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## SÉRIE DE DOCUMENTS DE RECHERCHE

### AFRICAN GROWTH INITIATIVE PROJECT SOCIAL PROTECTION, POVERTY and DEVELOPMENT in SENEGAL

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## **List of abbreviations**

DFES: Direction of forecast and economic studies

DESP: Document of Economic and Social Policy

FGT : Foster Greer Thorbecke poverty index

NASD: National Agency for Statistics and Demography

NRF: National Retirement Fund

NSSP: National strategy for social protection (NSSP).

PRGF: Poverty Reduction and Growth Facility

PRSP: Poverty Reduction Strategy Paper

SHS I : Survey on the households in Senegal, 1995

SHS II : Survey on the households in Senegal, 2001

SPPS : Survey on the Perceptions of Poverty in Senegal

UNDP: United Nations Development Program

## 1 Introduction

Senegal is one of the developing countries of West Africa. It has borders with Mauritania, Mali, Gambia, Guinea, and Guinea Bissau. It is also bordered by a long coastline of 700 km, which explains the importance of seaside tourism. Counted among the Least Developed Countries (LDCs) since 2001, the country maintains a weak formal economy. Despite its political stability, it also faces many economic and social problems, leading to permanent interventions of the government. The critical situation of the country compared to other ones can be read in the high levels of some indices. For example, in 2011, the human development index established by the United Nations Development Program (UNDP) placed Senegal as the 155th of 187 countries. The business environment is being degraded (157th of 183 in Doing Business 2012 rankings while the average of sub-Saharan Africa stands at 137th rank).

Socially, the population faces major difficulties, exacerbated by rising world prices, which have already generated demonstrations since late 2007 and riots in 2008.

Really, the socioeconomic situation is very dependent from risks of rising oil prices, sharp decline in remittances from migrants, international aid and foreign direct investment. Since February 2012, there is a political change in the country and a new liberal regime is ruling, directly coming from the precedent ruling political party, which governed the country since 2000. This allow to think that the spirit of the future economic policies will not drastically change and the structural measures taken before 2012 will continue, especially when they are deemed useful and effective.

The structure of the Senegalese economy is not typically different from any other developing country in West Africa, because of the persistence some characteristics: poverty, wide informal sector, critical lack of infrastructure (which is evaluated to 20% of GDP in 2020 by the National agency for statistics and demography, NASD), etc. another characteristic is the fact that the private sector and business opportunities are underdeveloped, particularly because of downward rigidities in input prices, taxation, corruption, insufficient access to finance, etc.

Since the year of independence (1960), it has regularly been necessary for the State, to make plans, projects and programs, so as to ensure the social stability and to enhance the economic performance of the country.

The performance of Senegal remained fairly good, especially since the change of parity of the CFA franc in 1994, and this, despite the structural difficulties faced by some key sectors such as agriculture and energy. The economy is enough diversified but it is too vulnerable to its external environment (world price fluctuations, flow of foreign direct capital, climate disasters, etc). Structurally it is dominated by the tertiary sector (representing 60% of GDP), and it remains largely informal. The primary sector (16% of GDP) is vulnerable to natural conditions and volatility of the world prices. Recently, its production experienced a decrease of 10.8% in 2011 after an increase of 5% in 2010 (DFES, 2011). This is mainly due to weaknesses in the agricultural sector which is affected by inadequate rainfall and reduced inputs distributed to farmers. This usual situation explains the wide consensus (also among the donors) that the sector deserves supports and specific policies from the government.

The secondary sector (24% of GDP) is based on the extraction and processing of phosphates, food processing, construction and cement industry. These latter activities are mainly supported by investments from Senegalese emigrants and the government. The sector has been dynamic in 2011, thanks to the improvement of electricity supply, following the Plan "TAKKAL"<sup>1</sup> and the recovery of Chemical Industries of Senegal (CIS). The sector of energy is very critical and socially sensitive in Senegal that is why many specific policies are adopted and they are not always successful.

The historical evolution of the economic policies shows that between 1960 and 2012, there are four phases during which the economy has undergone changes resulting from different types of programs taken by the government.

In the *first phase*, from 1960 to 1980, groundnut crop is prominent in the improvement of living standards of populations, particularly rural women. Indeed, recycling of groundnut income is the main driver of the other sectors of the economy, which is also dependent on a strong seasonality that affects both the production and the distribution. During this phase, national planning was the main economic policy tool.

In the *second phase*, from 1980 to 1990, the country faces new challenges, such as economic and natural crisis, including bad climate conditions, leading to government's direct interventions. A stabilization plan was adopted for the first time, followed by adjustment policies. The social effects are adverse to what

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<sup>1</sup> It means lightening, in the local language, Wolof. The plan is the subject of widespread support from development partners of Senegal, and it has significantly reduced the power cuts in the country.

was expected. The *third phase* began with the devaluation of the franc CFA in 1994, which boosted competitiveness and growth in the economy.

The *fourth phase* begins in 2000 with the political change that appears when a liberal regime replaces the socialist one. The new authorities face the social challenges of poverty, inequality, illegal immigration, climate problems (floods in the suburbs, etc.). In this phase, Senegal has implemented various programs for budgetary and financial reforms. While responding to the critical situations, and despite the mixed social and economic results, the authorities still aim to transform Senegal as an emerging country within ten years, through national and regional projects. However, major constraints and challenges of the economic policies should be noted: vulnerabilities, weak private sector, infrastructure deficit, tight supply and low competitiveness, recurrence of external shocks (floods, drought, fluctuating food prices and oil products, international financial crises).

But from the economic planning adopted in 1960 to the structural adjustments of the 1980s and 1990s, and to the new generations of policies from 2000 (for poverty reduction, accelerated growth, etc.), the country has faced many economic and social challenges. This led the authorities to respond with flexibility by accommodating its institutional and practical ways of conducting economic policies. For example, the roles of stakeholders are more refined, the objectives have become more targeted and the methods of implementation and monitoring policies are more efficient. Political and economic governance is also a recent aspect of the policies undertaken by the authorities.

