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Poverty Dynamics in Benin: a Markovian Process Approach

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Abstract

In this paper the Markov model has been used to analyze poverty dynamics in Benin. Assuming that the observed successive changes in classes of wellbeing at the household level could be considered as a Markov chain, the *first-step-analysis* method is used to derive several indicators to measure the relevance of poverty reduction policies implemented in Benin. Data used come from a two-year panel of 16,562 households (2006 and 2007).

The analysis shows that Benin will attain its objective of 15% extreme poverty, but probably five years later than the target date of 2015. There exists a high level of mobility for wellbeing with a large number of households exiting extreme poverty. The poverty policies implemented between 2006 and 2007 were effective and allowed sustained upward mobility.

Keywords: Markov chain, Poverty dynamics, ordered model, Benin.

JEL code: C23, C25, D31, I31, I32

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Introduction

Following the economic crisis in the 1990s, Benin has developed and has implemented a strategy to combat poverty. Implementation of this strategy over 2003-2005 has helped guide economic reforms. Inflation was kept within the limits prescribed by the UEMOA convergence pact (less than three percent) and the current account balance has improved over 2004-2005 due to positive changes in the balance of services and income. However, the growth objective could not be achieved due to external shocks which slowed down economic activity. The average real rate of economic growth was 3.3% over 2003-2005 as opposed to the goal of 7% annual growth that had been anticipated.

Despite this performance, the level of poverty has remained insensitive to development efforts that have been carried out. Over 2001-2006, the incidence of income poverty increased substantially from 28.5% in 2002 to 36.4% in 2006 (INSAE, 2009). This increase is more marked in urban areas (from 23.6% to 35.0%) than in rural areas (from 31.3% to 38.8%) between 2002 and 2006.

Thus, the fight against poverty still remains a major challenge for Benin. This deteriorating poverty situation noted in the context of implementing the Poverty Reduction Strategy Papers (PRSP) (2003-2005), contrasts with the first year of the second round of the PRSP. The poverty rate in Benin fell by 5.2 percentage points from 37.4% in 2006 to 32.2% in 2007 (INSAE, 2009).

This situation can be explained by stronger economic activity in 2007. In fact, the growth rate has increased to 4.6% in 2007, as opposed to 3.8% in 2006 and 2.9% in 2005. This growth rate is largely based on an increasingly dynamic tertiary sector, promotion of the private sector and the effects of higher cotton production in the secondary sector. Tertiary sector activities increased by 5.6% in 2007 compared to 3.4% in 2006. This growth was driven by trade, transport and telecommunications, and other services, which respectively registered growth rates of 5.0%, 6.4% and 6.0% in 2007.

On the other hand, the primary sector which concentrates an important proportion of the rural population, largely poor, has experimented a slight slowdown, moving down from 5.6% in 2006 to 4.9% in 2007. However, its contribution to the GDP growth is estimated at about 1.9 percentage points in 2007 as opposed to 2.1 percentage points in 2006. This slight slowdown can be attributed to slower growth in agricultural production, which moved from 7.2% in 2006 to 4.9% in 2007, while fisheries and forestry has registered a growth of 7.1% in 2007 compared to a decline of 1.0% the year before.

It comes out that policies implemented with the Growth Strategy for Poverty Reduction (2007-2009) have helped consolidate the economy and promote poverty reduction in Benin.

At the moment where the Government makes the fight against poverty a priority, which was clearly stated through its Growth Strategy for Poverty Reduction (2007-2009) and its Development Strategic Orientations (2006-2011), it appears necessary to analyze, beyond describing the profile of this phenomenon, its complex dynamics in order to bring out all the factors which can explain the observed situation. One would thus contribute to reorient existing policies or todevelop new poverty alleviation policies more effective and sustainable. That is what justifies the relevance of the present study.

The remainder of the paper is organized as follows: the second section presents the problematic and the research objectives; the literature review is found in the third section and introduces various works on the subject of poverty in Benin, along with several concepts and definitions, as well as the analytical methods and factors that can explain the transitions; the fourth section discusses the methodology; the fifth section presents the results; and the last section presents the conclusions and recommendations for economic policy.

2. Problematic and research objectives

After more than a decade of development policies geared towards poverty alleviation, one cannot help but notice that millions of Beninese's continue to live in poverty. Such a situation points to the need to conduct complementary empirical research in order to inform new development policies and to improve their implementation. To that end, analyzing the dynamics of poverty – especially those aspects which are insufficiently addressed in previous works relating to Benin – would be of a great contribution. In effect, households may be faced with economic situations which increase their vulnerability of falling into poverty and/or directly have negative impacts on their standard of living.

The study therefore aims to identify indicators which can measure the relevance and effectiveness of policies implemented in the context of poverty reduction strategies in Benin. An effective policy should promote positive changes in the state of wellbeing and allow households who have moved into a higher state of wellbeing to stay in this preferable state for as long as possible. The study also intends to identify the factors which explain the transitions between different states of wellbeing such that decision makers will know which policies geared towards combating poverty are most suitable and effective.

As such, the study seeks to answer the following questions:

(i) what is the probability of being chronically poor, transitionally poor, or of never being poor?

(ii) in the long term, what is the probability of being in a given state of wellbeing when the process of moving between states of wellbeing is in equilibrium (i.e., when the number of households exiting poverty is equal to the number entering poverty)?

(iii) what is the average period of time spent in a state of wellbeing?

(iv) what is the probability of transitioning to a given state j from state i?

(v) what is the expected amount of time for a household to return to a given state after having gone through other states?

(vi) which factors explain the transition from one state to another?

3. Literature review

Poverty is a dynamic phenomenon because standards of living change over time such that individuals and households move into or out of poverty over time. In order to understand the dynamics of poverty we need to distinguish between the short term poor (the transitional poor) and the long term poor (the chronic poor), which amounts to analyzing transitions between different classes of wellbeing (Odouro, 2002; Clément, 2003 and 2005). Accounting for this aspect of poverty has two main advantages: (i) more realistic explanatory models can be proposed when accounting for household heterogeneity in terms of poverty, and (ii) improved specifications for policies which effectively combat poverty.

After a general presentation of works on Benin, this review discusses factors which influence households' transitions between various states of wellbeing.

3.1. Overview of work on poverty in Benin

The most recent studies on poverty in Benin have addressed questions of health and education as well as redistribution, targeting, inequality and growth. They have not, however, addressed economic mobility and transitions between states of wellbeing. For example, Ahovey and Vodounou (2003) analyzed health-related aspects of child poverty using a multidimensional approach. Using stochastic dominance tests with two dimensions as per Duclos, Araar and Giles (2006), robust comparisons of poverty were carried out on the basis of the mother's number of years of education.

Similarly, Vodounou et al. (2005) used the stochastic dominance approach in an analysis of poverty dynamics and questions of redistribution, growth and targeting.

Furthermore, methods of parameterizing Lorenz curves, such as those based on functional, generalized quadratics, and Beta forms were explored by Balaro using cross sectional survey data. Their research shows that growth in inequality results from the effects of growth together with the effects of implementing macroeconomic policies and reforms.

The most recent study targeting the question of transitions relating to poverty is that of Mededji (2009). This study used panel data to analyze the transition in poverty and factors determining whether households belong to a given class of households. It is, however, limited to the urban environment and applies a multinomial logistic model. Thus, most of the research questions relevant to our study have not been addressed in previous research on poverty in Benin. Beyond the classical methods of analyzing poverty, this study proposes a simple method which is suitable for the type of data used.

3.2. Determinants of the transition

Very little research exists on the individual dynamics of poverty in developing countries which are able to provide enough information on factors that explain transition into poverty. This is particularly true for Africa. The most enlightening of the studies that do exist, however, are by Ravallion and Jalan (1998a, 2000) on China, and by Gaiha (1988, 1992), and Gaiha and Deolaliker (1993) on India. These works on the determinants of chronic and transitional poverty also address vulnerable households, emphasizing the households' intrinsic characteristics.

Their analyses look at both rural and urban areas. Gaiha and Deolaliker (1993) show that chronic rural poverty in southern India results from variation in earnings and wage levels. They explain these differences in per capita income as a result of inequalities in capacities needed to increase income. In the same vein, Drèze, Lanjouw and Stern (1992) showed that the persistence of poverty in southern India is not only due to a lack of productive assets, but also due to certain intrinsic disadvantages in terms of human capital, such as basic skills needed in the workplace. Analyzing transitory poverty in the same area, Gaiha and Deolalikar (1993) find that transitory poverty is the result of adverse effects of price variations.

Ravallion and Jalan (1998a) showed that the common explanatory factors for the two types of poverty in rural China are physical assets and life cycle effects. Wealth held by the household is an important factor which reduces both chronic and transitory poverty. Factors which are significant for chronic poverty but not for transitory poverty include demographic factors, level of education and household members' health, such that chronic poverty is less common among small households with a high level of education. These factors do not,

however, affect transitory poverty. As such, living in an area where health and education infrastructure are available reduces chronic poverty but has little effect on transitory poverty.

In Côte d'Ivoire, Grooteart (1996) finds that human capital is the factor which best explains changes in the standard of living over time in urban areas. Indeed, a household with a high level of education has a strong chance of exiting poverty. However, these authors emphasize that this is not necessarily always the case: a diploma even appears to act as a possible handicap for finding work with small businesses.

Furthermore, their work also shows that a household with fewer children and headed by a young employee – notably in the public sector – also has a strong chance of escaping poverty. Large households also tend to have a lower standard of living, while households have difficulty maintaining a constant standard of living when additional members are added.

The works of Woolard and Klasen (2004) on South Africa have highlighted the importance of shock variables for mobility of wellbeing. According to these authors, the events which lead to the largest changes in household income are demographic and economic. From the economic perspective, they specify: (i) loss of employment for the household head and/or other household members, (ii) reduction in transfers from migrants in the household and (iii) reduced non-wage income for the household head and/or other household members. From the demographic perspective, events which affect mobility in wellbeing are variation in household size (due to death, birth, or migration) and the demographic composition of the household (the proportions of children, active men under 65, active women under 60, etc, in the household).

This previous research offers a good framework to understand the factors that determine the different states of wellbeing in Benin.

4. Methodological approach and data used

The methodology used relies on the Markov chain model. This approach uses the transition matrix associated with the Markov chain to estimate performance indicators of the strategies used in the fight against poverty. This amounts to an analysis of the relevance of economic policies implemented to improve the wellbeing of a population. An ordered logit model and a model of the variation of the wellbeing function (an estimate of the variation in per capita consumption expenditures, normalized by the poverty line) are used to determine the factors which explain the states of wellbeing and transitions between the different states of wellbeing.

