Beyond SDGs. The Demographic Dividend and SDGs Monitoring Index

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Abstract

The relationship between investments and the demographic dividend has been gaining interest in Africa for a number of years, both for scientists and policy makers. This renewed interest is justified in a context of demographic transition in African countries that are looking for ways and means to take advantage of the potential of their large youth population by focusing on capturing the demographic dividend. In this context, the need to improve the efficiency of sectoral investments to create favorable conditions for dividends becomes unavoidable.

On the basis of a composite indicator for monitoring the demographic dividend and sustainable development, this article seeks to identify the priority sectors that need to be addressed in order to increase the demographic dividend, and to measure the amount of investment needed. These sectors are first identified on the basis of a "gap analysis", which examines the difference between standardized indicators comprised between 0 and 1, compared to a calibrated average reference target of 0.5. Then, elasticities linked to the variations of sectoral investments are calculated, so to make it possible to determine the volume of such investments necessary to fill the observed gap.

In the case of Senegal, the results reveal that education is a priority sector for investment. In fact, the education index, one of the monitoring sub-indicators, is below the target with a gap of 0.07. To reduce this gap over a five-year horizon, estimates have shown that an additional investment of around 30 billion CFA francs would be needed in this sector.

keywords: Demographic dividend, indicators, investment elasticities, gap analysis, strategies.

1. Context

The demographic dividend is a real opportunity for States and is an appropriate strategy to rule out other possible - but undesirable - scenarios, such as the persistence of unwanted pregnancies, illegal migration, endemic youth unemployment and rising religious fundamentalism, all scourges for which Africa pays a heavy price. Thus, youth is an essential asset to benefit from the demographic dividend, turning it into a continental initiative. But this requires strategic investments for youth in priority areas, such as education or training, health, wealth creation, governance, and so on.

The main objective of this paper is to propose a fine targeting of the investments, via a synthetic indicator to monitor the demographic dividend, making it possible to reach a specific target of demographic dividend capture.

i. Demography

According to United Nations statistics, Africa records the fastest population growth compared to any other continent (2.6% annual growth during the period 1975-2009, against 1.7% for Asia, for example) and the gap with other developing regions is deep. The extremely young African population (40% under age 15) is characterized by high fertility (4.6 children on average per woman) and high mortality rates (life expectancy at birth is 54 years). All other developing regions are at the end of their demographic transition, with fertility close to the replacement level (2.1 children per woman) and life expectancy approaching 70 (United Nations, 2009).

According to the average United Nations projections, the population of Africa will have doubled by 2050 and, with 2 billion inhabitants, will represent 22% of the world's population (compared to a current share of 15%), and 27 % of its workforce will be under 15 years of age (United Nations, 2009). Thus, this drop in the proportion of under-15 population would lead to a reduction in demographic dependency ratios, and consequently to increased savings rates. This will be the starting point for the beneficial effects of the demographic dividend, especially for Africa. In this sense, the Heads of State and Government have magnified and recalled the importance of youths, who need adequate training with contextual expectations. But the observation is, so far, indicative.

The continent remains one of the most underdeveloped regions in the world, with the highest fertility rates. Thus, a new consideration for youth is needed to better understand the demographic dividend through it. Indeed, this mainly young population represents a potential for economic growth and economic development.

ii. Human Capital

In the education sector, efforts undertaken by African States to invest in education and training have steadily increased. These efforts have been noticeable since the 1990s and are reflected at the level of expenditures, where a

significant portion of their budget has been allocated to education and training. The overall evolution on a country-by-country level shows different trends, as the share of education expenditure has been ranging from 1% to 7% of the budget since the 90s.

These trends are due to several factors, such as the decline in the duration of compulsory schooling for the new generations and the restrictive public spending policies that have been advocated by States since the advent of their Structural Adjustment Programs.

Net enrollment rates (NER) vary greatly from one country to another within the continent. Where countries like Cape Verde have rates approaching 100% in primary education, others like Liberia are lagging far behind, with a primary NER of 38% in 2014. Along with education, health is also one of the most important pillars for understanding human capital. Indeed, considerable efforts have been made in African countries in this sector. Nevertheless, medical coverage is still far from being assured, since some tropical diseases that have a long history are still persistent. However, some countries are making significant progress.

In view of the evolution of the infant mortality rate (IMRT) from 1990 to 2014, it can be seen that the infant-juvenile mortality ratio, which measures the probability of a child dying before his fifth birthday, has slightly declined since 2014 but is still high in some countries in the region. This is the case of Chad (138.9 ‰) and Sierra Leone (120 ‰). While some countries like Cape Verde have relatively low under-five mortality rates (25‰).

