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Genuine progress indicator and other alternative measures of economic development: First estimates for the Czech Republic

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Declaration of Authorship

The author hereby declares that he compiled this thesis on my own under the guidance of my supervisor, using only the listed resources and literature.

I further declare that the thesis has not been used previously for obtaining any university degree.

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Abstract

Nowadys when measuring economic development, the main focus is on gross domestic product, which is a measure of market activity. Genuine progress indicator is an alternative measure of economic development, which shifts focus to well-being, environment and sustainability. The main goal of this study is to construct genuine progress indicator for the Czech Republic.

In the first part I point out weaknesses of current measurement of economic progress. Then I address other indicators proposed as an alternative measure of economic development. After that I discuss genuine progress indicator in detail and explain its calculation for the Czech Republic. In the last part I discuss results of my computations and compare it with gross domestic product and with foreign calculations of genuine progress indicator.

Keywords Genuine progress indicator, measure of well-being, economic development, alternative economic indicator, gross domestic product

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Abstrakt

Dnes, při měření ekonomického pokroku, se zaměřujeme především na hrubý domácí product, který je měřitkem tržní activity. Indikátor skutečného pokroku je alternativní měrou ekonomického vývoje, který se zaměřuje na blahobyt, životní prostředí a udržitelnost. Hlavním cílem této práce je vytvoření indikátoru skutečného pokoku pro Českou Republiku.

V první části poukazuji na slabiny dnešního měření ekonomického pokroku. Poté se zabývám jiné indikátory, které byly navrženy jako alternativy k měření ekonomického vývoje. Dále se detailně zabývám indikátorem skutečného pokroku a výpočtem pro Českou Republiku. V poslední části zkoumám výsledky mých výpočtů a porovnávám je s hrubým domácím produktem a výpočty z jiných zemí

Klíčová slova	Indikátor skutečného pokroku, měření blahobytu, ekonomický vývoj, alternativní ekonomické indiktory, hrubý domácí produkt

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1 Introduction

Every human society must confront three fundamental problems economic problems. What commodities are to be produced, how much goods and services should the economy make and when will they be produced. (Samuelson, Nordhaus, 1992) In order to answer these questions we need a measure of today's economic performance. With a little exaggeration, we can state that gross domestic product (GDP) is nowadays a king among macroeconomic indicators and the most often used statistical figure to comment on economy of every country. It is used by economists to describe conditions of economy and by policy makers to make decisions and then justify them to the public. Both consumers and institutions adjust their expectations according to changes in gross domestic product. Almost every topic concerning economy is somehow influenced by GDP and its changes. GDP is an indicator of economic activity and it measures overall market production of the economy. GDP is the most widely used economic indicator by International Monetary Fund and World Bank since the Bretton Woods system. (Constanza et al, 2009) In this time it became used as a measure not only for economic activity, but also for standard of living, economic progress and well-being of population. The common belief is, the higher GDP the better. But is it really reliable to use GDP for everything?

This problem was recognized already with creation of GDP and the economists realized that growth of GDP does not correlate well with social welfare; thus it might not be the ideal and certainly not the only indicator of economic growth. (Stiglitz, Sen, Fittousi, 2009) Nowadays these discussions were reopened again in large scale with increasing emphasis on environment, renewable energy sources and social aspects of human lives. There have been a number of alternative economic indicators suggested since 1960's, but none of them came even close to be as widespread as GDP. Most of them were constructed for USA and only for the most important economies in the global economy. Sadly the Czech Republic is not one of them, hence only several alternative economic indicators were constructed for the Czech Republic.

Genuine progress indicator (GPI) is one of such indicators and in my opinion it is one of the best alternative indicators and it is suitable to be a supplement of GDP in measuring economic growth and progress of the economy. It was in introduced in 1995 and it has been further updated an upgraded to be more comprehensive and informative economic indicator. While GDP represents only economic component of society, GPI contains not just economic, but also environmental and social items. National well-being does not depend solely on monetary value of production, but also on various components from social life and environment, most of which are included in GPI.

One of the main goals of this thesis will be constructing GPI for the Czech Republic. In the first chapter I will talk more about GDP and how it is nowadays misinterpreted. I will also address its strengths and weaknesses and reasons, why it is not as good indicator of economic growth as is common belief. I will also try to capture what features a quality new economic indicator should not be missing.

In the second chapter I will introduce more alternative economic indicators, which have been created. I will address their strong and weak sides, mention critique and show their methodological basis. In the third chapter I will describe GPI in detail. I introduce its methodological and theoretical basis and its components and discuss aspects, for which GPI was criticized, possible proposed upgrades and impacts of these discussions on my calculations of GPI.

In the fourth chapter I will show construction of GPI for Czech Republic item by item and talk about reasons for selected computational methods and about its possible shortcomings. There will be two computations of GPI; GPI where I will use exchange rate for adopting foreign values for certain components and GPI (PPP), where I will use purchasing power parity when using foreign values. The usual approach in GPI studies is with exchange rate, but I think using purchasing power parity reflects better the impact of these components on the Czech Republic. In last chapter I will present results of my computations. I will not focus only on GPI, but also on single items. I will also make a short comparison of GPI with other countries. We also cannot forget to note some limitations of these computations and possible ways for improvement.

2 Current problems of measuring economic development

2.1 About GDP

GDP was created as a resulting summary of statistics describing national economy – the System of national accounts (SNA). GDP and SNA were initially developed in 1930s in USA by future Nobel Prize winning economist Simon Kaznetz. SNA was created as a clear overview of economic activity. Such thing was not available in that time and policy makers sorely needed something, according to what they could fight the Great Depression and few years later maximize production in the time of war. With the SNA USA government could effectively allocate resources and boost production according to current needs. “Only those who had a personal share in the economic mobilization of World War I could realize in how many ways and how much estimates of national income covering 20 years and classified in several ways facilitated the World War II effort” (Bureau of economic analysis, 2000, p. 7). After the war SNA and GDP became one of the most essential tools used by governments and international institutions all over the world. GDP have become so common in economics that it is easy to forget that they were inventer in specific time for specific reason. (Anderson, 1991)

GDP measures total value of goods and services summing by consumption, investment, government spending and net export. I agree with Nordhaus, who described GDP as one of the great inventions of twentieth century (Nordhaus, 2002). If it is used as a measure of economic activity only, there is nothing even remotely as good as SNA and GDP. It is great for measuring flow of goods and services and its value within the market, the output of the economy and much more. GDP is easily calculated, transparent and comprehensive. But it is often viewed as an indicator of economic and social well-being. (Haggart, 2000)

2.2 A misused indicator

It is no fault of GDP or its creators, but over time GDP has been associating with well-being of society, until we arrived at a point, where general public considers GDP as a measure of welfare and that growing GDP automatically means social improvement, better quality of life and that people of the country where GDP is growing quickly are somehow better off than those where GDP is growing slowly or not growing at all. But that does not have to be true. By itself GDP is somewhat non-dimensional. It measures total output and economic activity. But not all economic activity is beneficial to society or increasing welfare of all involved or uninvolved. Also everything on what you cannot for some reason put price tag is virtually invisible to GDP. The economists have warned against misuse of GDP since its beginnings. The creator of GDP Simon Kaznetz stated that goals for more growth should specify more growth of what and for what (Haggart, 2000). Nordhaus and Tobin in their study said: “GNP is not a measure of economic welfare. Maximization of GNP is not a proper objective of policy. Economists all know that and yet their everyday use of GNP as the standard measure of economic performance apparently conveys the impression that they are evangelistic worshipers of GNP” (Nordhaus, Tobin, 1972, p. 4). By wild exaggeration Cobb captures one of the main reasons why GDP is not a good indicator of well-being: “By the curious standard of the GDP, the nation's economic hero is a terminal cancer patient who is going through a costly divorce“(Cobb, Halstead, Rowe, 1995, p. 8).

One of the main deficiencies of GDP as a measure of economic progress is, that it measures only those activities, which are valued by the market. In other words, if in certain activity monetary transaction did not take place, it does not affect GDP. So for example volunteer work or child care or any kind of community activity is not included in GDP. The market value approach may have some impacts on what GDP is really measuring. Anything, what shifts from market to non-market level decreases GDP, when in fact nothing has changed. If you for example befriend your gardener so much that he starts to work for free, GDP has declined yet in reality the same value of work has been performed. Next big error as aforementioned quote of Cobb pointed out, (Cobb, Halstead, Rowe, 1995) not all production is beneficial to welfare.

By the accounting of GDP events like wars, natural disasters are taken as a positive. The environmental pollution is in some cases taken as twice positive; its cost is added once for its creation and once for its removal. It can be sometimes very difficult to clearly state, if production adds to welfare or not. Let us take for example involuntary expenditure on house protection against crime such as alarms or locks. On one hand it does not add to welfare, but on the other it creates job opportunities, which add to welfare. By this remark I do not want to defend crime or wars as an addition to well-being. I just want to point out that dismissing some fields of production entirely can be problematic.

Another deficiency of GDP is not as much about welfare, but more about sustainability. It focuses only on flows, while ignoring stocks; hence measures only income, but not wealth. Thus extraction of natural resources is counted as income, while the rest is not counted as wealth, in fact it does not appear in GDP. This applies not only to resources as oil or minerals, but for all natural capital such as forests, lakes, fisheries etc. From this point of view the whole planet is just one big bag of money just waiting to be drained and this depletion would not cause any trouble. (Cobb, Halstead, Rowe, 1995) GDP also does not make any adjustments for income inequality. Theoretically, if in a country the Gini index is one, all income goes to one person, while everyone else has nothing. As far as GDP measure is concerned, nothing is wrong. As I mentioned above, if GDP is used as it supposed to, as a measure of economic and market activity, it is brilliant. It is time for a new indicator, not necessarily a single one, which will measure actual welfare, economical progress and sustainability.

