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Dynamiques de la population et marché du travail

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Contents

List of Tables

List of Figures

General Introduction

Evolution of population

In the twentieth century, the world and most countries have experienced significant demographic shifts. The global population has increased in all regions of the world (Figure1). In less than one century, the world population has exponentially increased, from 2.5 billion in 1950 to 8 billion in 2022, according to UN estimates. In 2022, the population of Sub-Sahara Africa was comparable in number to that of Europe and Northern America combined (respectively 1.2 and 1.1 billion). However, the pace of growth is different. Along with the increase in the global population, other significant demographic trends occurred. The average fertility rate has decreased by more than half, levels of mortality decreased, and life expectancy at birth has increased. In addition, migration flows are rising both within and between countries. These changes affect the size, structure, and distribution of the population over time. Understanding population dynamics is crucial for accurately predicting and planning for future societal needs and challenges.

The total fertility rate is defined as the average number of children born to a woman of childbearing age if she has to experience pregnancy and live until the end of her reproductive age. Despite the fact that fertility rates have decreased across the globe, many African countries are still experiencing high fertility rates, with an average of 4 children per woman. This is high compared to other regions of the world where the average fertility rate is much lower (Figure 2). High fertility rates can result in high dependency ratio rates. On the one hand, implementing policies and initiatives that can generate more job opportunities, promote education, and accelerate economic growth can effectively reduce the dependency ratio. Consequently, this can encourage self-sufficiency and lead to a more prosperous future for everyone. On the other hand, the decline in fertility rates can lead to a change in the population's age structure and an efficient reallocation of resources to other sectors. According to demographics, many African countries have not yet begun

their demographic transition, which involves a shift from high birth and death rates to low birth and death rates. This transition can also contribute significantly to the socio-economic development of the continent by reducing the dependency ratio and relocating resources for investment in other sectors.

Along with high rates of fertility, childcare and women's participation in the labor market should also be addressed. The particularity of the African society, culture, tradition, and religion are the various factors that explain the high rates of fertility. However, as the economy grew, its structure also changed, leading to a shift from agriculture to industry and services. Agriculture has long been the sector with a high demand for human capital due to the lack or absence of technological progress. Children constituted the labor force and wealth for the family. Their education was also not the sole responsibility of their parents but the responsibility of the whole family or community. This system allowed them to send children to another family in the same or other geographical areas (rural to urban areas or outside of the country) to care for their education. With the economic development of cities, many jobs are concentrated in cities, which influenced the movement of people from rural to urban areas. In addition to modernization, the increase in living costs in urban areas has reduced and modified the frequency and family arrangements. Family structures are changing. People are now less likely to take care of others' children. The desire for high family size or fertility preferences is decreasing. Methods to achieve the desired family size were then developed and included modern and traditional or natural contraceptive methods. Debate was then raised on the mechanism through which family planning programs affect fertility. On the one hand, some studies argue that family planning programs help to achieve the desired family size, and on the other hand, other studies suggest that family planning programs only reduce the number of children. Most of the family planning programs were focused on married couples, especially married women. However, from the age of menarche (usually in adolescence) to marriage, there is a latent time when pregnancy can occur for sexually active women. According to the World Prospects 2022 (Figure 2), in 2021, 13.3 million babies were born to young mothers who were under 20 years old. This number accounts for approximately 10% of the world's total births. Half of these babies were born in sub-Saharan Africa, where the birth rate among adolescents was estimated to have declined in recent times. Despite this decline, sub-Saharan Africa still has the highest birth rate among all regions,

with 101 births per 1,000 women aged 15 to 19 years old in 2021(Figure3). This highlights the need for continued efforts to improve reproductive health and education for young women in the region to reduce unintended pregnancies.

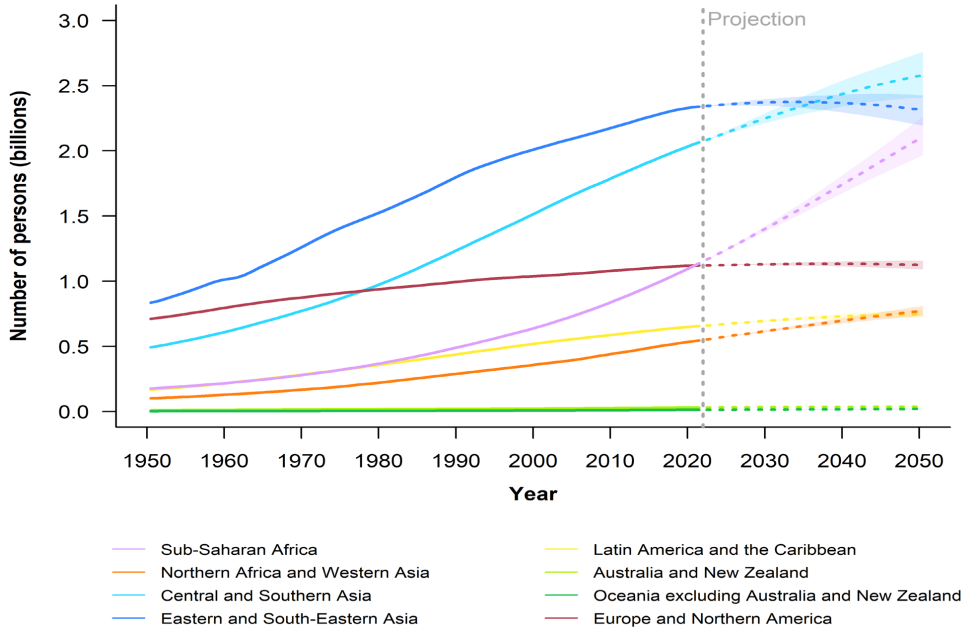


Figure 1: Population estimates, 1950-2022, and projections, 2022-2050, by region (Data from United Nations. World Population Prospects 2022: Summary of Results. UN DESA/POP/2022/TR/NO. 3.).

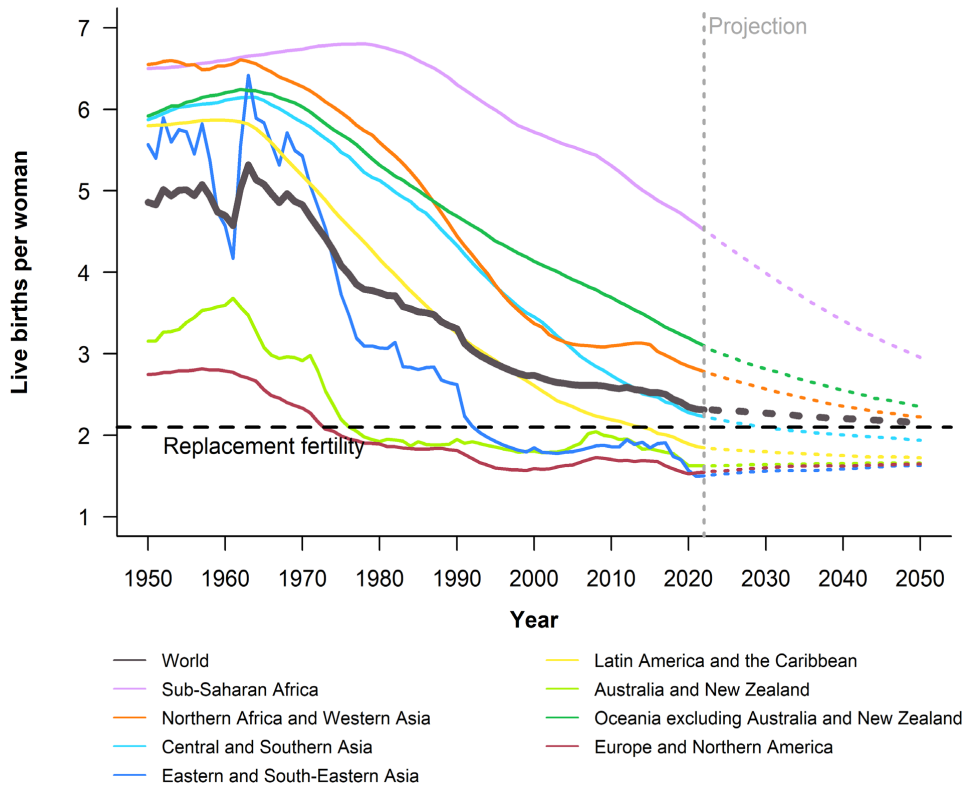


Figure 2: Total fertility rate: estimates, 1950-2021, and projections 2022-2050, by region (Data from United Nations. World Population Prospects 2022: Summary of Results. UN DESA/POP/2022/TR/NO. 3.).

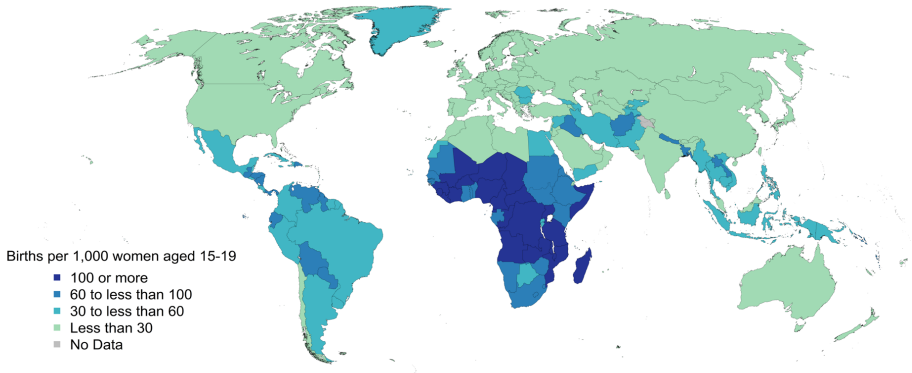


Figure 3: Adolescent birth rates(World Population Prospects 2022)

The link between labor market and demography

The changing global demographics of population growth and aging are likely to have a significant impact on the labor market in the future. The labor market is a crucial platform where job seekers and employers can connect and collaborate, enabling the workforce to meet the demands of the job market and contribute to the economy. As the world population continues to grow, the demand for jobs and employment opportunities will

increase.

To ensure that the market needs are met efficiently, it's important to consider the demographic composition, encompassing factors like age, gender, education, and experience. There are various ways to examine how changes in population impact the labor market. These include the Malthusian effect, the Solow effect, the dependency effect, the life-cycle labor supply effect, the child-quality effect, the health improvement effect, the Boserup effect, and the endogenous feedback effect.

The Malthusian effect (Malthus, 1826) implies that the rate of population growth exceeds the rate of resource growth, causing a decrease in wages and an increase in unemployment. The Solow effect (Solow, 1956), on the other hand, suggests that a larger population can lead to more innovation and technological advancements, resulting in increased productivity and higher wages. The dependency effect (high ratio of dependence) (Kelley, 1973) suggests that population growth can lead to a higher dependency ratio, with more young and elderly people relative to the working-age population. This can strain the labor market and result in reduced employment opportunities. The life-cycle labor supply effect suggests that changes in the age structure of the population can affect labor market participation rates, with different age groups having varying levels of labor force participation. The child-quality effect (Becker, 1965; Chiswick, 1988) argues that changes in the quantity and quality of children can affect the labor market, with improved child quality leading to higher levels of education and improved labor market prospects. The health improvement effect suggests that advancements in health can lead to increased labor productivity and higher wages. The Boserup effect (Boserup, 1996; Lipton, 1989) argues that population growth can lead to increased pressure on resources, which in turn can lead to innovation and technological advancements, resulting in increased productivity and higher wages. Finally, the endogenous feedback effect suggests that population growth and labor market outcomes are interdependent, with each affecting the other in a feedback loop. Our main focus is on the endogenous feedback effect and the child quality effect.

The International Labor Organization estimates that in 2022, African workers will make up 15.2% of the global labor force. From 2020 to 2050, the working-age population in Africa is projected to more than double. In contrast, although Asia currently has the largest labor force, the working-age population is expected to experience a much

smaller increase of only 10% during the same period (2020-2050) (Lam et al., 2019). The labor force participation rate in Sub-Saharan Africa is also the highest (Figure 4). The gender composition of the labor force varies depending on the region of the world. The Middle East and North Africa region is the region with the lowest female labor force (Figure 5) and participation rate. Considering the various challenges that Sub-Saharan African countries are confronted with, an increase in female labor force participation could contribute to economic development. Bloom et al. (2009) estimated that a woman's labor supply decreases by almost two years during her reproductive life after giving birth. The study also suggests that an increase in female labor supply plays a significant role in contributing to economic growth, particularly during the demographic transition period when fertility rates decline.

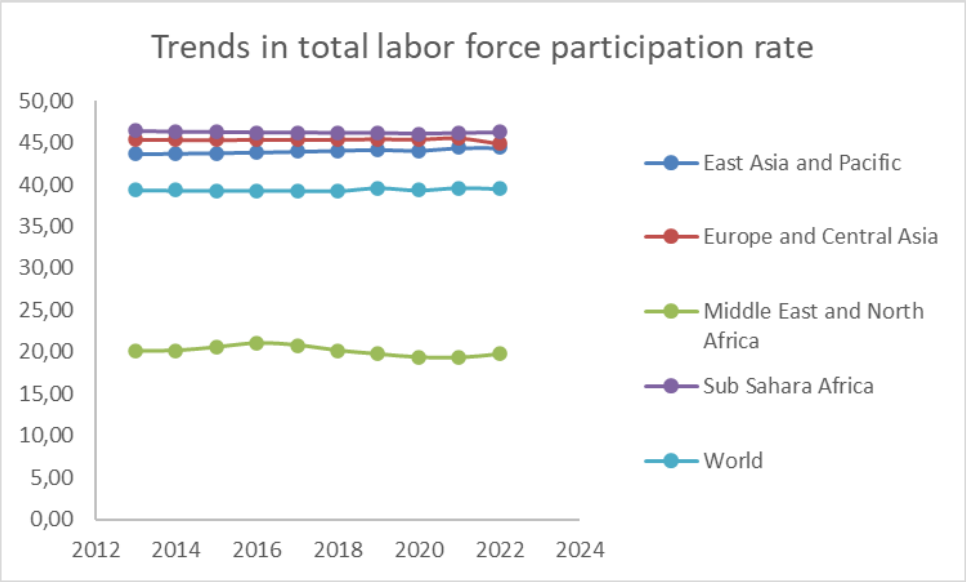


Figure 4: Trends in total labor force participation rate (ILO database)

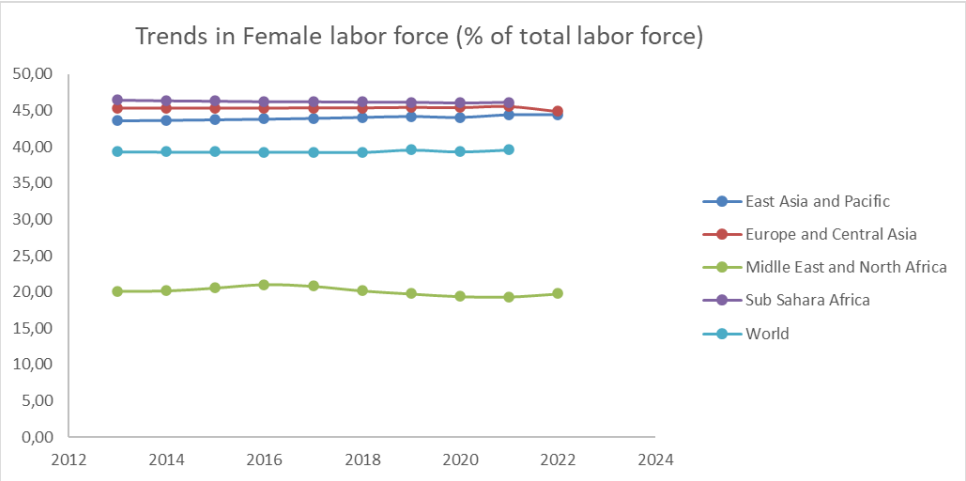


Figure 5: Trends in female labor force (ILO database)

Objective and contribution of the thesis

Demography is an important factor to consider when analyzing labor market dynamics in Sub-Saharan Africa. First, there is a need to understand how the annual influx of new cohorts in the labor market year after year will affect the labor market outcomes. According to the African Development Bank, every year, around 10 to 12 million young people enter the workforce, but only 3.1 million new formal jobs are created (AFDB, 2016). However, Lam et al. (2019) have estimated that this number has increased, and now, over 1.5 million people are being added to the workforce every month. The annual growth is expected to be 3% in 2025 and to remain high for several decades. By 2037, the working-age population will continue to increase, adding 2 million people per month, eventually peaking at 2.3 million per month in 2055 (Lam et al., 2019). Although the current high fertility rate is declining at a slow pace, it still results in the creation of large youth cohorts in both rural and urban areas, which could pose serious challenges in sectors like employment, education, and health if efficient policies are not implemented.

Although there are policies that can be implemented to absorb the surplus of labor supply, such policies may not always be effective or implemented in a timely manner. In such cases, reducing the fertility rate can be an option to help reduce the surplus of labor supply. By lowering the number of new entrants into the labor market, there will be fewer individuals seeking employment, which can alleviate the pressure on the job market and improve employment opportunities for those who are already looking for work. It is then crucial to take into account the effects of family planning, girls' education, women's empowerment (or participation in the labor market), and political leadership on the labor

market and its outcomes. By promoting these factors, we could potentially witness a shift towards lower fertility rates, which in turn could affect both individual behavior and government policies. This highlights the importance of considering both personal choices and state-level interventions when examining demographic trends. This thesis presents a compelling analysis of two main areas. Firstly, it examines demographic and occupational trends at a microeconomic level, with a particular emphasis on intergenerational transmission in ***Chapters 3 and 4***. Secondly, it provides a comprehensive understanding of the short and long-term dynamics between fertility rates and women's participation in the labor market at a macroeconomic level, as proposed in ***Chapter 1***. The findings of this thesis are expected to contribute significantly to the existing research on these topics, and it is hoped that the insights gained from this work will be useful for policymakers, researchers, and practitioners alike.

The present thesis includes then an in-depth analysis of both macroeconomic and microeconomic factors. The research methodology involves the use of advanced macro or micro econometric models that are adept at analyzing time series or qualitative data.

The thesis is organized into four distinct chapters, each of which focuses on a unique topic related to the overall research statement. While each chapter can stand independently, together, they provide a comprehensive understanding of the research statement.

Chapter 1 analyses the relationship between fertility and female labor force participation in the labor market in Africa using aggregated data from five Sub-Sahara African countries (Kenya, Ghana, Cote d'Ivoire, Nigeria, and Rwanda) from 1990 to 2019. The main objective is to show how these variables adjust to variations in the short term of long-term of each other. In particular, we studied both short- and long-term relationships using the Error Correction Model and took into account structural breaks that may occur in the cointegrating relationship. We found evidence of a long-run negative effect between fertility and women's participation in the labor market. Overall, results show that fertility slowly adjusts to variations in women's participation in the labor market in the long-term equilibrium in Kenya, Ghana, and Cote d'Ivoire. However, in Rwanda, women's participation in the labor market quickly adjusts to variations in fertility rates in the long-run equilibrium. Each variable negatively responds to changes in the other variable in Ghana in the short term. These findings can inform policymakers and stakeholders in designing targeted policies and interventions that promote women's participation in the labor

market and address fertility-related challenges in Africa.

Chapter 2 focuses on adolescents' fertility and education. Figure 3 shows that in 2021 in Africa, 10% of adolescent girls aged between 15 and 19 became pregnant. This trend is particularly concerning as some of these girls may still be students, which could significantly impede their educational pursuits. The implications of this trend are far-reaching and may result in the perpetuation of poverty, gender inequality, and limited opportunities for young girls. It is, therefore, important that concerted efforts are made to address this issue and empower young girls with the knowledge and resources they need to make informed decisions about their reproductive health. Our aim is not to concentrate on pregnancies but rather on the factors that can assist in preventing adolescent pregnancies. Firstly, we analyze the knowledge of family planning methods among adolescents. Secondly, we investigate how identifying fertility time preference along with the knowledge of family planning methods can help avoid unplanned pregnancies and enable controlled fertility of adolescents in Sub-Saharan African countries.

In ***Chapter 3***, we analyze the trends in fertility rates from an intergenerational perspective. The objective is to analyze cohort-completed fertility trends and factors by comparing women and their mothers' fertility. Using 23 Demographic and health surveys (DHS), we calculated completed cohort fertility rates and used Poisson and Quantile regression models to analyze the effect of the completed fertility in the destination family size on the completed fertility in the origin family size. Our findings indicate that the more recent generations in Kenya, Rwanda, and Madagascar have significantly lower completed fertility rates than their mothers. However, in Mali and Malawi, women had, on average, more children than their mothers, particularly in Mali. Additionally, we found that women with lower education levels, those who were first-born, those who experienced child mortality, and those who gave birth to twins had significantly higher completed fertility rates in Africa.

Migration is also a significant factor in population dynamics, driven primarily by the search for better opportunities or lack of opportunities in the origin location. At the national or international level, migration can modify the structure of the population, economy, culture, and even the environment of both the source and destination areas. Research on migration tends to be more concentrated on destination areas rather than departure areas because challenges faced by migrants are more pronounced in destination

areas. These challenges can include difficulties in accessing services like healthcare, education, and jobs, as well as discrimination and social exclusion. In this same vein, ***chapter 4*** focuses on the challenges (education and employment) of migrants in the destination area by focusing on the intergenerational mobility of migrants. In particular, we investigate how neighborhoods impact the intergenerational mobility of migrant descendants in one of the developed countries with a long migration history: France. Intergenerational mobility measures the degree to which economic or social status is transmitted from parents or previous generations to children (next generation). It is often used to address inequality or promote equal opportunities between individuals of the same generation. The particularity of second-generation migrants (compared to natives) is the migration history of their parents, and some factors, such as language or culture, are easily transferrable from one generation to another and are not the responsibility of the state or the country of destination. However, it is the responsibility of the government to ensure that every citizen has access to quality education, employment opportunities, and healthcare facilities, regardless of their social background or their parents' country of origin. Factors that could contribute to inequality among citizens must be identified and addressed. After analyzing the environmental context in which people live or have lived, we have then examined how the impact on intergenerational transmission of education and occupation differs between natives and second-generation migrants in France.

Chapter 1

Trends in fertility and female participation in the labor market in Sub-Sahara Africa: a time series analysis

Introduction

The rapid growth of the world population in the 1960s raised significant concerns and challenges regarding agricultural production, scarcity of resources, and poverty. From 1960 to 1999, the world population doubled from 3 billion to 6 billion. Among the various theories at that time, the Malthusian theory assumed that the world could not feed everyone because agricultural production did not follow a similar pattern. The rapid increase in population would then lead to an increase in famine and mortality. However, the world survived the demographic explosion thanks to some economic (innovation, globalization) and demographic factors (urbanization and fertility decline) (Lam, 2011). Regarding demographic factors (educational level, income), the United Nations (UN) estimates of the world fertility rate show an overall decline from 5 births per woman during her lifetime in the early 1950s to 2.5 births in 2019. African countries also experienced a decrease in the fertility rate over the years. The fertility rate has decreased from 7-8 children per woman during the independence to 3-4 children in 2019 in mainly North African countries.

The decline in fertility is, on the one hand, attributed to the decrease in women's desired fertility (Pritchett and Summers, 1994) and, on the other hand, to women's ability to achieve their desired family size (role of contraception)(Bongaarts, 1994). The decline

in desired fertility is also attributed to economic development, including industrialization, the increase in women's participation rate in the labor market, and the incompatibility between employment and childrearing (the workplace being separate from the house). Emancipation, feminization, and gender equality movements have also drawn attention to women's participation in the labor market, which also involves women's role in the house and the costs of raising children. Indeed, in many societies, women bear the most moral and psychological costs of raising children, which influence their participation rate in the labor market and their desired family size.

The relationship between fertility rate and women's participation in the labor market has received much attention, especially in developed industrialized countries(Adsera, 2004; Mishra and Smyth, 2010; Narayan and Smyth, 2006). As fertility rates in many countries continue to decline, there has been an increase in women's participation in the labor market. This trend has led many researchers to investigate the relationship between these two variables. Studies have found that there is a negative correlation between fertility rates and women's participation rates in the labor market. However, the question of which variable causes the other variable remains. An increase in female labor force participation in the labor market decreases the desire for a large family and reduces fertility. The main factor is the separation between workplace and house and the incompatibility between employment and childrearing (Brewster and Rindfuss, 2000; Rindfuss and Brewster, 1996). A high fertility rate also increases or decreases women's participation in the labor market, depending on income. For example, women in low-income households are highly engaged in the labor market despite high fertility rates to meet household needs.

Unlike in developed countries, the family structure and social norms in African countries differ. The extended-family structure, traditional or religious considerations, and the low use of technology in agricultural production in many African societies encourage people to have large families (Caldwell and Caldwell, 1987). Urbanization, the development of informal activities, modern education, and the development of family planning programs also contribute to reducing the desire for large families. The research question is: does a long-term relationship exist between the fertility rate and women's participation rate in the African labor market? If so, is the relationship different from that in developed countries? Our objective is not to study the effect of one variable on the other but to analyze the causal relations and the long and short-term dynamics by considering

possible changes. Most fertility and female labor force participation rates in Africa focus on microeconomic data. In contrast to these studies, we use aggregated data, and analyzing long-term relationships is also important for policies on reducing the birth rate and empowering women.

We analyze the long-term relationship between fertility and women's participation rate in the African labor market since the fertility rate has declined over the years and childrearing practices are changing. Regression of the two variables, whether in cross-sections or panel data, can lead to simultaneous bias since they influence each other. Using the instrumental variables method allows us to deal with the simultaneity bias, but searching for valid instruments is challenging. Secondly, African countries have different fertility decline patterns (pace and level) (Gerland et al., 2017). For example, Kenya and Rwanda had the highest fertility rate in Africa (an average of eight births per woman) in the 1980s. But from the 1990s, the fertility rate declined significantly in these countries and reached a rate of 3-4 births in 2019. In addition to educational improvements and economic development, many studies, including the World Bank, highlight the success of family planning programs in these countries as a factor explaining the decline in fertility rate. Indeed, Kenya was the first sub-Saharan African country to set up a family planning program in 1967, following the high fertility recorded after independence. On the contrary, Nigeria, one of the Sub-Saharan African countries with the lowest fertility rate in the 1960s, has become one of the Sub-Saharan African countries with the highest fertility rate in 2019 (an average of 5.32 births per woman). For all these reasons, we consider a time series analysis. Another reason for using time series is to consider structural breaks that may occur in each series and influence the long and short-term dynamics between fertility rate and women's participation in the labor market.

We consider five African countries, including Kenya, Ghana, Nigeria, Rwanda, and Cote d'Ivoire, based on the availability of fertility data. The women's participation rate in the labor market and the fertility rate data come from the World Fertility Survey (WFS) and the World Bank indicators website. Variables such as women's educational attainment and wages may also influence the relationship. However, the lack of data on these variables over an extended period leads us to consider a bivariate analysis.

We first analyze the statistical properties of the variables using the Augmented Dickey-Fuller test and the Zivot and Andrews test to consider the presence of structural breaks.

The results show that the fertility rate in Ghana, Nigeria, and Cote d'Ivoire is trend-stationary with a structural breakpoint that occurs both in the trend and in the intercept in 2000, 2010, and 2013, respectively. At the end of the 20th century, many countries, including Ghana and Nigeria, adopted population-related policies to reduce fertility rates and increase the contraceptive prevalence rate.

In a second step, we test for a long-run relationship with structural breaks using the Gregory and Hansen (1996b,a) method. Further, the Toda and Yamamoto (1995) test results show a bidirectional causal relationship between total fertility rate and women's participation in the labor market in all countries except Rwanda, where we found a unidirectional relationship (from labor force participation rate to fertility rate).

The paper is structured as follows: Section 2 presents the context, and the literature review is in section 3. The data, the methodology, and the econometric framework are presented in sections 3 and 4. Following the econometric framework, we show the empirical results and conclude with a discussion.

1.1 Context

1.1.1 Childrearing practices and fertility rate in Sub-Saharan African societies

The extended family type was the most prevalent in most African countries. Despite structural changes influencing family structure, it is still predominant in many African societies. The traditional African family consisted of generations of relatives (parents, sisters/brothers, aunts/uncles, or cousins) and children living in the same house. It is more an implicit social arrangement (and also a lack of financial resources)in which people have duties or responsibilities towards their close relatives. Within this extended family structure, there are a series of childrearing practices that even began from children's birth. When a woman gives birth, she generally receives help from her parents (or parents-in-law), grandparents, or aunties to carry the newborn. These practices exist not only in rural but also in urban areas.

Childrearing practices are often carried out to adulthood when children are in other family members' care. There was and is still a system of child fostering. Children are

transferred by their biological parents to other households where their aunties/uncles, grandparents, or cousins are responsible for their education. In most African societies, children's education was collective and not only the sole responsibility of biological parents. Even though childrearing practices differed depending on cultures, one idea emerged: the child belongs to all community members, and everyone is responsible for his education. These childrearing practices reduce the costs of raising children (monetary and non-monetary) and may encourage people or couples to have high fertility goals.

Most Sub-Saharan African economies are agrarian, and agriculture is the main activity in many rural areas. The labor force used is still important in agriculture because of the low use of agricultural technology. Consequently, the desire for a large family is important in rural areas (Orubuloye, 1995). Parents (in particular fathers) had a greater preference for male children not only for their physical strength but also because of the practices of inheriting lands. These practices still exist in many African societies. Agricultural lands mainly belong to men, and male children are more likely to inherit farmlands from their parents. Children were then raised to engage in agricultural activities, and pressure from extended family members(or community) led men to have many children or to marry many women to have many children (Wusu and Isiugo-Abanihe, 2003). In these rural areas, men have the reproductive decision-making power over women.

Even though childrearing practices within the extended family structure are still present in Sub-Saharan African societies, the duration and the moral and financial support parents received from their close relatives decreased over time because of structural changes (Wusu and Isiugo-Abanihe, 2006). The main factors explaining these changes are industrialization, urbanization, and modern civilization. Industrialization and urbanization, while creating jobs, also led to a rural exodus. Job opportunities in urban areas led people to leave their extended family in rural areas. People are then more oriented towards the nuclear family. Even though the child fostering system continues to move from rural to urban areas, the high cost of urban living has reduced the pace and duration of the process. The contribution of the other relatives to raising children is then decreasing. Children's education has become the sole responsibility of the biological parents, who bear almost all the costs of education (emotional, financial, material, time,..). Consequently, the desire for a large family decreases, and people are more interested in the quality than the quantity of children. Western education, women's emancipation movements, global-

ization, and family planning programs have also negatively influenced the desired family size in Africa (Bongaarts, 1997; Bongaarts et al., 1990). Consequently, the fertility rate decreased from 7-8 to 3-4 children in many African countries from the 1960s to 2019.

1.1.2 Women's labor force participation in developing and developed countries

Female labor force participation is an important driver of growth and development. The World Bank estimated 2.5 trillion dollars, the losses due to the earnings gap between women and men in Sub-Saharan Africa.

Among the theories on the relationship between women's labor force participation and economic development in industrialized, developed countries, the non-linear (U-shaped) relationship or the threshold effect is the most common at a global level. At an early stage of economic development, women's participation in the labor market is high because they are more engaged in agricultural activities. However, during the transition from an agricultural to an industrial economy, women's participation rate decreases due to low skills and education levels and a high fertility rate. At a high rate of economic development or industrialization, women's level of education increases, their fertility rate declines, and their participation rate in the labor market increases (Boserup, 1970).

At the individual level, the decision to participate in the labor market is mainly determined by the market wage rate (Mincer, 1962). A variation in the real wage rate or the wage rate has both substitution and income effects on the labor supply. An increase in wage rate leads to a rise in income and reduces the number of hours worked. However, at the household level, the effect is different. The main theories analyzing women's participation in the labor market at the household level are the time allocation theory, the domestic production theory, and the work-leisure theory of Becker (1965); Mincer (1962). Leisure, goods, and services production decisions in the household are collective so that an increase in the wage rate of a member (for example, the husband) does not influence his amount of hours worked but negatively influences that of another household member(such as wife)(Mincer, 1962). Demand for leisure, goods, and services in the household is income-elastic. As a result, an increase in household income due to an increase in a member's wage rate increases consumption and the production of goods and services in the household. Women are the ones who bear most of the production costs

of goods in the household and are more likely to reduce their participation in the labor market. However, women's participation in the labor market also helps families escape poverty by increasing household income.

The tertiary sector, particularly the informal sector, is the most widespread in developing countries, including many African countries. It is the primary source of female employment. According to the 2016 United Nations report on women's economic empowerment, 89% of employed women have an informal occupation. They are more involved in trade, service, and subsistence farming. In developing countries, women's participation rate in the labor market is mainly determined by strategies for survival. Decisions to participate in the labor market not only depend on their personal characteristics but also on household characteristics. Unlike the global level, the relationship between women's participation in the labor market and income at the household level is an inverse U-shaped. For low household income levels, the participation rate is high and decreases for high levels of income (Klasen et al., 2021; Idowu and Owoeye, 2019). In low-income families, women's participation in the labor market is higher and more concentrated in livelihood activities than in rich families. The main determinant of women's participation in the labor market in wealthy families is their level of education. Young girls in low-income families are more likely to work and study simultaneously, depending on interest and motivation, role models, and perceptions of education values.

1.2 Literature review

Literature on the relationship between fertility rate and women's participation rate in the labor market is based on some difficulties in reconciling fertility and employment since women generally bear a large part of the (especially non-monetary) costs of procreation and childrearing. Many studies found a negative long-run relationship between fertility and women's labor force participation (Engelhardt et al., 2004; Freedman and Campbell, 1959; McNown and Ridao-Cano, 2005) in developed countries. However, whether fertility influences women's labor force participation or the latter influences the former remains a debate. Weller (1977) identified four causal links between the two variables. The first causal link is from family size to labor force participation. The second causal link is from labor force participation to family size. Both variables could also influence each other. The

last causal link identified by Weller (1977) is a spurious negative relationship because other common factors influence both variables. One common factor is male income. Indeed, according to Easterlin (1976, 1973), the relative male income is the sole determinant of fertility and women's labor force participation in the labor market. However, the effect depends on marital status. McNown and Ridao-Cano (2005) suggested that married women are more likely than single women to benefit from an increase in men's income. By considering a static household and with the New Home Economics, Butz and Ward (1979) show that the likelihood of childbirth depends mainly on the husband's income and the wife's wage (which is equal to the shadow price of her time or the opportunity cost of childrearing). Depending on the husband's income, a change in the wife's wage less than the opportunity cost of childrearing does not affect fertility due to a non-significant effect on her participation in the labor market. On the opposite, an increase in the wife's wage higher than the shadow price of her time reduces fertility by increasing her participation in the labor market.

According to Easterlin (1976, 1973), decisions concerning marriage, childbearing, and economic aspirations are concentrated in the family-building age group(the 20-29 age group) and depend on their relative cohort size and the family background to which they belong. The fertility rate in urban areas is positively related to the rate of labor market entry of the young male population (positive income effect). In periods of expansion, an increase in labor would increase income and employment, encouraging marriage and childbearing (all other factors being equal). Butz and Ward (1979); Ermisch (1979) suggested that the demographic explosion in the 1950s (shortly after the Second World War) resulted from the increase in male income. Variations in fertility rates are then caused by economic conditions (income and employment) and demographic composition (age, gender, and nationality).

The increase in women's participation in the labor market despite an increase in male income in many developed countries suggests a lack of substitutability between women's and men's employment (Mincer, 1962; Butz and Ward, 1979; McNown and Ridao-Cano, 2005). Indeed, the increase in education, wages, and income in developed countries has resulted in an increase in women's participation in the labor market and a decline in the fertility rate. The New Home Economics (Becker, 1973, 1974, 1981a) suggests then taking into account women's wages in explaining their participation in the labor mar-

ket. Women's wage rate represents the opportunity cost of childbearing. A variation in women's wage rate has both income (positive) and substitution (negative) effects on fertility and opposite effects on the number of hours worked. The incompatibility between childrearing and women's employment is mitigated by changes in institutions and society that encourage women's work.

Due to the family structure, the relationship between fertility and women's employment in Africa may differ. Family programs are the main channel explaining the relationship between women's employment and fertility. They are insufficient in many African countries, and consequently, the total fertility rate remains high compared to developed countries. However, their participation in the labor market is high, especially in the informal sector and non-market activities. Indeed, in low-income households, fertility does not affect women's participation in the labor market. In contrast, in high-income households, fertility reduces women's participation in the labor market (especially those that are not career-oriented) (Klasen et al., 2021; Idowu and Owoeye, 2019).

1.3 Data

There is a global idea that countries could benefit from a decline in fertility (demographic transition). The fertility transition began around the 1880s in Europe and much earlier in the United States of America and France. Asian and Latin American countries started their fertility transition around the 1960s and much earlier in Uruguay and Cuba in 1950. Many studies suggested that the fertility transition began around the 1990s for African countries. However, due to the lack of vital registration data during the period preceding and immediately following the 1960s, Garenne and Joseph (2002) assumed that some African countries have started their fertility transition early. Studies on fertility in Africa relied on periodic survey data (for example, the DHS surveys often conducted over five years). They used many methods to estimate the fertility rate during the pre-survey period. For example, using retrospective maternal histories from the World Fertility Surveys (WFS) and the Demographic Health Surveys (DHS), Garenne and Joseph (2002) have reconstructed trends in fertility over time. They concluded that fertility declined significantly in urban areas in Kenya in the 1960s-1969s.

Fertility data come from the 2019 World Fertility Survey (WFS) and the World Bank

database from 1960 to 2019. Data from the World Fertility Survey derive from civil registration systems, censuses, and sample surveys from the 1950s. Fertility levels and trends are estimated using many methods including the own-children method, the Brass method, the Gompertz relational method, the reverse survival method... Because of incompleteness and sampling problems in some surveys [1]. We first consider countries with at least a World Fertility Survey and a Demographic and Health Survey. They are more consistent and reliable thanks to their data collection method. We then consider Kenya because it is the most used country in Africa's fertility transition studies. Kenya has a world fertility survey (WFS 1978) and six DHS surveys (from 1989 to 2014). Secondly, it is one of the first Sub-Saharan African countries to begin its fertility transition thanks to a successful family planning program. We also consider Rwanda for the same reasons as Kenya. The Republic of Ghana also meets the criteria for selecting countries because it has six DHS surveys and one WFS survey. Nigeria is the country with the highest population in Africa. Its fertility rate is among the highest, with five DHS surveys and one WFS survey. The last country we included in the analysis is Cote d'Ivoire, even though it has only one DHS and WFS survey. Cote d'Ivoire experienced a civil war in 2001, which caused many deaths and led to displacements of the population.

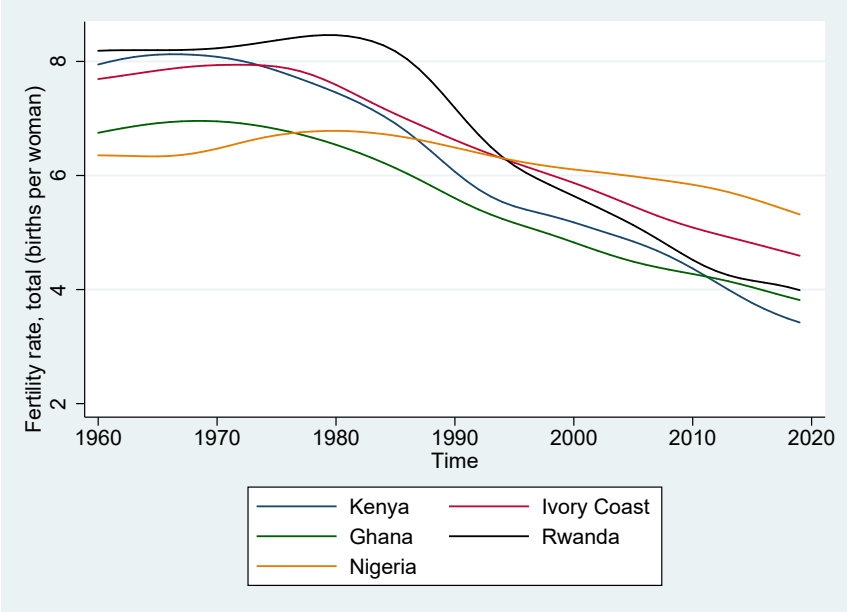
According to the population division of the United Nations, total fertility is "the average number of children a woman would have by age 50 if she survived to age 50 and was subject, throughout her life, to the age-specific fertility rates observed in a given year". Figure 1.1 shows a global decreasing trend in the fertility rate in all countries. Nigeria had the lowest total fertility rate until the 1980s. But, since the 1995s, its fertility rate has been the highest compared to other countries. On the other hand, Kenya, which belonged to countries with the highest fertility rate until 1975, now has the lowest fertility rate.

