The Demographic Window of Opportunity and Economic Growth at the Sub-National Level in Sub-Saharan Africa

Lamar Crombach[a]
Jeroen Smits[b]

[a] ETH Zürich, Switzerland. *E-mail: crombach@kof.ethz.ch*
[b] Radboud University Nijmegen, The Netherlands. *E-mail: j.smits@fm.ru.nl*

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Abstract

This paper uses a cross-sectional dataset including 329 sub-national regions of 39 Sub-Saharan African countries to investigate the effect of the demographic transition on economic growth at the sub-national level in Sub-Saharan African countries. The importance of age structure and population dynamics on economic performance hardly received attention. Changes in age structures are important, because different age groups display different behavior. Fertility reduction may allow a region to reap the demographic dividend during the demographic window of opportunity (DWO), characterized by a large size of the working age population compared to the dependent population. This DWO consists of six distinct phases in this paper. Since the late 90s, the DWO and associated demographic dividend has gained traction in the literature. The empirical basis of this literature, however, is biased towards growth in middle-income countries with a well-educated population and good infrastructure where the potential for economic growth was better than in many of the low-income countries. The literature has also focused on the national level, whereas fertility decline and economic growth may differ substantially among different areas within a country. The preliminary analysis shows that, at the sub-national level, the youth dependency ratio and the level of life expectancy are important determinants of the growth rate, while the old dependency ratio and population growth are not determinants of economic growth. There are indications that education is a significant determinant, though this result is not robust.

[1] DRAFT VERSION 1 – Acknowledgements:

Introduction

The role of demography in studying the sources of economic growth has long been restricted towards the effects of population size and population growth. The importance of age structure and population dynamics on economic performance got hardly any attention. Changes in age structures are important, because different age groups display different (economic) behavior. Fertility reduction through the use of family planning may allow a region to reap the demographic dividend during the demographic window of opportunity, which is characterized by a large size of the working age population compared to the dependent (green and grey) population. This demographic window of opportunity is split into six distinct phases in this paper. Standard neoclassical growth theory, however, assumes a constant population growth and ignores the effects of the demographic transition. Only since the late nineties, the demographic window of opportunity and associated demographic dividend has gained traction in the growth literature. The empirical basis of this literature, however, has been heavily biased towards growth in middle income countries with a well-educated population and good infrastructure -- like the East Asian tigers – where the potential for economic growth was better than in many of the current-day low-income countries. The literature also has been very focused on the national level, whereas fertility decline and economic growth may differ substantially among different areas within a country.

In this paper we first aim to find out whether and to what extent the positive effect of the demographic dividend on economic growth that has been found in middle income countries is also present in the low-income countries in the Sub-Saharan African (SSA) context. Our central research question therefore sounds:

To what extent does the demographic window of opportunity foster economic growth in low-income countries in the SSA context?

To answer this question, we have built an area cross-sectional database with information on changes over time with regard to average household wealth and other relevant variables for 329 sub-national regions within 39 SSA countries. With this database, we can study effects of the demographic window of opportunity on economic growth at the sub-national level within countries. As economic growth tends to differ within countries, the use of this sub-national database is an improvement compared to earlier research.

The literature mentions several factors as essential for a country to profit from the demographic window of opportunity and reap the demographic dividend: effective family planning, good public health, a well-educated population, and economic policies that promote labor-market flexibility, openness to trade, and savings. In our analyses, we will test to what extent these factors indeed help countries to make use of the demographic window of opportunity more effectively.

Methodology

A cross-sectional database was constructed from data of the Global Data Lab Areadatabase (Global Data Lab, 2019). Variables obtained from these surveys were aggregated from the household level to the sub-national level, culminating in a dataset with 39 countries and 329 sub-national areas. Unfortunately, sub-national data for SSA countries is not rich enough to develop a panel dataset. Instead, the two most recent years with data (T1 and T2) for each country is used for the analyses. The intervals between the two surveys ranges from 1 to 16 years. Yearly averages were computed to maintain comparability among countries with different survey year ranges. In some instances, not all variables were available in a given year. In such a scenario, an earlier year would be used for those variables, accounting for the different time period to compute average yearly values.