4.1 Theoretical framework of the Markovian model

Let $E = \{e_j\}$, *j = 1, 2, …, r,* be the set of states of wellbeing for a household. By construction, the states are ordered and we have: $e_1 \prec e_2 \prec \cdots \prec e_r$, such that that state e_2 is preferable to state e_1, state e_3 is preferable to state e_2, and more generally, that state e_j is preferable to state e_{j-1}. That is to say, that a household classed in e_j has a higher standard of living than another one classed in e_{j-1}. The level of wellbeing attained by a household is a random phenomenon. When a household moves from state e_j to state e_{j-1} reflecting a lower standard of living, we can say that it has had a negative state change (a negative transition). We can conversely speak of a positive state change (a positive transition).

The goal of a poverty reduction strategy is to progressively reduce the number of households in state e_j and increase the number in state e_{j+1}. In other words, an effective anti-poverty policy will reduce the number of households in the lower wellbeing classes and increase the number of households in the higher wellbeing classes. Thus, the logic behind a poverty reduction strategy wants that a household in class e_{r-1} or e_r should stay in as long as possible; therefore, the poverty reduction strategy aims to reduce negative transition such that in the long-run, state e_r becomes absorbing[1] , i.e., where households will stay for the long run.

This situation as described can be modeled by a Markov type stochastic process of finite dimensions (i.e., a limited number of states). In other words, we suppose that the process of changing one's state of wellbeing is a discrete time Markov chain, X(t), characterized by a transition matrix ***P*** with an initial distribution of $\boldsymbol{a_0}$. At time t, X(t) = e_t signifies that the observed household is in state of wellbeing e_t. This process can be analyzed using a descriptive method based on the indicators in the matrix ***P*** and a multivariate method. The descriptive method is based on a method called "*First-step analysis"* as described by Ross (1997) and also by Kulkarni (1995), while the multivariate method uses econometric techniques to identify the factors affecting transitions between states of poverty.

First-step analysis is used to analyze discrete time Markov chains by examining obstacles which may arise at the end of the first transition in the chain (Batabyal, 2004). The

[1] Unfortunately, this is not the case because rich households can also become poor. The ideal of poverty reduction strategies would be for households who become rich to stay in this state for as long as possible.

probability distribution and the Markov property are then used together to identify the relationship that exists between the variables of interest.

The model is based on two fundamental hypotheses:

(i) the model is a time-homogeneous finite Markov chain. Thus, the transition matrix does not depend on time, and only the changes observed at the moment of observation are accounted for;

(ii) a household's state of wellbeing in a given period depends only on its state in the preceding period and not on the history of its state of wellbeing.

In this study, the states of the Markov chain are defined as the quintile of the per capita consumption expenditure normalized by the poverty line[2] of each stratum. To classify individuals within the wellbeing states, the initial year quintile cutoffs in both initial period and final period are used. By doing this, the percentage of persons in each income group in the terminal year will vary, depending on growth in the poverty line, changes in inequality, and changes in relative mobility.(Quah, 1993; Gottschalk and Danziger, 1997).

4.2. Estimation of the indicators

The indicators are estimated from the transition matrix ***P*** whose elements, denoted as p_{ij}, are the probabilities of transition from state of wellbeing ***i*** to state of wellbeing ***j***. Two cases can be distinguished: the case where the Markov chain is absorbing and the case where the chain is ergodic or irreducible.[3] In reality, the empirical observations of household wellbeing show that it is nearly impossible to have an absorbing Markov chain, so we consider an ergodic Markov chain later on. This form of Markov chain has been used by other authors in analyses of regional convergence (Le Gallo, 2004) and income derived from agricultural activities (Temel and Albersen, 2003).

The analysis is based on four main points: (i) the probabilities of transition from one state to another, found in the transition matrix; (ii) the rate at which household members leave one state for another, found in the matrix detailing the average duration of the first passage; (iii) the limit distribution. This is a long run projection of the proportions of the population in each class of wellbeing which, all else equal, are the equilibrium probabilities for each state of wellbeing; and (iv) interclass individual mobility using mobility indicators.

[2] We could alternatively define the states in the Markov chain by considering quintiles of household expenditures; the transition matrices are not the same.

[3] A Markov chain is absorbing if there exists at least one state i belonging to the set such that $p_{ii} = 1$ and $p_{ij} = 0$ for all $i \neq j$. A Markov chain is called ergodic or irreducible if every state is attainable from another state.

- ***Transition probabilities***

The transition probabilities are the elements of the matrix $P = \left(p_{ij} \right), i = 1,...,r$ et $j = 1,...,r$. These are estimated using the maximum likelihood method, where:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_{i\bullet}}, \qquad (1)$$

with:[a1]

- n_{ij} the number of transitions registered between i and j
- $n_{i.}$ the number of households in poverty state i
- $n_{i.} = \sum_j n_{ij}$, and $\sum_j \hat{p}_{ij} = 1$

This estimator is the same regardless of the number of observation periods. Determining the n_{ij} is simple for two periods, but when the number of periods is greater than two, determining the n_{ij} is not so easy. Anderson and Goodman (1957) proposed a method to determine this statistic.

For a given individual, the successive sequence of states found for time *t = 0, 1, 2, … T*, are *i(0), i(1), … i(T)*. Given an initial state *i(0)*, there are r^T mutually exclusive possible sequences.

Let $n_{ij}(t)$ be the number of individuals in state *i* at time t-1 and state *j* at time *t; (i, j = 1, 2, …, r and t = 0, 1, …, T)*. The r^2T $n_{ij}(t)$ are a sufficient set of statistics of the sequences observed (Anderson, 1957). Let $n_{i(0)i(1)\ldots i(T)}$ be the number of individuals whose sequence of states is *i(0), i(1), …, i(T)*. Then:

$n_{gj}(t) = \sum n_{i(0)i(1)\ldots i(T)}$, où *g = i(t-1) and j= i(t)*.

For a stationary Markov chain, we have: $n_{ij} = \sum_{t=1}^{T} n_{ij}(t)$. (2)

P is a stochastic matrix which we can estimate for the entire population. This matrix can also be estimated for population subgroups to make comparisons between groups. The variables to consider when determining the subgroups in this study are: the sex of the household head, the setting of the household (rural or urban), the place of residence (the department, a sub-national level of organization), the household head's level of education, employment status and the sector of employment. The standard deviation of these estimators is given by:

$$\hat{\sigma}_{\hat{p}_{ij}} = \sqrt{\frac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_{i\bullet}}} . \quad (3)$$

- ***Rate of transition between states***

This is measured by the average duration of the first passage. This amounts to the time required for the Markov chain to reach one state from another given state. In the case of poverty analysis, this is the average time for an individual to enter a given state of wellbeing for the first time given that they started in another state of wellbeing. In matrix form, $M = (m_{ij})$ is given by:

$$M = (I - Z + cc' Z_{diag})D \quad (4)$$[4]

where

- **M** is the matrix of the average duration of the first passage;
- **c** i the column vector where all elements equal 1;
- **Z** is the fundamental matrix of the ergodic Markov chain: $Z = (I - P + W)^{-1}$;
- **W** is the limit matrix where all lines are equal to the row vector of limit probabilities π_j ;
- $\mathbf{Z_{diag}}$ is the diagonal matrix from Z (the elements of the diagonal of Z form this matrix);
- **D** is a diagonal matrix where all diagonal elements, d_{ii}, are equal to $1/\pi_j$.

The variance of **M** is given by:[5]

$$M_2 = M(2Z_{diag}D - I) + 2(ZM - cc'(ZM)_{diag}) - M_{sq} . \quad (5)$$

We want m_{ij} to be as small as possible for *i* < *j*, and as large as possible for *j* > *i.* When i = j, we can speak of the duration of the Markov renewal process, which is the expected amount of time required for an individual in state of wellbeing i to return to this state after having gone through other states. For the lower classes of wellbeing, a longer renewal period implies a more effective anti-poverty policy, whereas it is desirable that this figure is small for the higher classes of wellbeing. Overall, this is an important measure of the effectiveness of anti-poverty policies. Indeed, an effective policy in the fight against poverty should ensure that those who exit poverty can remain in their new state of non poverty for as long as possible. Authorities in charge of development policy should thus take this variable

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4 Kemeny and Snell (1976), p. 79.

5 Kemeny and Snell, (1976), p. 93.

into consideration in order to minimize negative transitions associated with implementing a development plan.

This indicator was used by Le Gallo (2004) in his study of spatio-temporal disparity in European regions and by Temel and Albersen (2003) in their study of income convergence associated with US farms.

- ***The limit or ergodic distribution***

The limit distribution exists when the Markov chain is regular, i.e., when for any **N**, the elements of the matrix P^N differ from zero (Le Gallo, 2004). In this case, the matrix of the probabilities of transition converge towards a matrix **P*** with a rank of 1: $P^{T*} = P*$ where T* is the time required to attain the ergodic distribution formed by the probabilities of being in each state at equilibrium.

Let π_j be the equilibrium probability for state e_j; j = 1, 2, … r, such that: $\pi_j = \sum_{i=1}^{r} \pi_i p_{ij}$ with

$$\sum_{j=1}^{r} \pi_j = 1. \qquad (6)$$

The matrix form of the solution for the system of equations is $\Pi' = c'(I - P + cc')^{-1}$

where:

$$\Pi = \begin{pmatrix} \pi_1 \\ \pi_2 \\ \vdots \\ \vdots \\ \pi_r \end{pmatrix}, \; c = \begin{pmatrix} 1 \\ 1 \\ \vdots \\ \vdots \\ 1 \end{pmatrix} \text{ and } I = \begin{pmatrix} 1 & 0 & \cdots & \cdots & 0 \\ 0 & 1 & 0 & \cdots & 0 \\ \vdots & 0 & \ddots & \cdots & \vdots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & \cdots & \cdots & 0 & 1 \end{pmatrix}$$

The π_j are the respective percentages of the population in state of wellbeing *j, j = 1, 2, … r* when the process is “in equilibrium”. This amounts to a forecast of the effects of the anti-poverty policies implemented in the period of study, assuming that these policies are not changed and that there are no external shocks.

This indicator was also used by Le Gallo (2004) in her study of spatio-temporal disparity in european regions, and by Temel and Albersen (2003) in their study of income convergence associated with US farms.

- **Mobility indices**

The analysis of mobility allows us to see the rate at which the limit distribution is approached. The mobility estimates derived from the transition matrix are, in the literature, considered as the best indicators. They measure relative mobility and do not show any mobility if the observed changes in the standard of living do not engender any movement between the defined classes.