Actually, the country is engaged in three major programs of economic policy: the development of the third Poverty Reduction Strategy Paper (PRSP III from 2011 to 2015) the Document of Economic and Social Policy (DESP) and the formalization of the prospective vision of Senegal in 2025. All of these policies directly include social protection aspects meaning its increasing importance for the country. The purpose of this paper is to show how structural economic characteristics of households can explain their vulnerability and their exposure to risk, which justifies their need of protection.

## 2 Socio-demographic context and recent economic performances

The demographic pressures create a set of problems in the country. Senegal's population was approximately 3 million inhabitants in 1960. It is about 12.9<sup>2</sup> millions in 2010 and its growth rate is of 3% while it was of 2.7% in the early 1980s. The population is young (64% are under 25 years) and 57% of it live in rural areas. It displays a high unemployment rate of 49% according to the NASD, especially among young people, and most of them have no access to basic education. Women illiteracy is widespread and the population is predominantly rural. The capital Dakar represents a quarter of the total population with about 3.4 million inhabitants. There is a large group of people in urban areas, especially in Dakar, due to migration from rural areas, but also the sub-region's countries, such as Mali, Niger. Migration of men to Dakar is mainly explained by the search for a job, while for women the migration is more often due to the fact that they are trying to reach their families.

According to the SHS II survey, the average age for men is 21.8 years and 22.6 years for women. The proportion of young people in the total population has increased according to the survey and 55.6 percent of the population is under 20 years.

However, the high population growth will inevitably impact the social and economic life. With better life expectancy, future older generations will face problems in the labor market and the tension will grow when they reach the age of retirement. Before analyzing the impact of growth on the population and poverty reduction, we present the economic performance in Senegal, since 2000.

Since that year, the alleviation of poverty was, among others aims, the primary policy objective of the government of Senegal and that led it to initiate a program named Poverty Reduction and Growth Facility (PRGF), which ended in 2002. In 2003, a new PRGF is signed for a period of three years (2003-2005). Through this program, assessed in 2006, Senegal has achieved a considerable macroeconomic stability.

The strategic options lead to exceptional performances of the economy as it can be shown there with some indicators:

*Inflation:* An inflation rate of 2.2% on average in the period of the PRGF. In terms of macroeconomic performance, inflation stood at 1.7% in 2003-2005. An episode of inflation around 6% is observed between the years 2007 and 2008, but it declined in 2009 by 0.9%. Over the period from 2000 to 2012, it has averaged 2%.

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<sup>2</sup>See NASD (2010)

*Economic growth* : The period 2000-2002 was marked by a real GDP growth rate of 2.8%. In 2003-2005 the real GDP growth rate was of 6.1% over the period. Over the period 2006-2010, the average economic growth is of 3% per annum meaning a loss of 3 points compared to the period 2003-2005.

*Public budget*: Broadly regarding the management of public finances, there is a significant improvement of the tax system by broadening the tax base, combined with reforms. The tax revenues rose in fact by nearly 16.1% in 2000 to 18.8% in 2010. Is it the share in GDP or the annual growth rate of revenues. Compared to their level of 1994, the budgetary revenues tripled in 2011. They passed from 562.5 in 2000 to 1.237 billion CFA francs in 2010, more than doubling.

In detail, the public deficit is about 12% of the GDP in the period 2000-2002, according to the NASD (2010). In 2003 – 2005, the public deficit is 6% of GDP. From 2010 to 2011, the budget deficit is below 5% of the GDP, improving the quality of the public expenditures.

Public spending rose sharply from 2000 to 2010. Thus, the total expenditure as a percentage of GDP increased from 18.1% to 28%.

It is worth noting that the economic policies in Senegal are more successful where the government' initiatives are supported by the international financial and technical partners.

Concerning the impact of macroeconomic policies on poverty, there are not enough households' surveys in Senegal for the assessment of the evolution of poverty. The country remains poor, though the proportion of poor people has been reduced. It passed from 61.4% in 1995 to 48.5% in 2002, and to 40 % in 2006, according to the different respective surveys (SHS I, and II and the Survey on the Perceptions of Poverty in Senegal, SPPS). But the SPPS in 2006 shows that 65% of households interviewed consider themselves as poor and 23% consider themselves as very poor. Furthermore, 64% of households consider that poverty has worsened over the past five years. Poverty is largely localized in rural areas: the poverty rate in rural areas varies between 72 % and 88% while in urban areas it varies between 44% and 59%. This situation raises questions on the effectiveness of the policies adopted until now, for the reduction of poverty.

### **3 The paradox of growth and the recent strategies to alleviate poverty**

The average annual growth rate of the economy (about 2.7% per year is less than the population growth over the period 1960 -1995), did little to improve real income per capita and employment. In addition there is a very unequal income distribution.

The growth achieved is not yet of great quality and it is largely driven by sub-sectors that were not enough job providers (oil, processing of fish products, phosphates, cement, tourism and telecommunications). The situation in the primary sector remained precarious, combined with a weak secondary sector, insufficiently competitive, has been a major constraint to the creation of jobs and higher incomes, leading to a continued deterioration of the living conditions of households. Moreover, the weakness and lack of export diversification even in terms of products (three products are nearly 60% of total) continue to substantially inhibit the growth potential.

The macro-economic situation, did not guarantee wider access of the poor to productive and financial resources. There is a deficiency in the promotion of micro-enterprises and the informal sector from the rest is the main provider of jobs that the size of the public are kept constant for several years and that recruitment in the formal sector grew only very slowly. However, the uncertainty that prevails has not fostered an improvement in incomes of the poor.

The hope raised by the return of growth during the period 1995-2002 has not been realized because poverty in Senegal was not strongly reduced. The low levels of investment and the weakness of the agriculture and the industry explain the weak impact of economic growth on the poorest populations' life.