This information reflects the improvements achieved in health in Africa. At the same time, for people to make the most of educational opportunities, they must be in good health. In this way, enhancing human capital means investing in social health sectors to end preventable maternal deaths, ensuring that every child and every young person is in school and that job opportunities are created to address the radicalization of youth and violent extremism.

iii. Social development

In the area of social development, wealth creation is the first step in the fight against poverty. In view of the WB's estimates, South-East Asia and Sub-Saharan Africa appear to be the least wealth-generating regions in the world. They have a per capita GDP of US $ 1,504 and US $ 1,791, respectively, while the global average is close to US $ 11,000.

Although many African countries, especially those in sub-Saharan Africa, have been experiencing high rates of economic growth for a long time, it is a fact that

poverty and inequality remain more important in this region compared to the rest of the world. Thus, the proportion of people living on less than US $ 2 a day is higher in sub-Saharan Africa (45% in 2012) compared to other regions of the world, such as South Asia, where this share is 22%, and other regions that remain below 10%.

The change in per capita GDP as a function of the demographic dependency ratio immediately suggests taking appropriate action in Africa to accelerate the demographic transition, strengthen human capital and create decent and sustainable jobs for young people.

iv. Governance

In terms of good governance, the general trend remains good over the last decade. On average, overall governance on the continent has increased, according to the Mo Ibrahim Index of African Governance, with 37 countries - corresponding to 70% of the continent's population - having improved. This general trend is mainly driven by the marked progression related to *Human Development and Participation and Human Rights*. The *Sustainable Economic Development* category also improved, but at a slower pace.

This positive trend, however, contrasts with the significant and worrying decline observed in the *Security and the Rule of Law* category. Thirty-three of the continent's 54 countries - nearly two-thirds of the continent's population - have seen a decline in this category since 2006, with a particularly sharp decrease for 15 of them.

This worrying shift has worsened recently, with almost half of the continent's countries registering the worst score in this category in three years. These results are due to a significant deterioration of the *Individual Security and National Security* components, while the *Accountability* factor is now the one with the lowest score in the entire Index. All countries, without exceptions, which have seen their score deteriorate in terms of *Global Governance* have also recorded a decline in *Security and Rule of Law.*

The improvement in the *Participation and Human Rights* category, observed in 37 countries of the continent, is driven by the increase in the *Parity and Participation* sub-categories. However, there is a very slight decline in the *Rights* sub-category, with some worrying trends noted in some countries regarding the indicators related to *Space allocated to civil society*.

2. Selective review of literature

This section devoted to the literature review is divided into two parts. The first part discusses the main theoretical studies on the demographic dividend, and the second part presents the results of some empirical work on the subject.

i. Brief theoretical review of literature

The nature and importance of population dynamics from a "young" to an "aging" structure have become important in the economic literature on development. This stems from the potential effects that changes in the age structure of the population, as opposed to population size and growth, have on the economic growth of both developed and developing countries.

Indeed, for Thomas Malthus, a strong demographic dynamic would weigh heavily on the food supply, which would reduce the standard of living of the populations. The negative effects of population growth on economic well-being lead to the idea of fertility control. This view of the negative effect of population growth on economic well-being is called the "Malthusian trap".

On the other hand, according to other researchers, there is a positive link between demographic change and economic growth (Bloom and al., 2003, among others). This positive effect of changes in the age structure of the population on economic growth is referred to as the *demographic dividend* (United Nations, 2013). This concept was introduced in the 1990s to describe the interaction between changes in population structure and rapid economic growth in East Asia (Bloom, Canning and Malaney 2000, Bloom and Williamson, 1998).

The demo-economic literature identifies two types of demographic dividend, called the *first and the second demographic dividend,* respectively.

The *first demographic dividend* measures the increase in per capita income due to the increase in the share of the working-age population in a demographic boom. The demographic transition is at the origin of this process: in fact, during the demographic transition, the fall in infant mortality followed by the decline in fertility results in a reduction in the proportion of younger individuals and an increase in the proportion of working-age population. As observed by Canning et al. (2016), having a large number of active people gives a boost to the economy, provided that there are enough job opportunities. Decent job opportunities for the labor force result in increased savings and favorable changes in human and physical capital spending. Thus, particularly through the decline in fertility, the demographic transition leads to immediate gains in per capita income, thanks to

the reduction in the dependency rates of the youngest, which stimulates faster economic growth.

