INEQUALITY OF OPPORTUNITY AND DEGREE OF HUMAN DEVELOPMENT: EVIDENCE FROM TUNISIA

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There are many socio-economic factors beyond the individual control that can affect human development indicators. In this setting, this paper aims to examine the effects and evolution of unequal opportunities on the distribution of human development indicators embodied by monetary well-being (consumption) and education in Tunisia for the period 2005-2010. We used parametric and non-parametric approach in addition to Dissimilarity-Index and Shapley's Decomposition to identify most important factors explaining inequality of chances in Tunisia. We found that Father's education, residence area, and connection to drinking water appears to be the most important background variables affecting well-being profile. However, child's sex appears to be the most important determinant of the accessibility to education. Inequality of opportunity in consumption and education persists and tends to increase over time which is undesirable for the country. As an economic implication of our results, policy makers must make appropriate policies to reduce intergenerational transmission of parental background and sex discrimination and to overcome traps of inequality for future generations

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1. INTRODUCTION

The term inequality of opportunity lies in the political philosophy initiated by Rawls (1971) whose objective was the search for an ethically acceptable social order. To this end, the search for equality in well-being measured by the utility proposed by the welfarist tradition is strongly criticized because it does not hold individuals accountable for their responsibilities, preferences or choices. The authors then began to search for the most appropriate space where well-being, and hence inequality, should be assessed in the light of social ethics. The main contributions are those of Rawls (1971) who

proposes the space of primary goods; Dworking (1980) for resources; Cohen (1989) that of access to benefits and Arneson (1989) concerning opportunities. Sen (1985 and 1992) proposes two spaces such us the capacities and performance.

According to Roemer (1998), Peragine (2004), Ramos and Van de Gaer (2012), inequalities on the distributions of human development indicators can be explained by two types of factors: The factors that individuals are not responsible for or circumstances and the factors that individuals are held accountable for and that are part of their efforts. In contexts where the inequalities of opportunities are much accentuated, the social status of the parents for example conditions the level of the monetary incomes of the individuals. In general, the inequalities of opportunity that individuals face in a society need to be illuminated for three reasons: (i) Inequalities of opportunity constitute an unacceptable social injustice because ideally only the efforts of individuals explain inequalities (Kolm, 1996); (ii) Only economic policies designed to reduce inequalities of opportunity are of interest as the state should only compensate for inequalities of opportunity and allow individuals to compensate for the inequalities associated with their efforts (Arneson, 1989); (iii) According to the World Bank (2005), Ferreira and Gignoux (2008) countries where inequalities of opportunity are accentuated experience low economic growth rates because they discourage investments in human development. On the other hand, inequalities linked to personal efforts encourage investment in human capital, resulting in high rates of economic growth. It is understandable that controlled variables can become circumstances for future generations.

Since the origins of inequalities (circumstances against efforts) influence individual motivations and political orientations, they have an impact on the economic performance measured by growth rate. The explanation is that the inequities due to circumstances result in an under-accumulation of human capital because they discourage individuals from investing in human capital. On the other hand, the inequalities due to efforts encourage individuals to invest in human capital and thus have a positive effect on growth.

As for its scope of policy, it should be noted that since the work of Roemer (1998) the general tendency invites the public authorities to fight against the inequalities of opportunities rather than against the inequalities of the variables under control. In fact, when they want to fight against the inequalities linked to individual efforts, the public authorities generally apply two types of policies: the first is fiscal and consists in taxing citizens with progressive taxes in order to compensate for low wages. The second is based on quotas that allow groups disadvantaged by their poor performance to still be present in all public bodies and all training schools for the preparation of future leaders. According to Hassine (2011), such strategies that directly target the equality of well-being indicators result in the demotivation of individuals' efforts, the discouragement of investing in human resources and the annihilation of innovation.

In general, it is more appropriate to fight against inequalities of opportunity rather than against inequalities under control for at least two reasons. The first, based on social justice, distinguishes just inequalities from unjust inequalities. For Peragine (2004),

Ferreira and Gignoux (2008), some inequalities may be considered fair if the circumstances are equitable and other inequalities will be considered unfair if the circumstances that explain them are unfair. The second suggest that there is a negative link between inequality of opportunity and economic growth (World Bank, 2005; Marrero et al., 2013). Since the origins of inequalities (circumstances versus efforts) influence individual motivations and political orientations, they have an impact on the economic performance. The explanation is that the inequities due to circumstances result in an under-accumulation of human capital because they discourage individuals from investing in human capital. On the other hand, the inequalities due to efforts encourage individuals to invest in human capital and thus have a positive effect on growth.

The present study is part of the multidimensional approach of development as recommended by the United Nations Development Program (UNDP, 2014) and considers two indicators of human development as the monetary indicator and education.

Once the concept of inequality of opportunity is explained and justified, it remains to discuss the foundations of its algebraic measure. In the preliminary discussions, the authors argue that it is difficult to identify all the circumstances in one context, especially since there are no specific bases. Therefore, the basics of household consumption surveys used, as the case in this research, only measure the lower bound of unequal opportunities which remains instructive on their scale in the context (World Bank, 2009). The second discussions indicate that measures of inequality of opportunity must be guided by a certain number of principles (Ramos and Van de Gaer, 2008), the most important of which, as it leads to concrete proposals for measurement, is the compensation principle. According to this principle, inequalities of opportunity must be eliminated and we can measure them according to two approaches (Francisco et al., 2015). The ex-post approach looks at the differences in an indicator of well-being between individuals with the same characteristics of responsibility. The ex-post compensation then seeks to ensure that the indicators of well-being are equal between individuals with the same efforts as far as possible. Because one must observe responsibilities and efforts, this approach is difficult to implement. The ex-ante approach considers that there is equality of opportunity if all individuals are faced with the same circumstances. As a result, ex-ante compensation prefers a redistribution of the types most favored by circumstances to the most disadvantaged types. It should be noted that a type is a set of individuals having the same circumstances. It is more operational because according to this methodology, it is enough to know the circumstances and the indicators of well-being to measure the inequality of opportunity.

The literature on the inequality of opportunities in MENA region is limited but also in process because of data availability. All recent studies show that there are a high levels of inequality of opportunity in this these region particularly "Arab spring region", Krafft et al., 2018), furthermore, (Assad et al., 2018) show that degree of inequality of opportunity in wages and consumption in Egypt tend to increase over time since 1988. Similarly, other works studied poverty and inequality in Tunisia (Saidi and Hamdaoui,

2017; Jeammli and Amara, 2018; Jemmali, 2019; Ayadi et al., 2005; World Bank, 1995) shows that inequality of opportunity exist and a major part of this inequality due to circumstances beyond individual's control (families background, location, etc…). However, all research in the Tunisian context was limited to analyze the inequality of opportunity for access to basic services like electricity, drinking water, sanitation, education and health among children. So, we try in this work to study the extent of inequality of opportunity on the distribution of development in terms of monetary well-being and education access over time in this country by using to different methodologies.

In addition, traditional measures of inequality do not reflect precisely the reality and do not allow for fair and unjust inequalities to be taken into account. For example, the level of inequality measured by the standard Gini index is not particularly high for the MENA countries (Bibi and Nabli, 2009; Hassine, 2015). A possible explanation for this "contradiction" is that the observed inequality may mask a significant portion of unjust and unjustifiable inequality associated with social class or other circumstances over which the individual has no control.

This work try to study both the evolution of inequality of opportunity for the monetary (consumption) and non-monetary (education) dimension in Tunisia using parametric and non-parametric techniques. Also, parametric methods have the advantage of yielding estimates for the contribution of different sets of circumstances in total inequality.

So we will study the effects of unequal opportunities on the distribution of monetary well-being indicators and education. For the robustness of our estimation, we apply firstly the parametric approach and the nonparametric approach to the monetary dimension captured by the final consumption of households. Then, we apply the dissimilarity indices on accessibility to basic education by children at school age. Our results show that, without efficient policies to reduce sex discrimination and intergenerational transmission of parental disadvantages, disparities in Tunisia may intensify.

The rest of the paper proceeds as follows: in Section 2 we develop our conceptual framework discussing the different techniques to measure inequality of opportunity. In Section 3, we describe our data set and explain main variables of interest. In Section 4, we present our results and discussions. Section 5 concludes.

