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THE RELATIONSHIP BETWEEN ENERGY CONSUMPTION, ECONOMIC GROWTH AND HAPPINESS

NEILA BEN AFIA

University of Sousse, Tunisia

For the important role of happiness in our life, the aim of this study was to investigate empirically the relationship between the consumption of energy, economic growth and happiness. A distinction is drawn between the direct and indirect impact of consumption of energy on happiness which functions throughout the impact of consumption of energy on per capita income and the resulting impact of income on happiness. Using panel data analysis of 47 different countries over 14 years covering the period from 2001 to 2014, both direct and indirect effects of consumption of energy on happiness are estimated. We remedy the potential endogeneity problem when estimating the indirect effect by instrumenting the variable "consumption of energy". Our results show that the consumption of energy has a significant positive direct impact and indirect effects on happiness resulting in an overall positive effect of consumption of energy on happiness for all countries.

Keywords: Consumption of energy, Income, Happiness, Panel data
JEL Classification: C23, A13, I3

1. INTRODUCTION

Empirical investigations have first devoted attention to the effect of income on the happiness. Then other different aspects deemed to influence happiness has been considered. Unequivocally, there is a close relationship between economic growth and life satisfaction. Thought-out the empirical part of the paper, it has been shown that countries that experienced a rapid economic growth rate has also in equivalence and increase in life satisfaction levels. In the same vein, the situation of East Germany and Russia during the 1990s illustrates well this statement. However, for the most cases, the steady income appears not to have a positive impact on the happiness levels in rich countries. Indeed, although on average richer countries tend to be happier than poorer countries; beyond a certain threshold the average income makes little difference to the average self-reported happiness (Blanchflower and Oswald, 2004; Clark and Oswald,

1996; Frey and Stutzer, 2002).

A part income, researchers have analyzed different influences on happiness. In this vein, several studies have explored the impact of demographic factors like age, sex and material status on happiness (Davoine, 2007). Other economic variables (such as inflation rates, efficiency of government services, civil liberties, unemployment status) have been highlighted (Gorge et al., 2015), and also the political and institutional influences on happiness (Frey and Stutzer, 2000; Helliwell, 2003).

However, there is almost no study that addresses the possible interactions between happiness, consumption of energy and growth in the same time, but there is a relationship between consumption of energy and economic growth and a relationship between economic growth and happiness. Although the merits of the contributions proposed within these separate lines of studies are remarkable, we argue that they don't get grip on all the aspects of consumption of energy. This lack of connection in research leaves many empty spaces between these different aspects, yet closely interacted. This article intends to contribute to fill this gap.

The aim of this paper is to provide an accurate assessment of the links between consumption of energy, growth and happiness. From this perspective, we argue that there are two mechanisms by which consumption of energy may impact happiness.

The first is a direct mechanism where the consumption of energy directly impacts the happiness. The second is the "indirect" mechanism by which it affects per capita income which in turn impacts happiness. We assert that the total effect of consumption of energy on happiness is the result of these two effects. To empirically investigate these direct and indirect effects of consumption of energy on happiness, we use a sample of 47 countries covering the period 2001 to 2014.

Economic writings are replete with references to the relationship between the consumption of energy and growth (Crompton and Wu, 2005; Skeer and Wang, 2007; Cheng, 1999; Squalli, 2007; Halicioglu, 2007).The energy sector plays an important role in economies, and social development of countries, being a key factor in increasing economic growth and living standards. In this regard, the analysis of the relationship between energy consumption and economic growth has received a great attention during recent years. This relationship between the two variables has been the aim of many researches in the energy economics literature since the pioneering study of Kraft and Kraft (1978).

These studies adopted several approaches including short-term and long-term impact analysis and analysis in terms of causality between energy consumption and economic growth.