Data on women's participation in the labor market (% of the female population of 15-64 years) come from the World Bank indicators website, especially from the ILO-STAT (International Labour Organization) database. The ILO uses information from censuses and surveys, including labor force surveys. Participation in the labor market also includes the availability component. Then, women's labor force participation rate

[1] Estimates from the civil registration database, for example, depend on the completeness of birth registers. In other words, data from civil registration systems are considered good quality only if they cover 90 percent or more of all live births in a country or region.

includes those currently engaged and those willing to engage in market activities. It also includes self-employment, for example, the production of market or household consumption goods. In low-income African households, women are more involved in farming and self-employment, informal activities that sometimes combine economic activity and childrearing. This may explain the high participation rate in many African countries (Rwanda, Ghana, and Kenya) since the industrial sector is still developing. Childrearing activities and housework are not part of women's labor force participation measures. Data on women's participation in the African labor market starts from the 1990s. Figure 1.2 shows the global trend for countries considered. We notice that female labor force participation has slightly decreased over time (except for Kenya) despite a decreasing fertility rate. Among the five countries considered, Rwanda has the highest female labor force participation rate due to a high participation in the agricultural sector (67% in 2021). Because data on women's labor force participation rate starts from 1990, the analysis covers the period 1990 to 2019.

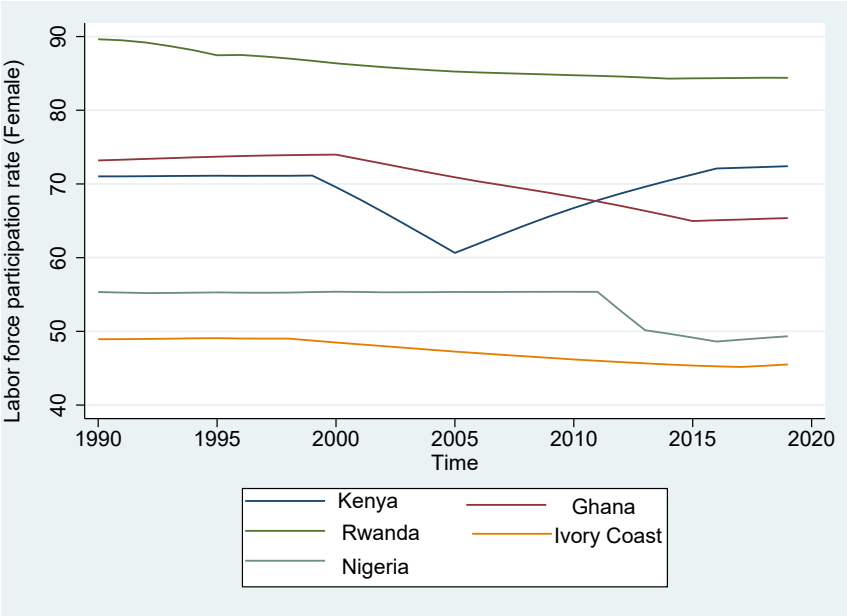
Figure 1.1: Time series of total fertility rate (% of the female population of 15-64 years) for five African countries from 1960 to 2019



Time delay analysis using cross-correlations

In this paragraph, we use cross-correlations to analyze movements in the fertility and female labor force participation rates over time. The objective is to determine if the two series are synchronous over time or if there is a time lag between them. In other

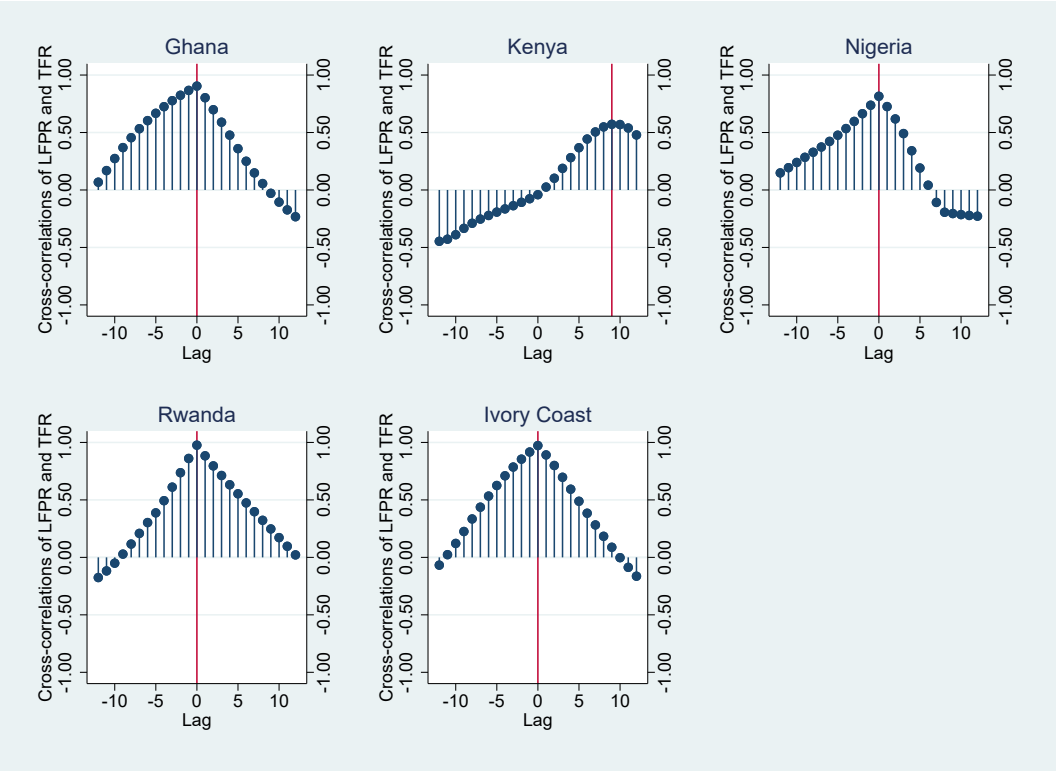
Figure 1.2: Time series of female labor participation in the labor market for five African countries, from 1990 to 2019



words, do the movements in female labor force participation rate tend to follow or precede movements in fertility rate? However, higher cross-correlation coefficients do not imply Granger causality. We will further use the Toda and Yamamoto non-causality test to check the causal relationships between the two variables.

The time delay represents the lag of the highest cross-correlation coefficient between the two series. The cross-correlogram is presented in Figure 1.3. The highest value of the cross-correlation coefficient is found at lag zero in all countries except Kenya. In these countries, movements in the fertility rate and female labor force participation rates are synchronous. Moreover, cross-correlation coefficients are globally positive, which assumes a positive relationship between both variables. In Kenya, cross-correlation coefficients are both positive and negative. The highest cross-correlation coefficient is found at lag 9 and is positive. This implies, for example, that a high fertility rate leads to a high female labor force participation rate nine years later. We also find a negative cross-correlation coefficient at lag -9.

Figure 1.3: Cross-correlogram between female labor force participation rate and fertility rate



1.4 The Econometric framework

Before analyzing the relationship between series, we first study their statistical properties. If we were to use Ordinary Least Squares (OLS), variables must be stationary, i.e., the mean and variance should be time-invariant. Otherwise, the estimation will lead to spurious results.

Many tests exist to check for the standard properties of the series. We first use the standard Dickey and Fuller (1979); Kwiatkowski et al. (1992) tests. Further, we use the Zivot-Andrews unit root test (Zivot and Andrews, 1992) to check for the presence of structural breakpoints. Graphics 1.1 and 1.2 show, in fact, a shift in the trend at specific periods for some countries.

1.4.1 Standard unit root test

Dickey and Fuller (1979) investigated three classes of models where the time series is represented by an autoregressive model with or without an intercept and a trend. It allows distinguishing series with a stochastic or deterministic trend and mixed series (with

both trends). The null hypothesis is the presence of a unit root against the alternative hypothesis that the series is stationary. We use the Augmented-Dickey Fuller test to consider a possible autocorrelation in the error terms. We consider the third Dickey-Fuller model and assume that each time series is adequately represented by an autoregressive AR(p) model with a trend (t):

$$Y_t = \mu + ct + b_1 Y_{t-1} + \sum_{i=2}^{p} b_i Y_{t-i} + e_t \tag{1.1}$$

The Augmented Dickey-Fuller test equation is the following:

$$\Delta Y_t = \alpha + ct + \gamma Y_{t-1} + \sum_{i=1}^{p-1} \eta_i \Delta Y_{t-i} + e_t \tag{1.2}$$

The trend t is included in the analysis if it is significant. Otherwise, we remove the deterministic trend in the equation and estimate the model without a trend. We accept the null hypothesis of a unit root if $\gamma = 0$, Y_t is the fertility rate or women's participation in the labor market.

Using many macroeconomic time series for the US, authors such as Nelson and Plosser (1982) presented some limits of the Augmented Dickey-Fuller test, particularly its low power of detecting trend-stationary series. Indeed, Nelson and Plosser (1982) found that the Dickey-fuller test failed to reject the null hypothesis for most of their series that are, in fact, trend-stationary. Other tests have been developed later to check for the stationarity of series when they present a deterministic trend. One of them is the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. In addition to the Augmented-Dickey-Fuller test, we also perform a KPSS test. As for the Dickey-Fuller test, we include the deterministic trend in the analysis if it is significant. But unlike the Dickey-Fuller test, the null hypothesis of the KPSS test is level or trend-stationary. In short, we test both the null hypothesis of unit root and stationarity using two different tests. By doing so, we can distinguish series that appear to be level or trend-stationary and series that have a unit root. The results from both tests are presented in Table 1.1.

1.4.2 The Zivot-Andrews unit root test

Over the years, African countries have settled programs and reforms to limit and control births and increase women's participation in the labor market. These are, for example, family planning programs, loan facilities for women entrepreneurs, or enactment of legislation to address discrimination against sex in the labor market. For instance, in Kenya, the women's enterprise fund was created in August 2007 to increase women's participation rate in the labor market. All these reforms may affect the trend in the total fertility rate or the women's labor force participation rate. We introduce a structural break in the model, but this affects the standard unit root test results. In fact, Perron (1989) showed that the standard Dickey-Fuller test has less power or is inconsistent when data exhibit breakpoints. He presented an alternative to the standard unit root test, which allows taking structural breaks into account. In its model, the break date is known a priori. However, an incorrect break date reduces the power of the Perron (1990)test.

To deal with Perron (1990) test limits, Zivot and Andrews (1992) proposed an alternative method that considers models with unknown break dates. They test the null hypothesis that the series presents a unit root without exogenous structural breaks against the alternative hypothesis that the series is trend-stationary with a structural break occurring at an unknown point. Zivot and Andrews (1992) investigated three models that allow for a single breakpoint in the intercept, the trend, or both. We follow their regression models:

$$\Delta y_t = \mu + \theta DU_t(\sigma_b) + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} \phi_i \delta y_{t-i} + \epsilon_t \tag{1.3a}$$

$$\Delta y_t = \mu + \gamma DT_t(\sigma_b) + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} \phi_i \delta y_{t-i} + \epsilon_t \tag{1.3b}$$

$$\Delta y_t = \mu + \theta DU_t(\sigma_b) + \beta t + \gamma DT_t(\sigma_b) + \alpha y_{t-1} + \sum_{i=1}^{k} \phi_i \delta y_{t-i} + \epsilon_t \tag{1.3c}$$

Where Δ represents the first difference, μ the intercept, t the deterministic trend, and ϵ the white noise. DU_t is a dummy variable that captures a shift in the intercept, and DT_t is the trend shift dummy variable. $DU_t(\sigma_b) = 1$ if $t > \sigma_b$ and 0 otherwise, and $DT_t(\sigma_b) = t - \sigma_b$ if $t > \sigma_b$ and 0 otherwise. σ_b represents the break date and, is

determined endogenously. Their method consists first of estimating each date (t=2,..., T-1) as a breakpoint date by the ordinary least squares. The endpoints (t=1 and t=T) are not included. Moreover, we choose the break date that minimizes the one-sided t-statistics for testing $\alpha = 1$ (Zivot and Andrews, 1992) in the three models. The number of additional lags of models is determined using the Akaike Information Criteria (AIC) with a maximum lag of 4. We accept the null hypothesis of a unit root if $\alpha = 0$. For $\alpha < 0$, the series is trend-stationary with a structural break occurring at time σ_b. The results are presented in Table 1.2.

1.4.3 The Co-integration Analysis

Figures 1.1 and 1.2 show that aggregate time series of fertility and women's participation in the labor market may present a unit root or be trend-stationary depending on the country. According to Granger et al. (1974), using linear or traditional methods regressions on non-stationary variables would lead to "spurious results." For series with a deterministic trend, including the trend in regressions eliminates spurious results. Still, the method is not applicable when series have a stochastic trend (series are difference-stationary or are integrated). The Vector Auto-Regressive (VAR) model may be used to estimate difference-stationary variables, but information on the long-term dynamic between variables is not provided.

The most widely used methods to analyze both long-run relationships and short-term dynamics are the two-step procedure of Engle and Granger (1987) and the maximum-likelihood method of Johansen (1988); Johansen and Juselius (1990). Because we consider bivariate series that are likely to be I(1), if they are co-integrated, the number of relations of cointegration cannot exceed 1. The two-step method of Engle and Granger (1987) is then appropriate for analyzing the relationship between fertility and women's participation rate in Africa.

The standard error correction model is the following:

$$\Delta Y_t = \gamma + \mu \hat{\epsilon}_{t-1} + \sum_{i=1}^{s} \phi_i \Delta Y_{t-i} + \sum_{i=0}^{s} \theta i \Delta X_{t-i} + v_t \tag{1.4}$$

where v_t is a white noise, μ is the speed of adjustment and $\hat{\epsilon}_{t-1}$ is the error correction

term from the long-term relationship :

$$Y_t = \alpha + \beta t + \lambda X_t + \epsilon_t \tag{1.5}$$

We include a deterministic trend in the cointegrating relation to consider the different trend series. The total fertility rate and women's participation in the labor market have a long-run relationship if their linear combination is stationary, i.e., ϵ_t is stationary. According to Engelhardt et al. (2004), a long-run relationship between variables results from incompatibility between childrearing and women's employment rather than between pregnancy and employment.

One of the challenges of the Engle and Granger (1987) is the identification of the dependent variable. Misspecification of the dependent variable may lead to different results. In our model, the total fertility rate and women's participation rate in the labor market may be both dependent variables because they influence each other. Therefore, we consider two equations where the total fertility rate (women's participation in the labor market) is the dependent variable on the one hand and the independent variable on the other. By doing so, the first step of the Engle-Granger method will allow us to determine the direction of the cointegrating relationship, i.e., if it goes from fertility to women's participation rate or from women's participation rate to fertility.

We also use the Akaike and Schwartz information criteria to select the lag order s with a maximum lag order 4.

Co-integration tests and parameters instability

The Engle-Granger cointegration test results are presented in table 1.3. They show a co-integrating relationship between total fertility and women's participation in the labor market in both directions in Kenya and Ghana. For Cote d'Ivoire, the relation of cointegration is in one direction, i.e., from women's participation in the labor market to fertility. In Nigeria and Rwanda, we found no relationship of cointegration in either direction when using the Engle-Granger method. However, in the presence of a structural break, the test has low power and tends to reject the hypothesis of cointegration (Gregory and Hansen, 1996a). It is then necessary to check for parameter instability in the cointegration regression.

The stability of the model is necessary for econometric inference. Since programs and

policies have been implemented in countries, it is important to analyze whether or not the model is invariant to policy interventions. An unstable model makes it challenging to interpret regression results and may be due to a regime shift (Hansen, 1992a).

The most common tests used to detect model or parameter instability are those of Chow (1960); Quandt (1960). In the Chow test, the structural break date should be defined a priori under the alternative hypothesis that parameters are unstable. He identified many methods of determining the break date. The breakpoint can be selected conditional on the data (i.e., using a variables graph) or by analyzing historical events that should be exogenous. However, the Quandt test suggests specifying a single structural break of unknown timing under the alternative hypothesis. There is no need to specify the break date a priori. But, one of the critics of the Quandt test is the lack of distributional theory (Hansen, 1992a).

We use Gregory and Hansen (1996b,a) tests to determine whether the cointegrating relation has a structural break. But, in the first step, we analyze parameters instability using the Hansen (1992b) test that considers non-stationary series or those with a deterministic trend. Under the alternative hypothesis of Hansen (1992a,b), the long-run relationship is subject to a break at an unknown point in time. The results are presented in Table 1.4. In a second step, we perform the Gregory and Hansen (1996b,a) cointegration test in the presence of a structural change under the alternative hypothesis. The break in the cointegrating equation can occur whether in the intercept, the trend, or the slope. By doing so, Gregory and Hansen (1996b,a) developed many regression models to account for each case. These are the level shift model (C), the level shift with trend model (C/T), the regime shift model(C/S), and the regime and trend shift model. The baseline model is the standard model of cointegration with trend and no structural change (Equation 1.5). To model structural changes, we define a dummy variable $DT_t(\sigma_b)$ which is equal to 1 if $t > \sigma_b$ and 0 otherwise. σ_b is the break date and, is determined endogenously. We present the general cointegration model with regime and trend shift.

$$Y_t = \alpha_1 + \alpha_2 DT_t(\sigma_b) + \beta_1 t + \beta_2 t DT_t(\sigma_b) + \lambda_1 X_t + \lambda_2 X_t DT_t(\sigma_b) + \epsilon_t \tag{1.6}$$

α_1 and α_2 are, respectively, the intercept before the break date and the change in the intercept at the time of the break; β_1 and β_2 represent the trend slope before the break date and the change in the trend slope at the break date; λ_1 and λ_2 denote respectively the

cointegrating slope coefficient before the regime shift and, the change in the cointegrating slope coefficient at the time of the break. The results of the Gregory-Hansen test are presented in table 1.5.

1.4.4 Toda and Yamamoto non-causality test

In this section, we are interested in causal relations between the total fertility rate and women's participation in the labor market. In other terms, we test the economic hypothesis as restrictions of the model coefficients. The Granger-Causality test is one of the tests for investigating causal relations between series but relies on the statistical properties of series. For example, when variables are stationary, a level VAR can be applied, and then restrictions on the model coefficients can be tested. However, in our model, where variables are first-difference stationary, we found a co-integration relation and used an error correction model. With variables that are integrated, we could use a VAR in the first differences of the variables and then test restrictions on model parameters.

Whether with VAR models or Error Correction models, we need to do pre-tests for the presence of unit root or co-integrating vector. However, these models may suffer from pre-test biases. Toda and Yamamoto (1995) proposed testing linear or non-linear coefficient restrictions by testing a level VAR and applying the Wald criterion. In other terms, we can estimate a VAR in level and test restrictions on the model coefficients even if variables are integrated (with the same or different orders) or co-integrated. By doing so, little attention is paid to the integration or co-integration properties of the time series because the test is robust to the statistical properties of the series. Their approach consists of estimating an "augmented" VAR model.

Following the Toda and Yamamoto (1995) approach, we consider a bivariate VAR(p+d_{max}) model and examine the causal relations between the total fertility rate and women's participation in the labor market.

$$TFR = \phi_0 + \sum_{i=1}^{p} \phi_i TFR_{t-i} + \sum_{i=p+1}^{p+d_{max}} \phi_i TFR_{t-i} + \sum_{i=1}^{p} \gamma_i LFPR_{t-i} + \sum_{i=p+1}^{p+d_{max}} \gamma_i LFPR_{t-i} + V_{1t} \tag{1.7a}$$

$$LFPR = \chi_0 + \sum_{i=1}^{p} \chi_i TFR_{t-i} + \sum_{i=p+1}^{p+d_{max}} \chi_i TFR_{t-i} + \sum_{i=1}^{p} \eta_i LFPR_{t-i} + \sum_{i=p+1}^{p+d_{max}} \eta_i LFPR_{t-i} + V_{2t} \tag{1.7b}$$

Where $\phi_i, \gamma_i, \chi_i, \eta_i$ are the model parameters; d_{max} is the maximum order of integration we suspect to occur in the model; p is the optimal lag length; V_{1t} and V_{2t} are error terms and are assumed to be white noise and non-correlated.

We test the null hypothesis that LFPR does not cause TFR and vice versa using the (Wald) F-test. It is expressed as:

$$\gamma_i = 0 \quad \forall i = 1, ...p \tag{1.8a}$$

$$\eta_i = 0 \quad \forall i = 1, ...p \tag{1.8b}$$

The test procedure involves many steps. The first step is to determine the order of integration of variables (in which we use the Zivot and Andrews (1992) test, the KPSS, and the Augmented Dickey-Fuller test). We assume that the maximum order of integration (d_{max}) of variables in the system is equal to 1. The optimal lag length p is determined using the Akaike and Schwartz information criteria. In the second step, we run a levels VAR model and test for serial autocorrelation of residuals (table A1.3). Finally, we test the null hypothesis that parameters γ_i are jointly equal to zero in the TFR equation, and parameters η_i are jointly equal to zero in the LFPR equation. Results are presented in table 1.7.

1.5 Empirical results

Table 1.1 presents both the Augmented Dickey-Fuller and the KPSS test results. Tests are performed on Eviews. By using both tests, we can distinguish series that appear to be stationary around a level or a trend and series that are stationary. We follow the conclusions of Kwiatkowski et al. (1992) regarding the use of the two tests. If both tests indicate that the series is stationary (or has a unit root), then they are stationary (or not stationary). If the KPSS test suggests the presence of a unit root and the Dickey-Fuller test indicates stationary, we conclude that the time series is not stationary. If the Dickey-Fuller test indicates non-stationarity and the KPSS test indicates stationarity, then the time series is stationary. The tests are performed on the level and first-difference variables.

The results show that in all countries (except in Cote d'Ivoire), the total fertility rate is not stationary when using the Augmented Dickey-Fuller and KPSS tests. When considering the first difference, both tests indicate stationarity in Kenya and Nigeria. The first-difference results are different in Ghana, Rwanda, and Cote d'Ivoire. Indeed, while the Augmented-Dickey-Fuller test suggests that the first difference in the total fertility rate is not stationary (the trend is significant in Rwanda and Cote d'Ivoire), the KPSS test indicates trend-stationary in Ghana and Rwanda and level-stationary in Cote d'Ivoire. We conclude that the total fertility rate is also I(1) in these countries (Ghana, Rwanda, and Cote d'Ivoire).

For the labor force participation rate, both tests indicate non-stationarity in all countries (except Kenya, where the KPSS test indicates stationarity). Moreover, the first difference of the variable is also non-stationary in all countries when using the Augmented-Dickey-Fuller test. However, the KPSS test indicates that the series is I(1).

Assuming the existence of structural breakpoints, the Zivot and Andrews (1992) test results in table 1.2 provide strong evidence that the total fertility rate has a unit root in Kenya and Rwanda. In Ghana, Nigeria, and Cote d'Ivoire, the variable is trend-stationary with a structural breakpoint that occurs both in the trend and in the intercept in 2000, 2010, and 2013, respectively. Since the analysis period begins in 1990, for most countries, structural breaks may appear after the 2000s. This may be the result of population policies and structural transformation adopted at the end of the 20th century. For example, article 37 of the 1992 Constitution of Ghana stipulates that the government should have a

Table 1.1: Standard unit root tests results

Countries	Variables	Augmented Dickey-Fuller			Kwiatkowski-Phillips-Schmidt	
		Statistics	Lags	Trend	Statistics	Trend
Kenya	TFR (level)	-0.55 (0.86)	7	No	0.17	Yes
	First.diff	-4.57 (0.002)	6	No	0.12	Yes
	LFPR (level)	-2.18 (0.48)	1	Yes	0.16	No
	First.diff	-1.82 (0.36)	0	No	0.21	No
Nigeria	TFR (level)	1.63 (0.99)	3	No	0.15	Yes
	First.diff	-3.35 (0.022)	2	No	0.37	No
	LFPR (level)	-2.16 (0.49)	0	Yes	0.16	Yes
	First.diff	-2.69 (0.087)	0	No	0.2	No
Ghana	TFR (level)	1.11 (0.99)	5	No	0.72	No
	First.diff	-1.76 (0.39)	4	No	0.11	Yes
	LFPR (level)	-2.56 (0.30)	1	Yes	0.16	Yes
	First.diff	-1.55 (0.49)	0	No	0.27	No
Rwanda	TFR (level)	-3.71 (0.01)	7	No	0.71	No
	First.diff	-6.02 (0.000)	7	Yes	0.09	Yes
	LFPR (level)	-1.24 (0.88)	1	Yes	0.19	Yes
	First.diff	-5.05 (0.002)	0	Yes	0.5	Yes
Cote d'Ivoire	TFR (level)	-2.18 (0.22)	3	Yes	0.097	Yes
	First.diff	-5.25 (0.001)	2	Yes	0.13	No
	LFPR (level)	-2.27 (0.19)	1	No	0.67	No
	First.diff	-0.72 (0.82)	0	No	0.19	No

Notes: TFR is total fertility rate and LFPR is labor force participation rate.
P-values are in brackets. The number of additional lags is selected using the Akaike Information Criteria (AIC).
5% critical values for models with and no trend based on Kwiatkowski et al. (1992) are respectively 0.146 and 0.463.

policy population consistent with the country's development objectives. The 1994 Revised Population Policy and Action Plans were therefore intended to set up, for example, family

planning programs to reduce the fertility rate from 5.5 to 5 and increase the contraceptive prevalence rate of 15% by the year 2000. Other population-related policies have also been adopted to contribute to achieving the objectives. These are, for example, the Adolescent Reproductive Health Policy in 2000. Like Ghana, Nigeria has adopted many policies regarding population in the 20th and 21st centuries. Nigeria is one of the African countries with the highest fertility rate. For example, in 2004, the country adopted the National Policy on Population for Sustainable Development (NPP). It launched the Strategic Plan for the National Policy in 2008 to reduce the fertility rate and increase modern contraceptive prevalence. It is no different for countries like Kenya, Rwanda, and Cote d'Ivoire, where many policies, reforms, and programs related to population have been set up at the end of the 20th century and the beginning of the 21st century to reduce fertility rates and increase contraceptive prevalence.

The Zivot-Andrews test results show that women's participation in the labor force presents a unit root in all countries except for Nigeria, where a structural breakpoint occurs both in the trend and in the intercept in 2012. The structural breakpoint occurs in Kenya between 2000 and 2005. Unlike other countries where women's labor force participation in the labor market is decreasing, Kenya exhibits an increasing trend from 2005 (Figure 1.2). The increase in female labor force participation rate may be attributed to a reduction in fertility rate, an increase in access to child care, a change in technology, increased levels of education, and the promotion of soilless and hydroponic crops, which allow the practice of agriculture in urban areas. Accessibility to credit and productive assets and non-labor income can also increase women's participation rate in the labor market. The decreasing trend in women's participation in the labor market is typical in developing countries despite economic growth, progress in education, and reductions in fertility in these countries. This may correspond to the first (decreasing) phase of the U-shaped relationship between economic growth and women's participation in the labor market.

The standard Engle-Granger cointegration test results are presented in Table 1.3. However, the possibility of a structural break in the long-run relationship between variables is not taken into account. Therefore, we also use the Hansen (1992b) and the Gregory and Hansen (1996b,a) tests. The Hansen parameter instability test is performed using Eviews, and the Gregory-Hansen co-integration with structural break test is run on Stata.

Table 1.2: The Zivot-Andrews unit root test results

Countries	Variables	Lags	Shift in the intercept		Shift in the trend		Shift in both	
			Break date	Test stat.	Break date	Test stat.	Break date	Test stat.
	Level							
Kenya	TFR	2	2002	-4.403	2005	-3.892	2002	-4.300
	LFPR	1	2000	-4.463	2005	-4.223	2000	-4.641
	Level							
Ghana	TFR	2	1997	-3.991	2001	-7.852	2000	-6.519
	LFPR	1	2008	-2.954	1998	-2.672	1996	-2.579
	Level							
Rwanda	TFR	2	2001	-2.709	2010	-2.782	2008	-3.212
	LFPR	0	1994	-1.523	1995	-2.16	2002	-1.865
	Level							
Nigeria	TFR	2	2006	-3.61	2010	-6.695	2010	-6.476
	LFPR	1	2012	-14.351	2010	-4.174	2012	-5.731
	Level							
Cote d'Ivoire	TFR	2	2001	-3.655	2015	-4.211	2013	-5.476
	LFPR	1	2007	-2.015	2015	-3.209	2015	-3.324

Notes: The 5% critical values of Zivot and Andrews (1992) test of the model with a shift in the intercept, in the trend or in both are -4.80 -4.42 and -5.08 respectively.

Results are presented in Table 1.4 and 1.5. The Hansen (1992b) test results show evidence of unstable parameters. In other words, we reject the null hypothesis that parameters in the long-run relationship between total fertility and women's participation rate are stable or time-invariant in all countries except Nigeria. When the women's participation rate is the dependent variable, the test statistic suggests that the long relationship between the total fertility rate and women's participation in the labor market may be unstable in Kenya and Cote d'Ivoire at 10%. For Ghana and Rwanda, the relationship is unstable at 1% regardless of the dependent variable used. In Nigeria, both variables indicate a stable relationship: the test statistic is not significant.

Table 1.5 reports the Gregory and Hansen (1996b,a) tests results for cointegration with a structural break in the level, trend, slope, and the break date using both variables as a dependent variable. The results in the total fertility rate equation indicate rejection of the null hypothesis of no cointegration in all countries except Nigeria and Rwanda. The structural change only occurs at the level and trend shift model in 2005 in Kenya and Cote d'Ivoire. For Ghana, the level and trend shift model and the regime and trend shift model also show a significant result with a break date that occurs in 2015. The null

Table 1.3: Engle-Granger cointegration test results

Countries	Dependent variable	tau-statistic	P-value	z-statistic	P-value.
Kenya	TFR	-4.125	0.050	-37.640	0.000
	LFPR	-4.177	0.046	-36.012	0.000
Ghana	TFR	-4.352	0.033	-36.783	0.000
	LFPR	-4.398	0.03	-41.923	0.000
Cote d'Ivoire	TFR	-4.848	0.012	-58.233	0.000
	LFPR	-3.194	0.245	-29.312	0.002
Nigeria	TFR	-2.320	0.645	-190.567	6.389
	LFPR	-3.111	0.276	-28.413	0.003
Rwanda	TFR	-3.627	0.127	-40.798	0.000
	LFPR	-2.229	0.690	-9.108	0.652

Notes: Since we run the test on Eviews, it provides both the Engle-Granger tau-statistic (t-statistic) and the normalized autocorrelation coefficient (z-statistic).

hypothesis of no cointegration in the total fertility equation is accepted in Rwanda and Nigeria.

In the labor force participation rate equation, the hypothesis of no cointegration is also rejected in all countries except for Cote d'Ivoire. The level and trend shift model in Kenya and Ghana presents a significant result involving cointegration with a structural break in 2004 and 2015, respectively. In Rwanda, only the regime and trend shift model has a significant result with a break date in 2003, while results in all models are significant in Nigeria. Therefore, we present the results of the error correction model (ECM)(Table 1.6) for countries and variables based on the results in Table 1.5 and those of short-term residuals tests (Table A1.2). We also test the assumptions of normality, heteroscedasticity, and autocorrelation of residuals. The ECM results for Kenya and Rwanda are corrected for heteroscedasticity and autocorrelation of residuals. For Ghana and Cote d'Ivoire, error terms are already homoscedastic and non-correlated.

Results are presented in Table 1.6 (we do not present the results of the error correction model in Nigeria because the error correction term coefficient is positive). Our estimation results show evidence of a long-run effect of fertility rate and female participation rate in the labor market (or the reverse effect) for the remaining countries. We begin interpretations using the total fertility rate equation. In Ghana, the long-run effect of female labor force participation on the total fertility rate is negative and significant before the break in the slope (before 2015) and not significant after the break (the second column of Table 1.6). In Kenya, we obtain the same effect without the structural break in the slope.

Table 1.4: Hansen (1992) parameter instability test results

Countries	TFR		LFPR	
	Lc	P-value	Lc	P-value
Kenya	3.45	< 0.01	0.50	0.097
Ghana	11.93	< 0.01	2.69	< 0.01
Rwanda	1.21	<0.01	0.91	< 0.01
Nigeria	0.24	< 0.02	0.42	0.16
Cote d'Ivoire	2.46	< 0.01	0.51	0.09

Notes: Hansen (1992a) proposed three tests: the SupF test, the MeanF test, and the Lc. We present the Lc test with a null hypothesis that parameters in the cointegrating relation are time-invariant.

However, in Cote d'Ivoire, female labor force participation has a positive and significant long-run effect on fertility.

In Rwanda, the total fertility rate has a positive and significant long-run effect on the female labor force participation rate before the second regime (before 2003). In the second regime (2003), the effect is negative but non-significant.

The error correction term coefficient is an important parameter in short-run equations that measures the speed at which disequilibrium between two variables is corrected. Theoretically, this coefficient should range between -1 and 0 for an equation to be valid. This assumption is true for all countries. The error correction term coefficient in the equation for the total fertility rate in Kenya, Ghana, and Cote d'Ivoire is -0.119, -0.173, and -0.181, respectively. It indicates, for example, that 17.3% of the disequilibrium between the fertility rate and female labor force participation rate in Ghana is dissipated before the next period. Among all countries, Rwanda has the highest rate of adjustment. Specifically, the pace of adjustment in the labor force participation rate equation in Rwanda is much faster (0.955) than that in Ghana (0.302). This means that 95% of the gap between female labor force participation and total fertility rate is rectified before the next period in Rwanda, while only 30.2% of it is corrected in Ghana.

The results of the short-run model are presented in the lower part of the Table 1.6). In Ghana, short-term fluctuations in the total fertility rate negatively and significantly affect female labor force participation. The effect is also negative but non-significant in Rwanda. Fluctuations in female labor force participation have a significant and positive effect on the total fertility rate in Cote d'Ivoire while the effect is negative in Ghana and

Kenya (at 10% in Kenya).

These findings are essential in understanding the dynamics of the variables and how they affect each other. The speed of adjustment is an important factor in policy-making, as it can inform decisions on the timing and effectiveness of interventions aimed at correcting imbalances.

Table 1.6: Error Correction Model results

Parameters	Kenya	Ghana		Cote d'Ivoire	Rwanda
	ΔTFR	ΔTFR	$\Delta LFPR$	ΔTFR	$\Delta LFPR$
	T=2005	T=2015	T=2015	T=1997	T=2003
		Long-run relationship			
α_1	31.464***	33.060***	62.251***	23.523***	6.794***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
α_2	21.70***	-2.265	-7.880	-4.523***	-3.691**
	(0.000)	(0.588)	(0.364)	(0.004)	(0.024)
β_1	-0.147***	-0.015***	-0.028***	-0.012 ***	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.057)
β_2	-0.0108***	0.001	0.004	0.002***	0.002**
	(0.000)	(0.550)	(0.364)	(0.004)	(0.018)
λ_1	-0.114*	-0.401***	-1.750***	0.741***	0.109***
	(0.087)	(0.000)	(0.000)	(0.000)	(0.001)
λ_2		0.340			-0.031
		(0.992)			(0.389)
F-statistics	3071.13	3448.28	191.81	10154.55	1250.71
P-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
		Short-run relationship			
EC(-1)	-0.119***	-0.173***	-0.302 ***	-0.181***	-0.955***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.0017	0.048***	-0.006 *	0.001	-0.150**
	(0.429)	(0.000)	(0.087)	(0.207)	(0.011)
ΔTFR_t			-2.865***		-0.029
			(0.002)		(0.607)
$\Delta LFPR_t$	-0.020*	-0.053***		0.118***	
	(0.080)	(0.002)		(0.001)	
ΔTFR_{t-1}	0.842***	0.935***	2.412***	1.040***	-0.0017
	(0.000)	(0.000)	(0.005)	(0.000)	(0.974)
$\Delta LFPR_{t-1}$	0.035***	0.072***	0.902***	-0.099**	0.626***
	(0.000)	(0.000)	(0.000)	(0.012)	(0.000)
R-squared	0.9467	0.993	0.826	0.977	0.777
$\chi^2(1)$		0.09	0.02	1.21	
P-value		(0.768)	(0.886)	(0.271)	
N	28	28	28	28	28

Notes: EC(-1) is the lagged error correction term; *; ** and *** indicate significance levels at 10%, 5% and 1% respectively. Numbers in parentheses are p-values. Δ is the first difference operator.$\chi^2(1)$ is the result of the Breusch and Pagan (1979) heteroscedasticity test at one degree of freedom. Long and short run equations are respectively $Y_t = \alpha_1 + \alpha_2 DT_t(\sigma_b) + \beta_1 t + \beta_2 tDT_t(\sigma_b) + \lambda_1 X_t + \lambda_2 X_t DT_t(\sigma_b) + \epsilon_t$ and $\Delta Y_t = \gamma + \mu\hat{\epsilon}_{t-1} + \sum_{i=1}^{s} \phi_i \Delta Y_{t-i} + \sum_{i=0}^{s} \theta i \Delta X_{t-i} + v_t$

The existence of a co-integrating relationship between the total fertility rate and women's participation in the labor market for Kenya, Ghana, Cote d'Ivoire, and Rwanda

suggests that there must be a causal relationship between these variables in at least one direction. As mentioned previously, we use the standard unit root test and the Zivot and Andrews (1992) test to determine the order of integration of variables. The Akaike and Schwartz information criteria allow us to determine the number of lags to include in the VAR model. Table 1.7 presents the Toda and Yamamoto (1995) test results. We find a bidirectional causality between total fertility and women's participation in the labor market in all countries except Rwanda. Indeed, in Rwanda, only women's participation in the labor market significantly affects the total fertility rate. It is explained by the Rwandan policy of promoting women's work. Legislation meets quotas of women in ministerial departments and legislative elections: women hold about 40% of ministerial portfolios and represent more than 60% of parliament's members.

The bi-directional causality may be explained by structural changes, urbanization, social norms, and the development of nuclear families at the expense of traditional or extended families in African societies. The causal relation from women's participation in the labor market to fertility rate can be explained by inadequacy between employment and childrearing that may encourage the use of contraceptives. Indeed, Amin et al. (1994) found that high participation of poor women in income-generating projects has not only increased the level of contraceptive use but also decreased the level of desire for additional children. This is the case in Rwanda. Past childrearing practices in African countries might not influence fertility due to the presence of extended family members. But, because of urbanization and economic development, the nuclear family is more dominant, and past childrearing practices are decreasing. Parents bear the most of the education costs of their children. High participation of African women in the labor market may, then, reduce their desire for a large family, increase their level of contraceptive use, and reduce their fertility rate.

The causal relation from fertility rate to women's participation in the labor market may also be explained by this incompatibility factor between childrearing and women's employment but depends on men's wages and household income. It also depends on women's level of education. Indeed, in high-income households, a high fertility rate can reduce women's participation rate, while in low-income households, women continue to work to contribute to the family's needs. Rural households have a much greater incidence of this result.

Table 1.5: Gregory and Hansen (1996) cointegration test results

Countries	Variables	Level shift		Level and trend shift		Regime shift		Regime and trend shift	
		ADF Stat.	Break date	ADF Stat.	Break date	ADF Stat.	Break date	ADF Stat.	Break date
Kenya	TFR	-3.75	2001	-5.18	2005	-3.71	2001	-5.25	2006
	LFPR	-3.46	2001	-5.66	2004	-3.62	2001	-4.44	2011
Ghana	TFR			-6.13	2015			-5.88	2015
	LFPR	-2.87	1996	-5.32	2015	-3.77	1999	-5.35	2012
Rwanda	TFR	-2.56	2009	-4.25	1994	-3.19	2004	-5.27	2013
	LFPR	-3.62	1997	-3.77	1997	-4.77	2003	-6.22	2003
Nigeria	TFR	-2.79	1999	-2.74	2015	-3.91	2011	-4.79	2013
	LFPR	-5.93	2012	-5.73	2012	-5.74	2012	-7.45	2011
Cote d'Ivoire	TFR			-5.58	1997				
	LFPR			-3.42	1997	-2.5	2013	-3.78	2011

Notes: Gregory and Hansen (1996b,a) proposed three tests for cointegration with structural break. These are the ADF test of Engle-Granger, the Z_t test and the Z_a test of Philips and Ouliaris. We present only the ADF test of Engle and Granger (1987). The 5% critical value for level shift model, the level and trend shift, the regime shift model and the regime and trend shift model are -4.61; -4.99; -4.95 and -5.50 respectively.

Table 1.7: Toda and Yamato Non-causality test Results

Countries	LPFR does not cause TFR			TFR does not cause LFPR		
	Lags	Wald Statistics	P-value	Lags	Wald Statistics	P-value
Kenya	3	23.77***	0.000	3	22.91***	0.000
Ghana	4	36.11***	0.000	4	9.17*	0.057
Rwanda	3	7.13*	0.068	3	1.22	0.747
Nigeria	2	13.63***	0.001	2	13.53***	0.001
Cote d'Ivoire	4	36.85***	0.000	2	10.28**	0.0359

1.6 Conclusion

The fertility rate in Africa remains high in comparison with the rest of the world, and many studies have raised questions about the causes or consequences of the high fertility rate. Researchers have explored various theories to explain the high fertility rate, including the possible influence of female labor force participation as a determining factor. However, the fertility rate can also be a determinant of female labor force participation. Empowering women can lead to a reduction in the fertility rate, which can, in turn, enable women to participate more fully in the labor force and contribute more to the economy. On the other hand, government's initiatives to reduce births and empower women can also contribute to a decrease in the fertility rate.