The *second demographic dividend* originates from the aging process subsequent to the demographic transition. In this case, the aging of the population could produce a permanent increase in capital (Mason, 2005, Lee and Mason, 2007, Mason and Lee, 2007). The *second dividend* stems from the fact that the increase in per capita income brought by the first demographic dividend allows, through an increase in longevity, to increased savings that could also promote a productivity growth (Mason, 2005; et al 1990). This dividend is not as direct as the first. In addition, it is highly dependent on how intergenerational transfers are funded. Moreover, the achievement of the second dividend is not exclusively linked to the demographic transition, but it depends also on other factors, including labor productivity and the level of human resources (through a better education), among others.

Theoretical analysis of the redistribution of resources between ages, and intergenerational transfers in particular, has been carried out in several studies mentioned in the economic literature. A common framework that is often used is related to nested generation models. The framework of overlapping-generation models presents and analyzes the economic activities through which, during their course, different generations of people coexist and maintain relations with each other. This is a result of the work of Samuelson (1958) and Diamond (1965).

Most advanced textbooks now explore macroeconomic theory from the perspective of overlapping-generations models. This framework was used to analyze population growth peaks and economic fluctuations, among others. However, most nested-generation models analyses make many strong assumptions that are difficult to rationalize in national economic systems. For example, some models assume that the life cycle is divided into two broad age groups that exclude the child-dependency age group.

This assumes that the life cycle begins at entry into the labor market and ends with dependency on old age (Lee, 1994). This compromises the appropriateness of policy formulations based on such models because child dependency is an important step in the economic life cycle. Indeed, children can be expensive in terms of care and education, that may include the period of higher education. Becker and Murphy (1988) have developed a theory linking parental transfer decisions to the development of the welfare state to address some of the issues raised by the omission of children from nested generation models.

They maintain that there is a socially optimal amount of investment in children for which an adequate investment of parents in the education of children would be made to the point where the rate of one additional year of education would be equal to the rate of return of an additional unit of capital.

ii. Empirical review of literature

The demographic dividend has been the subject of many empirical studies most often applied to developing countries. The work of Bloom, Canning, Fink, and Finlay (2010) also appears to be a reference for the link between population dynamics and economic growth. These authors estimate that the fertility rate has a negative effect on the labor supply of women, which is higher in the age group of 20-39, but which also extends to all ages. Thus, a decline in fertility would have a positive effect on per capita income growth in South Korea.

In this study, three important facts were noted: first, lower fertility implies lower population growth and therefore an increase in the capital / labor ratio in Solow's standard model; then, this decline would lead to a decrease in the demographic dependency ratio; finally, the decline in fertility has a positive impact on women's participation in the labor market. If, over a given period of time, the per capita income of South Korea has grown by 11 times, the combination of the three effects mentioned above accounts for an increase in this income by 3 times. Thus, the decline in fertility seems to have contributed significantly to the economic growth of South Korea by releasing the demographic bonus.

Other studies have shown that countries in East and South-East Asia have benefited from the demographic dividend for their economic take-off. Indeed, Bloom and Williamson (1998) - using econometric modeling - have estimated the contribution of the demographic dividend to about one-third of the economic growth in Asia.

In an empirical analysis based on the comparison of Asian and African countries between 1965 and 1990, Bloom, Canning and Malaney (1999) show that both declining fertility and declining dependency ratio contribute positively to economic growth. It should be indicated, however, that this effect is not automatic.

Indeed, the economic take-off of the countries in South-East Asia did not happen in isolation; it was accompanied by an ability of the economy to accumulate physical and human capital, coupled with the capacity to absorb the potentially active population into productive employment. After application of this model to African countries, these authors note that in this case these factors are lacking and result in low demographic benefits, unlike in Asian countries. In one of their studies, Bloom et al. (2010) applied a growth model to measure the health effects and demographic changes on the economic growth of China and India. According to their findings, the main factors underlying the economic take-off of these two countries were improved health, greater trade openness, but also an increase in the ratio of labor to skilled population.

Finally, in his work on a sample of 17 countries in West and Central Africa, Dramani (2017) showed that potentially all but one of these countries are in a capture phase of the demographic dividend. The window of demographic opportunity is indeed open since the 2000s in West Africa and around 2010 in Central Africa, because the population of workers has been growing faster than the population of consumers during these periods.

3. Methodology

i. Synthetic indicator for monitoring the dividend

The synthetic indicator for monitoring the demographic dividend (I2S2D, abbreviated) is a composite indicator created by the Regional Centre of Excellence in Generational Economics (CREG) to assess and monitor the progress of countries in achieving the demographic dividend (DD). It is based on five (05) dimensions: economic dependence, the quality of the living environment, the dynamics of poverty, human capital and polarizations, networks and territories.

