



**LUND UNIVERSITY**  
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## **The Valuation of the Priceless**

-The implications associated with the valuation of life relative to income in different countries.

Bachelor Thesis in Economics (NEKH01)

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## **Abstract**

Life is generally viewed to be priceless, however, for an economy to work, there has to be some sort of value-placement on human life. The concept applied to attain such a value-placement is called the *value of statistical life*. This study seeks to identify if there is a connection between the value of statistical life in different countries and what implications such a result might hold. Using Miller (2000) and the World Data Bank (2014) for the collection of data it becomes evident that such a connection does exist and that high income countries tend to have a higher VSL than lower income countries. However, the income elasticity of VSL is calculated to be 0.83, which suggests that the relative spending on VSL will diminish with an increasing income. Approaching the subject is not easy and problems with VSL, such as inconsistencies in applied methods and the applicability of the results, are discussed to be affecting the measurement enough to make it too unreliable to be used on a global scale. Instead it is suggested that until the day when calculations of VSL has evolved further and a standardized measuring system has been put in place, it should be constrained to comparisons between specific sectors.

**Keywords:** Value of Statistical Life, VSL, Health Economics

## **Table of Abbreviations**

<i>CWD</i>	<i>Compensating wage differentia</i>
<i>EU</i>	<i>European Union</i>
<i>ex ante</i>	<i>Before the event</i>
<i>ex post</i>	<i>After the event</i>
<i>FDI</i>	<i>Foreign direct investment</i>
<i>GNI</i>	<i>Gross national income</i>
<i>OLS</i>	<i>Ordinary Least Squares</i>
<i>UN</i>	<i>United Nations</i>
<i>USD</i>	<i>United states dollar</i>
<i>VSL</i>	<i>Value of statistical life</i>
<i>WDB</i>	<i>World Data Bank</i>
<i>WTA</i>	<i>Willingness to accept</i>
<i>WTP</i>	<i>Willingness to pay</i>

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## Introduction

### Background

The value of life might be one of the most frowned upon subjects to discuss simply due to the fact that most people consider life to be priceless and should therefore stand somewhat outside the grasp of economics. Nevertheless, as Fuchs and Zeckhauser (1987, p. 267) put it: *“That life is priceless need not imply that we will spare no expense to save a life or cure a disease. Yet that myth persists and gives us comfort”*. This provided comfort clouds the minds of many and serves as a platform to bring the concept of the *value of statistical life* (VSL) into the light of the public. Despite the fact that many consider life to be priceless, it is evident that in everyday life, decisions are made that directly or indirectly reflect a degree of value placement on peoples' lives. Whether it is stepping into a car, not wearing a helmet when riding the bicycle, putting up a safety railing on the side of a road or taking a trip abroad, a decision had to be made whether the risk of death or injury was worth the benefit received by the action. However, when faced with a situation with an outcome of certain death it seems reasonable to assume that a person will pay any amount to avoid that outcome. In that sense, the concept of valuing the life of an identified person is mute and will not lead to a sensible conclusion to the subject. As a result of this, and perhaps other ethical and moral problems associated with valuing identified life, the approach followed in economics has been to place a value on statistical life (unidentified life) and thereby avoid the problem of having to decide over the life or death of a specific person. This opens up for the discussion of social issues that need to be entertained in order for a society to work.

Within the society where one grows up or lives it is only natural to not think about all the risk assessments that we do in everyday life. This might be considered a crude assumption, but it serves its purpose when extending the situation to a new society where one is not aware of the value-placement on life. Therefore, is it sensible to be expected to do the same assessments when we are abroad as when we are in our home country? It seems reasonable to assume that higher and lower income countries might place different values on life simply due to the fact that rich countries have more money and resources to spend. If this would turn out to be true, which is very likely, it would have some serious implications not only for the individual person doing his/her risk analysis, but also for the interactions between countries. A country or organization for instance providing another country with money for

charity, *foreign direct investment* (FDI) or influence in other ways, without the knowledge of the targeted country's VSL, might not be using its resources efficiently. Therefore, it is an important issue for the *United Nations* (UN) or the *European Union* (EU) to have available data. Some studies provide collective VSL estimates for the entire world, with Miller (2000) being an example of one of these studies. This in hope of creating a world standard that can be used by organizations such as the ones mentioned above. Due to the huge socioeconomic differences between countries, however, it seems likely that the applicability of such a measure is minimal.

Instead of looking at a country's VSL measure and reflect on its growth with income it is more beneficial to take the means the country has at its disposal in reducing risk for its citizens into consideration and compare this to the VSL. The percentage share spent towards the VSL could be argued to be a more suitable measure in some cases as it reflects more on the proportional willingness to pay for health interventions. It is unnatural to assume that a country does not value the life of its citizens as high as another country just based on the level of spending in risk reduction, health care, education and so forth. This argument leads to a question more suitable for such comparisons which this study seeks to answer, namely:

*Is the statistical value of life relative to income level the same in different countries?*

## Purpose

The way a country values life can be seen through many different viewpoints, such as health care providers, patients, economics and drug companies. Since it would be impossible to cover all of them an attempt to narrow the definition of value of life will be made. To achieve this the study at hand will follow Morris (2012 p. 287) and adopt a societal point of view as it is considered to be the broadest and the most relevant approach when doing this kind of analysis. This will hopefully illustrate that the numbers represented will show the general approach and the valuation-method applied by governments in the past. The separate views on how much life should be valued by individuals or companies, although represented through the aggregate, will not be in focus. The importance of the study becomes evident when looking at the implications the results could have on organizations such as the UN and the EU. Humanitarian work can in many cases be seen as the projection of one country's VSL on another country. During disasters it can be seen as a country's

responsibility to help the country in duress in order to save and aid as many people as possible. By doing so it is no longer the VSL of the affected country that is the dominant one. It is interesting how the same willingness to help is not expressed to the same extent in the absence of a disastrous event. The hope is that the analysis might indirectly shine some light on the subject. However, the main purpose of the study is to analyze if there is a difference between the VSL relative to income in different countries.

