inclut pas la démographie reflète dans une certaine mesure le manque d'attention que la question de l'impact de la démographie sur la croissance économique a eu dans la littérature ces dernières décennies. Ce manque d'attention est encore plus criard pour la région d'Afrique Sub-Saharienne. En effet, très peu de travaux se sont penchés sur la question (e.g. Barro, 1997 ; Bloom and Sachs, 1998 ; Kelley and Schmidt, 1999 ; Radelet and al, 2001 ; Kelley and Schmidt, 2004). Ensuite, ces recherches n'ont pas été menées spécifiquement sur la région ASS mais plutôt sur un échantillon de pays incluant des pays de la région ASS. Enfin, les périodes d'analyses des études les plus récentes s'arrêtent à la fin des années 1990.

Face à ces insuffisances, cette thèse fait trois contributions essentielles à la littérature. Primo, notre recherche évalue l'impact de la démographie sur la croissance économique exclusivement en Afrique sub-Saharienne, permettant d'avoir des résultats spécifiques à la région ASS. Ces résultats sont nécessaires pour

politiques publiques appropriées à la région ASS. Secundo, notre thèse éclaire sur le rôle joué par la démographie au cours de la période (2000-2015) de forte croissance économique connue par l'Afrique Sub-Saharienne. Tercio, notre travail identifie les déterminants de la croissance de la population de 1995 à 2015, spécifique l'Afrique Sub-Saharienne.

III. OBJECTIVE ET METHODOLOGIES DE LA RECHERCHE

L'objectif de notre recherche est de montrer que les facteurs démographiques sont des contraintes potentielles à la croissance économique en Afrique Sub-Saharienne. Par conséquent, ces facteurs démographiques devraient être prise en compte dans une analyse de diagnostic de croissance à la HRV.

Dans ce but, nous adoptons une approche en trois étapes. La première consiste à démontrer l'importance de la méthodologie HRV pour le diagnostic de la croissance d'une économie en Afrique Sub-Saharienne. La deuxième étape vise à établir un lien entre le profil démographique d'une population et la croissance économique par personne active. Enfin, nous identifions les déterminants de la croissance de la population qui déterminent la distribution du revenu par habitant.

Concernant la première étape, nous démontrons la valeur pratique de la méthode HRV pour le diagnostic des contraintes de croissance économique des pays de l'Afrique Sub-Saharienne. Nous illustrons cette utilité en appliquant la méthodologie HRV sur l'une des économies à croissance les plus fortes de la région : la Côte d'Ivoire.

La seconde et troisièmes étapes se basent sur la logique suivante : Nous considérons que la croissance économique se mesure par le PIB par tête. La variation du PIB par tête résulte de deux facteurs : la variation de la production par travailleur (approximée avec la population active) et la variation de la taille de la population.

Par conséquent, dans la deuxième étape, nous évaluons l'impact of facteurs démographiques sur la croissance du PIB par personne active. A cette fin, nous

utilisons un modèle de convergence inspiré des recherches précédentes (Barro, 1997 ; Kelley et al., 2004). Nous faisons une régression de panel avec le PIB par personne active comme variable dépendante et variables explicatives incluant non seulement les variables démographiques mais aussi les variables économiques et institutionnelle. Pour cela, nous utilisons les données de 1985-2015 de 29 pays d'Afrique Sub-Saharienne. Les autres pays d'Afrique Sub-Saharienne ne sont pas inclus en raison d'un manque de données.

A la troisième étape, nous identifions les déterminants de la croissance de la population en Afrique Sub-Saharienne. Pour cet exercice, nous nous focalisons sur les déterminants des principaux composants de la population. En effet, la variation de la taille de la population s'opère par trois composants : i) le nombre de naissance ou fertilité, ii) le nombre de décès reflétant l'espérance de vie, et iii) le nombre net de personnes migrantes. De cette équation, nous nous intéressons aux déterminants de la fertilité, l'espérance de vie et l'immigration. L'immigration représente une part marginale de la variation de la population, environ 5 pour cent de la variation démographique. Ainsi, nous limiterons seulement aux déterminants de la fertilité et l'espérance de vie. Nos données nous permettent de nous focaliser sur 29 pays pour une période allant de 1995 à 2015 pour faire des régressions de panel.