This study analyzed relationships between fertility and female labor force participation using aggregated data from five Sub-Saharan African countries from 1990 to 2019. We analyzed both short and long-term relationships using the Error Correction Model. One of the specificities of the analysis is to consider the instability of the parameters, in particular, the structural breaks that can appear in the long-term relationship. Some key findings emerged from this analysis.

First, we showed evidence of a long-run negative relationship between fertility rate and women's participation in the labor market in Kenya, Ghana, and Rwanda. We also found a regime trend shift in Ghana and Rwanda, even if the coefficient is not significant.

Secondly, we found that in Kenya, women's participation in the labor market is more sensitive to changes in fertility rate as compared to Ghana. In other words, when the fertility rate changes, women in Kenya tend to adjust their labor market participation more quickly than women in Ghana. However, overall, the fertility rate slowly adapts to variations in women's participation in the labor market in the long-term equilibrium. This means that when women's participation in the labor market changes, the fertility rate takes a longer time to adjust to the new equilibrium. It is important to note that the speed of adjustment is relatively lower in Kenya, Ghana, and Cote d'Ivoire. Further research is required to identify the causes behind the slow adjustment rate.

In the short term, the fertility rate responds negatively to changes in women's participation rate in Kenya and Ghana, while the effect is positive in Cote d'Ivoire. Likewise, women's participation in the labor market responds negatively to short-run fertility rate

variations. The effect is not significant in Rwanda.

Using Toda and Yamamoto (1995) non-causality test, we found a bi-directional causality between fertility rate and women's participation in the labor market in all countries except Rwanda, where we found a unidirectional causality.

Chapter 2

Schooling and childbearing: Fertility time preference and precautions among adolescents in Sub Sahara African countries

Introduction

Population growth has traditionally been seen as a positive sign of progress and a means of meeting the demands of the labor market. However, as living conditions have changed, increased birth rates have become a challenge for developing countries, in particular, with potential negative effects on their socio-economic development. The concept of the demographic dividend thus emerged, suggesting that reductions in birth and mortality rates could have positive effects on the development of countries.

High fertility rates are still prevalent in African countries, and many Sub-Saharan African countries have yet to undergo their demographic transition. A change in the population's age structure could have a positive impact on their economic performance. As birth and death rates decrease, the amount of investment required to meet the needs of the youngest age group also decreases. This means that resources can be used to invest in economic growth and family welfare. According to demographic projections, the African population will increase from 1.2 billion in 2020 to 2.6 billion in 2050, accounting for 60% of worldwide population growth across all age groups. Early fertility may contribute to an increase in the total number of children. For example, in the Democratic Republic of Congo, 21.2% of teenagers are mothers (Figure 2.4).

African countries have varying fertility patterns, with a common one being the desire for large families, which is still present in many African countries (Pritchett and Summers, 1994; Bongaarts and Casterline, 2013; Casterline and Agyei-Mensah, 2017). Traditional, cultural, and religious considerations largely explain this pattern. However, as the economy grows and child mortality rates decrease, jobs are created, and the cost of childbearing increases, leading to a decrease in the desire for large families and ultimately influencing the fertility rate (Casterline, 2017). Therefore, declines in desired fertility are strongly correlated with total fertility declines.

Studies on fertility in Africa have mainly concentrated on the effect of education on fertility rates. When it comes to adolescents, research tends to examine how teenage pregnancy affects their education and how it influences them once the pregnancy occurs. The literature usually focuses on women who have either completed their education or dropped out of school, using methods like impact analysis to explore the relationship between education and fertility. However, since teenage pregnancy is usually unplanned,

it is crucial to address the issue before it leads to unwanted consequences. Thus, our focus has shifted towards fertility time preference. We believe that by identifying fertility time preferences and taking precautions such as family planning, we can prevent teenage pregnancy and reduce unplanned or unintended pregnancies among adolescents.

It is common for young people, in particular, to experience unplanned pregnancies. To better understand this phenomenon, many studies use contraception as a way to measure the intentions of individuals regarding having children. In line with this methodology, we are conducting research to determine whether fertility time preference can be used to increase the usage of contraceptives and decrease the occurrence of unintended pregnancies among adolescents.

Fertility time preference refers to the decision-making process that young people undertake when considering the trade-off between education and fertility. This preference is a crucial factor in determining the choices that young people make regarding their reproductive health. Our study aims to investigate whether educating adolescents about fertility time preference can increase their knowledge and understanding of this concept and, as a result, lead to an increase in contraceptive use and a decrease in unintended pregnancies.

Through our research, we hope to provide valuable insights into the factors that influence adolescent reproductive health decision-making and contribute to the development of effective interventions that can reduce the incidence of unintended pregnancies among young people.

According to Bongaarts et al. (1990), the quality and quantity of family planning services can reduce unintended fertility rates. However, Pritchett and Summers (1994) suggests that a decrease in fertility is typically due to the decline in wanted fertility, and a reduction in unwanted fertility is not significant. Nonetheless, without contraceptive methods, women would be at a higher risk of unintended pregnancies, even if they do not intend to have large families (Bongaarts, 1997). Family planning programs can help reduce unwanted fertility by improving knowledge, perceptions, and attitudes toward reproduction and contraceptive methods. They can also influence the desire for smaller families by highlighting the benefits of small families and the need to reduce births through contraceptive methods (Bongaarts, 2020). Therefore, we have considered the indicators of family planning methods, including knowledge, perceptions, and attitudes toward reproduction,

while conducting our research.

Our analysis is based on data collected from the Performance Monitoring for Action (PMA) program across several African countries. However, we focus on data obtained from Burkina Faso, The Democratic Republic of Congo, Kenya, and Nigeria in the years 2019-2020. To analyze the data, we utilized Exploratory and Confirmatory Factor Analysis (EFA and CFA). Additionally, we used a bivariate recursive probit model for estimations. Our findings show that fertility time preference has a significant impact on the decision to use contraception, but only in the case of Kenya. However, when controlling for perceptions about contraceptive methods, the effect is not significant. Nonetheless, we found that in all countries, decision-making power regarding fertility time, knowledge of contraceptive methods, and exposure to family planning messages significantly affect the decision to use contraception. We also found that adolescents possess limited knowledge of the different contraceptive methods.

The study is structured as follows: in the first section, we present a review of the literature of studies that studies the relationship between education and fertility. In the second section, we provide a detailed description of the data and analysis methods that we have used for this study. It includes a discussion of the data sources that are used, the variables that are measured, and the statistical techniques that have been employed to test our hypotheses. We present the empirical results in sections 3 and 4, providing a detailed analysis of the findings that have emerged from the econometric model. Finally, in sections 5 and 6, we discuss the implications of our findings for policy and practice.

2.1 Background information and literature review

The distribution of fertility rates among 15-19-year-olds in Sub-Saharan Africa varies among Burkina Faso, Nigeria, Kenya, and the Democratic Republic of Congo, as depicted in Figure 2.1. Among these countries, Congo DRC has the highest fertility rate, with an average of 147 births per 1,000 women aged 15-19, while Kenya has the lowest with an average of 62 births per 1,000 women aged 15-19.

Unfortunately, a high percentage of teenagers in these countries have already started childbearing or are already mothers. Between 2003 and 2013, 27.2% of teenage women in Congo DRC had started childbearing, while 21.2% had become mothers. In Nigeria,

19% of teenage girls had already given birth, while 16% were pregnant with their first child. Burkina Faso and Kenya also have high percentages of teenage pregnancies and early childbearing.

Moreover, the use of contraceptive methods among young women in these countries is low, as shown in Figure 2.2. In Burkina Faso, only 10% of sexually active teenagers use any form of contraception, while in Nigeria, the percentage is even lower, at 5%. In Congo DRC, only 2% of married adolescents use any form of contraception. Kenya, however, has one of the oldest family planning programs in Africa, and the percentage of young women currently using any method of contraception was 10.1% between 2003 and 2014, with a higher percentage among urban women compared to their rural counterparts.

Figure 2.1: Age-specific fertility rate 15-19

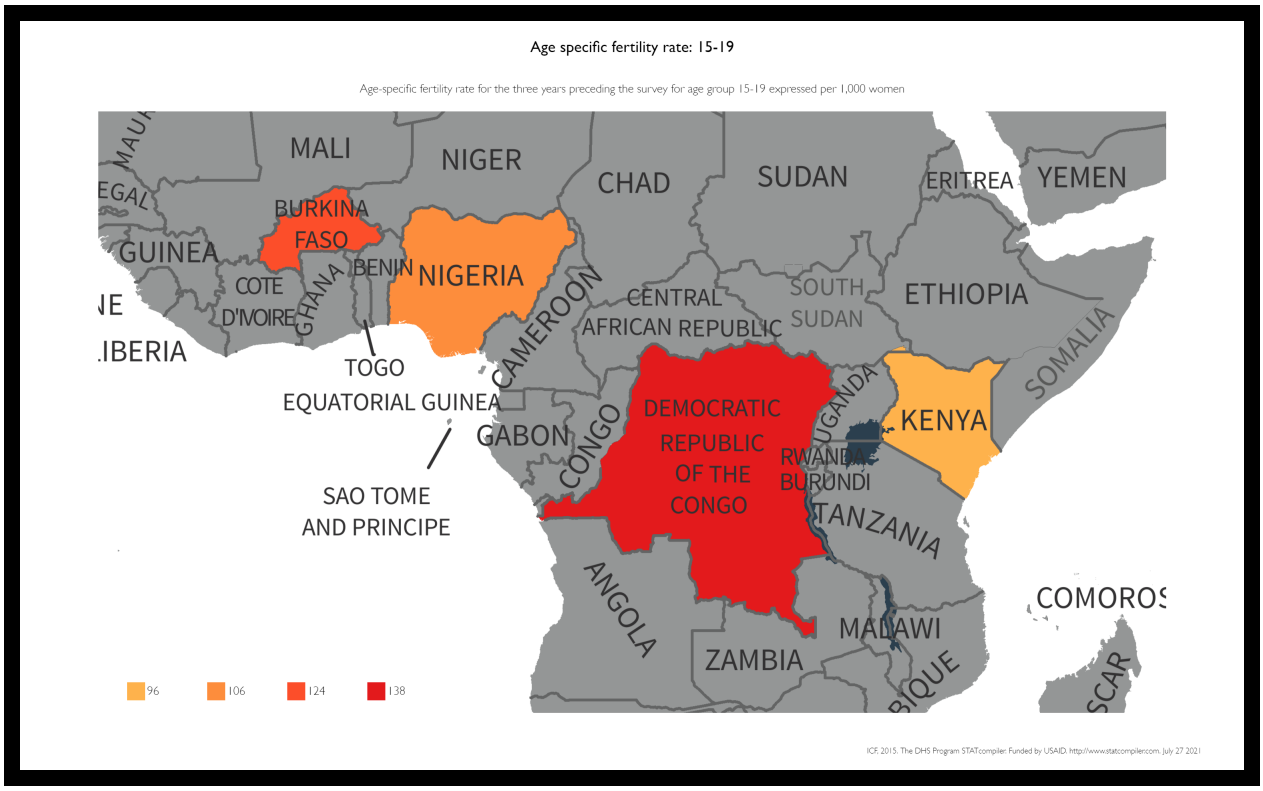


Figure 2.2: Current use of any method of contraception (young women)

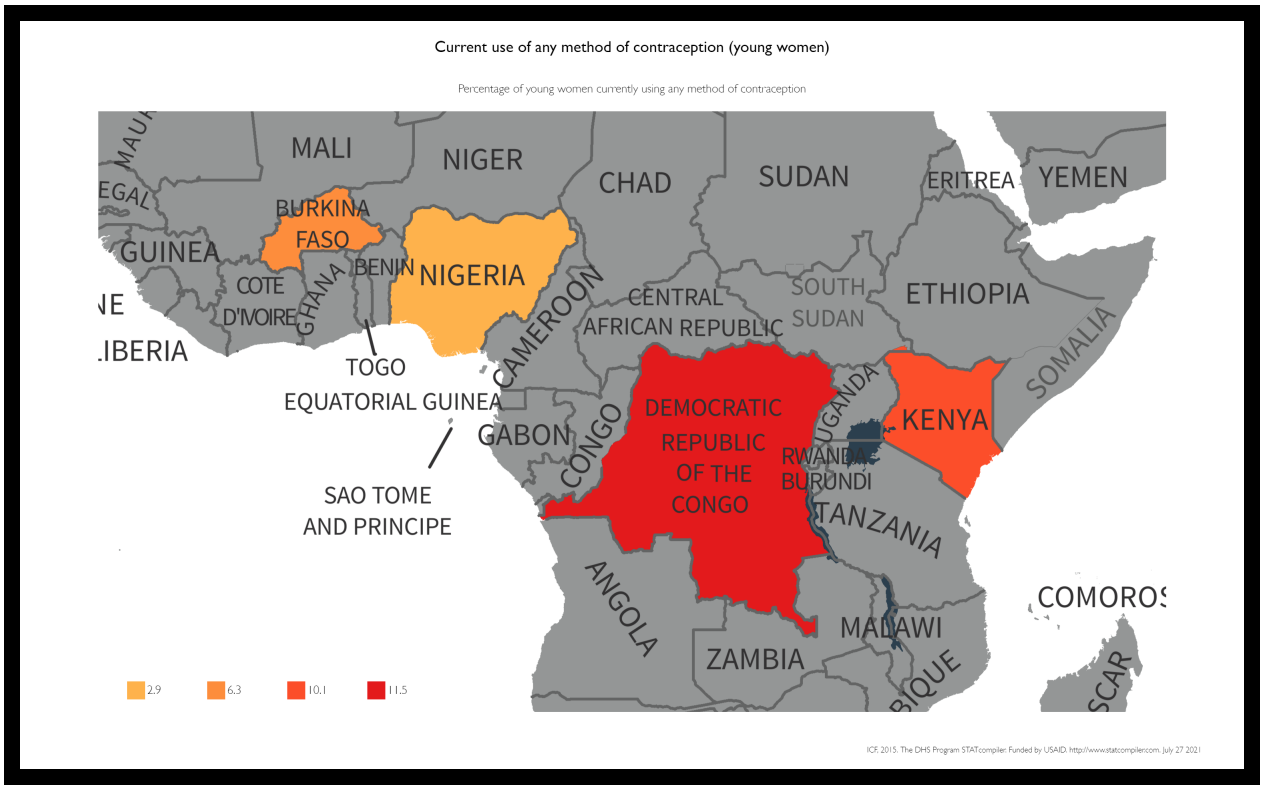


Figure 2.3: Teenagers who have begun childbearing

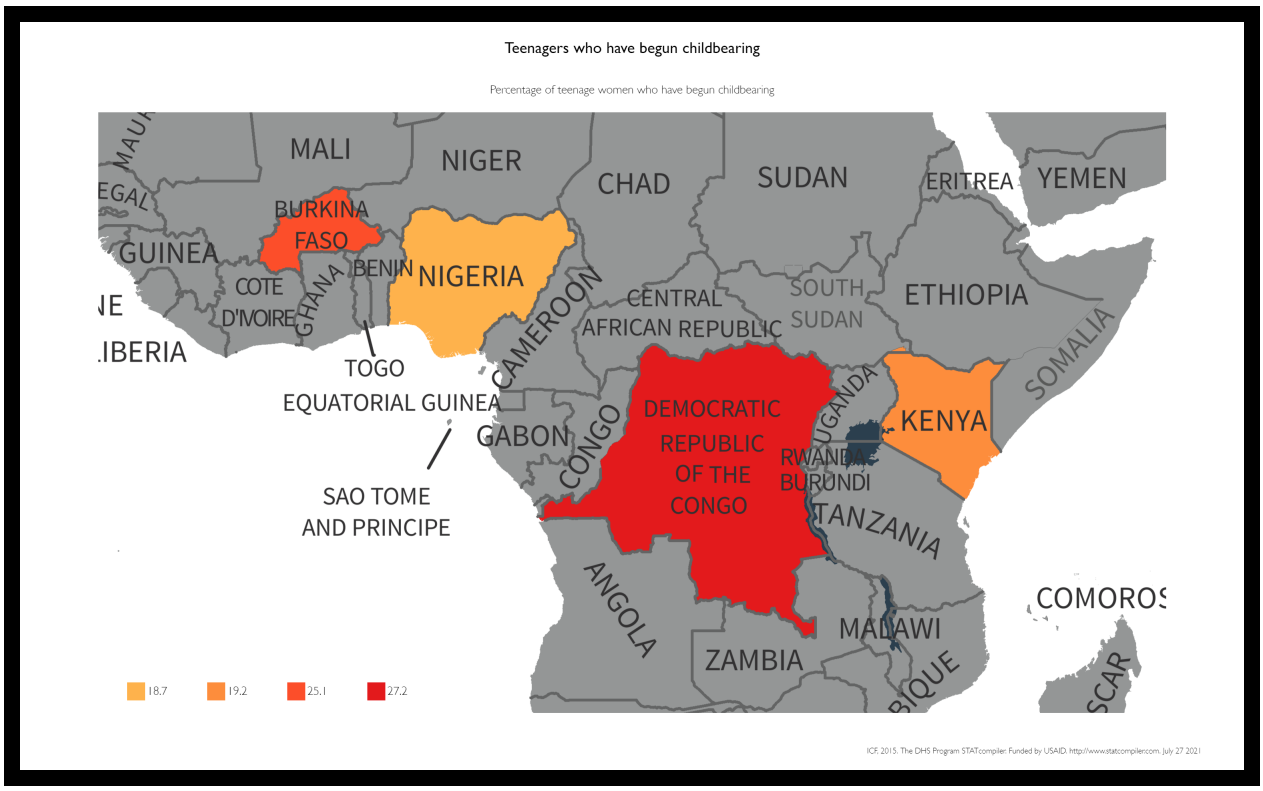
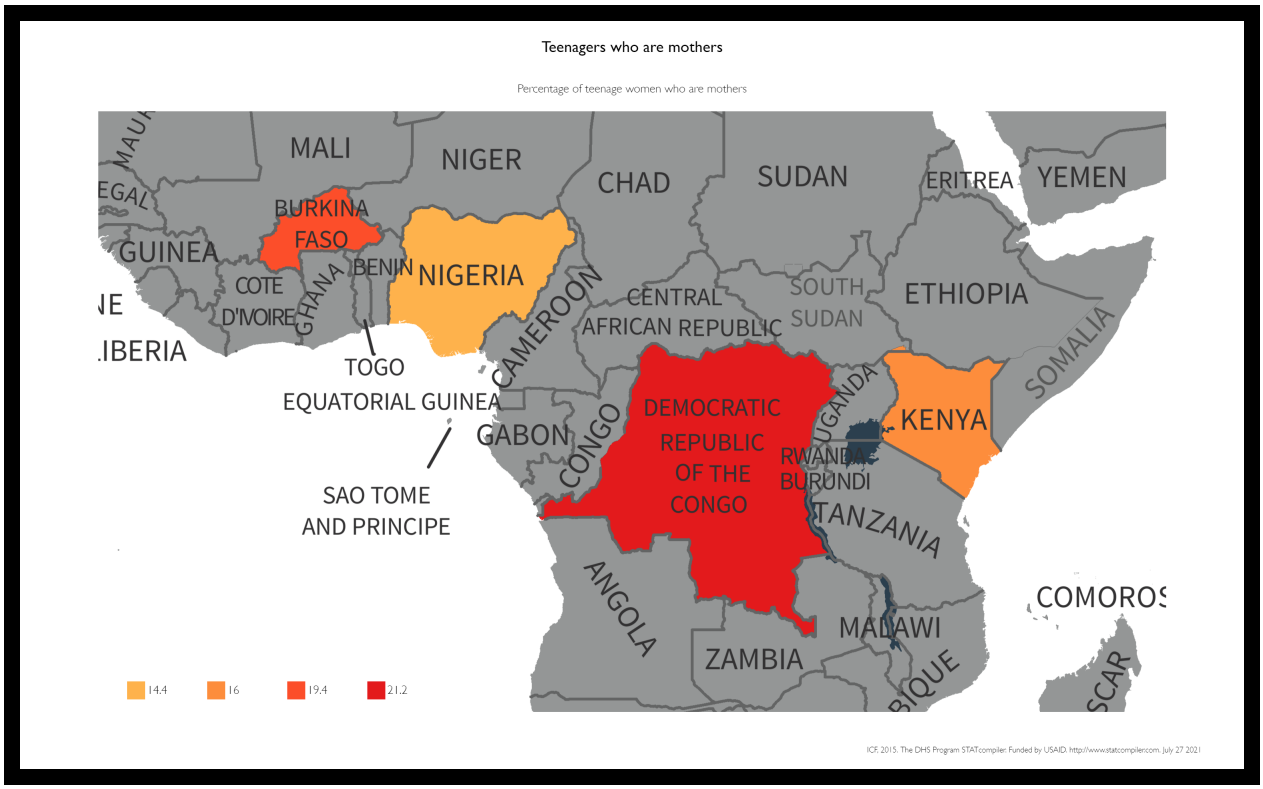


Figure 2.4: Teenagers who are mothers



Studies have shown that education and fertility have a reverse causal relationship (Rindfuss et al., 1980; Rindfuss and St. John, 1983). In particular, the impact of early childbearing on schooling has been a topic of debate in the literature, with mixed results depending on the methodology used. Negative results are the most commonly found. For example, Klepinger et al. (1995) found that adolescent childbearing has a largely negative impact on the level of schooling achieved, using longitudinal data and the average age of first menstruation as an instrument for fertility. The number of years of education typically declines by 1 to 3 years, depending on race. Similarly, Moore and Waite (1977) found that delaying the age of first birth by even just 1 to 2 years increases the level of schooling. Teenage mothers, in particular, are unable to achieve the same level of education as their classmates who postpone childbearing. Comparing the two groups, it becomes apparent that teenage mothers are at a more significant economic and social disadvantage than those who delay births. Furthermore, the negative impact of early childbearing on education persists over time. According to the National Research Council, teenage mothers are less likely to attain an education and more likely to have a large family than those who delay childbirth. Hoffman et al. (1993), accounting for unobserved family characteristics, found that the effect of early childbearing is still significant and negative

but not large. The high incidence of early motherhood can be attributed to factors like family size, high school graduation, and economic status (Fletcher and Wolfe, 2009; Moore and Waite, 1977).

According to a study conducted by Hotz et al. (2005), teenage childbearing can result in economic and social disadvantages for women. The study suggests that delaying pregnancy until adulthood can slightly decrease the probability of poverty and increase the chances of completing high school education. In other words, although adolescent mothers are more likely to face social and economic challenges, postponing pregnancy until adulthood can have positive consequences. Economic hardships prior to motherhood can contribute to the negative outcomes associated with early childbearing. Adolescents who experience greater social and economic inequalities have a higher likelihood of becoming pregnant at a young age. Therefore, policies aimed at reducing teenage pregnancy rates should prioritize addressing these inequalities among young girls, as suggested by (Geronimus, 1991).

The effect of education on childbearing is that it generally leads to a positive and significant reduction, and it goes through the age of first birth. Women may experience unplanned pregnancies in their early stages of development, especially when they are still in school. Education helps in increasing the age at first birth through the accumulation of human capital, "incarceration," and the income effect (Black et al., 2008). Women with higher levels of education tend to have better-paying jobs, so they may postpone their first birth to increase their level of education. The decision to delay or avoid childbirth during adolescence is determined by the opportunity costs of having a child, the returns on investment in education, and the expected life-cycle income. Having higher expectations may encourage young women to delay their first sexual activity or use contraceptive methods (either traditional or modern) to avoid childbirth.

Education plays a vital role in the human capital effect, which leads to the "knowledge" effects of extended schooling. Higher levels of education provide better access to information regarding family planning and contraception, as supported by research studies (Thomas et al., 1991; James and Vujić, 2019). Education not only influences fertility preferences by shaping thoughts but also by enabling the acquisition and use of knowledge that empowers women to make informed choices.

In addition, education may also have a direct and negative impact on childbearing.

For example, adolescents who are currently attending school are more likely to have less parental control and are more likely to find their partner at school, as pointed out by research (Meekers, 1994). This could increase their chances of getting pregnant if they do not use contraceptive methods.

2.2 Data

The data used in this study is from the Performance Monitoring for Action (PMA) program. The program's objective is to provide information for policy-making and improve the well-being of communities, especially young girls and women. Its focus areas include family planning, maternal and child health, nutrition, water and sanitation, neglected tropical diseases, and Covid-19. The PMA program often conducts longitudinal and cross-sectional panel surveys at the household and service delivery point levels in nine African and Asian countries: Burkina Faso, Ivory Coast, The Democratic Republic of Congo, Ethiopia, Ghana, India, Indonesia, Kenya, Niger, Nigeria, and Uganda.

The longitudinal data comprises many waves. During Wave I, the program identified households and women to be surveyed. The second wave re-examined households and women surveyed during Wave I, which occurred from 2019 to 2020. However, data from the second wave is currently unavailable, and we focus our analysis on data from Wave I. Data is available for only four countries: Burkina Faso, The Democratic Republic of Congo, Kenya, and Nigeria. In Nigeria and The Democratic Republic of Congo, data is collected only in Kano and Lagos (for Nigeria) and Kinshasa and Central Congo (for The Democratic Republic of Congo). For Burkina Faso and Kenya, data is collected at both national and subnational levels.

The data is standardized, which allows for fair comparisons between countries. The sampling method and questionnaires are consistent across all countries, with the only variation being the sample size. The women's questionnaire is used for all women in the household between the ages of 15 and 49. It provides useful information on socio-economic characteristics, contraception, reproduction, pregnancy and fertility preferences, sexual activity, and empowerment.

Measures

Our research is focused on providing a detailed analysis of adolescents, which are defined by the World Health Organization (WHO) as girls and boys aged 10 to 19 years old. However, for our study, we have chosen to focus solely on young girls aged 15 to 19 years old. For the purpose of our analysis, we are only considering adolescents who are not pregnant or mothers at the time of the survey. We are also taking into account whether or not they are enrolled in school or a training program, or neither, as this can have a significant impact on their overall well-being and development. Our sample sizes are 1483 for Burkina Faso, 1008 for Congo (DRC), 2063 for Kenya, and 510 for Nigeria.

Our study, based on the methodology ofPeipert et al. (2012); Moreau et al. (2013), uses the "use of contraceptives" as a measure of unwanted fertility. We aim to investigate the impact of identifying fertility time preferences on young girls' contraceptive use and its link to teenage pregnancy. Our dependent variable is contraceptive use, which we analyzed based on three aspects: current use, ever used, and intention to use. To account for all young women in the sample, we combined data from those who currently use, those who have ever used, and those who intend to use contraceptive methods. We also included those who are entirely reluctant to use contraceptive methods (those who have never used and do not intend to use them). It's worth noting that some women prefer traditional methods (such as rhythm, withdrawal, beads, or lactational amenorrhea method) to modern ones for various reasons such as health, access, or reliability. We included these women in the analysis with those who have ever used contraceptive methods but are not currently using them to consider discontinued methods such as condoms (which are used once at a time).

Fertility time preference is a measure of whether a woman would prefer to complete her education before having a child. It is equal to 1 if she would like to finish her education first and 0 otherwise. Women's level of patience affects how they value future returns. Education can act like an incarceration effect, which can influence a woman's patience (Frederick et al., 2002). Students who expect higher returns from education tend to have a lower discount rate and are more likely to delay having children, compared to those with a lower expected return and a higher discount rate (James and Vujić, 2019). However, having higher expectations of education returns may not necessarily prevent a delay in childbearing. Adolescents, for whom the opportunity cost of childbearing is higher, are

more likely to delay having children. Thus, the variable *Fertility time preference* is used to measure the trade-off between schooling and childbearing or a woman's time preference. As part of our research, we used several variables to measure the future aspirations(within two years) and time preferences of the participants. These variables included "Important to complete studies"(secondary of university), "Important to have a job," "Important to have a business," "Important to have children," and "Important to get married" (for definitions, please refer to the annex). For instance, the variables "Important to have children" and "Important to get married" aimed to measure the participants' time preference concerning childbearing and marriage. We assume that adolescents who reported that having children in two years is "very important" (in response to the question about "Important to have children") have a high discount rate and are less likely to use contraceptive methods to delay childbearing.

On the other hand, adolescents who reported that completing secondary school or attending university in two years is "very important" are more risk-averse and more likely to use contraceptive methods to avoid childbearing. We also assume that this group of girls has higher expectations of education returns.

It is important to consider the aspirations of parents or guardians for their children. These aspirations can be different or similar for each child. For instance, some parents may encourage their children to find a job or get married, while their children may have other aspirations. The method used to identify these aspirations is the same for children. The variables used to measure these aspirations are all measured similarly. For example, if respondents report that it is "very important for their parents or guardians that they achieve secondary school or attend university in two years," then the variable is equal to 1 and 0 otherwise. This variable is measured in the same way as the "Important to complete studies" variable. The tables 4.6 and A2.3 present the descriptive statistics and descriptions of these variables.

The level of education is measured by the highest level of schooling attained. We also take into account those in a training program. The variable *School level* is coded as 1 if the girl has completed at least primary school and 0 otherwise. *School level* is also equal to 1 for those in a training program.

Fertility decisions are influenced by women's reproductive or sexual behavior, as stated in a study by Timæus and Moultrie (2015). We used three variables to measure repro-

ductive behavior. Firstly, physical maturity, which may influence sexual activity, was measured by the number of years since the first menstrual period (Averett et al., 2002). Secondly, decision-making power can be influenced by the environment in which young girls live. The third variable indicates whether the respondent currently has a partner or not.

There are various types of contraceptive methods available, such as traditional, neo-traditional, or modern. Traditional and neo-traditional methods include periodic and post-partum abstinence, breastfeeding, and withdrawal. However, these methods are less effective than modern methods, as per the report by (Rossier and Corker, 2017). Modern methods are widely used by women, but their utilization depends on factors such as the level of education, income, socio-professional category, marital status, husband's role (for married women), cost, and accessibility.

The survey provides a comprehensive range of information on contraceptive methods. The variables are divided into three groups representing knowledge of natural, hormonal, and non-hormonal contraceptive methods. The second group of variables is related to attitudes towards reproduction and contraception. These variables help to understand the decision-making power of individuals when it comes to using contraception methods. The third group of variables is related to perceptions about family planning methods. We have assumed that community perceptions can influence the decision to use contraceptive methods, especially in the case of young girls. The last group of variables concerns exposure to family planning messages through different media channels like radio, television, mobile, magazines, and social networks.

The analysis also included religion, age, ethnicity, household wealth, and residential area as factors. However, information on ethnic groups is unavailable for Kenya and we have no information on the residential area of Congo (DRC). The head of the household provided information on his ethnic and religious groups. In Congo (DRC) and Kenya, the majority of people are Christians, so the variable *religions* is coded as 1 for Christians and 0 for other groups. However, in Nigeria and Burkina Faso, Islam is the major religion. In Burkina Faso, other religious groups are also important, so the variable *religions* is coded 1 for Muslims, 2 for Christians, and 3 for other religious groups. Ethnic groups are different depending on countries. For example, in Burkina Faso, the Mossi are the major ethnic group, while in Nigeria, the Hausa, Yoruba, and Igbo are the major ethnic groups.

In Congo (DRC) database, ethnic groups are grouped into three categories: 1 for girls from Bakongo, 2 for those from Kasai, and 3 for other ethnic groups. The marital status is coded as 1 for adolescents who are living with someone, married, or separated, and 0 for the other group, for all countries.

The survey also provided information on household wealth, which is coded from 1 for the lowest quintile to 5 for the highest quintile of wealth, except for Burkina Faso (where the variable is coded from 1 for the lowest tertile to 3 for the highest tertile of wealth). The variable was computed using information from the household questionnaire (in the "assets" section) and the Principal Component Analysis (PCA) method.

Analytical approach

We first used the Exploratory Factor Analysis (EFA) method to describe the data and create indices. In factor analysis, each observed variable is a linear function of common factors ($X_i = function(factor_j, \epsilon_i)$ with $i = 1, ...p$,$j = 1, ...m$ with m < p, ϵ, the specific factors or random errors and X_i the observed variables) while in principal component analysis, each component is a linear combination of observed variables ($Component_j = function(X_i)$ with $i = 1, ...p$) and $j = 1, ...m$ with m < p). We used factor analysis to identify the common factors and variable-specific factors, which is not possible with principal component analysis. To ensure that our model was appropriate for factor analysis, we conducted a Kaiser-Meyer-Olkin (KMO) test. This test helps to determine if the observed variables have enough common variance to proceed with the factor analysis. If the KMO value is less than 0.6, it indicates that the model is inadequate. The following are the assumptions of our model:

$$X_i = function(factor_j, \epsilon_i) \tag{2.1}$$

The specific and common factors have a normal distribution:

$$E(\epsilon_i) = 0; i = 1; .., p \tag{2.2a}$$

$$E(factor_j) = 0, j = 1, ...m \tag{2.2b}$$

The variance of specific factors (specific variance) differs for each observed variable, while common factors share the same variance (equal to 1). Moreover, the correlation between

common and specific factors equals zero.

$$Var(\epsilon_i) = \phi_i; i = 1; .., p \tag{2.3a}$$

$$Var(factor_j) = 1, j = 1, ...m \tag{2.3b}$$

$$Cov(\epsilon_i, \epsilon_k) = 0, i \neq k \tag{2.3c}$$

$$Cov(factor_j, factor_l) = 0, j \neq l \tag{2.3d}$$

$$Cov(factor_j, \epsilon i) = 0 \tag{2.3e}$$

We used the principal axis factor to extract factors and parameter estimates. We considered factors with eigenvalues greater than 1 (Kaizer-criterion)[1]. The Principal axis factor assumes that the commonality is less than 1 (equal to 1 - the specific variance) and uses the squared multiple correlation coefficient between factors and the variable.

To avoid multicollinearity between factors, we used the oblique oblimin rotation for factor interpretation. Factors extracted can be interpreted using different types of rotations, with orthogonal and oblique rotations being the most commonly used. While the orthogonal rotation (usually varimax rotation) is easy to interpret, it requires factors to be independent, which may not reflect reality. On the other hand, the oblique rotation requires no factor structure, but factor correlation in ProMax rotation (one of the oblique rotation techniques) makes it challenging to interpret the results. The oblimin rotation allows setting the degree of correlation between factors, and we chose to obtain weakly correlated factors since we used factor scores as independent variables in the analysis.

In addition, we used the regression method to predict scores, which provides accurate scores despite the biased results. For example, factor A scores correlate with factors A and B even when using an orthogonal rotation. The Bartlett method provides unbiased scores but non-accurate estimates, while the Anderson-Rubin method gives accurate and uncorrelated scores.

To assess the reliability of our models, we employed a Confirmatory Factor Analysis (CFA) approach. CFA examines the relationship between observable and latent variables. It is a measurement model and a component of the Structural Equation Modeling (SEM) technique. In order to use a CFA model effectively, it is essential to determine the number of factors and understand how variables are correlated.

[1]Since we also used the Confirmatory Factor Analysis method to determine the model that fits the data best, we used some factors with eigenvalues less than 1 as they give a best-fitted model.

It is important to note that a factorial structure found in Exploratory Factor Analysis (EFA) may not be applicable in CFA. Therefore, we employed an iterative EFA-CFA process. This involved moving back and forth between EFA and CFA to add or remove items, or adjust the number of factors to obtain an optimal CFA model. Since the observed variables were binary and categorical, we used the robust weighted least squares estimator (WSLMV) with standard errors and oblique rotations. Unlike the maximum likelihood estimator used in CFA, the WSLMV estimator does not require variables to have a normal distribution.

We carried out EFA using Stata 15, and CFA using Mplus7, as the WSLMV estimator is not available in Stata. The quality of the models was assessed using three goodness-of-fit measures: Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and Comparative Fit Index (CFI). RMSEA is the most commonly used measure of model fit. SRMR is a standardized measure of the difference between the observed and predicted correlation (Hu and Bentler, 1999). The SRMR is also an absolute measure of fit. The model is generally considered a good fit when RMSEA is less than 0.05 or SRMR is less than 0.08. CFI compares the goodness-of-fit of a hypothesized model with that of a baseline model. Bentler and Bonett (1980) suggests that the model is best fitted when the CFI is higher than 0.9. We selected models that met at least one of the above-mentioned criteria for a good fit.

2.3 Results of factor analysis (EFA-CFA)

Results for aspirations

We used an iterative process of Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to identify measures of aspirations. Our questions were related to both the respondents' and their parents' aspirations. At first, we included personal and parental aspirations in a single model, but the CFA results showed that the model did not fit the data well. To address this issue, we divided the variables into personal and parental aspirations and conducted EFA again. The results of the EFA (shown in Table 2.1) revealed a two-factor model. Although the KMO statistic for Burkina Faso and Nigeria was lower than 0.9 in both groups, the results from CFA suggest that the two-factor model fits the data best. In particular, the Comparative Fit Index (CFI)

and Standardized Root Mean Square Residual (SRMR) meet the good fit criteria for the model.

The first factor comprises variables that indicate the intentions to achieve secondary school education, attend university, start a business, or have a job. We have named this factor as "economic" since it represents personal and parental aspirations related to economic choices. On the other hand, the second factor includes variables that represent intentions to marry or have children. We have named this factor as "familial" since it reflects family choices.

Results for knowledge of contraceptive methods

We used an iterative process of EFA-CFA to identify measures of knowledge of contraceptive methods and determine which factors had the highest explanatory power. Initially, we applied EFA to all variables of knowledge of contraceptive methods, which resulted in the identification of three factors. However, the third factor only explained two variables ("knowledge of female sterilization" and "knowledge of male sterilization"). Furthermore, the results of CFA confirmed that the three-factor model did not fit the data well. We then tried a two-factor model, but the results were similar to the three-factor model. As a result, we categorized variables into three groups (natural, hormonal, and non-hormonal contraceptive methods) and considered a 1-factor model for each group. We removed "knowledge of female sterilization" and "knowledge of male sterilization" from the analysis since they did not contribute to the best fit of the data.

The table 2.2 shows the factor loadings obtained from EFA for each group. The Kaiser-Meyer-Olkin (KMO) statistic had a value greater than 0.6 in all models except for the non-hormonal methods model in Kenya and Congo (DRC). However, the results of Confirmatory Factor Analysis (CFA) indicate that the non-hormonal method model in Kenya and Congo (DRC) is the best fit as it meets all the goodness-of-fit criteria.

We found that only CFI met the goodness-of-fit criteria for the model of "knowledge of natural methods" in all countries. The confirmatory factor analysis (CFA) showed that the one-factor model was the best fit for all groups' data. In the models for natural, hormonal, and non-hormonal methods, the factor was named "nat," "hormon," and "nonhorm," respectively.

Results for the decision-making power and the perceptions about the consequences of using contraceptive methods

The findings of the EFA-CFA analysis are shown in Table 2.3. Our analysis revealed that two factors best represent the given data. The CFA results confirmed that the two-factor model provides an adequate explanation for the correlation between the variables related to decision-making and the perceptions regarding the outcomes of using contraceptive methods. Each factor was uniquely measured by a specific set of variables.