The values on the main diagonal of the transition matrix are interpreted as the probabilities of remaining in the initial state (Regoli, Quintano and Castellano, 2003). In term of mobility, the households found on this diagonal have not moved from their initial state of wellbeing and are considered as the "*stayers"*. The others are mobile and are referred to as "movers". From this point of view, the off-diagonal probabilities can be used as mobility indicators. The higher transition probabilities the greater mobility. Such mobility indicators depend not only on the number of classes of wellbeing that have been defined, (the higher the number of classes, the higher mobility) but also on the size of each class (op. cit.). The other indices used in this study are that of Shorrocks (1978).

Although in certain cases, wellbeing classes used for the transition matrix are defined exogenously (for example income interval), the most common used method is the one which considers quintiles or deciles as wellbeing classes (endogenous method of determining wellbeing classes.) The smaller defined intervals, the higher mobility because individuals or households move frequently from one class to another. Thus, by using deciles for example, one assures more mobility in the studied population than when quintiles are used, since in the first case (deciles cases) the groupings intervals are smaller than that of the second case (quintile cases.)

The Shorrocks index can be used to quantify mobility using a transition matrix with the following formula:

$$\mu_1 = \frac{n - tr(P)}{n-1} = \frac{1}{n-1}\sum_j (1 - p_{jj}) \qquad (7)$$

where *n* is the number of states of wellbeing (the number of lines or columns in the transition matrix ***P***), p_{jj} is the j^{th} diagonal element of ***P*** and *tr(**P**)* is the trace.

It is easy to see that the values of μ_1 are between *0* and $\frac{n}{n-1}$. When there are no stationary households $p_{jj} = 0$. Mobility is highest at this point and therefore $\mu_1 = \frac{n}{n-1}$. This

amounts to perfect mobility. However, if no one changes their status of wellbeing, $p_{jj} = 1$ and therefore $\mu_1 = 0$, the case of perfect immobility.

The normalized form of μ_1 is as follows:

$$\mu_{1nor} = 1 - \frac{tr(P)}{n}. \quad (8)$$

Since $1\text{-}p_{jj}$ is the probability of exiting state j, μ_1 is interpreted as the inverse of the harmonic average of the mean time needed to move to a given state j. From this perspective, μ_1 appears to be a suitable indicator of mobility: the higher its value, the less persistence is observed in the Markov process characterized by transition matrix ***P***.

Two other mobility indicators are used: one is based on the largest eigenvalue of ***P*** less than 1, often named λ_2, and the other is the determinant of ***P***. These are calculated as follows:

$$\mu_2 = 1 - |\lambda_2| \text{ and } \mu_3 = 1 - |\det(P)|^{1/(n-1)}. \quad (9)$$

μ_2 is an indicator of the convergence speed and engenders an asymptotic convergence.

In fact, when ***P*** leads to a unique ergodic distribution $\{P^T : T \geq 1\}$ converges to a unique ergodic distribution. This convergence arises at a geometric rate determined by the sizes of λ_j (the eigenvalues of P). When all the eigenvalues, except the one equal to 1, are strictly less than 1 in absolute value, λ_2 becomes the dominant term so long as the horizon of T increases. As for μ_3, it expresses the possibility that all the eigenvalues are equal to 1 (perfect immobility) and the possibility of having at least two equal eigenvalues (perfect mobility).

These indicators measure general mobility, which means that movements between states of wellbeing have the same effect on the indicator regardless of whether the change was positive or negative. When analyzing poverty, it is interesting to see whether the movements are towards the top or bottom of the scale. As such, we have chosen to use the directional indicators proposed by Gang, Landon-Lane and Yun (2003), and used by Bhaumik and Landon-Lane (2007). These indicators are:[a2]

$$\mu_U = \frac{1}{n-1}\sum_{i=1}^{n-1}\sum_{j=2}^{n} p_{ij} \text{ and } \mu_D = \frac{1}{n-1}\sum_{i=2}^{n}\sum_{j=1}^{n-1} p_{ij} \quad (10)$$

Gang, Landon-Lane and Yun (2003) show that: $\mu_1 = \mu_U + \mu_D$.

We can also use the conditional mobility index proposed by Prais (1955), which has the formula: $\mu_p(j) = \sum_{k=1,k\neq j}^{n} p_{jk}$. (11)

This can be interpreted as the probability of moving to a state j given that we come from a given state i.

Some convergence indicators are also used to study the speed at which the observed distribution approaches the limit distribution. This is the case for the second eigenvalues of ***P***. It is used as a mobility measure, but can also be used to evaluate the speed at which the limit distribution of the Markov chain is approached. The convergence time to this limit distribution is T such that $\lambda_2^T \to 0$.

To measure this convergence time, Shorrocks proposed the following estimated indicator:

$$dm = -\frac{\log 2}{\log|\lambda_2|}, \quad (12)$$

where λ_2 is the second eigenvalues of ***P*** and $|\bullet|$ is the absolute value operator. The *dm* indicator is interpreted as the "*half-life time"*, which is the time necessary for the households to fill half of the variation, which separates them from their stationary state.

4.3 Analysis of the transition determinants

Two types of economic models are estimated to identify the determinants of the transition to poverty in Benin: the model of the variation of wellbeing and the ordered logit model. The first identifies the factors explaining variation in the indicator of wellbeing, estimated using per capita consumption expenditures normalized to the poverty line. The second can be used to analyze the determinants of the transition between states of wellbeing.

To define these states of wellbeing, we use a variable ***y*** defined as follows:

$$y = \begin{cases} 0 \text{ if the household is a loser} \\ 1 \text{ if the household is a stayer} \\ 2 \text{ if the household is winner} \end{cases} \quad (13)$$

A household is a loser when it has negative transitions and is a winner if it has positive transitions.

The model of variation of the wellbeing function we use is as follows:

(14)

$$\Delta lny_i = \alpha x_i + \varepsilon_i$$

where ***lny$_i$*** is the logarithm of real per capita expenditures for household i normalized by the poverty line and x_i represents the characteristics of household *i*.

In practice, this model was estimated taking into account not only all households, but also the three groups of households as defined by their observed transition: loser households (26.0%), stayer households (36.5%) and winner households (37.5%).

As for the second model, which allows to determine explanatory factors of households movements between different states of poverty, the ordered nature of **y** it taken into consideration. In fact, the **y** variable, as defined in (13), takes values which are naturally ordered, and in this perspectives, ordered models are suitable to analyze its determinants. Thus, to analyze associations between these different transitions and the households' socio-economic characteristics, an ordered *logit* model of the following form was estimated:

$$y_i^* = \alpha' x_i + \varepsilon_i \qquad (15)$$

where α' is a vector of parameters to be estimated, x_i is a vector of socio-economic variables for household i and its members, and ε_i is an error term with a logistic distribution. The dependent variable y_i^* is not observed (it is a latent variable). It is found that: $y = 0$ if $y_i^* \leq 0$, $y = 1$ if $0 \leq y_i^* \leq \mu_1$, $y = 2$ if $\mu_1 \leq y_i^* \leq \mu_2 \leq 0$, … y=J if $\mu_{j-1} \leq y_i^*$.

The μ_i's are unknown parameters to be estimated with an unknown threshold (Greene, 2002). For the case of this particular study, there are three categories, so there is just the threshold parameter μ to estimate.

The probabilities to estimate are:[6]

$$Prob(y = 0) = \Lambda(-\alpha' x)$$

$$Prob(y = 1) = \Lambda(\mu - \alpha' x) - \Lambda(-\alpha' x) \qquad (16)$$

$$Prob(y = 2) = 1 - \Lambda(\mu - \alpha' x)$$

Because the ordered *logit* is a non-linear model, it difficult to interpret the estimated coefficients. In order to facilitate the analysis, the odds ratios, exp(alpa),[7] were calculated for each parameter.

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[6] $\Lambda(.)$ is the logistic distribution function

(7) e^{α}

4.4 Sources of data

The data used in this study come from the Integrated Modular Survey of Household Living Conditions in Benin (EMICoV). This is a repeated passage survey (four passages of three months at one month intervals. It was carried out by direct interview and includes a national sample size of 17,982 households across the 77 communes in Benin. There are 7,438 urban households and 10,544 rural households included in the survey. The sample is a two-stage stratified random sample. The first level of selection in the sample is to select 750 census zones, drawn in proportion to the number of households from the 2002 general census. A list of households in each of the census zones is then used for the second level of selection, where 24 households are drawn from each zone. The first round ran from August to November 2006 and the last one was completed in December 2007.

The analyses cover a panel of 16,562 households, the number of households surveyed in 2006 and 2007. That is to say that the unit of analysis is the household. The problem of attrition was dealt with by the National Institute of Statistics and economic Analysis (INSAE) which supplied us with the data. The number of households successfully surveyed in the 2006 retrospective survey was 15,922, less than in 2007. Imputation methods were used to bring the panel size in line with the number of households surveyed in 2007. This brought about changes in the weights used. The reference period for the explanatory variables is 2006 to account for previous household living conditions (Woolard and Klasen, 2004).

5. Results and analysis

As stated above, the five classes of wellbeing considered are defined by quintile of per capita consumption expenditures normalized by the poverty line of each stratum. This method of discretization means that there are the same number of households in each category for the initial distribution, and also ensures that we can have enough observations in each category to make clear estimations. Finally, the data were fully weighted.

5.1 Results of the Markovian model

Table 2 presents the matrix of the transition probabilities for the entire country. The chi^2 test and the likelihood ratio test show that the assumption of the Markov property cannot be rejected. From this perspective, the structure of the transition is consistent with that of a Markov chain. For example, the transition matrix is irreducible because there is perfect communication between the different states (the p_{ij} are all different from *0*). This means that an ergodic Markov chain is indeed present. From now on, the quintiles are called “state of the Markov chain” and are defined in table 1.

Table 1: Definition of states of wellbeing

	State of the household head	Definition
First quintile	State 1	Very poor households
Second quintile	State 2	Poor households
Third quintile	State 3	Average households
Fourth quintile	State 4	Less rich households
Fifth quintile	State 5	Rich households

Source: The authors.

5.1.1 Analysis of transitions

Table 2 shows a remarkable amount of absolute mobility. We can see that there is a strong decline in the share of households in states 1 and 2 in the first year and an increase in the number of households in the higher states of wellbeing. Indeed, from the starting point of 20% of household in each state in 2006 there is a decline in the number of households in both state 1 and state 2. A process of exiting poverty has thus begun.

