New Approach for Monetary Valuation of the Statistical Life

Frantz Daniel Fistung[1]

Abstract: This work aim at proposing a new method for monetary valuation of Statistical life. This approach is different from the existing ones in that moment because propose to link the Value of Statistical Life with to major economic indicators: Gross Domestic Product per capita and the Life Expectancy. Comparing the results obtained using the new formulas proposed in this work, with some other analysis made, at the international level, on the same purpose, the differences are not significant. The proposed method is more relevant and creates the possibility of adopting a unique value for the Value of Statistical Life at world level.

Keykords: Life expectancy; monetary valuation method; value of statistical life comparisons

JEL Classification: A13; B41; C22

1. Introduction

I believe in God and I think that the human life is priceless. Even I have these believes I must accept that science needs, often, some instruments, techniques or models that are outside of our intimate convictions. This is for a simple reason. Many times, we must justify or dimension our activities in order to survive and develop ourselves.

In this respect, certain approaches such as monetary evaluation of some aspects, such as human life, represent always, a real problem, both in terms of methodological approaches, and in some cases, of moral reasons. However, it turned out that such approaches are need in order to dimension the changes made on human health status and relate this with some other important life aspects such morbidity or mortality.

Therefore, the Value of Statistical Life (VSL), in monetary terms, is only a theoretic tool needed in human society planning, developing and management. Between the areas where VSL is used it can be mentioned the insurances industry and transportation. In this last domain, VSL is use in order to proper evaluation of the

[1] Senior Researcher, Academy, The Centre of Industrial and Services Economics, Romania, Address: Academy House, 13 September, district 5, Bucharest, Romania, Tel.: +40213182418, Corresponding author: dfistung@yahoo.com.

total social cost of the transportation activities and especially for the monetary valuation of the external costs due to transportation.

The evaluation of the total social cost of transportation represent one of the most important activity goals, in the last decades, for many researchers in transportation economics. Between them, I can mention J.M. Beauvais (1977)[1], G. Bouladon (1979), A. Kanafi, who have done some special studies for OECD, A.J. Harrison (1983) who investigate the situation in EU and recently E. Quinet (1990) or D. Maddison and D. Pearce (1996).

Even so, some insuperable difficulties still exist in monetary valuation of the total social costs of transportation due, mainly, by the lack of some generally accepted method for the external costs monetization. However, in the last 10-15 years some big steps forward has been done in that area. For instance, for the air pollution and noise especially the scientific researchers made some promising results from EU and USA.

Interesting is that in all the recent researches, make at international level, it aimed to evaluate the effects on the environment taking into consideration:

- The evaluation of the impact on the environment;
- The technological evaluation;
- The elaboration of the ecological balance.

Obviously, the analysis concerning the impact on the natural environment cannot be separate from those of some other important aspects such as social and economic indicators such as: demographic evolution and effects produced on migration/immigration, population repartition and the evolution of the employment, jobs repartition, space utilization, urban planning and so one. For these analyses, the VSL is extremely important.

In economic terms, the Value of a Statistical Life (VSL) is the amount of money a person (or society) is willing to spend to save a life[2]. The act of placing a monetary value on human life is bound to stir up ethical, religious and philosophical questions. Even if one can be pass these deeper issues, there is still much debate on the correct way to dimension, indirectly, the VSL.

Nils Axel Braathen at the OECD[3], who collected all the published values for statistical life calculated by contingent valuation methods, therefore carried out a meta-analysis, regarding the models for evaluation of VSL. According to this

[1] See (Fistung, 1999).
[2] Definition taken after Maxwell School of Syracuse University, at http://sites.maxwell.syr.edu/vsl/.
[3] The Value of Statistical life: a meta-analysis, (2012), Working Party on National Environmental Policies, OECD, ENV/EPOC/WPNEP(2010)9/FINAL.

analysis, we can divide into three main categories the methods that were used to determine the value of statistical life. The first category based on the compensation paid to accident victims by insurance companies and accounts for the fact that these benefits only cover insured losses. The second category, referred to the human capital, estimates the prejudice caused to society by the death or injury of an individual. The third category is referring to the willingness to pay principle.

My new approach is relate to the second category, even if the third one has received the most attention in recent years.