2.3 Towards new indicator

Due to shortcomings of GDP and its continuous misusing as a measure of well-being, there is a growing need for better measure of economic progress and well-being, which will address these shortcomings. There has been a number of different alternative indicators proposed so far and many of them will be explored later in detail, but let us now consider how, in theory, such ideal indicator should look like. According to International Institute of Sustainable Development (2013), a good

alternative economic indicator is characterized by the following factors: Relevance, simplicity, validity, time series data, availability of affordable data and ability to aggregate information. In my opinion it should also be easily comparable between countries.

To elaborate these factors, in my opinion an ideal indicator should address a relevant problem. It should be clear what it measures in order to avoid being misinterpreted. It should be scientifically valid. It means to have clear theoretical and methodological basis to support its relevancy. It should be also comprehensive or somehow easily interpretable for broad public. We are looking for an indicator, which could be used ideally all over the world, where data quality can be very low. Thus data needed to create our goal should be already available, preferably historical ones or at least possible to create monitoring process for future data collection as cheap as possible.

I think that achieving this can be extremely problematic. The fact that GDP measures only what has market price, has its merits. It is crystal clear how to evaluate every item; by its market price. There is no clear and generally accepted consensus how to evaluate things outside market, this is especially true for social dimension of human society. In my experience a collection of little unusual data tends to be a time consuming problem and create “clear” time series without extrapolation is nearly impossible. It is important for indicator to be able to aggregate information, on the other hand I think that the ideal indicator also should not be too inclusive. By aggregating too many measures the indicator becomes literally useless, because by implementing new concept it has to get further away from the original one. (Neumayr, 1999) There should be a well-considered balance in included information for indicator to be broad enough to arouse interest, but not too broad to become meaningless.

Let us now look at gross domestic product and genuine progress indicator in the light of these criteria. When comparing data availability, the GDP has clear advantage. The system of national accounts has a long tradition, thus creating even long historical time series is not a problem. With GPI on the other hand the situation is in my experience much more complex and time consuming. Also the international

comparison is better with GDP, because its methodology is clearly unified, while with GPI there are usually some variations between countries. Both have good theoretical foundation and their complexity is at a similar level. I see the biggest difference in relevance. Not to say that GDP is irrelevant, it is still one of the most used economic statistics in the world, but it is time to shift emphasis from economic production to measuring people's well-being. (Stiglitz, Sen, Fittousi, 2009)

Stiglitz in his report gave a series of recommendation for measuring economic performance. When evaluating material well-being we should focus more on consumption than production. We should look more on household perspective and with consumption also evaluate wealth anddistribution of consumption, income and wealth. We should also consider non-market activities, sustainability and quality of life. (Stiglitz, Sen, Fittousi, 2009) GPI tackles all these issues in my opinion much better than GDP. That does not mean we should abandon GDP, we should just give more emphasis on well-being. I thing that GPI aggregate addressing these issues the best and that is why it is in my opinion the best alternative indicator of economic progress. Let us now explore other alternative indicators as well as GPI in more detail.

3 Alternative economic indicators

Although deficiencies of gross domestic product were known since creation of system of national accounts, the first serious attempt for alternative measure of economic progress and welfare did not come until 1972. Since then a great number of indicators has been suggested for better measuring of well-being, sustainability, economic or social progress. In this chapter I discuss other alternative indicators than GPI. 5 indicators are explained in more detail: Measure of economic welfare for its historical relevance, Index of sustainable economic welfare for its relevance as a predecessor of GPI, Human development index and adjusted GDP for their relative international success and Inclusive wealth index is mentioned in detail as one of the most recent indicators created. It is impossible to discuss in detail every alternative indicator ever made, but I will at least try in more or less detail address as much of them as possible.

3.1 Measure of economic welfare

Measure of economic welfare (MEW) was created by Nordhaus and Tobin already in 1972, which makes it one of the first attempts to create alternative economic indicator. Nordhaus and Tobin (1972) recognized that GDP is not a measure of welfare or appropriate measure of economic growth, but it is commonly used as such. When creating MEW they did not have in mind creating an indicator, which would replace GDP, maybe not even one that would supplement GDP as they in study when MEW was introduced called it “primitive and experimental”. But they wanted to point out, that GDP is very often misused and that there is a need for some measure of true welfare. The basic problem with GDP is that it measures production. But the goal of economic activity should be consumption (Norhaus, Tobin 1972). The authors start at GNP and then make adjustments, to create a consumption targeted index. First of all they reclassify GNP expenditures as consumption, intermediate and investment, to count only true consumption. Then make adjustments for leisure,

household work and services of consumer capital and finally take into account consequences of urbanization and environmental damage.

Reclassification of GNP expenditures is done again in three steps; capital consumption, growth requirements, instrumental expenditures. Capital consumption is merely starting from *net* national product and not from the gross national product. In other words they subtract the depreciation of capital stock. In this step health and education expenditures both private and public are treated as an investment and not consumption. Growth requirements try to measure whether growth of capital stock is proportional to growth in population, because the capital stock must be growing at the same rate as population and the labour force in order to sustain per capita growth level. Instrumental expenditures deduct expanses, which are necessary, yet do not contribute to welfare. The major item of this is expenditure on national defence, also for police, repairs of roads etc. After that leisure, non-market work and services of consumer capital both private and public is valued and added and cost of environmental cost is deducted. Also cost of urbanization is deducted. Tobin and Nordhaus argue that despite the fact that people in big cities have higher salary, they have to face things like noise pollution, traffic, higher air pollution etc. These costs have to be deducted. As will be seen later, the conceptual framework is very similar to GPI.

Very interesting aspect of MEW is that it distinguishes between actual MEW and sustainable MEW, where

Sustainable MEW = actual MEW + net investment

Net investment is difference between gross investment and capital depreciation, hence it can be both positive and negative. If sustainable MEW is higher than actual, the economy is creating provisions for the future, if the opposite is true current consumption is decreasing the stock of capital for future generation.

In my opinion this indicator served its purpose. It inspired a creation of many new indicators and serve as a basis for them. As you will see lower, many indicators including GPI retake logic of MEW and just perfect the inclusion of items for adding

and deducting. On its own, it has one huge weakness that makes it currently unusable and hat is too little attention devoted to environmental items. Granted, it was created when this topic was not as hot as today, but it does not make it nowadays more applicable.

3.2 Index of sustainable economic welfare

Table 1: Components of GPI and ISEW

ISEW	GPI
Personal consumption	Personal consumption
Income distribution index	Income distribution index
Services of household labour	Value of household work
Services of consumer durables	Value of higher education
Services of highways and streets	Value of volunteer work
Public expenditure on health and education	Services of consumer durables
Cost of consumer durables	Services of highways and streets
Defensive private expenditures	Cost of crime
Expenditures on national advertising	Loss of leisure time
Cost of commuting	Cost of underemployment
Cost of urbanization	Cost of consumer durables
Cost of car accidents	Cost of commuting
Cost of water pollution	Cost of household pollution abatement
Cost of air pollution	Cost of car accidents
Cost of noise pollution	Cost of water pollution
Loss of wetlands	Cost of air pollution
Loss of farmland	Cost of noise pollution
Depletion of non-renewable resources	Loss of wetlands
Long term environmental damage	Loss of farmlands
Net capital growth	Loss of forests
Change in net international position	Depletion of non-renewable resources
	Damage from greenhouse gas emissions
	Cost of ozone depletion
	Net capital investment
	Net foreign borrowing

ISEW is an economic indicator of progress and sustainability. Some experts claim that GPI and ISEW are the same indicator, GPI is just revised. To some extent,

they may be right. ISEW was created in 1989 by Daly and Cobb as the appendix of the book *For the common good* and it is a methodological base which GPI is built on. In this subsection, I will only show the item variation in ISEW and GPI (table 1) and since both have the same theoretical base, I will attend to that in detail later.

3.3 Human development index

Human development index is an indicator, which focuses solely on well-being of population. It was created by economist Mahbub ul Haq with in 1990 as a part of Human Development Report published every year since. The main goal of creating this index was to redirect focus of public from indicators based only on economic output. This indicator is relatively successful; it is one of the few alternative indicators, which is created annually for almost all countries of the world. Since its creation in 1990 it was updated several times and the biggest updated several times and biggest update is from 2010 (Klugman, Rodríguez, Choi), when a methodological formula has been slightly upgraded as an answer for critique. Nowadays HDI is calculated as follows:

$$\mathrm{HDI} = (\mathrm{H}_{\mathrm{Health}} * \mathrm{H}_{\mathrm{Education}} * \mathrm{H}_{\mathrm{Living\ standart}})^{1/3}$$

Where H_i are normalized indicators of achievements.

$$\mathrm{H}_{\mathrm{health}} = \frac{\mathrm{le} - \mathrm{le}_{\mathrm{min}}}{\mathrm{le}_{\mathrm{max}} - \mathrm{le}_{\mathrm{min}}}$$

$$\mathrm{H}_{\mathrm{education}} = \left[\frac{\mathrm{mys} - \mathrm{mys}_{\mathrm{min}}}{\mathrm{mys}_{\mathrm{max}} - \mathrm{mys}_{\mathrm{min}}} * \frac{\mathrm{eys} - \mathrm{eys}_{\mathrm{min}}}{\mathrm{eys}_{\mathrm{max}} - \mathrm{eys}_{\mathrm{min}}}\right]^{1/2}$$

$$\mathrm{H}_{\mathrm{living\ standart}} = \frac{\ln(\mathrm{gni}) - \ln(\mathrm{gni}_{\mathrm{min}})}{\ln(\mathrm{gni}_{\mathrm{max}}) - \ln(\mathrm{gni}_{\mathrm{min}})}$$

Where *le* is life expectancy, *mys* is mean years of schooling, *eys* is expected years of schooling, *gni* is gross national income. There are set upper and lower bounds; upper are maxima over time series from 1980 and lower are subsistence minima.