IV. PLAN DE LA THESE

Notre thèse a trois chapitres. Le chapitre 1 vise à réaffirmer l'importance du dernier cadre de diagnostic de la croissance économique, le cadre d'analyse HRV. Nous démontrons cette importance en le modèle HRV sur l'une des pays connaissant l'une des croissances économiques les plus rapides de l'Afrique Sub-Saharienne. Cette analyse permet d'identifier les obstacles les plus contraignants pour maintenir un niveau élevé de l'investissement privé dans le court et moyen terme. Dans ce contexte, nous faisons une revue de l'histoire de la croissance économique de la Côte d'Ivoire avant de s'intéresser à sa récente période de croissance débutant en 2012 pour identifier ses contraintes majeures pour le maintien d'une croissance économique soutenue.

Le chapitre 2 vise à montrer que la structure de la population impacte la croissance économique en Afrique Sub Saharienne. A cet effet, nous utilisons un modèle de convergence comprenant des variables économiques, institutionnelles et démographiques afin d'identifier les déterminants de la croissance économique au cours des trois dernières décennies (1985-2015) sur 29 pays de l'Afrique Sub saharienne. Le chapitre passe dans un premier temps en revue les développements démographiques depuis les indépendances. Ensuite, nous faisons une revue de littérature des principaux travaux sur le rôle de la démographie sur la croissance impliquant des pays d'Afrique Sub saharienne. Enfin, nous mettons en œuvre notre modèle de convergence susmentionné.

Le chapitre 3 a pour but d'identifier les déterminants de la croissance de la population. Dans cet objectif, nous nous focalisons sur les déterminants des composants de la croissance de la population en Afrique Sub Saharienne : la fertilité

et l'espérance de vie. D'abord, le chapitre passe en revue les évolutions des composants de la croissance démographique (fertilité, mortalité ou espérance de vie et immigration). Ensuite, le chapitre résume la littérature sur les déterminants de la fertilité et l'espérance de vie menées sur des pays incluant des pays d'Afrique Sub-Saharienne. Enfin, nous faisons des régressions de modèles de panels à variables instrumentales pour la fertilité et l'espérance de vie. Nous testons la robustesse de nos résultats du chapitre 2 et 3 en estimant deux équations simultanées.

V. PRINCIPAUX RESULTATS DE LA THESE

Notre travail doctoral démontre que la croissance et la structure démographique sont des déterminants significatifs de la croissance économique en Afrique Sub-Saharienne. Par conséquent, nous proposons que le cadre de diagnostic de croissance HRV soit raffiné en incluant l'analyse de la croissance et de la structure démographique dans la détermination des obstacles les plus contraignants à la croissance économique future d'un pays donné en Afrique Sub-Saharienne.

Spécifiquement, le chapitre 1 conclut que la corruption, l'accès limité au financement et la faible sophistication des exportations sont les principaux obstacles à une forte croissance sur le moyen terme. Ces résultats n'intègrent pas de facteurs démographiques en raison de la démarche méthodologique du cadre actuel HRV.

Le chapitre 2 permet de contredire la croyance populaire selon laquelle une croissance de la population active bénéficie nécessairement à la croissance économique par travailleur. Au contraire, en Afrique sub-Saharienne, nous trouvons que la croissance de la population active affecte négativement la croissance économique. La croissance rapide de la population active ne constitue la bouée de sauvetage de nos économies africaines. C'est plutôt une croissance de la population active cohérente avec les capacités du marché du travail pour absorber les nouveaux entrants provenant de cette population active. En plus, l'accroissement du taux de dépendance des personnes du troisième âge en Afrique Sub Saharienne impacte négativement l'augmentation du revenu par travailleurs. L'espérance de vie a une contribution positive sur la croissance économique.