Although the country has good economic performance compared to the average in sub-Saharan Africa (the inequality index is lower (41.3 against 47.1), and the growth rate is higher, combined with low inflation), it remains a poor country and has significant gaps in the areas of infrastructure and human development. Senegal remains a poor country although the share of the poor population decreased from 61.4% in 1995 to 48.5% in 2002, and to 40% in 2006, which represents a great progress.

As shown by the Senegalese Survey on the Perception of Poverty (SSPP), in 2006, two-thirds of households consider themselves poor, while one third of them believe that poverty has increased considerably in their community over the past five years. That is why in 2000 Senegal has initiated a participatory

process for the preparation of a strategy for reducing poverty based on a redistributive growth and satisfaction of basic needs of the poor people. Consensus on the strategy focuses on the need to mobilize policy makers, national stakeholders and development partners in the reduction of poverty and exclusion through the establishment of a close link between poverty reduction, economic development and capacity building.

Even if there is no survey data to assess the increase in income inequality since the devaluation, all observers agree are concerned about the level of social indicators.

#### **4. The social protection in Senegal**

Social protection is any intervention by public or private entities that intends to relieve the burden of risks or the needs for households and individuals. Thus, the involvement of public and private organizations is the first criterion for identifying a social protection action. The problem with that is a great loss of information about individual informal actions (such as remittances from migrants and family solidarity), which are highly developed in Senegal. The domains of application of social protection are:

- Health and medical care: it covers all services to preserve, establish or improve people's health and their ability to work and meet their personal needs,
- Sickness: they concern benefits paid to individuals who lose their wage for medical reasons,
- Unemployment benefits: This function covers the benefits provided to individuals who have lost their job,
- Retirement benefits: they cover the services provided to persons who have left the labor market because of retirement,
- benefits of occupational accidents and diseases: they are covered by a compensation of occupational accidents and diseases related to professional activities,
- Family benefits: This function covers benefits to support households, so that they can bear the costs and meet the needs of their members,
- Maternity benefits: They are provided during pregnancy and after birth, over a given period,

- Disability Benefits: This function covers any benefits provided to individuals unable to engage in paid work due to accident or illness,
- Benefits for survivors are given after the death of a protected person, and paid to the beneficiaries because of the family relationships.

By extension, the definition of social protection, the following functions can be added: housing assistance, basic education, the system that helps face social exclusion, social assistance.

In Senegal, unemployment and sickness benefits are not often taken into account in the field of social security programs. Though the programs do not cover a great proportion of the population, the overall contribution is relatively high in the country and the social security is mainly financed by the formal sector. That is why the government has initiated a social protection program, named National strategy for social protection (NSSP).

The main objective of the NSSP is the adoption of a comprehensive, integrated and coordinated political vision on social protection that will increase the access to risk management instruments and to social protection systems for the most vulnerable groups in Senegal. The implementation of the NSSP program will increase the capacity of vulnerable groups' access to basic social services and to economic opportunities, in equitable and sustainable manner. It is supposed to contribute to the following specific objectives:

- Expand and diversify the instruments of social protection and risk management,
- Improve the capacity to respond to shocks and risks for populations, especially the most vulnerable groups,

The implementation of these objectives is built around five (05) priority intervention areas:

- Improve the access to basic services for vulnerable groups,
- Increase access to risk management instruments and systems of social protection,
- Improve the targeting, monitoring and evaluation of actions aimed at vulnerable groups,
- Ensure a legal, fair and adequate scheme to vulnerable groups,
- Strengthen mechanisms for direct transfer of resources to vulnerable groups.

The NSSP is supposed to be integrated in the national strategies developed for the reduction of poverty such as the PRSP.

#### **4.1 Social protection expenditure**

Pension plans exist in Senegal since the colonial period. Many reforms have emerged and the current mandatory pension system comes from occupational pension schemes. The pension system in Senegal is made up by three systems.

The *National Retirement Fund* (NRF), which is devoted to the officials, the *Senegalese Provident Retirement Institution, General Scheme* (SPRI-GS) which is for private sector workers and its *Supplementary Scheme for Managers* (SPRI-SSM). A scheme exists for unhealthy employees.

The National Retirement Fund is a social insurance scheme for officials managed by the Directorate of Pay, Pensions and annuities at the Ministry of Economy and Finance. It pays retirement, disability and survivors as well as some benefits related to family allowances. NRF is created by Law n. 61-35 of 15 June 1961 and it concerns the following people:

- Officers of the civil service and the agents of the Railway Board under former statutes,
- Judges,
- The regular- staff of higher education,
- The firefighters
- Customs and Police,
- Military personnel of the Armed Forces and the national body of firemen,
- Widowees and orphans of the above categories.

The monthly contributions are withholding amounts. The law provides a rate of 23% for employer contributions and social security contributions of 12% for the employees. As for the contribution bases of the NRF, they depend on the specific salary scales of officials. The contribution base has all the common elements of the salary of officials of different categories, such as monthly balance index.

There exist different kinds of pensions that may be paid because of old age: the so-called "proportional" (when the conditions of grant are not all filled), and the so-called "seniority." Proportional pension is paid to officials who have reached the retirement age, or have completed at least 15 years of service,

retired due to disability. The conditions for granting the pensions called "seniority" categories vary according to the population covered.

Survivor's pensions also exist. A reversionary pension to male widows is very rare and is subject to strict resources conditions. These conditions do not apply to female widows, who receive the pensions of their husbands. In the case of polygamy, an egalitarian pension is shared proportionally to the number of wives.

Concerning the benefits, there have retirement benefits and the rights of the retirement pension depend on the period during which contributions were paid. The new base for the calculation of the pension consists essentially of:

- The indicial balance,
- The additional special pay,
- Residence allowance,
- Allowance for special education,
- Increases and salary adjustments,
- Survivors' benefits

#### **4.2. The basic scheme for the private sector**

The private sector employees are subject to a pension scheme managed by the SPRI. In theory, all employees in the private sector are covered by the regime of SPRI.