## Theory

The VSL estimates do not have a standardized measuring system and it is therefore important to understand the different ways it is computed. While there are many ways to calculate VSL the following methods below have been concluded to be the most prevalently used. As stated previously, the main methods are discussed below and the section starts with the general theory of the VSL and goes on to explain the hedonic approach, revealed vs. stated preference, the human capital approach and finally in order to connect VSL to income a description of the income measures used in the study will be made.

### The Value of Statistical Life:

VSL is by Access Economics (2008, p. 27) described as a response to the seemingly impossible task of assigning value to identified life – identified life meaning the life of a known individual. However, it also implies that the life at stake is merely statistical and in that sense the value of the specific life is irrelevant for the estimation of VSL; only the valuation of an unidentified life should be considered. Access Economics (2008, p. 27) continues by arguing that while being, what some would call, a more fair system of valuation, it also suffers from complete unawareness of the life at stake. It might therefore undervalue a life compared to how it is valued by the people known to the person in question alternatively how the person's life is valued by society. A statistical life is not as highly valued as it would be to the person in question or his/her family for instance.

The way the VSL is measured is through the amount a person is *willing to pay* (WTP) in order to not have the risk of premature death increased compared to the risk he/she face today (Morris, 2012, p. 284). The reason for it being the WTP to avoid increased risk of death rather than the WTP to avoid certain death is because, when faced with certain death, people can be assumed to give up everything in order to stay alive. The situation of being in the presence of certain death is also not something that can be expected to happen often enough for it to be valid as measurement of an entire population. This concept of WTP is also implying that the person in question is unidentified, a very important concept in the valuation of life, as life itself, from an ethical point of view, is priceless. Depending on a person's standing in society he/she might have different WTP to avoid increased risk, therefore, a collective value is calculated (Morris, 2012, p. 284). The VSL measure can be

applied on individual level as well as between countries, but to limit the scope of this study the focus will be on the latter.

Hammitt and Robinson (2011, p. 2) explain the VSL as an individual's WTP for a risk change divided by the risk:

$$VSL = \frac{WTP}{RISK}$$

WTP is an important concept when it comes to monetizing the value of life. Morris (2012, p. 280) describes WTP as a measure of how much money a person is willing to forgo in order to avoid an increased risk of death or how much a person is willing to pay in order to reduce the risk of death by a certain amount. A similar construct is *willingness to accept* (WTA), which focuses on the amount of money a person would be willing to accept in order to agree to a certain increase in the risk of death.

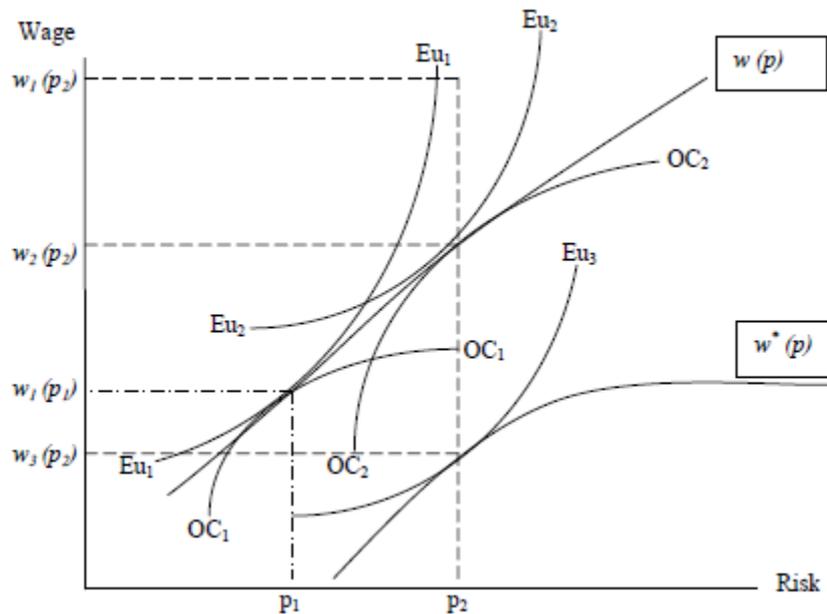
### Hedonic Approach

The hedonic approach focuses on the relationship between the worker and groupings of several characteristics of a certain job. These characteristics can for example be working conditions or risk level. Through the process of finding a reasonable salary where the employee feel that he/she is compensated for the different risk levels that are associated with a particular job and the amount that the employer is willing to offer that employee to accept the risk, a salary is reached (Shanmugam, 2013, p. 6). Since this salary is supposed to reflect the money needed to accept a certain risk level, it can be seen as the WTA the increased risk of death that the job entails. Through this type of measure one can deduce the VSL. This relationship is also evident in the fact that firms may have to lower employees salaries in order to improve on the safety standards of the firm, yet again establishing the WTP for the employee (lowering of the salary) in order to decrease the risk of death (Shanmugam, 2013, p. 6). A common expression for this used in estimations of VSL is *compensating wage differential* (CWD).