Table 2: Transition matrix for EMICOV

			Final distribution (2007)				
Initial distribution (2006) (*)							
	Absolute	Relative	State 1	State 2	State 3	State 4	State 5
State 1	1.297.517	0.20	0.3477	0.2685	0.1862	0.1333	0.0642
State 2	1.299.570	0.20	0.2166	0.2502	0.2403	0.1967	0.0963
State 3	1.295.511	0.20	0.1263	0.2055	0.2532	0.2343	0.1807
State 4	1.298.074	0.20	0.0852	0.1629	0.2136	0.2760	0.2624
State 5	1.297.752	0.20	0.0584	0.0767	0.1236	0.2284	0.5129
Total	6.488.424	1	0.1669	0.1928	0.2034	0.2137	0.2233

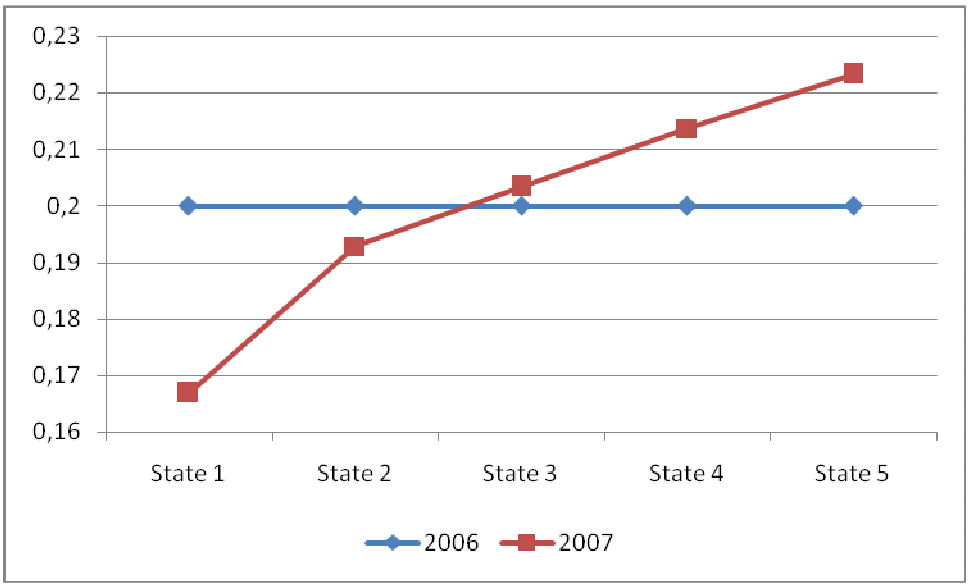
Source: Estimations from 2006-2007 EMICOV data, INSAE.
(*) The initial absolute distribution is the size of each class of wellbeing after weighting; the relative distribution is the relative frequency.

This reflects the consolidation of economic activity in 2007, with GDP growth of 4.6% in 2007 compared to 3.8% in 2006. The poverty rate also fell by 5.2 percentage points, from 37.4% in 2006 to 32.2% in 2007 (INSAE, 2009). The results for the differing initial states of wellbeing are quite different. About 34.8% of households who were initially in extreme

poverty remained in this state a year later, while 6.4% left extreme poverty and reached state 5 (rich).[8]

There were plenty of other state changes between these extremes. About 26.8% of very poor households became poor, 18.6% became average and 13.3% became less rich. Similarly, of households classified as "poor" after the first observation, 21.7% became very poor, 25.0% stayed in their initial state, 24.0% became average, 19.7% reached the less rich class and 9.6% climbed to the rich class. Among those who were rich in 2006, 5.8% fell into extreme poverty and 51.3% remained in their initial state.

Graph 1: Absolute mobility



Source: Developed by the authors using EMICOV data, 2006-2007, INSAE.

Looking at the principal diagonal, we can see that the number of households remaining in their initial state is relatively small. On average, 32.8% of households are stayers, although this figure ranges from 25% to 52% for the different categories. We can therefore be quite certain in saying that there is a large amount of transition between states of wellbeing.

Indeed, the elements which lie off the principal diagonal show a large amount of transition between the states of wellbeing. In particular, we can see more positive transitions (upward mobility) than negative transitions (downward mobility) between states of wellbeing. For example, among the average households (state 3) in 2006, only 12.6% fell into extreme poverty and 20.6% fell into poverty, as opposed to 23.4% moving to state 4 (a positive transition) and 18.0% to state 5. Overall, this yields a positive transition for 41.4% of this

[8] This presumably unlikely result in the space of one year could be due to issues with the data (input errors)

group, compared to a negative transition for 33.2%. Similarly, among households who were classed in state 2 in 2006, 21.7% fell into “extreme poverty” as opposed to 53.3% who rose to states 3, 4 and 5. However, only 26.2% of initially “less rich” (state 4) households saw a positive transition as compared to 46.2% of this group whose situation was worse in the following year.

It can be seen that most of the positive transitions are from states 1, 2, and 3 to states 3, 4 and 5, and that most of the negative transitions are from states 4 and 5 to states 1, 2 and 3. We can see that the risk of falling into poverty or extreme poverty from state 4 is far from negligible. It seems that the development policies are not sufficient to allow non-poor household to maintain their position for long.

These results are confirmed by several other indicators: the mean time of first passage conditioned by the initial state, the duration of the Markov renewal process and the mobility indicators.

The average duration of the first passage conditioned by the initial state

This is the average amount of time it takes for a household to enter a given state for the first time after having been in some other state. We can see in table 3, below, that m_{21} = 7.91 is greater than m_{12} = 5.24. Similarly, m_{31} = 8.87 is greater than m_{13} = 5.26. We can also easily verify that $m_{41} > m_{14}$.

In general, we find that $m_{i>j} > m_{i<j}$ except for ($m_{53,}$ m_{35}) and ($m_{54,}$ m_{45}). This means that the descent from a higher state of wellbeing to a lower state of wellbeing is slower than the rise from an inferior state of wellbeing to a higher state of wellbeing. Stated otherwise, households transition from higher states to lower states less quickly than the other way around. This confirms that there are more positive transitions than negative transitions.

Table 3: Matrix of the average time of first passage (m_{ij})

	2007				
2006	State 1	State 2	State 3	State 4	State 5
State 1	**(6.666)**	5.236	5.256	5.441	7.335
State 2	7.913	**(5.503)**	5.000	5.045	6.943
State 3	8.867	5.951	**(5.002)**	4.789	6.264
State 4	9.382	6.351	5.279	**(4.545)**	5.654
State 5	9.948	7.168	5.946	4.715	**(4.027)**

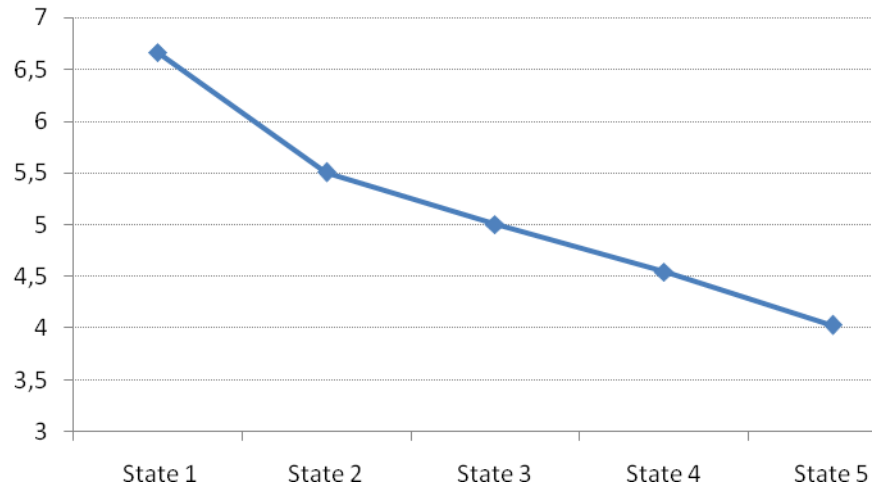
Source: Estimations carried out using EMICOV data, 2006-2007, INSAE.

The duration of renewal

This is measured by the elements of the diagonal in table 3. Overall, the duration of renewal declines as we continue along the scale of wellbeing. This period of time is shortest for households classified as rich, followed immediately by households who are classified as

less rich. As such, a rich household tends to return to its initial position in a relatively shorter period of time, even if they may visit the lower end of the scale in the meantime. Households initially in states 1, 2 and 3 take longer to return to their initial state of wellbeing.

Graph: Duration of the renewal process for wellbeing



Source: Developed by the authors using EMICOV data, 2006-2007, INSAE.

One could say that the development policy implemented between 2006 and 2007 allowed households at the top of the scale (states 4 and 5) to return to their initial position faster, after positive or negative transitions. It also allowed other households, especially those classed as the extreme poor, to exit their initial state on a more permanent basis. In other words, the rich tended to remain rich, but the policy allowed other classes to stay out of their initial positions for somewhat longer (5 years, on average) before returning.

The mobility indicators

These indicators confirm high mobility between states of wellbeing for households (see table 4). The values of μ_1 and μ_3 are close enough to 1 to confirm strong household mobility between different states of wellbeing. In particular, Gang, Landon-Lane and Yun (2003)'s directional indices, μ_U and μ_D, show strong convergence towards higher levels of wellbeing, which is clearly key for the existence of upward mobility.

Table 4: Mobility indicators

	Benin as a whole
Shorrocks index	0.840
Normalized Shorrocks index	0.672
$\mu_2 = 1 - \lvert\lambda_2\rvert$	0.560
$\mu_3 = 1 - \lvert\det(P)\rvert^{1/(n-1)}$	0.944
Upward mobility index (μ_U)	0.466
Downward mobility index (μ_D)	0.374
Half-life *(dm)*	0.845
Time until convergence	14.043

Source: Estimations carried out using EMICOV data, 2006-2007, INSAE.

Analyzing the differences between certain household's characteristics (see table 6 in the annex) shows that mobility of wellbeing differs according to the socioeconomic situation of the household head. The transition matrix indicates that households led by a man are somewhat less mobile than those led by a woman, and also generally experience more downward mobility than those led by women. Households headed by individuals with at least a secondary education have more positive transitions than those with primary or no education.

The level of upward mobility is higher among households headed by someone in management than those headed by employees, labourers, independent workers or those working in the informal sector. Negative transitions are more frequent in the private sector than in the public sector. This is not surprising given that the private sector in Benin is dominated by the informal sector where income is very precarious.

An effective policy to combat poverty should account for these elements, not only to ensure a reduction in inequality, but also to ensure balanced regional development.

5.1.2 Analysis of the ergodic or limit distribution

The ergodic distribution derived from the transition matrix characterizes households' *limit behaviour as* the power[9] of the transition matrix becomes higher. This is essentially a forecast for a situation where the development policies remained unchanged for a relatively long period of time.