Likewise, there is an extent study about the relationship between growth and happiness (Clark and Oswald, 1996; Frey and Stutzer, 2002; Blanchflower and Oswald 2004). For instance, Easterlin (1974) found no significant relationship between happiness and income. He showed that per capita income in the United States during the period 1946-1970 almost doubled, while the average level of happiness showed no notable increase. This so called Easterlin Paradox has been confirmed by other studies

(e.g. Inglehart, 1990; Diener et al., 1995; Easterlin, 2013). Other studies have confirmed the existence of this positive relationship between GDP and life satisfaction in developed countries (Blanchflower and Oswald, 2004; Shields and Price, 2005) and also in developing countries (Graham and Pettinato, 2002; Lelkes, 2006).

In addition, consumption of energy is not only related to economic growth, the use and consumption of energy is very important for the human life, because we need all forms of energy, for example in factories the machines work with electricity and the employees are paid because of their work done in factories and to satisfy our needs; we need means of transport that reduce distances and facilitate movement, to get to work for exrmple, educational institutions and also air conditioning to adapt to the climate. Generally, based on the benefits of energy consumption, it is considered a way to improve our living condotions. Since energy consumption is a means of satisfying all our important needs, we can say that it is considered as an important source of happiness for the humans.

Energy consumption seems to be a means to promote human well-being. It gives individuals a sense of satisfaction of their needs. As such, people living in energy-using and energy-producing countries should be happier.

From this point of view, it seems reasonable to assume that the higher the energy consumption in a nation, the higher the average happiness of that nation will be.

The rest of the paper is organized as follows; Section 2 examines the previous, literature, whilst Section 3 outlines the methodology used within this paper. Section 4 provides the results, and Section 5 provides the conclusion.

2. THE LITERATURE REVIEW

2.1. The Relationship between Consumption of Energy and Economic Growth

The energy-growth nexus is of great interest for economists as well as for policy makers because of its significant policy implication. Some researchers argue that economic growth and key macro-variables are the determinants of consumption of energy and hence apply these variables to project energy consumption (Li, 2003; Crompton and Wu, 2005 and Skeer and Wang, 2007).

The first relevant study on energy and growth dates back to the late 1970s. The relationship between energy consumption and economic growth has been examined thoroughly since the pioneer work of Kraft and Kraft (1978). However, the direction of causality between energy consumption and economic growth remained controversial. Kraft and Kraft (1978) used annual data from 1947 to 1974 in U.S to study the relationship between gross national product (GNP) and gross energy inputs. They employed the Sims causality test procedure to infer the causal relationship, and discovered that increased GNP leads to increased energy consumption.

Cheng (1999) used the Granger causality method on the India data for the time

period 1952 to 1995. The result showed that the direction of causality runs from economic growth to energy consumption both in the short-run and in the long-run. No causal relation is found between energy consumption to economic growth. In another study, Squalli (2007) suggests the possibility that an increase in consumption of energy may have a negative effect on the GDP. Similar results were found in Turkey by Halicioglu (2007), who also found that income has a significant impact in consumption of energy in Turkey. Huang et al. (2008) not find causality between energy use and economic growth in low-income groups, but found that economic growth in middle- and high-income countries leads to a higher energy consumption.

2.2. The Relatioship between Economic Growth and Happiness

Easterlin (1974) found no significant relationship between happiness and income in his studies. He noted that per capita income in the United States, during the period 1946-1970 almost doubled, while the average level of happiness showed no appreciable increase. This Easterlin Paradox has been confirmed by other studies (Inglehart, 1990; Diener et al., 1995; Easterlin, 2013). On the contrary, (Deaton, 2008; Inglehart, 1990; Stevenson and Wolfers, 2008), claim that life satisfaction seems to be strictly monotonically growing with income. Other researchers have suggested that this positive relationship disappears for some income values, which means, beyond a certain threshold, the increase in income does not increase happiness (Inglehart et al., 2008; Inglehart, 1990; Di Tella et al., 2010).