In figure 1 the process of determining the CWD is explained. The notation ( $w(p)$ ) is representative of the market opportunities available at some wage-risk combination and from this the worker has to choose a level that maximizes the expected utility ( $E_u$ ). The

maximization occurs in the tangent of (Eu) and (OC), which is the firms offer curve at the different wage-risk levels.

**Figure 1. Compensating Wage Differential (CWD).**



Source: Shanmugam (2013), p. 7

### Revealed Preference vs. Contingent Valuation (Stated Preference)

The details of how calculations are made using the hedonic approach lies within the concepts' revealed preference and contingent valuation. The revealed preference method can be seen as rather self explanatory. Through the actions of the individual one can deduce the WTP for a risk reduction in a particular situation. According to Laonie, Pedro, and Latour (1995, p. 237), the majority of the revealed preference studies done have been wage-risk studies. This approach takes into account the wage of the individual and bases this off of the risk of death on the job. It uses revealed preferences in order to determine the wage, which is then seen as the trade-off between wealth and physical risk. Through this trade-off the VSL is estimated (figure 1, where the wage-risk is determined by choices made by the worker). However, as Laonie, Pedro, and Latour (1995) discuss, it relies on some assumption that opens it up for criticism. Mainly, there is the fact that the approach assumes the individual to be in a situation where he/she can make an informed decision on the matter. This will be very difficult in practice as actual risk and perceived risk rarely are the same. Secondly, it also assumes that the worker will have the opportunity to move freely between

jobs and thereby is in a position to decide on a wage appropriate to face the risk of the work. If not, the worker might be "forced" to accept risk at a lower wage than desirable.

The contingent valuation approach or the stated preference approach, as it is also called, on the other hand, still using the theory behind figure 1, tries to deduce the VSL through surveys. As stated by Laonie, Pedro, and Latour (1995, p. 237) these surveys carry the advantage (compared to the revealed preference approach) of being applicable to the general public instead of having to focus on workers. However, it also comes with the potential price of having to sacrifice the greater reliability of observed behavior for answers to hypothetical questions, which might be a lot more difficult to determine the accuracy of. The work of Jones-Lee, Hammerton, and Philips (1985), nevertheless, disputes this and concludes that contingent valuation studies can, through reliability and validity tests, provide information on people's WTP for risk reduction that is reliable.

#### Human Capital Approach:

The human capital approach can be seen as a simpler way of calculating the VSL. Todaro and Smith (2011, p. 365) describe the term *human capital* to be the measure of human capacities that influence productivity. This description implies that life is connected to the contribution one can make to the productivity of the society. Shanmugam (2013, p. 15), among others, describe how it is used as an instrument to objectively measure the VSL. There are two main approaches to the method that both take the discounted value of future earnings, gross output and net output, into consideration. The gross output approach takes into account the expected future earnings ( $L_1$ ) of a person, calculated through the use of earnings ( $E_i$ ) and the probability of survival ( $p_i$ ):

$$L_1 = \sum_{i=n}^{\infty} \frac{p_i E_i}{(1+r)^{1-n}}$$

As Shanmugam (2013) mentions there is a problem with this method. By neglecting the future consumption the person would have had if he/she would have lived until year ( $i$ ), one might be criticized of oversimplifying the issue. The net output method instead focuses on the value of a life saved ( $L_2$ ). This is the same method used as for gross output. However, in addition, an estimation of future consumption is also used in the valuation:

$$L_2 = \sum_{i=n}^{\infty} \frac{p_i(E_i - C_i)}{(1+r)^{1-n}}$$

Morris (2012, p. 284), on the other hand, does not give the method much credibility and describes it as an old concept that focuses mainly on the amount of deaths occurring and its effect on GNI. Therefore, according to the method, the value of life is seen as the loss of production due to the absence of the particular person in the labor forces from the time of his/her death to the time of retirement. There are more sophisticated ways of conducting this approach, but Morris (2012, p. 284) maintains that this is the main purpose of the valuation.

### **Income Measures**

The main attention of this study is on the implications associated with the valuation of life relative to income in different countries. To be able to do so one must specify the measures used to represent income. In order to keep the scope of the study narrow and as effective as possible the focus will be on the income elasticity of VSL (GNI per capita representing income) and the Gini-coefficient.

#### **Income elasticity of VSL**

The income elasticity of VSL is used to show the effects of a one percent increase in income on VSL. The income elasticity for VSL has been covered in previous works on VSL, but it has not yielded any conclusive results. Viscusi and Aldy (2003, p. 6) have made several meta-analyses on data around the world where they found an income elasticity of VSL between 0.5 and 0.6. Biaisque (2012, p. 17), on the other hand, reached the conclusion in his meta-analysis on VSL based on contingent valuation that the income elasticity of VSL is significant and close to one. Previous studies do, however, show a tendency for the income elasticity to be lower or equal to 1. This could mean that lower income countries value statistical life higher than higher income countries do relative to their income level.

#### **Gini-coefficient**

The income distribution of the world creates problems for countries to target measures to increase VSL, the same problem being present within the respective countries as well. Ray (1998, p. 237) states that: "Inequality has a built-in tendency to beget inefficiency, because it does not permit people at the lower end of the wealth or income scale to fully exploit their

capabilities". In order to capture this and to gain an understanding of how income affects the VSL, a measure of this income inequality must be used. According to Ray (1998, p. 174) an inequality measure has to satisfy four main criteria in order to be reliable:

**Anonymity Principle:** It should not matter who the income goes to. The people in the study should be anonymous and not able to affect the outcome in any way.