To analyze the factors that impact the decision-making power of fertility preferences,

Table 2.1: Factor loadings from Exploratory Analysis (EFA) for aspirations

	Burkina Faso			DRC			Kenya			Nigeria		
Variables	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness
					Exploratory Factor analysis							
Personal aspirations												
Important to have a business		0.6340	0.5332		0.6090	0.5930		0.5777	0.5862	0.3948	0.5192	0.5414
Important to complete studies		-0.3943	0.8506		0.3945	0.8569		0.3982	0.8555		0.4463	0.7566
Important to get married	0.9042		0.1727	0.8406		0.2786	0.8568		0.2686	0.9216		0.1540
Important to have children	0.9011		0.1801	0.8471		0.2890	0.8532		0.2581	0.9072		0.1729
Important to have a job		0.5990	0.5770		0.6301	0.5802		0.6872	0.5141		0.6929	0.4947
N		928		753			1723			358		
Chi2 (10)		1870.21		1134.76			2877.41			807.11		
sampling adequacy		0.5899		0.6102			0.6032			0.5826		
Parents' aspirations for their children												
Important to have a business		0.6479	0.5427		0.5987	0.5702		0.6128	0.5747	0.3164	0.6239	0.4860
Important to complete studies		0.4453	0.7990		0.4089	0.8500		0.4197	0.8350		0.3884	0.7869
Important to get married	0.8712		0.2385	0.8642		0.2177	0.9051		0.1832	0.9609		0.0679
Important to have children	-0.8727		0.2361	0.8811		0.2347	0.8998		0.1821	0.9597		0.0644
Important to have a job		0.6858	0.5095		0.6365	0.5391		0.7112	0.4901		0.7103	0.4854
N	929			757			1719			356		
chi2(10)	1635.30			1364.95			3517.43			1127.63		
sampling adequacy	0.5660			0.6186			0.5856			0.5750		

Notes : In the factors column blanks represent abs (loading) < 0.3

Table 2.2: Factor loadings from Explanatory analysis of knowledge of contraceptive methods

Variable	Burkina Faso Factor1	Uniqueness	DRC Factor1	Uniqueness	Kenya Factor1	Uniqueness	Nigeria Factor1	Uniqueness
Natural methods								
Heard about beads	0.4845	0.7652	0.3929	0.8457	0.5240	0.7255	0.5260	0.7233
Heard about LAM	0.3744	0.8599	0.2694	0.9274	0.4430	0.8037	0.4554	0.7926
Heard about rhythm methods	0.5203	0.7292	0.3968	0.8425	0.5634	0.6826	0.5616	0.6846
Heard about withdrawal	0.5818	0.6615	0.5000	0.7500	0.6180	0.6180	0.6562	0.5693
Heard about other methods	0.1850	0.9658	0.2134	0.9545	0.2893	0.9163	0.4509	0.7967
N	1480		1008		2060			501
Chi2 (10)	608.56		216.16		1169.48			366,77
sampling adequacy	0.6771		0.6153		0.7279			0.7214
Hormonal methods								
Heard about implants	0.6935	0.5191	0.5530	0.6942	0.6990	0.5114	0.6705	0.5504
Heard about IUD	0.4946	0.7553	0.3807	0.8551	0.5941	0.6470	0.4877	0.7621
Heard about injectables	0.6851	0.5306	0.6141	0.6229	0.6931	0.5196	0.7698	0.4074
Heard about pills	0.6822	0.5346	0.5810	0.6624	0.6835	0.5329	0.7281	0.4699
Heard about emergency method	0.4027	0.8379	0.4664	0.7825	0.5827	0.6605	0.3135	0.9017
N	1483		1 006		2062			510
chi2(10)	1732.92		680.65		2889.32			649.11
sampling adequacy	0.7496		0.7316		0.8078			0.7446
Non-hormonal methods								
Heard about male condoms	0.4720	0.7772	0.4045	0.8364	0.2321	0.9461	0.4776	0.7719
Heard about female condoms	0.5752	0.6691	0.4365	0.8094	0.4064	0.8349	0.5845	0.6584
Heard about diaphragm	0.5052	0.7448	0.2121	0.9550	0.6635	0.5598	0.6074	0.6311
Heard about foam or jelly	0.4275	0.8172	0.2312	0.9465	0.6557	0.5701	0.5872	0.6551
N	1482		1006		2063			509
Chi2(6)	673.40		135.01		1095.25			375.83
sampling adequacy	0.6025		0.5265		0,5907			0.6009

Notes : In the factors column blanks represent abs (loading) < 0.3

two variables are considered: personal decision-making power regarding fertility time preference and having confidence in discussing it with a partner. However, according to the general rule of Confirmatory Factor Analysis (CFA), each factor should have at least three variables. If a factor has only two variables, the correlation between them should be higher than 0.7, and their correlation with other variables should be low. This rule comes from Worthington and Whittaker (2006).

We have decided to retain the factor with two variables as they hold significant meanings. In all the countries under consideration, the correlation between personal decision-making about fertility time preference and the confidence to discuss it with one's partner is weak. The correlation coefficients are 0.42, 0.46, 0.64, and 0.47 for Kenya, Burkina Faso, Nigeria, and Congo (DRC), respectively. Each variable has a weak correlation with other variables analyzed, but they are crucial for the analysis.

We assumed that the variables "Future children will have anomalies," "Will have trouble getting pregnant next time," and "Partner will seek another partner" all measure the same indicator, which is perceptions regarding the consequences of contraceptive methods. We also assumed that the second group of variables, "personal decision-making power about fertility time preference and having confidence in discussing it with a partner," measures the decision-making power about fertility time preference.

Results for perceptions about family planning programs

In the survey, two groups of perceptions were identified: the perceptions of the respondents and the community. These groups were then combined, and an EFA (Exploratory Factor Analysis) was performed. CFA (Confirmatory Factor Analysis) was also conducted, which revealed two factors with an eigenvalue greater than one. The factor loadings are presented in Table 2.4a. The questions used to evaluate both the respondents' and the community's perceptions about family planning programs correspond to the variables that measure factors 1 and 2. For all countries except Nigeria, the KMO (Kaiser-Meyer-Olkin) Statistic is higher than 0.6, indicating that the two-factor model fits the data well. However, only CFI (Comparative Fit Index) complies with the goodness-of-fit criteria for Burkina Faso, Kenya, and Nigeria. The Comparative Fit Index (CFI) is higher than 0.9 in all countries. The CFA results indicate that the variables used to measure perceptions about family planning methods are correlated and can be explained by two factors, which we have

Table 2.3: Factor loadings from explanatory analysis for reproductive attitudes

	Burkina Faso			DRC			Kenya			Nigeria		
Variables	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness
Personal decision-making power about fertility time preference		0.6280	0.6004	0.5481		0.6959		0.5477	0.7035	0.7677		0.4211
Having confidence in discussing with the partner		0.6271	0.6103	0.5618		0.6865		0.5501	0.6915	0.7517		0.4128
Future children will have anomalies	0.5559		0.6923		0.4227	0.8226	0.6426		0.5863		0.5364	0.7186
Will have trouble getting . pregnant next time	0.5942		0.6517		0.3388	0.8614	0.6949		0.5236		0.6018	0.6401
Partner will seek another partner	0.5214		0.7194		0.4743	0.7753	0.5564		0.6836		0.4628	0.7591
N	989			691			1638			226		
chi2(10)	679.93			243.61			1293.09			222.04		
sampling adequacy	0.5825			0.5359			0.6134			0.5537		

Notes : In the factors column blanks represent abs (loading) < 0.3

named *personal perceptions* and *community perceptions*.

The variables that measure factors 1 and 2 correspond to the questions used to evaluate the perceptions of the respondents and community about family planning programs, respectively. In all countries, except for Nigeria, the KMO Statistic is higher than 0.6, indicating that the two-factor model fits the data appropriately. Only CFI meets the goodness-of-fit criteria for Burkina Faso, Kenya, and Nigeria. The Comparative Fit Index (CFI) is higher than 0.9 in all countries. According to the CFA results, the variables of perceptions about family planning methods are correlated and explained by two factors. We named the first factor "personal perceptions" and the second-factor "community perceptions."

Results for exposure to family planning messages

We conducted an analysis of variables related to exposure to family planning messages using a consistent process across all countries. However, we encountered an issue with the variable "magazine" in Congo (DRC) as it was not loading to any factorial structure. Consequently, we removed it from the EFA-CFA process in Congo (DRC). The EFA factor loadings are presented in Table 2.4b, and the KMO Statistic is higher than 0.6 for all countries, indicating a good model fit. The results from CFA confirmed the results from EFA, and we found that the two-factor model met at least one of the goodness-of-fit criteria.

In Nigeria and Kenya, "radio" and "television" loaded on the first factor, while in Burkina Faso and Congo (DRC), they loaded on the second factor. The second factor was measured by "mobile" and "social media" in the case of Nigeria and Kenya, while in Burkina Faso and Congo (DRC), they loaded on the first factor. To simplify the analysis, we assumed that the first factor is measured by "radio," "television," and "magazine," and named it factor *audio-visual media* (audio-visual). The second factor is measured by "mobile" and "social media," and we termed it *other media*. However, in the case of Burkina Faso, "magazine" is explained by the second factor and belongs to *other media*.

Predicting factor scores

The descriptive statistics of factor scores are shown in Tables 2.5. We transformed the factor scores to a range between zero to one. The first indicator, which assesses the

Table 2.4: Factor loadings from EFA for perceptions about family planning methods and exposure to family planning messages

	Burkina Faso			DRC			Kenya			Nigeria		
Variable	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness
Adolescents using FP are promiscuous	0.5431		0.6889	0.4508		0.7837	0.4072		0.7331	0.1214	-0.5276	0.6569
FP is only for married people	0.6524		0.5775	0.6817		0.5497	0.7042		0.5435	0.5255	-0.1086	0.6675
FP is only used to avoid pregnancies	0.5692		0.6861	0.6216		0.6150	0.6213		0.6153	0.6996	0.1171	0.5609
For community members: Adolescents using FP are promiscuous		0.5547	0.6988		0.4638	0.8063		0.5394	0.7479	0.0595	0.6448	0.6106
For community members: FP is only for married people		0.5881	0.6666		0.5686	0.6473		0.5322	0.6485	-0.3922	0.3011	0.6633
For community members: FP is only used to avoid pregnancies		0.4466	0.7830		0.4967	0.7282		0.5057	0.6985	-0.6070	0.0795	0.5875
N	1337			911			2033			442		
chi2(15)	1164.72			860.99			2277.93			581.75		
sampling adequacy	0.6545			0.6135			0.6629			0.5812		

Notes : In the factors column blanks represent abs (loading) < 0.3

(a) perceptions about family planning methods

	Burkina Faso			DRC			Kenya			Nigeria		
Variable	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness	Factor 1	Factor 2	Uniqueness
radio		0.4940	0.7774		0.5846	0.6798	0.5780		0.7138	0.5353		0.7454
television		0.4660	0.7038		0.6003	0.6380	0.5194		0.5966	0.6246		0.5848
magasine	0.4001		0.7597			0.8171	0.4058		0.6102	0.3335		0.7012
mobile	0.5245		0.7457	0.6534		0.6094		0.5683	0.6928		0.4200	0.8324
social-media	0.4979		0.7576	0.5947		0.5877		0.5762	0.6088		0.3027	0.7104
N	1475			1006			2060			506		
chi2(10)	688.59			754.36			1849.54			316.63		
sampling adequacy	0.6781			0.6612			0.7570			0.6983		

Notes : In the factors column blanks represent abs (loading) < 0.3

(b) Exposure to family planning messages

decision-making power of fertility time preference, showed that all countries had almost the same average score and that adolescents had a strong decision-making power in this regard. This is indicated by an average score higher than 0.7, which we assumed would significantly affect the outcome variable. The second indicator, which measures perceptions about the consequences of using contraceptive methods, also had almost the same average score for all countries, with Kenya having the highest. The average score is higher than 0.7 for all countries, indicating that young girls are not fearful of using contraceptive methods. They don't believe that the methods will harm their future babies' health, prevent them from getting pregnant, or cause their partner to leave them. We included both indicators in the analysis, as there is a weak and positive correlation coefficient of perceptions about the consequences of using contraceptive methods indicators for all countries except Congo (DRC), where the correlation coefficient is negative. The correlation matrix of the index is presented in table A2.5a, table A2.5b, table A2.6a, and table A2.6b.

Our analysis focused on two indicators of perceptions regarding family planning programs: personal perceptions and community perceptions. Nigeria scored the lowest (0.29) in terms of personal perceptions, while scoring the highest (0.67) in community perceptions. This implies that young girls in Nigeria have a positive perception of family planning, whereas communities have a negative perception. In other words, respondents (on average) in Nigeria do not believe that adolescents who use family planning are promiscuous or that family planning is only for married women or women who do not want more children. However, they think that the majority of people in their communities hold opposite beliefs. Since the average score of community perceptions is high (0.67), many Nigerian communities believe that adolescents who use contraceptives are promiscuous. This negative perception can impact the decision of young girls to use or not use contraceptive methods. Personal and community perceptions are moderately and negatively correlated; hence, both indicators were included in the list of independent variables. For Burkina Faso, Congo (DRC), and Kenya, the average score of perceptions about family planning is moderate. This suggests that some people in the communities of these countries believe that adolescents who use contraceptive methods are promiscuous. The correlation coefficient of personal perceptions and community perceptions is higher for Congo (DRC) and Kenya. Therefore, only one indicator of perceptions was included in the list of independent variables of their model.

Among the three indicators of knowledge regarding contraceptive methods, the second indicator, 'hormonal,' has obtained the highest score. This indicates that hormonal contraceptive methods such as pills, implants, and injectables are more commonly known compared to natural methods like LAM, beads, and withdrawal, as well as non-hormonal methods. The index correlation matrix shows a moderate correlation between these three indicators, which led us to include them in our model.

Many channels are available for transmitting knowledge about contraceptive methods, including radio, television, magazines, mobile devices, and social media. However, in most countries, the exposure index for family planning messages is weak, indicating that family planning programs are low or non-existent in many regions. The correlation coefficient between traditional media (TV, radio, and magazines) and other media (social and mobile) is high. Therefore, only one indicator of exposure to family planning messages is included in the list of independent variables.

We also found that the personal aspirations of young girls in all countries primarily revolve around economic goals. This means that for them, finishing high school or attending university, starting a business, or having a job are the top priorities. While family aspirations are moderately important, getting married or having a child in the next two years is not as high of a priority as economic aspirations.

When it comes to making decisions about their children's future, parents' economic aspirations seem to be more important than their family aspirations. This indicates that parents prioritize their children completing their secondary education, attending university, finding a job, or starting a business, just as their teenagers do. Moreover, "parents' economic aspirations" and "parents' family aspirations" are positively and moderately correlated, indicating that economic and family choices are not incompatible.

Table 2.5: Descriptive statistics of indexes (factor scores)

Variables	Burkina Faso Mean (SD)	Congo (DRC) Mean (SD)	Kenya Mean (SD)	Nigeria Mean (SD)
Decision-making power regarding fertility time preference	0.72 (0.30)	0.79 (0.26)	0.74 (0.32)	0.79 (0.29)
Perceptions about the consequences of using methods	0.78 (0.3)	0.74 (0.25)	0.92 (0.19)	0.74 (0.24)
Personal aspirations				
Economic aspirations	0.67 (0.34)	0.60 (0.33)	0.74 (0.28)	0.62 (0.30)
Family aspirations	0.43 (0.44)	0.35 (0.41)	0.31 (0.40)	0.36 (0.43)
Parents' aspirations for their children				
Economic aspirations	0.69 (0.36)	0.62 (0.33)	0.77 (0.28)	0.62 (0.36)
Family aspirations	0.52 (0.43)	0.36 (0.43)	0.33 (0.43)	0.44 (0.44)
Knowledge of methods				
Natural	0.20 (0.31)	0.40 (0.24)	0.27 (0.28)	0.18 (0.25)
Hormonal	0.64 (0.31)	0.56 (0.30)	0.60 (0.35)	0.45 (0.35)
Non-hormonal	0.39 (0.26)	0.33 (0.16)	0.26 (0.26)	0.20 (0.24)
Exposure to messages				
Media and audio-visual	0.23 (0.24)	0.16 (0.22)	0.38 (0.31)	0.14 (0.21)
Other media	0.13 (0.2)	0.07 (0.17)	0.25 (0.28)	0.23 (0.27)
Perceptions about family planning programs				
Personal perceptions	0.58 (0.32)	0.49 (0.32)	0.54 (0.32)	0.29 (0.27)
Community perceptions	0.44 (0.26)	0.43 (0.26)	0.42 (0.28)	0.67 (0.27)

2.4 Empirical model

Deciding whether or not to have children is a complex decision that can be influenced by a variety of factors. One such factor is the cost and potential benefits associated with investing in education. For instance, young women who prioritize their education may choose to delay having children or use contraception to prevent unwanted pregnancies. This decision is often made with the recognition that having children can be costly and may limit their ability to pursue educational opportunities. The aim of this study is to explore the extent to which this consideration plays a significant role in young women's

decision-making with regard to childbearing and contraception use. By examining this relationship, we hope to gain a better understanding of the factors that impact reproductive decision-making and inform strategies for supporting women's health and well-being.

In the case of adolescents, we made the assumption that the decision to use or intend to use contraceptive methods is also linked with being sexually active. We hypothesized that these variables would be positively correlated and considered that some unobserved individual characteristics could impact both variables simultaneously. To account for this possibility, we simultaneously estimated two equations instead of performing separate estimations. This approach allows us to model sexual activity and controlled fertility (use or intention to use contraceptive methods), which can provide insights into the effective effects. It is similar to the seemingly unrelated regression model but applied to non-linear models (Greene, 2003). The model can be expressed as follows:

$$Y_1^* = X_1\beta_1 + \epsilon_1, with\ Y_1 = 1\ if\ Y_1^* > 0,\ 0\ otherwise \tag{2.4a}$$

$$Y_2^* = X_2\beta_2 + \delta Y_1^* + \epsilon_2, with\ Y_2 = 1\ if\ Y_2^* > 0,\ 0\ otherwise, \tag{2.4b}$$

$$E(\epsilon_1) = E(\epsilon_2) = 0 \tag{2.4c}$$

$$Var(\epsilon_1) = Var(\epsilon_2) = 1 \tag{2.4d}$$

$$Cov(\epsilon_1, \epsilon_2) = \rho \neq 0 \tag{2.4e}$$

Y_1 and Y_2 are respectively *sexual activity* and *controlled* and, X_1, X_2 are vector of independent variables. Some variables used in the first equation are also used in the second equation (wealth, religion, ethnic groups). However, variables of family planning indicators are only used in the second equation.

In statistical analysis, it is assumed that the correlation between error terms, denoted as rho (ρ), is not zero. If the Wald test confirms that ρ is not zero, then it is reasonable to estimate the two equations simultaneously. However, if we fail to reject the null hypothesis that ρ equals zero, then the two equations are independent and are equivalent to two separate probit models. This implies that unobserved factors are not correlated. However, recent research by Filippini et al. (2018) highlighted that a zero or near-zero correlation in a bivariate probit model does not always imply independence between the equations. It can result from estimation errors that occur when using a bivariate probit model on a

recursive bivariate probit data. Therefore, to account for this, we employed a recursive bivariate probit model, following Burnett (1997), which assumes that the probability of using contraceptive methods is correlated with sexual activity. The correlation coefficient is denoted by δ, and the model allows the dependent variable in one equation to be a predictor variable of the second equation.

2.5 Results

The tables 2.7, 2.8, 2.6 present marginal effects for model parameters estimated using the maximum likelihood estimator for Burkina Faso, Congo, DRC, and Kenya.

The results from all countries support the idea that having or identifying a preference for fertility timing has a positive impact on controlled fertility. However, this effect is only significant in Kenya, but only if we do not control for knowledge of methods or perceptions. As a reference point for interpreting the results, we will use the case of Kenya. We found that the desire to complete school before having children (*Fertility time preference)* has a positive and significant effect on controlled fertility. However, when considering perceptions, the effect is no longer significant. As *economic aspirations* and *parents' economic aspirations* are strongly correlated, they are separately included in the analysis. In model 2, *economic aspirations* is not significant while *parents' economic aspirations* is significant. However, the effect is negative and surprising. It suggests that even though completing secondary school (or attending university), having a job, and starting a business (in two years) are much more important for parents; young girls are less likely to control their fertility. Family choices could explain the result. The kernel density function (Figure A2.1) of *parents' economic aspirations* is almost the same as for *family aspirations*. The negative effect of *parents' economic aspirations* can be explained by the fact that parents with economic purposes for their children also have family goals. Indeed, *parents' economic and family aspirations* are positively and significantly correlated.

On the other hand, the effect of decision-making power is significant and positive. The effect increases when controlling for personal aspirations and decreases when considering personal and community perceptions about family planning programs. In other terms, adolescents are more likely to use contraceptive methods when they can choose their childbearing time preference.

We included both *community perceptions* and *personal perceptions* in the analysis but in separate models (6 and 7) as they are strongly correlated and have different effects. *community perceptions* has a positive effect (at 10%) while the effect of *personal perceptions* is negative. The negative effect of *personal perceptions* implies that a high score of *personal perceptions* implies that people disagree with the fact that family planning is only for married women or those who do not have children but are less likely to use contraceptive methods. On the contrary, the positive effect of *community perceptions* implies that a high score means that the community agrees that family planning is only for married women and adolescents using it is promiscuous. Still, the result suggests that adolescents are more likely to control their fertility. The results for perception indicators are surprising. On the other hand, we found that knowledge and exposure to family planning messages on television or radio have the expected effects.

We also found that people with higher levels of education are more likely to control their fertility. The effect decreases and becomes non-significant when we control for perceptions and consequences about family planning programs or the use of methods. In Burkina Faso and Congo, DRC, the effect of personal perceptions about family planning is positive and significant.

Table 2.6: Marginal effects from the bivariate probit model(Kenya)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fertility time preference(ref.yes)	0.383*	0.358*	0.346	0.360	0.334	0.235	0.238
	(2.32)	(1.98)	(1.91)	(1.93)	(1.77)	(1.20)	(1.21)
Decision-making power of fertility time preference	0.646***	0.659***	0.660***	0.661***	0.678***	0.600***	0.579***
	(6.29)	(6.33)	(6.31)	(6.17)	(6.26)	(5.37)	(5.15)
Personal economic aspirations		-0.199					
		(-1.55)					
Parents' economic aspirations			-0.274*	-0.267*	-0.316*	-0.354**	-0.350*
			(-2.11)	(-2.01)	(-2.35)	(-2.60)	(-2.56)
Knowledge of methods							
Non hormonal methods				0.0365	-0.00680	-0.0142	-0.0103

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Table 2.6 – *Continued from previous page*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				(0.21)	(-0.04)	(-0.08)	(-0.06)
Hormonal methods				0.675***	0.618***	0.611***	0.597***
				(5.16)	(4.65)	(4.57)	(4.45)
Natural methods				-0.138	-0.179	-0.199	-0.207
				(-0.80)	(-1.02)	(-1.13)	(-1.17)
Exposure to media							
Media and audio-visual					0.471***	0.455***	0.454***
					(3.67)	(3.51)	(3.50)
Personal perceptions about the consequences of using methods						0.424*	0.421*
						(2.08)	(2.06)
Personal perceptions about family planning programs							-0.292*
							(-2.52)
Community perceptions about family planning programs						0.234	
						(1.81)	
Sexual activity	1.141***	1.165***	1.156***	0.990***	0.919***	0.908***	0.902***
	(6.17)	(6.33)	(6.14)	(4.60)	(4.09)	(3.93)	(3.86)
School level	0.578**	0.453*	0.470*	0.402	0.334	0.292	0.283
	(2.75)	(1.97)	(2.06)	(1.71)	(1.41)	(1.22)	(1.18)
Religion (ref. monotheist)							
Non-believer and other religions	0.0625	0.0455	0.0568	0.0234	0.0280	0.0233	0.0200
	(0.45)	(0.32)	(0.40)	(0.16)	(0.19)	(0.16)	(0.14)
Wealth (ref.lowest)							
Lower	0.161	0.113	0.120	0.0720	0.0680	0.0746	0.0634

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Table 2.6 – *Continued from previous page*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	(1.51)	(1.04)	(1.10)	(0.65)	(0.61)	(0.66)	(0.56)
Middle	0.232*	0.203	0.211	0.157	0.124	0.130	0.125
	(2.15)	(1.84)	(1.91)	(1.38)	(1.09)	(1.12)	(1.08)
Higher	0.156	0.136	0.139	0.0670	0.0220	0.0348	0.0289
	(1.33)	(1.13)	(1.15)	(0.54)	(0.18)	(0.27)	(0.23)
Highest	0.0657	0.0489	0.0492	-0.0375	-0.0815	-0.0473	-0.0556
	(0.49)	(0.35)	(0.35)	(-0.26)	(-0.57)	(-0.32)	(-0.38)
Residential area (ref. urban)							
Rural	-0.138	-0.109	-0.106	-0.121	-0.0938	-0.101	-0.108
	(-1.59)	(-1.22)	(-1.19)	(-1.34)	(-1.02)	(-1.09)	(-1.16)
Age	0.0592*	0.0581*	0.0613*	0.0294	0.0240	0.0220	0.0228
	(2.07)	(2.00)	(2.11)	(0.98)	(0.80)	(0.73)	(0.75)
Marital status	-0.275	0.0458	0.0679	0.0924	0.0747	0.137	0.138
	(-1.25)	(0.16)	(0.23)	(0.31)	(0.25)	(0.45)	(0.45)
In training /in school	-0.245	-0.237	-0.229	-0.167	-0.168	-0.142	-0.138
	(-1.66)	(-1.55)	(-1.49)	(-1.06)	(-1.05)	(-0.89)	(-0.86)
N	1519	1449	1448	1448	1447	1434	1434
Rho	-0.444**	-0.508***	-0.448**	-0.345*	-0.302*	-0.30*	-0.291
$Wald\_test\_of\_rho$	10.85	11.56	10.40	5.62	4.22	3.92	3.65

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.7: Marginal effects from the bivariate probit model (Burkina Faso)

Variables	(1)	(2)	(3)	(4)	(5)
Variables					
Fertility time preference (ref. yes)	0.0484	0.0258	0.0464	0.0311	0.0741
	(0.42)	(0.21)	(0.39)	(0.24)	(0.51)

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Table 2.7 – *Continued from previous page*

Variables	(1)	(2)	(3)	(4)	(5)
Decision-making power of fertility time preference	0.897***	0.942***	0.900***	0.939***	0.837***
	(5.69)	(5.66)	(5.62)	(5.54)	(4.30)
Personal economic aspirations		-0.0113		0.00834	-0.00745
		(-0.07)		(0.05)	(-0.04)
Knowledge of methods					
Non hormonal methods			-0.0184	0.00543	0.0291
			(-0.07)	(0.02)	(0.10)
Hormonal methods			0.770***	0.615**	0.637**
			(3.59)	(2.70)	(2.58)
Natural methods			0.568*	0.657*	0.550
			(2.12)	(2.26)	(1.79)
Exposure to media					
media and audio-visual				0.309	0.321
				(1.40)	(1.35)
Personal perceptions about the consequences of using contraceptive					0.278
					(1.25)
Personal perceptions of family planning programs					0.496*
					(2.22)
Community perceptions about family planning programs					-0.418
					(-1.54)
Sexual activity	1.505***	1.469***	1.399***	1.361***	1.173***
	(6.78)	(6.61)	(5.79)	(5.56)	(4.16)

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Table 2.7 – *Continued from previous page*

Variables	(1)	(2)	(3)	(4)	(5)
Religions (ref. Muslims)					
Christian	0.144	0.112	0.119	0.106	0.102
	(1.39)	(1.03)	(1.13)	(0.94)	(0.86)
Traditional and others	0.531*	0.489	0.567*	0.534*	0.612*
	(2.11)	(1.93)	(2.20)	(2.05)	(2.22)
Ethnic groups (ref. Mosses)					
The major ethnic groups	-0.0581	-0.0101	-0.0439	0.0244	-0.0481
	(-0.51)	(-0.08)	(-0.38)	(0.20)	(-0.37)
The minority ethnic groups	-0.183	-0.106	-0.204	-0.122	-0.140
	(-1.23)	(-0.68)	(-1.35)	(-0.77)	(-0.81)
Other nationalities	-0.394	-0.476	-0.620	-0.633	-0.784
	(-1.15)	(-1.24)	(-1.77)	(-1.60)	(-1.92)
Wealth (lowest)					
Middle	-0.185	-0.187	-0.218	-0.209	-0.211
	(-1.10)	(-1.06)	(-1.28)	(-1.17)	(-1.10)
Highest	0.196	0.273	0.148	0.204	0.258
	(1.16)	(1.55)	(0.86)	(1.14)	(1.33)
Residential area (ref. urban)	-0.0577	-0.0194	-0.00762	0.0276	0.0605
	(-0.43)	(-0.14)	(-0.05)	(0.19)	(0.38)
Age	-0.0345	-0.0489	-0.0918*	-0.108*	-0.101*
	(-0.86)	(-1.17)	(-2.20)	(-2.47)	(-2.17)
Marital status	-0.829***	-0.329	-0.886***	-0.510	-0.400
	(-3.40)	(-0.69)	(-3.51)	(-1.06)	(-0.70)
In training /in school	0.218	0.194	0.0548	0.0242	-0.0319
	(1.68)	(1.39)	(0.40)	(0.16)	(-0.19)
N	773	694	773	692	644
Rho	-0.582**	-0.615**	-0.546**	-0.571**	-0.489*
$Wald\_test\_of\_rho$	9.067	8.98	7.579	7.455	5.171

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A

Table 2.8: Marginal effects from the bivariate probit model (Congo (DRC))

	(1)	(2)	(3)	(4)	(5)
Fertility time preference(ref.yes)	0.0307	0.0181	0.105	0.0648	0.165
	(0.15)	(0.08)	(0.47)	(0.29)	(0.64)
Decision-making power of fertility time preference	0.814***	0.850**	0.838**	0.849**	1.106***
	(3.34)	(3.21)	(3.06)	(3.08)	(3.53)
Personal economic aspirations		-0.174	-0.301	-0.298	-0.446*
		(-0.88)	(-1.47)	(-1.46)	(-2.00)
Knowledge of methods					
Non hormonal methods			-0.457	-0.481	-0.535
			(-0.98)	(-1.03)	(-1.04)
Hormonal methods			0.387	0.459	0.344
			(1.42)	(1.63)	(1.14)
Natural methods			1.329***	1.371***	1.248**
			(3.68)	(3.77)	(3.28)
Exposure to medias					
Audio-visual medias				-0.322	-0.0682
				(-1.06)	(-0.20)
perceptions about the consequences of using methods					0.0756
					(0.27)
Personal perceptions about family planning programs					1.084***
					(4.64)
Sexual activity	1.104***	1.137***	0.999***	0.980***	0.912***
	(5.74)	(5.66)	(4.79)	(4.67)	(3.77)

Continued on next page

Table 2.8 – *Continued from previous page*

Variables	(1)	(2)	(3)	(4)	(5)
School level	0.970**	1.161**	0.838*	0.867*	0.936
	(2.58)	(2.86)	(1.97)	(2.03)	(1.85)
Religion (ref.Christian)	0.176	0.108	0.0575	0.0460	0.0977
	(1.16)	(0.68)	(0.35)	(0.28)	(0.54)
Ethnic groups (ref.Bakongo)					
Kasai	0.0975	0.164	0.113	0.131	0.116
	(0.75)	(1.16)	(0.77)	(0.89)	(0.72)
Other ethnic groups (including non Congoleese)	0.414*	0.527**	0.385	0.393	0.392
	(2.19)	(2.59)	(1.83)	(1.87)	(1.70)
Wealth (ref.lowest)					
Lower	-0.278	-0.239	-0.133	-0.151	-0.164
	(-1.37)	(-1.12)	(-0.61)	(-0.69)	(-0.68)
Middle	-0.171	-0.177	-0.0926	-0.109	-0.216
	(-0.81)	(-0.80)	(-0.41)	(-0.47)	(-0.86)
Higher	-0.0765	-0.0692	-0.0591	-0.0779	-0.158
	(-0.40)	(-0.35)	(-0.29)	(-0.38)	(-0.68)
Highest	0.274	0.432	0.521*	0.517*	0.478
	(1.32)	(1.94)	(2.27)	(2.25)	(1.88)
Age	0.0429	0.00887	-0.0496	-0.0459	-0.115*
	(0.94)	(0.18)	(-0.94)	(-0.86)	(-1.97)
Marital status	0.461	0.428	0.414	0.377	0.624
	(1.15)	(0.83)	(0.77)	(0.71)	(1.08)
In training /in school	0.0264	-0.0589	-0.0464	-0.0258	-0.0223
	(0.14)	(-0.29)	(-0.22)	(-0.12)	(-0.10)
N	591	527	525	525	438
Rho	-0.408**	-0.420**	-0.408**	-0.403**	-0.512*
$Wald\_test\_of\_rho$	7.95	7.45	7.06	6.99	7.04

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For Nigeria, the correlation coefficient of error terms (ρ) is not significant. As a

result, the two equations are independent. Since we focused on the likelihood of using contraceptive methods, we only presented marginal effects from the probit model in table A2.4 as descriptive.

2.6 Discussion

The number of teenage mothers or pregnant teenagers in Sub-Saharan African countries is still high, as shown in Figures 2.3 and 2.4. However, a factor analysis indicates that they have the ability to determine when they want to have children. The decision-making power is high in all countries, as shown in Table 2.5, and this has an impact on controlled fertility according to the results of a bivariate probit model. When we looked at young girls in school or training programs, we found that identifying their preferences for when to have children increased the likelihood of controlling their fertility in Kenya. However, this effect disappeared when perceptions about family planning indicators were taken into account.

Many qualitative studies showed that young women are reluctant to use modern methods because of the fear of side effects or religious factors(Nsubuga et al., 2015). Side effects include infertility or difficulties in conceiving when they get married due to hormonal methods (Williamson et al., 2009; Otoide et al., 2001; Castle, 2003). Studies have shown that in some African communities, young women's reputations are seen as a hindrance to contraceptive use, with pre-marital sex perceived negatively. Young girls who engage in such activities are often labeled "promiscuous women". As a result, seeking contraception from a clinic or pharmacy is often viewed as an admission of sexual activity. The perception of contraception in Nigeria is that only married women should use it, with young women who use it seen as promiscuous.

According to Meekers (1994), the school environment allows young women to interact with boys. Parents have less control over their girls' sexual behavior. They might engage in sexual relations even with their oldest partners because of money or gifts. Young girls from lower levels may be exposed to sexual relations more than those from the highest levels for gifts or money. It is also possible that young girls from privileged backgrounds have sexual activity (as those from disadvantaged backgrounds) if they have less parental support(either financially or morally). We found that teenagers are more likely to have

sexual activity if they have a current partner. However, the desire to achieve schooling before having a child increases their likelihood of using contraceptive methods (for Kenya).

Despite its effectiveness on fertility declines, contraception is weakly used in Africa because of poor political support (Caldwell and Caldwell, 2002; Bankole et al., 2015; Bongaarts, 2020; Bongaarts and Casterline, 2013). Within countries, family planning programs are either non-existent or insufficient in some regions, particularly rural ones. Women's needs are not always met, even in regions with family planning programs. Table 2.5 confirms that knowledge of contraceptive methods among young girls is low. Only knowledge of hormonal methods is high (implants, injectables, and pills). The results are not surprising because they have low exposure to family planning messages. It indicates that awareness-raising campaigns need to be strengthened and natural methods need to be emphasized even though they are less effective in avoiding pregnancy than modern methods (Rossier and Corker, 2017). It also appears that women substitute traditional methods for modern methods. From 2003 to 2014, the percentage of women using modern methods increased from 12 to 17% while the percentage of women using traditional methods declined from 6 to 4% (Bankole, 2015). Meanwhile, Pritchett and Summers (1994) highlighted unmet needs for modern contraceptive methods. Unmet needs involve availability and access to appropriate methods. We found for Burkina Faso and The Democratic Republic of Congo that knowledge of natural or traditional methods of contraception significantly and positively affects the use of contraception. Natural methods include rhythm, withdrawal, beads, and abstinence methods. Therefore, in the absence of appropriate modern methods of contraception, natural methods can be used as complementary methods. Thus, the importance of promoting natural methods is also crucial.

Conclusion

The percentage of adolescents who are mothers or have begun childbearing remains high in Sub-Sahara Africa. Many studies have shown the negative effects of early childbearing on education and future income. In Africa and many developing or developed countries, teenage motherhood is one of the causes of school dropouts. Abortions are illegal in many African countries, and because of the fear of parents or society's attitude toward pregnant

young girls, they resort to unsafe abortions. It indicates a non-use or ineffective use of the contraceptive method or that the pregnancy was unexpected.

In this study, we assumed that the identification of fertility time preference and the knowledge and perceptions about different methods of contraception could influence adolescents' decision to use a contraceptive method. In particular, we assessed whether the desire to achieve school before having children or the decision-making power of fertility time preference influences the decision to use a contraceptive method. We used factor analysis methods to identify measures of knowledge of contraceptive methods, the perceptions about the consequences of using contraceptive methods, perceptions, and exposure to family planning messages on the 2019-2020 data of the Performance Monitoring for Action (PMA) program. The results show that, on average, young girls have a higher decision-making power of their fertility time preference. However, they have low knowledge of natural and non-hormonal methods. Their low exposure to family planning messages could explain the result.

Using a bivariate probit model, we showed that the decision to use contraceptive methods is simultaneous to sexual activity. The results also show that the capacity to decide when to have children, the knowledge of contraceptive methods, the desire to achieve school before having children, and the exposure to family planning messages significantly affect the decision to use contraception.

Conducting a social experience or qualitative survey can provide valuable insights into the fertility time preferences of adolescents and women in African countries. Such surveys can help researchers to understand the various factors that influence the reproductive choices of women in these countries, including cultural, social, and economic factors. By gathering information on the age at which women prefer to have children, the number of children they desire, and the reasons behind their preferences, researchers can develop a better understanding of the fertility patterns in these countries. This information can be used to develop targeted interventions and policies that address the unique reproductive health needs of women in Africa.

Chapter 3

Inter-generational mobility of fertility in Africa: Trends and associated factors

3.1 Introduction

The inheritance aspect of fertility patterns was first been suggested over a century ago by Pearson et al. (1899) with their paper on *Reproductive or Genetic Selection*. Over time, demographers, sociologists, and economists have become more interested in understanding fertility patterns, especially in developed countries (Murphy and Knudsen, 2002; Axinn and Thornton, 1993; Murphy, 1999). Several research studies have found evidence to suggest that parents' fertility histories may have a significant impact on the fertility outcomes of their children. There is a positive correlation between the fertility histories of parents and their offspring (Murphy and Knudsen, 2002; Booth and Kee, 2009). This means that children of parents who had more children or longer reproductive spans are more likely to have higher fertility rates themselves. The main focus of these studies was on the transmission mechanisms, which included genetics, economics, socialization, and culture. Fertility transmitted through the family is behavioral tendencies relative to social behavior (Anderton et al., 1987). Parents transmit their genetic traits, social backgrounds, preferences, norms, and values to their children. These factors have significant implications for population dynamics and, consequently, for social inequalities (Bengtson et al., 2002).

For a long time, researchers suggested that intergenerational transmission was particularly strong in natural fertility populations and weak in populations that used birth control (contraceptives). It was based on the assumption that genetic inheritance influences women's ability to have children. However, some studies indicated that it is the desire for children and motivations for parenthood in the form of physiological dispositions that are heritable (Bras et al., 2013; Rodgers et al., 2001). The desire for a large family was one of the main factors explaining the high fertility rates in Africa. The socio-economic heritability, i.e., the exposition to similar environmental influences and opportunity structures, could also result in similar sets of preferences and normative beliefs for parents and children(Moen et al., 1997). Much literature has demonstrated that family has transmitted education, occupation, and income. However, Education, income, and social status are also the determinants of fertility. Indeed, Johnson and Stokes (1976); Ben-Porath (1975); Berent (1953); Duncan et al. (1965) have shown that determinants of fertility, such as education and occupation, are also transmitted through families.

Despite the overall result of a positive relationship between mothers' and daughters' fertility, the strength of the intergenerational transmission of fertility is not stable over time (Bras et al., 2013; Murphy and Knudsen, 2002; Anderton et al., 1987). Previous studies have suggested a weak correlation, but the results of recent studies in developed countries are different. The strength of the relationship in developed countries is supposed to be stronger over time and is compared in magnitude to the effect of level of education on fertility (Murphy and Wang, 2001). According to Bras et al. (2013), on the one hand, cohort effects may explain the weak relationship found in prior studies, and on the other hand, the role of heritability is larger and rises in more recent cohorts for women.

Most studies on intergenerational fertility transmission focus on developed countries. However, research in developing countries, where fertility rates remain high (for example, 4.6 and 3.5 in Afghanistan and Papua New Guinea in 2021), is scarce. There are few studies on developing countries, especially African countries, due to a lack of relevant data. Using DHS data from developing countries, including African countries, Murphy (2012) presents a descriptive analysis of parents' and children's family size. He found a positive but small correlation for both completed fertility size (CFS) and effective fertility size (EFS).

We use data from five African countries to estimate the intergenerational persistence of fertility. We rely on demographic and household surveys to estimate the associations between grandmothers' and mothers' completed fertility. The analysis is based on the coexistence in the survey of a sibling and birth history module. The sibling history module provides information on the number of siblings (dead and alive), and the birth history module provides information on the number of children born to the women (dead or alive). In such a survey, we can estimate fertility persistence as the relationship between parents and children completed fertility. A vast literature on the effect of education on fertility showed a significant effect: highly educated parents are less likely to have a high family size compared to less educated parents. The level of education of parents is then likely to affect the intergenerational transmission of fertility patterns. However, the information on parents' level of education or occupation is missing in our data. The sample used consists of women aged 45-49 years, with birth cohorts ranging from 1943 to 1975 at the time of the survey. Based on the assumption that their parents with large family sizes were less likely to be educated, it can be inferred that the sample group's parents were

not highly educated on average.