A multilevel analysis with fixed country-level effects is used to answer the research question. The dependent variable is the average yearly growth rate of the International Wealth Index (IWI) (Smits & Steendijk, 2015). IWI, which ranges between 0 and 100, is a survey-based wealth index that is comparable across countries and over time. The level of IWI at T1 is used as an independent variable to control for the converging growth rate argument as established by the Solow-Swan model (Solow, 1956; Swan, 1956). Due to the bounded nature of IWI, growth rates tend to be close to 0 when IWI is close to 100, and relatively large when IWI is relatively small. As such, each regression includes two dummy variables that indicate whether or not the observation has an IWI score which is lower than or equal to 20 (IWI20), or larger than 60 (IWI60). Additionally, each regression includes a dummy that indicates if the average yearly growth rate of the region's IWI exceeds 20%. the changes over time in aggregated household material wealth as dependent variable and the area's age structure and its changes over time as the major independent variable will be used. The age structure was indicated by the dependency ratio, measured as the ratio of the population below 15 and over 65 to the population aged 15-65. The area's level of economic development is indicated by the average level of income in the area, as reported in the database of the Sub-National Human Development Index (Smits & Permanyer, The Subnational Human Development Database, 2019).

The main demographic variables of interest are the youth dependency ratio, the old dependency ratio, and population growth. The youth dependency ratio is the ratio of individuals aged younger than 15 to the working-age population, defined as the share of the population aged between 15 and 64. The old dependency ratio is the ratio of individuals aged 65 or older to the working age population. All demographic variables are available at the Global Data Lab.

The main policy-environment variables of interest are life expectancy and education. Life expectancy is defined as the amount of years that an individual can expect to live based on the mortality-rates of the existing population, and is taken from the sub-national human development database (Smits & Permanyer, 2019). The level of education is defined as the mean years of education of adults aged 20 or older. Education is available at the Global Data Lab.

Table 1 - Descriptive statistics[2]

	Observations	Mean	St. Dev.	Min	Max
IWI Growth	329	6.32	5.19	-5.07	32.20
IWI	329	28.34	15.84	7.28	80.97
Youth Dependency	329	90.27	20.72	32.80	135.90
Old Dependency	329	8.19	3.15	1.40	21.90
Life Expectancy	329	56.42	5.47	43.40	72.20
Education	329	4.41	2.48	0.38	11.44
Population Growth	329	3.04	4.28	-9.86	33.53
IWI20	329	0.37	0.48	0	1
IWI60	329	0.06	0.23	0	1
Extreme Growth	329	0.02	0.51	0	1

Table 2 shows the descriptive statistics of the sample. The descriptive statistics reveal that the data are rich in terms of variety. For instance, while the regions of Basse Kotto, Mbornou and Houte Mbormou , Central African Republic, suffered a negative average yearly growth rate of 5.07 during the period 2006-2010, the regions of Lunda Norte, Moxico and Lunda Sul, Angola, enjoyed a yearly average growth rate of 32.2% during the period 2011-2016. Additionally, one can see that the regions in the sample are at different stages of the demographic transition, as the youth dependency ratio ranges from 32.8% to 135.9%, and the average yearly rates of population growth range from -9.86% to 33.53%. Moreover, in terms of policy-environment variables, the average life expectancy at birth is 56.42 years, ranging from 43.4 years to 72.7 years. The average level of education is 4.41 years, ranging from 0.38 years in Est and Sahel, Burkina Faso, to 11.44 years in Nairobi, Kenya. Furthermore, 37% of the sample has an IWI that is 20 or lower, 6% of the sample has an IWI of 60 or larger, and 2% of the sample had a yearly average growth rate of IWI of 20% or higher.