The DD is the economic contribution that results from a decline in fertility. The consequences of such a phenomenon go beyond the purely demographic or economic aspect, and also relate to other sectors. While it is clear that the demographic transition is its starting point, the achievement of DD is accompanied by change in many areas that interact with it. These include the living environment, transitions into poverty, human capital and territorial mobility, among others. The I2S2D makes it possible to appreciate to what extent positive or negative evolutions in any of these areas can create favorable conditions for optimization of the DD.

i.i Principal

The I2S2D is a unitless indicator with a value between 0 (worst) and 1 (excellent). It is obtained by the average of five (05) indicators related to the dimensions mentioned above. These dimensional indicators are:

- Economic Dependency Coverage Indicator (EDCI)

- Quality of living environment indicator (IQCV)
- Synthetic indicator of the exit from poverty (ISSP)
- Expanded Human Development Index (HDI)
- Synthetic Network and Territory Indicator (ISRT)

Each dimensional indicator covers one (01) to seven (07) fields or sub-dimensions. In turn, the sub-dimensions are made up of several elementary indicators which are specific to them. All the dimensions, sub-dimensions and elementary indicators have been validated by the countries adhering to the Sahel Women's Empowerment and Demographic Dividend (SWEDD) initiative, which established National Observatories for the Demographic Dividend (ONDD). The initialization of the I2S2D calculation is carried out by these ONDDs with the technical support of the CREG.

The methods for developing dimensional indicators are described in the following paragraphs.

i.ii Economic Dependency Coverage Indicator (EDCI)

The Economic Dependency Coverage Indicator (EDCI) is generational and is based on the Life Cycle Deficit (LCD). The LCD refers, by definition, to the difference at each age between consumption and labor income. Not only it quantifies the social demand at the aggregate level, but also the economic surplus created by the population as a whole. The determination of the LCD is based on the National Transfer Accounts (NTA), whose method of construction is developed in the manuals of United Nations (2013) and CREG (2016). The key indicators for calculating the life cycle deficit are consumption, whether public or private, and labor income, and these vary according to the age of the individual.

Indeed, the life cycle reflects many behavioral and non-behavioral factors that influence the relationship between age, on the one hand, and labor consumption and income, on the other. During life, individuals consume at all ages, but they only produce at active ages. During periods of youth and old age, it follows that the consumption of individuals exceeds their production. Therefore, these individuals originate a deficit and are economically dependent.

On the other hand, people of working age produce more than they consume, and thus generate a surplus that makes it possible to “subsidize” those whose production does not cover consumption. Thus, those age groups whose production exceeds consumption are the source of transfers to those in the opposite situation, i.e. young people and the elderly (United Nations, 2013).

These transfers can be private (intra and inter-household) or organized by public decision-makers.

As a consequence, only one age category of the population, i.e. the active adults, is responsible for assuming the role of production, in order to ensure that the needs of the entire population are met. In most cases, the surplus generated by active adults does not fully finance the total deficit of economically dependent individuals. For example, according to Mason and Lee (2012), India and Germany have a total surplus that is considerably lower than the deficit of young people and elderly people combined. EDCI is defined as the ratio between the economic surplus of non-dependent individuals and the deficit of economically dependent persons.

$$\boldsymbol{EDCI = \frac{Surplus}{Deficit}}$$

Surplus and deficit are obtained by the following expressions:

$$\boldsymbol{Surplus = -\sum_{a}(C_a - YL_a)} \text{ under the condition } \boldsymbol{C_a \leq YL_a}$$

$$\boldsymbol{Deficit = \sum_{a}(C_a - YL_a)} \text{ under the condition } \boldsymbol{C_a > YL_a}$$

where $\boldsymbol{C_a}$ and $\boldsymbol{YL_a}$ represent aggregated consumption and aggregate labor income, respectively, of individuals at age a.

For example, the EDCI estimates what share of deficit in economically dependent age groups is covered by the labor income surplus generated by the age groups with an economic surplus.

In essence, it measures the capacity of the country to meet the social demand of economically dependent individuals by the only resources derived from work.

i.iii Living Environment Quality Indicator (LEQI)

The living environment quality indicator (LEQI) was created by the OECD in 2011 as part of the "Better Life Initiative" program, in order to provide countries with tools to measure the living environment. In a standard way, the living environment is conceived as the set of elements surrounding the life of a person. In other words, it is the environment in which one lives, considered from the point of view of its influence on the quality of life.

In its standard formulation, the LEQI covers 11 criteria considered essential to well-being. But in the DD monitoring framework, only 7 out of these 11 criteria are considered in the quality dimension of the living environment, the remaining 4 being taken into account by the other dimensions. Each well-being criterion is measured from one to four indicators. Within each criterion, the average of the relevant elementary indicators is calculated with the same weighting, the latter being standardized beforehand.