2.   CONCEPTUAL FRAMEWORK

All discussions on measures of inequality of opportunity must be guided by a number of principles (Ramos and Van de Gear, 2012), the most important of which in the sense that it leads to concrete proposals for measurement are the principle of compensation. It requires that inequalities of opportunity must be neutral with respect to results. So, two approaches are proposed in the literature to distinguish ex-post and

ex-ante inequality. Ex-ante equality is achieved when circumstances do not affect the results. However, ex-post inequality is excreted on effort, and it is reached when all individuals with the same effort achieve the same results.

In this respect, we will use the ex-ante approach to measure the inequality of opportunity because it is simple and we can estimate the inequality without taking into account the effort, contrary to the ex-post approach (the variable of effort are not observable)[1]. In our case, we will apply the parametric and non-parametric approach on the monetary well-being to be apprehended by the final consumption of the households, then we will apply the dissimilarity index for accessibility to basic education to study the distribution of inequality on the human development in Tunisia.

2.1.   Inequality of Opportunities: Distribution of Consumption

As we have announced before, in order to assess the inequality of opportunity for monetary well-being, two fundamental concepts must be defined:

• *The types approach:* This approach consists of evaluating the distributions of income or other dependent variable across homogeneous sets of individuals sharing the same circumstances called types. This approach considers that equality of opportunity is validated if and only if the expected value of income is the same whatever the type (Checchi and Peragine, 2005). Then, these intra-type inequalities (which consist in evaluating the inequalities across the types) are due to the individual responsibility (in other terms to the effort), whereas the inter-types inequalities reflect the inequality of opportunity.

• *The tranches approach:* This approach focuses on the distribution of income across sets of individuals with the same level of effort. According to the slice approach, there is equality of opportunity if and only if the persons having exercised the same degree of effort have the same chances of reaching the objective whatever the type (Checchi and Peragine, 2005). From this approach it is possible to evaluate the inequality inside the groups having exercised the same level of effort (inter-slice inequality). In other words, it is the difference of the levels of effort.

In this section, we want to answer the following questions: what is the value of inequalities of opportunity in 2005 and 2010 and what is their relative value in relation to the inequality of monetary well-being? The human development indicator is the monetary well-being approached by final household consumption. Since the circumstances are socio-economic variables of an ordinal nature and the indicator of well-being is a continuous variable, our methodology measuring the degree of associated inequality of opportunity is inspired by the methodological framework developed by Peragine (2004), Bourguignon et al., (2007), Tartakowsky and Nunez (2007), Ferreira

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[1] Table A1 in the Appendix illustrates the different measures of inequality of opportunity according to the nature of the variables.

and Gignoux (2008), Checchi and Peragine (2010). This framework makes it possible to measure the inequality of opportunities using the parametric and the non-parametric approach. It also breaks down the inequality of opportunity in the first case by sources.

Let y_i be a continuous distribution of a well-being indicator. Its values can be explained by a set of variables of circumstances represented by C_i; a set of variables measuring effort and choice E_i and unmeasured factors v_i. The factors under control of individuals are choices in terms of number of children, number of wives. The measurement function of y_i can be represented by:

$$y_i = f(C_i, E_i, v_i). \tag{1}$$

The degree of inequality of opportunity can be measured by the extent to which the conditional distribution of y_i on the circumstances differs from the distribution function of of $y_i F(y|C) \neq F(y)$. This inequality of opportunity can be measured using the non-parametric and the parametric approach.

2.1.1.   Measurement of the Inequality of Opportunities by the Parametric Approach

The measure of inequality requires the choice of an index of inequality. In our case, we will use the generalized entropy index GE(0)[2], it is the most recognized and the most used (Ferreira and Gignoux, 2011).

$$\ln(y_i) = C_i\alpha + E_i\beta + v_i, \tag{2}$$

where $E_i = AC_i + \varepsilon_i$ (because the circumstances also influence the efforts); α and β: are vectors of the coefficients, A is a matrix of coefficients that specify the effects of the circumstances on the forces and ε_i is an error term. Equation (2) can be written in a reduced form:

$$\ln(y_i) = C_i\delta + n_i, \tag{3}$$

where $\delta = \alpha + A\beta$ and $n_i = v_i + \varepsilon_i\beta$. Indeed, the problem to solve is to calculate by an aggregation process, the predicted values of well-being for each individual given a number of circumstances which can be ordinal or qualitative variables. If it is simply to explain y, the analysis of variance would be considered because it compares the means of y between the modalities of the qualitative variables. Ultimately, the appropriate method for calculating the weights required for aggregation is multiple regressions.

The only constraint in our situation is that indicator variables must be created for the modalities. For example, the dwelling zone variable that has two modalities (rural,

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[2] GE(0) is known as the Teil-L or the logarithmic mean. This index gives a little more importance to inequality in the bottom of the distribution than to inequality among the rich.

urban) must be entered into the model by a binary variable corresponding to urban; rural area being considered as a reference modality.

From the estimated coefficients $\hat{\delta}$ in (3), one can calculate a counterfactual distribution $\hat{z}_i$ where the inequality is only due to the circumstances. It is obtained simply by ignoring the error term n_i and $\hat{z}_i = \exp(C_i\hat{\delta})$. Essentially, predicted values are used as estimates of means for types. Inequality between these means is a measure of inter-type inequality. If the linear relationship is maintained and there are no missing interaction terms, the results would be the same as for a nonparametric estimate. So the proportion of inequality of opportunity in total inequality is given by:

$$\theta^d = I(\hat{z}_i)/I(y_i) = \frac{GE(0,\hat{z}_i)}{GE(0,y_i)} \qquad (4)$$

Still using the estimated coefficients $\hat{\delta}$, one can calculate the inequality of opportunities by the residual approach. We then estimate a counterfactual distribution $(\hat{y}_i)$ where we give the circumstances the same value $(\bar{C})$. It is arbitrary because some authors propose 0 while others propose the average of the circumstances. In all cases, $\hat{y}_i = exp(\bar{C}\hat{\delta} + \hat{n}_i)$. So, $\theta^d = 1 - I(\hat{y}_i)/I(y_i) = 1 - \frac{GE(0,\hat{z}_i)}{GE(0,y_i)}$

The direct and the indirect or residual methods may give different results. The only measure of inequality that gives the same results with both methods is the $GE(0)$[3] entropy measure. In addition to calculating the value of the inequality of opportunity, (3) also allows the decomposition by sources.

2.1.2. Decomposition of the Inequality of Opportunities by Sources Using the Value of Shapley

2.1.2.1. The Principles of Shapley's Value

The value of Shapley (1953) is part of cooperative game theory and has been introduced and applied in the development economy by authors such as (Shorrocks, 1999; Chantreuil and Trannoy, 1999). An indicator I (inequality, poverty, etc.) is determined by $K = 1, 2,...m,..,q$ factors. We are interested in the contribution of the coalitions or subsets of the factors to the formation I. For every factor m, $m \notin S$, its marginal contribution is given by $F(S \cup \{m\}) - F(S)$ where $F(S)$ is the function which makes it possible to generate the index I, $S \subseteq K - \{m\}$, it is to say, is any coalition not containing m. The effective contribution of the factor m is the weighted average of all its marginal contributions. But each marginal contribution depends on the rank of m in S. Suppose that the coalition S contains s elements, its weight is the probability that the first elements of S are s. It is the ratio between all the arrangements

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[3] GE (0) is defined by Theil-L or standard deviation.

not containing m, that is, $[s!\,(q-s-1)!]$ and the total number of possible arrangements, that is, $q!$. Finally, the contribution of the factor m is given by

$$\Phi^S(K,F) = \sum_{s=0}^{q-1} \sum_{S \subset K-\{m\}} \frac{s!\,(q-s-1)!}{q!} F(S \cup \{m\}) - F(S). \tag{5}$$