[9] The ergodic distribution is obtained from the relationship that $\boldsymbol{P^T = P^*}$ where T is the number of years required for convergence towards said limit (or ergodic) distribution, $\boldsymbol{P^*}$

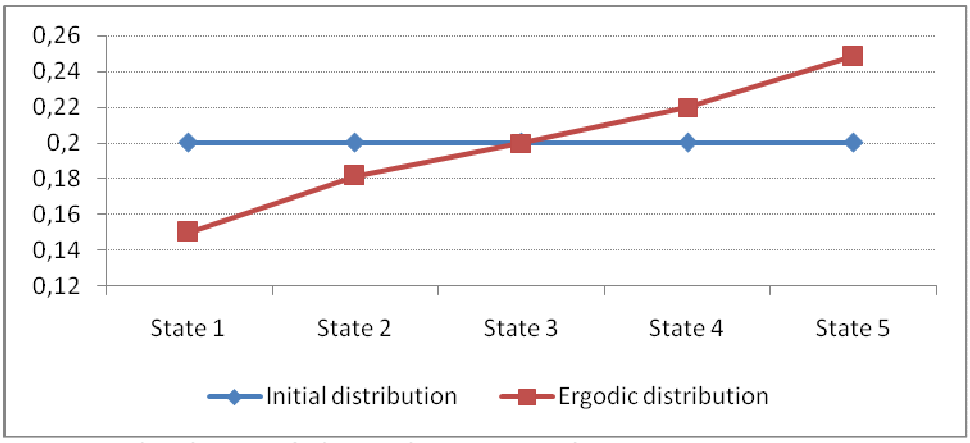
Table 5: Ergodic distribution for Benin as a whole

	Total	State 1	State 2	State 3	State 4	State 5
Initial distribution	1	0.20	0.20	0.20	0.20	0.20
Ergodic distribution	1	0.1500	0.1817	0.1999	0.2200	0.2483

Source: Estimations carried out using EMICOV data, 2006-2007, INSAE.

The ergodic distribution shows that in the long term, 15% of households are in a state of extreme poverty and 24.8% are in state 5 (rich). The proportions of households in the intermediary states are as follows: 18.2% in state 2 (poor), 20.0% in state 3 and 22.0% in state 4. Compared to the initial situation, a smaller proportion of households are in states 1 and 2, while the proportion of households in the higher classes of wellbeing (states 4 and 5) increases. This indicates that a large number of households will exit poverty in the long term if the development policy implemented in 2007 remains unchanged.

Graph 3: Ergodic distribution for Benin

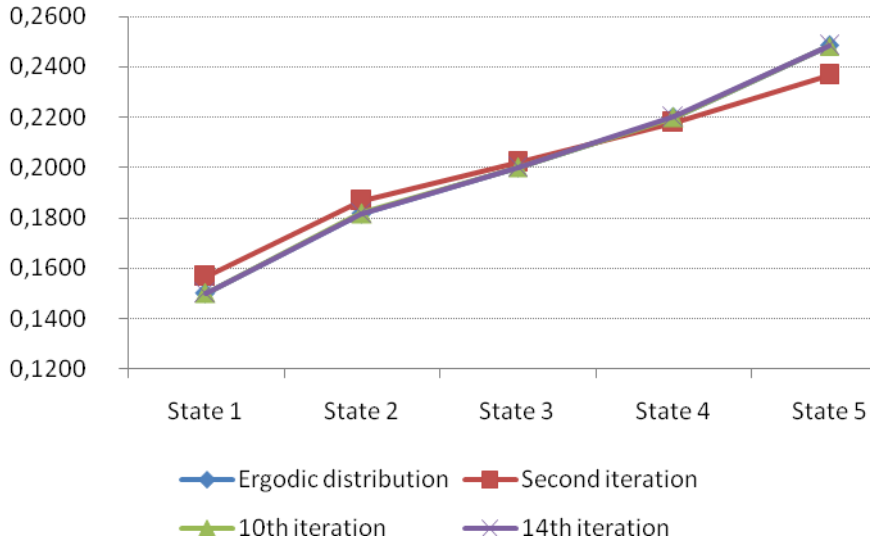


Source: Estimations carried out using EMICOV data, 2006-2007, INSAE.

The convergence towards this distribution is relatively fast. Using the 2006 distribution of consumption expenditures normalized by that year's poverty line as the starting point, it would theoretically take 14.04 years to reach the limit distribution. In other words, if the policies implemented in 2006 and 2007 did not change, 15% of the population would be extremely poor and 18.2% would be poor in 14 years.

It thus appears that the objective of reducing extreme poverty to 15% of the population will not be achieved by the target date of 2015. Assuming that the policies implemented in 2006 and 2007 remain unchanged, the MDGs for poverty reduction will not be reached until 2020.

Graph 4: Convergence towards ergodic distribution – Benin as a whole



Source: Estimations carried out using EMICOV data, 2006-2007, INSAE.

5.2 Results of the econometric analysis

5.2.1 Determinants of variations in households' standard of living

The indicator of household standard of living used in this study is the log of per capita expenditures. The analysis is based on the models constructed in table 7 (in the appendices).

In general, variation in the standard of living between households does appear to be influenced by the initial standard of living, represented by the log of per capita expenditures normalized by the 2006 poverty line. The negative sign shows that the standard of living converges towards the mean. This is consistent with Woolard and Klasen (2004)'s results for South Africa, and shows that it is more likely for a household to have a lower standard of living in the following year if it had a high standard of living in 2006. This attests to the existence of a relatively large transitory component in permanent income for many households, and fits together with the strong mobility presented above.

The size of the household in 2006 has the usual impact: an increase in household size decreases households' standard of living. This result was observed in each of the three household categories: losers, stayers and winners. The age of the head of the household had a negative effect such that, the older the head of the household, the lower the standard of living. This can be explained by the fact that economic opportunities (such as on the labour market) are lower, as confirmed by the results shown above. Looking at the segmentation variables, we can see that the zone of residence influences variations in the standard of living. Households living in the North experience more variation in standard of

living than those in the South, while the variation in the standard of living is fairly similar for those living in the North and Central zones.

In terms of variables linked to the labour market, the job held by the household head in 2006 had an impact on variation of the standard of living. Compared to households led by an independent worker, being unemployed has a negative effect on variation in households' standard of living. The same is true when comparing the unemployed to those working in the public sector. Among variables linked to physical capital, owning land in 2006, owning durable goods and owning housing are variables which positively influence variation in households' standard of living.

The economic policy variables which significantly contribute to explaining variation in the standard of living are: access to credit in 2006, economic accessibility to housing and electricity in 2006, economic accessibility to health services, physical accessibility to drinking water and economic accessibility to communications. The most important shock variables are: variation in household size, access to credit, housing, health services, education, communications and the distance from a source of potable water.

With few exceptions, the determinants do not vary from one category of households to another. For the losers, the difference with respect to other categories is found in the age of households, the status of being unemployed, and ownership of land and a rental house. The negative sign of the initial level of per capita consumption expenditure suggests convergence towards the average. This means that higher consumption expenditures in 2006 were associated with a greater likelihood of a lower standard of living in 2007. This suggests the existence of a sizeable transitory component in the standard of living for most households, which is consistent with the high levels of mobility seen above (Woolard and Klasen, 2004).

5.2.2 Determinants of the transition

In general, the movement of households between different states of wellbeing are strongly linked to their initial wellbeing, their endowment in human and physical capital, circumstances in the job market and the zone of residence.

The initial state of a household's wellbeing appears to influence transitions to higher states of wellbeing. In particular, those who are initially very poor have a higher probability of positive transitions than those starting in other states of wellbeing. There was a large amount of movement out of poverty in Benin between 2006 and 2007 in both urban and rural areas.

The age of the head of the household has a negative effect, such that an older household head is associated with a greater chance of downward mobility. This can be

explained by the fact that as one gets older, opportunities become less common (for example, on the labour market), which can have a negative effect on income and wellbeing

Household size has the usual effect. The results show that an initially large household has a larger chance of being a loser than an initially small household. Similarly, an increase in the size of the household contributes to downward mobility. This result holds for both urban and rural areas.

Human capital has a known effect on households' transitions between states of wellbeing. In terms of the household head's initial level of education, the results indicate that the household head's level of education has an insignificant effect on wellbeing, although the parameters do take on the expected sign. This phenomenon appears whether looking at the population as a whole or looking at urban households alone. This result is the opposite of what was noted in the literature review, which suggested that a high level of education for the head of the household positively affects the probability of having positive transitions.

When we consider the segmentation variables, we observe that the sex of the head of the household does not influence households' transitions. This econometric analysis indicates that households headed by men or women have similar odds of experiencing social promotion or demotion. This result is the same as with models constructed separately for rural and urban areas. In terms of the zone of residence we can see that generally speaking, households in the Central region are more subject to social demotion than those in the (although the parameter is not statistically significant). This result is valid for both rural and urban households.

For variables relating to physical capital, we can see that households which initially possess physical capital and other durable goods have a greater chance being upwardly mobile. This result is consistent for all three models constructed. However, it should be mentioned that owning land and a rental house which, a priori, should constitute an important determinant, do not promote households' transition to a better state of wellbeing. This may point to the weight of land taxes faced by households in Benin. Conflicts related to land (also known as "*conflits domaniaux*" in Benin) can also drastically reduce household income, resulting in greater probability of downward mobility. The comfort of the living environment index has a significant and positive effect, such that an improvement in household's living environment could play an important role in combating poverty.

Variables linked to the labour market did not have a perceptible impact. This can be explained by the arguably excessive size of the informal sector in households' economic activities.

Variables linked to economic and social policies have desirable effects. For example, access to credit in the initial period increases the household's probability of having a positive transition. Similarly, the initial economic accessibility of social goods, measured by per capita expenditures as a proportion of the poverty line, strongly contributed to the probability of transitions. For example, improving the economic accessibility of housing and electricity increased a household's odds of a positive transition six-fold.

Improvements to the economic accessibility of health services multiplied the probability of a positive transition by five. This multiplying factor is two for the accessibility of communications. However, the accessibility of education had a non significant but negative effect due to those among the rural population who barely have any education, even at the primary level. Accessibility to potable water, measured by the average distance to a source of drinking water, had the expected effect. The estimated models show that a household has a smaller chance of improved wellbeing if it lives further from a source of drinking water.

This analysis shows that a poverty reduction policy should improve access to credit, the economic accessibility of housing, communications, health services and the accessibility of drinking water. The shock (or transition) variables had, for the most part, the expected effects. All three models showed that the variation in household standard of living (the difference between the natural log of a household's per capita expenditures in 2006 and 2007) unambiguously had a positive effect on the transitions. The larger this change, the more likely households were to leave lower social classes for higher ones.