Le chapitre 3 conclut que les plus grands facteurs influençant la fertilité sont l'âge au premier mariage et la participation des femmes au marché du travail. Ensuite, la baisse de la mortalité infantile serait tout aussi positivement impactant pour la fertilité que la promotion des méthodes contraceptives. Enfin, l'espérance de vie est principalement déterminée par le niveau de revenu, la prévalence du VIH, la démocratie et dans une moindre mesure l'éducation dans sa contribution intrinsèque.

BIBLIOGRAPHY

- Andersen, T., & Jensen, P. (2013). *Is Africa's Recent Growth Sustainable* . Discussion Papers on Business and Economics.
- Angora, A., & Tarazi, A. (2011). Banking crises in WAEMU countries: an early warning system based on multinominal logit approach.
- Apt, N. A. (2001). *Rapid Urbanization and Living Arrangements of Older Persons in Africa*. Legon: Center for Social Policy .
- Bank, W. (2008). *Local governance and national crisis in Côte d'Ivoire*.
- Bank, W. (2013). An Analysis of issues shaping Africa's economic future . *Africa's pulse* .
- Bank, W. (2018). *Cote d'Ivoire facing climate change challenges*. Washington DC: World Bank.
- Barlow, R., & Vissandjee, B. (1999). Determinants of National Life Expectancy . *Canadian Journal of Development Studies*, 9-29.
- Barrett, C., & Shimeles, A. (2017). *On the Structural Transformation of Rural Africa*. Oxford: Journal of African Economies.
- Bergh, A., & Nilsson, T. (2009). *Good For Living? On the Relation Between Globalization and Life Expectancy*. Las Vegas.
- Beyeza-Kashesya, J., Neema, S., Ekstrom, A., & Kaharuza, F. (2010). *"Not a Boy, Not a Child": A Qualitative Study on Young*. Stockholm.
- Bhatti, S. H. (2013). Estimation of the Mincerian Wage Model Addressing its Specification and Different Econometric Issues.
- Bloom, D. E., Canning, D., & Graham, B. (2003). Longevity and Life Cycle Savings. 319-338.
- Bloom, D., & Prettner, K. (2016). Africa's prospects for Enjying a Demographic Dividend. *NBER Working paper* .
- Bloom, D., & Canning, D. (2007). Commentary: The Preston curve 30 years on: Still sparking.
- Bongaarts, J. (2008). Fertility Transitions in Developing Countries: Progress or Stagnation. *Studies in family planning*, 105-110.
- Bongaarts, J. (2011). Can family planning programs reduce high desired family size in sub Saharan Africa? *International Perspectives on Sexual and Reproductive Health*, 209-216.
- Bongaarts, J., & Casterline, J. (2012). Fertility Transition: Is Sub Saharan Africa Different? *Population and Development Review*, 153-168.

- Bor, J., Rosen, S., & Chimbind, N. (2015). Mass HIV Treatment and Sex Disparities in Life Expectancy: Demographic Surveillance in Rural South Africa. *PLoS Med.*
- Brockerhoff, M., & Xiushi, Y. (1994). Impact of migration on fertility in sub-Saharan Africa. *Social Biology*, 19-43.
- Burkhart, R. (1997). Comparative Democracy and Income Distribution: Shape and Direction of the Causal Arrow. *The Journal of Politics*, 148-164.
- Center, P. R. (2015). *The Future of World Religions : Population growth, 2010-2050.*
- Channon, M., & Harper, S. (2018). *How education mitigates the realisation of fertility intentions: Is sub-Saharan Africa different?* Oxford: Institute of Ageing population.
- Chawala, S. (1996). The eradication of poverty in old age . *United Nations Bulletin on Ageing*, 4-8.
- Collier, P., & Gunning, J. (1999). *Explaining African Economic Performance.* Journal of Economic Literature.
- De Jong, E., Smits, J., & Longwe, A. (2017). Estimating the Causal Effect of Fertility on Women's Employment in Africa Using Twins. *World Development*, 360-368.
- Easterly, W. (2001). *The Lost Decades: Developing Countries' Stagnation in Spite of Policy Reform 1980-1990s.* Washington DC: World Bank.
- EDWARDS, R. (2016). Mining away the Preston curve. *World Development*, 22-36.
- Ezeh, A., Mberu, B., & Emina, J. (2009). Stall in fertility decline in Eastern African countries: regional analysis of patterns, determinants, and implications. *The Royal society*, 2991-3007.
- Fayisaa, B., & Nsiah, C. (2013). The impact of governance on economic growth in Africa. *Journal of Developing Areas.*
- Fink, G., & Peet, E. (2014). Returns on Education in Low and Middle Income Countries: Evidence from the Living Standards and Measurement Surveys. *Program on the Global Aging (Harvard University).*
- Forum, W. E. (2007). *The Global Competitiveness Report 2006-2007.* Geneva.
- Forum, W. E. (2018). *The Global Competitiveness Report 2017-2018.*
- Fosu, A. K. (1992). Political instability and Economic Growth: Evidence from Sub Saharan Africa . *The University of Chicago Press Journals*, 829-841.
- Fosu, A. K. (2016). The Recent Growth Resurgence in Africa and Poverty Reduction: Assessing the context and Evidence. *CSAE Working Paper.*
- Gelb, A., Meyer, C., & Vijaya, R. (2014). Development as Diffusion: Manufacturing productivity and sub-Saharan Africa's Missing Middle . *Center for Global Development.*