Results

To answer our research question, we present information on the demographic window phase of SSA countries based on a new demographic window classification that distinguishes between the following 6 demographic window phases:

Table 2 - Definition of Demographic Window Phases

Phase	Under 15 (%)	Over 64 (%)
Traditional	>40	-
Pre-window	30-40	-
Early-window	25-30	-
Mid-window	20-25	-
Late-window	<20	<15
Post-window	-	>15

[2] Currently, the descriptive statistics are based on all observations. This is less informative, as countries differ in their amount of regions. As such, a region-weighted would be of additional interest in a future version.

Using this classification, we will first describe the demographic window phases in the SSA context at the national, urban/rural and sub-national regional levels.

Figure 1 – Demographic Window (DW) Phase SSA

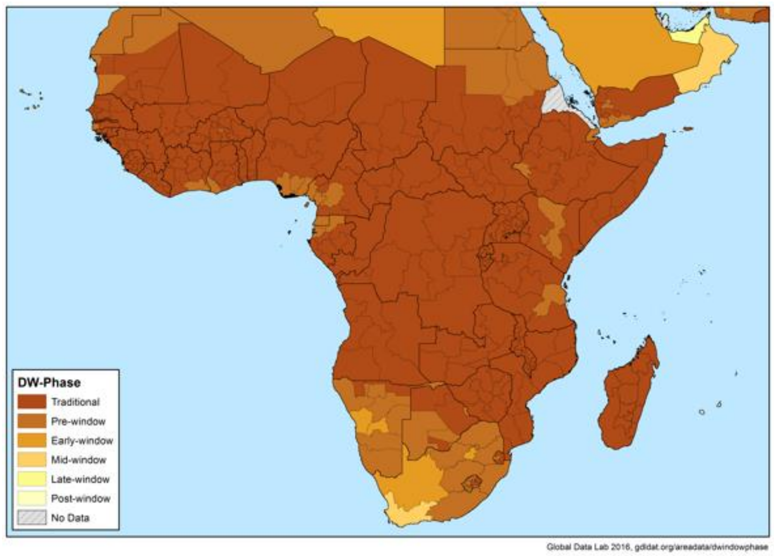


Figure 1 shows the demographic window phases for the SSA countries. The figure shows that African regions are predominantly in the traditional phase. Only a limited number of regions around the Gulf of Guinea and a few other regions are in a later stage.

Table 3 - SSA countries that are not in the traditional phase.

Country	Phase	Country	Phase
Mauritius	5	Namibia	2
Cape Verde	3	Swaziland	2
Gabon	2	South Africa	2
Lesotho	2		

Table 1 shows the SSA countries that, at the national level, are not in the traditional phase anymore. Mauritius has reached phase 5, Cape Verde phase 3, and Gabon and the four most southern countries are in phase 2. Thus, in SSA, only 7 countries are not in the traditional phase.

A different picture is painted when a distinction is made between urban and rural areas of SSA countries and their regions. Table 2 shows the subnational regions that are not in the traditional phase. It shows that the demographic transition is occurring and is at different stages in more places than one would expect based on Table 1. For instance, while South Africa is only at the second phase of the demographic window of opportunity, some of its regions such as Western Cape and KwaZulu Natal are in the fourth phase.

Table 4 - Urban areas of subnational regions that are not in the traditional phase.

Country	Urban Regions	Phase	Country	Urban Regions	Phase
Ethiopia	Addis Ababa	4	Lesotho	Leribe	3
South Africa	Western Cape	4	Lesotho	Berea	3
South Africa	KwaZulu Natal	4	Lesotho	Maseru	3
South Africa	Eastern Cape	3	Lesotho	Mafeteng	3
South Africa	Northern Cape	3	Lesotho	Quthing	3
South Africa	Free State	3	Namibia	Erongo	3
South Africa	North West	3	Namibia	Khomas	3
South Africa	Gauteng	3	Namibia	Ohangwena	3
South Africa	Mpumalanga	3	Swaziland	Hhohho	3
South Africa	Northern Province	3	Swaziland	Lubombo	3
Ethiopia	Oromiya	3			