6. Conclusions and implications for development policies

The principal results of this study are as follows:

1) the existence of absolute mobility of wellbeing characterized by a relatively large exit from poverty is a reality in Benin;

2) among the households who started in extreme poverty, about 34.8% remained in this state after one year and 6.4% left the state of extreme poverty to attain state 5 (rich);

3) the positive transitions are more common than the negative transitions; about 46.6% of households experienced social promotion and 37.4% experienced social demotion;

4) the fall from a higher state of wellbeing to a lower state of wellbeing is slower than the climb from a lower state to a higher state, which confirms that there are more positive transitions than negative transitions;

5) the duration of the renewal process is shortest for households in states 4 and 5. That is, that a rich household is likely to return to their initial position more quickly than households who were initially in other states, even if they experience transitions towards the bottom of the scale in the meantime;

6) Benin is at risk of not attaining the MDGs in terms of poverty until 2020. If the policies implemented between 2006 and 2007 do not change, 15.0% of the population of Benin will be extremely poor by 2020, rather than the goal of 2015.

7) households led by a man are somewhat more mobile than those led by a woman, and also tend to experience more social demotion than those led by women;

8) mobility of wellbeing is sensitive to variables related to initial human capital (age of household head, household size), segmentation variables (zone of residence and being led by a woman), variables linked to initial physical capital (possession of durable goods), and to economic policy variables (improved access to housing, electricity, communications and education);

9) in general, households' movements between different states of wellbeing are strongly linked to the starting level of wellbeing, their endowments in human and physical capital, the zone of residence and the composition of the household.

These results show that putting together a pro-poor development policy should be done in consideration of a number of factors, the most important of which are: economic growth, the development of human capital, access to physical capital, access to financial capital, improved capacities for households to access health and communications services, housing and electricity. Access to the labour market can also be one of the levers to effectively conduct a pro-poor economic policy.

Specifically, policies that could follow from this work are an increase in the supply of services for credit, health, housing and communications. The state should also encourage a proliferation of access points for drinking water in order to reduce the distance travelled by households to access potable water. It is also essential to identify any good practices in economic management that supported the improvements between 2006 and 2007 in order to replicate them over time, for the good of households in Benin.

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Annex 1: Supplementary results

Table A11: Transition matrix

	State	1	2	3	4	5
All of Benin	1	0.3477	0.2685	0.1862	0.1333	0.0642
	2	0.2166	0.2502	0.2403	0.1967	0.0963
	3	0.1263	0.2055	0.2532	0.2343	0.1807
	4	0.0852	0.1629	0.2136	0.2760	0.2624
	5	0.0584	0.0767	0.1236	0.2284	0.5129
Ergodic distribution	***E***	***0.1500***	***0.1817***	***0.1999***	***0.2200***	***0.2483***
Sex of head of household 2006						
Men	1	0.3612	0.2703	0.1848	0.1267	0.0570
	2	0.2189	0.2599	0.2338	0.1998	0.0877
	3	0.1321	0.2160	0.2533	0.2279	0.1706
	4	0.0877	0.1777	0.2214	0.2711	0.2420
	5	0.0662	0.0817	0.1271	0.2300	0.4950
Ergodic distribution	***E***	***0.1617***	***0.1950***	***0.2032***	***0.2159***	***0.2242***
Women	1	0.2746	0.2587	0.1940	0.1691	0.1036
	2	0.2050	0.2014	0.2731	0.1811	0.1394
	3	0.0967	0.1516	0.2528	0.2668	0.2321
	4	0.0719	0.0857	0.1729	0.3014	0.3681
	5	0.0193	0.0517	0.1064	0.2207	0.6018
Ergodic distribution	***E***	***0.0890***	***0.1125***	***0.1744***	***0.2390***	***0.3851***
Area of residence						
Urban	1	0.3361	0.2603	0.1635	0.1542	0.0860
	2	0.1908	0.2340	0.2306	0.2080	0.1366
	3	0.0965	0.1698	0.2413	0.2489	0.2434
	4	0.0690	0.1263	0.1920	0.2926	0.3202
	5	0.0417	0.0592	0.1072	0.2250	0.5668
Ergodic distribution	***E***	***0.1116***	***0.1414***	***0.1742***	***0.2347***	***0.3381***
Rural	1	0.3540	0.2731	0.1986	0.1220	0.0524
	2	0.2294	0.2583	0.2451	0.1911	0.0762
	3	0.1434	0.2260	0.2600	0.2259	0.1447
	4	0.0944	0.1836	0.2258	0.2666	0.2296
	5	0.0707	0.0896	0.1357	0.2309	0.4731
Ergodic distribution	***E***	***0.1727***	***0.2049***	***0.2146***	***0.2104***	***0.1974***
Level of education 2006						
None	1	0.3674	0.2809	0.1739	0.1202	0.0576
	2	0.2375	0.2542	0.2395	0.1894	0.0794
	3	0.1409	0.2150	0.2635	0.2255	0.1552
	4	0.1002	0.1755	0.2236	0.2659	0.2348
	5	0.0789	0.0996	0.1404	0.2338	0.4473
Ergodic distribution	***E***	***0.1809***	***0.2040***	***0.2099***	***0.2092***	***0.1960***
Primary	1	0.3095	0.2673	0.2002	0.1572	0.0658
	2	0.1801	0.2596	0.2416	0.2131	0.1056
	3	0.0893	0.1901	0.2490	0.2624	0.2092
	4	0.0521	0.1575	0.2212	0.2965	0.2727
	5	0.0495	0.0525	0.1267	0.2471	0.5243
Ergodic distribution	***E***	***0.1073***	***0.1630***	***0.2013***	***0.2472***	***0.2812***

	State	1	2	3	4	5
Secondary or higher	1	0.2734	0.1698	0.2556	0.1862	0.1151
	2	0.1775	0.2133	0.2418	0.2037	0.1637
	3	0.1249	0.1896	0.2147	0.2254	0.2453
	4	0.0818	0.1311	0.1729	0.2806	0.3336
	5	0.0290	0.0556	0.0911	0.2037	0.6206
Ergodic distribution	***E***	***0.0996***	***0.1257***	***0.1650***	***0.2227***	***0.3870***
Employed 2006						
Yes	1	0.3528	0.2698	0.1855	0.1298	0.0620
	2	0.2198	0.2534	0.2453	0.1919	0.0895
	3	0.1326	0.2088	0.2548	0.2321	0.1718
	4	0.0824	0.1672	0.2197	0.2736	0.2571
	5	0.0616	0.0776	0.1278	0.2270	0.5059
Ergodic distribution	***E***	***0.1554***	***0.1865***	***0.2046***	***0.2165***	***0.2371***
No	1	0.3054	0.2581	0.1919	0.1624	0.0822
	2	0.1871	0.2211	0.1942	0.2402	0.1573
	3	0.0624	0.1722	0.2370	0.2570	0.2714
	4	0.1088	0.1252	0.1604	0.2972	0.3085
	5	0.0386	0.0710	0.0977	0.2369	0.5557
Ergodic distribution	***E***	***0.1104***	***0.1426***	***0.1596***	***0.2473***	***0.3401***
Socio-professional category 2006						
Unemployed	1	0.3054	0.2581	0.1919	0.1624	0.0822
	2	0.1871	0.2211	0.1942	0.2402	0.1573
	3	0.0624	0.1722	0.2370	0.2570	0.2714
	4	0.1088	0.1252	0.1604	0.2972	0.3085
	5	0.0386	0.0710	0.0977	0.2369	0.5557
Ergodic distribution	***E***	***0.1104***	***0.1426***	***0.1596***	***0.2473***	***0.3401***
Senior management	1	0.3994	0.3469	0.0292	0.2244	-
	2	0.1562	0.1749	0.3030	0.2246	0.1414
	3	0.1534	0.1801	-	0.2902	0.3763
	4	0.0472	0.0411	0.1693	0.3489	0.3935
	5	0.0215	0.0866	0.0647	0.1943	0.6328
Ergodic distribution	***E***	***0.0942***	***0.1206***	***0.1092***	***0.2499***	***0.4261***
Middle management	1	0.2222	0.2716	0.2506	0.2054	0.0502
	2	0.0276	0.2371	0.3322	0.2489	0.1542
	3	0.0961	0.1802	0.2297	0.2444	0.2496
	4	0.1031	0.0632	0.1144	0.3260	0.3933
	5	0.0248	0.0276	0.0857	0.2094	0.6525
Ergodic distribution	***E***	***0.0686***	***0.0960***	***0.1493***	***0.2469***	***0.4392***
Employees and semi-skilled or skilled workers	1	0.3345	0.2003	0.2104	0.1505	0.1042
	2	0.1752	0.2574	0.2427	0.2190	0.1057
	3	0.0982	0.1921	0.2568	0.2162	0.2367
	4	0.0861	0.1202	0.1973	0.2613	0.3351
	5	0.0305	0.0521	0.0967	0.2059	0.6148
Ergodic distribution	***E***	***0.1066***	***0.1354***	***0.1789***	***0.2156***	***0.3635***

	State	1	2	3	4	5
Independent worker	1	0.3538	0.2729	0.1867	0.1265	0.0601
	2	0.2263	0.2558	0.2430	0.1876	0.0874
	3	0.1345	0.2114	0.2597	0.2303	0.1641
	4	0.0821	0.1785	0.2276	0.2717	0.2401
	5	0.0721	0.0829	0.1391	0.2323	0.4736
Ergodic distribution	***E***	***0.1637***	***0.1955***	***0.2117***	***0.2143***	***0.2149***
Labourer, apprentice and caregiver	1	0.4154	0.2217	0.0642	0.1876	0.1111
	2	0.2428	0.1333	0.2550	0.3208	0.0481
	3	0.1930	0.1788	0.1730	0.3364	0.1189
	4	0.0869	0.1482	0.1752	0.2309	0.3587
	5	-	0.1305	0.1259	0.2714	0.4722
Ergodic distribution	***E***	***0.1567***	***0.1575***	***0.1571***	***0.2655***	***0.2632***
Institutional sector 2006						
Public	1	0.2993	0.3163	0.1785	0.1442	0.0617
	2	0.1852	0.1718	0.3648	0.2075	0.0708
	3	0.1191	0.2231	0.2362	0.1579	0.2636
	4	0.0638	0.0570	0.2089	0.3196	0.3506
	5	0.0361	0.0609	0.1047	0.2000	0.5983
Ergodic distribution	***E***	***0.1060***	***0.1336***	***0.1950***	***0.2123***	***0.3531***
Private	1	0.3490	0.2672	0.1864	0.1330	0.0643
	2	0.2176	0.2528	0.2361	0.1963	0.0971
	3	0.1267	0.2047	0.2540	0.2377	0.1769
	4	0.0865	0.1696	0.2139	0.2732	0.2568
	5	0.0608	0.0784	0.1256	0.2314	0.5038
Ergodic distribution	***E***	***0.1527***	***0.1849***	***0.2005***	***0.2204***	***0.2415***
Geographic zone						
North	1	0.4068	0.2497	0.1658	0.1138	0.0639
	2	0.2466	0.2619	0.2187	0.1858	0.0870
	3	0.1607	0.2234	0.2468	0.2177	0.1514
	4	0.1127	0.1887	0.2367	0.2469	0.2150
	5	0.1008	0.0899	0.1159	0.2478	0.4456
Ergodic distribution	***E***	***0.2087***	***0.2047***	***0.1975***	***0.2010***	***0.1881***
Central	1	0.2694	0.3344	0.2231	0.1372	0.0358
	2	0.2121	0.2627	0.2706	0.1915	0.0631
	3	0.1021	0.2220	0.2922	0.2460	0.1377
	4	0.0509	0.1808	0.2307	0.3131	0.2244
	5	0.0323	0.0832	0.1442	0.2513	0.4889
Ergodic distribution	***E***	***0.1182***	***0.2058***	***0.2350***	***0.2390***	***0.2020***
South	1	0.3336	0.2585	0.1876	0.1458	0.0745
	2	0.2030	0.2393	0.2395	0.2043	0.1139
	3	0.1175	0.1888	0.2405	0.2385	0.2147
	4	0.0822	0.1402	0.1928	0.2788	0.3060
	5	0.0397	0.0659	0.1217	0.2081	0.5645
Ergodic distribution	***E***	***0.1263***	***0.1567***	***0.1863***	***0.2209***	***0.3097***