In order to analyze the intergenerational transmission of fertility, we used two methods: the Poisson logit hurdle model and quantile regressions. Our results show that the origin family size has a significant and positive impact on the average destination family size of the respondents in all countries. This finding holds true even after controlling for relevant socioeconomic and demographic variables. Specifically, we found that the average destination family size increased by a significant amount with each additional sibling on the mother's side. Quantile regressions were also performed to analyze the impact of the origin family size on the destination family size across different percentiles of the distribution. Our findings suggest that the positive impact of the origin family size on the average destination family size remains significant but not consistent across all percentiles of the distribution.

This study is structured into several sections that provide a comprehensive overview of our research findings. The first section will present the data and descriptive statistics. The second section will discuss the empirical methods used in our research. In the third and fourth sections, we present the results of our analysis and a detailed discussion of the findings. Finally, we will conclude our report by summarizing the key findings of our research.

3.2 Data and descriptive statistics

3.2.1 Data sources

The use of longitudinal data is important to study intergenerational mobility as it enables the tracking of intergenerational fertility trends over time. However, obtaining nationally representative longitudinal data can be a challenging task. In the absence of such data, we resorted to using the Demographic and Health Surveys (DHS), which is a household survey program that collects data on population, health, and nutrition in low- and middle-income countries. Although this data is not ideal, it provides valuable insights into intergenerational fertility patterns and trends, particularly in areas where longitudinal and nationally representative data is not available. The DHS is comprised of several data files, one of which is the Individual Recode (IR) file, which consists of data collected from individual women. These cross-sectional and retrospective surveys have national

geographic coverage and provide information that can be used to construct the reproductive history of women aged 15-49 years who participated in the surveys. We followed a two-step process to select the data analyzed in this study. Firstly, we only considered DHS, which contained information on the number of siblings of women surveyed, which helped us identify a list of countries and their respective surveys. Secondly, we identified cohorts of women who had completed their reproductive life at the time of each survey. Due to data limitations, we set the age range for these cohorts as women aged between 45 and 49 years. The sample is described in table A3.1. The estimated sample consisted of six countries, including Madagascar (3086 women), Malawi(5349 women), Mali(4505 women), Kenya(4367 women), and Rwanda(5263 women).

To ensure that respondents had completed their fertility, we excluded women less than 45 years old. For each woman in this sample, we have information about the number of siblings as well as the number of her biological children (including dead children). We also controlled for variables related to the level of education of respondents, the age at first birth, birth order, and variables capturing whether the respondent has twin or dead children.

3.2.2 Cohort fertility computation

Our first approach to intergenerational fertility trends is to calculate the completed fertility rate in the destination family and compare it with that of the origin family size. For a cohort of women, completed cohort fertility (CCF), also called lifetime fertility or completed fertility, is the average number of children at the end of their reproductive life. It is calculated by dividing the total number of children of women in the cohort by the number of women in the cohort or by summing the cohort's age-specific fertility rates $(f^c{}_x)$(Jasilioniene et al., 2015, 2016).

$$CCF = \left(\frac{\text{Total number of children of women in the cohort (destination family size)}}{\text{Total number of women in the cohort}}\right) = \sum_{x=15}^{49} f_x^c \tag{3.1}$$

In order to determine the origin family size (total number of children born to the respondent's mothers) of the women in our study group, we rely on the information provided by each participant regarding their total number of siblings. In the case of DHS,

the question about the number of her siblings also includes the respondent herself.

$$\text{Completed fertility in the origin family size (number of children of mothers of women in the cohort)} = \frac{\text{Origin family size (total number of siblings, including the respondent)}}{\text{Total number of women in the cohort}}$$

Given that the women in the studied cohorts are between the ages of 45-49, it is safe to assume that their mothers have completed their reproductive lives. However, there are two potential biases that might influence our estimation of the origin family size (total number of children of the women's mothers). The first bias relates to the presence of sisters among the respondents. This is an unavoidable situation that could either overestimate or underestimate the mothers' fertility, depending on the size of the siblings. However, since the DHS sampling is random, we assume that this bias is insignificant. The second type of bias is the heterogeneity of the generations to which the mothers of the surveyed women belong. The women selected for each survey belong to the same cohort, but their mothers come from various generations and, hence, several periods of fertility.

3.2.3 Description of variables

Completed fertility in the destination and origin family size

Figure 3.1 presents trends in women's completed fertility and the number of their siblings. The number of children women have in different countries has been changing over time. In Kenya, for example, women who completed their reproductive lives between 2000 and 2005 had more children on average than their mothers. However, after 2005, this trend started to reverse, and the average number of children per woman began to decline. In fact, by 2014, the average number of children per woman in Kenya had decreased to 3.9, the lowest it had been in over 20 years. Similarly, in Madagascar, the average number of children per woman peaked in 2000 at 6.5 and then decreased to 4.2 by 2013. In Rwanda, the peak occurred in the early 1980s at 8.0, and by 2014, it had dropped to 4.2. In both Madagascar and Rwanda, the trend towards fewer children per woman began later than in Kenya, but the decline was more rapid. In Malawi and Mali, however, the average number of children per woman has been consistently higher than their mothers' generation. In Malawi, this gap is slowly narrowing, with the average number of children

per woman decreasing from 7.6 in 1992 to 5.5 in 2015. In Mali, the gap is widening, with the average number of children per woman increasing from 6.5 in 1992 to 6.8 in 2015.

Tanzania (though it is not included in our analysis) is similar to these countries, with the average destination family size only dropping below their origin family size in 2015. In 1988, the average number of children per woman was 6.7, but by 2015, it had decreased to 5.2.

Overall, these trends suggest that while the number of children per woman in many African countries is decreasing, there is still significant variation in fertility rates across the continent.

Socio-demographic variables

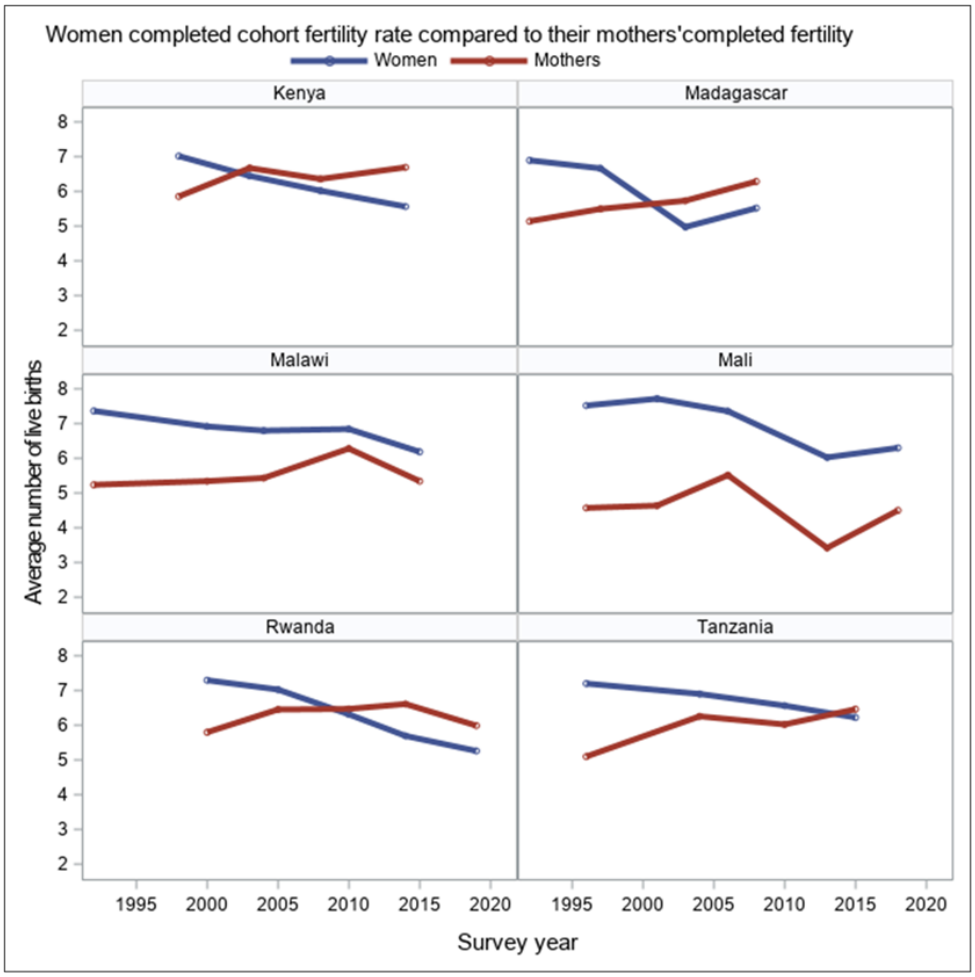
We also took into account variables such as the level of education, age at first birth, birth order, etc (Table A3.2). In our sample, Mali has the lowest levels of education, with 94.5% of respondents in the 1947-1951 cohort having no education. In Madagascar and Kenya, on the other hand, only 20% of respondents had no level of education in the 1953-1957 and 1964-1968 cohorts, respectively. Given the low levels of education of respondents, it is assumed that their parents also had limited education due to the political and historical climate of these countries before independence.

Age at first sexual intercourse and age at first birth are important indicators that can reflect the socio-economic conditions and cultural norms of a given population and also influence fertility rate. The analysis by cohort shows that the cohort in Mali, which was born between 1947 and 1951, had the lowest mean age at first sexual intercourse, which was 15.7 years. On the other hand, the highest mean age at first sexual intercourse was recorded in the Rwanda cohort, which was born between 1966 to 1970, with an average age of 20.6 years. Similarly, when it comes to the age at first birth, the cohort in Madagascar, which was born between 1943 and 1947, had the lowest mean age, which was 18.9 years. In contrast, the Rwanda cohort born between 1971 and 1975 had the highest mean age at first birth, which was 22.4 years.

We also assumed that having a twin or a dead child could also influence the fertility of women. The percentage of women who reported having at least one twin birth varied significantly across the cohorts. Mali's 1952-1956 cohort had the highest percentage of women (21.3%) who reported at least one twin birth. This indicates that twin births were relatively common during this period in Mali. In contrast, Rwanda's 1971-1975

cohort had the lowest percentage of women (5.5%) who reported at least one twin birth. The percentage of women who reported having at least one dead child also varied across the cohorts. Mali's 1947-1951 cohort had the highest percentage of women (84.4%) who reported at least one dead child. This suggests that infant and child mortality rates were high during this period in Mali. In contrast, Madagascar's 1953-1957 cohort had the lowest percentage (35.5%) of women reporting at least one dead child, indicating that infant and child mortality rates were low during this period in Madagascar (data for Kenya and Rwanda is missing for this category).

Figure 3.1: Trends in women completed cohort fertility and their mothers' completed fertility



3.3 Methods for analyzing intergenerational fertility factors

We examined women's completed fertility (destination family size) from the age of 45 and above at the time of the survey. Destination family size is defined as the number of children ever born during the woman's reproductive period and represents the dependent variable. It can only take non-negative values.

Several studies have used standard Poisson, negative binomial models, or quantile regression to analyze fertility decisions or aspirations (Booth and Kee, 2009; Wang and Famoye, 1997; Miranda, 2008). However, the standard Poisson model has limitations related to the distribution of variables (equidispersion) and independence. In the case of fertility data, these properties are not met because the probability of having 0; 1; 2 or more children depends on socio-economic variables such as education, income, and wealth. The decision to have an additional child or not is also influenced by the current number of children. Additionally, the standard Poisson model does not account for excess or insufficient zeros that may exist in fertility data. There are two types of zeros in fertility data - women who decided not to have any children and those who are sterile. To account for zeros, the Zero-inflated Poisson model or the Poisson-hurdle regression model can be used. Both models estimate two equations simultaneously. First, a probit or logit model is used to count for zeros (probability of having zeros), and a Poisson model is used to count for non-zero counts. However, the Zero-inflated model cannot deal with zero-deflated and over/under-dispersed data, whereas the Hurdle model can. Therefore, we consider the Poisson logit hurdle model in the analysis. The Poisson hurdle model is a mixture model consisting of a point mass at zero and a truncated Poisson distribution for nonzero observations. The model is defined as:

$$\begin{cases} P(Y\_i = 0) = 1 - p, 0 \leq p \leq 1 \\ P(Y\_i = k) = p\frac{e^{-\mu}\mu^k}{k!(1-e^{-\mu})} \end{cases} \tag{3.2}$$

Where $k > 0$ and $Y\_i = 1, 2...n$ and μ are the mean of the truncated Poisson distribution. We also control for the respondent's level of education, age at first birth, respondent's birth order and age-period cohort.

We also applied quantile regression to examine the complete distribution of the variable of interest. This more detailed approach will enable us to gain a better understanding of the relationship between variables. To make this analysis more robust, we will be using a jittering approach that was introduced by Machado and Silva (2005). This approach has been shown to be effective in addressing certain issues that can arise in quantile regression. In particular, it can help to deal with boundary effects that may occur when the data contains a large number of zeros or other extreme values. The jittering approach has also been applied in various contexts, including the analysis of fertility data by Miranda (2008), health data by Winkelmann (2006), and crash data by Wu et al. (2014).

3.4 Results

3.4.1 Trends in marginal effects of family size by cohort

Figure 3.2 presents a graphical representation of the marginal effects of family size for each birth cohort. These marginal effects were calculated using Poisson regression, which is a statistical technique used to model count data. The analysis was performed by not taking any other variables into consideration and only included women who have children.

It is important to note that the magnitude of the effect varies across countries. The marginal effects are relatively small in Mali and Kenya, with a range of 0.06 to 0.16, respectively. On the other hand, they are relatively large in Malawi and Madagascar, with a range of 0.30 to 0.46, respectively. This indicates a strong relationship between the origin family size (number of siblings) and the destination family size (number of children ever born to women).

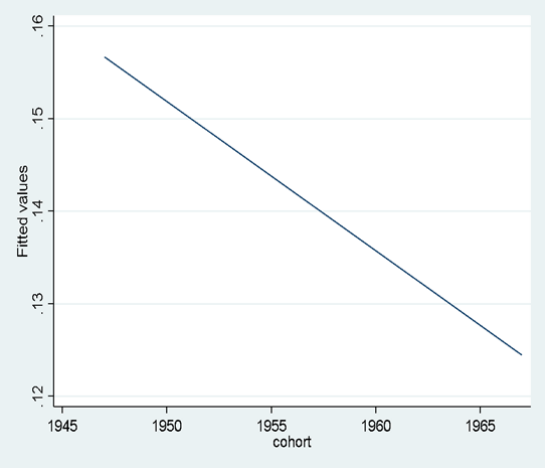
For instance, the marginal effect for the 1940-1945 cohort in Malawi is almost equal to 0.46. This means that women born during this cohort who come from larger families are more likely to have a higher family size. Similarly, the marginal effect for the 1965-1970 cohort in Madagascar is almost equal to 0.30, indicating that women from larger families in this cohort are also more likely to have more children.

Moreover, the marginal effect of origin family size on the completed destination family size decreased over time (over birth cohorts). This trend can be attributed to progress in fertility control and increased female education levels. In the next section, we have controlled for the level of education. However, as information on family control is incomplete,

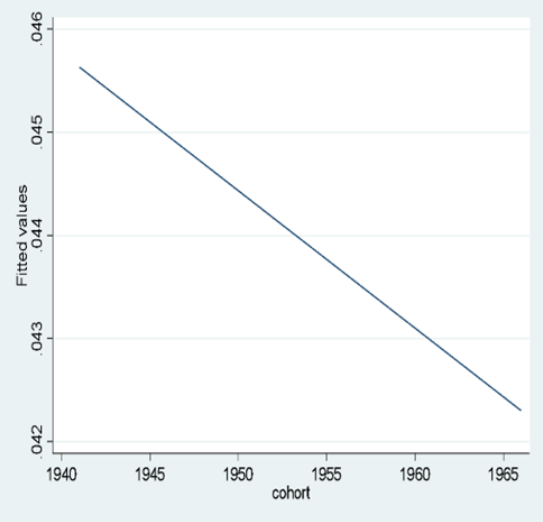
it was not taken into account in the analysis.

Figure 3.2: Trends in marginal effects of origin family size on women's completed fertility

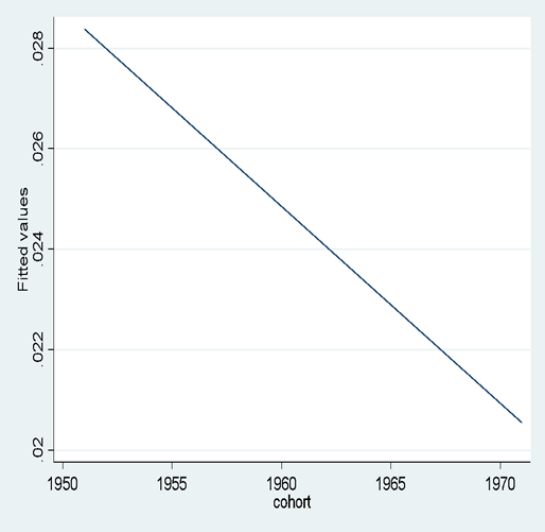
(a) Mali



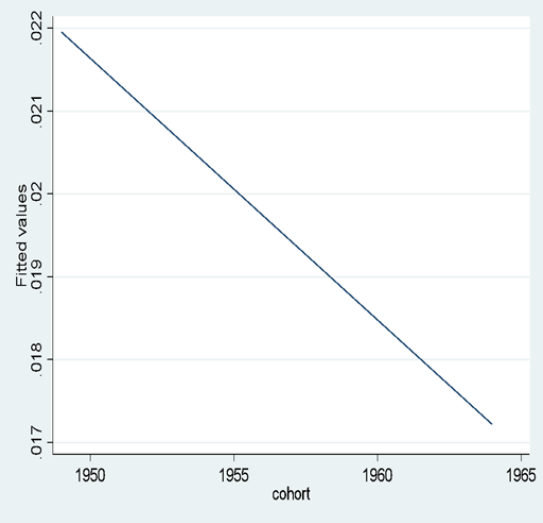
(b) Malawi



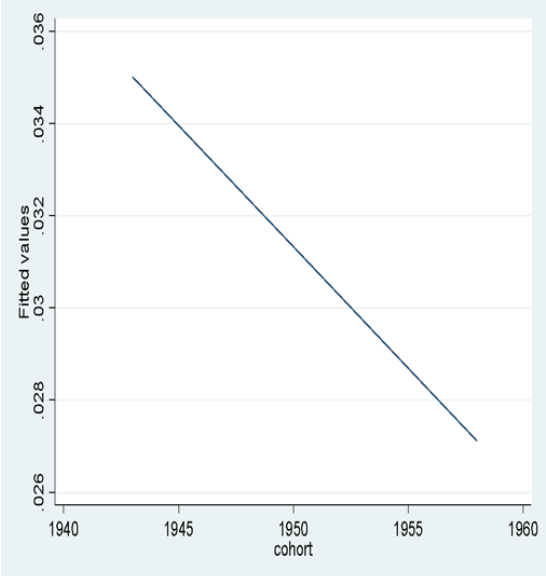
(c) Rwanda



(d) Kenya



(e) Madagascar



3.4.2 Intergenerational fertility associations in Africa: variables control

Poisson logit hurdle model

Zero hurdle model

The first part of table 3.1 presents the results of the Zero Hurdle Model, which aims to explain and predict the likelihood of having children. According to the results, there is a significant and positive relationship between the origin family size (number of siblings) and the probability of having children, but only in Kenya. This means that if the size of the original family increases by one unit, the odds of having children increase by a factor of 1.03. This finding suggests that having more siblings may positively influence one's decision to have children in Kenya.

In Rwanda, the analysis reveals that the level of education and cohort also have significant effects on the likelihood of having children. Interestingly, the results indicate that educated women are 1.33 times more likely to have children than those who are not educated. Given that we are interested in the probability of having children versus not having children, we can explain the effect by assuming that educated women who experience difficulties in conceiving may have access to medical information and resources as well as greater financial opportunities than non-educated women. This enhanced accessibility could increase their likelihood of having children compared to non-educated women. On the other hand, birth order does not seem to have a significant effect on the probability of having children in any of the countries studied.

Truncated Poisson model

In the second part of the regression analysis (Part B), we present the results of the truncated Poisson model, which is the most important part of the analysis. Our analysis reveals that all the variables in the model have a significant impact and demonstrate the expected effect on the destination family size in all countries.

The coefficients of regression are moderate across all countries, which may imply a high intergenerational mobility. Mali has the largest effect compared to other countries. For instance, an additional child in the original family size leads to an increase in the average destination family size by 1.023 (exp(0.24)), representing a significant increase of 2.3%. This finding suggests that the cultural and social norms in Mali might encourage

larger families, which in turn, increases family size.

Moreover, the level of education has a negative and significant impact on the destination family size in all countries. For example, in Kenya, educated women are expected to have 0.82 fewer children than non-educated women. This finding confirms previous research on fertility, which suggests that educated women are less likely to have many children compared to non-educated women. Education can empower women with knowledge and opportunities, leading to better access to family planning and career opportunities, which can reduce their desire to have many children.

Studies have shown that the birth order of children may have an impact on the number of children they will have (Johnson and Stokes, 1976). We found a significant effect in Rwanda and Madagascar. For instance, in Madagascar, women who are the first-born in their families are expected to have 1.06 times more children than women from other birth orders. Specifically, the eldest child in a family is more likely to have a higher family size than their younger siblings. It can be explained by the fact that eldest children often play a significant role in supporting their parents in raising their younger siblings. They may even take on a parental role, which can influence their decision to have more children in the future. However, it's important to note that not all eldest children will have more children than their parents did. Some may choose to have fewer children for various reasons. Overall, while birth order appears to be a factor in the average family size a person may have in some cultures, it is not a universal rule, and other factors, such as personal beliefs, economic status, and access to healthcare, also play a role.

We also found that the cohort variable has a significant and negative association with the number of children born to a woman. This suggests that women who belong to different birth cohorts have a different number of children. This trend was observed across all countries that were part of the study. For instance, in Madagascar, women who were born in cohorts other than 1943 are expected to have 0.98 times fewer children than those born in 1943.

Quantile regressions results

In order to establish a benchmark statistical model, we utilized the Poisson model, as per the methodology suggested by Miranda (2008). The dependent variable for the model is the completed fertility in the destination family size (total number of children ever

Table 3.1: Results of the Hurdle Poisson logit (coefficients)

	Malawi	Rwanda	Mali	Kenya	Madagascar
Zero hurdle model coefficients (with logit link)					
Origin family size	-0.011	0.045	-0.025	0.031**	-0.033
	(-0.29)	(1.23)	(-0.72)	(2.18)	(-1.33)
Birth order of Respondent (ref,1st)	0.013	-0.489	-0.262	-0.191	-0.071
	(0.05)	(-1.80)	(-1.05)	(-0.51)	(-0.37)
Education level(ref.educated)	-0.106	0.285**	0.262	-0.033	0.010
	(-0.60)	(2.19)	(1.69)	(-0.19)	(0.10)
Cohort	-0.005	0.031**	-0.009	-0.034	-0.018
	(-0.29)	(2.27)	(-0.61)	(-1.37)	(-1.28)
Constant	5.444	66.996**	14.497	64.068	33.946
	(0.17)	(-2.42)	(0.49)	(1.29)	(1.19)
Count model coefficients (truncated Poisson with log link)					
Origin family size	0.009***	0.007**	0.024***	0.006***	0.012***
	(4.70)	(3.28)	(11.87)	(3.67)	(5.18)
Birth order of Respondent (ref.1st)	-0.020	0.043**	0.016	-0.001	0.059**
	(-1.57)	(3.09)	(1.19)	(-0.07)	(3.19)
Level of education (ref. no education)	-0.111***	-0.113***	-0.110***	-0.200***	-0.222***
	(-12.44)	(-12.51)	(-9.17)	(-20.77)	(-22.08)
Cohort	-0.004***	-0.014***	-0.010***	-0.011***	-0.015***
	(-4.87)	(-17.30)	(-11.70)	(-8.41)	(-10.44)
Constant	9.748***	30.128***	22.239***	23.594***	31.319***
	(6.09)	(18.47)	(12.79)	(9.20)	(11.15)
N	5322	5250	4418	3063	3054

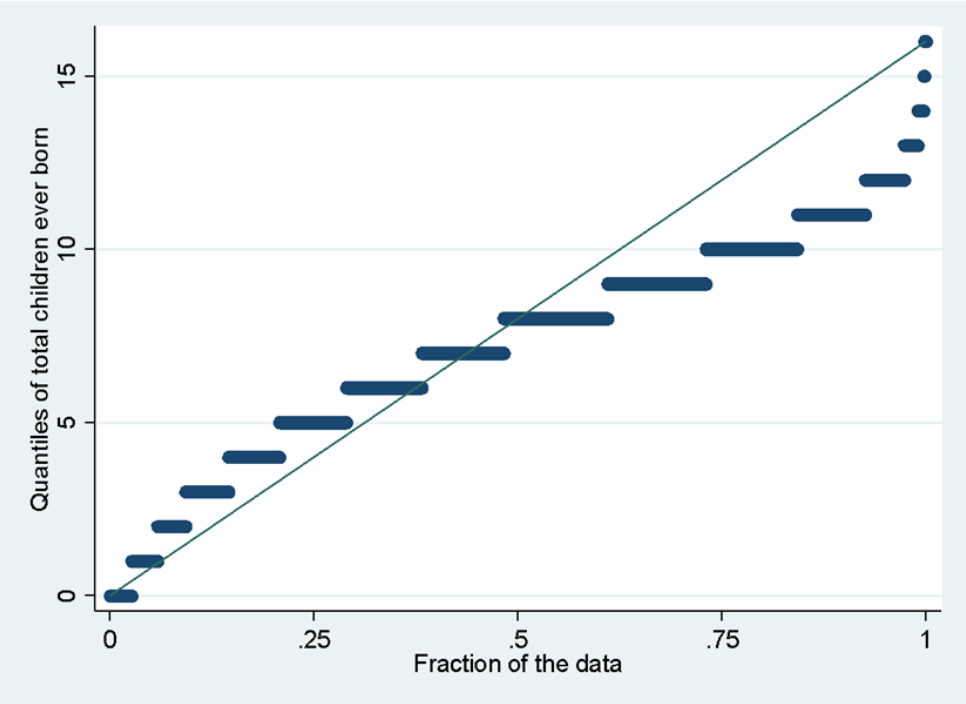
z statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

born to the respondent), and it is a continuous variable. To ensure accuracy, we set the number of jittering samples to 1000. For calculating marginal effects, we followed Miranda (2008)'s method of setting continuous variables to their means and dummies to their modes. We also divided the variable into quartiles of 0.25, 0.5, and 0.75 based on the distributional graph. The distributional graph of the dependent variable in Mali is displayed in Graph 3.3. By setting the number of jittering samples to 1000, we are able to obtain more accurate results than if we had used a smaller number of samples. Additionally, by dividing the variable into quartiles, we can see how different parts of the distribution affect the outcomes of the model.

We have presented the results of the quantile regressions for each country in the tables 3.2 3.3 3.4 3.5 3.6. The impact of the origin family is positive for all countries, regardless of the quartile of regressions. However, this impact is not consistent across all distributions.

Figure 3.3: Quantiles distributional graph of the completed fertility in the destination family in Mali (all cohorts combined)



For instance, in Mali and Rwanda, the effects are more significant on the left tail and decrease towards the right tail of the distribution. The effect is larger in Mali compared to other countries, which can be attributed to its high fertility rate. The marginal effects by quantile regression suggest that the effects vary across different regions of fertility distribution, ranging from 0.066 to 0.096. For example, an increase in the origin family by one unit leads to an increase of 0.099 units in the conditional mean of fertility estimated by Poisson regression. Although the estimates are small, they are significant.

The effect is significant for Madagascar and Kenya, but only until the median. From the third quartile (q=0.75), the effect is no longer significant. For Malawi, the effect is significant from the median and increases towards the right end of the distribution.

The age at which a woman gives birth for the first time and her level of education are two factors that significantly impact all quartiles of completed fertility. A woman's educational level and age at first birth have a negative effect on completed fertility, which means that as the level of education increases or the age at first birth increases, the completed fertility rate decreases. This negative correlation between the level of education and fertility is well-documented in previous studies. Higher levels of education may lead to greater career opportunities and financial stability, which may delay or reduce the

desire for childbearing. Similarly, having a child at a younger age may limit educational and career opportunities, leading to a lower level of completed fertility.

In all countries, child mortality has a positive and significant impact on completed fertility, with the exception of Rwanda and Kenya where data on child mortality is missing. Women may plan to have additional children to "replace" those who have passed away. Similarly, having twins also has a positive and significant effect on completed fertility, as it relates directly to the parents. These two variables have the most significant impact compared to other variables.

The impact of birth order on fertility varies across different countries. In Mali and Malawi, birth order does not appear to have a significant effect. In Madagascar, being born first has a positive effect only for families in the lower quartile of the distribution and is not significant for families in the upper quartiles. In Kenya, birth order has a positive and significant effect on fertility for families at the median level. In Rwanda, being the eldest has a positive effect only at the lower end of the distribution and is not significant for families in the upper levels. Overall, being the eldest in the family tends to have a positive effect on fertility.

Table 3.2: Quantile regression results: Mali

	Quartile=0.25	Quartile=0.5	Quartile =0.75
Variables	Total children Ever born	Total children Ever born	Total children Ever born
Number of siblings	0.066***	0.099***	0.096***
	(3.46)	(6.56)	(6.94)
Age at first birth	-0.193***	-0.221***	-0.234***
	(-16.5)	(-21.6)	(-23.9)
Birth order of Respondent (ref.1st)	0.105	0.024	0.052
	(0.837)	(0.236)	(0.513)
Education level(ref.educated)	-0.368***	-0.542***	-0.604***
	(-4)	(-5.92)	(-6.52)
Cohort (ref.1947)	0.011	-0.012*	-0.025***
	(1.37)	(-1.81)	(-3.79)
Have twin	0.985***	0.873***	0.838***
	(7.98)	(8.3)	(8.04)
Age at first intercourse	-0.002	-0.002	-0.001
	(-0.647)	(-0.975)	(-0.545)
Had a dead child	2.798***	2.695***	2.362***
	(20)	(23.6)	(21.3)
Number of obs	4300	4300	4300
No, jittered samples	1000	1000	1000

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.3: Quantile regression results:Malawi

	Quartile =0.25	Quartile =0.5	Quartile =0.75
Variables	Total children	Total children	Total children
	Ever born	Ever born	Ever born
Number of			
	0.011	0.034**	0.054***
siblings			
	(0.685)	(2.79)	(4.03)
Age at first birth	-0.149***	-0.178***	-0.207***
	(-10.3)	(-18.2)	(-20.4)
Birth order of			
	-0.032	-0.034	-0.027
Respondent (ref.1st)			
	(-0.267)	(-0.394)	(-0.318)
Education level(ref.educated)	-0.594***	-0.748***	-0.742***
	(-6.67)	(-12.2)	(-11.3)
Cohort (ref.1941)	0.0148***	-0.009**	-0.020***
	(2.53)	(-2.06)	(-4.34)
Have twin	1.394***	1.258***	1.205***
	(9.65)	(9.89)***	(9.74)
Age at			
	-0.005**	-0.003	-0.002
first intercourse			
	(-2.08)	(-1.72)	(-1.08)
Had a dead child	2.031***	1.858***	1.902***
	(14.4)	(21.6)	(21.4)
Number of obs	4917	4917	4917
jittered samples	1000	1000	1000

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.4: Quantile regression results: Madagascar

Variables	Quartile =0.25 Total children Ever born	Quartile =0.5 Total children Ever born	Quartile =0.75 Total children Ever born
Number of siblings	0.041**	0.038**	0.020
	(2.51)	(2.32)	(0.983)
Age at first birth	-0.193***	-0.265***	-0.329***
	(-15.6)	(-22.1)	(-22.2)
Birth order of Respondent (ref. 1st)	0.347**	0.171	0.187
	(2.4)	(1.46)	(1.140)
Education level(ref.educated)	-0.418***	-0.897***	-1.155***
	(-5.19)	(-11.8)	(-14.3)
Cohort (ref.1943)	-0.035***	-0.046***	-0.037***
	(-2.95)	(-4.59)	(-3.13)
Have twin	1.501***	1.093***	1.058***
	(10.9)	(8.5)	(3.37)
Age at first intercourse	-0.006	-0.006	-0.011***
	(-0.85)	(-1.61)	(-3.38)
Had a dead child	1.981***	2.237***	2.076***
	(14.4)	(18.4)	(15.1)
Number of obs	2867	2867	2867
No, jittered samples	1000	1000	1000

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.5: Quantile regression results:Kenya

Variables	Quartile =0.25 Total children Ever born	Quartile =0.5 Total children Ever born	Quartile =0.75 Total children Ever born
Number of siblings	0.027***	0.023***	0.028
	(6.020)	(3.610)	(1.140)
Age at first birth	-0.195***	-0.216***	-0.250***
	(-14.5)	(-16)	(-13.2)
Birth order of Respondent (ref.1st)	0.277	0.232**	-0.039
	(1.880)	(1.920)	(-0.287)
Education level(ref.educated)	-0.895***	-1.263***	-1.442***
	(-12.6)	(-18.3)	(-17.6)
Cohort (ref.1949)	-0.046***	-0.059***	-0.066***
	(-4.56)	(-5.82)	(-6.23)
Have twin	1.770***	1.704***	1.743***
	(8.590)	(9.280)	(9.110)
Age at first intercourse	-0.002	-0.002	-0.005**
	(-0.572)	(-1.15)	(-1.95)
Number of obs	3010	3010	3010
No, jittered samples	1000	1000	1000

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.6: Quantile regression results: Rwanda

	Quartile =0.25	Quartile =0.5	Quartile =0.75
Variables	Total children Ever born	Total children Ever born	Total children Ever born
Number of siblings	0.050***	0.047***	0.038**
	(3.97)	(3.89)	(2.93)
Age at first birth	-0.219***	-0.241***	-0.272***
	(-22.1)	(-26.8)	(-26.8)
Birth order of Respondent (ref.1st)	0.189**	0.199**	0.110
	(2.3)	(2.83)	(1.48)
Education Level (ref. educated)	-0.402***	-0.473***	-0.375***
	(-6.9)	(-8.55)	(-6.79)
Cohort (ref.1951)	-0.062***	-0.071***	-0.081***
	(-16.5)	(-19.9)	(-21.4)
Have twin	1.255***	1.137***	1.029***
	(10.7)	(10.9)	(9.36)
Age at first intercourse	-0.006**	-0.006**	-0.009***
	(-2.1)	(-2.54)	(-3.76)
Number of obs	5117	5117	5117
No, jittered samples	1000	1000	1000

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.5 Discussion

3.5.1 Intergenerational transmission

By comparing the total number of children of each woman surveyed with that of her mother in the five countries (Madagascar, Malawi, Mali, Kenya, and Rwanda), this study has shown that the more recent the generations, the more they tend to have much lower completed fertility than their mothers. The most significant differences were observed in Kenya, Rwanda, and Madagascar. However, in Mali and Malawi, we found that in all the surveys studied, the respondents had, on average, more children than their mothers, especially in Mali. These different results, which vary from country to country, should be seen in the context of the different paths these countries take regarding fertility decline. East African countries such as Kenya and Rwanda are pioneers in fertility decline in sub-Saharan Africa (Shreffler and Nii-Amoo Dodoo, 2009). Meanwhile, West African countries such as Mali are experiencing high fertility levels with much slower downward trends (Bongaarts and Casterline, 2013; Garbett et al., 2021). This study also found that the origin family size positively and significantly influences the destination family size. The effect was higher in Mali than in other countries. This effect of the origin family size on the destination family size was confirmed by the Poisson model and by the Quantile regression model after controlling for the level of education, birth order, age at first birth, and first sexual intercourse, whether or not she had ever had twins, and whether or not she had ever had a child who died. The positive effect of the origin family size on the destination family size was also found by studies in some other developing countries: Lotfi et al. (2017) in Iran, Ndahindwa et al. (2014) in Rwanda, Smith (2004) in Nigeria, (Silalahi and Setyonaluri, 2018) in Indonesia. The solid intergenerational transmission of fertility practices in sub-Saharan African countries could explain our results. In these countries, the cohabitation of several generations in the same family dwelling (Van Hoyweghen et al., 2023) and the influential place traditionally given to the elders would enable them to convey their 'visions' of high fertility. Religious beliefs in high fertility, the economic and retirement insurance value of children, the high mortality rate among children, etc., are all ways and arguments that convey the ideals of high fertility from generation to generation (Randall et al., 2010).

3.5.2 Fertility factors

The variables we used to control the effect of the origin family size on the average destination family size also produced results about fertility factors. One of these results shows that the average destination family size for educated women is lower than that of non-educated women. This finding corroborates previous research on fertility, which indicates that educated women are less likely to have many children than non-educated women(Bougma* et al., 2014; Shapiro, 1992). Another result showed birth order has a significant impact on fertility, as first-born children are more likely to have more children than their younger siblings. This finding aligns with a study conducted in Sweden (Morosow and Kolk, 2020; Johnson and Stokes, 1976). In fact, eldest children are likely to support their parents in raising their younger siblings and sometimes even take on a parental role. However, this does not necessarily mean that all eldest children will have more children than their parents. Some may choose to have fewer children than their parents. We found that child mortality has a positive link with women's completed fertility rates. This means that having dead children is associated with a high completed fertility rate. This must be put in line with replacement fertility that is very widespread in the context of no or low fertility control and low birth spacing, as in sub-Saharan African countries (Aksan, 2014). The present study also showed that women having twins are significantly associated with high completed fertility. This result could be explained by having twins (dizygotic especially) being partly a genetic inheritance from mother to daughter (Ouedraogo, 2023).

3.6 Conclusion

This article aimed to study the trends and factors associated with convergence or divergence in fertility between the generation of women surveyed and that of their mothers. To do this, we focused on five sub-Saharan African countries: Madagascar, Malawi, Mali, Kenya and Rwanda. We showed that there are still intergenerational solid convergences in completed fertility levels in sub-Saharan Africa. We also found that women with lower education levels, first-born order, having dead children, and twinning were significantly associated with high completed fertility in Africa. Our results describe a context in sub-Saharan African countries where fertility decline is complex, with intergenerational ties

playing an important role.

With longitudinal data, we can gain a deeper understanding of how factors such as income and occupation impact fertility rates across generations. For instance, we can identify patterns of mobility or stagnation in terms of fertility rates among different socio-professional categories. By tracking the lives of households and respondents over an extended period, we can gain valuable insights into the factors that influence fertility rates across generations.

Chapter 4

Geographical context and Intergenerational mobility of education and occupation

4.1 Introduction

Migration is a significant factor in population dynamics, driven primarily by the search for better opportunities or lack of opportunities in the origin location. At the national or international level, migration can modify the structure of the population, economy, culture, and even the environment of both the source and destination areas. Socio-economic and demographic conditions in the country of origin, such as the quality of education, economic opportunities, and social structures, can greatly impact the ability of migrants to integrate into and succeed in the destination country. Factors linked to the origin country explain inequality between migrants and natives. However, if the inequality between descendants of migrants and natives persists and is explained by factors beyond their efforts, the government should intervene and act in order to reduce inequality (Black et al., 2005). On the one hand, studies have found that inequality in terms of education and income between migrants and natives is reduced over generations (Card et al., 1998; Bauer and Riphahn, 2006; Borjas, 1993; Oberdabernig and Schneebaum, 2017; Van Ours and Veenman, 2003).

The social and economic status of children is a complex and multifaceted issue that goes beyond just their personal attributes and family background. While these factors play a significant role in shaping children's lives, the environment in which they grew up can also have a significant impact on their development. Research has shown that the neighborhood or community in which children reside can have a significant effect on their educational and professional aspirations, as well as their personal and social growth (Sewell and Armer, 1966; Garner and Raudenbush, 1991). For instance, children who grew up in disadvantaged areas with limited access to quality education, healthcare, and other resources may face significant barriers to achieving their full potential. On the other hand, those who reside in wealthy neighborhoods with access to quality schools, healthcare, and other resources may have a better chance of achieving their goals. Therefore, it is essential to consider the neighborhood context when examining children's social and economic status. By understanding the impact of the environment on children's lives, policymakers and educators can take steps to address the structural inequalities that limit children's opportunities and improve their overall well-being.

Countries with high inequality also have low mobility, and the relation is called the

"Great Gatsby Curve" (Krueger, 2012). France is one of the countries with a low income inequality (compared to the United States) and, therefore, with a high mobility. Consequently, children whose parents have low skills will also be more likely to have high skills (Oberdabernig and Schneebaum, 2017; Van Ours and Veenman, 2003; Schneebaum et al., 2016; Bauer and Riphahn, 2013). However, the type of neighborhoods in which they live could influence their parents' attitude towards their education and future occupation, and then their intergenerational mobility. Indeed, in many destination countries, some neighborhoods have a high concentration of migrants. The spatial assimilation model proposes that recent immigrants tend to settle in areas where there is a high concentration of people from their own ethnic group. This gives them access to information on employment, housing, and administrative documents, which can help them integrate more easily into their new environment. However, such neighborhoods are typically characterized by poverty and deprivation. Over time, individuals whose living conditions have improved tend to move to other neighborhoods. However, those who did not have the same opportunity remain in their current neighborhood or region, raise their children, and provide them with an education within that same environment. However, studies found ethnic or residential segregation has negative effects on employment, criminality (Kain, 1968; Harry, 1987; Hall, 2013; Catsambis and Beveridge, 2001) and, in general, on the socio-economic development of residents.