The results of Easterlin have been confirmed by numerous studies; Veenhoven (1991) and Inglehart (1988) reported a positive but scattered correlation between GDP growth and happiness. Beyond a certain level, it has little impact on feelings. Some poor countries have higher levels of satisfaction than developed countries. For example, the satisfaction of the average life of Brazilians is much higher than that of the Japanese, although Brazil has a real income per capita lower. We quote the Belgian case, after the first oil shock, real GDP per capita increased by 80%, but the satisfaction of life decreased on average by 8.80%.

Frey and Stutzer (2002) noted, following this conclusion, that the idea that individuals in poor countries are happier than those in rich countries because they live in more “natural” and less stressful conditions is a myth. Helliwell (2003) agrees with Frey and his colleagues. He concluded that the people who know the highest well-being are not those who live in the richest countries, but those who live where the social institutions and policies are effective, where mutual trust is high and where there is little corruption.

Similar works in the happiness economy noted that perceived well-being and objective economic indicators are not strongly correlated. It is thus possible for a person to have “objectively satisfactory” living conditions and to feel unhappy (Kahneman et al., 2006) or conversely, that a person living in unfavorable conditions declares himself satisfied and happy (Biswas-Diener and Diener, 2001, 2006; Graham, 2010).

Other analyzes have demonstrated a positive relationship between GDP and life satisfaction in developed countries (Blanchflower and Oswald, 2004; Shields and Price, 2005) and also in developing countries (Graham and Pettinato, 2002; Lelkes 2006). This is true for both developed and developing countries, and the correlation between income and happiness is higher in developing and transition countries than in developed countries (Clark et al., 2009).

Without pretending to be exhaustive, Table 1 provides the main contributions related to the relationship between economic growth and subjective well-being

Table 1. The Correlation between Subjective Well-being and Income

Correlation	The concept used	Countries	References
0.13	Satisfaction of life and economic growth	19 countries	Diener and Oishi (2000)
(0.06 – 0.15)	Satisfaction of life and economic growth	West Germany	Schyns (2003)
0.18	Happiness and economic growth	United States	Hagerty (2000)
0.12	Life satisfaction and economic growth	United States	Johnson et Krueger (2006)
0.50	financial satisfaction and economic growth	South Africa	World Value Survey II (1994)
(0.17 – 0.27)	Life satisfaction and economic growth	Russia	Schyns (2003)
0.45	Life satisfaction and economic growth	poor countries	Biswas-Diener and Diener (2001)
0.35	Aggregate of satisfaction town and economic growth	India	Brinkerhoff et al., (1997)

In Table 1, the correlations between individual incomes and different indices of well-being are significant but modest (around 0.15 on average) in rich countries. In poor countries, the correlations are higher and more significant, such as for South Africa and India.

3. METHODOLOGY AND EMPIRICAL STRATEGY

3.1. Presentation of the Model

In order to capture both the direct and indirect effects of consumption of energy on happiness, we use the joint estimation of two equations: an equation expressing happiness (H) as a function of income, consumption of energy and other factors and the second equation expressing income (Y) as a function of consumption of energy and other factors. Equations (1) and (2) are defined below:

$$H_{it} = \gamma_i + \kappa_t + \alpha_1 Y_{it} + \alpha_2 CE + \alpha_3 Z_{it} + \mu_{it}, \quad (1)$$
$$Y_{it} = \lambda_i + \tau_t + \beta_1 X_{it} + \beta_2 CE + \varepsilon_{it}. \quad (2)$$

Where subscripts i and t denote country and year, respectively. Eq. (1) expresses happiness as a function of consumption of energy (CE) and per capita income (Y). Equation (1) also includes Z, a vector of additional explanatory variables. These include the inflation rate, in order to capture the effect of purchasing power, the rate of unemployment $(Unemp)$ to capture the effect of government consumption on the happiness and the share of exports in GDP to determine whether openness to trade influences happiness. Finally, γ_i and κ_t represent country and year specific effects, and μ_{it} and ε_{it} denote error terms.