Normalization is based on a classical formula that converts the original values of the indicators into numbers between 0 (worst case score) and 1 (best case score). The details of the methodology are explained by CREG (2017) in the Training Manual on Dimensions and Monitoring Indicators of the Demographic Dividend Observatory.

The list of criteria (or sub-dimensions) and basic indicators are listed in the following table.

Table1: Sub-dimensions and indicators of the quality dimension of the living environment

Criteria or Sub-dimensions	**Indicators**
Civic engagement	Electoral participation
	Stakeholder participation in the development of regulations
Social connections	Quality of the social network
Environment	Atmospheric pollution
	Quality of water
Housing	Number of rooms per person
	Access to basic sanitary facilities
	Cost of housing
Satisfaction	Satisfaction with life
Work-life balance	Heavy work schedules
	Time devoted to leisure and self
Security	Feeling of safety when walking alone in the night
	Homicide rate

Source : CREG (2017).

i.iv Poverty Escaping Synthetic Index (PESI)

The measurement and analysis of poverty is of particular importance in the process of monitoring and evaluating the effectiveness of public policies, but also in monitoring the evolution of the situation with regard to the capture of DD and achieving the SDGs.

However, given the large inequalities in the distribution of wealth and the high vulnerability of households in developing countries, it seems even more important to better understand the phenomenon of poverty and to better target populations at risk. In this regard, poverty dynamics studies aim at identifying individuals entering or leaving poverty over time and at analyzing the main factors that play a key role in this mobility of poverty.

In this sense, the Poverty Escaping Synthetic Index (PESI) was designed to measure the greater or lesser odds of the population's well-being to improve or deteriorate in response to a decrease in persistent poverty.

The PESI builds on a new approach to measuring poverty transitions in Dang and Lanjouw (2013).

The latter developed a pseudo-panel construction method and estimation of the transition matrix on two or more poverty surveys. The idea is to follow cohorts of individuals (or households) over time.

Considering two periods T1 and T2, the method makes it possible to estimate:

- **P-P**: the proportion of individuals who remained poor in periods T1 and T2 (chronic or permanent poverty),

- **P-NP**: the proportion of individuals who have passed from a state of poverty to a state of non-poverty between T1 and T2 (out of poverty),

- **NP-P**: the proportion of individuals who have transited from a state of non-poverty to a state of poverty between T1 and T2 (change in poverty), and

- **NP-NP**: the proportion of individuals who remained non-poor in both periods T1 and T2 (not pure poverty).

The PESI, whose formula is given below, makes it possible to determine the rate of escape from poverty among the vulnerable population, i.e. people who move from a state of poverty to a state of non-poverty and vice versa.

$$\boldsymbol{PESI = \frac{P \rightarrow NP}{P \rightarrow NP + NP \rightarrow P}}$$

i.v Expanded Human Development Indicator (EHDI)

The Expanded Human Development Index (EHDI) is a composite measure of human capital. It incorporates the dimensions and indicators of the HDI (Human Development Index, developed by the UNDP) and the total fertility rate, and presents the possibility of disaggregation at a subnational level.

Like the HDI, the EHDI covers three essential sub-dimensions of life:

• **Health.** It is represented by life expectancy at birth and the total fertility rate (TFR). Life expectancy at birth measures longevity and indirectly integrates the satisfaction of basic material needs, such as access to healthy food, clean water, decent housing, good hygiene and medical care. Regarding fertility, its inclusion in the HDI is justified by the fact that "*high fertility poses health problems and presents risks for children and their mothers, harms investment in human capital, slows economic growth, and poses a «potential threat»*" (Dramani, 2016). According to Cleland et al. (2006) and Canning and Schultz (2012), a reduction in fertility rates is considered beneficial for low-income countries, as it is associated with better maternal and child health, women's empowerment, poverty and the fight against hunger. It also contributes to the achievement of the DD;
• **Education**: It is measured by the average duration of schooling for adults over 25 and the expected duration of schooling for school-aged children. It reflects the satisfaction of intangible needs, such as the ability to participate in decision-making at the workplace or in society;
• **The standard of living:** It is apprehended by the logarithm of per capita consumption expenditure. In fact, the final consumption of individuals makes it possible to measure their decent standard of living or the level of their economic well-being.

The EHDI represents the geometric mean of the normalized indices used to measure the levels reached in each sub-dimension (CREG, 2017). Maximum values are the highest values observed during the period considered (1980-2016). The minimum values are those that we are entitled to consider as subsistence values.

As for the Fertility index (ISF), a specific treatment is carried out so that the standardized index takes the value 1 when the ISF is 3 children per woman, and the value 0 when the ISF is equal to 0 (minimum) or 8 (maximum).