The main objective for this study is to show how neighborhood effects could explain the differences in the level of education and occupation between descendants of migrants and natives in France. We use data on more than 21,000 people (including migrants, descendants of migrants, and natives). The particularity of migrants and descendants of migrants is that most of them live in poor neighborhoods with high rates of immigrants and unemployment, compared to natives (Figures A4.2;A4.4 and A4.5). In addition, countries and regions of origin are different. As Figure A4.6 shows, children of migrants from Sub-Sahara and North Africa tend to live in neighborhoods where their community is the most represented. To take into account the effects of neighborhoods, we use neighborhood variables and control for the duration of residence. When we analyze children's intergenerational mobility, the social environment in which they live is implicitly taken into account. Hence, we separate family's effects from neighborhood's effects in the French context. The survey groups people into regions, departments, municipalities, and

neighborhoods. Data on neighborhood characteristics are classified into deciles.

There are various ways to measure intergenerational mobility, depending on the type of variables used (discrete or continuous). Some of these measures include the intergenerational correlation coefficient, intergenerational elasticity, and the Shorrocks Mobility Index, among others. We consider transition matrices to measure intergenerational mobility using discrete variables (as in our case). The transition matrices show that, on the total sample, 75.29% of individuals have achieved a higher level of education than their parents. In addition, 17.73% of individuals have attained the same level of education as their parents, while 6.98% have a lower level of education than their parents. 81.04% of the individuals have a different socio-professional category from their fathers, while 18.86% share the same category. The results of the Shorrocks (1978); Sommers and Conlisk (1979) measures of intergenerational mobility show that people have more equal opportunities than their parents to move up or down the education and socio-professional category. The second generation of migrants has a higher intergenerational mobility index in education and occupation compared to natives.

We also performed estimations using the standard model of regression of Black (2011). The results confirm our hypothesis that the environmental context matters more for second-generation migrants than natives. The study is in line with previous studies on intergenerational mobility, which presented factors such as age, sex, intelligence, income, and education that may explain differences in levels of education and profession between people (Becker and Tomes, 1979, 1986; Black et al., 2005; Solon, 2002; Borjas, 1992).

The paper is structured as follows: The literature review is presented in the first section. The data and the model are described in sections 2 and 3, respectively. In section 3, we present the empirical review, and the paper concludes with section 4.

4.2 Literature review

4.2.1 Neighborhood effects

Research has demonstrated that the environment of family residence is more decisive for the future life of children than for adults. Parents choose their place of residence based on their own characteristics (income, social class) and also on the neighborhoods ' characteristics (the rates of criminality, unemployment, and social transmission)(Kim

and Lee, 2018). Moreover, neighborhoods are heterogeneous and are generally classified into deprived and non-deprived neighborhoods. Some countries like the United States and the Netherlands have created a deprivation indicator to identify neighborhoods with high needs based on variables such as the rates of unemployment, criminality, ethnic or racial segregation, and the share of graduates and skilled workers. All these factors do not only characterize neighborhoods but also influence children's educational and professional attainment. Indeed, people's behavior is influenced by the average behavior of the neighborhood or the social group in which they are growing up (Manski, 1993). For example, children from deprived neighborhoods (that is, neighborhoods with a high rate of unemployment and a low rate of graduates) have fewer incentives to study and, therefore are less likely to have a high level of education (Garner and Raudenbush, 1991; Sewell and Armer, 1966; Dynes et al., 1956). However, the effect is indirect because it passes through some variables such as personal development, the quality, and the frequency of interactions with people. Psychological studies (Butcher et al., 1963) have shown that neighborhoods can consist of people with particular personalities, which can affect their attitudes toward education. For instance, those living in neighborhoods where competition is prevalent may develop a competitive spirit and may strive to outperform their peers. On the other hand, those living in areas with a high rate of criminality may face a range of risks and challenges that can negatively impact their educational prospects. They may be more likely to become involved with dangerous groups and engage in risky behaviors, which can lead to academic underachievement or even dropping out of school.

Economic pressures are intensifying nowadays, and some people may have difficulties finding a job that matches their training. Neighborhoods can provide information about job opportunities for individuals and children may identify themselves to adults. When children grow up in neighborhoods where the gap between adults' educational attainment and their occupational status is high, they may not feel encouraged to study. The Central Advisory Council for Education (CACE, 1967) (cited in Garner and Raudenbush (1991)) explains that children tend to identify with adults, and if they perceive that education is useless because adults cannot find jobs that match their qualifications, they may become less motivated to pursue education. As a result, they may end up being less educated.

Many developed countries have implemented a public housing policy in order to help poor families to have decent houses. However, some neighborhoods have a high public

housing concentration, which has negative effects not only for residents but also for the entire municipality. A high concentration of public housing indicates both residential and income segregation as it is allocated to low-income families. Segregated areas, especially those with high public housing, are located in some countries, such as France, in the periphery of municipalities (Dujardin and Goffette-Nagot, 2005). They are far away from jobs which are generally located in the center of the city. As a result, time and transportation costs increase, which may discourage residents from looking for a job in the city(Leonard, 1987). Moreover, the distance from their location to the center may also create information asymmetry in the sense that people may have less information about the available jobs when the informal method to find a job is the most used (Harry, 1987). Living in a deprived area or a high public housing concentration area can then have negative effects on education and employment. The rate of unemployment increases as a consequence of residential segregation (Kain, 1968).

4.2.2 Neighborhood effects and intergenerational mobility

According to Chetty et al. (2014), intergenerational mobility varies across areas and may be explained by two main factors. First, there is a causal effect between neighborhood and economic mobility. Second, differences between areas in terms of demography or wealth could also explain differences in intergenerational mobility. Indeed, Chetty and Hendren (2018) found that children's move or exposure to a more (less) advantageous neighborhood than the one in which they lived increases (decreases) their future income conditional on their parent's income.

Parents also adopt different styles or strategies of education (permissive, authoritarian) depending on the neighborhoods in which they live with their children. In some deprived neighborhoods where the rate of criminality is high, parents might focus their efforts on monitoring their children in order to protect them and prevent them from joining dangerous groups (Catsambis and Beveridge, 2001). In addition, parents in deprived areas are less involved in children's curricular and extra-curricular activities than those in non-deprived areas. In particular, living in a low-educated neighborhood decreases the intergenerational mobility of children (Chetty and Hendren, 2018; Ioannides, 2002). Parents living in low-educated neighborhoods may have lower educational expectations for their children than parents in high-educated neighborhoods. As a result, the neighborhood's

effects may be larger than parents' education (Kremer, 1997).

The transmission of resources from parents to children is a complex process, and the type of neighborhood in which a family resides plays a critical role. Studies have shown that in high socio-economic status neighborhoods, a family's financial stability is a significant determinant of their children's educational attainment. Families in such neighborhoods have access to better educational resources, and their children have a higher probability of attending prestigious schools and receiving an excellent education. On the opposite, in poor neighborhoods, the mother's level of education is more crucial than their financial stability. Children in such neighborhoods face several challenges, including limited access to quality education, lack of resources, and low-quality living conditions. Therefore, the mother's education level becomes a critical factor in determining the children's educational outcomes. Studies have shown that mothers with high levels of education in poor neighborhoods have a more significant impact on their children's success than financial stability (Fischer and Kmec, 2004).

Neighborhoods do not only influence children's future economic characteristics but are also an indicator of the type of neighborhood in which they will live when they become adults. Indeed, children may also inherit the neighborhood's type of their parents (Van Ham et al., 2014). Children from a low socio-economic status neighborhood are more likely to live in this type of neighborhood as adults, and this is more relevant to ethnic minorities.

4.3 Data

The Trajectories and Origins (TeO) survey was conducted in France in 2008 by the National Institute of Statistics (Insee) and the National Institute of Demographic Studies (Ined). The survey targeted descendants of migrants, i.e., individuals born in France with at least one parent born abroad. It was conducted by interviewing individuals face-to-face. Each participant was asked to provide information about their parent's level of education, occupation, place of birth, and other relevant details. The total sample size was 21,800 individuals, which included 8,200 migrants, 8,300 descendants of migrants, 3,900 natives, and 1,400 individuals from overseas territories.

The survey was supported by additional data on the type of neighborhoods in which

people reside. The data was gathered from the 2006 population census and includes information such as educational attainment, employment and unemployment rates, and tax income of neighborhoods. To ensure the privacy of individuals, neither the names of neighborhoods nor individuals' addresses were provided. Nevertheless, neighborhood variables are measured by deciles, and the information is available.

4.3.1 Individual characteristics

Country of Origin of descendants of migrants

Table 4.1 presents the distribution of descendants of migrants across the regions of origin of their parents. Descendants of migrants are defined as individuals born in France with at least one parent who is a migrant. In case both parents are migrants, we only considered the father's region of origin. People who are descendants of migrants come from various parts of the world, with a significant representation from Europe, Africa, and Asia.

Migration from European countries is linked to the Industrial Revolution. During the Industrial Revolution in the 19th century, labor demand increased in France, and the country could not meet the demand due to its low population growth rate. Therefore, France resorted to immigration from neighboring countries, particularly from Southern European nations such as Italy, Spain, and Portugal. As a result, there was a substantial migration of people from these countries to France.

Migration from Africa has a historical association with the two world wars. These wars had a significant impact on all European nations, including France. Consequently, France became more dependent on migration from African countries. However, nowadays, people move from Africa for various reasons such as education, seeking employment opportunities, escaping internal conflicts, and reuniting with their families. The percentage of people from North Africa is the highest (30.64%).

Migration from Asia to France is mainly driven by Turkey. In 1965, France and Turkey signed a bilateral agreement to facilitate the migration of Turkish workers to France. In addition, some Asian countries, including Pakistan, Afghanistan, and Syria (Middle East), are currently facing internal conflicts, leading to the displacement of populations to other countries, especially France.

Table 4.1: Proportion of descendants of migrants by parent's region of origin

Region of origin	Proportion
Asia	13.57
North Africa	30.64
Sub Sahara Africa	12.58
South Europe	20.12
Other European countries	20.61
Other countries	2.15
Total	100

Variables specification and descriptive statistics

The survey primarily focuses on migrants and their children who were born in France, also known as second-generation migrants. In the sample, the number of second-generation migrants is higher than that of natives. Specifically, there are 8,614 individuals born in France with at least one parent born abroad and 3,507 natives. These numbers represent 39.58% and 16.12% of the sample, respectively. We have considered education and occupation as dependent variables. Descriptive statistics are presented in Tables 4.3 and 4.4:

Education: is measured by the highest level of diploma achieved. The level of education of a parent is determined by the highest degree attained by either their father or mother (Borjas, 1992, 1993; Oberdabernig and Schneebaum, 2017). In our dataset, fathers have achieved the highest level of education in 84% of cases. More than half of parents in Southern Europe and Northern Africa lack any educational qualifications. However, the situation appears to be improving over time, as over 50% of their children have achieved a baccalaureate degree or higher.

Occupation: The new classification of occupations established in 1982 by the French National Institute for Statistics defines six groups of socio-professional categories: 1.Farmers, 2.Artisans, Traders, and Entrepreneurs, 3.Executives and Higher Intellectual Professions, 4. Intermediate Occupations, 5.Employees, and 6.Workers. We use the same categorization and also include categories of skilled and unskilled workers. Furthermore, we classify the categories in ascending order based on the monthly income information. This classification is helpful for identifying the regression model. Table 4.2 presents descriptive

statistics of socio-professional categories by income. It shows that higher executives and intellectual professions have the highest income.

Table 4.2: Average income by occupational group

Occupational group	Mean	Sd	Number of observations
Unskilled workers	1035.65	413.62	2420
Farmers	1173.1	326.94	90
Artisans, traders, and entrepreneurs	1181.85	634.55	857
Employees and skilled workers	1387.48	465.83	4911
Intermediate occupations	1711.55	778.94	3121
Executives and higher intellectual professions	2811.94	1788.89	1870

We have considered the occupations of both parents in our regression model, although in table 4.3, we have only included the socio-professional category of the father. The percentage of migrant parents who occupy unskilled jobs (23.94%) is higher than that of natives (14.44%). This indicates that migrant parents are more likely to have jobs that do not require special skills compared to natives. According to the studies of Van Ours and Veenman (2003) and Oberdabernig and Schneebaum (2017), the initial wave of immigrants is less skilled in the labor market compared to the native population. However, with the second generation, which is born in the destination country, this gap is reduced, and they achieve the same skill level as the native children. The data shows that the proportion of people with unskilled jobs decreases over the generations, as shown in table 4.4.

We also included a variable capturing the occupational status (employed, unemployed, retired, inactive) of the respondent's father or primary caregiver when he was 15 years old.

The variables of control are:

The number of siblings and the number of older siblings with a high school degree: The number of children in a family is likely to have a significant effect on their education. As the number of children increases, investments in each child decrease (Becker, 1981b). Having older siblings who have completed high school could also positively influence the educational achievement of younger siblings, as they may consider their older siblings as role models for academic success.

Age and gender: The average age of individuals in the sample is 23 years old. We controlled for gender as intergenerational education mobility differs by gender (Schneebaum

et al., 2016). Gender was coded as 1 for females and 0 for males.

The individual always attended the schools of his neighborhood: Parents choose whether to enroll their children in schools that are located in their own neighborhoods or not. This decision could be based on several factors, such as the school's performance, the distance between the school and their home, or the distance between their workplace and the school. According to a sample study, approximately 74.98% of individuals attended schools that were in their own neighborhoods.

The proportion of students who were immigrants at the college the respondent attended: In neighborhoods with a high concentration of ethnic groups and a large number of children attending neighborhood schools, the proportion of immigrant students in schools is likely to be high. According to the 2017 report from the French Evaluation, Foresight, and Performance Direction, a negative correlation between the proportion of immigrant students and school performance in these areas cannot be associated with the presence of immigrant students but rather with the social background of the students, whether they are immigrants or not. However, we assumed that the proportion of immigrant students at college may have a negative impact on education through various mechanisms. Panza (2020) found that ethnic segregation at school has negative effects on school performance through several channels. For instance, he identified language comprehension difficulties and class cohesion as factors that can affect students' performance. Language difficulties may arise from students of foreign origin, causing teachers to spend more time assisting them or to reduce the pace of schooling to the detriment of other students. Secondly, class cohesion may be negatively affected, which can also influence class performance.

Perceptions of differences of treatment during the academic orientations: After completion of middle school, students in France are required to choose their major study in high school. Students have the option to enroll in technical or vocational training programs (TVET), as well as general studies courses. However, studies have revealed that some students have been directed towards a different field of study than the one they had initially chosen. For instance, Brinbaum and Primon (2013) found that migrant students or children of migrants often reported being oriented towards vocational and technical education instead of general studies. Such decisions can have an adverse impact on their education and could even lead them to drop out of school.

Number of years parents have lived in France: The duration of migration of parents

is the variable being considered. We assume that the longer parents have been living in France, the more familiar they become with the French system and gain more experience. This experience can be shared with their children, which can lead to better job prospects and education. It is not surprising to find that parents from European countries have been living in France for a longer time compared to parents from other countries. This could be because of the distance between European countries and France, as well as the fact that European countries were the first to migrate to France.

Table 4.3: Descriptive statistics of parents

Variables	South Europe	Other European countries	Central Africa	North Africa	Other African Countries	Asia	Total (descendants of migrants)	Natives
Number of years parents have lived in France								
Father	48.10	51.85	35.50	44.97	36.97	35.59	45.13	
Mother	44.00	48.25	33.69	41.31	36.43	33.70	42.31	
Education(degree) (%)								
None	52.08	11.15	10.67	53.63	22.76	42.25	39.96	11.63
Primary	15.43	19.95	4.67	8.79	6.9	6.61	11.67	25.95
Middle school	23.34	31.62	12	21.32	20.69	19.15	22.75	29.54
High school	3.82	12.91	15	6.48	16.55	11.06	8.5	13.32
University	5.34	24.38	57.67	9.78	33.1	20.93	17.12	19.57
Socio-professional Category(%)								
Unskilled workers	21.45	17.65	10.29	31.88	19.14	24.49	23.94	14.44
Farmers	3.69	4.09	1.76	2.68	1.85	2.92	3.13	8.61
Artisans, traders and company managers	44.31	30.28	17.35	32.23	25.31	32.45	33.12	24.89
Employees and skilled workers	18.64	21.57	26.76	21.61	24.07	18.83	21.02	23.84
Intermediate occupations	8.85	15.17	20.29	7.44	11.73	11.32	10.67	16.84
Executives and higher intellectual professions	3.05	11.25	23.53	4.17	17.9	9.99	8.11	11.39

Table 4.4: Descriptive statistics of descendants of migrants and natives

Variables	South Europe	Other European countries	Central Africa	North Africa	Other African Countries	Asia	Total (descendants of migrants)	Natives
Age(mean)	34.52	34.32	27.24	30.58	27.28	25.62	30.91	37.63
Number of siblings including the respondent (mean)	3.05	3.05	4.04	5.3	3.6	3.96	4.17	3.32
Gender								
Male	49.74	48.82	48	44.45	58.86	49.62	47.88	47.02
Female	50.26	51.18	52	55.55	41.14	50.38	52.12	52.98
Education (degree) (%)								
None	11.79	9.53	9.09	15.84	8.67	12.85	12.67	8.65
Primary	1.14	1.72	0.53	0.84	1.16	0.60	1.04	2.80
Middle school	38.12	29.32	27.01	32.86	20.23	27.08	31.96	35.19
High school	20.98	23.58	29.14	25.08	36.99	28.88	25.31	21.15
University	27.98	35.84	34.22	25.38	32.95	30.59	29.02	35.22
Socio-professional Category (%)								
Unskilled workers	13.06	9.82	9.39	12.54	10.53	11.79	11.90	10.58
Farmers	0.75	0.76		0.42	0.58	0.46	0.52	2.78
Artisans, traders and company managers	11.91	8.69	7.46	10.25	8.19	10.88	10.42	10.33
Employees and skilled workers	33.93	29.00	17.13	31.20	19.88	20.93	29.63	30.28
Executives	10.61	17.75	10.77	8.87	10.53	11.88	11.43	16.68
Intermediate occupations	22.72	22.81	19.61	18.83	18.13	13.89	19.61	22.97
N (total)	**2113**	**1395**	**375**	**2639**	**175**	**1169**	**8614**	**3507**

4.3.2 Neighborhood variables

Composite index of Neighborhood

We combined different neighborhood variables at the neighborhood level to create a composite index using Multiple Correspondence Analysis (MCA). The list of variables used is described in table A4.1 and A4.2 and graphical representations are also presented in Figures A4.2; A4.1; A4.4; A4.8. We found two dimensions that explain almost 90% of the total inertia (Table 4.5).

France is divided into several administrative subdivisions, including regions, departments, districts, counties, and municipalities. The municipality is the smallest unit. The number of municipalities in Metropolitan France changes each year. Between 2008 and 2019, the number of municipalities decreased by 4.73%, from 36569 in 2008 to 34838 in 2019. Immigrants, regardless of their country of origin, tend to prefer municipalities with a population of over 10,000 people because larger municipalities offer more job opportunities than smaller ones.

Municipalities are categorized into IRIS (Ilots Regroupés pour l'Information Statistique) based on their population size, with a minimum of 5,000 residents. Iris can be

considered as a neighborhood in France. A law was enacted by the French government in 1966 to categorize urban areas into critical urban zones (CUAs) and non-critical urban zones. CUAs are neighborhoods that face difficulties due to poor-quality housing, high unemployment and poverty rates, and limited opportunities for young people to find jobs. Young families of foreign origin typically inhabit these areas. Almost 20% of immigrants and their descendants live in critical urban areas, compared to only 4% of French natives.

Urban areas with a high number of public housing units are facing different challenges. French public housing has a history dating back to the 18th and 19th centuries when it was initially referred to as "cheap housing." Private firms or individuals created it to provide housing for low-income agricultural and industrial workers. Later on, in the 1900s, the state played a significant role in providing this type of housing, which is generally located on the outskirts of the city and assigned to families based on their economic and demographic situations. According to Figure A4.1, the proportion of migrants in a neighborhood and the percentage of public housing available in the area are positively correlated. It also indicates that Migrants and their descendants tend to live in neighborhoods with a high concentration of public housing. For example, over 40% of migrants live in Iris, which has more than 24% of public housing (9th decile). However, in Iris, with 24% of public housing available, less than 20% of natives reside, in comparison to 37.45% of descendants of migrants. Migrants and their descendants are more likely to live in public housing than natives.

The concentration of migrants and their children in areas with a high concentration of public housing can result in ethnic segregation. Housing market segregation based on race or ethnicity can have an impact on the distribution of unemployment, as noted by Kain (1968). This can be attributed to several factors, including limited access to education, training, and employment opportunities, as well as discriminatory practices by employers. Figure A4.3 shows that the proportion of migrants and the unemployment rate in neighborhoods are positively correlated. The unemployment rate for the French population in 2008 was 7.4%. The youth and women unemployment rates are following a similar trend (Figure A4.4).

The percentage of migrants and descendants of migrants in neighborhoods and the proportion of immigrant families are correlated (Figure A4.2). We also found that immigrants tend to reside in poor neighborhoods (Iris), where the income per consumption

unit (IPCU) is less than 13,934 euros. In contrast, natives tend to live in non-poor Iris with an IPCU of over 24,000 euros (last decile). The IPCU is the ratio of the sum of a household's gross resources to the number of consumption units, which is determined by household size. The IPCU serves as an indicator of living standards at the regional or neighborhood level. In figure A4.5, the proportion of migrants and descendants of migrants in neighborhoods is negatively correlated with the level of income per consumption unit. For high levels of IPCU, the proportion is low. More than 20% and 15% of descendants of migrants from Africa and Asia, respectively, live in neighborhoods (iris) with lower fiscal income per consumption unit (first decile) in contrast to 5% of descendants of migrants from European countries.

The graph in Figure A4.8 shows the education levels in different neighborhoods. The distribution is right-skewed, indicating that descendants of European migrants are more likely to reside in highly educated neighborhoods. On the other hand, migrant children from regions such as Sahel Africa, North Africa, and Asia are present in both low and high-educated neighborhoods, indicating that they are not only concentrated in low-educated neighborhoods.

Table 4.5: Multiple/Joint correspondence analysis

principal Dimension	inertia	percent	cumulative
Dimension 1	0.15	61.11	61.11
Dimension 2	0.072	28.47	89.59
Total	0.25	100.00	
Number of observations	21 211		
Total inertia	0.25		

Individual-level neighborhood variables

In this section, we present individual-level variables, such as the duration of residence and the type of neighborhood or house of residence, that were included in the analysis.

Types of neighborhoods: they are characterized into 4 groups depending on the survey: 1.high-density housing complexes, 2.downtown neighborhoods, 3.houses in suburban or residential neighborhoods, and 4.other neighborhoods. High-density housing complexes are complexes of collective buildings consisting of several isolated buildings in the form of bars or towers. They were built between 1950 and 1973 and are, on average, occupied by a population from a working-class community. In some cities, regions, and depart-

ments (for example, Seine-Saint-Denis, Marseille), some high-density housing complexes are characterized by a high ethnic group concentration and low levels of employment. On the other hand, suburban or residential neighborhoods are characterized by individual housing with low levels of unemployment.

The individual has lived in the same house since he was 15 years: during their childhood and adolescence, individuals are greatly affected by the living conditions of their neighborhoods, which encompass cultural, economic, and social factors. These factors can significantly affect their intergenerational mobility. In addition, an individual's career path is often determined in adolescence, especially during middle and high school, when professional orientations begin to emerge. Hence, it can be assumed that depending on the neighborhood, an individual's professional orientation or type of employment will vary. For instance, individuals who grew up in rich neighborhoods are more likely to secure higher-paying jobs as compared to those who grew up in deprived neighborhoods where well-paid employment is scarce. One of the characteristics of migrant children is that they are less mobile in terms of changing housing in adulthood compared to natives. In our database, over 29% of migrant children (2470 people) had been living in the same residence since the age of 15, compared to only 11% (275 people) for natives. Moreover, at least half of the population in their neighborhood are migrants.

The individual has recently moved to the neighborhood (5 years or less): The survey also allows us to distinguish between people who have recently moved and those who have been living in the same residence for more than five years. We assume that people who have been living in the same residence for more than five years will also be more exposed to the neighborhood effects than others.

4.4 Model specification

We used the standard intergenerational mobility model (Becker and Tomes, 1979; Black, 2011) :

$$Y_i^c = \beta_0 + \beta_1 Y_i^p + \epsilon_i \tag{4.1}$$

It describes the relationship between the outcome variable Y_i^p of the parents and children Y_i^c. The two types of mobility considered are education and occupation. β represents the

coefficient of regression. The error term ϵ is supposed to be independent and identically distributed across individuals with a zero mean and covariance σ_ϵ.

Both education and occupation variables are ordered variables that measure respectively the level of degree achieved and the occupational category according to the French educational system and the National Institute for Statistics. We use an ordered probit model.

Let $E_i = e$ denote an individual's level of education (or an occupational category). The probability of obtaining a degree level (or a higher occupational category) higher than e conditional on the parent's level of education (occupational category) and individual characteristics X_i, is defined as:

$$P(E_i > e|X_i\beta) = \frac{exp(X_i\beta - \mu_e)}{1 + exp(X_i\beta - \mu_e)} \tag{4.2}$$

e=0,1,2...,4 for the categories of education e=0,1,2...,6 for occupational categories; With $\mu_0 = 0$

Other examples of measure of Intergenerational mobility: intergenerational mobility index

In addition to intergenerational coefficient, elasticity, or correlation, intergenerational mobility indexes have also been created by some authors (Shorrocks, 1978; Bartholomew, 1983) depending on the type of variables used (discrete or continuous). To measure intergenerational mobility using discrete variables (as in our case), we first need to create a transition matrix. In the sample population, which includes migrants, second-generation migrants, and natives, 75.29% of individuals have achieved a higher level of education than their parents. On the other hand, 17.73% of individuals have attained the same level of education as their parents, while 6.98% have a lower level of education than their parents. 81.04% of the individuals have a different socio-professional category from their fathers, while 18.86% share the same category.

Secondly, we computed Shorrocks (1978); Bartholomew (1983); Sommers and Conlisk (1979) mobility indices using the Stata command "igmobil" developed by Savegnago (2016). His command employs the transition matrix to determine the proportion of individuals moving from one category to another based on their parents' category. A higher

value of the index indicates greater intergenerational mobility which suggests that children have more equal opportunities than their parents to move up or down the education and socio-professional category. The results of our analysis are presented in Tables 4.6 and 4.7 without any control variables and show that the second generation of migrants has a higher intergenerational mobility index in education and occupation compared to natives.

Table 4.6: Intergenerational mobility in education using a transition matrix

Transition matrix indices	All	Second generation of migrants	Natives
Shorrocks (1978)	0.88***	0.90***	0.86***
	(0.004)	(0.005)	(0.011)
Bartholomew (1983)	0.3***	0.32***	0.28***
	(0.002)	(0.003)	(0.004)
Sommers and Conlisk (1979)	0.63***	0.703***	0.6***
	(0.008)	(0.012)	(0.017)
N	18400	7438	2956

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.7: Intergenerational mobility in occupation using a transition matrix

Transition matrix indices	All	Second generation of migrants	Natives
Shorrocks (1978)	0.91***	0.91***	0.87***
	(0.004)	(0.006)	(0.010)
Bartholomew (1983)	0.31***	0.313***	0.30***
	(0.002)	(0.005)	(0.004)
Sommers and Conlisk (1979)	0.73***	0.69***	0.66***
	(0.011)	(0.017)	(0.022)
N	16900	6396	2964

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the following section, we present the estimation results.

4.5 Estimation results

4.5.1 Education

The marginal effects of the ordered probit model, taking into account neighborhood variables, are presented in Tables 4.8 and 4.9. The results signify that parental characteristics play a crucial role in shaping the educational outcomes of both natives and second-generation migrants. The probability of obtaining a high school or university diploma is higher even if parents have the same or lower educational level than their children. Our analysis indicates that having at least one parent with a middle school degree significantly increases the chances of an individual obtaining a high school or university degree. Similarly, having a parent with a high school degree significantly increases the likelihood of obtaining a university degree, indicating higher intergenerational mobility. Furthermore, the effect of parental education on the probability of having a university degree is larger for natives than for second-generation migrants. The findings suggest that parental education is a critical factor in determining the educational success of individuals, and it has a more significant impact on the educational outcomes of natives. Overall, our results indicate that parental education has a significant impact on the probability of having a university degree, which highlights the importance of intergenerational mobility and the role of parental education in shaping educational opportunities for individuals.

A second key finding is that contextual variables have a significant impact on the educational attainment of second-generation migrants compared to natives. Among the contextual variables, the type of neighborhood and the proportion of immigrant students are particularly important. Living in a high-density housing complex is found to be a significant barrier to obtaining a high school or university degree, and this effect is not observed for natives. In France, high-density housing complexes are characterized by a high concentration of public housing, a large number of migrants, high unemployment rates, violence, and crime. These factors create an environment that is not conducive to academic success. We also found that the duration of residence, particularly living in the same house or neighborhood since the age of 15, significantly influences the educational level of both natives and descendants of migrants. People living in the same house since the age of 15 years represent 22.35% of the sample and are, on average, 24 years old (the

oldest are 60 years). Furthermore, we found that the neighborhood index (which measures the socio-economic status of the neighborhood) significantly and negatively affects the likelihood of obtaining a higher degree for both descendants of migrants and natives. This suggests that, regardless of ethnic composition, students who live in disadvantaged neighborhoods may face additional obstacles to success in college.

The presence of immigrants or students with a migration background in a college has a more significant impact on the descendants of migrants than on natives. In particular, attending a college where more than 50% of students are immigrants (or have a migration background) can significantly reduce the likelihood of obtaining a high school or university degree for descendants of migrants. This negative effect, however, is not statistically significant for natives. These findings support our hypothesis that the residential context is more critical for descendants of migrants than natives in terms of educational outcomes. We believe that this is due to the fact that descendants of migrants often face additional challenges, such as language barriers, cultural differences, and discrimination, which can make it harder for them to succeed in college, especially if they are surrounded by peers who face similar challenges.

We also found that perceptions of discrimination during academic orientations negatively influence the chances of obtaining a high school degree for descendants of migrants. Previous studies (Brinbaum and Primon, 2013; Pan, 2011; Préteceille, 2006) have shown that migrants or descendants of migrants were more likely to report differences in treatment during academic orientations that occur after middle school. Some students expressed their desire to pursue general education, but school counselors recommended vocational studies. The negative perceptions resulting from such experiences can lead to discouragement and lack of motivation, which can ultimately reduce the chances of obtaining a high school degree. The lack of access to academic opportunities can also lead to a sense of hopelessness, which can result in students dropping out of high school. This can further exacerbate the achievement gap between students of migrant backgrounds and those from non-migrant backgrounds.

The study found that the number of siblings has a significant impact on the educational outcomes of both native individuals and descendants of migrants. Specifically, the research shows that having more siblings is associated with lower chances of obtaining higher degrees, such as a bachelor's or master's degree. This phenomenon can be attributed to

the "quantity-quality tradeoff" theory proposed by Becker (1965), which suggests that as the number of children in a family increases, the investment per child decreases. However, the study also found that having more siblings with a high school or university degree has a positive impact on one's own chances of obtaining a higher degree, while also decreasing the likelihood of obtaining lower levels of education. This finding implies that having educated siblings can offer valuable support and motivation for one's own academic pursuits. Interestingly, the effects of sibling number on educational outcomes are more significant for descendants of migrants than for native individuals. This may be due to cultural differences in family size or educational expectations.

The impact of the father's employment status at the age of 15 differs between native individuals and descendants of migrants. The findings reveal that having a father who has never worked significantly decreases the likelihood of obtaining higher education for descendants of migrants. This could be attributed to a lack of financial resources and social capital, which are crucial for supporting a child's education. In contrast, for native individuals, having retired parents increases the chances of acquiring higher degrees than those with working parents. Retired parents may have more time to supervise and assist their children, and they may have accumulated financial resources during their working years to support their children's education.

Finally, gender differences exist among descendants of migrants. Females have a higher probability of obtaining a high school or university degree than males. This is not the case for natives, where we find no gender differences.

Table 4.8: Estimation results for education (second generation of migrants)

Variables	None	Primary	Middle school	High School	University
Parent's highest level of education					
Primary	-0.060***	-0.003***	-0.041***	0.023***	0.081***
	(0.017)	(0.0013)	(0.014)	(0.0062)	(0.026)
Middle school	-0.076***	-0.004***	-0.0574***	0.028***	0.11***
	(0.014)	(0.0014)	(0.015)	(0.005)	(0.025)

Continued on next page

Table 4.8 – *Continued from previous page*

Variables	None	Primary	Middle school	High School	University
High school	-0.099***	-0.006***	-0.0905***	0.033***	0.164***
	(0.02)	(0.002)	(0.03)	(0.005)	(0.047)
University	-0.100***	-0.006***	-0.091***	0.033***	0.165***
	(0.017)	(0.002)	(0.025)	(0.005)	(0.039)
Age	0.002**	0.0001*	0.001**	-0.0007**	-0.003**
	(0.001)	(0.0001)	(0.0006)	(0.0003)	(0.0013)
Gender (ref.male)	-0.050***	-0.003***	-0.031***	0.017***	0.067***
	(0.012)	(0.0009)	(0.007)	(0.004)	(0.016)
Number of siblings (on the mother's side)	0.012***	0.0006***	0.007***	-0.004***	-0.016***
	(0.002)	(0.0002)	(0.001)	(0.0008)	(0.003)
Number of siblings with at least a baccalaureate or higher degree	-0.054***	-0.003***	-0.033***	0.018***	0.072***
	(0.005)	(0.0007)	(0.003)	(0.002)	(0.006)
Number of years that parents have been living in France	0.0007	0.0000	0.0004	-0.0002	-0.0009
	(0.0006)	(0.0000)	(0.0004)	(0.0002)	(0.0009)
Type of neighborhood (ref. high-density housing complex)					
Downtown neighborhoods	-0.049***	-0.003**	-0.029***	0.017***	0.063***
	(0.017)	(0.001)	(0.01)	(0.006)	(0.022)
Residential neighborhood	-0.037**	-0.002*	-0.02**	0.013*	0.045**
	(0.019)	(0.001)	(0.01)	(0.007)	(0.022)
Other neighborhoods	-0.026	-0.0016	-0.013	0.009	0.031
	(0.022)	(0.001)	(0.012)	(0.008)	(0.027)

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Table 4.8 – *Continued from previous page*

Variables	None	Primary	Middle school	High School	University
Attended schools located in his neighbrohoo(ref.yes)	-0.023	-0.001	-0.014	0.008	0.031
	(0.016)	(0.0009)	(0.01)	(0.005)	(0.021)
Proportion of students in college with a migration background (ref. at least half of students)					
Less than half of students	-0.023*	-0.001*	-0.014*	0.008*	0.03*
	(0.012)	(0.0007)	(0.007)	(0.004)	(0.016)
The person has been living in the same house since he was 15 years old.	0.065***	0.003***	0.040***	-0.022***	-0.087***
	(0.021)	(0.001)	(0.013)	(0.007)	(0.028)
Index	0.0944***	0.005***	0.058***	-0.031***	-0.126***
	(0.024)	(0.002)	(0.015)	(0.008)	(0.033)
Employment status of the individual who raised the respondent at the age of 15(ref. active)					
Unemployed	0.004	0.0002	0.003	-0.0014	-0.006
	(0.042)	(0.002)	(0.025)	(0.014)	(0.055)
Retired	0.05	0.002	0.023*	-0.018	-0.057
	(0.040)	(0.002)	(0.013)	(0.015)	(0.04)
Inactive(has ever worked)	0.024	0.001	0.013	-0.008	-0.03
	(0.029)	(0.0014)	(0.014)	(0.010)	(0.034)
Inactive(never worked)	0.854***	-0.012***	-0.39***	-0.197***	-0.255***
	(0.009)	(0.003)	(0.012)	(0.010)	(0.010)

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Table 4.8 – *Continued from previous page*

Variables	None	Primary	Middle school	High School	University
Perceptions of differences of treatment during the academic orientations (ref. has been treated well)					
Has been equally treated	0.065	0.004	0.065	-0.016***	-0.118
	(0.04)	(0.003)	(0.058)	(0.004)	(0.097)
Has been treated less well	0.084**	0.005	0.075	-0.022***	-0.142
	(0.043)	(0.003)	(0.059)	(0.007)	(0.099)
Investment made in education	0.072***	0.004***	0.045***	-0.024***	-0.097***
	(0.021)	(0.001)	(0.013)	(0.007)	(0.027)
Observations	1514	1514	1514	1514	1514
LR chi2	434.21	434.21	434.21	434.21	434.21
dof	23	23	23	23	23
Pseudo-Rsquared	0.10	0.1043	0.10	0.1043	0.10

Standard errors in parentheses

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

Table 4.9: Estimation results for education (natives)

Variables	None	Primary	Middle school	High School	University
Parents highest level of education					
Primary	-0.075***	-0.018***	-0.051***	0.038***	0.107***
	(0.025)	(0.007)	(0.014)	(0.014)	(0.030)
Middle school	-0.0840***	-0.021***	-0.063***	0.042***	0.126***
	(0.027)	(0.007)	(0.019)	(0.014)	(0.036)
High school	-0.103***	-0.027***	-0.094***	0.048***	0.176***

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Table 4.9 – *Continued from previous page*

Variables	None	Primary	Middle school	High School	University
	(0.030)	(0.009)	(0.036)	(0.015)	(0.058)
University	-0.116***	-0.032***	-0.126***	0.051***	0.224***
	(0.028)	(0.009)	(0.035)	(0.014)	(0.054)
Age	0.0001	0.0000	0.0001	-0.0000	-0.0001
	(0.0007)	(0.0002)	(0.0007)	(0.0002)	(0.0013)
Gender(ref.male)	-0.011	-0.003	-0.012	0.004	0.022
	(0.012)	(0.003)	(0.013)	(0.004)	(0.024)
Number of siblings (on the mother's side)	0.019***	0.005***	0.021***	-0.007***	-0.038***
	(0.003)	(0.001)	(0.004)	(0.0014)	(0.0065)
Number of siblings with at least a baccalaureate or higher degree	-0.032***	-0.008***	-0.035***	0.011***	0.064***
	(0.006)	(0.002)	(0.006)	(0.002)	(0.010)
Type of neighborhoods(ref.high-density housing complex)					
Downtown neighborhoods	-0.024	-0.006	-0.025	0.008	0.046
	(0.028)	(0.007)	(0.028)	(0.011)	(0.052)
Residential neighborhoods	-0.017	-0.004	-0.017	0.006	0.031
	(0.027)	(0.007)	(0.024)	(0.01)	(0.047)
Other neighborhoods	-0.004	-0.0009	-0.003	0.001	0.006
	(0.029)	(0.007)	(0.026)	(0.011)	(0.051)
Attended schools located in his neighborhood (ref.yes)	-0.006	-0.001	-0.006	0.002	0.011

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Table 4.9 – *Continued from previous page*

Variables	None	Primary	Middle school	High School	University
	(0.016)	(0.004)	(0.017)	(0.006)	(0.031)
Employment status of the individual who raised the respondent at the age of 15(ref.active)					
Unemployed	0.016	0.004	0.015	-0.006	-0.028
	(0.058)	(0.014)	(0.049)	(0.024)	(0.097)
Retired	-0.069***	-0.022***	-0.14***	0.002	0.229***
	(0.016)	(0.007)	(0.053)	(0.012)	(0.084)
Inactive(has ever worked)	0.041	0.009	0.032	-0.016	-0.065
	(0.051)	(0.011)	(0.029)	(0.022)	(0.069)
Perceptions of differences of treatment during the academic orientations(ref.has been treated well)					
Has been equally treated (no differences)	0.077***	0.026***	0.181*	0.012	-0.296*
	(0.020)	(0.01)	(0.094)	(0.034)	(0.153)
Has been less treated	0.118***	0.036***	0.215**	-0.005	-0.364**
	(0.039)	(0.013)	(0.096)	(0.037)	(0.16)
Investment made in education	0.038**	0.009*	0.040**	-0.013*	-0.074**
	(0.018)	(0.005)	(0.019)	(0.007)	(0.036)
Proportion of students in college with a migration background (ref. at least half of students)					

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Table 4.9 – *Continued from previous page*

Variables	None	Primary	Middle school	High School	University
Less than half of students	-0.024	-0.006	-0.022	0.009	0.042
	(0.023)	(0.005)	(0.018)	(0.009)	(0.037)
The person has been living in the same house since they were 15 years old.	0.04**	0.010*	0.042**	-0.014**	-0.078**
	(0.019)	(0.005)	(0.021)	(0.007)	(0.038)
Index	0.077**	0.02**	0.083**	-0.027**	-0.152**
	(0.032)	(0.009)	(0.034)	(0.012)	(0.063)
Observations	704	704	704	704	704
LR chi2	215.20	215.20	215.20	215.20	215.20
dof	21	21	21	21	21

4.5.2 Occupation

The marginal effects of socio-professional categories have been analyzed and presented in tables 4.10 and 4.11. The findings suggest that parental characteristics continue to have a significant impact on the occupational status of both descendants of migrants and natives. Interestingly, the results show that only the socio-professional category of the father has a significant influence, whereas the mother's category is not statistically significant. Furthermore, the study reveals that a higher socio-professional category of the father is positively associated with a higher occupational status for both descendants of migrants and natives. Specifically, the chances of reaching higher socio-professional categories such as intermediate occupations and executive positions are higher for those whose fathers are employed and skilled workers. In contrast, having a father who is a farmer increases the likelihood of being a farmer or occupying an artisan/trader or unskilled/skilled occupation. These findings suggest that there is a significant relationship between parental occupation and the occupational status of descendants of migrants and natives.