- Ghazanchyan, M., & Stotsky, J. (2013). Drivers of Growth: Evidence from Sub-Saharan African Countries. *IMF, Working paper* .
- Golub, S., & Hayat, F. (2014). Employment, Unemployment, and Underemployment in Africa . *Wider Working paper*.
- Grant, M., & Hallman, K. (2008). Pregnancy-related School Dropout and Prior School Performance in KwaZulu-Natal, South Africa . *Studies in Family Planning* , 369-382.
- Grosse, R., & Auffrey, C. (1989). Literacy and Health Status in Developing Countries . *Annual Review for Public Health* , 281-297.
- Grosse, R., & Perry, B. (1982). Correlates Of Life Expectancy in Less Developed Countries . *Health and Policy Education* , 275-304.
- Group, A. D. (2014). *Tracking Africa's Progress in Figures*.
- Hanmer, L., Lensink, R., & White, H. (2003). Infant and Child Mortality in Developing Countries: Analysing the Data for Robust Determinants . *The Journal of Development Studies* , 101-118.
- Harwood-Lejeune. (2001). Rising Age at Marriage and Fertility in Southern and Eastern Africa. *European Journal of Population* , 261-280.
- Hausmann, R., & Hidalgo, C. (2009). *Supplementary material for : the building blocks of economic complexity*. Cambridge : Center for International Development, Harvard University .
- Hausmann, R., & Hidalgo, C. (2009). *The building blocks of economic complexity*. Center for International Development, Harvard University .
- Hausmann, R., & Hidalgo, C. (2009). *The building blocks of economic complexity*. Cambridge: Center for International Development .
- Hausmann, R., & Klinger, B. (2008). Growth Diagnostic: Peru . *Center For International Development* .
- Hertrich, V. (2017). Trends in Age at Marriage and the Onset of Fertility Transition in sub-Saharan Africa. *Population and Development Review*, 112-137.
- IMF. (1964). *Ivory Coast-- 1963 Article XIV Consultations*.
- IMF. (1973). *Ivory Coast: Staff Report and proposed Decision for the 1973 Article XIV Consultation* .
- IMF. (1978). *Ivory Coast--Staff Report and Proposed decision for the Article XIV Consultation 1978*.
- IMF. (1980). *Ivory Coast: Staff Report for the 1979 Article XIV Consultation*.
- IMF. (1980). *Ivory Coast--Staff Report for the Article IV Consultation* .
- IMF. (1981). *Ivory Coast--Staff Report for the 1980 Article IV Consultations* .

