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Opportunity cost of time and value of human life in Burkina Faso and Ivory Coast

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Abstract

The monetary valuation of human life is both controversial and complex, giving rise to passionate debate and profound ethical dilemmas. This article uses a new method to measure the value of human life based on a marginal valuation of the individual's available time over her life cycle. The results of an empirical application carried out in two African countries on microeconomic data reveal a significant divergence in the valuation of human life compared to accumulated GDP per capita. This finding calls into question the usual ethical considerations and social equity thesis and shows that this individual estimation of the value of human life may be an interesting indicator for public choice.

1   Introduction

The concept of the value of a life in economics refers to the monetary worth assigned to avoid death or to save a life. Understanding the value of human life is essential for guiding public policies, social investments, and ethical decision-making (see Dionne and Lebeau, 2010 and Anderson and Treich, 2011). However, the concept of the statistical value of life has an important limitation due to the diversity of methods and empirical results (see Gardes, 2022). Moreover, the question of the effect of age and various socio-economic characteristics of the individual on the value of her life is not clear. Aldy and Viscusi (2008) suggest a relationship in the form of an inverted U, whereas OECD studies (2012) refute the existence of a relationship. On the other hand, income emerges as a determinant of the value of human life, yet it is rejected for ethical reasons (Thouverez, 2016). The differences between countries in this value are closely correlated with GDP per capita (Madeshwaran, 2007 and Gardes, 2022). For instance, according to Treich (2015), the value of life significantly increases with income and shows more modest values in developing countries compared to developed ones.

In light of these controversial facts, this article examines the empirical results arising from the application of a new concept of the value of a life proposed by Gardes (2022), which is based on the marginal value that each individual places on his or her available time. Beyond its methodological relevance, this paper raises major ethical and political issues: how can the economic approach to the value of life be reconciled with principles of social justice? What public policies could help reduce valuation disparities between social groups and countries? The contribution of the paper is twofold: (i) Comparing the value of human life in two African Countries; (ii) Analysing the determinants that influence the value of human life in the African context. These two countries differ much as concern, both their economic development and the market structures (especially the labor market), independently of their particular economic, social and politic situations. It is thus difficult to disentangle all possible causes of the differences observed in households' use of their monetary and time resources. The two countries have the same average life duration (around 58 years), but the demographic structures of families may be quite different (and very variable across each population).

The article is structured as follows: Section 1 describes the methodology, section 2 presents the data-sets and section 3 discusses the results.

2   Methodology

2.1   A new definition of the value of human life

Suppose an economic agent evaluates her marginal value for disposable time at ω_t in period t. This marginal value can be integrated over the head's whole life (from birth to death: 0 to T_0) or remaining life (present age t_0 to T_0)[1] in

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[1]see in Gardes, 2022, the evaluation of the VHL in this case.

order to obtain a monetary value of her total living time. This marginal value is applied to all types of activities, an assumption which is also made in all other methods evaluating the 'statistical' value of human life, for instance those based on the willingness to pay for an extra hour or on hedonistic wages.

The economic value of a length of time, for instance a year, lived by some individual is the product of the value of time (supposed constant during the year in the final formula (2)) with this duration (measured in yearly hours τ if the opportunity cost of time corresponds to one hour). The total value of a human life of an individual is thus the sum of yearly values actualized at the interest rate (the household's Inter-temporal Substitution Rate) ρ over the household's life cycle from $t = 0$ (or t_0) to T_0:

$$V = \int_0^{T_0} \omega_t \tau e^{-\rho t} dt \tag{1}$$

with τ the number of disposable hours during one year. The assumption that ω is constant along the life cycle gives the following value (see Gardes, 2022):

$$V = \left(\frac{1}{\rho} - \frac{e^{-\rho T_0}}{\rho} \right) \omega \tau \tag{2}$$

Disposable hours are defined as those which are free to choose and which could therefore be substituted for another activity, either domestically or on the labor market. It may correspond to 24 hours a day (including sleep in this substitution) or disposable time after necessary activities (16 hours per day for instance corresponding to 5840 for one year).[2]

The value of a human life thus depends, first on the household's psychological interest rate (Inter-temporal Substitution Rate) ρ, second on the opportunity cost of time, third on the agent'age and fourth on life duration. This model supposes a common evaluation of time uses spent during the life cycle, either in the market or at home, which corresponds to the assumption of a perfect substitution between market work and domestic work (a possible difference between the wage rate and the opportunity cost of time being caused by the desutility of market labor) and between periods (by means of the ISTR ρ).