Multivariate analyses

Table 5 shows the determinants of the average yearly growth rate of IWI while only taking into account T1 levels without interactions or non-linearities. The results show that the level of IWI at T1 is a strong and robust determinant of the average yearly growth rate of IWI, which is in favor of the convergence argument. We introduce the youth and old dependency ratios in the second column. The youth dependency ratio shows a robust negative effect, indicating that a decrease in the youth dependency ratio of 1% is predicted to increase the average yearly growth rate of IWI by about 0.05%. For instance, assuming the beta coefficient of column 2 for the youth dependency ratio, if Boucle de Mouhoun, Burkina Faso, with a dependency ratio of 105.9%, would experience a decrease in the dependency ratio by 30.1 percentage points to 75.8,% the level of Antananarivo, Madagascar, Boucle de Mouhoun would be expected to have a growth rate of IWI that is 1.68 percentage points larger. On the contrary, the old dependency ratio does not have a significant association with IWI growth in any of the regressions. In columns 3, 4, and 5, life expectancy, education and population growth are introduced, respectively. None of the variables significantly affect the IWI growth rate. In column 6, all variables are included simultaneously. As before, there is no significant effect of the three variables on IWI growth.

Table 5 - Determinants of the average yearly growth rate of IWI, levels.

	(1)	(2)	(3)	(4)	(5)	(6)
IWI	-0.122***	-0.188***	-0.201***	-0.200***	-0.188***	-0.210***
	(-5.66)	(-6.03)	(-6.12)	(-5.89)	(-6.02)	(-5.98)
Youth Dependency		-0.0558***	-0.0544***	-0.0466**	-0.0556***	-0.0467**
		(-2.90)	(-2.83)	(-2.15)	(-2.87)	(-2.14)
Old Dependency		-0.0349	-0.0497	-0.0247	-0.0359	-0.0401
		(-0.46)	(-0.65)	(-0.32)	(-0.47)	(-0.51)
Life Expectancy			0.0922			0.0848
			(1.24)			(1.13)
Education				0.217		0.185
				(0.92)		(0.78)
Population Growth					-0.00498	-0.00150
					(-0.12)	(-0.04)
Constant	8.753***	15.92***	11.10**	14.37***	15.92***	10.18**
	(11.57)	(6.21)	(2.39)	(4.69)	(6.20)	(2.11)
# Observations	329	329	329	329	329	329
Within R2	0.503	0.518	0.521	0.519	0.518	0.522
Overall R2	0.494	0.442	0.455	0.435	0.442	0.449
Between R2	0.417	0.297	0.317	0.292	0.297	0.313

Notes: *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6 shows the determinants of the average yearly growth rate of IWI with the inclusion of interaction effects. Column 1 is the equivalent of Column 2, Table 5, for reference. The interactions with the old dependency ratios are not reported, as none showed any signs of significance. In Column 2, we introduce population growth and an interaction between population growth and youth dependency. Neither the level nor the interaction show any sign of significance in any of the regressions. Column 3 shows the effects of life expectancy and its interaction with youth dependency. The main effect of youth dependency is now positive with a coefficient of 0.238. The coefficient of youth dependency is now, however, dependent on life expectancy. The coefficient of 0.238 assumes that life expectancy is 0, which is an unrealistic value. Once one considers the minimum life expectancy value in the sample, i.e. 43.4, the marginal effect of youth dependency is expected to be 0.06[3]. While this is still a positive effect, it is important to consider that this marginal effect of youth dependency is *not* significant, as shown in Figure 2. When analyzing interaction effects, the standard error of the coefficient is irrelevant. Instead, the standard errors of interest are those of the marginal effects (Brambor, Clark, & Golder, 2006). In fact, the first value of life expectancy at which the marginal effect of youth dependency becomes significant is 54.9. Column 4 introduces the effects of education, which are once again

[3] This calculation is based on the results of Table 6, Column 5.

similar in Column 5, in which both life expectancy and education are introduced simultaneously. Figure 5 shows the marginal effect of youth dependency on the growth of IWI for different levels of education. It is shown that a decrease in the youth dependency ratio would only be significantly beneficial for IWI growth if the level of education in a region is about 3.6 years or more.