2.1.2.2.   Applying the Value of Shapley to Unequal Opportunities

Shorrocks (1999) has developed a unified framework for distributional analysis called Shapley decomposition. Consider a well-being indicator y_i explained by $K = 1, 2, \ldots, k, \ldots, K$ factors; the inequality which goes back to the factor k can be evaluated by analyzing a counterfactual distribution to answer the following question: what would be the inequality in the distribution y_i if the factor k were eliminated? By considering the simple variance as a measure of inequality, Shorrocks (1999) proposed as a measure of inequality opportunity, s a special case of Equation (4) and its conclusion is that:

$$s_k = \frac{cov(y, y_k)}{Var(y)}, \tag{6}$$

where cov is covariance, Var is variance and y_k is the estimated counterfactual distribution with the factor k, the others being constant. The application of the unified framework of Shorrocks (1999), that is to say the decomposition by the counterfactual distribution of the opportunity inequality is proposed by Ferreira and Gignoux (2011) by considering variance as a measure of inequality (6) can then be written as follow:

$$\theta^d = \frac{Var(C_i \hat{\delta})}{Var(y_i)}. \tag{7}$$

Note that coefficients $\hat{\delta}$ are estimated without logarithmic transformation. According to the authors, this measure of inequality of opportunity is attractive in several respects: (i) it is simple to compute, (ii) it measures the lower bound of inequality of opportunity in total disparities and (iii) finally, it is decomposable according to the circumstances so that one can write that:

$$\hat{\theta}^d = \sum_j \hat{\theta}^j = \sum_j [Var(y)]^{-1} \left[\delta_j^2 Var(C_j) + \frac{1}{2} \sum \delta_k \delta_j cov(C_k, C_j) \right]. \tag{8}$$

$[Var(y)]^{-1}\delta_j^2 Var(C_j)$ gives the contribution of the factor j when it varies and the other factors are constant while $[Var(y)]^{-1}\frac{1}{2}\sum \delta_k \delta_j cov(C_k, C_j)$ gives the contribution

of the factor j when all the other factors vary and it remains constant. It is, in a way, the average of Shapley's marginal contributions in the decomposition of Shorrocks.

2.1.3. *Measure of Inequality of Opportunity by non-Parametric Approach*

This approach is based on the assumption of the distribution of the total population according to two categories of variables, where first partition is based on types, recalling that there are the individuals with the same circumstances. The second is based on the efforts and divides the population in tranches of individuals having the same efforts.

Since the distinction between inequalities due to circumstances and efforts poses two immediate problems in the sense that in some cases the efforts themselves are considered as circumstances. For example, an illiterate head of household with a low income, his descendants have a great opportunity to leave school at an early age or to receive low education. So, it must be known that the variables associated with the effort are themselves associated with the circumstances. In this case, and since the efforts are unobservable, one has the possibility of dividing the population on the quintiles of y_i conditioned by the circumstances and to consider that all the individuals belonging to the same quintile made the same efforts. Indeed, according to the type approach, one can estimate the inequality of opportunity by the direct and indirect method.

2.1.3.1. The Direct non-Parametric Approach

Following the approach by types, inequality of opportunity is measured by inequality between types. This inequality can be estimated directly by performing a smoothing that leads to consider constancy as a reference to the value of efforts ($\bar{E}$). The smoothed distribution denoted $\{u_c\}$ is obtained by replacing the values y_i observed on the individuals by the means u_c of the types to which they belong. By this process, all intra-type inequalities (Within) are eliminated. Therefore, inequality on $\{u_c\}$ measures only inequality due to circumstances, it is in this sense that this method is called direct. If we consider I a measure of inequality, the value of inequality of opportunity is given by:

$$\theta^d_{types} = I(\{u_c\}). \tag{9}$$

If we want to express it in relative value, the proportion of the inequality of opportunities in the total inequality of y_i is given by:

$$\theta^d_{types} = \frac{I(\{u_c\})}{I(F(y))}. \tag{10}$$

This measure is called direct because it measures the inequality of opportunities on the variables of measurement of the circumstances.

2.1.3.2.   The Indirect non-Parametric Approach

Inequality of opportunity can also be obtained indirectly through a standardized distribution obtained by replacing the values y_i^c observed on individuals i in types c by $z_i^c = \frac{\mu}{\mu_c} y_i^c$ where μ is the overall average of y_i and μ_c is as previously defined, the average of y_i on the type c (Ferrira et Ginoux, 2008). The standardized distribution eliminates all inter-type inequalities and leaves only intra-type or effort-related inequalities. We can then calculate inequality due to opportunities as following (Ramos and Van de Gaer, 2012):

$$\theta_{types}^{ind} = I(F(y)) - I(\{z_i^c\}). \tag{11}$$

If we want to express it in relative value, the proportion of the inequality of opportunities in the total inequality of y_i is given by:

$$\theta_{types}^{ind} = 1 - \frac{I(\{z_i^c\})}{I(F(y))}. \tag{12}$$

Following the approach by tranches, inequality of opportunity is measured by focusing on the distribution of y_i within groups with the same efforts. As in the previous case, a smoothed distribution is calculated to eliminate all intra-tranches inequalities. Unequal opportunities are expressed by:

$$\theta_{tranche}^{ind} = I(F(y)) - I(\{u_e\}). \tag{13}$$

The share of inequality due to differences in opportunities is calculated by:

$$\theta_{tranche}^{ind} = 1 - \frac{I(\{u_e\})}{I(F(y))}, \tag{14}$$

where $\{\mu_e\}$ has a smoothed distribution where the values y_i of the individuals are replaced by the averages of their respective tranches. Unequal opportunities can also be calculated directly by removing all inter-tranches inequalities. As before, a standardized distribution is obtained by weighting all the distributions in the tranches so as to equalize the averages of the different groups of effort. The value of the well-being indicator for an individual i belonging to the tranches e and the type c ($y_i^{e,c}$) is replaced by $z_i^{e,c} = \mu/\mu_e y_i^{e,c}$. Inequality of opportunities can therefore be directly captured by:

$$\theta_{tranches}^{d} = I(\{z_i^{e,c}\}) \tag{15}$$

or in relative value by:

$$\theta^d_{tranches} = \frac{I(\{z_i^{e,c}\})}{I(F(y))}.$$ (16)

As in the case of types, the only measure of inequality that gives the same results for both direct and indirect measurement is the GE(0) entropy measure. There is some complement between the non-parametric and the parametric method because each of them has advantages and disadvantages. The nonparametric method has the advantage of not requiring a functional form to estimate the inequality of opportunities. But it does not allow breaking it down into different sources. The parametric method on the contrary has the advantage of being decomposable into its sources. But its limit is that it rests on the assumptions of a functional form between the indicator of well-being and the circumstances. Given this complementarities, it is useful to estimate them simultaneously to assess their trends.

2.2.   Inequality of Opportunity to Access Basic Education

2.2.1.   Calculation of the Dissimilarity Index: D-index of Access to Basic Education

International data on school success shows the increase in education in most countries of the world and in particular the MENA region to which belong Tunisia (Salehi-Isfahani et al., 2012). However, these rates remain low relative to international standards and taking into account high income levels for some of these oil producing countries.

To study the differential distribution of a binary variable on a set of socio-economic variables, we chose the Dissimilarity-index noted D-index as a methodology developed by the World Bank (2009), Kovacevic (2010) and Yalonetzky (2012). In our work, we calculated the D-index which is defined on the algebraic plane the weighted average of the differences between the probabilities of access to education conditioned by the circumstances and the probabilities of access actually observed.

Let y be the dependent variable, in our case for example, access to education. We can note 0 if the child attends a school and 1 otherwise. Let x be a binary explanatory variable such as rural or urban, for example, is it considered an opportunity. Let $p(x) = pr(y = 1/x)$ be the conditional probability of not being registered while the value of x is known. If circumstance x (exogenous variable) does not influence the dependent variable, the distribution of rural and urban non-beneficiary children should be the same as the distribution of rural and urban beneficiaries. Then, the inequality of opportunities is defined as the distance between the distribution of rural and urban non-beneficiaries and the same distribution among the beneficiaries. (The D-index is used in social science to measure this distance).

In practice, the D-index can be calculated in three steps. Let $x_1, \ldots, x_k, \ldots, x_m$ be a set of circumstances associated with an individual i, then this individual is characterized by a vector of circumstances $x_i = x_{1i}, \ldots, x_{ki}, \ldots, x_{mi}$.