2.2 The estimation of the opportunity cost of time

In the Becker's original allocation of time model, the same opportunity cost of time applies for the time factor of the home production and on the labor market. Gardes (2019) proposed a model where the value of time in domestic production can differ from the wage rate and where the agent maximizes a direct utility function depending on the quantities of a set of activities given by domestic production functions. This model gives rise to an estimation of the opportunity

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[2]Considering that the opportunity cost of time depends on age and various socio-economic characteristics of the household gives an alternative formula but rather concordant final average results, see Gardes (2022, section 2.1, equation 8) and Aldy and Viscusi (2008).

cost of time depending on the parameters of the utility and domestic production functions and on geometric means of household's monetary expenditures and time uses for all domestic activities (Gardes, 2019, equation 5). This value of time is estimated at the individual level (that is for each individual or household in the data-set).

3   Datasets

3.1   Burkina Faso: the Agricultural Family survey

The RGA Survey[3] (Recensement Général de l'Agriculture, 2008) covers 71 villages in the 45 provinces, with a total of 6941 households surveyed. It contains information on family characteristics (incomes from agriculture or other activities, age of the head and the spouses, number and age of children, education level, accessibility to social services, income, financial situation, equipment...), households' expenditures (over 40 goods and services) and time use over 14 activities: unproductive activity, agriculture in rainy periods, gardening, culture of trees, cattle breeding, fishing, gathering, wood harvesting for selling on a market, wood harvesting for family needs, search for water, market work, other domestic activities, personal activities, other activities.

The monetary expenditures and the time use have been grouped into three common domestic activities (activity 11 being excluded since it concerns market work): food (time activities 2 to 7, 9 and 10), domestic activities (12), other (13, 14). Detailed information on the country and the dataset can be found in Gardes and Thiombiano (2017, Appendix A) and Angbo-Gardes (2025).

3.2   Ivory Cost

We use two annual family budget surveys: BdF (2008) and BdF (2015). As these surveys do not provide data on the use of time for activities, we use a daily time budget survey: BdT (2013). This allows us to attribute the time spent on each activity in the family budget surveys, but only in urban areas, as the BdT (2013) survey was limited to these regions. All survey data were previously converted to monthly data for a consistent comparison.

Statistical matching

The statistical matching of these Ivorian surveys is based on the definition of four groups of activities that are compatible with the data available in the two family budget surveys and the time budget survey: food, housing, domestic activities, leisure and miscellaneous. The statistical matching process between the BdF(2008 and 2015) with the BdT (2013) is conducted by the cell-matching method (Deaton, 1985), leveraging a shared set of household characteristics

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[3]Acknowledgment to the General Directorate for the Promotion of the Rural Economy (DGPER) and the University of Ouaga II and to INSEE for the disposition of its Family Expenditures and Time-Use surveys.

present in all three surveys. These household characteristics, assumed to be invariant over time, are the head's cohort (date of birth by forming 6 age modalities in 10-year increments per survey year) and the household demographic type (3 modalities). After grouping households into cells, we established a temporal relationship between them. For example, a household with modality 1 for the demographic type, and aged 14 in 2008 is linked to the household with modality 1 for the demographic type, but aged 19 in 2013, which in turn is linked to the household with the same demographic type, but aged 21 in 2015. The variables of interest (monetary expenditure or use of time in each activity) for a household result from an imputation of the intra-cohort average of observations from all households within the same cohort. We control the size and homogeneity of the cohorts formed by retaining only those whose size (in number of households) is at least equal to 100 (according to the methodology proposed by Verbeeck and Nijman, 1992.). This results in a pseudo-panel made up of 12066 households observed at two separate times (in 2008 and 2015), grouped into 17 cells, representing an average of around 710 households per cell.