2. Methodology

The new model postulate that for each individual it is necessary to attach an expected utility function related to the living conditions at national level, very well determined by the value of GDP/capita (note with GDP in further formula) and the expectancy of life (E^1):

$$VSL = f(E, GDP) \qquad /1/$$

These two variables includes, in my opinion, the most important characteristics that could influence the dimension of the Statistical Value of life. GDP/capita reflects most accurately the annual value of the country economic performance related to each individual, and I underline that, in my opinion, this is the only monetary valuable indicator in this approach. In addition, the expectancy of life reflects the period, between borne and death moments, that individuals may gather the value of the annual country economic performance. Therefore, in this respect, VSL of the individuals of each country of the world differs because of these two variables.

According to this premise, our formula will be:

$$VSL_i = E_i \times GDP_i \quad \text{(monetary units)}, \qquad /2/$$

Moreover, for a period the formula became:

$$\overline{VSLi} = \frac{\sum_{i=1}^{n} E_i x GDP_i}{n} \quad \text{(monetary units)}, \qquad /2'/$$

With: i = the year of the VSL evaluation;

n = number of years of the period that is taking into analysis;

E_i = the expectancy of life in the "i" year;

GDP_i = GDP/capita in the "i" year.

[1] Life expectancy at birth is defined as the mean number of years still to be lived by a person at birth - if subjected throughout the rest of his or her life to the current mortality conditions (http://ec.europa.eu/eurostat/tgm/web/table/description.jsp).

Some of the most important methods for the evaluation of VSL show us the variety of VSL dimensions (Table 1)

Table 1. VSL estimate in different countries on the based of different methods[1]

PAPER (AUTHORS)	No.obs	Publication year	Country	Average VSL (USD)	Range (million USD)
Alberini et al.	2	2004	United States	1,421,025	1.1-1.7
Alberini et al.	3	2007	Italy	3,598,485	1.4-1.6
Alberini et al.	2	2006	Canada – United States	1,036,062	0.8-1.2
Chestnut et al.	12	2009	Canada – United States	5,142,629	2.5-9.4
Desaigues et al.	6	2004-2007	Denmark	2,651,682	1.1-4.9
Gibson et al.	1	2007	Thailand	659,955	----
Giergiczny	3	2006	Poland	795,082	0.2-1.7
Hakes & Viscusi	2	2004	United States	6,247,816	6.1-6.4
Hammit & Zhou	12	2006	China	115,515	0.02-0.4
Itaoka et al.	19	2007	Japan	1,280,220	0.5-2.8
Johannesson, Johansson & O'Conor	4	1996	Sweden	4,652,973	2.0-7.1
Jones-Lee, Hammerton & Philips	4	1985	United Kingdom	5,226,967	3.9-7.2
Krupnick et al.	8	2002	Canada	1,758,343	1.1-3.6
Krupnick et al.	110	2006	China	562,225	0.1-1.7
Leiter & Pruckner	24	2008-2009	Austria	3,021,948	1.9-5.2
Leiter & Pruckner	4	2008	Austria	2,445,736	2.1-2.8
Mahmud	4	2006	Bangladesh	5,248	0.04-0.07
Leung et al.	8	2009	New Zealand	2,870,491	1.8-4.4
Rheinberger	2	2009	Switzerland	4,362,827	4.2-4.5
Schwab Christe & Soguel	6	1995	Denmark	13,600,000	9.0-17.5

[1] Source: The Value of Statistical life: a meta-analysis,(2012), Working Party on National Environmental Policies, OECD, ENV/EPOC/WPNEP(2010)9/FINAL

Svensson	14	2009	Sweden	7,693,884	3.0-9.6
Vassanadumrondgee & Matusoka	4	2005	Thailand	1,555,256	1.3-1.8

3. Data and Results

In the Table 2, I present some comparisons between VSL levels presented in Table 1 and those obtained using the formula /2/.

Table 2. Comparisons between the sizes of the VSL calculated within the formula /2/ and other authors' methods