Firstly, conditional probabilities can be evaluated by specifying a logistic function (or Probit) between accessibility to a dependent variable (prenatal care for example) and circumstances by:

$$log \frac{p(y = 1/x_{1\_} x_{K--} x_m)}{1 - p(y = 1/x_1 - -x_k - - x_m)} = \sum_{k=1}^{m} \beta_k x_k.$$

Secondly, the probability of access to a service conditioned by its circumstances is calculated for each individual:

$$p_i = \frac{exp(\beta_0 + \sum_{k=1}^{m} x_k \beta_k)}{1 + exp(\beta_0 + \sum_{k=1}^{m} x_k \beta_k)}.$$

In the third step, the probability of access to a given service is calculated:

$$\bar{p} = \sum_{i=1}^{n} w_i p_i.$$

Where $w_i = 1/n,\ n$ is the sample size, then the D-index is given as follows:

$$D - index = \frac{1}{2\bar{p}} \sum_{i=1}^{n} w_i |p_i - \bar{p}|.$$

2.2.2.   Shapley's Decomposition: Identifying Which "Circumstances" Contribute to Inequality

The decomposition of inequality is an important step in any analysis of inequality because it makes it possible to evaluate the contribution of each subgroup to total inequality. The original idea of performing a Shapley's decomposition of the IOH is due to Hoyos et al., (2011) who used this technique in a paper entitled "Inequality of Opportunities among Children: How Much does It Matter?".

To study the evolution of inequality and to measure the contributions of different variables of circumstances in inequality of opportunity, we use the decomposition procedure proposed by Shorrocks (2013), which is based on the Shapley value concept of cooperation games.

After defining the index of Dissimilarity (D-index), we can see that its value depends on the number of circumstances considered. Indeed, if the number of circumstances is high, D-index is large.

The marginal impact of a particular circumstance c_j is calculated by the value of Shapley (World Bank, 2012)

$$D_{c_j} = \sum_{S \subset CN/\{c_j\}} \frac{s!\,(n-s-1)!}{n!} \left[D\big(S \cup \{c_j\}\big) - D(S) \right],$$

with N is the set of circumstances that contains n circumstances in total. S is a subset of N containing s circumstances that does not contain c_j. $D(S)$ is the estimated D-index with S. $D\big(S \cup \{c_j\}\big)$ is the D-index computed with the subset of the circumstances s and the circumstance c_j. If $D(N)$ denotes the D-index calculated with all the circumstances, the contribution of c_j to D-index is: $\theta_{c_j} = \frac{D_{c_j}}{D(N)}$ with $\sum D_{c_j} = 1$.

As previously explained, we can break the inequality and calculate the D-index in 3 steps. The starting point is the logistic regression of the variable dependent on accessibility to basic education.

3.   DATA AND SAMPLE

As part of our work, we analyzed the profile of inequality of opportunity in Tunisia using the two five-year national surveys carried out by the National Institute of Statistics which are the budget-consumption survey for years 2005 and 2010 among nine surveys conducted since independence in 1975, 1976, 1980, 1985, 1990, 1995, 2000, 2005 and 2010. The main objective of the latter was, on the one hand, to update the profile of poverty and to highlight processes for the fight against poverty.

The 2005 and 2010 national surveys are carried by a random sample of 13,392 stratified households at 2 degrees. It should be noted that of the 13,392 sample households drawn, a total of 11,281 households were actually surveyed, which is 84.2% of the initial sample. These surveys provided information on socio-demographic characteristics such as household size, education level of the head of household, socio-professional category, such as the environment and the region of residence of the household. Despite these regular surveys and the ease of access to such data after the 2010 revolution, there is little research on inequality in Tunisia limited to the calculation of an index at the national level.

In our work we did not use income for our analysis because estimates of wage-based economic mobility can be misleading since they account for more than half of all household incomes in Tunisia. As a result, the first human development indicator used was a monetary measure captured by consumption per adult equivalent or final consumption of households. It then has the properties of a continuous variable. However, in the second objective, the human development indicator is accessibility to education and concerns children aged between 6 and 12 years. It has the properties of a binary variable that takes the value 0 if the child is enrolled in a school and 1 otherwise.

3.1.   Monetary Dimension (Final Consumption): IOP of the Monetary Dimension

The most common calculation of the indicator of monetary well-being is an aggregate of household consumption per adult-equivalent constructed in three stages. First, we calculate a consumption aggregate at the household level. This aggregate includes: food expenditures (including meals taken outside the household), non-monetary food consumption resulting from self-consumption and donations, acquisition value of non-durable goods and services, estimation of the value of use of durable goods and the imputed value of housing for households owning or housed freely.

From these data, six hypothetical explanatory circumstances of the inequality on the monetary indicator were presented in the table below (Table 1): The sex of the head of the household, inhabited areas, the living environment (rural or urban), the connection of households to the sewerage network, branching of households with drinking water, and connection of households to electricity.

Note that the explained variable is the consumption per adult equivalent of households. Continuous variables were converted into qualitative variables because the decomposition method used in our work is based on the assumption that the circumstances are of a qualitative nature.

On one hand, this database permits to update the poverty profile and gives an idea about the living conditions of households such us consumption. On the other hand, to have a data base that allows us to make a comparison with previous studies in order to evaluate the effectiveness of the political programs implemented in the context of the fight against poverty[4]. Our data enables us to have data concerning residence, socio-economic and demographic indicators for six regions of the Tunisian territory. Otherwise, we use 7 variables of circumstances to explain consumption level by Tunisian people: Gender, Residence, Region, Household's education, Connection to the sewerage network, Connection to drinking water, and Connection to electricity.

Firstly, to study individual monetary consumption by Tunisian citizens in 2005 we are based on a sample of 12,318 selected households. Then, we used a second sample of 11,281 individuals identified through the National Survey on Household Budget, Consumption and Standard of Living in 2010. Descriptive statistics containing main demographic and socioeconomic characteristics of our samples are presented in Table 1. Then, to analyze inequality of opportunities in terms of education or school attendance by Tunisian children, we use crucial index measuring Primary school attendance among children aged 6-12 using data provided by the MICS (2005) and by LMPS (2010). The databases cover 12,169 and 11,123 observations, respectively.

For the choice of our variables, we are based on important indicators and outcomes identified by previous works as contributing to explain inequality of opportunity access to basic services, and as constrained by the data availability(Jemmali and Amara, 2014; Saidi and Hamdaoui, 2017). For these reasons, we considered total expenditures in

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[4] This is the last available database for this country (Tunisia)

consumption as indicator of living condition and as a measure of equality of opportunity by all citizens and primary school attendance as proxy for educational quality.

The level of consumption reflects living conditions and gives an idea about inequality of income distribution and about divergences in terms of difficulties encountered by Tunisian people. Agents who consume more are considered to be the most socially ranked with more opportunities and chances to have more training and professional skills. It is more probably that these types of people take adequate nutrition and will not be exposed to repeated morbid episodes and are healthy which can help them reaching their growth potential and are considered well fed. Undernourished children are more exposed to death or recurrent diseases and stunted growth, which push many organizations such as World Health Organization to find way to reduce percentage of people suffering from hunger and malnutrition. A reduction in the prevalence of malnutrition and improvement of living conditions and total consumption will also encourage children to pursue education receiving better vocational training which can stimulate economic growth.

Table 1 gives an overview of the evolution of the average consumption of Tunisian citizens between 2005 and 2010. This table shows an improvement in terms of purchasing power of Tunisian households such us consumption went from 8.66 to 9.00 with a slight reduction of discrepancies between agents during this period (the difference between the Max and Min value decreased; 6.63 instead of 7.86 which can be confirmed by the decrease in standard deviation). In addition, there is also difference between agents according to socio-demographic characteristics; for example females are disadvantaged compared to male in terms of consumption average in 2005 (8.35 against 8.73) and in 2010, men become more served with an average of 9.06 against 8.66 for the females. Disparities according to residence appear to be remarkable in 2010, with an average consumption of 9.18 by people in rural region against only 8.68 in urban areas. However, in 2005 consumption in both regions was lower.