$\{\mathrm{le}_{\mathrm{min}}, \mathrm{le}_{\mathrm{max}}\} = \{20, 83.2\}$

$\{\mathrm{mys}_{\mathrm{min}}, \mathrm{mys}_{\mathrm{max}}\} = \{0, 13.2\}$

$\{\mathrm{eys}_{\mathrm{min}}, \mathrm{eys}_{\mathrm{max}}\} = \{0, 20.6\}$

$\{gni_{min}. gni_{max}\}$ = {163 US$, 108211 US$}

As we can see from quite straightforward computation, HDI evaluates three dimensions of welfare; health, education and income per capita. The approach of HDI to well-being is rather unique. It considers well-being as an opportunity to lead long healthy life and have enough knowledge and personal capital to do so. (Klugman, Rodríguez, Choi) But this approach has its limitations and flaws especially if someone wanted to use it as a measure of economic welfare or to use it to make political decisions.

First of all although HDI has an economic dimension in its computation, it does not have any economic theoretical foundation to explain why include these particular dimensions in its methodology. Also the fact that HDI does not count with environment, which without doubt contribute to well-being, has been target of many critics. Another non-economical aspect is that HDI was not created for maximization, because that could lead to corner situation where we completely emphasize one dimension and disregard the others. (Engineer, King, 2010) In my opinion HDI is very good ex post indicator of standard of living, but it is not suitable for role of welfare measure or as a tool for policy making.

3.4 Adjusted gross domestic product

In this subsection, I will not address any new economic indicator, but describe adjustment of the current one. The need to consider also environment and natural capital is rooted in the second half of the last century. After extensive discussions, in 1992 at environmental summit, United Nations recommended all countries to implement environmental-economic accounts as soon as possible. Several months after that, in 1993, United Nation statistical division published a Handbook of National Accounting: Integrated Environmental and Economic Accounting, which has been referred to as a System of Environmental Economic Accounts (SEEA) and it has been recommended to implement it to existing System of National Accounts (SNA). After that there have been revisions to fix all deficiencies and to unite all methodological options not only by UN, but also by groups of experts, who created

groups working on this problem (London group, Oslo group). The implementation of SEEA has been conducted by many of UN countries including the Czech Republic (Veselá 2013), but full implementation of the (SEEA) has not been undertaken by any country.

The SEEA can be basically broken down into three modules; physical flow accounts, environmental activity accounts and related flows and asset accounts. The physical flows focus on flow of energy, water and other materials (wastes, emissions) and organize them according to SNA into National Accounts Matrix including Environmental Accounts (NAMEA). Environmental activity accounts and related flows concern all activity undertaken to preserve environment. For example accounts of expenditures of government and businesses for environmental protection are included in this category. Finally the asset account considers all items that have some value to society such as natural resources, soil, forests etc. The aim of SEEA is to closely identify the physical and monetary flows concerning environment and implement them in the existing SNA.

Since GDP is part of SNA and SEEA only supplement SNA it is not yet exactly clear what impact full implementation of SEEA will have on economic indicators per se, in other words how exactly will GDP be adjusted. Most probable scenario is Environmentally Adjusted Net Domestic Product (EDP). For now there is EDP I, which is Net domestic product minus depletion of natural resources and EDP II, which is EDP I minus cost of environmental degradation. Everything needed for calculation of EDP I and EDP II should be encompassed in SNA upgraded by SEEA.

In my opinion system of national accounts enhanced with SEEA will be measure of economic output somewhat adjusted for sustainable component. Penalization of GDP for depletion of non-renewable resources and damages done to environment is certainly step to the right direction, but many shortcomings of GDP discussed earlier remain still intact. Also I think that environmental damages will be seriously undervalued in this system.

3.5 Inclusive wealth index (IWI)

IWI is rather new indicator; it was presented in 2012 and it is trying to measure well-being by redirecting focus from flows (income) to stock metrics (wealth). This underlines the importance of preserving a portfolio of capital assets in order to maintain the productive base to sustain the well-being of future generations (UNU-IHDP, UNEP, 2012). This index also measures sustainability by measuring assets available to each country; hence if a country depletes its natural resources, it loses value of those resources. The IWI has four main areas of interest. It evaluates human capital, manufactured capital, natural capital and heath capital. The IWI is computed as follows:

$$\text{IWI} = P_{mc} * \text{MC} + P_{hc} * \text{HC} + P_{nc} * \text{NC} + \text{HeC} * P_{hec}$$

Where MC is manufactured capital, HC is human capital, NC is natural capital and HeC is health capital. P_i are shadow prices of each capital respectively. It is argued that wealth is an accumulation of different types of capital and the key to evaluating each type of capital is not in market price, but in shadow price. According to inclusive health report its definition of the shadow price is forecasted contribution of marginal unit to human well-being (UNU-IHDP, UNEP, 2012). By this definition the value of shadow price and market price can be the same.

Human capital refers to education attainment of population and compensation for it over time. The shadow price is expressed as present value of labour compensation for education over an entire life. Manufactured capital tries to capture benefits that come from human made capital, using so called perpetual inventory method, which basically values an accumulated capital over some period of time, taking in account its lifetime, depreciation, new investment, maintenance cost etc. The natural capital measure can be divided into five categories: Forests, fisheries, fossil fuels, minerals and agricultural land. It is valued as an amount available multiplied by its resource rent. Of course output created from these resources is treated in the index in order to avoid conclusion that their extraction is all negative. Finally heath capital is expressed as a life expectancy of population. Shadow price is a discounted value of every additional year of life taken from Value of statistical life

estimated in USA by Environmental protection agency. This is the basic framework of IWI. There can be miscellaneous adjustments according to what needs to be especially targeted. In IWI report there are three; adjustments for carbon damages, oil capital gains, which can show how the wealth of country depends on certain main resource and total factor productivity, which corresponds to technological progress.

Because IWI was published relatively recently it was not yet targeted by criticism in order to reveal the biggest weaknesses, but in my opinion it is one of the best indicators for sustainability and well-being. The only flaw that I can see is that it lacks any social dimension, which is necessary for measuring welfare. But since it is recognized in the report by authors it may be published in future revisions.

3.6 Additional indicators

I have described the aforementioned indicators in more detail, because of they are historically important, internationally well known, recent or important for the main focus of this study, which is GPI. But there are more indicators, which were developed, or which are still being developed and upgraded all around the world. I will not go into such detail as in those mentioned above, but they deserve at least short mention. In 1973 was approved Net national welfare (NNW) by Japan government, it is more or less just an offshoot of Nordhaus and Tobin's MEW. Next attempt for measuring welfare was made by Greek economist Zolotas in 1981 and his Economic aspect of welfare index (EAW). It also starts with private consumption expenditures and makes series of deductions and additions for social and environmental aspects. It differs from MEW by focusing on current flow of goods and ignoring the issue of sustainability. It also measures environmental damage more directly than MEW, where there is only cost of urbanization.

Next existing indicator, which focuses only on sustainability, is called genuine savings (GS) and it was proposed by World Bank and counted for 140 countries including the Czech Republic.

GS = Gross domestic savings – depreciation of produced capital – education expenditure – value of natural resources depletion – damages caused by pollutants (carbon dioxide and particular matters)

Although it underestimates environmental pollution by including only air pollution (and even it is underestimated since only carbon dioxide and particular matters are included) it is a decent indicator of sustainability. If its value is positive, observed economy is sustainable, if negative it is not. Another on-going project concerning itself with sustainability is project *ecological footprint.* Calculation of Ecological footprints accounts was created by Rees and Wackernagel in 1994. The ecological footprint is an indicator of sustainability measured in land units. It compares human consumption of natural resources with planet Earth's ability to regenerate them and absorb the corresponding waste (Nourry, 2008). It is very detailed and widespread indicator, that independently monitors environmental events (climate change, fisheries collapse, land degradation, land use change, food consumption, etc.) and then by assigning appropriate weights to different biomes it creates normalized bioproductive area available for every country. Then comparison of available land and land needed for production is made and based on this comparison decision about sustainability is made. It is sometimes criticized for the conversion method to bioproductive area. It is very detailed and transparent evaluation system of current sustainability, yet it has showed in empirical studies very low correlation between ecological footprint and land degradation (Fiala, 2008), which is lightly put very surprising. It also was criticized for bad adjustments for technological progress.

Gross National Happiness (GNH) is an index, which tries to orient people and policy makers towards happiness. It is composed from 33 items across 9 domains psychological wellbeing, time use, community vitality, cultural diversity, ecological resilience, living standard, health, education, good governance. By breaking down Gross national happiness index we can see where the unhappiness is coming from and for whom. (Ura et al, 2012)

Living planet index (LPI) was created to monitor the state of animal species on the planet. It tries to include to welfare measure changes in planet biodiversity. It

measures changes in terrestrial, marine and freshwater animal species. (Living planet report, 2012)

Multidimensional poverty index (MPI) is indicator created in 2010 for 104 countries of the world (including Czech Republic), which measure acute poverty. The MPI includes 10 indicators from dimensions; health, education and standard of living. Each dimension is equally weighted. MPI reflects deprivation of basic needs and core human functions. (Alkire, Santos, 2010) Environmental performance index (EPI) is an index, which tries measure current national environmental protection efforts. With 25 indicators it evaluates two main goals: Reducing environmental stresses to human health and protecting ecosystems and natural resources. (Esty et al, 2008) Of course there exist more indicators of well-being and sustainability, but it is impossible to mention every single indicator, which has ever been created.