Eq. (2) expresses per capita income as a function of country and year specific effects (λ_i and τ_t), consumption of energy (CE) and X, a vector of other explanatory variables that have commonly been used in the literature (Mankiw et al., 1992; Levine and Zervos, 1993). These variables include the population growth $(POPgr)$, gross capital formation (GCF), Inflation rate and the share of exportation in GDP and are added incrementally to assess the sensitivity of the coefficient on (CE) to the inclusion of additional explanatory variables.

3.2. The Data

In this part, we present below the structure of our sample and discuss the main variables of our study. These variables represent the consumption of energy, the happiness and growth. The data sample describes 47 different countries over 14 years from 2001 to 2014.

The happiness measures used in this study are provided by the world database of happiness.[1] This database offers many different variants of measures drawn from questionnaires on representative sample of the population as well as the distributional findings on happiness in Nation. In our study we have the average value obtained from the distribution of the four steps verbal life satisfaction.

Economists have used happiness variable for more than two decades (Easterlin, 2013; Deaton, 2008; Di Tella et al., 2010; Bjornskov et al., 2007).

The table below shows the variables used in our empirical study

[1] Veenhoven, R., World Database of Happiness, Erasmus University Rotter-dam. Available at URL: http://worlddatabaseofhappiness.eur.nl/hap nat/natfp.php

Table 2. Data Information

VARIABLE	DEFINITION	SOURCE
Gross capital formation (% of GDP) (**GCF**)	Gross capital formation (% of GDP) (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories.	World Bank
Gross Domestic Product per capita (GDP)	Gross Domestic Product per capita ($US constant 2000) is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	World Bank
Happiness level (Happ)	The mean value obtained from the distribution of the four steps verbal life satisfaction	World data base on happiness
Inflation rate (INFL)	Inflation rate (annual%), Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals.	World Bank
The share of exports of goods and services in GDP (EXP)	The share of exports of goods and services in GDP. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services	World Bank
Annual growth of population (POPgr)	Annual growth of population (% of total population)	World Bank
Life expectancy at birth (years) (LE)	The Life expectancy at birth (years) indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	World Bank
Unemployment rate (Unemp)	Unemployment rate as a percentage of labour	World Bank
Human Development Index (HDI)	Human Development Index is an index that measures the quality of life of the average population of a country t, theoretically the index is between 0 and 1.	Human Development Reports

3.3. Instrumental Variables

In the equation (2), income (Y) is a function of consumption of energy (CE), yet consumption of energy is itself likely to be a function of income; consequently, this equation may suffer from an endogeneity problem. To deal with this potential endogeneity, (CE) is instrumented in this equation. The instrumental variable solution is to find another variable that is highly correlated with energy consumption (CE), but not correlated with the error term (ε_{it}). In this case, we use the Human Development Index (HDI), the life expectancy at birth (in years) (LE), as instrumental variables. We selected these twoo variables because they have a high correlation with consumption of energy (CE).

Table 3. Correlation Matrix

	CE	H	GDP	EXP	Unemp	GCF	POPgr	INFL	HDI	LE
CE	1.0000									
H	0.207	1.000								
GDP	0.892	0.359	1.000							
EXP	0.437	0.142	0.349	1.000						
Unemp	-0.130	-0.378	-0.227	-0.142	1.000					
GCF	0.546	0.198	0.635	-0.259	-0.109	1.000				
POPgr	-0.379	0.435	-0.180	-0.108	-0.314	-0.077	1.000			
INFL	-0.278	-0.071	-0.379	-0.139	0.054	-0.197	0.165	1.000		
HDI	0.731	0.135	0.782	0.311	-0.069	0.506	-0.374	-0.389	1.000	
LE	0.664	0.329	0.870	0.163	-0.150	0.623	-0.091	-0.384	0.723	1.000

In view of the availability of the data of our problematic, Table 3 expresses the correlation between the different variables used in this study, while Table 4 presents the descriptive statistics of these variables.

Table 3 shows a positive correlation between happiness and energy consumption, although modest (0.207). In this panel, the result means that energy consumption is associated with happiness. There is also a high and positive correlation between energy consumption and GDP per capita and a positive correlation between GDP per capita and happiness (0.359).