Table A12: Mobility indicators according to household characteristics

	Shorrocks index	Normalized Shorrocks index	μ_2	μ_3	Upward mobility index μ_U	Downward mobility index μ_D	Half-life*(dm)*	Duration of convergence
Total	0.840	0.672	0.560	0.944	0.466	0.374	0.845	14.043
Sex of household head								
Man	0.840	0.672	0.565	0.936	0.450	0.390	0.832	13.824
Woman	0.842	0.674	0.536	0.898	0.547	0.295	0.902	14.974
Place of residence								
Urban	0.832	0.666	0.553	0.925	0.513	0.319	0.860	14.292
Rural	0.847	0.678	0.573	0.961	0.440	0.407	0.813	13.511
Level of education								
None	0.850	0.680	0.592	0.974	0.439	0.411	0.774	12.858
Primary	0.840	0.672	0.567	0.931	0.499	0.342	0.827	13.737
Secondary or more	0.849	0.679	0.552	0.951	0.535	0.314	0.863	14.337
Engaged in economic activity								
Yes	0.840	0.672	0.559	0.946	0.459	0.381	0.848	14.079
No	0.846	0.677	0.590	0.909	0.531	0.315	0.776	12.897
Job held								
Senior management	0.861	0.689	0.495	0.847	0.582	0.279	1.015	16.857
Middle management	0.833	0.667	0.545	0.948	0.600	0.233	0.881	14.636
Employees/workers	0.819	0.655	0.521	0.889	0.505	0.314	0.943	15.656
Labourers and others	0.894	0.715	0.576	0.882	0.506	0.388	0.809	13.431
Independent workers	0.846	0.677	0.580	0.948	0.450	0.397	0.800	13.281
Institutional sector								
Public	0.844	0.675	0.509	0.845	0.529	0.315	0.973	16.167
Private	0.842	0.673	0.566	0.937	0.463	0.379	0.830	13.785
Geographic zone								
North	0.848	0.678	0.595	0.944	0.417	0.431	0.767	12.743
Central	0.843	0.675	0.546	0.904	0.466	0.377	0.877	14.565
South	0.836	0.669	0.540	0.939	0.496	0.340	0.892	14.808

Source: Estimations carried out using EMICOV data, 2006-2007, INSAE.

Table A13: Estimation of the determinants of the changes in per capita consumption expenditures [10]

Parameters	Total				Downwardly mobile				Stationary				Upwardly mobile			
	Coeff	t -test	P-value		Coeff	t –test	P-value		Coeff	t -test	P-value		Coeff	t -test	P-value	
Constant	0.722	7.993	0.000	***	-0.071	-0.673	0.501		0.256	2.915	0.004	***	0.376	6.279	0.000	***
Log of per capita expenditures normalized by poverty line	-0.688	-28.330	0.000	***	-0.579	-12.109	0.000	***	-0.315	-7.587	0.000	***	-0.649	-16.993	0.000	***
Variables linked to human capital and household size																
Age of household head in 2006	-0.006	-3.530	0.000	***	-0.004	-1.757	0.079	*	-0.001	-0.328	0.743		-0.001	-0.833	0.405	
Age squared	0.000	3.648	0.000	***	0.000	2.214	0.027	**	0.000	0.078	0.937		0.000	0.589	0.556	
Household size in 2006	-0.058	-18.592	0.000	***	-0.028	-9.373	0.000	***	-0.027	-7.055	0.000	***	-0.022	-6.590	0.000	***
Level of education																
None	-0.004	-0.214	0.831		-0.015	-0.701	0.484		-0.005	-0.240	0.810		-0.013	-1.205	0.229	
Primary	0.011	0.736	0.462		0.018	0.967	0.334		0.007	0.423	0.672		-0.014	-1.451	0.147	
Secondary or higher	0.000	.	.		0.000	.	.		0.000	.	.		0.000	.	.	
Segmentation variables																
Household led by a man (Yes = 1, No = 0)	0.010	0.772	0.440		0.024	1.329	0.184		0.006	0.432	0.666		0.008	1.061	0.289	
Zone of residence																
North	0.134	5.727	0.000	***	0.078	3.546	0.000	***	0.093	3.282	0.001	***	0.062	3.782	0.000	***
Central	-0.031	-1.555	0.120		0.024	1.144	0.253		0.001	0.080	0.936		-0.020	-1.728	0.084	*
South	0.000	.	.		0.000	.	.		0.000	.	.		0.000	.	.	
Urban area of residence (Yes = 1, No = 0)	-0.015	-0.731	0.465		-0.019	-1.063	0.288		-0.009	-0.385	0.701		-0.014	-1.298	0.195	
Variables linked to the labour market																
Employment																
Unemployed	-0.131	-3.002	0.003	***	-0.162	-2.968	0.003	***	-0.043	-1.004	0.316		-0.017	-0.600	0.549	
Senior management	0.076	1.367	0.172		-0.040	-0.682	0.496		0.027	0.454	0.650		0.006	0.177	0.859	
Middle management	0.053	1.220	0.223		0.038	0.617	0.538		0.002	0.049	0.961		0.017	0.531	0.596	
Employees and qualified or semi-	-0.029	-0.790	0.430		-0.014	-0.279	0.781		-0.008	-0.210	0.834		-0.010	-0.369	0.712	

[10] Log(per capita consumption expenditure normalized by 2007 poverty line) – Log(per capita consumption expenditures normalized by 2006 poverty line)

Parameters	Total				Downwardly mobile				Stationary				Upwardly mobile			
	Coeff	t -test	P-value		Coeff	t –test	P-value		Coeff	t -test	P-value		Coeff	t -test	P-value	
qualified workers																
Independent workers	-0.010	-0.295	0.768		-0.020	-0.527	0.599		-0.011	-0.331	0.740		-0.019	-0.786	0.432	
Labourers, apprentices and caregivers	0.000	.	.		0.000	.	.		0.000	.	.		0.000	.	.	
Employed in the public sector (Yes = 1, No = 0)	-0.049	-1.807	0.071	*	-0.006	-0.165	0.869		-0.020	-0.620	0.536		0.007	0.347	0.729	
Variables linked to physical capital																
Own land in 2006	0.038	2.672	0.008	***	0.083	5.234	0.000	***	-0.010	-0.592	0.554		-0.004	-0.398	0.691	
Own a rental house in 2006	0.021	0.788	0.431		0.056	2.104	0.036	**	0.031	1.074	0.283		-0.015	-1.017	0.309	
Durable goods index 2006	0.044	6.053	0.000	***	0.016	1.830	0.068	*	0.015	1.795	0.073	*	0.015	2.614	0.009	***
Habitation index 2006	0.051	5.248	0.000	***	0.061	5.527	0.000	***	0.018	2.296	0.022	**	0.005	0.771	0.441	
Economic policy variables																
Access to credit level 2006	0.329	2.333	0.020	**	0.044	0.305	0.761		0.485	2.964	0.003	***	0.097	1.427	0.154	
Economic accessibility of lodging and electricity in 2006	0.957	6.501	0.000	***	1.838	12.353	0.000	***	0.472	4.638	0.000	***	0.152	1.877	0.061	*
Economic accessibility of health services in 2006	0.700	6.812	0.000	***	1.102	10.179	0.000	***	0.385	5.798	0.000	***	0.294	3.670	0.000	***
Economic accessibility to education in 2006	0.045	0.852	0.395		0.005	0.012	0.990		-0.029	-0.894	0.372		0.271	1.593	0.112	
Average distance to source of drinking water 2006	-0.070	-2.349	0.019	**	-0.035	-1.249	0.212		0.009	0.379	0.705		-0.010	-0.638	0.524	
Economic accessibility to communications in 2006	0.600	8.245	0.000	***	1.248	6.085	0.000	***	0.276	5.479	0.000	***	0.189	1.151	0.250	
Shock variables																
Variation of household size	-0.069	-16.489	0.000	***	-0.026	-5.677	0.000	***	-0.039	-4.407	0.000	***	-0.023	-5.506	0.000	***
Variation of access to credit	0.247	1.777	0.076	*	0.027	0.193	0.847		0.450	2.839	0.005	***	0.101	1.526	0.128	
Variation in accessibility of lodging	0.957	6.170	0.000	***	1.887	12.782	0.000	***	0.470	4.355	0.000	***	0.075	0.892	0.373	
Variation in accessibility of health services	0.678	6.348	0.000	***	1.118	10.008	0.000	***	0.379	5.379	0.000	***	0.094	1.721	0.086	*
Variation in accessibility to education	-0.003	-0.054	0.957		-0.009	-0.022	0.982		-0.007	-0.288	0.773		-0.024	-0.227	0.820	
Variation in the distance to source of	-0.248	-4.692	0.000	***	-0.037	-0.811	0.418		-0.038	-0.782	0.434		-0.059	-1.937	0.053	*

Parameters	Total				Downwardly mobile				Stationary				Upwardly mobile			
	Coeff	t -test	P-value		Coeff	t –test	P-value		Coeff	t -test	P-value		Coeff	t -test	P-value	
water																
Variation in accessibility of communication	0.609	7.365	0.000	***	1.336	7.034	0.000	***	0.334	5.224	0.000	***	0.049	0.722	0.470	
Variation in quality of life	0.049	3.276	0.001	***	0.028	1.968	0.050	*	0.038	3.096	0.002	***	0.318	9.577	0.000	***
Changes in the institutional sector of employment																
Private to public	-0.042	-0.965	0.335		0.052	0.873	0.383		-0.020	-0.361	0.718		0.095	3.247	0.001	***
No change	-0.019	-0.592	0.554		0.035	0.759	0.448		-0.029	-0.789	0.431		0.059	2.418	0.016	**
Public to private	0.000	.	.		0.000	.	.		0.000	.	.		0.000	.	.	
Change in engagement in an activity																
Increase in employment	-0.295	-7.697	0.000	***	-0.211	-4.411	0.000	***	-0.164	-3.946	0.000	***	-0.023	-0.959	0.338	
No change	-0.118	-3.898	0.000	***	-0.107	-2.595	0.010	**	-0.033	-1.000	0.317		-0.019	-1.011	0.312	
Loss of employment	0.000	.	.		0.000	.	.		0.000	.	.		0.000	.	.	