**Population Principle:** The population size should be able to be scaled back and forth without changing the inequality. The proportion of the population earning certain incomes is what matters.

**Relative income principle:** Relative income is the measure that matters. For example, the income distribution of 1,000 USD and 2,000 USD has the same inequality as 10,000 USD and 20,000 USD.

**The Dalton Principle:** If money is transferred from the people with higher income to people with lower income then it will result in a greater inequality (given that the money transferred isn't enough to offset the distribution the other way).

As the Gini-coefficient satisfies the four principles it is deemed by Ray (1998, p. 190) to be a good index for inequality. Without going into too much detail, it is calculated as an aggregate of inequality with values ranging from 0 to 1, where 0 represent perfect equality and 1 represent perfect inequality (Todaro and Smith, 2011, p. 208). Alternatively, it can be given as an index with 0 and 100 as representative values (World Data Bank, 2014). Todaro and Smith (2011, p. 208) also provide guidelines on how to interpret the results. Values between 0.50 and 0.70 are considered a measure of high income inequality and values between 0.20 and 0.35 is considered a relatively low income inequality.

## Method

Since this is a meta-analysis, the data on VSL used is taken from published papers and is supposed to reflect the different techniques used in the VSL studies made in the last few decades. The following section is meant to clarify where the data was collected from, the implications of this and also calculations performed to process the data in a meaningful way.

### Data sources

The VSL-measures that are used for the countries in this analysis are taken from the study made by Miller (2000). In his paper Miller creates a transfer function, based on a number of VSL studies, and creates what is considered by the author to be the best estimates of the VSL for the countries studied. The countries used to create the basis for the transfer function and the amount of studies on VSL done in each of these countries can be seen in the appendix. However, even though it is a good representation of the VSL estimates out there the transfer function has some set-backs. Most notably it becomes unreliable when GDP is less than 2000 USD and therefore there are no counties in the study that can represent such a low income level. Worth noting is that it is in general very difficult to find good values for VSL in very low income countries. The VSL studies used in Miller (2000) come from different methods of calculations, mainly contingent valuation and wage-risk (revealed preference), and as a result the final transfer function will to some extent be a reflection of the same inconsistencies as these methods hold. Miller reflects on some of these problems and tries to correct them by assigning weights to different methods (for more information on the weights see Miller (2000, p. 174)).

Building on the work of Miller (2000) this study extends the analysis to comparisons between the income levels (GNI per capita) and Gini-coefficients of different countries. With the use of the *World Data Bank* (WDB), data on income level was collected and put in relation to the VSL. Since the work of Miller (2012) states all the costs in 1995 USD, the data from WDB had to be converted from 2015 USD to 1995 USD. The year used for the GNI data is 1999, which is the year the study by Miller was conducted. This year was chosen as it is the best estimate for the comparison between VSL and income due to the fact that the VSL studies that Miller (2000) used are from different years ranging from 1974-1999. In order to give an effective analysis on the relationship between VSL and GNI per capita the countries

have been divided into different income levels. However, the income classification provided by the WDB (2014) in figure 2 has been changed:

**Figure 2. World Data Bank income classifications**

- Low income: \$1,035 or less
- Lower middle income: \$1,036 to \$4,085
- Upper middle income: \$4,086 to \$12,615
- High income: \$12,616 or more

The classification in figure 2 has been changed to a *high income* group and a *lower income* group of which the latter contains the upper middle and lower middle income groups. This decision was made since it is very difficult (sometimes impossible) to find reliable data of VSL from low income countries.

As stated previously the income distribution in the countries has also been taken into account as this is an integral part when dealing with income level. The measure used to do this is the Gini-coefficient. A country may have a high income level, but if the distribution is too skewed then it will give too much of a distorted view of the situation of the country. Bergh, Nilsson and Waldenström (2012, p.7) state that countries with high income inequality tend to have a lower life expectancy. It seems reasonable to assume that this would be reflected in the VSL and therefore it is an important piece when analyzing the implication of income on the VSL. When choosing the Gini-coefficient for the countries the analysis has relied on data from the WDB and is representative of the year 1999. When data for this year has been missing (which it has in some cases) the data shows the Gini-coefficient for the closest year. Since the data does not shift much over the years, and especially not between as few as 2-3 years it seems safe to assume that the irregularities associated with this are minimal and do not affect the results in a significant way.

### Calculations

The GNI per capita given in the WDB is in 2005 USD and in order to apply the values to the VSL data it had to be converted into 1995 USD as this is the base value used by Millers (2000). The conversion is given by:

$$GNI \text{ per capita (1995 USD)} = GNI \text{ per capita (2005 USD)} * \frac{P (1995)}{P (2005)}$$

P is an index for the specified base year. For P (1995) the GNI value for each year of the series is divided by the GNI for the year 1995. The same is done for P (2005).

In order to examine the effects of the two variables an *Ordinary Least Squares* (OLS) was done using Eviews to determine the effects of the GNI per capita and the Gini-coefficient on the VSL. Two types of OLS was done. One using the actual data for GNI per capita and Gini-coefficients and the other using logarithms for the two variables. The logarithmic approach gives the income elasticity of VSL. Through these calculations the R-squared value, which describes to what extent the data explains the VSL values, is also determined.