Table 4. Definition and Descriptive Statistics of the Variables

Variable (abbreviation)	Mean	Std. Dev	Min	Max
Happiness (H)	2.925	0.374	1.700	3.68
Gross Domestic Product per capita (GDP)	9.296	1.105	6.869	11.381
Gross capital formation (GCF)	23.999	1.801	20.594	28.604
Exports of goods and services (EXP)	44.154	26.866	9.390	183.75
Inflation rate (INF)	5.272	7.506	-4.480	96.090
Annual growth of population (POPgr)	0.716	0.846	-3.600	2.642
Consumption of energy (CE)	7.657	0.761	5.814	9.150
Human Development Index (HDI)	0.785	0.112	0.511	1.000
Life expectancy (LE)	75.976	3.909	62.950	85.160
Unemployment rate (Unemp)	2.022	0.470	0.262	3.306

As stated above, several variables are used in our empirical analysis. Table 4 reports the descriptive statistics of these variables from 2001 to 2014.

4. EMPIRICAL RESULTS

4.1. Estimation results

The following table provides estimates of per capita income equation.

Model (Y4) begins by expressing per capita income simply as a function of the gross capital formation (GCF) and consumption of energy. Models (Y1) to (Y3) include additional explanatory variables used by previous study.

Model (Y4) begins by expressing per capita income simply as a function of the gross capital formation (GCF) and consumption of energy. Models (Y1) to (Y3) include additional explanatory variables used by previous studies (Mankiw et al., 1992; Levine and Zervos, 1993; Levine and Renelt, 1992). These variables are the rate of inflation ($INFL$), the population growth rate ($POPgr$), the gross capital formation (GCF) and the share of exports in GDP (EXP).

In Table 5, consumption of energy is found to have a statistically negative impact on income in all models. This result obtained is confirmed by Squalli (2007) but contradicts by Huang et al. (2008).

The variables that measure the export of goods and services (EXP), the gross capital formation, the rate of inflation ($INFL$) and the population growth rate (POPgr) are statistically significant and have positive effects on income. The positive result of the relationship between the export of goods and services (EXP) and income is consistent with the literature in some works (Balassa, 1995; Savvides, 1995; Edward, 1998; Frankel and Romer, 1999; Ram, 1987).

Table 5. The Impact of Consumption of Energy Per Capita on Per Capita Income (Equation (2))

	exogenous consumption of energy	**(Y1)**	**(Y2)**	**(Y3)**	**(Y4)**
CE	0.208***	-0.4787**	-0.417**	-0.3965**	-1.440**
	(0.0367)	(0.2125)	(.178)	(0.1729)	(0.5116)
GCF	0. 220***	0.2971***	0.2916***	0.2908***	0.4218***
	(0.007)	(0.0252)	(0.0210)	(0. 0206)	(0.0607)
EXP	0.112***	0.1325***	0.1401***	0.1400 ***	
	(0.021)	(0.0273)	(0.0252)	(0.0250)	
POPgr	0.0004	0.0008**	0.0009**		
	(0.0005)	(0.0005)	(0.0004)		
INF	0. 0046	0.0037*			
	(0.0048)	(0.0064)			
R^2	Within = 0.7321	Within = 0.6437	Within = 0.6515	Within = 0. 654	Within = 0.3257
	Between = 0.7045	Between = 0.0037	Between = 0.0283	Between =0.0427	Between=0.3145
n	640	640	640	640	640
Sargan- test		0.988	1.415	1.448	0.702
P-value		(0.3203)	(0.2342)	(0.228)	(0.4022)
F-test on IVs		951.78	1095.42	1107.21	319.07
Prob > Chi^2		(0.000)	(0.000)	(0.000)	(0.000)

Note: Standard errors in parentheses (probabilities for Sargan and Ftests). In the first consumption of energy is treated as being exogenous with regard to income and is therefore not instrumented. In models Y1 to Y4 consumption of energy is instrumented using 2SLS. All models use a random effects. ***, ** and *denotes significance at 1%, 5% and 10 % respectively

However, in the opposite direction, other studies have concluded that the link between exports and economic growth is negative in some periods for some countries (Ahmad and Kwan, 1991; Onafowora and Owoye, 1998).