The standardized total fertility rate (ISFN) is given by the following expression:

$$\boldsymbol{ISFN(x) = \frac{x}{3} * \mathbf{1}_{[0;3]}(x) + \frac{(8-x)}{(8-3)} * \mathbf{1}_{]3;8]}(x)}$$

where x = ISF; $\mathbf{1}_{[0;3]}(\boldsymbol{x})$, and $\mathbf{1}_{]3;8]}(\boldsymbol{x})$ functions indicative of x.

A very high ISF presents barriers to achievement of the DD, as it accelerates the rate of growth of the young dependent population. On the other hand, when it is very weak it causes a rapid aging of the population and makes hypothetical its renewal. Thus, when ISF is either very high or very low, it has both economic and demographic disadvantages for the country. Under such conditions, demographers' recommendations lead to an optimal ISF of about 3 children per woman.

i.vi Network and Territory Synthetic Index (NTSI)

The Networks and territories synthetic index (NTSI) provides information on territorial mobility by describing the attractiveness of areas, human migration, financial and goods flows, and the distribution of infrastructure within a national territory. NTSI covers 4 sub-dimensions: urbanization, migration, infrastructure and financial flows.

In each sub-dimension, a certain number of indicators make it possible to quantify it. The indicators are normalized so that the values are between 0 (worst case score) and 1 (best case score). The sub-dimensional index is obtained by the geometric mean of the indicators that make up the sub-dimension. NTSI is also the geometric mean of the subsurface indicators. The table below gives the composition of the sub-dimensions.

Table2: Sub-dimensions and indicators of the Networks and Territories dimension

Criteria or Sub-dimension	Indicators
Urbanization	Population density
	Average size of households
	Urbanization rate
	Ratio of renter households to owner households
Migration	Entry index
	Output index
Infrastructure and basic social services	Index of access to infrastructure and basic social services
	Quality index of infrastructures and basic social services
Financial flows	Transfer index
	Rate of access to formal transfer services
	Per capita consumption
	Cost of the basket of housewives in the region

Source: CREG (2017)

4. Gap Analysis

i. The Gap Analysis concept

The *Gap Analysis* is a method of analysis that compares a current situation with a desired state, to establish what it would take to reach the desired state. Therefore, the method has three essential components:

(1) A measure to characterize the current situation;

(2) A definition of the situation deemed desirable; and

(3) A relatively simple measure to characterize the costs to be incurred, the measures to be taken to improve certain key indicators that should make it possible to go from (1) to (2).

Depending on the specific problem, how each of these components is operationalized can have different levels of complexity. In the simplest case, a gap analysis can be a direct comparison of some current indicators with a "desirable" level of this indicator.

For example, the literacy rate in the age group 15 to 24 year in country X is 60%. To be in a situation similar to the same age group in other countries, which are considered to be an appropriate benchmark, this number is expected to increase to at least 90%.

A slightly more complex form of Gap Analysis is that of the need to reduce women's unmet need for contraception, at all levels of education and in all regions of the country, to less than X%. This scenario requires a more comprehensive analysis of the reasons why the level of unsatisfied demand, in some regions or educational groups, is currently greater than X%. Causes could include poor infrastructure, cultural prejudices, gender inequality, community support and other factors. This requires at least the development of a more detailed set of indicators to measure progress towards the goal.

ii. Identification of indicators and gaps to be filled

This is to define a target and compare the current situation (as described by the sub-dimensions) against such target. The sub-dimensions scoring below the target are identified, as well as the indicators on which to act for the sub-dimension to reach the desired situation. However, the quantification of the gaps to be filled relies on the definition of reference thresholds.

Since dimensions, sub-dimensions and indicators have standardized values comprised between 0 and 1, the desirable situation is reached when the value of each component is greater than R = 0.5. Thus, the threshold of R = 0.5 is retained as a minimum reference point. As a result, any sub-dimension whose value is less than 0.5 is considered "hypothetical". In "hypothetical" sub-dimensions, indicators below 0.5 are areas where changes are needed to bring the sub-dimension back to the desired state.

The gap to be filled to reach the benchmark for an indicator that is below the reference level is given by:

$$\textit{Gap to be filled} = R - X$$

where X is the indicator and R = 0.5 the reference or threshold to be reached.

A first estimate of the DDMI and its sub-dimensions is carried out according to the methodology presented above. This presents the current situation for the country and gives an idea of the most important gaps in relation to the target threshold.

iii. Planning interventions and determining investment elasticities

After having identified the indicators below the reference and their deviations from it, the change to be made at the level of the indicator to bring it back to the desired situation requires a certain number of actions and costs.