## Results

The results from this meta-analysis are presented in the table and the figures in this section.

Table 1 gives a clear picture of the data concerning VSL, GNI per capita, and the Gini-coefficient associated with the particular countries in the study. The data is arranged in ascending order based on the GNI per capita.

**Table 1: Value of Statistical Life**

Country	Income level	Best VSL estimate	GNI per capita 1999	Gini-coefficient
Thailand	Lower income	380	2367,70086	43,5
Peru	Lower income	360	2676,520373	44,9
Brazil	Lower income	680	4507,00872	59,6
Venezuela	Lower income	520	4991,955589	47,2
Russia	Lower income	370	5017,439285	48,4
South Africa	Lower income	410	5335,475131	56,6
Malaysia	Lower income	610	5439,267674	48,5
Uruguay	Lower income	820	5889,595123	42,1
Argentina	Lower income	1200	6040,493726	48,9
Turkey	Lower income	410	7581,479941	41,5
Chile	Lower income	650	7808,006557	56,4
Mexico	Lower income	500	8861,476393	51,9
Hungary	Lower income	610	11527,59731	27,9
Czech Republic	Lower income	680	13236,37117	26,6
Trinidad	Lower income	630	14429,88757	40,3
Portugal	Lower income	1330	21077,74638	no data
Israel	High income	2150	21624,7619	35,5
New Zealand	High income	2020	28170,41648	no data
Spain	High income	1750	29812,00306	37,1
Italy	High income	2520	34384,17519	35,8
Germany	High income	3190	36913,2686	30,0
Japan	High income	4680	37145,24926	no data
Australia	High income	2680	37151,30805	33,7
Canada	High income	2540	39416,71396	31,4
France	High income	2990	39427,77774	32,4
Belgium	High income	3000	41217,71626	28,4
Austria	High income	3200	42392,16751	31,1
Netherlands	High income	2930	46789,31334	32,2
Finland	High income	2930	47900,11933	23,5
United States	High income	3670	50586,94724	38,9

Denmark	High income	3990	54186,4612	23,3
Norway	High income	4300	75619,98919	27,6
Poland	no data	480	no data	26,7
Saudi Arabia	no data	960	no data	no data
Greece	no data	1490	no data	37,2
Kuwait	no data	2250	no data	no data
Ireland	no data	2540	no data	37,0
United Kingdom	no data	2750	no data	36,8
Sweden	no data	3230	no data	25,5
Switzerland	no data	4430	no data	37,1

Best estimate VSL in thousands of 1995USD.

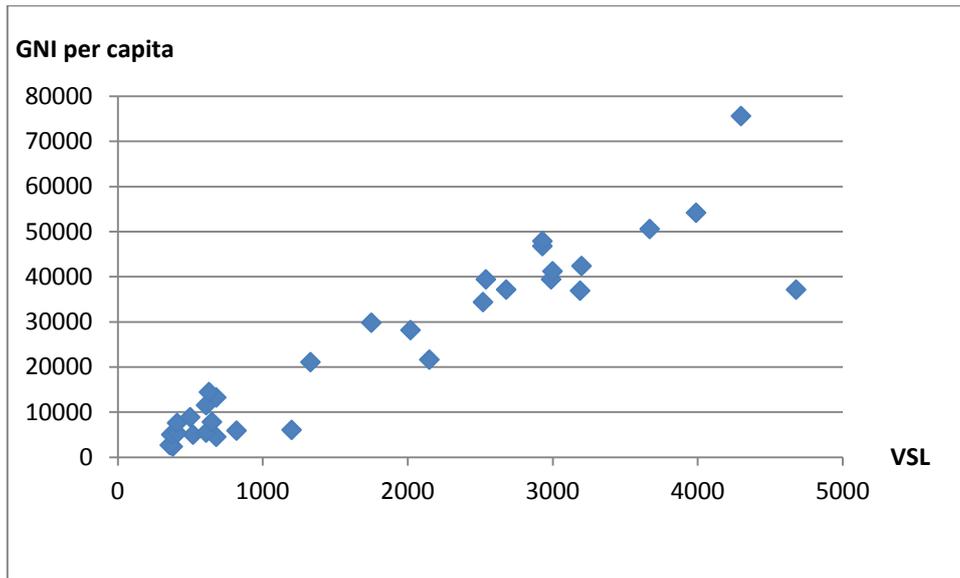
GNI per capita 1999 in 1995USD.

Gini-coefficient index between 1-100

In table 1 it is evident that that GNI per capita is affecting VSL as all the lower income countries have a VSL lower than the high income countries. The Gini-coefficient shows similar tendencies, with the exception of Poland, Hungary and the Czech Republic as they have some of the lowest Gini-values, but still have fairly low VSL (Poland 480 000 USD, Hungary 610 000 USD and Czech Republic 680 000 USD).

The data from table 1 has been used when illustrating the relation between GNI per capita and VSL in figure 3. It is evident that many of the lower income countries are clustered around a lower VSL and the higher income countries have a much greater spread. Despite this there is clear indication of a strong positive correlation between the two variables irrespective of whether the country is classified as a lower or higher income country. The same approach has been taken to create figure 4 where VSL is plotted against Gini-coefficients. The result from this is a little bit more inconclusive. The lower income countries have a wide range of Gini-values ranging from about 26-59 while the higher income countries have a narrower range between about 23-39. This makes it difficult to reach a conclusion on the Gini-coefficients effect on VSL.