4 Empirical analysis

Table 1: Values of Human Life and GDP

Country	V, $\rho = 0.03$	V, $\rho = 0.05$	ω	ω/w^{min}	ω/w^{av}	GDP pc	$V/GDP*$	$V/GDP**$
Burkina Faso	21 382	14 809	0.09	0.28	0.30	619	1.25	0.63
s.e.	(24 756)	(17 146)	(0.01)	-	-	-	-	-
Ivory Cost	91352	63511	0.58	0.94	0.59	1942	1.74	0.87
s.e.	(6895)	(4679)	(0.04)	-	-	-	-	

Note: VHL and GDP in 2015 USD. $\tau = 16$ disposable hours per day (5840 per year). w^{min}: minimum wage rate; w^{av}: average wage rate. GDP*: GDP per capita accumulated over the household's life cycle ($\rho = 3\%$)); GDP**:GDP per capita accumulated over the household's life cycle with equivalence scale.

First, the value of human life is much greater in Ivory Coast (in absolute value and also compared to the GDP per capita), which could be inferred considering their respective levels of being (as informed for instance by their GDP per capita in Table 1). These values are somewhat greater from the accumulated GDP per capita, which is here actualized at a real rate of 3% (generally used in public investment). In order to equalize the value of human life with the GDP per capita, it would be actualized at a rate of 4.6% in Burkina Faso and 6% in Ivory Coast. Note that fixing the number of disposable time at 24 hours per day instead of 16 would increase the ratio of the VHL over the accumulated GDP to 1.88 in Burkina Faso and 2.81 in Ivory Coast.[4]

Second, changing the Inter-temporal Substitution rate in the actualization of yearly time values changes a lot the evaluations. It could be therefore important to estimate the endogenous ISTR linked to the opportunity cost of time as suggested in Gardes (2021 and 2022).

Third, comparing the value of human life and the corresponding accumulated GDP per capita supposes that all households have a similar weight in the

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[4]These figures correspond approximately to the ratio of an enlarged GDP integrating the value of domestic work into the official GDP, see Gardes, 2022

national product, thus eliminating the necessity to aggregate income and values of time per unit of consumption using an equivalence scale. Evaluating an equivalence scale (valuing 1 the first adult, 0.7 other adults and 0.5 children), gives rise to an average number of units of consumption per family equal to 2.76. But the value of time is measured only for two adult in the family while consumption concerns all members of the family, so that a smaller demographic scale (averaging units of consumption of time use and U.C. of monetary expenses), equal to 2, is used to evaluate the value of time per capita. After this correction, the VHL is close to the accumulated GDP, being smaller than 1 when the VHL is computed per capita (0.63 for Burkina Faso and 0.87 for Ivory Coast) and slightly greater than 1 for no equivalence scale of the VHL (1.25 and 1.74). It is significantly greater in Ivory Coast, perhaps because of a more liberal labor market which allows individuals to compare the value of their domestic time to the value of market labor (i.e. its wage rate). [5]

The value of disposable time depends on the possibility to use disposable time for an activity which gives rise to a monetary counter-part, especially as concerns working on the market (either official or informal). This possibility to spend time on the labor market may bring together the opportunity cost of time to the wage rate of the individual on the market, so that the degree of substitution between time and money resources (as it can be measured by the elasticity of substitution between them) may influence the level of the opportunity cost of time (or more precisely its ratio with the wage rate). An economy which is more liberal (that is more based on market mechanisms) may therefore have an average opportunity cost of time closer to the average wage rate, and therefore probably magnified compared to the value which would appear if the substitution between the time and money resources disappears. This is probably an important factor of the higher ratio of the value of time to the wage rate in Ivory Coast.

Fourth, the value of human life can be estimated for sub-populations, contributing to discussions on ethics considerations and inequality (Sunstein, 2014, chapter V): the age-based distribution of the VHL in Ivory Coast appears to follow an inverted U-shaped curve, reaching its peak in midlife, among adults aged 36 to 55. This finding supports the conclusions of Aldy and Viscusi (2008) and Gardes (2022), while contradicting the position commonly held by governments that all human lives should be valued equally, regardless of individual characteristics. One may thus suspect a dependency of the VHL on age, so that the method proposed in Gardes (2022) to take care of the dependency of the value of time on the household's life cycle must be considered, which necessitates to estimate the influence of the age of the head (and possibly the difference of ages between the man and his spouse) on the household's average value of time and on life expectancy.