In 2003, 175,556 contributors were identified for approximately 355,000 members. The contributors are, individuals identified during a year by the SPRI and whose financial contributions have been recorded. The registered persons (also called affiliated persons) include not only the contributors, but also people leaving SPRI but still having rights to IPRES, and those who have multiple registration numbers due to a change of their jobs, for example.

The pension system is based on the distribution SPRI. The mechanism of this system lays on the allocation to some recipients of contributions made by contributors (employers and employees) after deduction of management fees. The pensions of a given period are funded by the levy on earned income in the same period; hence there exists a relationship between the number of

Contributors and the number of recipients. To obtain a pension one must be at least 55 or 60 years, have stopped working and have record at least 400 retirement points. The pension can also be liquidated in advance from 53 years.

## 5. Measuring vulnerability

The social protection measures can contribute to the alleviation of vulnerability and the welfare of the poor, and enhance economic growth. It is therefore useful to implement social protection policies that promote better relief of poverty. To improve the impact of social protection measures on poverty, it may be necessary to introduce, or reinforce reforms, programs or mechanisms of public and private provision of services.

The main objective is to show how structural economic characteristics of households can explain their vulnerability and their exposure to risk, which justifies their need of protection. The specific objectives are to:

- Identify first the main sources of vulnerability for the population and secondly, to know the population groups that are exposed to higher vulnerability,
- Examine for these groups, the expected role of the social protection, as well as sector-based interventions and macroeconomic levels,
- Analyze the gaps the social protection coverage can fill in order to reduce higher vulnerability and poverty
- Make policy recommendations.

### 5.1 Vulnerability to poverty

The measures of vulnerability to poverty indicators are presented here. The analysis is based on the permanent income hypothesis of Friedman. Households' welfare is measured relatively to the average inter-temporal living standard and they face chronic deprivation when this welfare is below the poverty line. Welfare can change because of unfavorable adverse shocks and the risk of changes makes the households vulnerable. Thus, the vulnerability of a household is the probability of poverty at time  $t+1$ , regardless of its level welfare at time  $t$ . Following, the vulnerability of household  $h$  at time  $t$ , can be expressed in terms of future expenditures conditional on his characteristics:

$$v_t^h = \text{Prob}(c_{t+1}^h = c(X^h, \alpha_{t+1}, \beta_h, e_{h,t+1}) \leq z/X^h, \alpha_{t+1}, \beta_h, e_{h,t+1}) \quad (1)$$

where:

- (i)  $c_{t+1}^h$  is the level of per capita expenditure of household  $h$  at time  $t + 1$ ,
- (ii)  $X_h$ , a set of observable socioeconomic characteristics of household  $h$ ,
- (iii)  $\alpha_{t+1}$  a vector of parameters describing the state of the economy at time  $t + 1$
- (iv)  $\beta_h$ , time-invariant unobservable effects at the household level,
- (v)  $e_{h,t+1}$ , idiosyncratic shocks inherent to some factors, helping differentiate the households' welfare
- (vi)  $z$  is the poverty threshold.

It is worth to note that it is impossible to directly observe vulnerability. Only current vulnerability with respect to future poverty can be assessed. Then the probability of poverty depends not only on the average expected expenditures, but also the fluctuation of this latter, measured by an inter-temporal variance. It is important to distinguish between situations where households are poor because of permanent low welfare from temporary deprivation. Despite the scarcity of panel data, following Chaudhuri, and under certain assumptions, the availability of cross-sectional data can allow the analysis of households' vulnerability (Chaudhuri, 2002; Chaudhuri, Jalan, Suryahadi, 2002). The starting point of this option is the analytical expression of the determinants of per capita expenditure household  $h$ , summarized by the following equation:

$$\ln c_h = X_h \alpha + e_h \quad (2)$$

where: (i)  $\ln c_h$  is the logarithm of per capita expenditures, (ii)  $X_h$ , a set of observable characteristics of household  $h$ , (iii)  $\alpha$ , a vector of parameters, (iv)  $e_h$ , a random term with zero mean, capturing the idiosyncratic shocks that help to differentiate the standard of living of households. The equation implies that the shocks related to the expenditures for each household, are identically and independently distributed in time. Thus there is absence of the specific unobservable effects of household that may influence their expenditure over time. This assumption is dictated by the cross-sectional nature of the available data used. Using Chaudhuri's approach, we consider that the variance of  $e_h$  can be explained by observable characteristics of households and we use the simple functional form expressed:

$$e_h^2 = X_H \omega + \alpha_h. \quad (3)$$

Under these conditions, the parameters are estimated by generalized least squares (Feasible Generalized Least Squares - FGLS) in three steps suggested by Amemiya (1977).

$$\text{Inc}_h = X_h \alpha + e_h \quad (4)$$

The distribution of the logarithmic of the expenditure is linked to the probability that a household with characteristics  $X_h$  is poor, that is to say the extent of the vulnerability of the group  $h$ . This is formalized in this way:

$$V_t^h = \text{Prob}(\text{Inc}_{t+1}^h \leq \text{Inz}) = \Phi \left[ \frac{\text{Inz} - \widehat{X}_h \alpha}{\sqrt{\widehat{X}_h \widehat{\omega}}} \right] \quad (5)$$

Where  $\Phi$  is the cumulative density function associated with a normal distribution. For the application, the variables included in the regressions are: household size (level and its square), age of the head of household from 17, the marital status, whether the head of the household is single, married, divorced, polygamous, monogamous, widowed, a set of dummies for whether the household head is illiterate, has attended primary school, secondary school, or tertiary education; whether the head of the household is male, lives in the capital Dakar, the other urban areas, rural areas; whether he is an active occupied, inactive or jobless, salaried worker in either the government or private sector, self-employed in agriculture, self-employed in non-agriculture sectors,

## **5.2. Measures of structural and transitional vulnerabilities**

### *a) Structural vulnerability*

- high poverty level, many people in extreme poverty and inequality
- Lack of access to basic services
- Seasonality of employment, income and consumption needs
- Concentration of the poor by region, gender or ethnicity
- Low number of commodities and lack of diversification of the portfolio assets
- Low skill level of labor force
- Structural unemployment (youth, graduates, women, etc..)