Country	Year	E[1] (years)	GDP/capita (USD)**	VSL after /2/ formula (USD)	VSL after other authors (USD)	Ratio between columns (5) and (6)	Rate *	Author
1	2	3	4	5	6	7	8	9
USA	2004	81.1	41,921.80	3,399,857.98	1,421,025	2.39[2]	-	Alberini
Italy	2007	84.2	40,005.20	3,368,437.84	3,598,485	0.94	1.460	Alberini
Poland	2006	79.7	9,500.70	757,205.79	795,082	0.95	1.319	Giergiczny
USA	2004	81.1	41,921.80	3,399,857.98	6,247,818	0.54	-	Hakes & Viscusi
China	2006	75.5	2,082.20	157,206.1	115,515	1.36	-	Hammitt & Zhou
Japan	2007	86.0	34,033.70	2,926,898.2	1,280,220	2.29[2]	-	Itaoka
Sweden	1996	81.7	32,587.30	2,662,382.41	4,652,973	0.57	-	Johannesson & others
UK	1985	77.6	8,652.20	671,410.72	5,226,967	0.13[2]	-	Jones-Lee & others
Canada	2002	82.0	23,995.00	1,967,590.00	1,758,343	1.12	-	Krupnick
China	2006	75.5	2,082.20	157,206.10	562,225	0.28[2]	-	Krupnick
Austria	2008	83.3	48,860.74	4,070,099.64	2,445,763	1.66	1.392	Leiter & Pruckner
New Zealand	2009	82.6	27,998.60	2,312,684.36	2,870,491	0.81	-	Leung
Switzerland	2009	84.6	71,678.30	6,063,984.18	4,362,827	1.39	1.433	Rheinberger
Sweden	2009	83.5	47,737.75	3,986,102.12	7,693,884	0.52	1.433	Svensson

Italy***	2007	84.2	37,716.40	3,175,720.88	3,598,485	0.88	-	Alberini
Poland***	2006	79.7	8,999.70	717,276.09	795,082	0.90	-	Giergiczny
Austria***	2008	83.3	51,386.40	4,280,487.12	2,445,763	1.75	-	Leiter & Pruckner
Switzerland***	2009	84.6	69,672.00	5,894,251.20	4,362,827	1.35	-	Rheinberger
Sweden***	2009	83.5	46,207.10	3,858,292.85	7,693,884	0.50	-	Svensson

Notes:

1 – I take the maximal values of E and for this reason the table present the values specific to females because they are, in general, greater than for males

2 - Values considered by me to be extremes and not taken into consideration in the analysis

* - Rate = the exchange rate between USD and EURO for 2006-2009 period is based on X-RATES at http://www.x-rates.com/historical/?from=USD&amount=1&date=2016-03-30.

** - For Europe, GDP/capita data is from EUROSTAT at http://ec.europa.eu/geninfo/legal_notices_en.htm, for other countries from OECD database at http://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

*** - *GDP/capita data is from OECD database at http://data.worldbank.org/indicator/NY.GDP.PCAP.CD*.

In this example, I use data collected from OECD (expectancy of life and GDP/capita)[1] and EUROSTAT databases (GDP/capita)[2].

Comparing data from columns 5 and 6 of the Table 2 (ratio between them is presented in column 7) we could easy see that if we cut the extremes values, the VSL levels obtained with formula /2/ differ between - 48.2% and + 66.4%, comparing with the medium values calculated according to other methods. That is not a very big margin of differentiation and the values calculated are in the range of the data obtained by the various researchers presented in the same Table 2.

Moreover, in my opinion, formula/2/is more appropriate for VSL estimation than other methods. The explication is very simple. If we compare the columns 5 and 6 of the Table 2 and agree that the VSL is a function related to E and GDP, the results obtained for VSL using some other authors' methods are not realistic. For example, in Table 2 the ratio, between VSL and GDP show us, for example, some values around 161 for Sweden (Svensson, 2009) 270 for China (Krupnick, 2006) and 150 for USA (Hakes & Viscusi, 2004). Taking into consideration formula /2/ that values

[1] Source: http://stats.oecd.org/(Health Status: Life expectancy).
[2] EUROSTAT at:
http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00001.

must indicate the years related to the life expectancy for the countries previous mentioned. That is not the reality, obviously. Therefore, formula/2/is more accurate than the other methods used for VSL calculation.

The function presented in /1/assumes the, each individual of a country have the same VSL, in the same period of analysis. This theory is different to that of Jones-Lee who underline that the VSL level and individual age are related (Jones-Lee et. alli., 1993). In that theory Jones-Lee consider that, the reference value (maximal value) of VSL is for an individual of 40 years old. In his opinion the lowest VSL are for youngest (under 18 years) and oldest (over 65 years) peoples (see Table 3).

Table 3. The variation statistical value of life depending on age

Age	Report to the VSL reference (40 years)
18	0,67
20	0,77
30	0,89
40	1,00
50	0,79
60	0,70

Source: Jones-Lee (1993)

I totally disagree with this idea. In Jones-Lee, theory it appears that a little children life is less "valuable" that of some mature individual. That is a mass. In my opinion, each individual must be, analytically and statistically, considered equal with others without taking into consideration the age. It is obvious that the people community is composed by kids, mature people and older. They are different off course but, economically speaking, the GDP of a nation is do for all the country inhabitants, without taking account of their age. So, why should we adopt different levels of VSL, based on the age of individuals? Moreover, the calculation of GDP/capita never take into account the age of the countries inhabitants.