	Model quality indices			
	Total	Downwardly mobile	Stationary	Upwardly mobile
R Squared	0.658	0.599	0.466	0.847
Information on the sample				
Sample size (valid)	16 534	4 300	6 039	6 216
Population size	6 479 130	1 941 969	2 126 048	2 411 112
Strata	135	135	135	135
Units	749	707	745	709
Sampling Design Degrees of Freedom	614	572	610	574

Table A14: Estimation of the ordinal logit model for analyzing the determinants of transition

Estimated parameters	Entire country				Urban				Rural			
	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)
Threshold												
Loser	-1.37	-3.72	0.000	0.255	-1.127	-1.935	0.054	0.324	-1.660	-3.311	0.001	0.190
Stayer	0.44	1.21	0.226	1.552	1.038	1.806	0.072	2.823	0.062	0.124	0.902	1.064
State of wellbeing in 2006												
Very poor	3.81	38.60	0.000	45.195	4.277	24.487	0.000	72.027	3.711	28.779	0.000	40.889
Poor	2.81	30.71	0.000	16.609	3.232	23.398	0.000	25.320	2.667	21.799	0.000	14.400
Average	2.00	25.26	0.000	7.357	2.527	19.674	0.000	12.518	1.766	17.194	0.000	5.846
Less rich	1.08	18.43	0.000	2.954	1.447	15.278	0.000	4.249	0.919	11.880	0.000	2.506
Rich	0.00	.	.	1.000	0.000	.	.	1.000	0.000	.	.	1.000
Variables linked to household human capital												
Age of head of household	-0.02	-3.00	0.003	0.979	-0.007	-0.543	0.587	0.993	-0.026	-2.993	0.003	0.975
Age squared	0.00	3.24	0.001	1.000	0.000	0.709	0.479	1.000	0.000	3.199	0.001	1.000
Household size	-0.21	-18.62	0.000	0.812	-0.240	-12.695	0.000	0.787	-0.199	-13.181	0.000	0.819
Education level of household head												
None	-0.01	-0.16	0.871	0.989	-0.106	-0.964	0.336	0.899	0.062	0.706	0.481	1.064
Primary	0.04	0.61	0.543	1.038	0.004	0.041	0.967	1.004	0.090	0.981	0.327	1.094
Secondary or higher	0.00	.	.	1.000	0.000	.	.	1.000	0.000	.	.	1.000
Segmentation variables												
Household led by a man (Yes = 1, No = 0)	0.04	0.71	0.475	1.038	0.101	1.288	0.199	1.107	0.012	0.171	0.864	1.012
Zone of residence												
North	0.36	3.88	0.000	1.430	0.543	3.692	0.000	1.722	0.281	2.350	0.019	1.325
Central	-0.14	-1.55	0.121	0.867	-0.410	-2.561	0.011	0.663	-0.040	-0.351	0.726	0.961
South	0.00	.	.	1.000	0.000	.	.	1.000	0.000	.	.	1.000
Urban resident (Yes = 1, No = 0)	0.01	0.13	0.893	1.011								

Estimated parameters	Entire country				Urban				Rural			
	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)
Variables linked to labour market												
Job held												
Unemployed	-0.32	-1.55	0.123	0.729	-0.451	-1.341	0.181	0.637	-0.210	-0.792	0.429	0.810
Senior management	0.43	1.89	0.059	1.541	0.310	0.890	0.374	1.364	0.471	1.411	0.159	1.601
Middle management	0.30	1.39	0.166	1.343	0.186	0.564	0.573	1.204	0.404	1.284	0.200	1.497
Employees and qualified or semi-qualified workers	-0.02	-0.12	0.908	0.978	-0.200	-0.650	0.516	0.819	0.162	0.584	0.559	1.176
Independent workers	0.02	0.13	0.894	1.024	-0.081	-0.268	0.789	0.922	0.058	0.251	0.802	1.060
Labourers, apprentices and caregivers	0.00	.	.	1.000	0.000	.	.	1.000	0.000	.	.	1.000
Institutional sector												
Public	-0.20	-1.57	0.116	0.819	-0.045	-0.268	0.789	0.956	-0.630	-2.881	0.004	0.533
Private	0.000	.	.	1.00	0.00	.	.		0.00	.	.	1.000
Variables linked to physical capital												
Own land (1 = yes, 0 = No)	0.04	0.70	0.482	1.043	0.062	0.692	0.489	1.064	0.042	0.506	0.613	1.043
Own a rental house (1 = Yes, 0 = Non)	0.03	0.28	0.777	1.036	-0.117	-0.583	0.560	0.889	0.198	1.216	0.225	1.219
Index of durable goods possession	0.16	5.10	0.000	1.179	0.150	3.614	0.000	1.162	0.227	4.116	0.000	1.255
Index of the comfort of the living environment	0.13	3.17	0.002	1.143	0.164	2.730	0.007	1.178	0.112	1.683	0.093	1.119
Economic policy variables												
Access to credit 2006	1.24	1.94	0.053	3.442	1.615	1.358	0.176	5.029	1.001	1.357	0.176	2.720
Economic accessibility of	1.81	6.39	0.000	6.114	1.925	6.059	0.000	6.857	1.908	4.195	0.00	6.739

Estimated parameters	Entire country				Urban				Rural			
	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)
housing and electricity in 2006											0	
Economic accessibility of health services in 2006	1.62	5.65	0.000	5.078	1.644	4.495	0.000	5.176	1.688	3.935	0.000	5.409
Economic accessibility of education in 2006	-0.09	-0.92	0.359	0.918	-0.074	-0.523	0.601	0.929	1.171	0.894	0.372	3.225
Average distance to source of drinking water in 2006	-0.41	-3.34	0.001	0.665	-0.457	-2.502	0.013	0.633	-0.380	-2.304	0.022	0.684
Economic accessibility of communications in 2006	0.64	2.73	0.007	1.904	0.913	3.220	0.001	2.492	0.579	1.238	0.217	1.784
Shock variables												
Variation in household size	-0.25	-13.53	0.000	0.779	-0.284	-8.456	0.000	0.752	-0.239	-10.500	0.000	0.787
Variation in access to credit	0.86	1.36	0.176	2.355	0.948	0.833	0.405	2.581	0.723	0.987	0.325	2.061
Variation in accessibility of housing	1.78	6.20	0.000	5.901	1.843	5.447	0.000	6.313	1.832	3.610	0.000	6.244
Variation in accessibility to health services	1.50	5.19	0.000	4.476	1.390	3.684	0.000	4.016	1.577	3.654	0.000	4.842
Variation in access to education	-0.22	-2.49	0.013	0.800	-0.331	-2.236	0.026	0.718	0.985	0.772	0.441	2.677
Variation in distance to water source	-0.89	-4.82	0.000	0.410	-0.917	-3.845	0.000	0.400	-0.838	-2.656	0.008	0.433
Variation in accessibility to communications	0.77	3.77	0.000	2.163	1.120	3.477	0.001	3.065	0.487	1.262	0.208	1.628
Changes in the institutional sector of employment												
Private to public	-0.39	-2.14	0.032	0.674	-0.227	-0.889	0.375	0.797	-0.864	-2.696	0.007	0.421
No change	-0.19	-1.44	0.150	0.823	-0.126	-0.732	0.465	0.881	-0.494	-1.891	0.059	0.610
Public to private	0.00	.	.	1.000	0.000	.	.	1.000	0.000	.	.	1.000
Change in engagement in an activity												
Increase in employment	-0.86	-5.37	0.000	0.422	-0.987	-4.166	0.000	0.373	-0.780	-3.484	0.001	0.459
No change	-0.32	-2.73	0.007	0.729	-0.324	-1.938	0.054	0.723	-0.272	-1.702	0.090	0.762

Estimated parameters	Entire country				Urban				Rural			
	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)	Coeff	t-test	P-value	Exp(B)
Loss of employment	0.00	.	.	1.000	0.000	.	.	1.000	0.000	.	.	1.000
Variation in standard of living	0.11	6.19	0.000	1.113	0.216	3.302	0.001	1.241	0.101	2.042	0.042	1.107

Model quality indices

	Entire country	Urban	Rural
Pseudo R Squares	**Values**	**Values**	**Values**
Cox and Snell	0.430	0.460	0.425
Nagelkerke	0.485	0.519	0.479
McFadden	0.257	0.284	0.253
Information on the sample			
Sample size	16.562	6.658	9.904
Total population	6.486.346	2.380.906	4.105.440
Strata	135	61	74
Units	750	310	440
Sampling Design Degrees of Freedom	615	249	366

Annex 2

Review of the likelihood test to verify the Markov chain property.

The two hypotheses to test are:

H_0: The successive events are independent from each other

H_1:The successive events are not independent

If H_0 is rejected, the process is a first order Markov chain

The -2lnλ statistic follows a Chi2 distribution with *$(m-1)^2$* degrees of freedom.

The statistic used comes from the formula:

$$-2\ln\lambda = 2\sum_{i,j}^{m} n_{ij}\ln\left[p_{ij}/p_j\right]$$

where

p_{ij} = probability of transition from *i* to *j* ;

p_j = marginal probability = $n_{.j}/n..$

m = state number;

n_{ij} = number of cells for *i,j*.

The likelihood ratio test is significant. The states of wellbeing in 2007 therefore depend on the states of wellbeing in 2006. Since the series is not long, we cannot draw conclusions in terms of any second order Markov process.

Annex 3

Reminder of the relationship between the incidence of poverty and the S/E ratio

S: Exit (Sortie) from poverty

E: Entry (Entrée) into poverty

In the long term, i.e., which the level of poverty has reached its equilibrium value H^*, the number of households exiting poverty (S) must equal the number of households entering poverty (E). We therefore have:

$$H^* S = (1 - H^*) E$$

Which leads to the relation:

$$H^*(S + E) = E$$

and finally

$$H^* = \frac{E}{S + E} = \frac{1}{\left(\frac{S}{E}\right) + 1}$$