- Limited social networks or family
- Number of working children
- Permanent physical or mental disabilities

*b) Transitional vulnerability*

- Linked to the environment or to time (floods, droughts, pests, etc.).
- Recession or economic crisis (loss of job, etc..)
- Illness or injury ( Individual health, AIDS, epidemics, temporary mental or physical disability)
- Circumstances related to the life cycle - effects on households' income of eldersness, death of a family member, widowhood, or rupture of the household, multiple births , etc.

We present a more detailed empirical evidence to link the socioeconomic characteristics to vulnerability. For this we present the conceptual aspects of the methodology before addressing the practical aspects

### **5.3 Conceptual framework**

Consider the period  $t$  ( $= 1$  or  $2$ ) selected between the years 1995, 2002 and 2006 when the household surveys are available in Senegal. The density functions of the distribution of income in periods 1 and 2 are denoted by  $f^1(y)$  and  $f^2(y)$  and let  $\varphi^t(y, X)$  be the joint distribution of incomes and households' or individuals' characteristics  $X$ .

Denoting by  $g^t(y / X)$  the distribution of income conditional on  $X$  and  $C(X)$  the domain of values of  $X$ .

We can write

$$f^t(y) = \int_{C(X)} g^t(y/X) H^t(X) dX \quad (6)$$

The term  $H^t(X)$  is the joint distribution of all the elements of  $X$  at time  $t$ . We can express the passage from  $f^1(y)$  to  $f^2(y)$  through on the distributions  $g^t(y / X)$  and  $H^t(X)$ . We define this counterfactual distribution:

$$f_g^{1,2}(y) = \int_{C(X)} g^2(y/X)H^1(X)dX \quad (7)$$

It is the distribution that would be observed during period 1 if the distribution of income conditional on characteristics X had been observed in period 2. This counterfactual distribution can be calculated if we identify the distributions  $g^1(y/x)$ ,  $g^2(y/x)$  and  $H^1(X)$ .

By altering the joint distribution of socioeconomic characteristics, we can as well define the counterfactual distribution:

$$f_H^{1,2}(y) = \int_{C(X)} g^1(y/X)H^2(X)dX \quad (8)$$

Note that the following equalities are true:

$$f_g^{1,2}(y) = f_H^{2,1}(y) \text{ and } f_H^{1,2}(y) = f_g^{2,1}(y) \quad (9)$$

The decomposition of distributional changes ( $f^2(y) - f^1(y)$ ) is:

$$f^2(y) - f^1(y) = [f_g^{1,2}(y) - f^1(y)] + [f^2(y) - f_g^{1,2}(y)] \quad (10)$$

The first expression of the second member gives the temporal change of income explained by the change of the conditional distribution on characteristics X. It shows how the distribution of characteristics in period 1 could lead to a different distribution of income if the distribution  $g(y/x)$  was that of period 2. The second term is the effect of changes of the endowments occurred between periods 1 and 2.

It is possible to rewrite the equation (5) as:

$$f^2(y) - f^1(y) = [f_g^{1,2}(y) - f^1(y)] + [f^2(y) - f_H^{2,1}(y)] \quad (11)$$

This gives a decomposition which is valid for poverty indices. We will apply the methodology using decomposing the vector of characteristics in sub-categories. The advantage of this decomposition is that it takes into account any distribution of living standards and features, not only distribution average. More generally, this last decomposition formula can be applied to any statistic defined on a distribution of living standards (income, expenses, etc..) and any measure of inequality and poverty based on poverty thresholds (Bourguignon et al. 2005)

## 5.4 Applications

We use the theoretical approach outlined above for the links between the characteristics of heads of households and poverty. At time  $t = 1$  or  $2$ , the income of individual  $i$  is given by:

$$\ln y_i^t = X_i^t \Omega_t + \varepsilon_i^t \quad (12)$$

The counterfactual income values between  $t = 1$  and  $t = 2$  are given by:

$$\ln (y_i)^{1,2} = X_i^1 \widehat{\Omega}_2 + \widehat{\varepsilon}_i^1 \quad (13)$$

with  $i = 1, 2, \dots, N_1$

These values are obtained by simulating the model (15) on the data available at time  $t = 1$ . This shows what would be the income of individual  $i$ , if the returns on each characteristic were those observed at time  $t = 2$ , rather than those observed in  $t = 1$ . The yields of the unobserved characteristics contained in the residuals  $\widehat{\varepsilon}_i^t$  are constant. Counterfactual values of the error terms in the distribution of  $(y_i)^{1,2}$  are a bit more tricky to build. To import the distribution of residual from time  $t = 2$  to  $t = 1$ , we use the expression (Bourguignon et al. 2005) :

$$\ln (y_i)^{1,2} = X_i^1 \widehat{\Omega}_1 + \widehat{\varepsilon}_i^1 \left( \frac{\widehat{\sigma}_\varepsilon^{(2)}}{\widehat{\sigma}_\varepsilon^{(1)}} \right) \quad (14)$$

for  $i = 1, 2, \dots, N_1$

Using these counterfactuals, we can find the estimators of the contribution (to total redistributive change between  $t = 1$  and  $t = 2$ ) of the variation of the parameters  $\Omega$  and the distributions of residuals. The effect of changing the distribution of individual endowments  $X$  corresponds to the complement of the previous two variations:  $(y_i)^2 - (y_i)^{1,2}$

For the empirical analysis, we build an income generation model that allows distinguishing between the sources of changes in the distribution of income into three forces. The first force is linked to the changes in the socio-demographic features of the households (named the endowment effects or population effects).