However, is necessary to use the age of each individual for evaluate this VSL? For that response, I propose to take an example. I will use the /2'/formula for calculate the VSL for two different aged people both from the same country. I will make this, in two ways. Firstly, I will calculate the VSL in the year of investigation with formula /2/. Secondly I will calculate the medium value of VSL for the periods determinate by the born data of the individuals of analysis and the actual year of evaluation (with formula /2'/).

For instance, I take the situation of two Romanian born one in 2006 and another one in 2012. The year of investigation is 2014. Generally VSL for Romania in 2014 is (using /2/ formula) 714,806.33 USD (Table 4).

Table 4. Annually VSL for Romania according to /2/ correlation, 2006-2014

YEAR	E (years)**	GDP/capita (EURO)	EURO/USD (exchange rate)*	GDP/capita (USD)	VSL_{RO} (USD)
2006	76.1	4600	1.319548	6,023.92	458,420.31
2007	76.8	6000	1.460044	8,760.26	672,787.97
2008	77.5	6900	1.392044	9,605.10	744,395.25
2009	77.7	5900	1.433566	8,458.04	657,189.71
2010	77.7	6300	1.340191	8,443.20	656,036.64
2011	78.2	6600	1.295900	8,552.94	668,839.91
2012	78.1	6700	1.318464	8,833.71	689,912.75
2013	78.7	7200	1.377614	9,918.82	780,611.13
2014	78.7	7500	1.211023	9,082.67	714,806.33

NOTES:

* - The exchange rate between USD and EURO for 2006-2009 period is based on X-RATES at http://www.x-rates.com/historical/?from=USD&amount=1&date=2016-04-12 (at 31 December of each year)

** - Source: http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsdph100&language=en

According to formula /2'/, and the Table 4 data, the medium VSL for Romania in the period 2006-2014 ($\overline{VSL_{RO(2006-2014)}}$) is:

$$\overline{VSL_{RO(2006-2014)}} = (VSL_{RO-2006} + VSL_{RO-2007} + VSL_{RO-2008} + VSL_{RO-2009} + VSL_{RO-2010} + VSL_{RO-2011} + VSL_{RO-2012} + VSL_{RO-2013} + VSL_{RO-2014})/ 9 = 671,444.44 \text{ USD}$$

The same formula gives us the:

$$\overline{VSL_{RO(2012-2014)}} = (VSL_{RO-2012} + VSL_{RO-2013} + VSL_{RO-2014})/ 3 = 728,443 \text{ USD}$$

Therefore, using medium values, for the Romanian child born in 2006 the VSL is equal with $\overline{VSL_{RO(2006-2014)}}$ and have the value of 671,444 USD. For the other child, borne in 2012 the VSL is equal with $\overline{VSL_{RO(2012-2014)}}$ which value is 728,443 USD. Nevertheless, annual value, for the year of interest (2014) is 714,806.33 USD. In this case, a life insurance policy will offer, in the same year 2014, terms far more generous for the child borne in 2012 than that one borne in 2006. This is not a normal point of view and is opposite with the Jones-Lee theory which assume that the youngest individual have a lover VSL. So, is much proper to use, in that case, for both kids, the annual VSL in order to calculate the value on a life insurance policy.

In the same time, in my example for the period analyzed, cutting out the extreme values, we can see that the medium value of VSL is, mostly, closely to each annual VSL figures (see Fig. 1).