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[5]Note that an equivalence scale for a family equalizing the VHL to the accumulated GDP per capita would be 1.25 in Burkina Faso and 1.74 Ivory Coast, which are slightly smaller than official equivalence scales for two adults and quite smaller for all families.

Table 2: Socio-economic differences in the Values of Human Life (2015 USD)

Sub-Populations		V, ρ=0.03	V, ρ=0.05
Social Status	Poor	90 840	63104
s.e.	-	(7786)	(5265)
Social Status	Non-poor	91 846	63905
s.e.	-	(5867)	(3995)
Head'age	Till 35 years	92 823	64 549
s.e.	-	(5846)	(3828)
Head'age	36-55 years	101 318	70331
s.e.	-	(10 326)	(7211)
Head'age	After 56 years	89 949	62549
s.e.	-	(5103)	(3403)

Note: VHL for the whole life cycle.

Fifth, the value of human life in Ivory Coast is not very different for non-poor individuals compared to the poor (Table 2). This pattern does not align with findings by Gardes (2022) in French households, where the value of life is positively correlated with income (see also Treich, 2015). Wealthier individuals tend to have greater access to resources, financial capital, time, and stability, all of which enhance their productivity in domestic and economic activities, thereby increasing their perceived economic value. In contrast, individuals living in poverty often face substantial barriers that limit their ability to achieve similar levels of productivity. Social status appears therefore as a key determinant of the value attributed to human life, which implies a critic for reinforcing social inequalities and undermining the ethical principle that all lives have equal economic worth (not to be confused with their intrinsic human value), regardless of economic standing.

Conclusion

The results obtained applying the domestic production framework to the computation of the Value of a Human Life show that it differs from the accumulated value of the GDP per capita and that it is clearly linked to the levels of being of the two countries and possibly to the development of their labor market and more generally on the structure of markets (degree of national economic liberalism which may shape the possibilities for investment in human capital, thereby indirectly affecting the value of time). It can also depend on the specific political problems encountered recently by these countries.

It seems important to consider that National Production (measured by the GDP) and the level of being of the population (measured by the GDP per capita or per unit of consumption - depending on a specific equivalence scale) are only partial indicators of the well-being of individuals. *First*, these indicators, based on National Income, must be accumulated over the whole life of individuals in order to represent the entire wealth proceeding from households' monetary income. *Second*, they must be augmented by the effects of other determinants of well-being (such as life expectancy, health status...) the influence of which

is partially conveyed by the valuation of free time by individuals. Policy recommendation must therefore: *first*, try to increase the life duration through an improvement of life duration. *Second*, diminish the economic and political uncertainty in order to lower the weight of the Inter-temporal Substitution in the valuation of life, which depends on the future achievements of the individual. *Third*, increase the substitution between time for domestic production and market labor in order to increase the value of domestic time.

Note finally that inferring the inter-temporal rate of substitution from the opportunity cost of time (as discussed in Gardes, 2021 and 2022) results in comparable but much less dispersed evaluations of the value of human life across the population. Moreover, it allows the computation of the value of human life for different types of households or individuals. This may be an interesting feature of that indicator for public choices.

Appendix: Descriptive Statistics

Table A1: Monetary expenditures and time use in Burkina Faso

Activities	Monetary b.s. (%)	Time b.s. (%)	Mon. exp.	Ratio mon. to time value
Food	74.5	45.9	2472	16.41
Housing	7.9	27.4	259	2.60
Leisure and Other	17.6	26.7	588	6.14
Total	1	1	3319	9.58

Note: Monetary expenditures in 2008 CFA francs (1000 FCFA (2008) correspond approximatively to 2.65 USD (2015)).