It comprises the changes in the socio-demographic structure of the population, as the area of residence, age, household's composition

The second one comes from the changes in the returns to factors of production (price effects), comprising changes in the returns to factors of production, such as education and experience.

The third one comes from the changes of the occupational structure in the population, (occupational effects), in terms of wage work, self-employment, unemployment, inactivity, private or public sector.

The data used come from the following recent surveys:

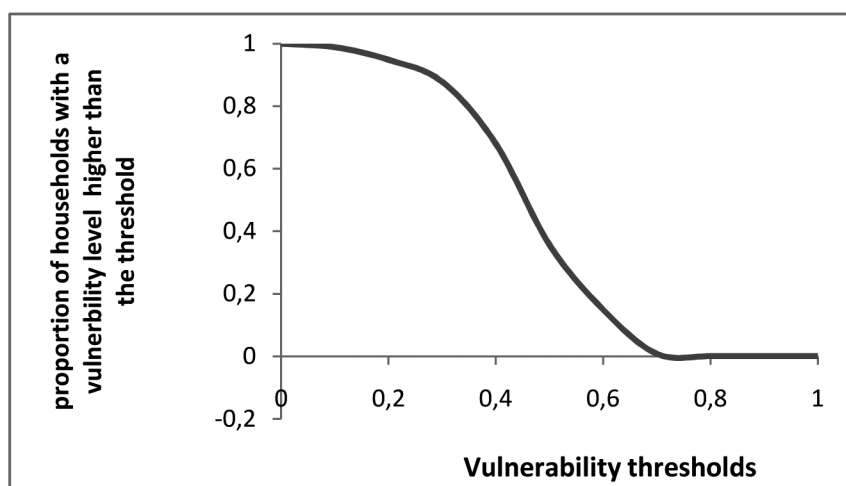
- Senegalese Survey for Monitoring and Perception of Poverty (SSMP) in 2006, on 13600 households ( 8640 from cities and 4960 from rural areas.)
- Senegalese Survey for Monitoring and Perception of Poverty (SSMP) in 2011, on 5953 households.

The second one is used for the assessment of high vulnerability and the first one for the evaluation of impact of socioeconomic characteristics on poverty.

## 6 Aggregate poverty and vulnerability in Senegal

The estimated aggregate distribution of vulnerability for the country is given in Figure 1. We use the SSMP of 2011 and we plot the incidence of vulnerability at different thresholds between 0 and 1, for the population as a whole. The incidence of vulnerability (the fraction of the population that has an estimated probability of being poor higher than the threshold) declines when the threshold increases. Thus, at a threshold of zero, everyone's probability of being poor is positive and no one is vulnerable at the threshold of one.

Figure 1. Aggregate vulnerability in Senegal



Sources: Authors calculations using the SSMP survey data of 2011

The choice of a vulnerability threshold is arbitrary and we try to choose three significant ones. We measure the relative vulnerability by using the incidence of poverty as threshold, because the poverty rate represents the mean vulnerability level in the population. We also consider as vulnerable those who have a probability greater than the mean vulnerability. The threshold of 75% gives the higher vulnerability.

Table. 1 in appendices shows that while 41.7% of the population is poor, 42.5% of the population remain vulnerable. In other words, the proportion of vulnerable people who have a probability of being poor in 2012 is greater than the poverty rate in Senegal.

We also see that 37.8 % of the non-poor people are vulnerable, 38.23 of

them are relatively vulnerable and 22.3 are highly vulnerable, meaning that their probability to be poor in 2012 is higher than 75%. More than half of the poor households (58%) are vulnerable and 42.1% of them are highly vulnerable.

In conclusion, the proportion of vulnerable population is higher than the proportion of poor. Social protection programs for the reduction of vulnerability in the population may be more urgent for the 42.1% of the population who are poor and highly vulnerable.

The poverty and vulnerability profiles in 2011 are presented in tables 2, 3 and 4 in the appendices. The estimates for the regions and selected demographic and community characteristics are also presented. The decomposition by regions in Table 2 shows the average distribution of vulnerability. It appears that high vulnerability is greater in the rural regions such as Tambacounda, Kaffrine, Diourbel. The capital Dakar is one of the cities where vulnerability is not very high though it has the greatest proportion of the population shares. The spatial distributions of poverty and high vulnerability are tightly correlated, mainly in the urban regions where population is concentrated. It is the case of Diourbel, Kaolack, Tambacounda and Kaffrine.

In average, the southern regions (Kolda, Sedhiou, Ziguinchor) face less high vulnerability than those of the north and center of Senegal.

Table 3 shows that poverty and vulnerability are mainly developed in rural areas. The share in the population of rural households is high (48.5) but the proportions of vulnerable and high vulnerable people are too disproportionate high (respectively 64 and 70%). Less than 6% of highly vulnerable populations live in the capital Dakar. The main explanation can be found in family solidarity within people coming from same villages.

Taking into account the sex of the head of households, we can see that in average, women have a mean vulnerability greater than men's. But families headed by men are poorer and highly more vulnerable than women: 69 versus 31%.

There are very significant differences between people according to the marital status of the heads of households. Not only the married monogamous are the poorer and the more vulnerable, but also they share the greatest proportion of the population (more than 51%). Single households are less vulnerable though they represent very small share in the total population.