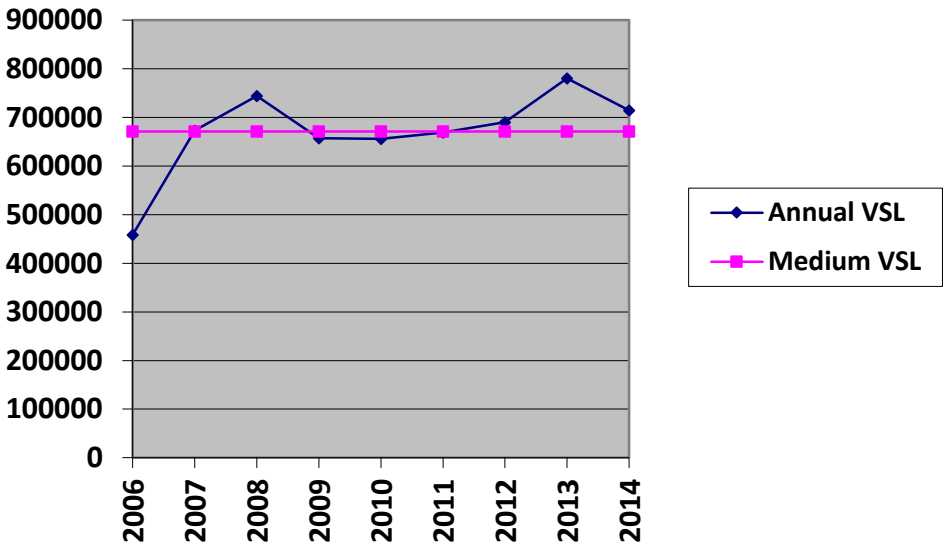

Figure 1. Annual and medium values for VSL in Romania, in 2006-2014 period

Despite this is obviously that if we calculate the medium VSL the age of individuals influence the values obtained. That confirms somehow the Jones-Lee theory but, in my opinion, it is very unjust.

In that respect, I recommend to use only the /2/formula when we want to make some investigations to evaluate some specific socio-economic aspects on specific conditions. For example, when we try to evaluate the level of damages produced on human health by the air pollution due to cars. The medium value of VSL is also OK, in my opinion, but in another context.

In that idea, we must introduce, into analysis, a new dimension: the space. In my attempt, the space will be define by the nations.

A controversial issue is if the VSL is the same for each individual, no matter where he lives. Certainly, in my opinion, the life value of each individual, in this world, must be the same. However, unfortunately, here appears many distortions related to economic activities, age, place of living and others. It is obviously that, taking into consideration the formula /2/described before, each individual VSL, differs from country to country. This is because of the GDP/capita variations. Very developed countries will have inhabitants much „valuable", in statistical matter of speaking, comparing with the inhabitants of the poor countries. Nevertheless, in my opinion,

the life expectancy corresponds quite accurately with the level of GDP/capita of the countries where we make our investigations. According to this idea, if we want to make a uniformed VSL for the entire world, or a country union (such OECD or UE, for instance) we can use arithmetic media of the /2/and /2'/formulas for the all-union countries (Formula /3/). For example, we can calculate the VSL of the OECD countries, in a desired year (Table 5) or a medium VSL for a period. In my opinion, this assumption will attract a lot of complaints and contradictory debates so, in that working paper I want only to launch this debate.