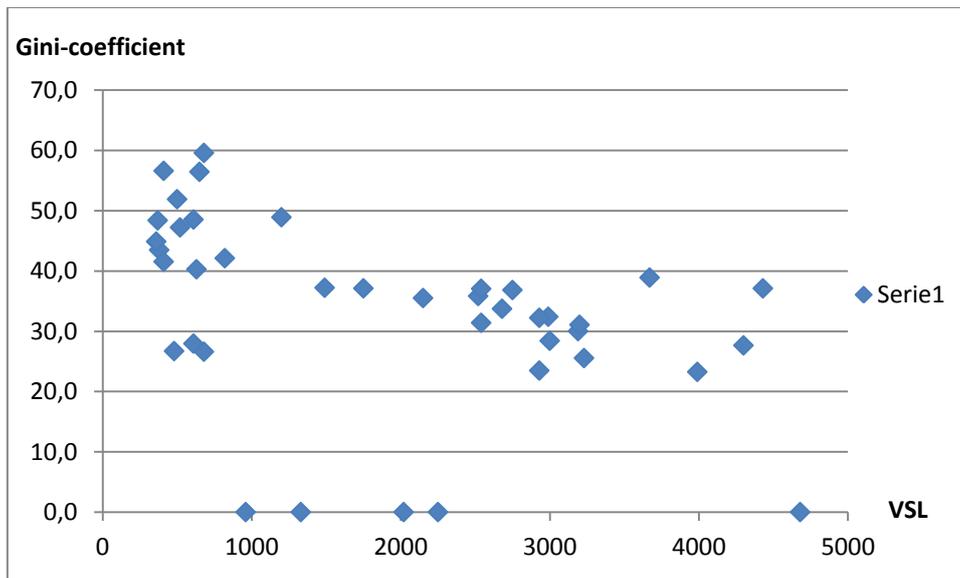
**Figure 3: GNI per capita in relation to VSL**



VSL in thousands of 1995USD

GNI per capita in 1995USD

**Figure 4: Gini-coefficient in relation to VSL**



VSL in thousands of 1995USD

In figure 5 a simple regression of the data in table 1 is presented. It is evident that GNI per capita has a positive effect on VSL (0.06) while the effect of the Gini-coefficient is unclear since the result for it (2.56) is not statistically significant (Prob. < 0.05). This supports the findings in figure 4, suggesting that it is unclear whether the Gini-coefficient has a positive or negative effect on VSL. The R-squared is high resulting in a high degree of confidence in that the two variables do a good job of explaining the VSL.

**Figure 5. Regression**

Dependent Variable: BEST ESTIMATE				
Method: Least Squares				
Date: 05/21/15 Time: 12:02				
Sample (adjusted): 1 38				
Included observations: 29 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	100.3153	461.9751	0.217144	0.8298
GNI_PER_CAPITA_199	0.063836	0.004788	13.33355	0.0000
GINI COEFFICIENT	2.555684	9.406144	0.271704	0.7880
R-squared	0.936047	Mean dependent var		1747.241
Adjusted R-squared	0.931128	S.D. dependent var		1314.887
S.E. of regression	345.0724	Akaike info criterion		14.62308
Sum squared resid	3095948.	Schwarz criterion		14.76453
Log likelihood	-209.0347	Hannan-Quinn criter.		14.66738
F-statistic	190.2753	Durbin-Watson stat		1.348223
Prob(F-statistic)	0.000000			

OLS. GNI per capita and Gini-coefficient

Estimation made in Eviews

Lastly in figure 6 the results from a logged GNI per capita and logged VSL is presented. The degree of explanation is still high (0.88) and the effect of the Gini-coefficient is still not statistically significant. It will therefore not be analyzed further. The GNI per capita, on the other hand, is still significant and suggests an income elasticity of 0.83.

**Figure 6. Logged Regression**

Dependent Variable: LVSL				
Method: Least Squares				
Date: 05/21/15 Time: 12:53				
Sample (adjusted): 1 38				
Included observations: 29 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.619701	2.065475	-0.784179	0.4400
LGNI	0.834702	0.091839	9.088733	0.0000
LGINI	0.189741	0.359284	0.528110	0.6019
R-squared	0.877895	Mean dependent var		7.121354
Adjusted R-squared	0.868502	S.D. dependent var		0.889315
S.E. of regression	0.322489	Akaike info criterion		0.672203
Sum squared resid	2.703981	Schwarz criterion		0.813647
Log likelihood	-6.746942	Hannan-Quinn criter.		0.716502
F-statistic	93.46545	Durbin-Watson stat		1.825896
Prob(F-statistic)	0.000000			

OLS. Logged GNI per capita and logged Gini-coefficient

Estimation made in Eviews

## Discussion

The results obtained in this meta-analysis tear us from the myth about how “life is priceless”, which was presented in the beginning of the study. It is evident that life is valued and that it is valued differently around the world. However, it is important to understand that these values presented are not definite values on human life – the scope of the study merely reflects the VSL and not the value of identified life (an important distinction which was briefly brought up in the introduction). In order to reflect on some of the implications of the results obtained, a discussion will follow on the VSL, potential applications of the results and problems associated with the concept.