A change in the level of the indicator requires planning and execution of specific actions on each identified indicator. In this sense, monetary calculations of supply factors should be made, in order to determine the amount of investment needed to lift the indicator from its current level to the desired reference state.

Thus, investment elasticities are calculated for each indicator whose value is to be shifted to a reference value. For a measured indicator X between two periods, the investment elasticity is obtained by the following formula:

$$e = \frac{\Delta X}{\Delta K} \times \frac{K}{X}$$

with ΔX the variation of indicator X between the two periods, and ΔK the changes in capital K of projects or sectors related to indicator X.

This elasticity makes it possible to measure the percentage change in the indicator (e%) following a change in the investment of 1%.

5. Applications and results

This part is devoted to the application of the methodology described above to the data from Senegal and to the presentation of the relevant results. It presents the Demographic dividend monitoring index (DDMI) and its components for Senegal, identifies the sectors of intervention to optimize the DD, as well as the cost of these interventions.

i. The demographic dividend monitoring index (DDMI)

In Senegal, the majority of the dimensional indicators (three out of five) are close to the target (50%). Efforts remain to be made with reference the other two indicators.

The analysis in Table 3 shows that in the life cycle dimension, the surplus generated covers only 37% of the deficit. The level of quality of the living environment is 64%. In terms of poverty dynamics, there are more people out of poverty than the chronically poor, as 54% of the Senegalese population escape chronic poverty. Nevertheless, 46% of this population remained, in 2011, in the trap of poverty.

In the context of human development, Senegal's EHDI stands at 53%, taking into account the level of fertility. Despite this, education remains a challenge.

Finally, the Senegalese network and territory remains poor in terms of people mobility and attractiveness. The index assigned to this area is only 15%.

Table 3: Dimensions of the demographic dividend monitoring index in Senegal (2011)

DDMI	**0,4223**
EDCI	0,3706
LEQI	0,6399
PESI	0,5385
EHDI	0,5263
NTSI	0,1998

Source: Author's calculations from State budget data

ii. Gap Analysis: Identification of intervention sectors

Gap Analysis is done for all DD monitoring indicators. In addition to the EDCI, of which 13% remains to be filled to reach the average target of 50%, five sub-dimensions are also in the red zone. These include civic engagement and subjective well-being in the living environment dimension, education in human capital, and urbanization and migration in the networks and territories dimension. This last sub-dimension shows the highest gap to fill (48.5%), while the gaps for subjective well-being and urbanization are lower than 15%; civic engagement (3%) and education (7%) have the smallest gaps to fill.

Table 4: Detection of intervention sectors

Indicators	Value	Gap to be filled
EDCI	0,371	0,129
LEQI	0,64	
CIVIC ENGAGEMENT	0,470	0,030
SOCIAL CONNEXION	0,970	
ENVIRONMENT	0,542	
HOUSING	0,683	
SUBJECTIVE WELL-BEING	0,352	0,148
EQUILIBRE TRAVAIL-VIE PRIVEE	0,778	
SECURITY	0,690	
PESI	0,540	
EHDI	0,526	
HEALTH	0,642	
EDUCATION	0,434	0,066
LIVING STANDARD	0,503	
NTSI	0,200	0,300
URBANIZATION	0,353	0,147
MIGRATION	0,015	0,485
INFRASTRUCTURES	0,549	
	0,553	

Source: Author's calculations from State budget data

The improvement of these indicators, in order to reach at least 50%, requires specific actions for each sub-dimension. In each area, it is necessary to set up investment projects or programs to develop monitoring indicators which could capture the demographic dividend.

ii.i Actions. Economic dependency coverage

To improve the EDCI, the surplus in the labor force must be greater than the deficit of youth and seniors. A policy to improve this indicator would aim at improving asset income, so that the deficit can be covered. In this context, a policy in support of job creation, particularly through investments in sectors with high growth potential and with a high potential for labor, remains necessary.

Moreover, the workforce must be qualified, which implies investments in general training but also - and especially - in vocational training. In addition, the business climate is a key element in attracting investment. In this sense, promoting private sector development and entrepreneurship through the implementation of a tax relief policy would be an asset, both for private sector wealth and job creation.

The earning supplement could result in increasing consumption; hence, a good policy for reduction of the consumption of the dependent population, especially of young people, might be required. This could happen in the long term, through implementation of a birth control policy. It could also go through promoting youth employment, so that they can get out of dependency sooner. In addition, a policy to reduce the dependence of senior population could consider a decline in the retirement age on the one hand, but also an improvement in social contributions on the other hand.

ii.ii Actions. Civic engagement

Citizen participation and civic engagement contribute to community integration, building and strengthening a sense of belonging and fostering an awareness of what can be achieved through concrete involvement in our communities.