Table 6 - Determinants of the average yearly growth rate of IWI, levels & interactions.

	(1)	(2)	(3)	(4)	(5)
IWI	-0.188***	-0.187***	-0.210***	-0.232***	-0.253***
	(-6.03)	(-5.98)	(-6.43)	(-6.44)	(-6.82)
Youth Dependency	-0.0558***	-0.0499**	0.238**	-0.00703	0.266**
	(-2.90)	(-2.32)	(2.20)	(-0.26)	(2.45)
Old Dependency	-0.0349	-0.0330	-0.0736	-0.00649	-0.0465
	(-0.46)	(-0.43)	(-0.96)	(-0.09)	(-0.60)
Population Growth		0.129			
		(0.57)			
Youth Dependency * Population Growth		-0.00139			
		(-0.60)			
Life Expectancy			0.552***		0.533***
			(3.02)		(2.93)
Youth Dependency * Life Expectancy			-0.00507***		-0.00475**
			(-2.75)		(-2.58)
Education				1.232***	1.181**
				(2.62)	(2.54)
Youth Dependency * Education				-0.0115**	-0.0111**
				(-2.48)	(-2.40)
Constant	15.92***	15.38***	-14.97	11.46***	-18.05*
	(6.21)	(5.63)	(-1.42)	(3.52)	(-1.70)
# Observations	329	329	329	329	329
Within R2	0.518	0.519	0.533	0.530	0.544
Overall R2	0.442	0.444	0.454	0.437	0.456
Between R2	0.297	0.299	0.318	0.291	0.320

Notes: *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 2 - Marginal effects of Youth Dependency on IWI Growth depending on Life Expectancy and Education (Table 6, Column 5).

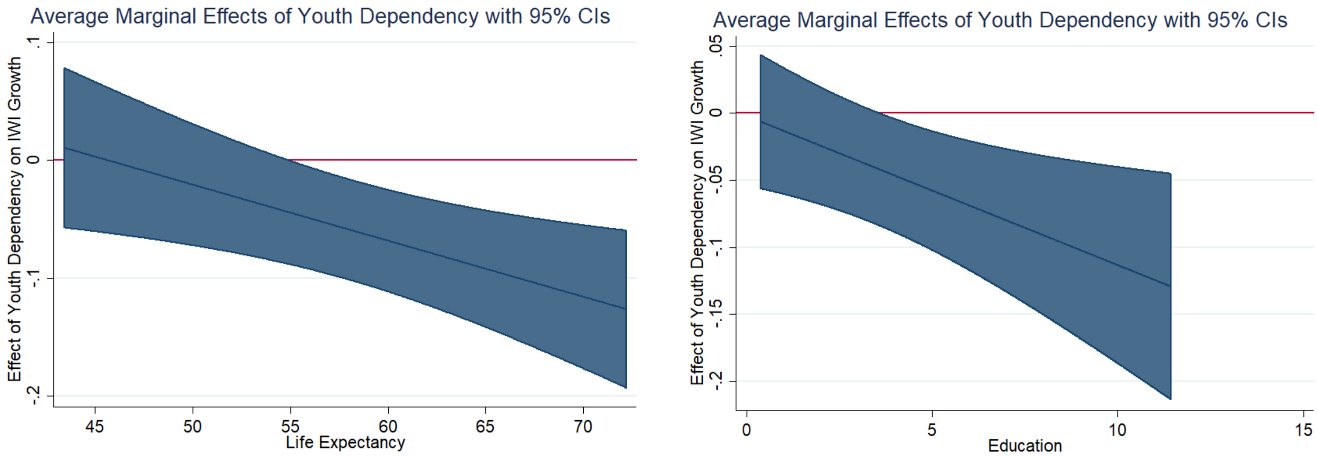


Table 7 shows the results when one takes into account the possibility of non-linear relationships between the independent variables and the average yearly growth rate of IWI. The non-linear terms of youth dependency, old dependency, life expectancy, education and population growth are introduced in columns 1, 2, 3, 4, 5, respectively. The only non-linear relationship that is significant at the conventional levels is that of the youth dependency ratio[4]. The marginal effects, as displayed in Figure 3, show that the effects of youth dependency increase as youth dependency declines.