Table 5. General VSL for OECD countries in 2011-2013 period

Country	2011			2012			2013		
	E[1]	GDP[2] /capita (USD)	VSL (USD)	E[1]	GDP[2] /capita (USD)	VSL (USD)	E[1]	GDP[2] /capita (USD)	VSL (USD)
Australia	84.2	43,702	3,679,708.4	84.3	43,081	3,631,728.3	84.3	46,826	3,947,431.8
Austria	83.8	44,039	3,690,468.2	83.6	45,878	3,835,400.8	83.8	47,428	3,974,466.4
Belgium	83.3	41,118	3,425,129.4	83.1	42,209	3,507,567.9	83.2	43,362	3,607,718.4
Canada	83.6	41,565	3,474,834.0	83.6	42,144	3,523,238.4	83.6	44,281	3,701,891.6
Chile	81.4	20,189	1643384.6	81.3	21,295	1,731,283.5	81.4	21,366	1,739,192.4
Czech Republic	81.1	28,603	2,319,703.3	81.2	28,732	2,333,038.4	81.3	30,054	2,443,390.2
Denmark	81.9	43,319	3,547,826.1	82.1	44,251	3,633,007.1	82.4	45,697	3,765,432.8
Estonia	81.3	23,914	1,944,208.2	81.5	25,872	2,108,568	81.7	27,124	2,216,030.8
Finland	83.8	40,251	3,373,033.8	83.7	40,437	3,384,576.9	84.1	40,951	3,443,979.1
France	85.7	37,353	3,201,152.1	85.4	37,499	3,202,414.6	85.6	39,236	3,358,601.6
Germany	83.2	42,942	3,572,774.4	83.3	43,600	3,631,880	83.2	44,999	3,743,916.8
Greece	83.6	26,626	2,225,933.6	83.4	25,980	2,166,732	84.0	26,753	2,247,252.0
Hungary	78.7	22,603	1,778,856.1	78.7	22,701	1,786,568.7	79.1	24,037	1,901,326.7
Iceland	84.1	39,558	3,326,827.8	84.3	40,278	3,395,435.4	83.7	42,715	3,575,245.5
Ireland	83.0	45,670	3,790,610	83.2	46,030	3,829,696	83.1	47,563	3,952,485.3
Israel	83.5	30,585	2,553,847.5	83.6	32,007	2,675,785.2	83.9	33,397	2,802,008.3
Italy	84.8	35,464	3,007,347.2	84.8	35,424	3,003,955.2	85.2	35,465	3,021,618.0
Japan	85.9	34,332	2,949,118.8	86.4	35,738	3,087,763.2	86.6	36,620	3,171,292.0
Korea	84.5	31,327	2,647,131.5	84.6	32,223	2,726,065.8	85.1	32,664	2,779,706.4
Luxembourg	83.6	90,889	7,598,320.4	83.8	90,694	7,600,157.2	83.9	95,587	8,019,749.3
Mexico	77.2	16,366	1,263,455.2	77.3	16,959	1,310,930.7	77.4	16,947	1,311,697.8
Netherlands	83.1	46,389	3,854,925.9	83.0	46,457	3,855,931.0	83.2	47,967	3,990,854.4
New Zealand	82.9	32667	2,708,094.3	83.0	32,991	2,738,253.0	83.2	36,947	3,073,990.4
Norway	83.6	62,738	5,244,896.8	83.5	65,394	5,460,399	83.8	66,812	5,598,845.6
Poland	81.1	22,250	1,804,475.0	81.1	23,310	1,890,441	81.2	24200	1,965,040.0
Portugal	83.8	26,932	2,256,901.6	83.6	27,125	2,267,650	84	27,930	2,346,120.0
Slovak Republic	79.8	25,169	2,008,486.2	79.9	26,098	2,085,230.2	80.1	27,416	2,196,021.6
Slovenia	83.3	28,513	2,375,132.9	83.3	28,487	2,372,967.1	83.6	29,103	2,433,010.8
Spain	85.6	32,535	2,784,996.0	85.5	32,240	2,756,520.0	86.1	32,861	2,829,332.1
Sweden	83.8	43,709	3,662,814.2	83.6	44,434	3,714,682.4	83.8	45,067	3,776,614.6
Switzerland	85.0	54,551	4,636,835.0	84.9	57,205	4,856,704.5	85.0	59,351	5,044,835.0

Turkey	77.1	17,692	1,364,053.2	77.2	18,437	1,423,336.4	79.4	19,156	1,520,986.4
United Kingdom	83.0	36,575	3,035,725	82.8	37,567	3,110,547.6	82.9	39,125	3,243,462.5
United States	81.1	49,710	4,031,481	81.2	51,368	4,171,081.6	81.2	52,592	4,270,470.4
VSL OECD	**3,081,837.874**			**3,141,456.974**			**3,265,118.147**		

Source: 1 - http://stats.oecd.org/(Health Status : Life expectancy)

2 - http://stats.oecd.org/ (National accounts; Gross domestic product (GDP: GDP per head, USD, current prices, current PPPs)

Medium level for VSL, in a period and for a countries union will be based on formula:

$$\overline{VSL_{CU}} = \{\sum_{j=1}^{m} \sum_{i=1}^{n} (\frac{Eij\ x\ GDPij}{n})\}/m \quad \text{(monetary units)} \quad /3/$$

With (in addition to those previously defined):

$\overline{VSL_{CU}}$ = Value of Statistical Life for a "countries union"

j = the country "j"

m = number of the countries in the union

E_{ij} = the expectancy of life for the country "j" in the year "i"

GDP_{ij} = GDP/capita for the country "j" in the year "i"

Using the data presented in the Table 5, and the /3/ formula, we can calculate, for the 2011-2013 period, the medium value of $VSL_{OECD:}$

$\overline{VSL_{OECD(2011-2013)}} = (VSL_{OECD\ (2011)} + VSL_{OECD\ (2012)} + VSL_{OECD\ (2013)})/3 =$ 3,162,804.331 **USD**.

Therefore, for each individual of OECD countries shown in Table 5 we can assume that his VSL is around 3.2 million USD. This assumption seems to be OK if we consider that, for example, the UK VSL_{UK} used in evaluation of external costs due to transportation is around 3 million of British Pounds (D.Maddison, D.Pearce, coord (1996)).

Interesting is if we make the same analysis for the VSL evolution in EU. After the EUROSTAT databases, the medium annual VSL for EU (with 28 members) in 2010 was 2,094,840 EURO and increase with 8.9% in 2014 (see Table 6).