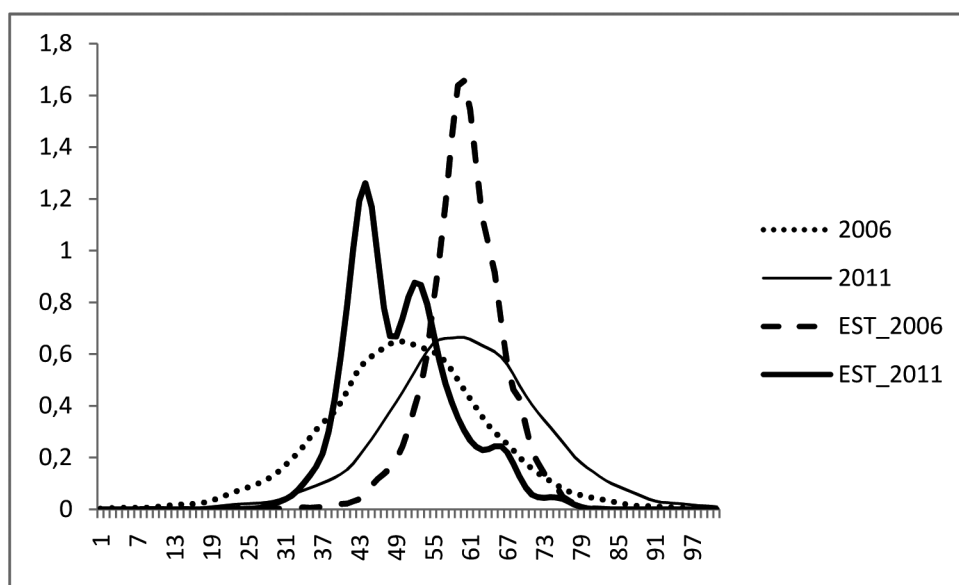
The households whose heads don't have formal education are very highly vulnerable and poor in Senegal. It can be linked to the fact that the level of

human capital of the heads excludes these ones from public administration and direct them to the informal sectors. The distribution of poverty and vulnerability according to the level of education nearly follows the distribution of population shares. People who have tertiary education are disproportionately less poor and vulnerable than those who are not formally educated.

According to the activity, jobless persons are in average more vulnerable and poor. But active persons who have job are highly vulnerable, probably because of uncertainty of the stability of their jobs. Also, inactive persons such as retired ones are not as poor as the active ones.

Following the business sector of the heads of households, we can see that people working in public sectors are less vulnerable than everyone. But the independent farmers face both poverty and vulnerability more than every other group in the country.

Figure 2 Densities of incomes and counterfactual incomes

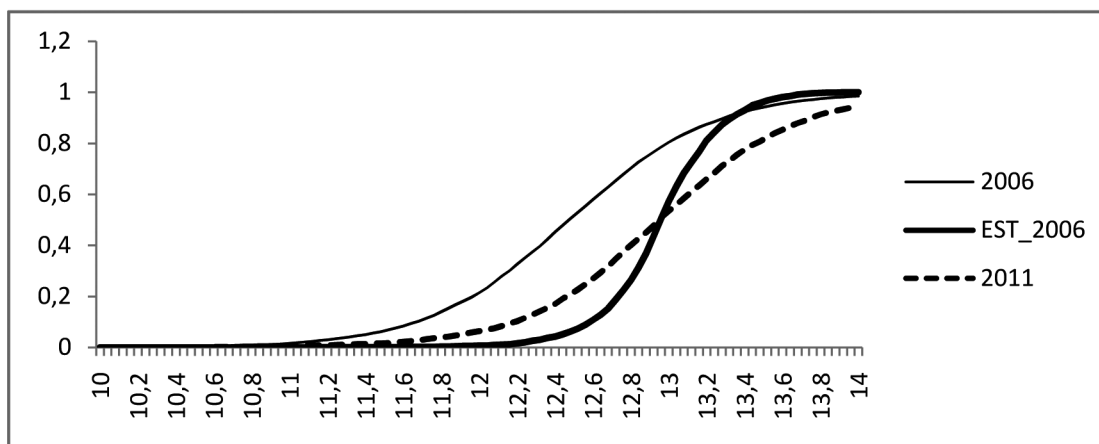


Sources: Authors calculations using the SSMP survey data of 2011

The density functions of the living standards (logarithm of the equivalent adult expenditure) in 2006 and 2011 are plotted in figure 2, with their respective counterfactuals. It appears that the distribution of income is more unequal in 2006 than in 2011. The estimated income (named EST\_2006 in the graph) is obtained by using the coefficients of the regression of income on the household characteristics, and applying them on the same characteristics in 2006. The same with the variable EST-2011 estimated with the coefficients of 2006. The figure

shows that if there were no changes in the households' characteristics from 2006 to 2011, inequality in the distribution of income would be higher in 2011.

Figure 3 FGT curves of incomes and counterfactual incomes



Sources: Authors calculations using the SSMP survey data of 2011

The FGT curves are shown in figure 3 where we plot the poverty incidence with varying levels of poverty lines in the horizontal axis. Poverty is higher in 2006 than in 2011. It appears also that the counterfactual estimation of the income (EST\_2006) presents less poverty than the two other distributions. It means that if the characteristics in 2011 were the same than those in 2016, poverty would be more reduced in 2011.

In table 5, we present the mean transfer necessary to compensate the difference between real income in 2006 and the counterfactual income, according to different households' characteristics. The aim is to identify how in average, a transfer can reduce poverty from the real situation in 2006 to a situation better than that of 2011. We take the average difference between the income in 2006 and the counterfactual in the same year. There is more need of social intervention in rural areas than in urban zones, in average. As we have previously shown that households headed by male are more vulnerable than those headed by female, it appears that the first ones need more economic assistance. Their average income transfer need is of about 0.49. Households headed by widowed person also need more transfer. Jobless persons need less assistance than inactive persons or occupied active persons.

We also see that tertiary education is a defense against vulnerability. The households whose heads just attained primary school, need more assistance.

According to the regions, it appears that the regions of Kolda, Diourbel Tambacounda, and the capital Dakar need more social transfer than the others

## 7 Conclusion

As poverty is an uncontrolled phenomenon, the poor individuals of one period may be poorer next period, the rich one also, can become poor because of their vulnerability. In this study, we have identified the link between vulnerability and socio-economic characteristics of the households in Senegal. The objective is to find appropriate orientation of social protection policy interventions, that will make population less exposed to future poverty.

Vulnerability is the probability that a household will be poor in the future. We use two approaches to conceptualize two different dimensions of vulnerability. First, we measure vulnerability to poverty, and then estimate vulnerability using cross-sectional data of 2011.