4 Genuine progress indicator

4.1 Theoretical base

GPI was presented for the first time in 1995 as a methodological extension of ISEW. The GPI tries to quantitatively express economic progress and well-being of nation's citizens rather, than just measure economic output in a country. The base idea for this comes from a so called threshold hypothesis. This hypothesis was created by Max-Neef (1995) and states that from a certain point, economic growth becomes not only largely unsustainable, but also undesirable, because at some point additional benefits of continuing growth will be exceeded by costs they can impose on general quality of life (Lawn, 2003). In the light of this hypothesis it is not enough to measure only economic output, but also decide if this output really brings benefits to society and it is certainly not desirable to base all national policies solely on economic output. The methodological procedure for GPI comes from a Hicksian and most importantly Fisherian notion of income (Lawn, 2005). Hicks in his definition of income recognize the value of sustainability, he argues (Hicks, 1946), that income is the maximum amount, that can be consumed and produced without compromising the ability to do the same in future. Fisher (1906) came up with an idea of "physic income", which are services enjoyed by consumer from all human-made capital. In other words producing more products does not necessarily mean increasing quality of life and that income in certain year can be created not only by output from that particular year, but also by output prior to this year. One of the main implications of Fisher's concept of income and capital is recognition that maintenance of human-made capital needs to be considered as a cost and also that in the process of accumulating and maintaining this capital brings many undesirable side-effects.

GPI starts with personal consumption expenditure, because the idea is, that starting point should be not how much a nation produces, but how much it consumes.(Lawn, 2003) Personal consumption expenditure reflects best a Fisherian notion of income. There can be objections, that for example junk food or alcohol do

not increase welfare, but since it is consumed voluntarily, it does brings some level of enjoyment, in order not to subjectively deciding what is good for consumer and what is bad, GPI includes consumption of all goods. (Talberth et al, 2007)

Personal consumption expenditure is then adjusted for income inequality, because it is obvious, that more money added for consumption of poor individual brings higher level of welfare and utility, than it brings to the rich one. For this adjustment a Gini coefficient is used, because it is nowadays the most commonly used index for income inequality. After this adjustment is made, we get a real base for GPI calculation: weighted personal consumption expenditure.

After that comes a series of deductions or additions to this base for a number of social and environmental items, according to a fact whether they provide a cost or benefit to welfare, as well as adjustments borne from human made capital. Full list of these items can be seen in table 1. One of the social benefits is the value of work provided without salary. This is work performed at home or as a volunteer. Many macroeconomic professors, when explaining GDP, use classical: When a housekeeper washes your dishes, it counts as an addition in GDP, but when your wife does, it does not. This clearly does not make any sense. More on next social benefit, value of higher education, can be found later.

The social costs can be divided into two categories. Either they are direct cost of undesirable side-effects created by economic activity - loss of leisure time, cost of unemployment and cost of commuting or they are defensive expenditures against them – cost of car accidents and cost of household pollution abatement. Cost of crime is not created by economic activity but it is still a defensive expenditure, which does not increase welfare, but decreases it.

As we can see in table 2, all environmental items of GPI methodology are negative. The costs caused to environment are not included in national accounts, but they obviously should be accounted for. Their inclusion needs no explanation why they decrease welfare. We are talking about cost of water, air, noise pollution, damage from greenhouse gasses and ozone depletion. The rest of environmental items, depletion of non-renewable resources, loss of wetlands, farmlands and forests,

is in violation with both Hicksian income and sustainability and Fisherian income. Depletion of non-renewable and in case of natural capital very slowly renewable capital endangers the ability to consume the same in remote and near future (for slowly renewable just near future). It also directly endangers the ability of creating and maintaining human-made capital, for which these resources are essential.

Table 2: Categorical division of GPI components

Social	Environmental	Capital adjustment
(+) Value of household work (+) Value of higher education (+) Value of volunteer work (-) Cost of crime (-) Loss of leisure time (-) Cost of unemployment (-) Cost of commuting (-) Cost of household pollution abatement (-) Cost of car accidents	(-) Cost of water pollution (-) Cost of air pollution (-) Cost of noise pollution (-) Loss of Wetlands (-) Loss of farmlands (-) Loss of forests (-) Depletion of non-renewable resources (-) Damage from Greenhouse gasses emission (-) Cost of ozone depletion	(+) Services of consumer durables (+) Services of Highway and streets (-) Cost of consumer durables (+/-) Net capital investment (+/-) Net foreign borrowing

Capital adjustment items reflects an ability of human made capital to provide their services for many years, thus creating income longer than just in thr year when they were purchased – these are services of consumer durables and services of highways and streets. Cost of consumer durables is included to express really just services they provide. Net capital investment refers again to Hicksian notion of income and sustainability, more precisely to be able to consume the same level now

and in the future, thus maintaining a certain constant level of capital is needed. If we are not able, it should be accounted for. As for net foreign it is also important, who is the owner of the capital, which we use to create our consumption level. More on every item can be found in the following chapter, as an explanation of calculation approach.

4.2 Criticism and other evaluating methods

Since 1989, when the ISEW was introduced for the first time, appeared several studies, which tried to critically comment on its methodology or even dismiss ISEW altogether. Since ISEW is direct predecessor of GPI built on the same theoretical and methodological foundations, in this section I will attend to critique both for ISEW and GPI. Also many controversial topics criticised in ISEW remained in GPI review of past debate seems to be relevant.

First criticism for ISEW tried to dismiss ISEW altogether, because it lacks any theoretical foundation and sound justification for including its items (Neumayer, 1999). With this argument was already dealt and a study explaining theoretical foundation of GPI/ISEW has been released in 2003. (Lawn, 2003) Short explanation of this theoretical base has already been mentioned. More criticism move from theoretical base, which has been clearly established, to certain items in methodology and their calculation.

Depletion of non-renewable resources is the first order of business in most critical studies. First of all there are three ways how to asses this item: method of resource cost, method of replacement cost and El Serafy method. The majority of GPI/ISEW studies uses replacement method and only few uses resource cost or El Serafy method. Rational behind resources cost is (Lawn, 2003) that income, which has been obtained in process of depleting non-renewable resources is unsustainable into the future and thus should be deducted. On the other hand replacement cost is based on the idea (Cobb et al., 1995) that the material that cannot be renewed has to be replaced by renewable sources. As I mentioned, replacement cost method is preferred, since it is more consistent with Fisherian definition of income, more precisely with an idea, that maintenance of human-made has to be considered as a

cost. In this case we have in mind human-made capital, which is a direct result of natural capital (fuels etc.). Although replacement cost method is superior to resource cost method there are few imperfections in it. First of all, there seems to be no point in the need to replace all non-renewable resources immediately. For example it is estimated, that coal should be available for the next 218 (provided the same level of extraction) years from 1998. (Neumayer, 2003) Also a 75$ per barrel of oil equivalent is considered to be too high especially with 3% escalation factor. The rationale for this doubt is that rational resource extractor would never use more expansive resource regardless if it is renewable or not. We should wait with switching until it will be unnecessary and likely much cheaper because of technological advancement. (Neumayer, 2003)

El Serafy method is a variant of resource cost method. It can be simply expressed in the following formula:

$$\frac{X}{R} = 1 - \frac{1}{(1+r)^{n+1}}$$

Where X is true income, R total net receipts (gross receipts minus extraction cost), r is discount rate and n the number of years over which the resource is to be liquidate. While almost all experts agree that this model is in theory the best, even despite the fact that it is variant of resource cost there are few practical issues. First the value of n can be estimated provided that the level of extraction stays the same, which is impossible. Also due to lack of data (in USA!!) it is difficult to estimate the value of R.

The second target of criticism is accumulation of costs in certain items, such as loss greenhouse emissions, ozone emissions, loss of wetlands, non-renewable resource depletion etc. There have been two approaches to accumulation of costs. In UK ISEW they compute the marginal social cost of air pollution and then discount this value for following years. This according to Neumayer leads to multiple counting. He claims that by valuing each tonne of emissions with its marginal social cost the future damage is already valued and accumulation is contradictory and wrong. (Neumayer, 2003) The second approach was used in US ISEW/GPI studies.

They take a value of 0.50$ for every tonne of oil equivalent and set it aside in order to compensate future generations for environmental damage. But through accumulation of costs we take this money aside not only in present year, but in every year after.

The third point of interest in critical studies is the income inequality. It is argued that by weighting personal consumption expenditure, we are abandoning the sustainability idea and focusing only on welfare, because welfare and sustainability cannot be very well measured in the same index. There always will be items that support sustainability and contradict welfare and vice versa. (Neumayr, 1999) This might be true, but since GPI made a step more to welfare than to sustainability, this point of critic should stay with ISEW. Also provided we decide to keep weighted personal consumption there is a big argument whether to use Gini coefficient or Atkinson index. Gini coefficient is defined as an area between diagonal of a unit square and a Lorenz curve. Gini index is commonly calculated using income distribution of population. Atkinson index can be computed:

$$1 - \exp[\sum_{i=1}^{n} \frac{Y_i}{\bar{Y}}^{1/(1-\varepsilon)} f_i]^{1/(1-\varepsilon)}$$

Where Y_i is income of all individuals in ith income group, f_i denotes percentage of population in ith income group. $\bar{Y}$ is mean income and ε indicates aversion of society to income inequality. Gini coefficient is here criticised for being somewhat non-dimensional and that Atkinson index gives more weight to specificity of every country. Despite these remarks, Gini coefficient is used in overwhelming majority of GPI computation. But there is a solution, which would end these discussions. Because one of these indices is used to weight consumption, Gini index based on consumption and not income (Brewer, O'Dea, 2012) is probably better suited for GPI computation.

There is also a proposition, that two items should be dropped from both ISEW and GPI; Net capital growth and foreign lending/borrowing. The reason for dropping net capital growth is that this item is not consistent with Fisherian notion of income, but only with Hicksian income. And since in creation of theoretical basis there were

efforts to incline more to Fisherian income than to Hicksian, this could seem as a theoretical inconsistency. As mentioned earlier, Fisher argues (1906), that creation of more human-made capital does not automatically mean increase in welfare and thus its changes should not be included.