### Comments on results

From the results obtained it becomes obvious that countries value lives differently and that these differences can be traced to the income of the country. The VSL, GNI per capita and the Gini-coefficient in table 1 give a first glimpse of the relation between the variables. Since table 1 is arranged in ascending order based on GNI per capita it is easy to follow how VSL, to a great extent, follows the increase in income. The values do not follow in a straight line, but it is fairly consistent. It is interesting to note that there seems to be a greater difference between the VSL in the high income countries than in the lower income countries. After countries reach the classification of high income the correlation between VSL and income seems to decrease. The reason for this is unclear, but could imply that at a higher income the problems of a low income are dealt with. An increase in the VSL would not do too much for the people of the high income country. This correlation between GNI per capita and VSL is seen in figure 5 with a R-squared of 0.94, which means that 94% of the change in VSL can be traced to the change in the GNI per capita and the Gini-coefficient. Unfortunately, the results do not include estimates of a change in correlation between lower and high income countries. This theory would have to be investigated further in future studies.

However, the relationship between income and the VSL does not say anything about the sentiment held in the different countries concerning how high the VSL should be. It merely states that under the current circumstances (the given income per capita) the VSL will be a certain amount (more commonly given as a range, but for the sake of analysis the best point-estimate has been used). It does not give any indications on whether low income countries value life higher or lower than high income countries as a percentage of income.

The valuation shows the absolute VSL instead of the relative VSL. It is far more interesting and beneficial when dealing with this subject to look at figure 6 and see the income elasticity of the VSL. The results show that the income elasticity of the VSL is 0.83 and that leads to more questions on how the VSL is actually perceived by the country, alternatively the people of the country. It might be that lower income countries value life higher than rich income countries when VSL is seen as a percentage of income. Since the elasticity of the Gini-coefficient is not statistically significant the inclusion of this would not be of great significance as the data is not reliable. It is also worth noting that the results only reflect the income elasticity of VSL between countries and caution must be practiced if attempting to apply the results on an individual level. It might be that the results are no longer applicable in those cases.

Ray (1998, p. 237) sees a clear connection between inequality and productivity as low income will prevent productive educational choices due to financial issues. The pay-off might be high in the long-run, but circumstances prevent the time in the short run to be spent on things that will not have an immediate positive effect on productivity, such as education for example. This will become clear when dealing with the human capital approach as this is based on expected future earnings (and consumption). A country with lower income, and as a result a lower degree of schooling, will have a lower VSL when using the human capital approach than the other approaches since the majority of the population will not have high paying jobs.

### **Potential applications of results**

There are several applications for the use of VSL around the world. As stated in the introduction it might be a great tool for organizations, such as the UN and the EU as well as other humanitarian causes. This in order to better understand the VSL of specific countries and to generate better efficiency in the distribution of money. However, it also creates the ethical problem of deciding on whose VSL that should be used. Should it be the VSL of the effected country or the VSL of the aiding country in the case of a crisis situation? A creation of an average world standard might look good at first glance, however, it is fraught with problems. For instance, the increased pressure on low income countries to increase their investment in risk reduction even though its population cannot afford it. Miller (2000, p. 183) suggests that a minimum international standard should reflect the VSL of the lowest

income country in order to produce as much equity as possible. From an ethical stand-point it seems like it would be a questionable idea to not try to impose some kind of increased VSL for the lowest income countries. The differences between VSL in high and lower income countries is further exacerbated with Millers (2000, p. 183) description of Lance Summers (World Bank Vice President) discussion in 1991. Summers suggested that the lower productivity losses associated with poor health in developed countries could make it beneficial to transfer pollution from higher income countries to lower income countries. This is in line with Millers own suggestion that "rich countries might have higher expectations about the quality of life and its value". However, the results in this study, with an income elasticity lower than one, might suggest the contrary. The lower than one income elasticity might indicate that low income countries are willing to spend a higher proportion of income on VSL than rich countries are and therefore it might be that the relative value of statistical life is higher in low income countries than in high income countries.

## Problems

There are several problems with the concept of VSL. The main ones that always seem to be mentioned is the ethicacy of the VSL as a measuring system and the lack of a standardized system of measuring VSL, which is connected to the already inherent problems with the established methods.

## Use of VSL

The connection between VSL and actions by governments are closely related due to the fact that governments are supposed to represent the people. Lyttkens (1985, p. 298) mentions that this might cause some controversy when actions made by the government have the potential to increase risk for the population. Such an action would inevitably lead to an early death of several people. The distinction between statistical life and identified life becomes slightly clouded when seen through this perspective. Perhaps it can be argued that a statistical life should be valued on the same basis as an identified life despite the fact that this would make the VSL measure superfluous. Lyttkens (1985, p. 301) further reflects on that in practice it is "absolutely forbidden to kill a specific person, [but] it is quite alright for the government to act so that somebody will die (provided only that we do not know who it is we are killing)". This hypocrisy in society makes the concept of VSL problematic.

Furthermore, as VSL is a representation of the WTP for a certain risk, it carries a lot of problems when the risk is not quantifiable. This would cause distortions in the CWD (figure 1) and cause individuals to make uninformed decision. This problem becomes very evident in war-time situations:

*“Without regarding the danger, however, the young volunteers never enlist so readily as at the beginning of a new war [...] Their pay is less than that of common labourers, and, in actual service, their fatigues are much greater” - Adam Smith (2009, p. 71).*

The differences in *ex ante* and *ex post* decision making is an interesting concept as VSL estimates are in principle only made *ex ante*. When the event has occurred the statistical life will be identified and the same standards do no longer apply out of ethical reasons (it is not considered the same to put a price on a specific person as putting a price on a random unidentified one). The *ex ante* valuation of the risk level in the war-time example is far less than the *ex post* valuation, which truly highlights the importance of information in the decision-making process that VSL is based on and the problems associated with the lack of information. The effects of this do not have to be as grave as in the case of war, but serve as a good reminder that VSL might change dramatically depending on the situation.