The main results that emerge from this analysis are the following ones. First, while 41.7% of the population is poor, 42.5% of the households remain vulnerable. The proportion of vulnerable people who have a probability of being poor in 2012 is greater than the poverty rate in Senegal. But social protection programs aiming to reduce vulnerability in the population may be more urgent for the 42.1% of the population who are poor and highly vulnerable.

In average, the southern regions face less high vulnerability than those of the north and center of Senegal. Poverty and vulnerability are mainly developed in rural areas. Less than 6% of highly vulnerable populations live in the capital Dakar. Households headed by men are poorer and highly vulnerable.

There are also very significant differences between people according to the marital status of the heads of households. Married monogamous are the poorer and the more vulnerable people.

Education is a great factor that differentiates vulnerable people. Less educated heads of households are highly more vulnerable than the formally educated ones. The independent farmers face both poverty and vulnerability more than every other socioeconomic group in the country.

We identify how in average, a transfer can reduce poverty from the real situation in 2006 to a situation better than the level of 2011. We take the average difference between the income in 2006 and the counterfactual in the same year.

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## Appendices

Table 1. Sources of vulnerability in Senegal

	Overall	Amongst the non-poor	Amongst the poor	Amongst the vulnerable	Amongst the highly vulnerable
Fraction poor	0.4161	0.00	1.00	0.5210	0.5686
Mean vulnerability	0.4248	0.3499	0.5300	0.5234	0.9039
Fraction vulnerable	0.4638	0.3786	0.5834	1.00	1.00
Fraction relatively	0.4682	0.3823	0.5886	0.9907	0.00
Fraction highly	0.3088	0.2281	0.4219	0.6595	1.00

Sources: Authors calculations using the SSMP survey data of 2011

Table 2. Distribution of poverty and vulnerability by regions

	Population share	Share of poor	Share of vulnerable	share of highly vulnerable	Mean vulnerability
Regions					
Dakar	10.06	4.36	8.47	6.42	35.01245
Ziguinchor	6.48	9.49	5.49	5.11	35.9986
Diourbel	7.56	6.86	7.36	8.27	43.31282
Saint-Louis	6.94	5.05	7.39	7.56	46.01953
Tambacounda	8.43	8.92	9.62	10.61	49.02045
Kaolack	7.51	9.08	8.0	8.22	43.89468
Thiès	7.54	5.33	7.75	7.34	43.17503
Louga	7.12	3.23	6.78	6.04	39.41618
Fatick	6.75	8.36	6.96	6.96	42.75137
Kolda	6.52	8.92	5.42	5.66	36.99589
Matam	6.03	5.73	6.17	6.37	44.07534
Kaffrine	7.31	8.16	8.9	9.68	51.09296
Kédougou	4.8	6.9	4.92	4.52	42.18715
Sédhiou	6.94	9.61	6.78	7.24	42.4543

Sources: Authors calculations using the SSMP survey data of 2011

Table 3. Poverty and vulnerability within different segments of the population

Sources: Authors calculations using the SSMP survey data of 2011

	Population share	Share of poor	Share of vulnerable	Share of highly vulnerable	Mean vulnerability
Zones					
Dakar	9.05	4.16	7.71	5.71	35.34803
Other urban zones	42.40	36.62	28.42	24.05	29.28229
Rural zones	48.55	59.22	63.87	70.24	55.35328
Sex					
Male	74.94	81.71	68.68	68.88	39.1787
Female	25.06	18.29	31.32	31.12	52.34334
Marital status					
Married monogamous	52.71	52.16	57.95	61.10	47.08837
Married polygamous	31.43	34.03	31.04	29.00	40.69663
Single	2.91	2.10	2.01	2.07	29.66415
Widowed	10.65	10.01	6.49	5.66	27.96989
Divorcee	2.30	1.70	2.51	2.18	44.50977

Table 4. Poverty and vulnerability within different segments of the population

	Population share	Share of poor	Share of vulnerable	share of highly vulnerable	Mean vulnerability
Without education	69.17	62.27	80.95	86.69	49,92
Primary education	15.35	16.68	9.20	5.84	24,06
Secondary education	12.02	15.58	7.76	6.00	27,93
Tertiary education	3.46	5.47	2.08	1.47	26,09
Occupation					
Occupied Active	78.92	78.36	80.30	81.28	42,93
Jobless	0.87	0.97	1.04	1.03	54,02
Inactive	20.21	20.67	18.66	17.68	40,21
Sector of activity					
Public sector	6.15	2.87	2.62	1.41	19,87
Private sector	7.71	5.77	8.54	6.37	45,33
Independant farmer	22.12	28.18	43.85	53.32	80,97
Independant non farmer	14.09	10.70	5.96	4.41	18,60
Other dependant	28.84	30.84	19.34	15.78	29,90
Jobless	21.08	21.64	19.70	18.72	40,79

Sources: Authors calculations using the SSMP survey data of 2011

Table 5. Mean transfer necessary to compensate the difference between and counterfactual income

<b>Zones</b>		<b>Region</b>	
Dakar	0.3693079	Dakar	0.4812556
Other urban zones	0.2154456	Diourbel	0.4926989
Rural zones	0.7076229	Fatick	0.4810859
<b>Sex</b>		Kaolack	0.4754445
Male	0.4921629	Kolda	0.4981814
Female	0.4743074	Louga	0.4618572
<b>Marital status</b>		Matam	0.4812046
Married monogamous	0.4764527	Saint-louis	0.4702735
Married polygamous	0.4863342	Tambacounda	0.4900141
Single	0.4713576	Thies	0.4632142
Widowed	0.4684898	Ziguinchor	0.4619211
Divorcee	0.4789237	<b>Level of education</b>	
<b>Occupation</b>		Without education	0.4214347
Occupied Active	0.6271253	Primary education	0.5294708
Jobless	0.3849538	Secondary education	0.3583651
Inactive	0.484036	Tertiary education	0.1658062