Foreign lending/borrowing is criticised for the measuring its annual change. The country still can be net lender, but in recent years its position as lender can be dropping. Thus in absolute terms this item should be positive, its annual change is negative and that can be misleading.

It is also worth mentioning that an idea of defensive expenditure was also extensively criticized as unclear and dubious and should be more precisely defined or dropped. But this critique was aimed at ISEW. The reason why I mentioned it is because it has largely affected the transformation of ISEW to GPI. Many experts argue that they are the same thing with different name, but it is not entirely true. GPI dropped almost all public expenditures in order to avoid ambiguity in defensive expenditures and left only items, where there is no argument, that they are in fact defensive (cost of crime, household pollution abatement etc.). All these are also private expenditures not public ones. The impact of this modification is major, so I leave the decision whether it is only a revision on the recipient.

GPI in large extent tries to correct shortcomings of GDP, but there is one extremely important thing, which both GDP and GPI fail to take into account; shadow economy. In fact no macroeconomic indicator considers shadow economy. And this is no negligible number. According to Schneider the size of shadow economy was in the Czech Republic from 2003 up to now just little under 20% of GDP every year. (Schneider, 2005) Shadow economy includes all monetary transaction legal or illegal which is not reported to proper authority. This can be avoiding taxes by both firms and individuals by not reporting income, tax evasion or income from drugs, prostitution, gambling and so on. Since the whole point of transfers in shadow economy is to be hidden, it is impossible to name all activities, but if GPI aspire to be an indicator, which does not have faults for which GDP is criticised, shadow economy, is certainly something to be somehow accounted for.

Alongside with shadow economy I would suggest including the value of health, similar as the value of higher education.

4.3 Implications for the Czech Republic methodology

In this section I would like to react on the opinions of critics and explain how and why these debates and arguments about methodology impact my calculations. As I mentioned theoretical base has been clearly and extensively established based on Hick's definition of income and mainly on Fisher and his notion of physic income. In theoretical base the Fisher's physic income is preferred, but in my opinion Hick's definition does not have to be put aside, since both definitions are consistent with each other and can co-exist and supplement one another.

For non-renewable energy I decided to acknowledge criticism quite a bit. I use replacement cost method, since it is most commonly used in all GPI/ISEW studies, but I agree, that El Serafy method is the best for estimated value of this cost. After unsuccessful attempts to implement this for the Czech Republic, I realized that if even American economists, whose data in my personal opinion are the best, were unable to use this method due to the lack of data, for the Czech Republic it is impossible. But I did not use replacement cost as it was used in original and its updated studies. I used the original 75$ cost of barrel of oil equivalent, but I omitted the 3% escalation cost, because I think that the replacement cost will not be increasing, but due to new technologies it will be an opposite. In the end, I remained on the original figure adjusted for inflation. I also agree with the criticism of need to replace all non-renewable sources right away, so I decided to value only those resources, where is a threat of relatively immediate scarcity. This approach was already used in Australian GPI. (Hamilton, 1997) The precise calculation can be found in column by column section.

With retaking evaluating figures from other studies comes another problem. And now we are not talking just about depletion of non-renewable resources, but valuation of all items that uses study, which was not originally created in the Czech

Republic and uses different currency than Czech Crown. This problem is whether to use exchange rate or purchasing power parity (PPP). PPP converts different currencies and in the process eliminate different price levels between countries. In its simplest form, PPP shows, the ratio of the prices in national currencies of the same good or service in different countries. (Eurostat-OECD, 2012) I think there is no need for introduction of exchange rate. PPP seems to be exactly what we need, but the issue is more complex. In this study this problem affects these items: Value of higher education, cost of crime, cost of noise, air, water pollution, depletion of non-renewable resources, and damage from greenhouse gas emission. And a choice between exchange rate and PPP depends on the point of view.

For the first two items, the problem seems to be in construction of these items. There are aspects that of education and crime that should be valued by PPP and aspects that should be valued by exchange rate. For example if we would focus on higher productivity of more educated individual or just property damages of crime, PPP would be used without discussion. But there is more to it. These items also include satisfaction from education, higher civic participation or emotional damage from crime. These sides have the same value all over the world, thus exchange rate is more appropriate. As for the pollution and resource depletion again the viewing angle is essential. If we look at these as a global problem, which affects not only us, but the whole word exchange rate would be used. The different price level between USA and CR does not make difference in global warming. Pollution affects quality of life everywhere the same. Depleted resource will still be depleted no matter where it was extracted. On the other hand if we stay strictly in our boarders and take somewhat monetary approach that Czech pollution is valued by Czech prices, depleted resource cannot create any income etc. PPP is more suitable. In my study I will use both approaches and calculate GPI using exchange rate and GPI (PPP) using PPP.

For the discussion about accumulativeness in my calculations I agree with criticism of accumulation of marginal social cost; it indeed leads to multiple counting, as for the second method of setting aside costs for other generations, I think that in this point the critics are wrong. This approach was created for accumulation of costs, but since I do not use this method even once, I do not create any extensive

defence. As can be seen later, I abandon the accumulation of costs completely, but reasons for this are also practical. For evaluating resource depletion and pollution I use marginal costs, which I do not think are meant to be accumulated. But even if they should, data for Czech Republic (Czechoslovakia) generally do not extend too far back and starting from year let us say 1993 would be too arbitrary. Accumulation was also used in items describing losses of natural fond: Wetlands, forests and farmland. For reasons explained later wetlands and forests were not included and for farmland I did not use accumulation simply to stay consistent in its dismissal.

The added national specificity in Atkinson index might be giving it a certain theoretical edge over Gini index, but because Atkinson index is not too widespread among all countries and concrete estimations of ε for most countries are missing. In practice, all countries would just take over value of ε from countries where it is available (I am familiar only with estimates for UK) and the whole point in using Atkinson index would be lost. Until Atkinson index is more used, I think that Gini index will work sufficiently.

Because in creating a net capital investment is not considered simply just increase or decrease of capital, but in GPI it is measured in relation to labour force, I think that it elimination would be wrong. Objections against net lending/borrowing are in fact futile for this study, because the Czech Republic is a net borrower in all years.

5 GPI for the Czech Republic by columns

The methodology itself is rather complex. I have tried to follow exactly the latest updated methodology from 2006, yet that proved to be an impossible task. In cases when there was a lack of data or it was not possible to evaluate certain item precisely as in latest methodology, I tried to find another satisfactory solution taking inspiration from other papers, which are creating GPI or its predecessor ISEW, since a lot of items remained unchanged. Because GPI was created in USA, which has different geographical conditions and social thinking, few items were insufficient enough, that they could be omitted for the Czech Republic, without a risk of compromising the eventual result. These items are: Loss of leisure time, Loss of wetlands, and Loss of forests and Cost of ozone depletion.

The column system used below may seem a little strange or at least unusual. This column system was used in the first calculation of ISEW (Cobb, Daly, 1989) probably for clear arrangement of results. This column system was used by every ISEW or GPI study ever since. Although indeed little unusual there was no reason for abandoning this system, which im my opinion became typical for ISEW and GPI studies.

Column A - Year

The GPI for the Czech Republic was calculated for years 2001 – 2011. Since GPI was created in USA several items required a little creativity and very detailed data, which has not been always available. Some extrapolation would be possible, yet it would provide more inaccuracy than needed. In cases where methodology required the lowest or highest value as a base year, if possible years outside this time period were used as well.

Column B - Personal consumption

Personal consumption is the basis for the GPI calculation, which makes it probably the most important item. There are no data for personal consumption on goods and services per se, but according to American bureau of economic analysis and its national income and product accounts handbook, it is equal to household and NPISH (non-profit institutions serving households) final consumption expenditure. This data set is freely available and the dataset used is from Czech statistical office (CZSO).

Column C - Income distribution index

Income distribution index is based on Gini coefficient, which describes income distribution among population. If its value equals zero, that means perfect equality in income distribution and if one, otherwise. Income distribution index measures relative change in Gini coefficient. Similarly to the original methodology it is set at 100 on its lowest value, in my case it is 1997. The values up to 2008 were calculated by Luboš Marek (Marek, 2010) and the rest was taken from Eurostat.

Column D - Weighted personal consumption

As the title suggests this column is personal consumption adjusted for income inequality of population. In practice it is column B divided by column C multiplied by 100. Column D now becomes a starting point, from which other items are either subtracted or added.

Column E - Value of household work

Household work is very important, but because it is not usually valued in market prices, it does not appear in any part of classical national account system. No coherent time series for household labour is available, yet there were several surveys and studies based on them. There are three papers targeted on this particular problem for years 1996 (Křižíková, 1999), 2002 (Chaloupková, 2005) and 2010. (Vohlídalová, 2012) Years in between were extrapolated using regression on

available years[1], assuming, that hours worked at home per week were increasing linearly from 1996 to 2002 and then decreasing from 2002 to 2011 as the available data are suggesting.

In the original methodology an hour of household work is valued by a hourly salary of a housekeeper. But since a profession of housekeeper is not that common in the Czech Republic and it is impossible to find out, which part of total hours should be valued by the salary of plumber, and which part by a salary of cook and so on, I decided to use the average salary in the Czech Republic.

Because hours of household work were very different between men and women, the average of all aforementioned were counted for men and women separately and then added up together. Data on salaries were obtained from average earnings information system, which is working under Ministry of labour and social affairs of the Czech Republic.