### Measuring VSL

As the theory states there are several ways to estimate VSL and naturally these ways will not reach the same final value. This will create inconsistencies in the estimates, which will reduce the reliability of the results.

It seems as if most of the VSL studies made to this date have been studies focused on the United States. Even so there has not been a lot of studies and the ones that have been done all share the same problem; it is difficult at best to compare the studies and at worst is pointless to do so because of the great irregularities in the data collection and the differences in methodology. It becomes clear in the theory portion of this study that the choice of method, when doing the calculations, do matter a great deal since the focus of the methods differ. Seeing that the data used in this study is taken from the transfer function conducted by Miller (2000), which in turn is based on different methodologies in the data collection, it is impossible to avoid falling into the most common problems with VSL estimates; the inconsistencies caused by different methods of data collection.

It would simplify decision-making a great deal if it was possible to create a set figure on VSL, which would serve as a standard for VSL around the world. However, because of the positive correlation between VSL and income it might be impossible or impractical to do so, due to inequity. A more reasonable hope would be to collect data on VSL for all countries in the world, since this could potentially help organizations such as the UN, the EU and different humanitarian organizations in creating programs to help people. This could for example be done through more efficient alleviation packages, based on VSL, to be distributed within countries to do the most good.

The complexity when dealing with the valuation of human life, or the VSL as this analysis is constrained to, becomes even more evident when one looks at the different techniques used in order to obtain the values presented in this study. The fact that many of the studies are divided between the different methods presented earlier (types of hedonic approaches or the human capital approach) creates a lot of inconsistencies when trying to compare the values between different countries, and even between and within sectors in separate countries. Bergh, Nilsson and Waldenström (2012, p. 19-20) report that the results from contingent valuation is connected to variables such as ethnicity and education and it is pointed out that highly educated Europeans have a tendency to exaggerate their health status and claim it to be worse than it actually is. This might cause irregularities when trying to analyze VSL between countries. However, VSL does not only differ between countries and between data collection methodologies. In the study by Access Economics (2008, p. 62) it was concluded that the choice of sector for the study had a significant impact on the VSL estimates. For example, it was shown that in Australia occupational safety had a mean VSL of 11.1 million AUD while in the health sector had a mean VSL of 4.0 million AUD. This is a pretty significant difference and works to exacerbate the importance of handling VSL estimates with care and realize that it is a measurement system that needs to be developed further. It does seem reasonable to assume a degree of confidence in the VSL estimates within a sector. Furthermore, if an agency within a country does not spend enough money to reach the predicted VSL it will result in more deaths than is acceptable by the society. Safety of the sector is then considered to be working at a sub-optimal level. Going back to the UN, EU and other similar organizations one can expand the reasoning and see the applications on a more global scale.

## Summary

It has become evident that the priceless can be valued and this is represented by the correlation between VSL and income. However, there are a lot of inconsistencies in the measuring system of VSL as a whole and within the different methods used in calculating VSL.

The different measuring systems discussed have been concluded to be subject to different advantages and problems. The hedonic approach seems to be (arguably) the most effective tool when there is close to perfect information and the risks of the jobs are well understood. The problem with this approach is when risks are understated or when perceived and actual risk are not the same, in the war-time example for instance, the compensating wages are no longer representative of the risks taken and the approach falters to a great extent. When relying on contingent valuation one further loses reliability since observed behavior is sacrificed in favor of survey results. The human capital approach is simpler and therefore also a cheaper way of conducting VSL calculations. There is a strong case that the method might not be the best method as it only focuses on the economic aspect of VSL and not on the fact that life can be considered to hold value in itself. There needs to be a greater focus on the issue of finding a system of measuring the VSL in the future in order to find a better solution to the problem and to establish a standardized measuring system.

The results point in the direction of a strong correlation between VSL and income with R-squared of 0.94 for the OLS and 0,88 for the OLS based on logged GNI per capita and the logged Gini-coefficient. The GNI per capita show a stronger correlation than the Gini-coefficient, which was expected from the beginning. The income elasticity is calculated to be 0.83, which is within the range of previous studies (higher than some, but lower than others) and the discussion following this result is that lower income countries value life higher than high income countries when seen as a ratio of income. The implications of such a result could be the subject of further discussion and future studies.

In conclusion, the results obtained are reliable to the extent of the theory discussed and methods used to this day. However, with the range of different methods to calculate the VSL, causing major differences in final values, it could be considered ignorant to presume that VSL in itself has evolved enough to be used in decision-making processes on a greater

scale than in individual sectors. To use it on a global scale, for instance in the UN or the EU, might at the moment be very inefficient and perhaps not even applicable. It is therefore advisable to restrain from using the values presented as definite guidelines on the VSL, outside of specific sectors where they still have great application. This until the day when calculations of VSL has evolved further and a standardized measuring system has been put in place.

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## Appendix

**A: Countries used to create the transfer function and the amount of studies conducted in these countries.**

<i>Country</i>	<i>Number of Values</i>
Australia	1
Austria	2
Canada	5
Denmark	1
France	1
Japan	1
New Zealand	3
South Korea	2
Sweden	4
Switzerland	1
Taiwan	2
United Kingdom	7
United States	39

Source: Miller (2012)