Table A2: Monetary expenditures and time use in Ivory Cost

Activities	Mon. expenditures	Mon. Budget share (%)	Time use	Time B. share (%)
Food	166.42	45.5	115.82	9.0
s.e.	(27.10)	-	(66.41)	-
Housing	52.31	21.6	240.36	18.6
s.e.	(23.87)	-	(109.11)	-
Domestic activities	61.04	24.9	180.35	18.6
s.e.	(25.89)	-	(61.12)	-
Leisure and Other	18.12	7.9	756.24	53.8
s.e.	(4.92)	-	(246.44)	-
Total	237.89	100	1292.78	100
s.e.	(73.56)	-	(428.68)	-

Note: 12066 observations. Monetary expenditures in US dollars 2015 per month. Time use in hours per month

References

Aldy, E., Viscusi, W. (2008) "'Adjusting the Value of Statistical Life for Age and Cohort Effects"', *The Review of Economics and Statistics*, Vol. 90 (3), 573-581.

Alpman, A., Gardes, F., Thiombiano, N. (2017) "'The pertinence of Matching Surveys on Households Time Use and Expenditures: a Test on Real Data"', *Cahiers de Recherche du CES 2017*, University Paris I Panthéon Sorbonne.

Andersson H., Treich N. (2011) "'The Value of a Statistical Life"', in *Handbook of Transport Economics*, A. de Palma, R. Lindsay, E. Quinet and R. Vickerman, Eds., North Holland.

Angbo, O. (2023), *"'Valeur du Temps et Production Domestique en Côte d'Ivoire"'*, doctoral thesis, University of Angers.

Angbo, O., Gardes, F. (2025) "'An Empirical Analysis of the Value of Human Life in Burkina Faso and Ivory Cost"', *Cahiers de Recherche de l'UCO*, Western Catholic University.

Becker, G. (1965) "'A Theory of the Allocation of Time"', *The Economic Journal* 75: 493-517.

Deaton, A. (1985) "'Panel Data from Time Series of Cross Sections"', *Journal of Econometrics*, vol. 30, 109-126.

Dionne, G., Lebeau, M (2010) "'Le Calcul Statistique d'une Vie Humaine"', *L'Actualité Economique*, vol. 86, 4, December, : 487-530.

Gardes, F. (2022) "'On the Value of Time and Human Life"', *Cahiers de Recherche du Centre d'Economie de la Sorbonne 2018.28, new version 2022, University Paris I Panthéon Sorbonne.*

Gardes, F. (2021) "'Infering Time Preference from the Value of Time"', *w.p. CES 21019*, PSE, Paris I University.

Gardes, F. (2019) "'The Estimation of Price Elasticities and the Value of Time in a Domestic Production Framework: an Application Using French Micro-Data"', *Annals of Economics and Statistics*, 135, September, 69-100.

Gardes, F., Thiombiano, N. (2017) "'The Value of Time and Expenditures of Rural Households in Burkina Faso: A Domestic Production Framework"', *Cahiers de Recherche du Centre d'Economie de la Sorbonne 2017.27.*

INS, ADS (2013) "'Enquête sur l'Agenda Journalier des Activités des Ménages en Côte d'Ivoire"', *Institut National des Statistiques de Côte d'Ivoire, Activities Diairy Survey 2013.*

INS, ENV (2008, 2015) "'Enquête du Niveau de Vie des Ménages en Côte d'Ivoire"', *Institut National des Statistiques de Côte d'Ivoire, Enquête Niveau de Vie des Ménages 2008.*

Madheswaran, S. (2007) "'Measuring the Value of Statistical Life: estimating Compensating Wage Differentials among Workers in India"', *Social Indicators Research* 84 (1), 83-96.

OCDE (2012) *"'La Valorisation du Risque de Mortalité dans les Politiques de l'Environnement, de la Santé et des Transports"'.*

Sunstein, C. (2014) *"'Valuing life"'*, University of Chicago Press.

Thouverez, P. (2016) "'Pourquoi une Valeur de la Vie Humaine?"' *Techniques de l'Ingénieur*, https://www.techniques-ingenieur.fr/actualite/articles/valeur-vie-humaine-31546/

Treich, N. (2015),"' "'La Valeur d'une Vie Humaine en Economie"', *Futuribles*, 404.

Verbeek, M., Nijman, T. (1992) "'Can Cohort Data be Treated as Genuine Panel Data?"', *Empirical Economics*, vol. 17, 19-23.