Column F - Value of higher education

The value of higher education is a new item in GPI. It hasn't been included in previous methodology of GPI. Yet it is in fact an important item. GPI is not focusing on a fact that more educated individual earns more money, because then it would be considered as an investment rather than contribution to social well-being. Instead we are focusing on spillover effect such as higher productivity, lower crime rate or providing new technology through research. There are many more of these spillover effects. (Hill, 2005)

The value was calculated by multiplying the number of people with higher education according to Survey of labour force published by CZSO with a value of a person with such education. This value was calculated by Hill (2005) based on econometric study of Moretti. (2004) This value was estimated to be 16000 $ in 2004 prices. Even though this value was estimated using American data, since we are not

[1] The autor relizes, that therm „regression“ might be overstatement and therm „fitted value“ is more appropriate in this case and creating time series from only 3 observations is not ideal, but when facing a serious lack of data it is the only way, how to create continous result.

talking about raw output, but social benefits, we can safely use this number for the Czech Republic. Furthermore, no, even similar, study is available for CR. I have calculated this value in Czech crowns using the average exchange rate for year 2004 and then transferred to current prices using inflation data from Czech statistical office. Data for number of college graduates were taken again from Ministry of Education and Czech statistical office.

Column G - Value of volunteer work

This item represents the first deviation from the original methodology, in which there were estimated hours of volunteer work based on few papers and then multiplied by value of an hour of volunteer work. Naturally it was my first course of action yet there were too many problems with it.

First of all there were no real data about hours of volunteer work. There are data about volunteer work performed, yet they are only for NPISH (non-profit institutions serving household), but they do not account for all volunteer institutions, for example environmental groups, so these numbers would be a serious underestimation. Second of all, how to evaluete a hour of volunteer work exactly? In Czech studies there are two approaches, use an average hourly wage, or 1, 5 times minimal wage. I could also use the American number (which would be probably the worse solution).

Because of all this I decided to use alternative approach. In the study about volunteering in European Union (EAC-EA, 2010), there was estimated, that in 2007 the value of volunteer work was 0,28% of GDP. For the purpose of this study let us assume, that this ration is constant and the value changes with GDP. This way we get a coherent time series. I have of course compared results from this approach with the original approach. I used average wages as evaluating an hour of volunteer work and took data for hours of volunteer work of NPISH and added up all available years (2004 – 2011). Then when I compared the results of GDP approach and the hourly approach the result is that hourly approach gives six sevenths of GDP approach, which is very plausible, since the hourly approach does not take in account for

example environmental groups as mentioned above. Data for both GDP and wages were taken from Czech statistical office.

Column H - Services of consumer durables

Services of consumer durables are calculated as 20% of total value of the stock of consumer durables. 20 % because it is assumed that average lifetime of durable good is 8 years, hence there is 12,5 % depreciation every year. There is also assumed 7,5% average interest rate. The user of durable good could have gained this interest if he decided to put his money in bank and not to buy this particular good. Adding up these two percentages, we get 20%.

Then there is a matter of estimating a total value of the stock of durables. We are assuming a linear depreciation path of 12,5 %, that means that durables purchased in one year is giving us utility for another 8 years. In other words in 2001 we are enjoying services of durables, which we purchased in 1994.

Durable good is defined as a good, which can be consumed over a longer period of time, typically at least 3 years, rather than being consumed very quickly. Typical goods, that are included in this item in other GPI or ISEW studies, are especially, big or small appliances such as refrigerators or phones, furniture, vehicles and durable recreational goods. Since there are very detailed data available from Czech statistical office and Eurostat I have also include some less typical items, for example carpets, garden tools, or equipment for media storage (flash drives). Unfortunately these detailed data were available only for years 2001 onwards. And since for computation of services for year 2001 we need data from 1994, a linear regression was used.

Column I - Services of Highways and streets

The GPI does not include most government expenditures, since they are largely defensive from nature. (Talberth et al, 2007) But not all government expenditures are defensive and some of them are beneficial to public needs. In GPI these expenditures are represented by services of highways and streets. The methodological idea is that 7,5% of public expenditure for roads, streets etc. is

considered as social benefit. This is based on logic that around 10% of this government expenditure is estimated value of services from roads, streets etc. 10% because 2,5% is assumed depreciation and 7,5 average interest rate. However it is also assumed, that 25% of all vehicle miles are for commuting, which is defensive expenditure. This leaves 75% as net benefit. Thus GPI assumes 7,5% (or 75% out of 10%) as beneficial services. (Anielski, 1999)

The data used are from the Czech statistical office and Eurostat and it is public expenditures solely for purposes of transport and street lighting. Transport does not include only highways, but also roads of 1st. 2nd and 3rd degree, streets, water and rail transport, and other transport such as cables, pipes, cableway etc. Data for street lighting is from the same source and it needs no further explanation.

There has been a discussion, whether to include this item at all, because it can be argued, that all these expenditures are (or should be) covered from taxes, fees for highway stamps, that personal railway transport is paid by customers and so on. Yet it would not be correct to assume that it is enough. Even if we admit that most of expenditures for highways are covered from highway stamps (discussion if it is true is beyond the scope of this study), highways count for less than 2% of overall road infrastructure. Other roads are not directly charged and maintenance cannot be covered from taxes alone. Also railways are not self-sufficiently financed and need more money from public funds. Because taxes and other fees are already included in private consumption expenditure, this item takes only 7,5% of these special public expenditures. Despite critique and discussions, this item was included in all but one GPI/ISEW study. The author of this study agrees that this item should indeed be included.

Column J - Cost of crime

Crime is a big problem of modern society, yet in regular system of national accounts the consequences of crime such as lost or damaged property and its replenishing or repairing, medical bills are treated as a positive attribute. GPI tries to account for this by treating cost of crime as a negative item.

I have used data from Eurostat and from the police of the Czech Republic to find out how many crimes were committed in examined years. I have taken 5 major groups of crimes: Homicide, violent crime, robbery, domestic burglary, motor vehicle theft[2]. In 2000, there was a very detailed study about cost estimates of crimes. (Brand, 2000) There was a detailed examination of average cost for each type of crimes mentioned above (and more). The examination included stolen and damaged property, emotional and psychological impacts, loss of output etc. The only thing excluded from these costs was criminal justice system, since it is public defence expenditure. This study was created for Great Britain in 2000, but after corrections for exchange rate and inflation, it could be used to create a time series for the Czech Republic.

There are of course many types of crimes beyond those accounted for. Such as moral crimes (sex offenders etc.), economical crimes (corruption, fraud etc.), more property crimes (disorderly conduct, criminal damage etc.) and other miscellaneous crime, yet it is impossible to account for every type of crime, so resulting value of this item might be underestimation.

Column K - Loss of leisure time

The idea behind this is that the rise of GDP in last 20 years or so suggests that people are getting richer, when in fact they are working more to achieve this. They took the year with highest leisure time (for USA it was 1969) and created loss of leisure time against this year) The original USA GPI study uses a paper about working hours and leisure time to create a time series for leisure time of labour force participants. Since no similarly useful long term study of leisure time is available for the Czech Republic[3], I have decided to use different approach.

[2] Author realises, that homicide is a violent crime, yet in all statistics these are reported as separate category.

[3] There are many sociological works studying spending free time in CR, yet none of them were particularly useful. First of all majority of them concerns about WHAT we do with our free time other than how long do we have for it, second of all none of them were working just with labour force participants, but with the whole population, which includes children, students retirees etc. using for example just percentage of population which is in active labour force would render the whole study useless, since people outside labour force tends to have naturally more free time. After this consideration alternative approach seems like a better solution

This different solution was used by creators of GPI for state Utah. (Berrick, Gaddis, 2011) They did not build their estimates around aforementioned USA study, but around how much have hours worked by full-employed people changed. Assuming, that people have 15 hours per day as discretionary time (9 hours of sleep), after deducting hours worked either at home or at work, the rest is considered as leisure time.

After exploring data for hours worked per week from Department of labour and social affairs and the Czech statistical office, I discovered that people in the Czech Republic are in fact working fewer hours both at work and at home (column E household work). That would mean, that there are two choices, value a loss of leisure time, using the last year as a base year and create loss retrospectively or value increase of leisure time, using the year, where there were hours worked in its highest (year 2000) and continue from there as in Utah GPI methodology. But both choices seemed unacceptable. If I were to use the first one, if a current trend would continue, and next year there were fewer hours, this whole column would be useless, because the base year would be wrong. As for the second one, I think that would go against the methodology of GPI. After this discussion, I have decided to omit this item, not because of lack of data or impossibility of creation, but because of its insignificance for the Czech Republic.

Column L - Cost of unemployment

The original methodology uses cost of underemployment, which include also people who are working less, than they would like to. But not enough detailed data for underemployment were available, so we will have to settle for unemployment. Costs of unemployment bear not only individuals and their families, but also community in form of higher crime rate, suicides, drug abuse etc.

The cost of unemployment was calculated by multiplication of number of unemployed and average annual wage. Data for both wages and unemployment were taken from the Czech statistical office. Since unemployment used here contains only people, who in monitored period were actively looking for work and were able to

start immediately or at least in 14 days, we do not have to worry about those voluntarily unemployed.

Column M - Cost of consumer durables

This item is included to avoid double counting from services of consumer durables (column H). We subtract this to focus only on services they provide to owner. In order to do that, we must deduct their original cost for which they were purchased

Column N - Cost of commuting

Commuting to and from work is a necessity, with which a majority of the population has to deal with. But time and means spend on it can hardly be taken as a positive thing. Thus GPI counts commuting as a negative item. This column accounts for costs linked with operating personal vehicle (mostly cars) and costs for public transportation. The costs for purchasing the vehicle were already counted in column H (services of consumer durables). The calculation is:

Cost = 0, 25 * (A - 0, 125A) + 0, 25*B where:

0, 25 is estimated number of miles used for commuting

0,125A is estimated cost of depreciation of vehicle (excluded to avoid double counting since it is already included in column H services of consumer durables)

A is cost linked with operating personal vehicle

B is cost for public transportation

There is also an indirect cost, the time that person spent by commuting. But there are no data available for the Czech Republic on how much time people spend on commuting. Because of that the indirect costs are omitted and the figure might be underestimated.