Table 6. Annual and medium VSL evolution for EU and EU countries in 2010-2014 period

YEAR	2010			2012			2014			
COUNTRY	GDP /capita (EURO)	E	VSL (EURO)	GDP /capita (EURO)	E	VSL (EURO)	GDP /capita (EURO)	E	VSL (EURO)	R
EU (28 countries)	25,300	82.8	**2,094,840**	26,400	83.1	**2,193,840**	27,300	83.6	**2,282,280**	***2,190,320***
Belgium	33,600	83.0	2,788,800	35,100	83.1	2,916,810	36,000	83.9	3,020,400	
Bulgaria	4,900	77.4	379,260	5,600	77.9	436,240	5,800	78.0	452,400	
Czech Republic	14,900	80.9	1,205,410	15,300	81.2	1,242,360	14,700	82.0	1,205,400	
Denmark	43,500	81.4	3,540,900	44,900	82.1	3,686,290	45,600	82.8	3,775,680	
Germany	31,600	83.0	2,622,800	33,600	83.3	2,798,880	35,400	83.6	2,959,440	
Estonia	11,000	80.8	888,800	13,300	81.5	1,083,950	14,800	81.9	1,212,120	
Ireland	36,200	83.1	3,008,220	37,600	83.2	3,128,320	40,200	83.5	3,356,700	
Greece	20,300	83.3	1,690,990	17,500	83.4	1,459,500	16,300	84.1	1,370,830	
Spain	23,200	85.5	1,983,600	22,600	85.5	1,932,300	22,800	86.2	1,965,360	
France	30,800	85.3	2,627,240	31,800	85.4	2,715,720	32,200	86.0	2,769,200	
Croatia	10,500	79.9	838,950	10,300	80.6	830,180	10,200	81.0	826,200	
Italy	26,800	84.7	2,269,960	26,800	84.8	2,272,640	26,600	85.6	2,276,960	
Cyprus	23,000	83.9	1,929,700	22,500	83.4	1,876,500	20,500	84.7	1,736,350	
Latvia	8,600	78.0	670,800	10,900	78.9	860,010	12,100	79.4	960,740	
Lithuania	9,000	78.9	710,100	11,200	79.6	891,520	12,400	80.1	993,240	
Luxembourg	77,900	83.5	6,504,650	8,2000	83.8	6,871,600	88,500	85.2	7,540,200	
Hungary	9,800	78.6	770,280	9,900	78.7	779,130	10,500	79.4	833,700	
Malta	15,900	83.6	1,329,240	17,200	83.0	1,427,600	18,500	84.2	1,557,700	
Netherlands	38,000	83.0	3,154,000	38,500	83.0	3,195,500	39,300	83.5	3,281,550	
Austria	35,200	83.5	,2939,200	37,600	83.6	3,143,360	38,500	84.0	3234,000	
Poland	9,300	80.7	750,510	10,000	81.1	811,000	10,700	81.7	874,190	
Portugal	17,000	83.2	1,414,400	16,000	83.6	1,337,600	16,600	84.4	1,401,040	
Romania	6,300	77.7	489,510	6,700	78.1	523,270	7,500	78.7	590,250	
Slovenia	17,700	83.1	1,470,870	17,500	83.3	1,457,750	18,100	84.1	1,522,210	
Slovakia	12,400	79.3	983,320	13,400	79.9	1,070,660	13,900	80.5	1,118,950	
Finland	34,900	83.5	2,914,150	36,900	83.7	3,088,530	37,600	84.1	3,162,160	
Sweden	39,400	83.6	3,293,840	44,500	83.6	3,720,200	44400	84.2	3,738,480	
United Kingdom	28,900	82.6	2,387,140	32,000	82.8	2,649,600	34,500	83.2	2,870,400	
EU Year Average			**1,984,165.7**			**2,078,822.0**			**2,164,495.0**	**2,075,827.5**

Source: EUROSTAT, at http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00001 and http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdph100.

NOTE: I take the maximal values of E and for this reason the table present the values specific to females because they are, in general, greater than for males.

$R = \overline{VSL_{EU\ 2010\text{-}2014}}$ (EURO)

Also, if we calculate the $\overline{VSL_{UE(2010-2014)}}$ using the EU (28 countries) with /2/ formula and data for 2010, 2012 and 2014 we obtain a value of 2,190,320 Euro. Making the arithmetic for the 2010, 2012 and 2014 VSL year average (shown in Table 6) we obtain a value of 2,075,827.5 Euro. Between these two values, the difference is about 5.2%, and that is more than acceptable.