- IMF. (1982). *1982 Article IV Consultation Statistical Annex*.
- IMF. (1983). *Ivory Coast---Staff Report for the 1982 Article IV Consultation and Review of the Extended Arrangement*.
- IMF. (1985). *Ivory Coast--Staff Report for the 1985 Article IV Consultation and Request for a Stand By Arrangement* .
- IMF. (1987). *Cote d'Ivoire--Staff Report for the 1987 Article IV Consultation and Request for a Stand By Arrangement*.
- IMF. (1990). *Cote d'Ivoire--Staff Report for the Second Review of the Stand By Arrangement* .
- IMF. (1991). *Cote d'Ivoire--Staff Report for the 1991 Article IV Consultation and Request for Stand By Arrangement*.
- IMF. (1994). *Cote d'Ivoire--Staff Report for the 1994 Article IV Consultation and Request for Enhanced Structural Adjustment Facility* .
- IMF. (1995). *Cote d'Ivoire--Request for the second Annual Arrangement under the Enhanced Structural Adjustment Facility*.
- IMF. (1995). *Cote d'Ivoire--Staff Report for the 1995 Article IV Consultation and Midterm Review of the Second Annual Arrangement under the Enhanced Structural Adjustment Facility*.
- IMF. (1995). *Cote d'Ivoire--Staff Report for the 1995 Article IV Consultation and Midterm Review under the Second Annual Arrangement under the Enhanced Structural Adjustment Facility*.
- IMF. (1996). *Cote d'Ivoire: Staff Report for the Article IV Consultation and Midterm Review under the Third Annual Arrangement Under the Enhanced Structural Adjustment Facility*.
- IMF. (2013). *Cote d'Ivoire: Thrid Review Under the Three Year Arrangement under the Extended Credit Facility*.
- IMF. (2017). *Restarting the Growth Engine*. Regional Economic Outlook (Sub Saharan Africa).
- IMF. (2018). *Cote d'Ivoire: 2018 Article IV Consultation and Third Review under the Extended Credit Facility*.
- IMF. (2018). *Domestic Revenue Mobilization and Private Investment* . Regional Economic Outlook (Sub Saharan Africa).
- Ja, H. (1974). The effect of high infant and child mortality on fertility: the west African case. *Concerned Demography*, 22-35.
- Jetter, M., Laudage, S., & Stadelmann, D. (2016). The Intimate Link between Income Levels and Life Expectancy: Global Evidence from 213 Years. *Econstor*.

- Jones, S., Page, J., & Shimeles, A. (2015). *Aid, Growth and Employment in Africa*. African Development Review.
- Juhn, C., Kalemli-Ozcan, S., & Turan, B. (2008). HIV and fertility in Africa: First evidence from population based surveys. *NBER working paper series*.
- Kabir, M. (2009). Determinants of Life Expectancy in Developing Countries. *The Journal of Developing Areas*, 185-204.
- Kelley, A. (1973). Population Growth, the Dependency Rate and the Pace of Economic Development. *Population studies*, 405-414.
- Kone, A. (2018). *Cote d'Ivoire: Use of lands, changes in lands and forest allocation*. World Observatory for Non Governmental Climate Action.
- Koski, A., Clark, S., & Nandi, A. (2017). Has child marriage declined in sub Saharan Africa? An analysis of Trends in 31 countries. *Population and Development Review*, 7-29.
- Kraydal, O. (2002). Education and fertility in sub Saharan Africa: individual and community effects. *Demography*, 233-250.
- Kuhn, R. (2010). Routes to Low Mortality in Poor Countries Revisited. *Population And Development Review*, 655-692.
- Lee, R., Mason, A., & Miller, T. (1998). *Saving, wealth, and Population*.
- Leff, N. H. (1969). Dependency Rates and Savings Rates. *The American Economic Review*, 886-896.
- Lin, R.-T., Chen, Y.-M., Chien, L.-C., & Chan, C.-C. (2012). Political and social determinants of life expectancy in less developed countries: a longitudinal study. *Bio Med Central*, 1471-2458.
- Mace, R., & Sear, R. (1997). Birth interval and the sex of children in traditional African population: an evolutionary analysis. *Journal of biosocial science*, 499-507.
- Mackenbach, J., Hu, Y., & Looman, C. (2013). Democratization and Life Expectancy in Europe, 1960-2008. *Social Science and Medicine*, 1-10.
- McCarthy, D., & Wolf, H. (2001). Comparative Life Expectancy. *Policy Research Working paper*.
- McCullough, E. (2017). *Labor productivity and employment gaps in Sub Saharan Africa*. Elsevier.
- Mogstad, M., & Wiswall, M. (2010). Linearity in instrumental variables estimation: Problems and solutions. *IZA Discussion Papers*.
- Mogstad, M., & Wiswall, M. (2010). Linearity in instrumental variables estimation: Problems and solutions. *IZA Discussion Papers*.