Column O - Private investment to environment

This item represents a Cost of household pollution abatement from the original methodology. This column stands for costs imposed on households caused by environmental damage. These are defensive expenditures that does not increase welfare, thus they should be deducted.

Unfortunately no exact data for household pollution abatement were available for the Czech Republic, thus I decided to replace them with private investment to environment. Detailed data for investment to environment were available only for 2005-2011. The rest of time series were extrapolated. From available years I found out, that private investment made about 9,5% of all investment to environment and with this fact I created the rest of time series based on data of all investment to environment. Data were taken from the Czech statistical office and Ministry of environment of the Czech Republic.

Column P - Cost of car accidents

Cost of car accidents are caused by increasing industrialization, higher traffic density and abuse of harmful substances. GPI deducts cost of car accidents as certainly item, which is harmful to welfare.

For valuing cost of accidents I used a study for years 2000-2006, which estimates a value of car accidents according to outcome of an accident (Daňková, 2006); to be more accurate whether the accident had fatal consequences, serious or light injury or “just” material damage. These estimates were available for years 2000-2006, the rest of time series were extrapolated using simple regression. Data for car accidents were taken from the Czech statistical office. These data were very detailed about how much accidents were fatal, with light or serious injury and how much in total were costs of material damage. The number of accidents were multiplied with appropriate cost and then added up with each other and with material damage to get resulting costs of car accidents.

We do not have stop with car accidents. We could also include aeroplane accidents, train accidents and accidents in water traffic. When included this item

would certainly be more coherent, but practical impact would be minimal since the number of car accidents is incomparably higher than number of other accidents.

Column Q - Cost of water pollution

Cost of water pollution is the first item, which deals directly with damage caused to environment. The GPI framework tries to avoid public expenditure (with exception of column I), which would be the easiest way. As a replacement I used the method originally used in the Italian version of ISEW, with base in the original USA methodology.

The Italians used so called Restoration cost approach. They used international measure of water quality BOD_5; Where BOD stands for Biological Oxygen Demand. The BOD indicates how much oxygen is needed to eliminate organic and inorganic substances in water. In other words it says how much oxygen is needed to make the water clean again. The number 5 refers to oxygen consumption in 5 days. There are data published by the Czech statistical office on pollution of watercourses expressed in tones of BOD_5 for years 2003 – 2011. The rest of data was calculated using data from Czech Hydro-meteorological Institute, which publishes water pollution in BOD_5 as a percentage with respect to year 1993 (1993 = 100%). With this time series and the value of BOD_5 in tones for few years I was able to complete the time series.

Now the only aspect missing is a unit value of tone of BOD_5 discharged to water. Unfortunately there are no useful studies for this particular topic, so different approach was in order. With cost of water pollution for USA from the original paper and the BOD_5 data in tones for USA from World Bank I calculated the value of a tone of BOD_5 discharged to water. I adjusted this number for exchange rate and inflation and crated a time series of value for water pollution. After that I only multiplied pollution expressed as tones of BOD_5 and multiplied it by unit cost. There is no reason for expecting that a unit of water pollution should be more expensive or cheap than in Czech Republic. The BOD_5 indicator does not count with underground water, just with surface water, so eventual figure might be underestimated.

Column R - Cost of air pollution

Air pollution is, especially in Czech Republic, a very serious problem and its expected cost is very high. For evaluating this item I used very detailed study by European Environmental Agency about air pollution in Europe. (EEA, 2011) This study used Impact pathway approach to evaluate costs arising from air pollution. More specifically this study evaluates cost from releasing the main air pollutants; these are: particulate matter (PM),NH_3, oxides of nitrogen (NO_x), carbon dioxide (SO_2) and volatile organic compound (VOC). The value of every pollutant is evaluated according to VOLY (value of a life year) methodology and is based on the loss of life expectancy caused by air pollution. A monetary estimate is calculated for every pollutant mentioned above for many European countries including the Czech Republic.

Detailed data for released air pollutants are available from Czech Hydro-meteorological Institute. After obtaining this data I multiplied tones of every pollutant released to environment with estimated cost of tone and added up. There are of course more pollutants, but ozone pollutants will be accounted for later and other pollutants for example heavy metals are neglected, because in comparison with the main pollutants it is a minor figure.

Column S – Cost of noise pollution

Assessing cost of noise pollution is very difficult. Though there are very detailed current data, any kind of historical data of noise pollution are not available. There are also many studies examining noise pollution and its impact on population, but those too are mostly rather new (most of them 06 and newer).

I started with a British study for valuation of noise pollution. (DEFRA, 2008) This study is evaluating costs of noise pollution in United Kingdom based on study of World health organization, which evaluates health costs of noise pollution in EU. These health costs include annoyance; sleep deprivation, increased change of heart disease etc. Because the UK study just scales down costs of noise pollution based on UK/EU population ratio, it was easy to calculate these costs for the Czech Republic and adjust them for exchange rate. This way I was able to calculate costs of noise

pollution in 2008. Because of lack of data I assumed according to original methodology, that the situation of noise pollution, hence also the cost, was steadily deteriorating by 1% per year. Although challenged by critics as an arbitrary figure, when facing lack of data, it is a reasonable assumption. On one hand there I a growing number of noise restriction, on the other hand there is an increasing number of traffic and industry.

Column T – Loss of Wetlands

Wetlands are one of the most important and productive biomes, yet in the Czech Republic their area is not as important as for example in Scandinavia or USA (thanks to Alaska). Also because the Czech Republic signed Ramsar convention, which protects wetlands their loss has been significantly decreased. Also not enough historical data are available for the Czech Republic. Because of their low importance, in compare with other items, I have decided to omit this item.

Column U – Loss of farmlands

Loss of farmland is contained in GPI, because its decline is destroying sustainable food supply. Because of that, farming is more extensive on the rest of the land, which is damaging its quality. Time series of hectares of farmland were taken from statistical yearbook of soil fond published each year by Czech statistical office. According to the original methodology I took a year with the biggest volume of farmland as a base year and the loss derived from this year. I valuted every hectare of farmland by current price of farmland in that year. The data for farmland prices were taken again from the Czech statistical office. To get a cost I multiplied hectares lost by its price each year.

Column V – Loss of forests

This is one of the items, where different area, landscape and geographical conditions play a major role. If we look at the data about forests, we will see, that the area of forests is increasing since 1993 and even if we compare forest area in years 1980 and 1993, we can see that in 1993 the value of forest area was higher than in 1980. So in this account there is no loss. Yet in the original methodology the authors are more focusing on loss of primary forests and native forests.

There are no actual data for native forests in the Czech Republic, but there are data about age growth structure of forests. In the Czech Republic in 1960 only 3% of forest land was older than 121 years. In 1990 it was already 4,4% and in 2010 it was 7,1%. In 1960 there was 6% of forest land in range between 101 and 121 years. In 1990 it was 8,2% and in 2010 even 12%. Now there are also bigger forests than in 1960, so the difference is even bigger than the percentages suggest. All data were taken from Statistical environmental yearbook of the Czech Republic from 2011 published by Czech statistical office.

As well as in Column K (loss of leisure time) I did not want to change originally negative item to positive and evaluating loss retrospectively with base in the latest year is also inappropriate, because in next year if values will be higher whole time series of cost will become useless. Because of that, I decided to omit this item.

Column W - Depletion of non-renewable resources

The item depletion of non-renewable resources represents sustainability and creating cost for the future generations by depleting finite resources. There has been a lot of argument about even including this item and if so in what form. There are many opinions on that matter and all of them are somewhere in between of two extremes. The first one is that with approaching scarcity of non-renewable resources competitive markets will drive technological progress onward and replace these resources. In the end the next generation will bear no cost for depleting resources, which is no longer needed. By assuming this the cost of depletion of non-renewable resources should be zero. While certainly a possibility no creator of GPI or ISEW has actually used this approach, because this item is in all studies one of the biggest, if not the biggest negative item, the study which would use this would no longer be consistent with the rest.

The second one is the one that lot of GPI/ISEW studies actually used. It is based on assumption that the cost of depletion should be expressed as an expenditure which would be needed to replace all energy created from non-renewable resources by renewable resources. It has been calculated, that the cost of replacing barrel of oil

equivalent from non-renewable by renewable resources would cost 75$ in 1988 prices. And that adjusting this figure for inflation is not enough, that it should be also increased by 3% per year as the depletion will continue.

Even if the second way is the most used one, I think it is too extreme. Firstly, mentioned by many critics, there is no reason to immediately replace all finite resources by renewable ones. It is unreasonable to do that. Of course the share of renewable sources should be higher, but to cut off all finite sources right now is too much, especially if we are not sure if all deposits have been found. Also the 3% increase per year is very questionable, since the price is often depending on political situation.

After this discussion I decided to use the "middle ground" used in Australian GPI. (Hamilton, 1997) He adopted the 75$ in 1988 prices but without 3% deterioration. Also he suggested as the cost of depletion just replacement of energy from natural gas and oil products since they are most unique and no true replacement is available. Also with this pace of depleting these two resources will run out by far the quickest.

The data for final energy consumption from natural gas and oil products are from Eurostat. Since data for Europe are in tonnes of oil equivalent (TOE) and initial price estimate in barrels of oil equivalent BOE I had to convert it.[4] Then I adjusted the initial price figure for exchange rate and inflation. Then I multiplied BOE needed to replace oil products and gas by adjusted price and summed up. Even with little "softer" approach this item still is the highest negative item in GPI.