Moreover, the correlation between (CE) and the instruments is high (See Table 3). Whereas the correlation between the residuals of the model (Y1) and the instruments is very low. The correlation between (HDI) and the residuals is (0.17) and the relation between (LE) and the residual is (0.15).

Indeed, the Sargan test of overidentifying restrictions fails to reject the null hypothesis that the instruments are not correlated with the error term and that the specification is correct. This gives us an additional justification for the validation of the instruments used (see the result of the Sargan test presented in Table 5).

Table 6. First Stage Estimations of Consumption of Energy

	(Y1)	(Y2)	(Y3)	(Y4)
HDI	-0.129* (0.278)	-0.128* (0.1397)	-0.141* (0.278)	-0.057* (0.143)
LE	-1.789*** (0. 365)	-1.834*** (0.366)	-1.937*** (0.699)	-1.104*** (0.317)
GCF	0.153*** (0.010)	0. 155 *** (0.010)	0.156 *** (0.010)	0.142 *** (0.010)
EXP	0.110*** (0.027)	0.112*** (0.027)	0.116*** (0.024)	
INF	0.0032 (0.0054)	0.0034 (0.0054)		
POP gr	0.00079** (0.0004)			
F	294 (0.000)	288 (0.000)	314 (0.000)	267 (0.000)
N	640	640	640	640

Note: Standard errors in parentheses. *, ** and *** denote significance at 10%, 5% and 1%.

In Table 6, the obtained F value is high and the first stage estimates are significant. This gives supplementary support to the validity of the instruments used in this study.

Finally, the first stage regression result, validate the use of the variables Human Development Index, life expectancy as instruments.

Table 7 provides estimates of happiness, using the results of the "full" income models (Y1) (see Table 3). A "basic" equation for happiness is estimated (models Y1a and Y1b) where happiness is expressed simply as a function of per capita income and consumption of energy. In all models (CE) has a positive and statistically significant effect on happiness. In addition, the variable export of goods and services (EXP) positively influence the happiness.

Table 7. Estimates of happiness based on model (Y1) (Equation (1))

	(Y1a) FE	**(Y1b) FE**
CE	0. 643*** (0. 109)	0.941*** (0.107)
GDP	-0. 2263** (0.111)	-0.193* (0.116)
INF	-0. 028** (0.012)	
EXP	0.261*** (0.057)	
Unemp	-0.024*** (0.003)	
R^2	within = 0.2207 between = 0.0178	Within = 0.1335 between = 0.0156
Hausman FE.v.RE	58.17 (0.000)	61.54 (0.000)
N	640	640

Note: Standard errors in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Estimated jointly with model Y1 in Table 1. Model Y1a and model Y1b use a fixed effect.

The coefficient of the economic growth is found to be negative and significant. Even though several authors have found a similar result (Deaton, 2008; Stevenson and Wolfers, 2008), this sign contrasts with the Easterlin paradox (Easterlin, 2013). This is probably due to the considered time span which is 12 years whereas Easterlin considered time series ranging from 12 to 34 years.

In Table 7, inflation rate has a negative and statistically significant effect on happiness levels. This result is in line with earlier studies that found a consistent negative effect of inflation on subjective well-being (Di Tella et al., 2001, 2003; Wolfers, 2003; Graham and Pettinato, 2001; Di Tella et al., 2003).

It is now possible to quantify the impact of consumption of energy on happiness. Firstly, Table 8 provides the direct, indirect and total effect of consumption of energy on happiness for each of the two models presented in Table 7.