In terms of geographical variations, we can see a higher prevalence of under consumption in Center West with an average of 8.33 in 2005 and in 2010 consumption increases slightly to reach 8.67. Families with household head that can read and write, meaning that he attained secondary or superior education or at least primary school, are characterized by a higher average level of consumption compared to families where household is illiterate. However, the gap between the two types of consumer is not too remarkable. This reflects an inefficient policy of production factors remuneration and an inadequate wage policy. State officials and public professions have become disadvantaged as a result of nominal wage increases where the resources of private and uneducated agents related to trafficking and terrorism are increased in an undemocratic country. Standard deviation of illiterate agents group is higher than the case for educated person who confirms our finding concerning great divergences in terms of incomes between smuggling people and normal citizens which are both uneducated.

For the effect of sanitation services, access to electricity and drinking water on the total consumption expenditures, we note that households that can access this type of

services are more likely to consume more during the studied periods. For example, citizens of regions connected to electricity consume on average 9.01 against only 7.85 for regions without electricity in 2010 with less dispersal among individuals (.681 against .822 for those not covered by electricity).

Table 1. Individual Characteristics by Sociodemographic Features
(Final Consumption)

	2005					2010				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Total	12318 (100)	8.66	0.73	4.83	12.69	11281 (100)	9.00	0.69	5.55	12.18
Gender										
Male	10189 (82.72)	8.73	0.70	6.02	12.69	9577 (84.89)	9.06	0.66	6.54	12.18
Female	2128 (17.28)	8.35	0.81	5.72	11.71	1704 (15.11)	8.66	0.75	5.55	11.20
Missing	1 (0.01)	4.83		4.83	4.83					
Residence										
Rural	4,685 (38.03)	8.38	0.70	5.72	11.84	4020 (35.64)	8.68	0.66	5.55	11.40
Urbain	7632 (61.96)	8.84	0.70	4.83	12.69	7261 (64.36)	9.18	0.63	6.57	12.18
Missing	1 (0.01)	8.96		8.96	8.96					
Region										
Great Tunis	2522 (20.48)	8.88	0.68	4.83	11.79	1989 (17.63)	9.25	0.59	7.40	11.90
North East	1679 13.63	8.53	8.53	6.02	10.95	1543 (13.68)	8.94	0.56	6.60	10.75
North West	1632 (13.25)	8.46	0.68	6.15	10.72	1553 (13.77)	8.65	0.67	6.47	11.40
Centre East	2315 (18.80)	8.88	0.69	6.44	12.69	2101 (18.62)	9.28	0.64	7.08	12.18
Center West	1697 (13.78)	8.33	0.75	5.72	11.71	1710 (15.16)	8.67	0.70	5.55	11.44
South East	1210 (9.82)	8.81	.767	6.165	11.84	1204 (10.67)	9.15	0.65	6.96	11.22
South Ouest	1262 10.25	8.57	0.69	5.88	10.63	1181 (10.47)	8.98	0.65	5.93	11.79
Missing	1 (0.01)	8.96		8.96	8.96					

Notes: The table displays the average, standard deviation, the minimum and maximum for consumption by circumstance since it is a quantitative variable. For ordinal variables (dummy variable), we reported the number and percentage of the circumstance in the total population.

Table 1.   Individual Characteristics by Sociodemographic Features
(Final Consumption) (con't)

	2005					2010				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Household's education										
Illiterate	10119 (82.15)	8.55	0.70	5.72	11.84	9195 (81.51)	8.90	0.66	5.55	11.79
Read and write	2198 (17.84)	9.20	0.66	6.70	12.69	2086 (18.49)	9.47	0.60	6.96	12.18
Missing	1 (0.01)	4.83		4.836	4.836					
Connection to the sewerage network										
Not connected	6142 (49.86)	8.48	0.72	5.72	11.84	4703 (41.69)	8.80	0.67	5.93	11.63
Connected	6131 (49.77)	8.85	0.70	6.02	12.69	6159 (54.60)	9.21	0.62	6.59	12.18
Missing	45 (0.37)	8.37	0.91	4.83	10.13	419 (3.71)	8.31	0.70	5.55	10.57
Connection to drinking water										
Not connected	2076 (16.85)	8.24	0.68	5.72	11.71	1915 (16.98)	8.49	0.64	5.55	11.09
Connected	10216 (82.94)	8.75	0.71	5.88	12.69	9360 (82.97)	9.11	0.65	6.45	12.18
Missing	26 (0.21)	8.91	1.17	4.83	10.23	6 (0.05)	8.42	0.44	7.75	8.93
Connection to electricity										
Not connected	136 (1.10)	7.77	0.76	5.72	9.55	44 (0.39)	7.85	0.82	5.55	9.47
Connected	12181 (98.89)	8.67	0.73	5.89	12.69	11235 (99.59)	9.01	0.68	5.93	12.18
Missing	1 (0.01)	4.83		4.83	4.83	2 (0.02)	8.37	0.04	8.34	8.39

Notes: The table displays the average, standard deviation, the minimum and maximum for consumption by circumstance since it is a quantitative variable. For ordinal variables (dummy variable), we reported the number and percentage of the circumstance in the total population.

3.2. Education

In the case of our work, we are interested in children old between 6 and 12 years, who find it difficult to enroll in school, we did not take into account children over 12 years to not include atypical cases illustrated by those who will never go to school for other reason. On this principle we have constructed a variable of ordinal nature which is coded as 1for an individual who does not attend a school and has an age equal to or less than 12 years old but more than 6 years old (which is the institutional age in Tunisia)

and 0 the other alternative. In the Table 2 below, we present the descriptive statistics of the variables circumstances that hypothetically explain the accessibility to education. We select 6 explanatory circumstances available on the basis of data and expected to have a significant effect on the opportunity of access to school: Sex of the individual, place of residence, education of the head of household, size of the household, sex of the head of household, activity of household head.

Table 2. Individual Basic Characteristics According to Selected Characteristics (Basic Education Services)

Primary school attendance among children aged 6-12 (never attended school)		2005			2010		
		Total	Yes	No	Total	Yes	No
Total		12169 (100)	3601 (29.59)	8568 (70.41)	11123 (100)	2745 (24.68)	8378 (75.32)
Sex of the child	Male	5172 (42.50)	946 (18.29)	4226 (81.71)	4777 (42.95)	684 (14.32)	4093 (85.68)
	Female	6997 (57.50)	2655 (37.94)	4342 (62.06)	6346 (57.05)	2061 (32.48)	4285 (67.52)
Household sex	Male	10065 (82.71)	2974 (29.55)	7091 (70.45)	9438 (84.85)	2288 (24.24)	7150 (75.76)
	Female	2103 17.28	627 (29.81)	1476 (70.19)	1685 (15.15)	457 (27.12)	1228 (72.88)
	Missing	1 (0.01)		1 (100)			
Residence	Urbain	4639 ()	1361 (29.34)	3278 (70.66)	7103 (63.86)	1487 (20.93)	5616 (79.07)
	Rural	7529 61.87	2240 (29.75)	5289 (70.25)	4020 (36.14)	1,258 (31.29)	2762 (68.71)
	Missing	1 0.01		1 100.0			
Households head's education	Illiterate	9993 (82.12)	2938 (29.40)	7055 (70.60)	9068 (81.52)	2333 (25.73)	6735 (74.27)
	Read and write	2175 (17.87)	663 (30.48)	1512 (69.52)	2055 (18.48)	412 (20.05)	1643 (79.95)
	Missing	1 (0.01)		663 (30.48)			
Household size	Little family (≤ 4)	6157 (50.60)	1788 (29.04)	4369 (70.96)	5244 (47.15)	1255 (23.93)	3989 (76.07)
	Big family (> 4)	6012 (49.40)	1813 (30.16)	4199 (69.84)	5879 (52.85)	1490 (25.34)	4389 (74.66)
Households Head Activity	No stable income	1319 10.84	422 (31.99)	897 (68.01)	9068 (81.52)	2333 (25.73)	6735 (74.27)
	Stable Income	10848 (89.14)	3178 (29.30)	7670 (70.70)	2055 (18.48)	412 (20.05)	1643 (79.95)
	Missing	2 (0.02)	1 (50.00)	1 (50.00)			

Notes: The table displays the average, standard deviation, the minimum and maximum for consumption by circumstance since it is a quantitative variable. For ordinal variables (dummy variable), we reported the number and percentage of the circumstance in the total population.