Individuals who have attained higher levels of education are more likely to have better occupational status. This means that obtaining at least a high school degree increases the likelihood of occupying a skilled job or an executive position. We found previously, that women who are descendants of migrants are more likely to hold higher degrees than men. However, despite holding higher degrees, women are less likely than men to hold higher positions in their jobs. This gender disparity is particularly problematic, especially considering the overall improvements in gender equality in recent years. According to the French National Statistical Institute's 2019 data on French public servants, women occupy only 38.6% of management positions in the territorial civil service, which is a significant gap compared to men. In addition, women in these positions receive a salary that is 6.8% lower than that of men in the same positions.

The findings of a study suggest that the type of neighborhood where children grow up does not have a significant effect on their socio-professional category. The result is not surprising since the type of residence or neighborhood is likely to be influenced by income and occupation. However, the study found that the duration of residence in the same house where the respondent was an adolescent has a significant impact on the type of occupation, but only for natives. The study also found that those who have lived in the same house since the age of 15 are less likely to reach higher positions such as intermediate or executive positions. People often relocate to access better job opportunities, and those with better job opportunities move to new homes and neighborhoods due to increased income. Living in the same house and neighborhood for years may limit job opportunities and career advancement, especially in highly competitive industries. Therefore, it may be beneficial to consider moving to a new location to access better job opportunities and improve career prospects.

The number of children or the marital status of migrants' descendants does not significantly impact their occupational status. On the opposite, natives' chances of occupying higher positions are significantly reduced by the number of siblings they have. This means that for migrants' offspring, factors like family size or marital status do not play a significant role in determining their occupational status. However, for natives, these factors can have a considerable impact on their career advancement.

Table 4.10: Estimation results for socio-professional categories (second generation of migrants)

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
Socio-professional category of the father (ref. Unskilled workers)						
Farmers	0.075**	0.003**	0.029***	0.011***	-0.052***	-0.066***
	(0.03)	(0.001)	(0.009)	(0.003)	(0.02)	(0.020)
Artisans	-0.0007	-0.000029	-0.0003	-0.0003	0.0005	0.00087
	(0.009)	(0.0004)	(0.005)	(0.004)	(0.007)	(0.011)
Employed and skilled workers	-0.022**	-0.00098**	-0.012**	-0.011**	0.015**	0.030**
	(0.009)	(0.0005)	(0.005)	(0.005)	(0.007)	(0.013)
Intermediate occupations	-0.0332***	-0.0015**	-0.019***	-0.019***	0.023***	0.049***
	(0.011)	(0.0006)	(0.007)	(0.007)	(0.008)	(0.018)
Executives	-0.049***	-0.00238***	-0.03***	-0.034***	0.033***	0.083***
	(0.012)	(0.0008)	(0.008)	(0.011)	(0.008)	(0.023)
Socio professional category of mother(ref. Unskilled workers)						
	0.0042	0.00018	0.002	0.002	-0.003	-0.0061
	(0.022)	(0.001)	(0.012)	(0.0109)	(0.014)	(0.032)
Farmers	0.006	0.00026	0.003	0.0029	-0.0037	-0.008
	(0.012)	(0.0005)	(0.006)	(0.0060)	(0.0075)	(0.017)
Artisans	0.013	0.000545	0.007	0.0059	-0.0079	-0.018
	(0.009)	(0.0004)	(0.005)	(0.005)	(0.006)	(0.014)
Employed and skilled workers	0.0045	0.0002	0.002	0.002	-0.003	-0.007
	(0.014)	(0.0006)	(0.007)	(0.007)	(0.009)	(0.020)
Intermediate occupations	-0.0009	-0.00004	-0.0005	-0.0005	0.0005	0.001

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Table 4.10 – *Continued from previous page*

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
	(0.020)	(0.0009)	(0.011)	(0.011)	(0.013)	(0.031)
Level of education(ref.none)						
Primary	0.002	0.00005	0.0004	-0.0008	-0.0012	-0.0003
	(0.073)	(0.002)	(0.0144)	(0.0311)	(0.045)	(0.013)
Middle school education	-0.059**	-0.0018**	-0.016***	0.021**	0.041***	0.014***
	(0.023)	(0.0008)	(0.005)	(0.009)	(0.015)	(0.005)
High school	-0.162***	-0.0063***	-0.066***	0.020**	0.144***	0.070***
	(0.023)	(0.002)	(0.008)	(0.010)	(0.017)	(0.008)
University	-0.245***	-0.012***	-0.157***	-0.151***	0.24***	0.327***
	(0.023)	(0.003)	(0.009)	(0.013)	(0.016)	(0.013)
Parent's highest level of education (ref. none)						
Primary	-0.003	-0.00015	-0.0018	-0.0015	0.00229	0.0046
	(0.009)	(0.0004)	(0.005)	(0.004)	(0.006)	(0.013)
Middle school	-0.0014	-0.00006	-0.0007	-0.0006	0.0009	0.0018
	(0.008)	(0.0004)	(0.004)	(0.004)	(0.006)	(0.012)
High school	-0.0024	-0.0001	-0.0012	-0.001	0.0016	0.0032
	(0.013)	(0.0005)	(0.006)	(0.006)	(0.008)	(0.017)
University	-0.023*	-0.001*	-0.012*	-0.012*	0.015*	0.034*
	(0.012)	(0.0006)	(0.007)	(0.007)	(0.008)	(0.018)
Age	-0.004***	-0.0002***	-0.003***	-0.002***	0.003***	0.006***
	(0.0005)	(0.0000)	(0.0003)	(0.0003)	(0.0004)	(0.0007)
Gender(ref.male)	0.065***	0.0028***	0.0333***	0.0286***	-0.041***	-0.089***
	(0.007)	(0.0007)	(0.004)	(0.003)	(0.004)	(0.009)
Number of children	0.005	0.0002	0.003	0.002	-0.003	-0.007
	(0.004)	(0.0002)	(0.002)	(0.002)	(0.003)	(0.006)
Matrimonial status (ref. single)						

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Table 4.10 – *Continued from previous page*

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
Married	-0.010	-0.0004	-0.005	-0.004	0.006	0.014
	(0.007)	(0.0003)	(0.004)	(0.003)	(0.005)	(0.010)
Widowed	0.008	0.0003	0.004	0.003	-0.005	-0.011
	(0.048)	(0.002)	(0.022)	(0.016)	(0.031)	(0.057)
Divorced	-0.010	-0.000430	-0.005	-0.004	0.006	0.014
	(0.014)	(0.0006)	(0.007)	(0.007)	(0.009)	(0.02)
Number of unit of consumptions in the household	-0.004	-0.0002	-0.002	-0.002	0.003	0.006
	(0.008)	(0.0004)	(0.004)	(0.004)	(0.005)	(0.0116)
Has recently moved to the neighborhood (5 years or less)	-0.008	-0.0004	-0.004	-0.004	0.005	0.012
	(0.007)	(0.0003)	(0.004)	(0.003)	(0.005)	(0.010)
Type of neighborhood (ref.high-density housing complex)						
Downtown neighborhood	-0.0004	-0.005	-0.004	0.006	0.013	
	(0.01)	(0.0004)	(0.005)	(0.004)	(0.006)	(0.014)
Residential neighborhoods	0.0002	0.00001	0.00013	0.000107	-0.0002	-0.00034
	(0.011)	(0.0004)	(0.005)	(0.004)	(0.007)	(0.014)
Other neighborhoods	0.004	0.00018	0.002	0.0017	-0.003	-0.005
	(0.012)	(0.0005)	(0.006)	(0.005)	(0.008)	(0.016)
The respondent has resided in the same house since he was 15 years old	0.008	0.0003	0.004	0.003	-0.005	-0.011
	(0.015)	(0.0007)	(0.008)	(0.007)	(0.009)	(0.021)
Index	0.038**	0.0017**	0.019**	0.017**	-0.024**	-0.051**
	(0.015)	(0.0007)	(0.007)	(0.007)	(0.009)	(0.02)

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Table 4.10 – *Continued from previous page*

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
Observations	2793	2793	2793	2793	2793	2793
LR chi2	434.21	434.21	434.21	434.21	434.21	434.21
Pseudo R-squared	0.15	0.15	0.15	0.15	0.15	0.15
Prob > chi2	0.00	0.00	0.00	0.00	0.00	0.00
dof	31	31	31	31	31	31

Standard errors in parentheses

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

Table 4.11: Estimation results for socio-professional categories (natives)

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
Socio-professional category of the father (ref. Unskilled workers)						
Farmers	0.0408*	0.00739*	0.0153*	0.00733**	-0.0275*	-0.0434*
	(0.0244)	(0.0042)	(0.0085)	(0.0037)	(0.0164)	(0.0236)
Artisans	-0.0108	-0.00226	-0.00507	-0.00408	0.00734	0.0149
	(0.0125)	(0.0026)	(0.0058)	(0.0046)	(0.0085)	(0.0168)
Employed and skilled workers	-0.00221	-0.000451	-0.000996	-0.000744	0.00150	0.00290
	(0.0127)	(0.0026)	(0.0057)	(0.0043)	(0.0087)	(0.0166)
Intermediate occupations	-0.0350***	-0.00786***	-0.0184***	-0.0181***	0.0232***	0.0562***
	(0.0128)	(0.0030)	(0.0068)	(0.0069)	(0.0089)	(0.0200)
Executives	-0.0370**	-0.00837**	-0.0196**	-0.0197**	0.0245**	0.0602**
	(0.0147)	(0.0035)	(0.0083)	(0.0091)	(0.0101)	(0.0251)

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Table 4.11 – *Continued from previous page*

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
Socio-professional category of the mother (ref. Unskilled workers)						
Farmers	0.0111	0.00215	0.00464	0.00316	-0.00707	-0.0140
	(0.0230)	(0.0044)	(0.0095)	(0.0062)	(0.0147)	(0.0284)
Artisans	-0.0137	-0.00283	-0.00635	-0.00535	0.00858	0.0196
	(0.0154)	(0.0032)	(0.0071)	(0.0060)	(0.0097)	(0.0219)
Employed and skilled workers	-0.00489	-0.000988	-0.00218	-0.00171	0.00309	0.00668
	(0.0130)	(0.0026)	(0.0057)	(0.0044)	(0.0082)	(0.0174)
Intermediate occupations	-0.0152	-0.00316	-0.00710	-0.00605	0.00952	0.0219
	(0.0161)	(0.0034)	(0.0076)	(0.0065)	(0.0103)	(0.0232)
Executives	-0.0304	-0.00664	-0.0153	-0.0147	0.0187	0.0483
	(0.0207)	(0.0048)	(0.0112)	(0.0122)	(0.0128)	(0.0358)
Level of education						
Primary	0.0304	0.00280	0.00229	-0.0142	-0.0162	-0.00522
	(0.0569)	(0.0050)	(0.0038)	(0.0269)	(0.0294)	(0.0093)
Middle school	-0.0980***	-0.0132***	-0.0191***	0.0345**	0.0669***	0.0289***
	(0.0308)	(0.0038)	(0.0044)	(0.0135)	(0.0183)	(0.0072)
High school	-0.179***	-0.0305***	-0.0553***	0.0312**	0.146***	0.0877***
	(0.0312)	(0.0053)	(0.0072)	(0.0140)	(0.0200)	(0.0119)
University	-0.259***	-0.0582***	-0.137***	-0.118***	0.220***	0.352***
	(0.0307)	(0.0075)	(0.0098)	(0.0164)	(0.0195)	(0.0164)
Parent's highest level of education						
Primary	-0.00333	-0.000640	-0.00138	-0.000961	0.00209	0.00422
	(0.0143)	(0.0027)	(0.0059)	(0.0040)	(0.0090)	(0.0179)
Middle school	-0.0240*	-0.00490*	-0.0109*	-0.00913*	0.0149	0.0341*
	(0.0145)	(0.0029)	(0.0063)	(0.0049)	(0.0093)	(0.0192)

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Table 4.11 – *Continued from previous page*

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
High school	0.00351	0.000663	0.00142	0.000924	-0.00221	-0.00431
	(0.0180)	(0.0034)	(0.0073)	(0.0048)	(0.0113)	(0.0221)
University	-0.0265	-0.00546	-0.0122	-0.0104	0.0164	0.0382
	(0.0179)	(0.0038)	(0.0084)	(0.0073)	(0.0116)	(0.0256)
Age	-0.00532***	-0.00108***	-0.00239***	-0.00194***	0.00321***	0.00752***
	(0.0005)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0007)
Gender(ref.male)	0.0556***	0.0113***	0.0250***	0.0203***	-0.0336***	-0.0786***
	(0.0074)	(0.0019)	(0.0035)	(0.0031)	(0.0046)	(0.0100)
Number of children	0.00951**	0.00193*	0.00427**	0.00347*	-0.00574**	-0.0134**
	(0.0048)	(0.0010)	(0.0022)	(0.0018)	(0.0029)	(0.0068)
Matrimonial status (ref.single)						
Married	-0.0215**	-0.00444**	-0.00985**	-0.00799**	0.0131**	0.0306**
	(0.0098)	(0.0021)	(0.0045)	(0.0036)	(0.0060)	(0.0138)
Widowed	0.00781	0.00148	0.00313	0.00194	-0.00481	-0.00955
	(0.0430)	(0.0080)	(0.0167)	(0.0096)	(0.0265)	(0.0508)
Divorced	0.00533	0.00102	0.00216	0.00137	-0.00328	-0.00659
	(0.0175)	(0.0033)	(0.0070)	(0.0043)	(0.0108)	(0.0213)
Number of unit of consumption in the household	-0.00527	-0.00107	-0.00237	-0.00192	0.00318	0.00744
	(0.0090)	(0.0018)	(0.0041)	(0.0033)	(0.0055)	(0.0127)
Has recently moved to the neighborhood (5 years or less)	-0.00849	-0.00172	-0.00382	-0.00310	0.00513	0.0120
	(0.0084)	(0.0017)	(0.0038)	(0.0031)	(0.0051)	(0.0118)
Type of neighborhood (ref.high-density housing complex)						

Continued on next page

Table 4.11 – *Continued from previous page*

Variables	Unskilled	Farmers	Artisans	Skilled	Intermediate	Executives
Downtown neighborhoods	-0.0122	-0.00277	-0.00648	-0.00663	0.00747	0.0206
	(0.0152)	(0.0034)	(0.0078)	(0.0076)	(0.0094)	(0.0245)
Residential neighborhoods	0.00646	0.00138	0.00314	0.00281	-0.00405	-0.00975
	(0.0153)	(0.0033)	(0.0076)	(0.0070)	(0.0095)	(0.0237)
Other neighborhoods	0.0359**	0.00706**	0.0154*	0.0110	-0.0227**	-0.0466*
	(0.0169)	(0.0036)	(0.0079)	(0.0069)	(0.0106)	(0.0244)
The respondent has resided in the same house since he/she was 15 years old)	0.0360***	0.00731**	0.0162**	0.0132**	-0.0218***	-0.0509***
	(0.0138)	(0.0029)	(0.0063)	(0.0053)	(0.0084)	(0.0196)
Index	0.0280	0.00569	0.0126	0.0102	-0.0169	-0.0396
	(0.0186)	(0.0038)	(0.0084)	(0.0068)	(0.0112)	(0.0262)
Observations	2046	2046	2046	2046	2046	2046
LR Chi-squared	1023.52	1023.52	1023.52	1023.52	1023.52	1023.52
Pseudo Rsquared	0.1547	0.1547	0.1547	0.1547	0.1547	0.1547
dof	23	23	23	23	23	23

4.6 Conclusion

Our study aimed to explore the complex relationship between parents and children's education and occupation, with a specific focus on the effect of the residential area on the intergenerational mobility of migrants and their descendants in France. We analyzed data from 2008 and compared the educational outcomes of descendants of migrants with those of native children. Previous studies have shown that the educational gap between migrants and natives decreases over time. The most common factors identified in the literature are income, investments in education, age at the first entry at school, and the number of siblings (Beck, 1983; Goldberger, 1989; Bauer and Riphahn, 2006). However, we investigated whether the environmental context, such as the type of neighborhood and the proportion of immigrant students, could also play a significant role in this relationship. Our research found that the residential environment mattered more for second-generation migrants than for natives. We found that the type of neighborhood and the proportion of immigrant students significantly influenced the level of education of descendants of migrants compared to natives. Although studies on the effect of the neighborhood on people's well-being have led to mixed results, our analysis suggests that the residential environment plays a crucial role in explaining the relationship between parent's and children's education. In conclusion, our study provides valuable insights into the factors that shape the intergenerational mobility of migrants and their descendants in France. By identifying the importance of the residential environment, our research highlights the need for policies that address the underlying structural inequalities that affect the educational outcomes of migrants and their children.

General Conclusion

The shifting demographic trends across the world, in particular in Africa, characterized by the increase in population growth and aging, are expected to have serious implications on the labor market in the next years. With the rise in the number of people in certain age groups, in particular, in the working-age groups, there has been an increased demand for education, jobs, healthcare, social services, and other related fields.

Policies can be implemented to absorb the surplus of labor supply. However, the effectiveness, the costs, and the timely execution are sometimes questionable. A demographic transition that leads to a significant decrease in the fertility rate is a solution promoted by demographers and economists to alleviate the pressure on the job market and improve employment opportunities for those who are already seeking work. The decrease in fertility and mortality rates can result in a lower number of new people entering the labor market over time.

There are different approaches to analyzing the relationship between population and the labor market. Among these, we have examined two approaches, in particular- the endogenous feedback effect and the child-quality effect (Becker, 1965, 1973). The endogenous feedback effect refers to the impact of population growth on labor market outcomes, while the child-quality effect focuses on the influence of human capital on labor market outcomes. Our thesis aims to analyze the effects of women's empowerment (or their participation in the labor market), family planning, girls' education, and political leadership on the labor market and its outcomes. By promoting these factors, we could potentially witness a shift towards lower fertility rates, which in turn can affect both individual behavior and government policies. For instance, family planning policies can encourage couples to have fewer children, which can lead to a smaller labor force in the long run. Similarly, investing in girls' education and women's empowerment can lead to increased labor force participation and better job opportunities for women, which can have positive

effects on the overall labor market. Demographic trends are influenced by both personal choices and state-level interventions. Therefore, it is important to consider both when examining the impact of population on the labor market. By doing so, we can gain a better understanding of how to create policies and interventions that promote sustainable economic growth and development.

Historically, the analysis of fertility has focused primarily on women as they are the ones who carry pregnancies. When examining the relationship between the fertility rate and the labor market, particularly in Africa, it is important to analyze the short and long-term dynamics between these variables to gain a more comprehensive understanding of their relationship. For instance, short-term interactions may include the impact of unemployment rates on birth rates or how access to maternity leave and other family policies affect women's decisions to have children. On the other hand, long-term dynamics may include the effects of education, healthcare, and economic development on fertility rates over time. In the first chapter of the thesis, we analyzed the relationship between these two variables over time. The analysis is based on a time series dataset covering a significant period, allowing us to identify trends and patterns in the data. We also account for the possibility of structural breaks occurring in the relationship between the two variables. These structural breaks may arise due to various factors, such as changes in demographic trends, due to the implementation of population-related policies aimed at reducing or controlling fertility rates, or reform initiatives aimed at promoting women's participation in the labor market. To identify the structural breaks, we employed econometric techniques that allowed us to detect changes in the slope or intercept of the relationship between the two variables. We found interesting results. Our findings revealed a bi-directional causality between the fertility rate and women's participation in the labor market. In other words, an increase in women's employment opportunities led to a decrease in the fertility rate, and vice versa. Additionally, we observed that each variable negatively responds to changes in the other in the short term. This means that when there was a temporary increase in the fertility rate, there was a corresponding decrease in women's participation in the labor market, and vice versa. Furthermore, our research illustrated a long-term relationship between these variables in Kenya, Ghana, and Rwanda.

The long-term dynamics may include the effect of education on the fertility rate over time. The reproduction age starts in adolescence, and many girls are often still pursuing

their education. It is a crucial phase in their lives when they make important decisions regarding their future. If they become pregnant during this phase, it could have a significant impact on their education and, subsequently, their ability to achieve their career goals. In the second chapter of the thesis, we showed that girls who prioritize finishing their studies before having children are more likely to take precautions to avoid pregnancy. These preventive measures include the use of contraceptives and other forms of birth control. Girls who have a clear goal of completing their education are more likely to use contraceptives and other preventive measures to avoid pregnancy. This not only helps them delay childbearing but also enables them to focus on their education and achieve their career aspirations. By postponing motherhood, women can devote more time and energy to their studies, acquire the necessary qualifications, and establish themselves in their chosen professions. This not only benefits the individual but also has a positive impact on the labor market, as it increases the number of skilled and experienced workers. Overall, the decision to delay childbearing is a personal choice that can have long-term effects on a woman's life and society as a whole.

By examining the fertility patterns of both mothers and daughters in Africa, we also have valuable insights into the trends that are occurring over generations. It provides a comprehensive understanding of how fertility rates are changing over time and helps to identify factors that may be contributing to these changes. By comparing the fertility rates of mothers and daughters, we identified patterns or correlations that also exist between the two generations in Chapter 3. We found that these variables are positively and significantly correlated. However, the coefficients of regression are moderate, which may imply a high level of intergenerational fertility mobility. In other terms, children are more likely to have a different number of children than their parents. The results may be explained by changes in societal norms (in terms of childrearing), income, education, access to family planning, and other demographic shifts.

In the final chapter of the thesis, we analyzed how the population dynamics, in particular immigration, affect socio-economic inequality between migrants and native people. Specifically, we focused on the effect of the neighborhood on intergenerational mobility trends. We aimed to gain a better understanding of how socioeconomic status differs between various generations by examining the effects of the environment in which individuals grow up and live. By exploring this topic, we hope to uncover insights that could lead to

solutions for reducing inequality and promoting greater social mobility. We focused on France, a developed country with a long history of movements of population from different regions of the world (Africa, Asia, Europe). Our research has revealed that there are differences in the residential areas of descendants of migrants and natives. On average, the descendants of migrants tend to live in neighborhoods that are relatively disadvantaged, with high unemployment rates, a high proportion of migrants (which can result in ethnic segregation), and densely populated housing complexes. These living conditions are similar to those of their parents, indicating a trend of intergenerational transmission of disadvantage. Furthermore, we found that these factors have a more significant impact on the level of education and occupation of descendants of migrants than on natives. For example, the high unemployment rate in these areas often leads to a lack of opportunities for social and economic mobility, which can exacerbate existing inequalities. Similarly, the high concentration of migrants can create barriers to integration into mainstream society, perpetuating the cycle of marginalization.

Policy recommendations

Our research has shown that there are crucial implications for policymakers in African countries. Given the young age structure of the population, it is essential to provide support and guidance to young people. We recommend training and education in schools to prepare them with the necessary skills and knowledge to make informed decisions that are beneficial for their future, their families, and their country. This training should be adapted to the specific needs of the communities in their countries. Such training could include access to education, healthcare, and other critical resources that can help women achieve their goals and lead fulfilling lives.

It is also crucial to raise awareness about the importance of continuing education and to take measures to prevent any obstacles that could hinder the progress of young people, such as early pregnancies. Early pregnancies can have detrimental effects on the health and well-being of young women, along with their ability to pursue higher education and professional development. It will enable them to achieve their full potential and make positive contributions to society. Delaying pregnancies will also give women the freedom to explore various career options and have control over their lives. In the long term, such a

decision may significantly alter the age structure of the population. This, in turn, can have a profound impact on the way that governments formulate policies and allocate resources. It can be particularly beneficial for governments that are struggling to address the needs of specific age groups, such as young adults seeking employment. Moreover, delaying pregnancies can also help improve the quality of education. When parents have children at a later age, they often have more financial stability and are better able to provide for their children's educational needs. This can result in a more well-educated and skilled workforce, which can contribute to long-term economic growth and development. Overall, delaying pregnancies can help lay a solid foundation for future generations.

Our research findings can also be used to develop effective policies and interventions that address the underlying factors responsible for changes in fertility rates over time. Such policies and interventions can promote family planning, improve access to healthcare, and encourage education and employment opportunities for women, among other measures.

In countries where there has been significant movement of population from other countries, particularly in developed nations like France, it is crucial to implement targeted policy interventions that address the unique challenges faced by migrants and their descendants. One of the most pressing challenges that these individuals face is the nature of their residential areas. Due to factors such as language barriers and a lack of social networks, migrants and their descendants may be concentrated in certain neighborhoods or areas of a city. This can result in a range of issues, including limited access to education and job opportunities, as well as social isolation and ethnic segregation. To address these challenges, policy interventions should focus on increasing access to education and job opportunities for migrants and their descendants. Another key area of focus should be social integration, with efforts made to foster a sense of belonging and reduce ethnic segregation.

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Contents

Annex of chapter 1

Table A1.1: Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Total fertility rate					
Kenya	30	4.758	0.763	3.423	6.066
Ghana	30	4.607	0.520	3.816	5.602
Rwanda	30	5.238	0.950	3.990	7.184
Cote d'Ivoire	30	5.539	0.630	4.593	6.622
Nigeria	30	5.964	0.315	5.317	6.490
Labor force participation rate					
Kenya	30	68.694	3.508	60.650	72.410
Ghana	30	70.327	3.420	64.970	73.980
Rwanda	30	86.011	1.706	84.290	89.630
Cote d'Ivoire	30	47.325	1.480	45.170	49.080
Nigeria	30	53.815	2.601	48.620	55.380

Table A1.2: Short-term residuals tests results

Countries	Breusch-Godfrey (Autocorrelation)		Jarque-Bera (Normality)	Portmanteau (white noise)
	Lags(p)	χ^2 (Prob>χ^2)	χ^2 (Prob>χ^2 (2))	χ^2(Prob>χ^2(1))
Kenya	1	13.583 (0.000)	4.05 (0.1323)	12.282 (0.056)
	2	15.727 (0.000)		
	3	16.232 (0.001)		
Ghana (TFR equation)	1	0.546 (0.460)	1.21 (0.545)	0.530 (0.466)
	2	0.548 (0.760)		
	3	0.830 (0.842)		
Ghana (LFPR equation)	1	1.417 (0.234)	5.27 (0.071)	1.089 (0.297)
	2	1.804 (0.406)		
	3	2.455 (0.483)		
Rwanda	1	6.132 (0.013)	10.14 (0.006)	1.928 (0.165)
	2	6.882 (0.032)		
	3	6.999 (0.072)		
Cote d'Ivoire	1	3.951 (0.047)	2.73 (0.254)	2.606 (0.106)
	2	4.369 (0.112)		
	3	5.190 (0.158)		

Table A1.3: Lagrange-Multiplier test results of residuals from the VAR model

Countries	Lags	χ^2	df	P-value
Kenya	1	8.51	4	0.07
	2	5.50	4	0.24
Ghana	1	2.18	4	0.70
	2	4.31	4	0.36
Rwanda	1	10.10	4	0.04
	2	8.26	4	0.08
Nigeria	1	16.14	4	0.00
	2	6.31	4	0.18
Cote d'Ivoire	1	3.24	4	0.52
	2	5.13	4	0.27

Annex of chapter 2

Table A2.2: List of variables

Variable name	Variable definition	Categorical value
Contraceptive use	Using or intending to use	1- yes 0-no
Sexual activity	Had sexual relationship in the 3 months before the survey	1- yes 0-no
School level	Has at least six years of schooling	1- yes 0-no
In training /in school	Is still in school or in training	1- yes 0-no
Number of years	Number of years from the time you had your first menstruation.	
Decision making(sexual relationship)	I can decide when to have sex	1- yes 0-no

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Current partner	Do you currently have a boyfriend or a partner?	1- yes 0-no
Religions	The religion of the head of household	
Wealth	Household's wealth	
Age	Age	
Marital status	Married or ever married or separated	1- yes 0-no
Fertility time preference	I want to complete my education before I have a child.	1- yes 0-no
Aspirations		
Personal aspirations		
Important to start a business	How important is it for you to start a business in the next two years	Very, Somewhat or Not Important
Important to complete studies	How important is it for you to achieve this in the next two years? Education	Very, Somewhat or Not Important
Important to get married	How important is it for you to get married in the next two years	Very, Somewhat or Not Important

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Important to have children	How important is it for you to have children in the next two years	Very, Somewhat or Not Important
Important to have a job	How important is it for you to have a job in the next two years	Very, Somewhat or Not Important
Parental choices (in two years)		
Important to start a business	How important for your parents/-guardian that you start a business in the next two years	Very, Somewhat or Not Important
Important to complete studies	How important for your parents/-guardian that you achieve this in the next two years: Education	Very, Somewhat or Not Important
Important to get married	How important for your parents/-guardian that you get married in the next two years	Very, Somewhat or Not Important

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Important to have children	How important for your parents/-guardian that you have children in the next two years	Very, Somewhat or Not Important
Important to have a job	How important for your parents/-guardian that you have a good job the next two years	Very, Somewhat or Not Important
Knowledge of contraceptive methods		
Knowledge of natural methods		
Heard about beads	Have you ever heard of the standard days' method or Cycle Beads?	1- yes 0-no
Heard about LAM	Have you ever heard of the Lactational Amenorrhea Method or LAM?	1- yes 0-no
Heard about rhythm methods	Have you ever heard of the rhythm method?	1- yes 0-no
Heard about withdrawal	Have you ever heard of the withdrawal method?	1- yes 0-no

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Heard about other methods	Have you ever heard of any other ways or methods to avoid pregnancy?	1- yes 0-no
Hormonal Methods		
Heard about implants	Have you ever heard of the contraceptive implant?	1- yes 0-no
Heard about IUD	Have you ever heard of the IUD?	1- yes 0-no
Heard about injectables	Have you ever heard of injectables?	1- yes 0-no
Heard about pills	Have you ever heard of the (birth control) pill?	1- yes 0-no
Heard about emergency method	Have you ever heard of emergency contraception?	1- yes 0-no
Non-hormonal methods		
Heard about male condoms	Have you ever heard of male condoms?	1- yes 0-no
Heard about female condoms	Have you ever heard of female condoms?	1- yes 0-no
Heard about diaphragm	Have you ever heard of the diaphragm?	1- yes 0-no

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Heard about foam or jelly	Have you ever heard of foam or jelly as a contraceptive method?	1- yes 0-no
Attitudes towards reproduction and family planning		
Personal decision-making power about fertility time preference	I can decide when I want to start having children.	Agree, Strongly agree, indifferent, disagree and strongly disagree
Having confidence in discussing with the partner	I feel confident discussing with my partner when to start having children	Agree, Strongly agree, indifferent, disagree and strongly disagree
Future children will have anomalies	If I use family planning, my children may not be born normal	Agree, Strongly agree, indifferent, disagree and strongly disagree
Will have trouble getting pregnant	If I use FP, I may have trouble getting pregnant the next time I want to	Agree, Strongly agree, indifferent, disagree and strongly disagree

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Partner will seek another partner	If I use family planning, my husband/partner may seek another sexual partner	Agree, Strongly agree, indifferent, disagree and strongly disagree
Perceptions about family planning methods		
personal perceptions		
Adolescents who use family planning are promiscuous.	Adolescents using FP are promiscuous	Agree, Strongly agree and Disagree, strongly disagree
Family planning is only for women who are married	FP is only for married people	Agree, Strongly agree and Disagree, strongly disagree
Family planning is only for women who do not want any more children.	FP is only used to avoid pregnancies	Agree, Strongly agree and Disagree, strongly disagree
Community perceptions		
For community members: Adolescents using FP are promiscuous	Adolescents who use family planning are promiscuous.	Most, some or few agree

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
For community members: FP is only for married people	Family planning is only for women who are married.	Most, some or few agree
For community members: FP is only used to avoid pregnancies	Family planning is only for women who don't want any more children.	Most, some or few agree
Exposure to family planning methods		
Radio	Have you heard about family planning on the radio?	1- yes 0-no
Television	Have you seen anything about family planning on television?	1- yes 0-no
Magasine	Have you read about family planning in a newspaper or magazine?	1- yes 0-no
Mobile Phone	Have you received a voice or text message about family planning on a mobile phone?	1- yes 0-no

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Table A2.2 – *Continued from previous page*

Variable	Variable definition	Categorical value
Social-media	Seen anything on social media about family planning	1- yes 0-no

Table A2.3: Descriptive statistics of variables

	Burkina Faso	Congo (DRC)	Kenya	Nigeria
Variable	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)
Fertility time preference	0.74 (0.44)	0.89(0.31)	0.96 (0.2)	0.85 (0.36)
Contraceptive use	0.64(0.48)	0.72(0.44)	0.72(0.45)	0.39 (0.49)
Sexual activity	0.35 (0.47)	0.35 (0.48)	0.22 (0.42)	0.23 (0.42)
School level	0.65 (0.48)	0.9 (0.29)	0.90 (0.3)	0.78 (0.41)
In training /in school	0.68 (0.47)	0.75 (0.43)	0.82 (0.38)	0.74 (0.44)
Number of years since the first menstrual period	2.98 (1,84)	3.29 (1.78)	2.84 (1.64)	3.47 (1.69)
Decision making (sexual intercourse)	0.62 (0.48)	0.6 (0.49)	0.83 (0.37)	0.69 (0.46)
Current partner	0.55 (0.5)	0.46 (0.5)	0.36 (0.48)	0.52 (0.5)
Religions	1.47 (0.65)	0.74 (0.44)	0.91 (0.28)	1.3 (0.48)
Wealth	2.01 (0.82)	3.08 (1.41)	2.71 (1.31)	3.07 (1.37)
Age	16.95 (1.46)	17.01 (1.43)	16.89 (1.43)	16.91 (1.38)
Marital status	0.28 (0.45)	0.11 (0.32)	0.09 (0.28)	0.23 (0.42)
Aspirations				
personal aspirations				
Important to start a business	1.58 (0.77)	0.51 (0.5)	0.66 (0.47)	0.67 (0.47)
Important to complete studies	0.66 (0.47)	0.78 (0.41)	0.90 (0.29)	0.77 (0.42)
Important to get married	2.01 (0.88)	0.40 (0.49)	0.26 (0.44)	0.42 (0.49)

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Table A2.3 – *Continued from previous page*

Variable	Burkina Faso Mean(SD)	Congo (DRC) Mean(SD)	Kenya Mean(SD)	Nigeria Mean(SD)
Important to have children	1.90 (0.88)	0.35 (0.48)	0.32 (0.47)	0.46 (0.5)
Important to have a job	1.29 (0.59)	0.73 (0.44)	0.83 (0.38)	0.61 (0.49)
Parental choices (in two years)				
Important to start a business	0.58 (0.49)	0.5 (0.5)	0.67 (0.47)	0.68 (0.47)
Important to complete studies	0.62 (0.48)	0.79 (0.41)	0.91 (0.28)	0.74 (0.44)
Important to get married	0.48 (0.5)	0.41 (0.5)	0.3 (0.46)	0.45 (0.50)
Important to have children	1.75 (0.87)	0.35 (0.48)	0.34 (0.47)	0.49 (0.5)
Important to have a job	0.74 (0.44)	0.73 (0.44)	0.84 (0.37)	0.59 (0.49)
Knowledge of contraceptive methods				
Knowledge of natural methods				
Heard about beads	0.29 (0.45)	0.33 (0.47)	0.24 (0.43)	0.11 (0.32)
Heard about LAM	0.09 (0.45)	0.09 (0.29)	0.21 (0.41)	0.11 (0.31)
Heard about rhythm methods	0.40 (0.49)	0.77 (0.42)	0.43 (0.49)	0.23 (0.42)
Heard about withdrawal	0.16 (0.37)	0.55 (0.5)	0.35 (0.47)	0.26 (0.44)
Heard about other methods	0.03 (0.16)	0.12 (0.33)	0.06 (0.24)	0.12 (0.32)
Hormonal Methods				
Heard about implants	0.78 (0.41)	0.73 (0.44)	0.64 (0.48)	0.40 (0.49)
Heard about IUD	0.30 (0.46)	0.16 (0.36)	0.35 (0.48)	0.17 (0.37)
Heard about injectables	0.76 (0.42)	0.75 (0.43)	0.76 (0.42)	0.59 (0.49)
Heard about pills	0.74 (0.44)	0.54 (0.5)	0.71 (0.45)	0.59 (0.49)
Heard about emergency method	0.18 (0.38)	0.32 (0.47)	0.44 (0.5)	0.18 (0.38)
Non-hormonal methods				
Heard about male condoms	0.80 (0.39)	0.88 (0.32)	0.91 (0.28)	0.59 (0.49)
Heard about female condoms	0.47 (0.5)	0.51 (0.5)	0.49 (0.5)	0.27 (0.45)
Heard about diaphragm	0.15 (0.36)	0.02 (0.15)	0.16 (0.37)	0.09 (0.29)
Heard about foam or jelly	0.11 (0.31)	0.05 (0.22)	0.11 (0.31)	0.08 (0.27)

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Table A2.3 – *Continued from previous page*

Variable	Burkina Faso Mean(SD)	Congo (DRC) Mean(SD)	Kenya Mean(SD)	Nigeria Mean(SD)
Reproduction and family planning attitudes				
Personal decision-making power about fertility time preference	2.5 (0.84)	2.71 (0.62)	2.98 (0.44)	2.54 (0.78)
Having confidence in discussing with the partner	2.58 (0.79)	2.66 (0.67)	2.81 (0.56)	2.6 (0.75)
Future children will have anomalies	2.54 (0.82)	2.7 (0.63)	2.5 (0.84)	2.56 (0.74)
Will have trouble getting pregnant next time.	2.28 (0.93)	2.25 (0.88)	2.34 (0.91)	2.31 (0.85)
Partner will seek another partner	1.72 (0.45)	1.75 (0.43)	1.81 (0.39)	1.68 (0.47)
Perceptions about family planning methods				
personal perceptions				
Adolescents using FP are promiscuous	1.53 (0.5)	1.48 (0.5)	1.52 (0.5)	1.71 (0.45)
FP is only for married people	1.53 (0.5)	1.5 (0.5)	1.51 (0.5)	1.77 (0.42)
FP is only used to avoid pregnancies	1.7 (0.46)	1.5 (0.5)	1.47 (0.5)	1.66 (0.47)
Community perceptions				
Adolescents using FP are promiscuous	1.64 (0.8)	1.69 (0.8)	1.73 (0.85)	1.52 (0.76)
FP is only for married people	1.79 (0.8)	1.81 (0.79)	1.77 (0.82)	1.5 (0.67)

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Table A2.3 – *Continued from previous page*

Variable	Burkina Faso Mean(SD)	Congo (DRC) Mean(SD)	Kenya Mean(SD)	Nigeria Mean(SD)
FP is only used to avoid pregnancies	2.09 (0.81)	1.93 (0.71)	1.96 (0.85)	1.69 (0.74)
Exposure to family planning methods				
Radio	0.48 (0.5)	0.25 (0.43)	0.68 (0.47)	0.48 (0.5)
Television	0.19 (0.39)	0.32 (0.47)	0.42 (0.49)	0.28 (0.45)
Magasine	0.09 (0.29)	0.11 (0.32)	0.34 (0.47)	0.09 (0.29)
Mobile	0.05 (0.23)	0.05 (0.21)	0.09 (0.3)	0.05 (0.23)
Social-media	0.06 (0.23)	0.06 (0.25)	0.19 (0.39)	0.17 (0.37)

Notes: All variables of perceptions (personal and community perceptions) were recorded. .
Higher scores reflect favourable perceptions

Table A2.4: Marginal effects from the probit model (Nigeria)

	(1)	(2)	(3)	(4)	(5)
School level	-0.098	-0.241	-0.298	-0.295	-0.257
	(-0.68)	(-1.27)	(-1.48)	(-1.46)	(-1.28)
Sexual activity	0.010	0	0	0	0
	(0.08)	(.)	(.)	(.)	(.)
Religions (ref.Islam)					
Chritianism	-0.116	-0.058	-0.005	0.0007	-0.009
	(-1.46)	(-0.61)	(-0.05)	(0.01)	(-0.09)
Ethnic groups (ref. Hausa)					
Yoruba	0.107	0.085	0.098	0.104	0.148
	(0.98)	(0.71)	(0.81)	(0.85)	(1.17)
fulfulde and Igbo	0.145	0.053	0.063	0.064	0.140
	(1.24)	(0.41)	(0.48)	(0.49)	(1.00)
Other ethnic groups	0.069	0.0003	0.022	0.019	0.053
	(0.57)	(0.00)	(0.16)	(0.14)	(0.38)

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Table A2.4 – *Continued from previous page*

	(1)	(2)	(3)	(4)	(5)
Wealth(ref.lowest)					
Lower	-0.341**	-0.464***	-0.458***	-0.453***	-0.445***
	(-3.17)	(-3.91)	(-3.98)	(-3.86)	(-3.41)
Middle	-0.476***	-0.588***	-0.589***	-0.590***	-0.571***
	(-4.48)	(-5.25)	(-5.41)	(-5.39)	(-4.73)
Higher	-0.344**	-0.346**	-0.346**	-0.344**	-0.326**
	(-3.27)	(-3.20)	(-3.29)	(-3.25)	(-2.75)
Highest	-0.287**	-0.355***	-0.359***	-0.357***	-0.328**
	(-2.99)	(-3.51)	(-3.70)	(-3.63)	(-2.90)
Residential area (ref.urban)	-0.288**	-0.298**	-0.271*	-0.273*	-0.261*
	(-3.18)	(-2.87)	(-2.49)	(-2.51)	(-2.36)
Age	0.065*	0.065*	0.060*	0.060*	0.063*
	(2.51)	(2.23)	(2.03)	(2.05)	(2.11)
Marital status (ref.living or ever lived)	-0.032	0.149	0.136	0.134	0.166
	(-0.22)	(0.76)	(0.67)	(0.66)	(0.81)
In training /in school	0.126	0.155	0.168	0.165	0.138
	(1.41)	(1.46)	(1.51)	(1.48)	(1.23)
Fertility time preference	0.042	0.045	0.029	0.025	0.014
	(0.43)	(0.40)	(0.26)	(0.22)	(0.12)
Decision-making	0.172	0.215	0.225	0.235	0.172
	(1.22)	(1.40)	(1.46)	(1.49)	(1.02)
Economic aspirations		-0.099	-0.098	-0.093	-0.131
		(-0.86)	(-0.84)	(-0.79)	(-1.10)
Non hormonal methods			-0.089	-0.087	-0.0963
			(-0.58)	(-0.56)	(-0.62)
Hormonal methods			0.188	0.193	0.219
			(1.41)	(1.43)	(1.63)
Natural methods			-0.004	0.0018	-0.0395
			(-0.02)	(0.01)	(-0.20)
Media and audio-visual				-0.052	-0.065

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Table A2.4 – *Continued from previous page*

	(1)	(2)	(3)	(4)	(5)
				(-0.31)	(-0.38)
Consequences					0.116
					(0.78)
Personal perceptions					-0.093
					(-0.59)
N	199	158	157	157	153
LR chi2 (17)	57.13	47.66	48.77	48.86	48.70
$Prob > chi2$	0.000	0.000	0.000	0.000	0.000

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: From model 2 to model 5, the marginal effect of sexual activity is equal to zero because Sexual activity = 1 predicts success perfectly.