As stated earlier, the ultimate object of this paper is to identify the impact of consumption of energy on happiness. Table 5 provides the direct, indirect and total effect of consumption of energy on happiness for each model presented in Table 7. The first part $(\delta H/\delta Y)$ of the indirect effect is consistent upon the level of income. For all models, Table 8 indicates a positive direct impact of consumption of energy on happiness. This result reflects the sign of the estimated coefficient "CE" indicated in Table 7. This positive effect implies that consumption of energy contributes directly to increased happiness in the panel countries used. Specifically, an increase in the level of the consumption of energy of 1% directly leads to an increase in happiness of 0.643% in (Y1a) and 0.941% in (Y1b). In other words, the energy sector directly harms the quality of happiness in the panel countries used.

Table 8. The impact of consumption of energy on happiness (elasticities)

Happiness Model	$\delta H/\delta CE$	$\delta H/\delta Y\ \delta Y/\delta CE$	dH/dCE
	Direct effect	**Indirect effect**	**Total effect**
(Y1a)	0.643	0.110[2]	0.753
(Y1b)	0.941	0.0926[3]	1.033

Moreover, for both models Y1a and Y1b, the indirect effect is positive, an increase in the level of consumption of energy of 1% results in an increase in happiness of 0.110% in Y1a and 0.0926% in Y1b. The indirect effect is composed by the product of the relationship between happiness and income ($\delta H/\delta Y$) and the relationship between consumption of energy and income ($\delta Y/\delta CE$). Therefore, a consumption of energy -decrease induces a reduction in income, which in turn leads to a decrease in happiness and vice versa.

The direct effect of energy consumption is positive and superior to the indirect effect, providing a positive total effect of the consumption of energy on happiness in the countries studied. A 1% increase in CE is likely to induce a total happiness increase of 0.753% in Y1a and 1.033% in Y1b.

5. CONCLUSION

The aim of this paper is to study the linkages between consumption of energy and happiness with a detailed empirical examination. Data covering a large panel of countries for the period 2001–2014 were used to estimate jointly a two-equation model examining the determinants of both income and happiness. Through these two equations, we examined the direct, indirect and total effect of consumption of energy on happiness.

Empirical results show that consumption of energy has a positive direct and indirect effect on happiness. This positive relationship was found to increase statistical significance when consumption of energy was instrumented as a determinant of income.

The positive effect implies that consumption of energy contributes directly to increase happiness in the panel countries used.

Moreover, the indirect effect is positive, an increase in the level of consumption of energy of results an increase in happiness. The indirect effect is composed by the product of the relationship between happiness and income ($\delta H/\delta Y$) and the relationship between consumption of energy and income ($\delta Y/\delta CE$).

The direct effect of energy consumption is positive and superior to the indirect

[2] $0.110 = \frac{\delta H}{\delta Y}\frac{\delta Y}{\delta CE}$ = (-0. 2263* -0.4787).

[3] $0.0926 = \frac{\delta H}{\delta Y}\frac{\delta Y}{\delta CE}$ = (-0.193* -0.4787).

effect, providing a positive total effect of the consumption of energy on happiness in the countries studied. An increase in consumption of energy is likely to induce a total happiness increase. Specifically, in other words, the sector of energy directly harms the quality of happiness in the panel countries used.

Generally, according to these conclusions, it can be said that energy consumption is a means of satisfying all our important needs in our life, we can say that it is considered as an important source of happiness for the humans.

This paper's results suggest that although the direct effect of consumption of energy on happiness is positive. In the light of these result, policies that seek energy conservation, for example the use of renewables energies, per se seem not to be a solution effective in all domains and in all countries. Our word today seems to be far from this situation which suggests even more consumption of energy.

Although we have offered new empirical evidence regarding the relationship between happiness and consumption of energy, we have not identified precisely the contribution of each mechanism to the overall impact. Indeed, the final result identified through regressions is likely to be the effect from different combinations of used of energy across countries. Moreover, we have not investigated whether these results hands equally for developed as well as for developing countries.

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Mailing Address: Street Farhat Hached Kalaa Kebira 4060, Sousse, Tunisie, Email: neilabenafia@yahoo.fr.

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