[4] The significance of the marginal effects of the non-linear terms of old dependency, life expectancy, education and population growth were also checked while including the non-linear term of youth dependency. The non-linear terms remained insignificant for all marginal effects.

Table 7 - Determinants of the average yearly growth rate of IWI, levels & non-linear terms.

	(1)	(2)	(3)	(4)	(5)
IWI	-0.218***	-0.188***	-0.199***	-0.207***	-0.190***
	(-6.62)	(-6.04)	(-6.07)	(-5.92)	(-6.12)
Youth Dependency	-0.285***	-0.0533***	-0.0552***	-0.0487**	-0.0578***
	(-3.19)	(-2.75)	(-2.87)	(-2.23)	(-2.99)
Youth Dependency^2	0.00122***				
	(2.63)				
Old Dependency	-0.0190	-0.254	-0.0436	-0.0229	-0.0289
	(-0.25)	(-1.05)	(-0.57)	(-0.30)	(-0.38)
Old Dependency^2		0.0109			
		(0.95)			
Life Expectancy			1.260		
			(1.64)		
Life Expectancy^2			-0.0102		
			(-1.53)		
Education				-0.0496	
				(-0.12)	
Education^2				0.0281	
				(0.81)	
Population Growth					0.0752
					(1.24)
Population Growth^2					-0.00542*
					(-1.76)
Constant	27.06***	16.65***	-21.98	15.24***	16.05***
	(5.47)	(6.22)	(-0.99)	(4.69)	(6.27)
# Observations	329	329	329	329	329
Within R2	0.529	0.520	0.525	0.521	0.523
Overall R2	0.444	0.438	0.458	0.438	0.446
Between R2	0.306	0.291	0.332	0.297	0.299

Notes: *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 3 - Linear predictions (left) and marginal effects (right) of youth dependency on IWI growth (Table 7, Column 1).