Table 2 presents the level of school attendance by Tunisian children aged between 6 and 12 years. We treat the variable "primary school attendance" as an outcome variable which reflects inequality of access to many circumstances since in this phase of life, children are still young to make efforts that make them stand out from the others, and so the inequalities of opportunities are explained by uncontrollable factors. So, in Table 2 we present the percentage of the Tunisian children without primary education making a simple comparison between the statistics of 2005 and 2010. Surprisingly, we observe that nearly 30% (29.59) of Tunisian children have not even had primary education in 2005; unlike in 2010 there is a high level of primary education (75.32%). This phenomenon of early dropout is more important for the girls with a percentage that attained 37.94% in 2005 and we can remark that the situation is slightly improved in 2010 for both sexes of children. Thus, we can notice that there is not a remarkable difference in terms of access to primary school between the children of the families whose parents are men or women. Similarly, we can see that children living in urban areas are slowly more favored in 2005. However, in 2010 the situation becomes too critical, as the abundance in the rural areas reaches 31.29% while it does not exceed 20.93% in the urban areas. We thus notice a difference in terms of the chance of following a primary education following parents education levels since 25.73% of children that belong to families with illiterate parents have never attended school in 2010 while only 20.05% of children that parents can read and write do not accede to primary school. Also, children have more opportunity to attend primary education if the household size is small and become less favored if they belong to big household.

Similarly, we can see that poor families or with instable incomes are less likely to allow their children attend primary education. But, wealthy families (or with stable income) are more favored in both periods with a high primary education attendance rates of 79.95% in 2010. In conclusion, despite that primary school attendance by Tunisian children is improved in the country as a whole especially between 2005 and 2010, additional efforts are still necessary to achieve international standard.

4. RESULTS AND INTERPRETATIONS

4.1. The Extent of the Inequality of Opportunities on Consumption by the Parametric Approach

Table 3 shows the results of the multiple linear regression where the dependent variable is monetary well-being taking into account 7 circumstances which we test the magnitude and significance in explaining the inequality of opportunity in total consumption. According to this table, we can notice that during the period 2005-2010 the inequality in terms of monetary welfare is explained by several variables and that all these variables of circumstances are significant which shows that the circumstances are not neutral in explaining monetary well-being disparities. As a result, these results are

consistent with the statistics on inequality and poverty in Tunisia and tend to confirm that circumstances do affect the inequality of income opportunity.

In 2005, we can see that all the variables of circumstances are significant which approves that they are not neutral in the distribution of monetary well-being and remains significant in 2010. In 2005, for example, we can see that the variable "region" is negative and statistically significant at the 1% level, which implies that the southern and western countries are less favored in terms of consumption. Otherwise, citizens of the northern and eastern region consume more than habitants of the interior zone. The variable "residence" is statistically significant at the conventional level with a positive coefficient, which means that on average, well-being is higher in urban areas than in rural areas. Similarly, the variable "household sex" is positively and statistically significant meaning that families in the responsibility of a man are socially more classified and are more likely to consume. On the other hand, infrastructure plays a crucial role in the sense that individuals with electricity access, a sanitation network and with a connection to drinking water tend to increase their well-being compared to those living in rural areas which are not covered by sanitation, drinking water or electrical connections.

Table 3.   Results of the Ordinary Least Squares Estimation (OLS)

Variables	2005		2010	
	Coef	P-Value	Coef	P-Value
Region	-0.0127	0.000	-0.0043	0.152
Residence	0.2286	0.000	0.1731	0.000
Household sex	0.2966	0.000	0.3101	0.000
Household's education	0.4990	0.000	0.3881	0.000
Connection to the sewerage network	0.0571	0.001	0.1346	0.000
Connection to drinking water	0.2123	0.000	0.2960	0.000
Connection to electricity	0.5441	0.000	0.5417	0.000
cons	7.495	0.000	7.727	0.000
Number of obs	12248		10857	
Prob > F	0.0000		0.0000	
R-squared	0.2148		0.2281	

Source: Author's calculation from HBS2005, 2010.

In general, we can see that all circumstances hypothetically related to consumption are not neutral in 2005 and remain in 2010 affecting monetary well-being. In this regard, the Table 4 below shows that the estimated IOP at (21.77%) in 2005 increased to (23.13%) in 2010, which is not desirable for the country. We achieved important results such us the inequality of opportunity tends to increase over time by an average rate of 2% during the period 2005-2010, from 21% to 23%, which is not favorable for the country. However, the extent of inequality in relation to monetary well-being is similar to previous studies. For example, in Egypt inequality has a downward trend; from 22% in 1988 to 15% in 2001

(Hassine, 2001), and in Cameroon has a tendency to increase from 26% in 2001 to 35% in 2007 (Ningayé, 2015), but inequality in Tunisia remains low compared to Turkey which has a rate of 31% according to Ferreira, Gignoux and Aran (2011).

To better understand things, we have decomposed inequality using Shapley's method in order to assess the contribution and influence of variables in total inequality (Table 4). Surprisingly, we found similar results for the studied periods, in the sense that the contribution hierarchy of the variables remains almost the same. That is, the variables that affected inequality in 2005 remain themselves in 2010 with slight variation. Indeed, in 2005 the variable household head's education is the most important factor explaining inequality in total consumption expenditures followed by the variable 'residence' with more than 37% and 18.25%, respectively. Similarly, household head's education remains important in 2010 in addition to connection to drinking water and residence variables. Their contributions to the inequality of opportunity are 28.70%, 19.92% and 19.26%, respectively.

In this study, we divided the Tunisian territory into 7 regions such as the central zone presented by the capital (Grand Tunis), North East; North West; East Center; Center West, South East and South West to implement a state of discrimination presented by a misallocation of regional monetary welfare or some sort of marginalization. Indeed, we recorded that when going from the capital to the South and West of the country, we can confirm that the consumption drops given the negative and significant sign associated with the region variable (Table 3). This result implies that inhabitants of southern and western areas find it difficult to increase their well-being compared to the areas of East and Greater Tunis which are considered as big cities.

Despite that he western regions of the country have a great economic weight, this weight being manifested by the important contribution (direct or indirect) to the country's GDP, then to economic growth they receive less interest in terms of infrastructure and sustainable development. For example, the North West region represented by Beja, Jendouba, Kef and Siliana represent 10.4% of the national territory and are renowned for their enormous agricultural, forestry and aquatic capacity. Similarly, the central and southwestern regions (composed by 6 regions) are reputed for the production of manufacturing, agricultural and oil products. However, the prosperity indices are found in the eastern regions (highways, airports, factories, etc.). Given this reality, Tunisia poses the greatest regional paradox. In other words, we have deduced that the regions are facing marginalization in all sectors, particularly monetary welfare (objective of our study).

Our decomposition of inequality confirms this paradox during our sample period (2005-2010). Although the region variable does not clearly explain the inequality of opportunity, we can clearly see the effects of regional disparity in terms of sustainable development and improved infrastructure on consumption through the level of education of household heads. From Table 4, we have already mentioned the importance of parental education to enter the labor market to subsequently increase the chances of ensuring good living conditions. Residents of most regions other than the capital and the

Eastern Region find major difficulties in finishing their education and thus increasing their monetary well-being in working age, and their situation is difficult even more recently in 2010.

We note that the variable "residence" is an important determinant of consumption disparities between Tunisian citizens even in 2010. It contributes in the first place to explain inequality showing that well-being is higher in urban than in rural areas in accordance with the profile of inequality in Tunisia. Indeed, the high importance of place of residence on the distribution of income in Tunisia can be explained by reference to the employment market and the geographical characteristics of the regions. From this perspective, it is seen that most coastal areas (which are attractive for work or study) are urban and are more populated than the inland areas. Still in this sense, we find that the rural environment suffers from an unequal distribution of income (low income, optional employment, unemployment, no training, etc.) and in terms of infrastructure (lack of electricity, drinking water, sanitation) which have a great effect on human capital. So it can be said that people living in rural areas are handicapped in terms of human capital which encourages internal migration. This phenomenon has increased to 27% of total movements, mainly to the governorate of Tunis, which accounts for 24% of the total population in full country (INS, 2014).