- Noumba, I. (2004). *Are wealthier Nations Healthier Nations? A Panel Data Approach to the Determinants of Human Development in Africa*. Somerset West: Forum Paper.
- Obiyan, M., Akinlo, A., & Ogunjuyigbe, P. (2019). Maternal Socioeconomic Status and Fertility behaviour in Nigeria: Evidence from Cross Sectional Nationally Representative Syrvey. *European Scientific Journal*.
- Okech, T., Wawire, N., & Mburu, T. (2011). Contraceptive Use among Women of Reproductive Age in Kenya's City Slums. *International Journal of BUsiness and Social Science*.
- Page, J. (2012). *Can Africa industrialise?* Oxford: Journal of African Economies.
- Parliament, E. (2016). Africa's economic growth: take off or slowing down?
- Pritchett, L., & Summers, L. (1993). *Wealthier is Healthier*. Washington DC: World Bank.
- Radelet, S. (2016). Africa's Rise-Interrupted? *Finance and Development*.
- Robinson, P. M. (1991). Best Nonlinear Three-Stage Least Squares Estimation of Certain Econometric Models. *Econometrica*, 755-786.
- Rodrik, D. (2016). An African Growth Miracle? *Jounral of African Economies*, 1-18.
- Rodrik, D. (2017). The Recent Growth Boom in Developing Economies: A structural change perspective.
- Sachs, J., & Warner, A. (1997). Fundamental sources of long run growth. *The American Economic Review*.
- Shapiro, D., & Gebreselassie, T. (2014). Marriage in Sub-Saharan Africa: Trends, Determinants, and Consequences. *Popul Res Policy Rev*, 229-255.
- Shapiro, D., & Tenikue, M. (2017). Women's education, infant and child mortality and fertility decline in urban and rural sub-Saharan Africa. *Demographic Research*, 669-708.
- Siegel, J., & Shryock, H. (1973). *The methods and materials of demography*. Washington: Bureau of Census, US Dept of Commerce.
- Takyi, B. (1993). *The Status of Women and Fertility Behavior in Sub Saharan Africa: THE effects of Female Labor Force Participation and Gender Preferences on Fertility in Ghana*. State University of New York.
- The African Capacity Building Foundation. (2017). Drivers of Economic Growth In Africa. *Occasional Paper*.
- Towriss, C., & Timaeus, I. (2018). Contraceptive use and lengthening birth intervals in rural and urban Eastern Africa. *Demographic Research*, 2027-2052.

- Turbat, V., May, J., & Groth, H. (2017). Policies Needed to Capture a Demographic Dividend in sub Saharan Africa. *International Population Conference*. Cape Town: African Population and Health Research Center.
- Verdeaux, F. (1998). The paradox and rationality of deforestation in Ivory Coast. *LSS*, 26-35.
- Vogl, T. (2005). New Routes to Low in Poor Countries? Crossover in the Roles of Income and Female Education. *Undergraduate Economic Review*.
- Wei, Z., & Hao, R. (2010). Demographic structure and economic growth: Evidence from China. *Journal of Comparative Economics*, 472-491.
- White, M., Tagoe, E., Stiff, C., Kubaje, A., & Smith, D. (2005). Urbanization and the fertility transition in Ghana. *Population Research and Policy Review*, 59-83.
- Young, A. (2004). The Gift of the Dying: the Tragedy of AIDS and the Welfare of Future African Generations. *NBER Working Paper Series*.