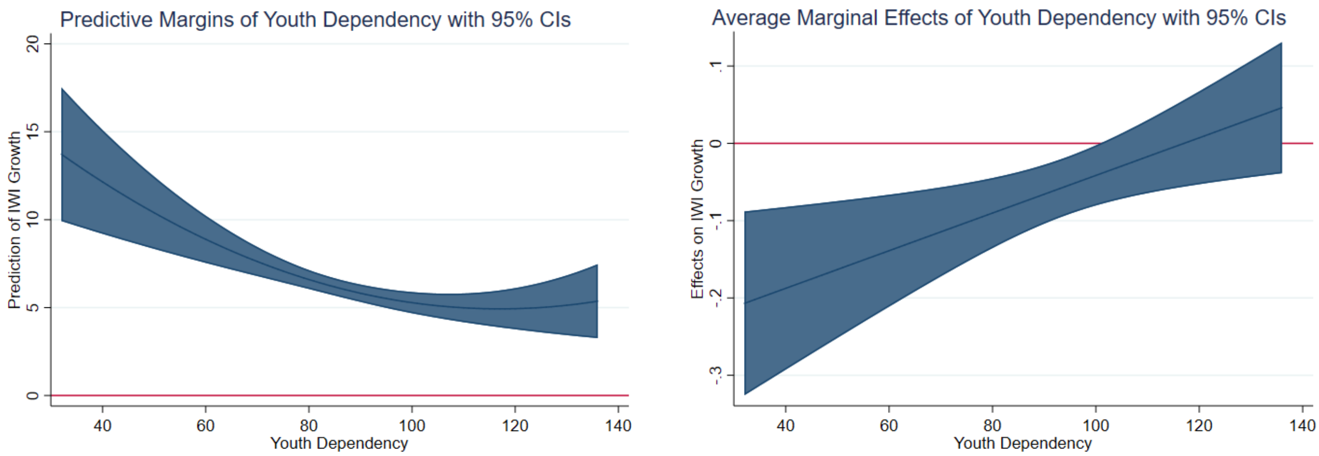


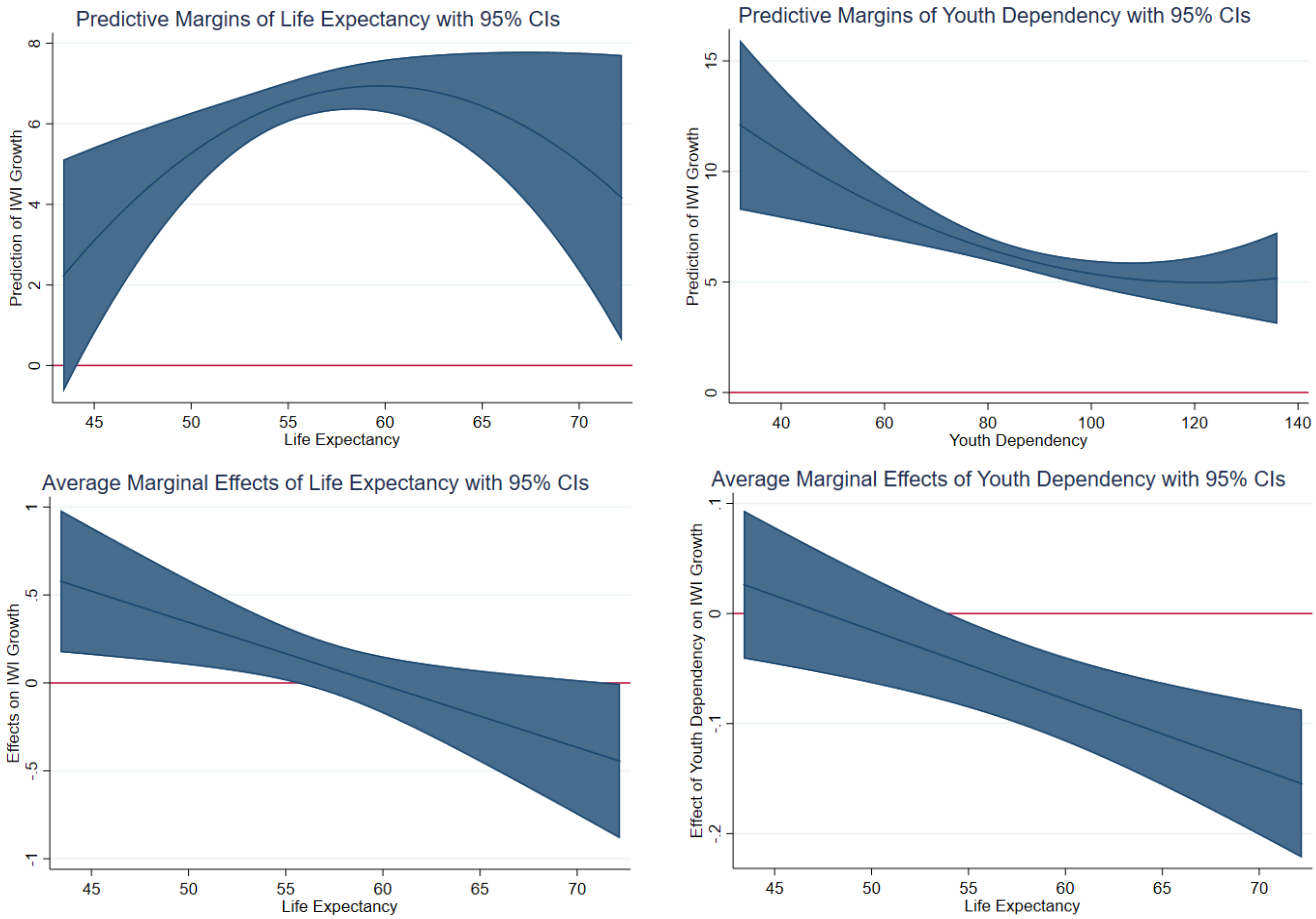
Table 8 shows the results with the inclusion of levels, interactions and non-linear terms. The first model introduces the effect of life expectancy, and its dependence on youth dependency. Figure 4 shows the marginal effects of life expectancy depending on the level of life expectancy, and the marginal effects of youth dependency depending on the level of life expectancy. Additionally, the predicted effects of life expectancy and youth dependency on the growth rate of IWI are shown. The results indicate that improvements in life expectancy improve the growth rate of IWI, but only up to a certain point. Furthermore, as shown before, decreases in youth dependency increasingly lead to increases in IWI growth, and this effect depends on the level of life expectancy, which has to be sufficiently high for youth dependency to have a significant effect on IWI growth. In column 2, the non-linear and interaction effects of education are introduced. While there is no evidence that education has a non-linear effect on IWI growth, there is an indication that the effect of youth dependency depends on the level of education. This result, however, is not robust once we simultaneously include the interaction and level of education with the non-linearity, interaction and level of life expectancy in column 4. Column 3 shows the results for the non-linear term and interaction of population growth, which show no signs of significance. All in all, the preliminary results indicate that column 1 provides the most suitable model to estimate the level of IWI growth, with life expectancy having a robust result, and the effect of youth dependency depending on the level of life expectancy.