Figure A2.1: Kernel density function of the factor: *parents' economic aspirations* per variable (Kenya)

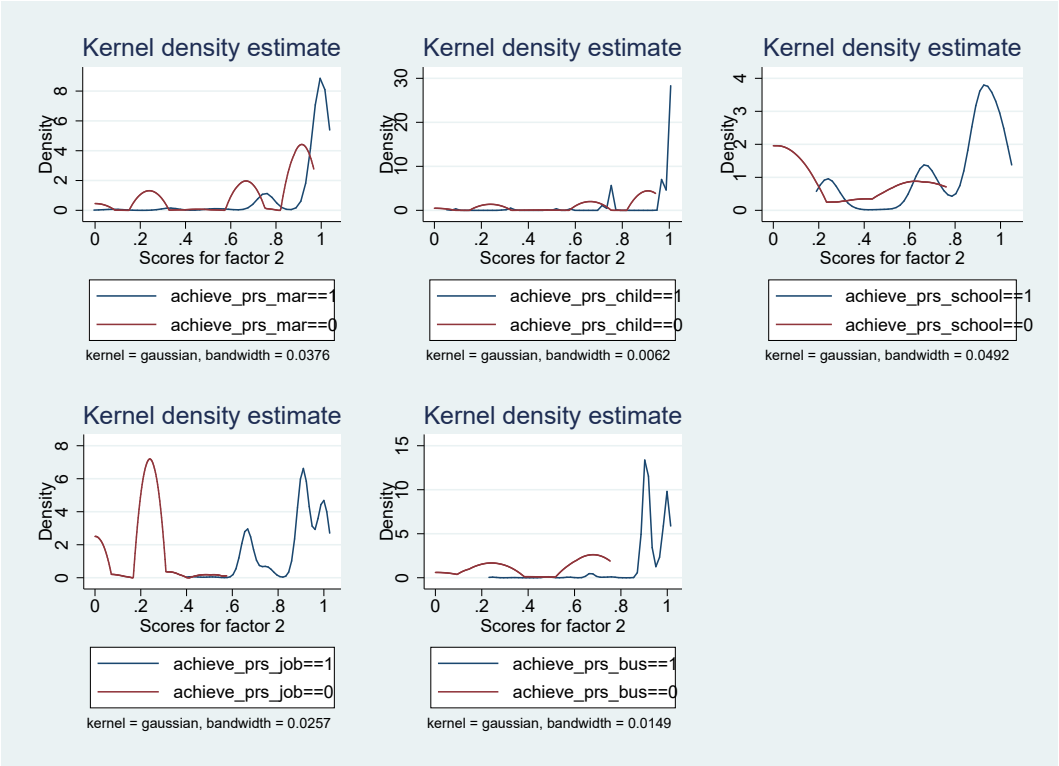

Table A2.1: Results from Confirmatory Factor Analysis (CFA)

Countries	Aspirations		Knowledge of contraceptive methods			Decision-making: attitudes towards reproduction	Perceptions about family planning methods	Exposure to family planning messages
	Own choices	Parental choices	Natural	Hormonal	Non hormonal			
Burkina Faso								
RMSEA	0.069	0.046	0.195	0.019	0.067	0.069	0.169	0.069
CFI	0.994	0.995	0.942	0.998	0.984	0.994	0.947	0.994
SRMR	0.994	0.995	0.154	0.023	0.041	0.043	0.146	0.043
Democratic Republic of Congo								
RMSEA	0.000	0.000	0.075	0.023	0.069	0.000	0.069	0.000
CFI	1	1	0.972	0.986	0.986	1	0.973	1
SRMR	0.022	0.029	0.064	0.986	0.034	0.022	0.063	0.011
Kenya								
RMSEA	0.034	0.041	0.184	0.047	0.024	0.034	0.155	0.180
CFI	0.999	0.995	0.184	0.993	0.999	0.999	0.965	0.970
SRMR	0.017	0.031	0.090	0.031	0.016	0.017	0.080	0.078
Nigeria								
RMSEA	0.078	0.082	0.192	0.066	0.065	0.078	0.163	0.155
CFI	0.992	0.987	0.942	0.981	0.995	0.992	0.960	0.970
SRMR	0.054	0.062	0.140	0.054	0.035	0.054	0.121	0.084

Notes: All factor loadings and covariances significant at 5%

Table A2.5: Index correlation matrix

(Burkina Faso)

	decision making	consequences	economic aspirations	parents' economic aspirations	family aspirations	parents' family aspirations	natural methods	hormonal	Non-hormonal	media and audio-visual	other media	personal perceptions	community perceptions
decision making	1												
consequences	0.361***	1											
Economic aspirations	-0.0529	0.113**	1										
Parents' economic aspirations	-0.0630	0.0844*	0.713***	1									
Family aspirations	-0.0946*	-0.0537	0.355***	0.243***	1								
Parents' family aspirations	-0.101**	-0.0268	0.273***	0.154***	0.718***	1							
natural methods	0.102**	0.134***	0.0386	0.0279	0.104**	0.0792*	1						
hormonal	0.0585	0.139***	-0.0591	-0.0240	0.0279	0.0439	0.493***	1					
Non-hormonal	0.0799*	0.109**	-0.0273	-0.00509	0.0284	0.0211	0.569***	0.583***	1				
media and audio-visual	0.102**	0.0922*	-0.0115	-0.0112	0.0463	0.0528	0.292***	0.333***	0.268***	1			
other medias	0.0917*	0.101**	0.00547	0.0135	0.0683	0.0407	0.301***	0.310***	0.295***	0.868***	1		
personal perceptions	0.247***	0.118**	0.0325	0.0749*	0.00650	-0.0324	0.130***	0.142***	0.0776*	0.0388	0.0338	1	
community perceptions	0.177***	0.0399	-0.0361	-0.00902	0.00781	-0.0213	0.0476	0.0204	-0.0307	-0.0140	-0.0240	0.597***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(a) Burkina Faso

(Congo (DRC))

	decision making	consequences	economic aspirations	parents' economic aspirations	family aspirations	parents' family aspirations	natural methods	hormonal	Non-hormonal	media and audio-visual	other media	personal perceptions	community perceptions
decision making	1												
consequences	-0.135**	1											
economic aspirations	0.141***	-0.0590	1										
parents' economic aspirations	0.104*	-0.0554	0.732***	1									
family aspirations	-0.0105	-0.0147	0.551***	0.467***	1								
parents' family aspirations	-0.00423	-0.0295	0.457***	0.512***	0.807***	1							
natural methods	0.0966*	0.0527	0.195***	0.173***	0.159***	0.136**	1						
hormonal	0.0399	-0.0368	0.103*	0.101*	0.126**	0.135**	0.504***	1					
Non-hormonal	0.114**	0.0978*	0.157***	0.126**	0.126**	0.0946*	0.460***	0.438***	1				
media and audio-visual	0.0527	0.0446	0.0567	0.0233	-0.0204	-0.0342	0.244***	0.319***	0.119**	1			
other mediasia	-0.0191	0.0588	0.0737	0.0454	0.0461	0.00862	0.168***	0.233***	0.107*	0.797***	1		
personal perceptions	-0.0609	0.167***	0.0959*	0.0416	0.0526	0.0422	0.109**	0.0949*	0.0920*	-0.0974*	-0.0775	1	
community perceptions	-0.139**	0.126**	0.0946*	0.0283	0.0569	0.0375	0.0571	0.0419	0.0162	-0.138**	-0.110**	0.754***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) Congo (DRC)

Table A2.6: Index correlation matrix (continued)

(Kenya)

	decision making	consequences	economic aspirations	parents' economic aspirations	family aspirations	parents' family aspirations	natural methods	hormonal	Non-hormonal	media and audio-visual	other media	personal perceptions	community perceptions
decision making	1												
consequences	0.190***	1											
economic aspirations	0.0313	0.0972***	1										
parents' economic aspirations	0.0361	0.0850***	0.789***	1									
family aspirations	0.0638*	0.0803**	0.544***	0.449***	1								
parents' family aspirations	0.0222	0.0519*	0.442***	0.458***	0.820***	1							
natural methods	0.0571*	0.0771**	0.151***	0.121***	0.165***	0.173***	1						
hormonal	0.0296	0.0640*	0.0645*	0.0472	0.0720**	0.0686**	0.554***	1					
Non-hormonal	0.0278	0.0763**	0.149***	0.128***	0.144***	0.128***	0.554***	0.443***	1				
media and audio-visual	0.0187	0.107***	0.161***	0.142***	0.111***	0.126***	0.255***	0.315***	0.256***	1			
other_media	0.0164	0.100***	0.157***	0.150***	0.128***	0.149***	0.280***	0.299***	0.269***	0.929***	1		
personal perceptions	-0.168***	-0.0918***	-0.0122	-0.0264	0.0110	0.00522	-0.118***	-0.138***	-0.0822**	-0.0369	-0.0331	1	
community perceptions	0.135***	0.0751**	0.0216	0.0505*	0.00835	0.00522	0.0979***	0.0872***	0.0756**	0.00781	0.0116	-0.858***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(a) Kenya

(Nigeria)

	decision making	consequences	economic aspirations	parents' economic aspirations	family aspirations	parents' family aspirations	natural methods	hormonal	Non-hormonal	media and audio-visual	other media	personal perceptions	community perceptions
decision making	1												
consequences	0.212**	1											
economic aspirations	0.181*	-0.0461	1										
parents' economic aspirations	0.113	-0.0321	0.693***	1									
family aspirations	-0.436***	-0.189*	0.107	0.214**	1								
parents' family aspirations	-0.455***	-0.124	0.0311	0.120	0.862***	1							
natural methods	0.0286	0.0747	-0.112	-0.120	-0.160*	-0.173*	1						
hormonal	-0.0382	-0.00828	-0.0296	-0.0790	0.0741	0.0549	0.513***	1					
Non-hormonal	0.170*	0.132	0.000382	-0.0455	-0.290***	-0.346***	0.523***	0.345***	1				
media and audio-visual	0.281***	0.116	0.137	0.0813	-0.321***	-0.358***	0.302***	0.193*	0.380***	1			
other mediasia	0.306***	0.167*	0.169*	0.0690	-0.378***	-0.411***	0.338***	0.197*	0.398***	0.912***	1		
personal perceptions	0.0475	0.164*	-0.0174	-0.0526	-0.111	-0.164*	0.144	0.0632	0.135	0.0144	0.0138	1	
community perceptions	0.0658	-0.0841	0.00254	-0.0129	-0.00876	0.0673	-0.218**	-0.141	-0.213**	0.0368	0.0673	-0.693***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) Nigeria

Table A2.7: Descriptive statistics of factor: *parents' economic aspirations* per variable (Kenya)

Variables	Mean	SD
Important to get married	0.95	0.14
Important to have children	0.94	0.15
Important to complete studies	0.81	0.24
Important to have a job	0.88	0.13
Important to start a business	0.93	0.08

Annex of chapter 3

Table A3.1: Sample of study

Country	Survey year	Sample of women aged 45-49	Corresponding birth cohort
Madagascar	1992	349	1943 - 1947
	1997	514	1948 - 1952
	2003	716	1953 - 1958
	2008	1507	1959 - 1963
Malawi	1992	314	1943 - 1947
	2000	914	1951 - 1955
	2004	770	1955 - 1959
	2010	1633	1961 - 1965
	2015	1718	1966 - 1970
Mali	1996	820	1947 - 1951
	2001	977	1952 - 1956
	2006	1303	1957 - 1961
	2011	715	1962 - 1966
	2016	690	1967 - 1971
Kenya	1998	580	1949 - 1953
	2003	553	1954 - 1958
	2008	720	1959 - 1963
	2013	2514	1964 - 1968
Rwanda	2000	786	1951 - 1955
	2005	991	1956 - 1960
	2010	1168	1961 - 1965
	2015	1020	1966 - 1970
	2020	1298	1971 - 1975

Table A3.2: Descriptive statistics of respondents' variables

Countries	Cohort	Level of education (Proportion)					Age at first intercourse	Age at first birth	Number of siblings	Had a dead child(Proportion)			Has/had twins(Proportion)		
		No education	Primary	Secondary	Higher	Total				No	Yes	Total	No	Yes	Total
Madagascar	1943-1947	37.36	49.71	12.36	0.57	100	16.41	18.93	5.13	40.11	59.89	100	94.04	5.96	100
	1948-1952	32.3	48.64	17.12	1.95	100	16.87	20.02	5.56	38.52	61.48	100	91.96	8.04	100
	1953-1958	18.99	45.39	29.33	6.28	100	17.84	21.08	5.77	64.53	35.47	100	94.35	5.65	100
	1959-1963	24.02	47.64	23.82	4.51	100	17.24	20.73	6.3	58.13	41.87	100	94.16	5.84	100
Malawi	1943-1947	50.33	45.51	3.94	0.22	100	16.81	19.46	5.34	24.4	75.6	100	93.76	6.24	100
	1951-1955	63.06	35.03	1.91	0	100		20.08	5.24	18.79	81.21	100	92.6	7.4	100
	1956-1960	51.56	44.03	3.9	0.52	100	16.79	19.41	5.43	30.39	69.61	100	92.96	7.04	100
	1961-1965	36.07	59.71	3.49	0.73	100	16.7	19.11	6.28	31.97	68.03	100	93.63	6.38	100
	1966-1970	34.11	55.65	7.8	2.44	100	16.27	19.42	5.32	44.53	55.47	100	90.63	9.37	100
Mali	1947-1951	94.51	2.93	2.44	0.12	100	15.69	19.46	4.64	15.61	84.39	100	88.93	11.07	100
	1952-1956	89.25	6.65	3.99	0.1	100	16.13	19.63	4.64	19.24	80.76	100	78.74	21.26	100
	1957-1961	85.57	8.29	5.6	0.54	100	16.45	20.06	5.54	24.64	75.36	100	88.77	11.23	100
	1962-1966	85.17	6.01	8.25	0.56	100	17.56	21.42	3.42	61.12	38.88	100	92.3	7.7	100
	1967-1971	85.36	9.42	4.2	1.01	100	16.68	21.47	4.5	47.25	52.75	100	91.15	8.85	100
Rwanda	1951-1955	59.92	35.62	3.69	0.76	100	19.52	21.78	5.79				92.41	7.59	100
	1956-1960	49.95	45.71	4.14	0.2	100	19.77	21.68	6.45				90.83	9.17	100
	1961-1965	39.81	52.48	6.76	0.94	100	20.43	22.22	6.47				93.58	6.42	100
	1966-1970	34.61	57.55	5.39	2.45	100	20.57	22.35	6.59				93.31	6.69	100
	1971-1975	25.35	64.1	7.78	2.77	100	20.12	22.4	6.01				94.54	5.46	100
Kenya	1949-1953	42.59	47.93	8.1	1.38	100	15.95	19.17	5.86				90.12	9.88	100
	1954-1958	35.08	43.94	15.73	5.24	100	16.88	19.41	7.26				92.05	7.95	100
	1959-1963	28.06	45.69	20.28	5.97	100	17.35	19.98	6.36				92.84	7.16	100
	1964-1968	19.13	50.8	22.67	7.4	100	17.5	20.19	6.69				93.33	6.67	100

Annex of chapter 4

Table A4.1: Variables used for neighborhoods

Variables	Definition	Nature
Fiscal income per consumption unit	Gross income of the household per consumption unit	Continuous
Unemployment rate	Total number of individuals from 15 to 64 years without a job out of the total number of individuals in the class	Continuous
Employment rate	Total number of individuals from 15 to 64 years with a job out total number of individuals in the class.	Continuous
Executive population	Proportion of the labor force with an executive job out of the total employed labor force	Continuous
Blue-Collar Population	Proportion of the labor force with a blue-collar job out of the total employed labor force	Continuous
Education	Proportion of individuals with at least a bachelor's degree	Continuous
Migrant Population	Proportion of migrants	Continuous
Sub-Saharan African Population	Proportion of migrants from Sub Sahara Africa	Continuous
North African Population	Proportion of migrants from North Africa	Continuous
Migrants unemployment rate	Proportion of migrants labor force who is unemployed	Continuous
Public Housing	Proportion of public housing	Continuous
ZUS	Critical Urban area	dichotomous

Table A4.2: Distribution of some neighborhood variables

Active persons in senior management and higher intellectual professions	Proportion (%)	Proportionage of people with at least a baccalaureate	Proportion (%)	The youth unemployment rate (15 years and more)	Proportion (%)
Less than 3.3%	6.41	Less than 20.5%	8.41	Less than 4.4%	2.19
From 3.3% to 4.9%	5.92	From 20.5% to 24.0%	6.10	From 4.4% to 5.8%	6.56
From 4.9% to 6.2%	6.48	From 24.0% to 26.8%	6.74	From 5.8% to 6.8%	7.71
From 6.2% to 7.4%	7.27	From 26.8% to 29.3%	7.25	From 6.8% to 7.8%	9.41
From 7.4% to 8.6%	7.99	From 29.3% to 31.9%	7.44	From 7.8% to 8.8%	8.48
From 8.6% to 10.1%	8.57	From 31.9% to 34.7%	7.93	From 8.8% to 9.9%	9.49
From 10.1% to 12.1%	10.27	From 34.7% to 38.1%	10.35	From 9.9% to 11.3%	11.11
From 12.1% to 15.0%	12.03	From 38.1% to 42.5%	12.83	From 11.3% to 13.2%	11.09
From 15.0% to 20.6%	14.80	From 42.5% to 50.3%	13.03	From 13.2% to 16.7%	12.85
20.6% and more	20.26	50.3% and more	19.91	16.7% and more	21.12
Total	100		100		100

Graphical representation of some neighborhoods variables

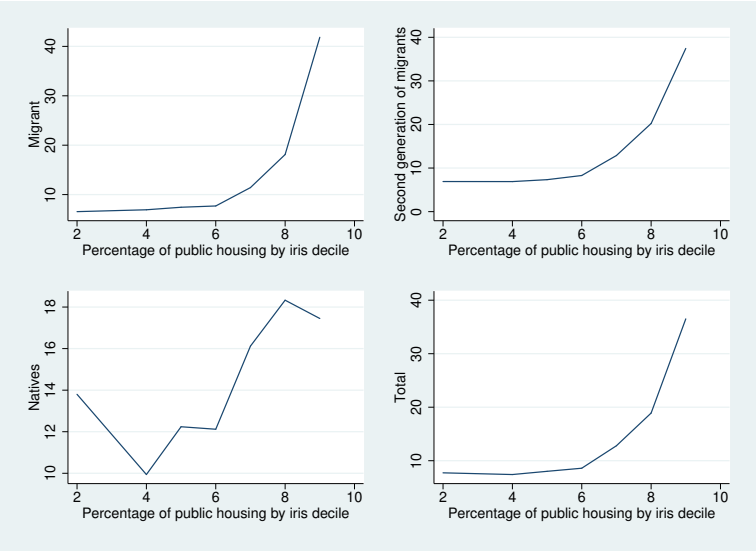

Figure A4.1: Proportion of people in iris based on public housing rate

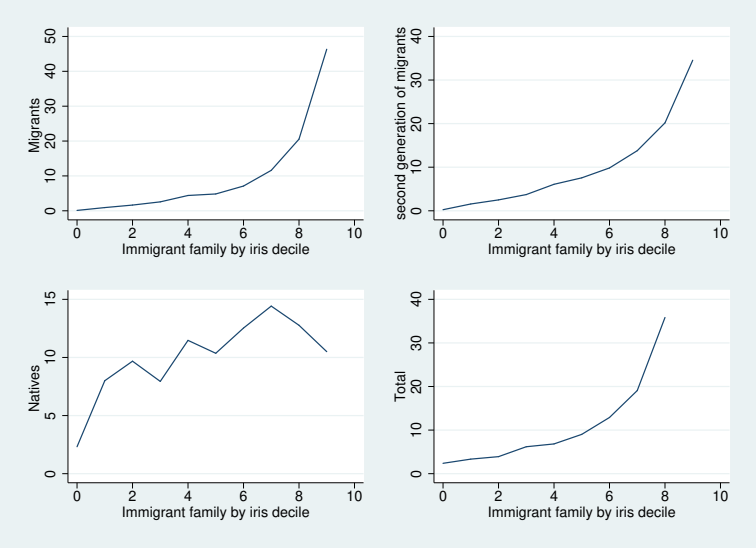

Figure A4.2: Proportion of people in Iris based on the immigrant families rate

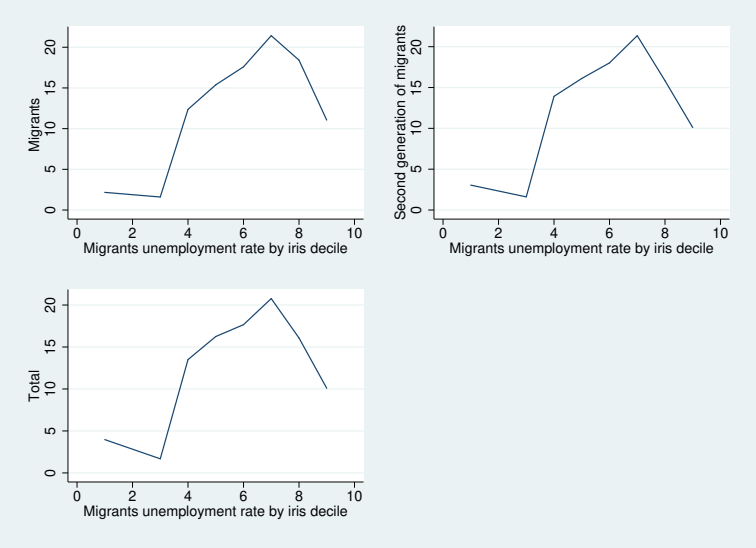

Figure A4.3: Proportion of people in iris based on the migrants' unemployment rate.

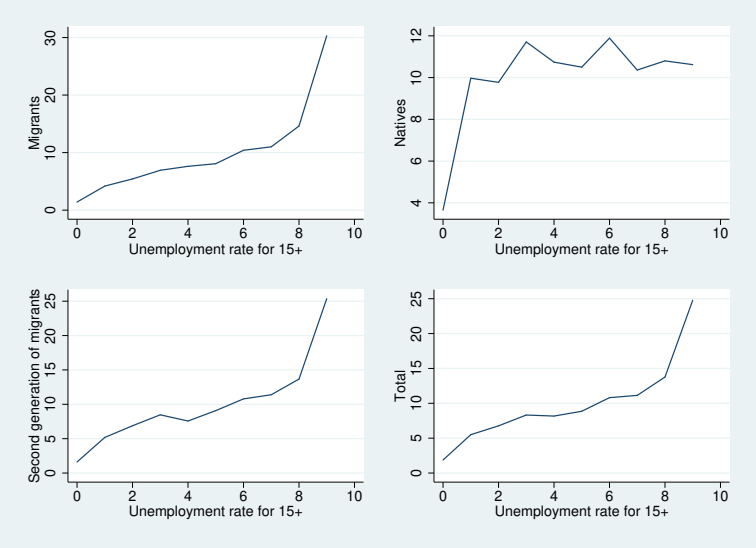

Figure A4.4: Proportion of people in iris based on the youth unemployment rate

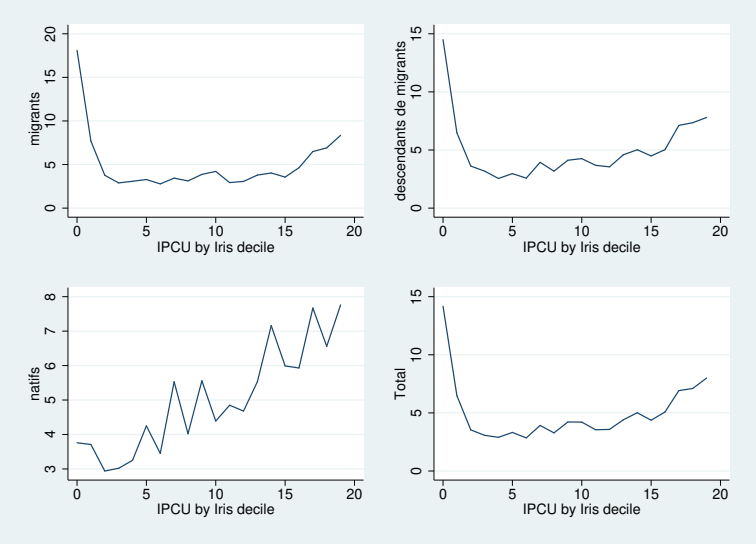

Figure A4.5: Proportion of people in Iris based on the Income Per Consumption Unit (IPCU)

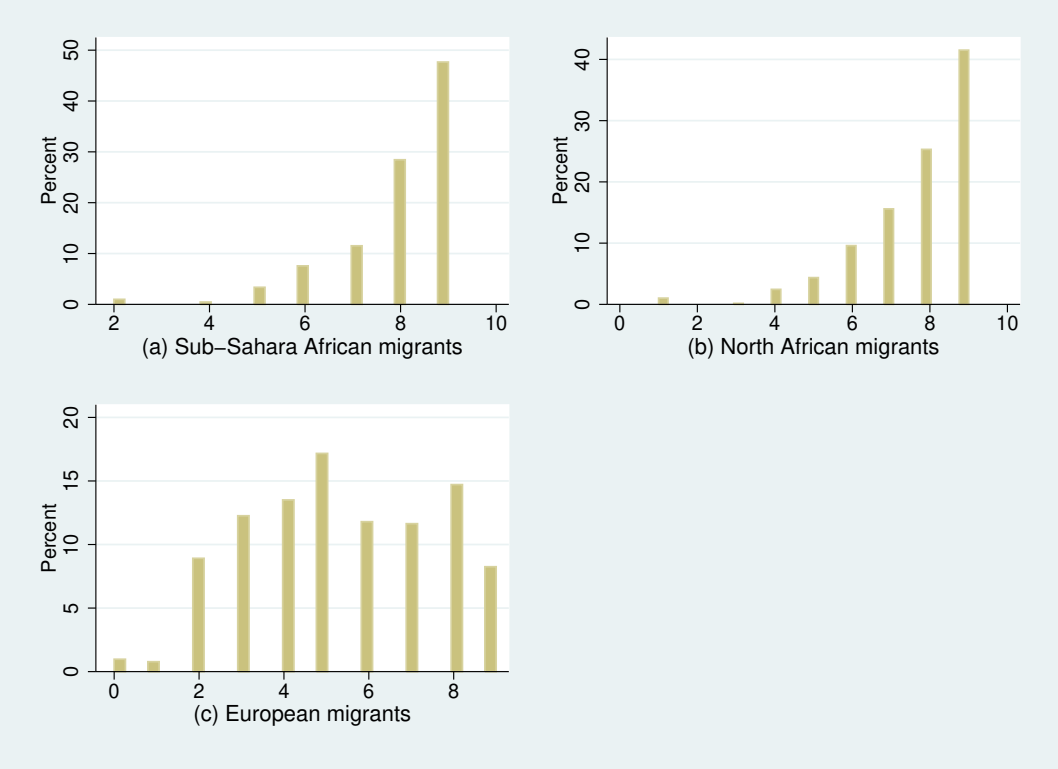

Figure A4.6: Proportion of migrants' children in iris based on the proportion of residents from their parent's region of origin

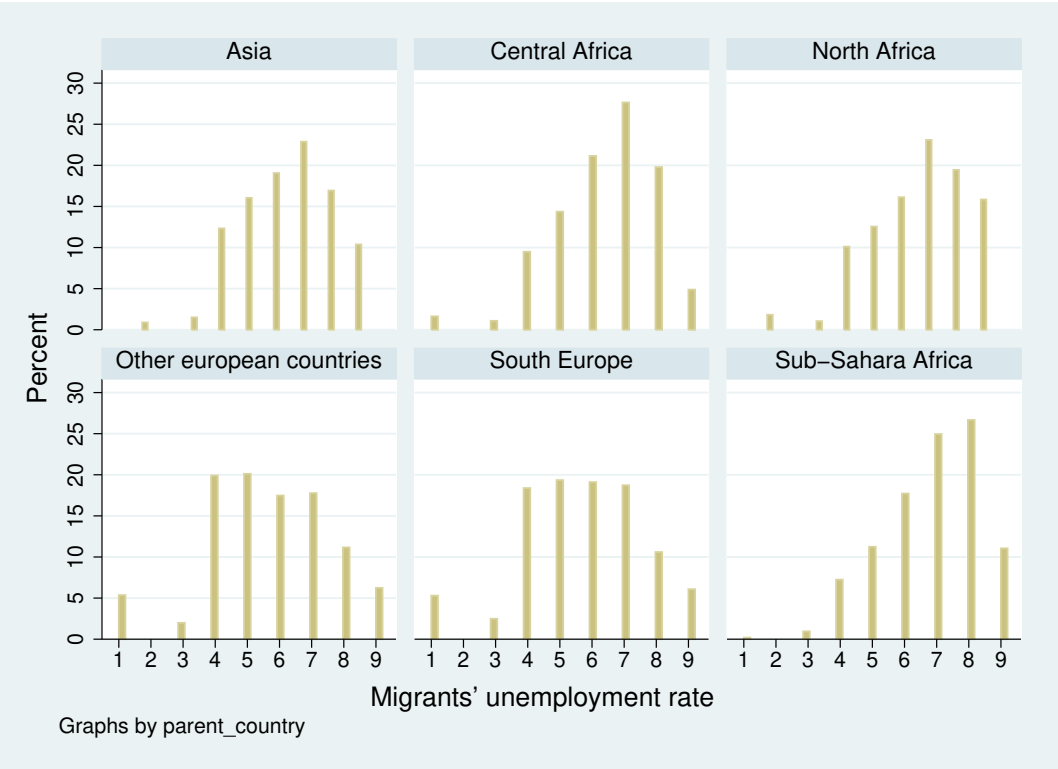

Figure A4.7: Proportion of migrants' children in iris based on immigrants' unemployment rate

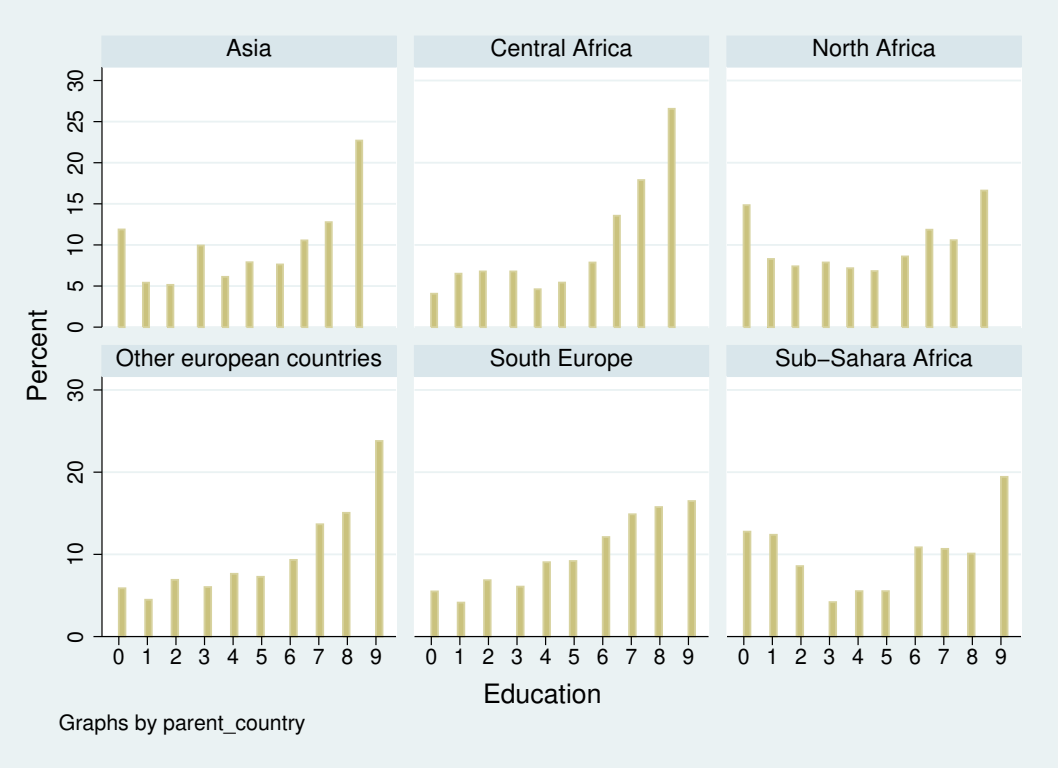

Figure A4.8: Proportion of migrants' children in iris children based on the proportion of people with a baccalaureate degree

Summary

This dissertation aims to provide a comprehensive understanding of the intricate relationships between population dynamics and the labor market and provide policy responses. Additionally, it provides evidence-based policy recommendations. Through a rigorous examination of the existing literature, as well as the use of statistical models and case studies, this study aims to provide insightful and practical policy proposals that can help address the issues and challenges arising from the complex interplay between population dynamics and the labor market. The study begins with a time series analysis of the short and long-term relationships between fertility rate and women's participation in the labor market in many African countries. We found, for example, that in Kenya, women's participation in the labor market is more sensitive to changes in fertility rate as compared to Ghana. Our research analysis also indicates that the rate (speed) of adjustment to variations of the variables in Ghana, Kenya, and Cote d'Ivoire is relatively low. Through Demographic and Health Surveys (DHS) of African countries, the thesis also examines the changes in fertility rates across generations, looking at both mothers and daughters and investigates the factors that may influence these changes. The results reveal significant variations in fertility rates among different generations of women. Specifically, the fertility rate of daughters tends to be lower than that of their mothers, suggesting a shift in attitudes towards childbearing and family size across different generations. Additionally, we found a low effect between the fertility rates of mothers and daughters. This may imply a high level of intergenerational mobility, where daughters are free to make their own choices regarding family planning and childbearing. Data on adolescent fertility rates reveals that Africa has the highest fertility rate. This is a matter of concern because most of these adolescents are still in school, and early childbearing can have a negative impact on their education, which, in turn, can hinder their future prospects. Therefore, we assumed that identifying the fertility time preferences of young women and promoting delayed childbearing can help young women complete their education, acquire skills, and enter the workforce, which can have a positive impact on their socioeconomic status. Migration is one of the factors that affect population structure in host countries. In the last chapter, we analyzed the mobility across generations in education and occupation between native people and the descendants of migrants in France, taking into account the impact of their place of residence. Data from a large survey revealed that the descendants of migrants are more likely to continue living in the same area as their parents when they reach adulthood. Additionally, the results show that the residential context is more significant for the descendants of migrants than for the native population.

Keywords— fertility rate, Labor market, education, family planning, occupation, long-term relationships, intergenerational mobility

Resumé de la thèse

Cette thèse vise à fournir une compréhension globale des relations complexes entre la dynamique de la population et le marché du travail. De plus, grâce à un examen rigoureux de la littérature existante, ainsi qu'à l'utilisation de modèles statistiques et d'études de cas, cette étude vise à fournir des propositions politiques pertinentes et pratiques qui peuvent aider à résoudre les problèmes et les défis découlant de l'interaction complexe entre la dynamique démographique et le marché du travail. L'étude commence par une analyse en series temporelles des relations à court et à long terme entre le taux de fertilité et la participation des femmes au marché du travail dans de nombreux pays africains. Les resultats montré par exemple qu'au Kenya, le taux de participation des femmes au marché du travail est plus sensible aux variations du taux de fertilité par rapport au Ghana. l'analyse revèle que le taux (vitesse) d'ajustement aux variations des variables au Ghana, au Kenya et en Côte d'Ivoire est relativement faible. À travers des enquêtes démographiques et sanitaires (EDS) des pays africains, la thèse examine également les changements des taux de fertilité entre les générations, en examinant à la fois le taux de fertilité dees mères et des filles et les facteurs qui peuvent influencer ces changements. Les résultats révèlent des variations significatives des taux de fertilité entre les différentes générations de femmes. De manière spécifique, le taux de fertilité des filles tend à être inférieur à celui de leur mère, ce qui suggère un changement d'attitude à l'égard de la maternité et de la taille de la famille entre les différentes générations. De plus, nous avons trouvé un faible effet entre les taux de fertilité des mères et des filles. Cela peut impliquer un niveau élevé de mobilité intergénérationnelle, où les filles sont libres de faire leurs propres choix en matière de planification familiale et de maternité. Les données sur les taux de fertilité des adolescents révèlent que l'Afrique a le taux de fertilité le plus élevé. C'est un sujet assez préoccupant car la plupart de ces adolescents sont encore à l'école, et une grossesse précoce peut avoir un impact négatif sur leur éducation, ce qui, peut entraver leurs perspectives d'avenir. Par conséquent, nous avons supposé que l'identification des préférences des jeunes femmes en matière de temps de fertilité et la promotion de la maternité retardée peuvent aider les jeunes femmes à terminer leurs études, à acquérir des compétences et à entrer sur le marché du travail, ce qui peut avoir un impact positif sur leur statut socioéconomique. La migration est l'un des facteurs qui affectent également la structure de la population dans les pays d'accueil. Dans le dernier chapitre, nous avons analysé

la mobilité entre les générations dans l'éducation et la profession entre les autochtones et les descendants de migrants en France, en tenant compte de l'impact de leur lieu de résidence. Les données d'une vaste enquête ont révélé que les descendants de migrants sont plus susceptibles de continuer à vivre dans la même région que leurs parents à l'âge adulte. De plus, les résultats montrent que le contexte résidentiel est plus significatif pour les descendants de migrants que pour la population autochtone.

Keywords— Taux de fertilité, marché du travail, education, planning familial, occupation, mobilité intergenerationnelle