Table 4.   Inequality of Opportunities and Shapley Decomposition

	2005		2010	
	Absolue	Relative %	Absolue	Relative %
IOP	0.000785	0.217732	0.000646	0.231314
Decomposition	Value	%	Value	%
Region	0.000010	1.28%	0.000004	0.70%
Residence	0.000143	18.25%	0.000124	19.26%
Household sex	0.000117	14.90%	0.000096	14.79%
Household's education	0.000291	37.12%	0.000185	28.70%
Connection to the sewerage network	0.000083	10.53%	0.000100	15.48%
Connection to drinking water	0.000104	13.21%	0.000129	19.92%
Connection to electricity	0.000037	4.72%	0.000007	1.16%
Total	0.000785	100%	0.000646	100%

On the other hand, we have noticed that inequalities in terms of income are accentuated for women than men, especially in rural areas and in central and western regions characterized by high levels of unemployment. The unsatisfactory socio-economic status of women in these areas is not new[5], their participation in

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[5] For more details see: Ridha Boukraa (1976), "Notes on Family Planning and Political Power in the Maghreb", *Tunisian Journal of Social Sciences*, 13, 193-199.

working life is very limited, perhaps due to traditions and cultural aspects in some regions, its function has been limited to house or traditional work. Thus, we find that men are more favored to increase their well-being than their counterparts (positive and significant sign of the variable household head's sex in Table 3).

Finally, we found that families who have easy access to a water source have the probability of increasing their well-being than families who have difficult access. Geographical and climatic characteristics in certain areas (the central and southern areas) and the intrinsic importance of water explain this situation by the fact that rainfall is very limited and the need for water for agricultural activities remains vital. A lack of water pushes the inhabitants towards low productivity jobs.

4.2. The Extent of Inequality of Opportunity on Consumption by the non-Parametric Approach

In this section, we divided the regions into three major axes such as the central zone presented by the capital (Greater Tunis), the East zone, and the West zone to implement a state of disparity and inequality. The results are shown in Table 5.

Table 5.   Inequality of Opportunities and Its Decomposition (Consumption)

	2005		2010	
	Absolute	Relative	Absolute	Relative
IOP	0.000620	0.171916	0.000605	0.216670
		17%		21%
Decomposition	Value	%	Value	%
1. Great Tunis	0.000031	4.93	0.000031	5.13
2. East zone	0.000024	3.90	0.000034	5.64
3. West zone	0.000071	11.49	0.000077	12.68
4. Residence area	0.000085	22.33	0.000102	20.51
5. Head's household gender	0.000098	21.70	0.000120	18.20
6. sanitation	0.000038	13.74	0.000007	16.81
7. drinking water	0.000138	15.76	0.000110	19.86
8. electricity connection	0.000134	6.15	0.000124	1.17
Total	0.000620	100	0.000605	100
Total inequality according to different methodologies	2005		2010	
	Absolue	Relative	Absolue	Relative
Inequality on final consumption	0.00362	-	0.00362	-
Direct non parametric approach of the IOP	0.17127	17%	0.20680	20%
Residual nonparametric approach of the IOP	0.00063	16%	0.00068	21%
Parametric approach of the IOP	0.00062	17%	0.00061	21%

Source: Author's calculation from HBS2005, 2010.

We therefore use 8 circumstances and note that this approach relies on "types" who are individuals with the same opportunities. Since the number of circumstance is 8, the expected number of modalities is $2^8 = 256$ types but because of the impossible combinations we only got 64. The impossible combinations are explained in the sense that we cannot find individuals who live in Greater Tunis and rural at the same time. In other words, the first type takes the name of *an individual from Grand Tunis, living in an urban area, male, who is connected to a network of sanitation, drinking water and electricity.* For 2010, we followed the same approach and we obtained 79 types instead of 256.

Subsequently, we generated the standardized distributions in both bases by replacing y_i by $\{u_c\}$ and applied the inequality index GE(0). In 2005, for the direct non-parametric approach: $I(\{u_c\}) = 0.00062$, this is the absolute IOP and $I(F(Y)) = 0.00362$, if we divide $I(\{u_c\})$ by $I(F(Y))$ we have $0.00062/0.00362 = 0.1712 = 17\%$, which is inequality in relative value. In the same way for 2010, $I(\{u_c\}) = 0.00062$ and $I(F(Y)) = 0.00294$, so, $0.00062/0.00294 = 0.2068 = 21\%$.

For the non-parametric indirect approach it is necessary to calculate first of all a standardized distribution (k type) by replacing the values y_i^c observed on the individuals i in the type c by $k_i^c = \frac{\mu}{\mu_c} y_i^c$ where μ is the average of y_i and μ_c is the average of y_i on type c. Then, we applied GE(0) on 12318 individuals in 2005 and 11281 individuals in 2010.

In 2005, $I(F(Y)) = 0.00362$ and I(k type) $= 0.00299 \rightarrow$ IOP $\approx 0.00362 - 0.00299 = 0.00063$ is very close to 0.00062 (17% in relative value). In 2010, $I(F(Y)) = 0.00362$ and I(k type) $= 0.00294$, l'IOP $= 0.00362 - 0.00294 = 0.00068$ very close to 0.000605 (21% in relative value).

There is some complement between the non-parametric method and the parametric method because each of them has advantages and disadvantages. The nonparametric method has the advantage of not requiring a functional form to estimate the inequality of opportunities. But it does not allow breaking it down into different sources. The parametric method on the contrary has the advantage of being decomposable into its sources. But its limit is that it rests on the assumptions of a functional form between the indicator of well-being and the circumstances. Given these complementarities, it is useful to estimate them simultaneously to assess their trends.

4.3. The Inequality of Opportunity of Accessibility to Education and Its Decomposition

To better understand these results we transformed the coefficients of the logit regression logit(β_k) into ODD_{ratio} such that $ODD_{ratio} = e^{\beta_k}$. On the basis of this technique one can directly interpret the relationship between the dependent variable which is accessibility to education and the variables of circumstance. It is sufficient to interpret taking into account the coding of the dependent variable which takes the value 0 when a children attend a school and 1 not attending a school. Then we compare the

coefficient e^β with respect to 1.

If the $ODD_{ratio} > 1$, then the circumstance is a risk variable of not attending a school, if $ODD_{ratio} < 1$, this means that the variable is in favor of attending school, and if, the $ODD_{ratio} \approx 1$, we can say that this variable is neutral.

Recall that the variable school attendance is coded 0 if the children has access to education and is coded 1 in the case of not access, on this basis there are 2 decisive opportunities in 2005 such as the sex of the children and the family income. In 2010, the situation is different such as the family income level is no longer significant but the variables residence, household size, household head's education and household's head gender matter in explaining never attended school by Tunisian children. In another way, the sex of children is a risk factor for not attending a school in 2005 and remains in 2010 with a negative coefficient implying that boy has more chance than girls to access to education. However, the other decisive explanatory variables (place of residence and level of education of the head of households) are neutral in 2005, but they become more and more important to inequality.

According to the logit regressions in Table (6), we noticed that in 2005 there are two variables that explain the access to education that are the sex of the child and the standard of living of households with negative coefficients, which means that boys have the probability of accessing a school that their counterparts, and that families with a stable income have the probability of leading their children to school compared to poor families.

In this sense, in 2005 we found, three variables that can maintain risks on school attendance that are the size of households, the place of residence, and the sex of the head of households, but these variables are not significant, then we will just remember the significant variables. Then, we found two significant variables that favor school attendance, child sex, and household income. However, in 2010 we found two variables household size (significant) which remains a risk variable even in 2010 and household income (not significant) but represents a risk factor. The other variables play in favor of school attendance.

Table 6.   Logit Regression Results: Primary School Attendance

Opportunities	2005			2010		
	Coef	p-value	e^β	Coef	p-value	e^β
Child's sex	-1.004	0.000	0.366	-1.046	0.000	0.351
Residence	-0.012	0.789	0.989	-0.511	0.000	0.600
Household's head education	0.060	0.271	1.062	-0.130	0.041	0.878
Household size	0.061	0.148	1.062	0.082	0.078	1.085
Household's head gender	0.0512	0.426	1.052	-0.134	0.079	0.875
Household income	-0.1493	0.047	0.861	0.058	0.508	1.060
Constant	-0.4353	0.000	0.647	-0.3861	0.000	0.680
Number of observations		12166			11123	
Chi-square Test		0.000			0.000	

Source: Author's calculation from HBS 2005, 2010.