Therefore, it is important:

- to promote the civic engagement of the population, by insisting on the involvement of citizenship in educational programs;
- to encourage people, especially young women, to get involved in their communities;
- to encourage them also to exercise their right to vote, in particular by inviting them early to join simulation exercises;
- to contribute to the creation of environments where people, especially young women, are listened to and where they know that their contribution will have an impact;
- to encourage projects aimed at citizen participation and at enabling young people to acquire leadership skills.

ii.iii Actions. Subjective well-being

This sub-dimension is about satisfaction with life and happiness. Improving this subjective and generic aspect requires actions in several areas, including economy, peace, security, etc. Ensuring the social and economic development of the population would be essential to improve this indicator.

ii.iv Actions. Education

It is about putting in place or strengthening policies to improve the length of schooling. This will necessarily involve raising awareness and promoting education for all, especially girls. It would also be important to make educational reform by identifying the real labor needs of the economy and adapting those needs to the education system.

ii.v Actions. Urbanization

Urbanization is characterized by a high density of population and requires investment in road infrastructure in urban and peri-urban areas. This facilitates the movement of people and products. The establishment of housing pools and spatial planning policies would also improve the urbanization indicator.

ii.vi Actions. Migration

Migration remains a complex phenomenon, whose causes are mostly attributed to the economic area. In this sense, on the one hand the implementation of a migration policy would require the identification of the causes of departure and, on the other hand, the assessment of the impact of migration on the labor market and security, in order to take adequate *ad hoc* measures. Thus, in-depth studies in the field are more than necessary.

iii. Determination of the cost of necessary investments

The cost of investments is approximated through the calculated elasticities. By default, based on the availability of certain information, these calculations concern only the sub-dimensions, which measure civic engagement and education.

Sub-dimension	Indicator	Elasticity
Civic engagement	Participation in the development of regulations	-0,006
Education	Average duration of schooling (DMS)	0,006
	Expected duration of schooling (DAS)	0,008

Source: Author's calculations from State budget data

In Senegal, the lack of investments in the field of civic engagement resulted in a decreasing indicator between 2005 and 2011. As a consequence, this led to a negative elasticity. This result precludes the possibility to estimate the investment cost necessary to fill the gap.

In the sub-field of education, the selected indicators are the average and the expected duration of schooling. They have elasticities of 0.006 and 0.008, respectively; in other words, a 1% increase in investment in this area leads to an improvement of 0.006% in the index of average duration of schooling (DMS). The education sub-dimension, which is a combination of two indices (DMS and DAS), has a value of 0.43, leaving a gap of 0.06 points with the target of 0.5.

In order to improve the education sub-dimension and reach the 50% target taking into account the current level of efficiency, a global investment of 14.7

billion would be needed. This would drive the average and expected duration indices to 41% and 59%, respectively.

These investments could be spread over a five-year period. The following table shows the distribution of investments over a period of 5 years, as well as the changes observed in the education index.

Table 5: Investment progress and impact on education indicators

	Reference	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Investments (10^6 CFA)		2943,65	2943,65	2943,65	2943,65	2943,65
Cumulative investments		2943,65	5887,30	8830,95	11774,60	14718,25
DMS index	0,36	0,37	0,38	0,39	0,40	0,41
DAS index	0,50	0,52	0,54	0,55	0,57	0,59
Education index	**0,43**	**0,45**	**0,46**	**0,48**	**0,49**	**0,50**

Source: Author's calculations from State budget data

Appendix 1 : Calculation of elasticities

	K 2005	K 2011	X 2005	X 2011	**e**
DIMENSION 2					
Stakeholder participation in regulatory development	1	22	0,51	0,45	**-0,0055**
Atmospheric pollution	18143	80626	0,43	0,36	**-0,0508**
Water quality	55846	309076	0,67	0,73	**0,0184**
Housing	48316	134000	0,56	0,68	**0,1299**
Security	1	720	0,72	0,69	**0,0000**
DIMENSION 4					
ISF	4501	28292	0,55	0,64	**0,0302**
Life expectancy at birth	266785	243741	0,62	0,69	**-1,2449**
DMS	23523	519203	0,32	0,36	**0,0057**
DAS	23523	519203	0,43	0,50	**0,0076**
Average consumption per head	140797	459510	0,48	0,50	**0,0175**
DIMENSION 5					
Infrastructure Access	30825	266441	0,48	0,51	**0,0068**
Quality of Infrastructure	122975	664112	0,40	0,59	**0,1046**
Average consumption per head	140797	459510	0,03	0,03	**0,0654**
Food expenditure	29945	199531	0,01	0,02	**0,0575**

Source: Author's calculations from State budget data

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