Moreover, in the analyzed period the annual $\overline{VSL_{UE}}$ increase with 9%, but $\overline{VSL_{UE(2010-2014)}}$ differs only with 4.6% to -4.1% according to the annual values of the period (see also Fig. 2).

Therefore, similar to the formula /2/, formula /3/ could be used at annual or medium values. In my opinion, because we speak of a large space dimension (regions, countries union or even the entire world) an economic strategy that is focused to evaluate the possibility to increase the human life conditions and need to use VSL must take into consideration the annual value of VSL (formula /3/ for the year of the analysis).

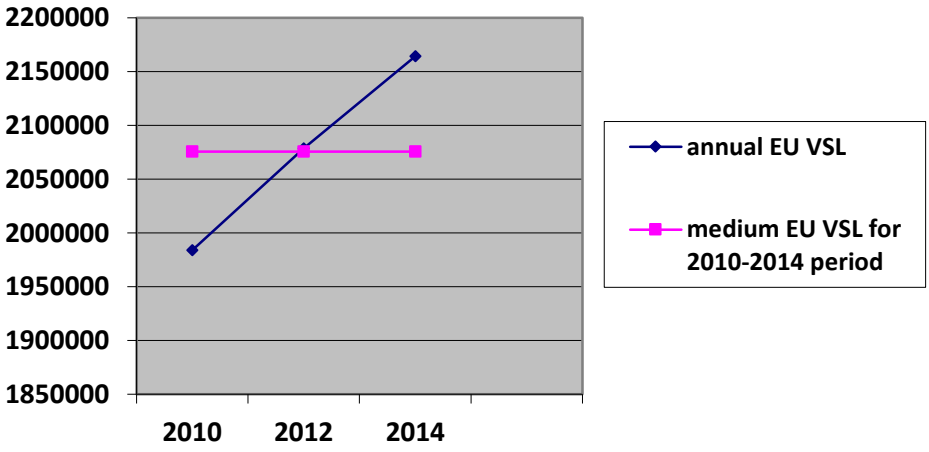

Figure 2. Differences between yearly medium and period VSL for EU, in 2010-2014 period

In addition, if we want to make some comparisons between some regions VSL in different time periods we better use the medium VSL values for those periods and in the same countries union.

In conclusion, I think that, generally speaking, is more proper to use the annual VSL calculate with /2/formula or /3/formula for only one year. In some specific conditions

and for bigger spaces (countries unions) we can use, also, medium VSL calculate with /3/ formula.

4. Conclusions

Analyzing the data resulted by using this new approach, I can underline the most important conclusions:

- Despite other points of view, I consider that VSL is not relate to the individual age.
- The VSL level is the same for each individual of an area of analysis (country, region) and in the same period where the main variables of the /2/ formula (GDP/capita and expectancy of life) are identically.
- The annual and medium values of VSL are different but both could be useful for economic analyses.
- The annual VSL is better to be use in transportation dimension of external costs and in life insurance activities.
- The medium value of VSL is properly to be use in the economic analyses that are make at world or regional levels for time period comparisons.
- It would be great if we could adopt a unique VSL (using /3/ formula) for each individual of the earth.

5. Bibliography

Braathen, N.A. (2012). *The Value of Statistical life: a meta-analysis*. *Working Party on National Environmental Policies*, OECD, ENV/EPOC/WPNEP(2010)9/FINAL.

EUROSTAT (2016). Gross domestic product at market prices, EUROSTAT at: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00001.

Fistung, D. (1999). Transporturi. Teorie economica, ecologie, legislatie (only in romanian language). Bucharest: All Beck Publishing House.

Jones-Lee, M.W. & Loames, G. et.al. (1993). The value of preventing non-fatal injuries: findings of a willingness to pay national sample survey. *Working Paper SRC/2*, Transport and Road Research Laboratory, Crowthorne.

Maddison, D. & Pearce, D. coord. (1996). *The true costs of road transport*. London: Earthscan Publications Ltd.

OECD (2016). *Health Status: Life expectancy*, OECD statistics at: http://stats.oecd.org/Index.aspx?DatasetCode=HEALTH_STAT

WORLD BANK (2016). *GDP per capita*, WORLD BANK at: http://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

*** (2016). *Historic Lookup: US DOLLAR rates table*, The XE Currency Data API, at: http://www.x-rates.com/historical/?from=USD&amount=1&date=2016-03-30.