4.4. Discussion of the Inequality of Opportunity access to Basic Education: D-index Analysis

We combined in Table 7 the results of IOP of education and its decomposition by the value of Shapley, the latter guides us to identify the degree of contribution of each circumstance to the total inequality. In 2005, for example, the sex of the child is found to contribute almost completely to inequality, it explains more than 94% of inequality of opportunities. This variable is also important in explaining access to education in 2010, but with a low rate, it contributes at 68.51% to inequality and the place of residence is found in a second place with a contribution of 22.23%.

Our analysis of the IOP from 2005 until 2010 shows that the inequality of access to education increases from 16% at the national level in 2005 to 17% in 2010, an increase close to 2% which is not desirable for the country. The evolution of the D-index in Tunisia remains relatively high compared to similar studies conducted by the World Bank (2009) in 19 Latin American countries such as Brazil Guatemala and Nicaragoua which have highest D-indexes of 30%, 27% and 24% respectively. However, Argentina had the lowest D-index (3%).

Table 7. The Inequality of Opportunity of Accessibility to Education and Its Decomposition

Decomposition	2005		2010	
	Value	%	Value	%
Child's sex	0.1534	94.46%	0.1236	68.51%
Residence	0.0006	0.38%	0.0401	22.23%
Household's head education	0.0016	1.02%	0.0093	5.13%
Household size	0.0030	1.85%	0.0027	1.49%
Household's head gender	0.0004	0.26%	0.0029	1.60%
Household income	0.0033	2.04%	0.0013	0.70%
Total	0.1623	100.00	0.1798	100.00

Source: Author's calculation from HBS2005, 2010.

As a result, our study of the IOP in access to basic education for Tunisian children in 2005, is based on the choice of socio-economic variables that are hypothetically explanatory to the accessibility that are available in our databases. Indeed, it has been found that there are decisive variables in the distribution of access to basic education hierarchical as follows: In 2005, we first found the sex of the child who contributes 95% of the total inequality, the income of the head of households and then the size of households. These variables persist over time until 2010 but not with the same contribution rate, as we see that the sex of the child and place of residence remain decisive variables with rates of 68.51% and 22.23%, respectively. However, we note that the education of the head of households comes in 3rd position in 2010 compared to 2005.

Recall that the explanatory variable is coded 0 attending a school and 1 not learning. First, we note that the sex variable of the child is a very decisive variable in the IOP of accessibility to education (inequality in learning achievements). Moreover, we note that the number of boys increased by 1% during the period studied and that Shapley's decomposition considers this variable as very contributive to inequality meaning that boys are more likely to attend school than girls in the 6-12 ages. So, we can observe a gender inequality in terms of accessibility to education that occurs during this period. The decrease in terms of contribution of this variable from 95% in 2005 to 68% in 2010 is explained by the role of the state in dealing with discrimination between the two sexes and the awareness programs carried out to fight against female illiteracy on everything in rural areas. In other words, during the period 2005-2010 the feminization of Tunisian society in terms of education continues to be confirmed.

In this sense, we found that in 2005 household income explains the inequality of access to education, that is, children with wealthy parents or those with a stable income are more likely to be enrolled in a school than children who have a low-income or poor family. Shapley's decomposition put this variable second as a variable contributing to inequality, which means that part of the inequality comes because of the financial constraints of some families. The third variable in the hierarchical order is household size, which is a variable correlated with the financial situation.

In 2010, we noticed that all the variables explain the inequality of access to education except household income, which becomes insignificant. In fact, the gender variables of the child, place of residence, the education level of the head of households, and the size of households have a negative sign. This means that boys have the probability of being enrolled in a school than girls. Likewise, children from urban areas, having educated parents, and belong to a small family are more favored than children who are located in rural areas, and their parents uneducated, and belong to a large family. Specifically, Shapley's decomposition in 2010 shows that gender inequality also persists in 2005, the child sex variable comes first as a variable that contributes to inequality, which means that boys remain favored to access a primary school as girls but with a lower contribution than in 2005 (68% instead of 95%). This decrease may be due to programs to combat female illiteracy during this period for girls in rural areas.

In a second time, we found that the place of residence with a contribution rate of 22.25%. Thus, the influence of the place of residence on the distribution of accessibility to education can be explained by the fact that the inhabitants of rural areas remain disadvantaged compared to urban dwellers in terms of lack of basic infrastructure (the distances that separate households from public primary or secondary establishments). This obstacle confirms the difficulties of moving to schools because of the long distances and will end with the abundant schooling at a very early age. In addition, the level of education of the head of households is a key variable for school attendance. Indeed, the most educated parents are more attentive to schooling unlike uneducated parents because illiteracy is a rural phenomenon in Tunisia, which represents a major obstacle to social and economic integration caused by financial constraints.

5.   CONCLUSION AND RECOMMENDATIONS

In this work, we tried to study the effects of inequality of opportunity on the distribution of human development indicators apprehended by monetary well-being and basic education throughout the period of 2005-2010. To achieve this goal, we firstly applied the parametric and non-parametric approaches to monetary well-being. Then, we apply the dissimilarity index D-index on the accessibility to basic education measured for children at primary school age.

According to its new report, the United Nations Development Program (UNDP, 2016) has revealed that Tunisia is among the countries with a high human development index; it ranks Tunisia in 4th place in Africa and 97th in the world. Its value goes from 0.67 in 2005 to 0.70 in 2010 (HDR, 2007). Nevertheless, it has been shown that human development indicators are very unequally distributed in Tunisia such as education and income and tend to increase over times.

Our study shows the existence of traps of inequalities in society concretized by the unequal distribution of indicators of human development between different social classes. Therefore, unequal distribution of wealth affects trajectories of getting out from poverty (poverty traps for those who cannot borrow to improve their income).

Compared to final consumption, the estimate confirms the evolution of inequality from 15% in 2005 to 18% in 2010 which is not desirable for the country. The sources of inequality in 2005 are household head gender and place of residence, while in 2010 the place of residence and connection to drinking water are the most important. It is therefore recommended, the implementation of vocational training that aims to increase human capital for rural areas to increase the productivity of their jobs through the provision of infrastructure (drinking water, road, electricity, sanitation, etc.). In addition, equal access for both genders must be guaranteed without discrimination following the sex. Given this situation the National Institute of Statistics (GNR, 2015) starts to develop surveys in collaboration with other national and international institutions "Gender National Report 2015" which aims to introduce the gender approach in the production of statistical indicators and to facilitate the study of the evolution of disparities of the inequality between men and women in Tunisia[6].

For the accessibility to basic education, the results estimate the increase in inequality from 6% in 2005 to 8% in 2010. The variables contributing most to inequality are the sex of the child in 2005, while 2010 was the sex of the child and the place of residence. Based on the decomposition of inequality we recommend: the abolition of tuition fees in all public primary schools and granting scholarships to girls and vulnerable children in priority areas. Furthermore, eliminating pay gaps between both sexes through the evaluation of progress in gender equality which allows ensuring equal access to education.

In sum, despite the efforts provided by the state since independence for the fight

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[6] For more details see INS 2015, Gender National Report 2015.

against poverty in Tunisia which is illustrated by an improvement for the period 2005-2010, and despite the increase in the indices of human development (monetary welfare, education, and health), the distribution of these indices among different social groups at the national level continues to hide disturbing inequalities in the country. This lack of equity can subsequently translate into political instability and this was the case in 2010. In this context, the government must strengthen interventions by acting on key variables.

APPENDIX

Table A1.   Different Measures of the IOP

	Ferreira et Gignoux (2011)	Ferreira et Gignoux (2013)	Paes DeBarros et al. (2007)	Wendelspiess Chavez and Soloaga (2013)
Type of variables	Continue with scale	Continuous, with arbitrary mean and dispersion	Dichotomous and limited	Dichotomous and limited
Methods applications	Income	PIZA score	Access to education	Access to education
Estimation methods $E[y/C]$	OLS	OLS	Probit or logit	Probit
Measure of inequality $I(y)$	Mean log deviation	Variance	Dissimilarity index	Dissimilarity index
Absolute measure	Yes	No	Yes	Yes
Relative measure	Yes	Yes	No	No

Source: Wendelspiess Chavez Juarez and I. Soloaga (2013).

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