Table 8 - Determinants of the average yearly growth rate of IWI, levels, interactions & non-linear terms.

	(1)	(2)	(3)	(4)
IWI	-0.230***	-0.239***	-0.219***	-0.246***
	(-6.81)	(-6.61)	(-6.66)	(-6.67)
Youth Dependency	0.137	-0.00126	-0.281***	0.262
	(0.87)	(-0.01)	(-3.13)	(1.36)
Youth Dependency^2	0.000897*	0.000170	0.00120**	0.000399
	(1.93)	(0.22)	(2.57)	(0.61)
Old Dependency	-0.0565	0.00350	-0.0142	-0.0473
	(-0.75)	(0.05)	(-0.19)	(-0.62)
Life Expectancy	2.689***			2.595***
	(3.02)			(2.89)
Life Expectancy^2	-0.0178**			-0.0169**
	(-2.52)			(-2.37)
Youth Dependency * Life Expectancy	-0.00628***			-0.00631***
	(-3.17)			(-3.18)
Education		2.931*		0.751
		(1.79)		(1.21)
Education^2		-0.0960		
		(-1.45)		
Youth Dependency * Education		-0.0205*		-0.00698
		(-1.72)		(-1.07)
Population Growth			0.127	
			(0.56)	
Population Growth^2			-0.00469	
			(-1.46)	
Youth Dependency * Population Growth			-0.000733	
			(-0.30)	
Constant	-70.33**	7.807	26.77***	-75.19**
	(-2.38)	(0.67)	(5.36)	(-2.50)
# Observations	329	329	329	329
Within R2	0.551	0.536	0.534	0.554
Overall R2	0.461	0.428	0.448	0.458
Between R2	0.346	0.274	0.308	0.339

Notes: *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 4 - Linear predictions (upper) and marginals effects (lower) of life expectancy (left) and youth dependency (right) on IWI growth.



Conclusion

This paper used a cross-sectional dataset to investigate the effect of the demographic transition on economic growth at the sub-national level in Sub-Saharan African countries. The preliminary analysis shows that, at the sub-national level, the youth dependency ratio and the level of life expectancy are important determinants of the growth rate of the International Wealth Index, which we used as a proxy for economic growth. There is an indication that increases in life expectancy increase the growth rate of IWI, but only up to a certain point, indicating that further increases to life expectancy may lead to increased healthcare costs. Furthermore, decreases in the youth dependency ratio increase IWI growth at an increasing rate, but this effect only exists if the level of health, as measured by life expectancy at birth, is sufficiently high. There are indications that the same holds for education, though this effect is not robust throughout the different models. Population growth does not seem to be a determinant of IWI growth. As such, the preliminary results indicate that governments of

Sub-Saharan African countries would be able to enhance the impact of the demographic window of opportunity by providing effective health services.

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