Column X - Damage from Greenhouse gas emission

Global warming is a serious environmental issue, which is nowadays discussed all over the world. In the original methodology there is only carbon dioxide emission damage, but carbon dioxide is not the only gas, which causes greenhouse effect, so I included all the greenhouse gases (GHG). Data for GHG emission were obtained from Eurostat.

[4] Tonne of oil equivalent = 7,142858 barrel of oil equivalent

In 2005 a meta-analysis of 103 different studies evaluated, that a value of tonne of carbon emitted in atmosphere is 87, 57$ in 2000 prices. (Talberth, 2007) Because data in Eurostat were in tonnes of CO_2 equivalents, first conversion had to be made. Then I adjusted this figure for exchange rate and for inflation to create a time series. After that I just multiplied a value of tonne of CO_2 equivalent to get to final cost of damage.

Of course, there is again an open discussion about matter of cumulativeness. Cumulative approach to damage was very strongly criticised. Because up to this point, I agreed with critics of cumulative approach, that this method creates multiple counting and that until the pollution is ended and resulting damage is assessed we should include "just" annual contribution to the problem, I did not account this damage cumulatively. Yet in this particular case it is really worth discussion. There was another reason not to include the cumulative method. Everyone, who uses cumulative approach, start from some point, where these costs were on 0 or very near and then cumulate costs. Because detailed historical data from Czechoslovakia are not available, starting the cumulate costs from 1993 would be arbitrarily starting from the middle.

Column Y – Cost of ozone depletion

Cost of ozone depletion is another item, which evaluates a damage done in past, which will have impact of future generation. Yet its inclusion in Czech GPI is probably not important for several reasons:

Of course, that in past there has been a serious damage caused to ozone layer, yet ozone holes are mostly on poles and effect on the Czech Republic is seasonal and even in those seasons minimal. Also the Czech Republic is a part of Montreal protocol. Goal of this treaty is to decrease and in the end halt use of substances, which are damaging ozone layer. This protocol was sign in 1987 and since 1995 the amount released in the air is economically speaking compared to other items negligible, we could even say practically zero. The last reason is methodological issue. This item was omitted in many ISEW/GPI studies, but if it is valued, it is valued cumulatively with respect to halogenated substances emitted into the

atmosphere especially chlorofluorocarbons. There are not data detailed enough from 60's and 70's to properly evaluate cumulative damage, which has been caused up to 1995, to carry out this damage into later years.

Column Z – Net capital investment

Net capital investment represents a sustainability of economy. In order for economy to prosper over time, the supply of capital must be maintained and increased to meet the demands of growing population. (Talberth, 2007) This column is especially targeted at demand of labour force to maintain productivity. Net capital investment is calculated as a difference between net capital growth (only private capital) and capital requirement, which is capital needed to keep the same level of capital per worker. Capital requirement is calculated as a percentage change in labour force multiplied by capital from previous year. The value of this column can be positive or negative. Data for this column were taken from Czech statistical office.

Column AA – Net foreign borrowing

As the name of this column suggests, net foreign borrowing reflects the fact if the country is self-sufficient or if it is borrowing money from abroad. This fact affects next generations, because they will have to deal with debt and its consequences. It also deals with sustainability, because no economy can live in long term only from borrowed means. This column can be either positive, if the country is net lender or negative otherwise. For the Czech Republic, I mentioned only borrowing, since for the whole time of its existence the Czech Republic is net foreign borrower. This means that this column is also negative for CR. Data were taken from Eurostat. For smoothing big spikes a rolling average of 5 years was used

Column AB – Genuine progress indicator

Genuine progress indicator as the final result is calculated starting with weighted personal consumption, adding the positive items (column E to I), subtracting negative items (J to Y) and then adding two items, which can be ether positive or negative (Z and AA).

Column AC – GDP

GDP as a today's main economic indicator is mentioned only as a clear comparison with GPI.

Column AD – Genuine progress indicator per capita

Per capita GPI is computed dividing the value of GPI by number of inhabitants in Czech Republic. The data for the Czech Republic were taken from CZSO.

Column AE – GDP per capita

GDP in per capita basis numbers serves again only for purposes of clear comparison.

Column AF – Genuine progress indicator (PPP)

Genuine progress indicator (PPP) has the same methodological procedure for computation. But there is a big difference in evaluating few of them. For every item that has been evaluated by estimate for foreign country and is expressed in foreign currency instead of exchange rate purchasing power parity is used. I actually used three currencies; American dollar, British pound and Euro. PPP for private consumption was applied. The data were taken from OECD. To be concrete items affected are: Value of higher education, cost of crime, cost of noise, air, water pollution, depletion of non-renewable resources, and damage from greenhouse gas emission.

Column AG – Genuine progress indicator (PPP) per capita

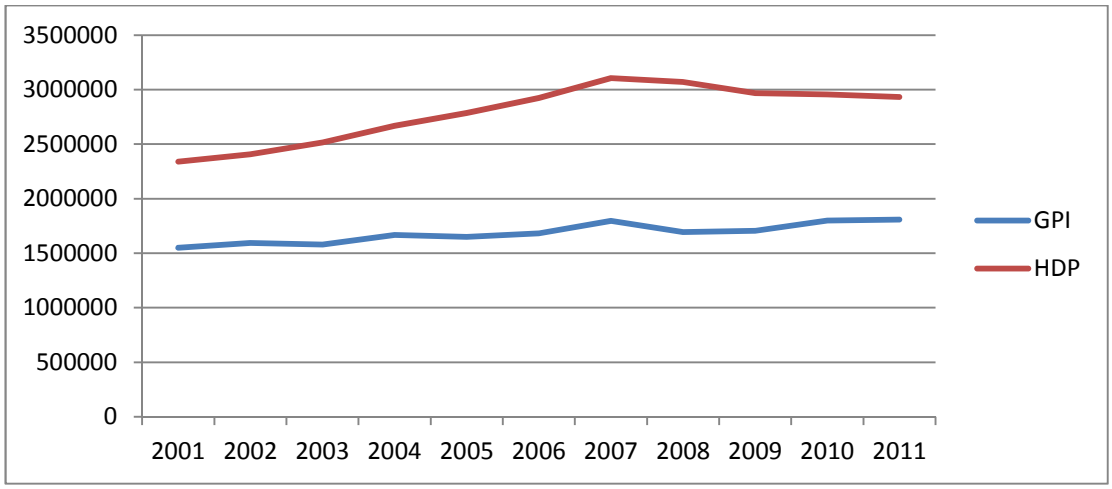
The same procedure as for column AD. The value of GPI (PPP), Column AF, divided by population of Czech Republic.

6 Results and limitations

6.1 Results

After finishing all calculations we can now report results. The full results column by column can be found in appendix A. The GPI and GDP together can be seen in figure 1. All figures are in Czech Crowns (CZK) in real terms of 2000 price level. The absolute level of GPI has risen from 1,52 trillion in 2001 to 1,82 trillion in 2011, with annual average growth rate of 1,99%, while GDP has increased from 2,34 trillion in 2001 to 2,93 trillion in 2011 and its average annual growth was 2,54%.

Figure 1: GPI vs. GDP comparison



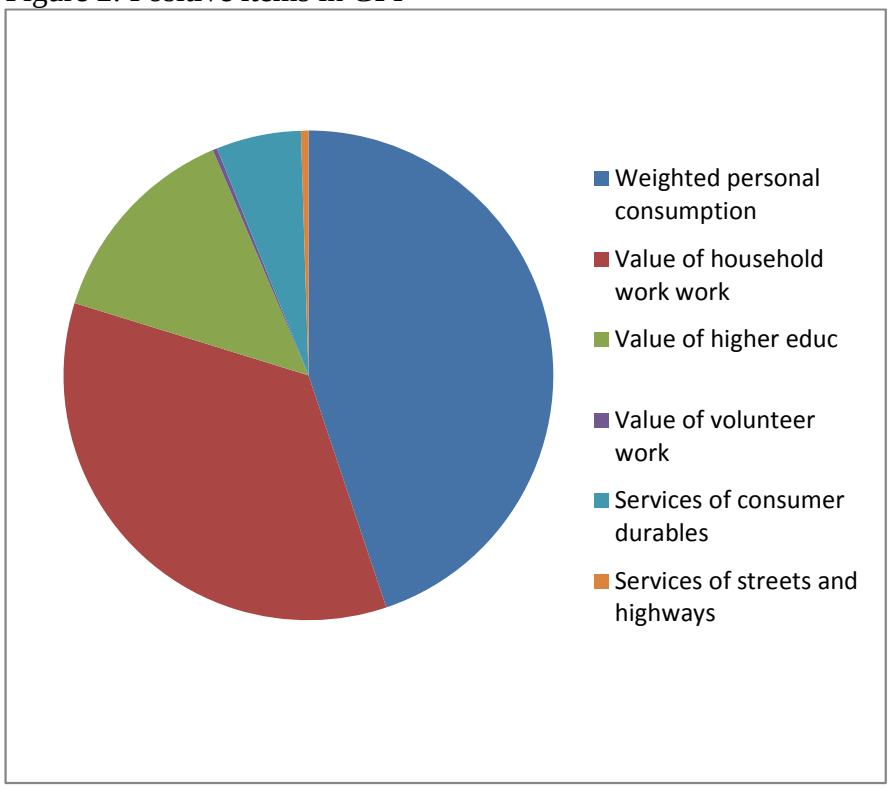
Source: CZSO and own computations

As we can see GDP rose 1,5 times faster than GPI. It is also important to report GPI and GDP in per capita terms to account for change in population. GPI per capita has changed from 148984 in 2001 to 173592 in 2011. The average growth was only 1,65% per annum, whereas GDP per capita in the same time period has grown from 229148 to 279171 with annual growth of 2,19%. It is very interesting to notice that we can see a drop in both GDP and GPI between 2007 and 2008, which can be explained by the financial crisis, but while GDP is still dropping in 2011, GPI was already in 2010 on its pre-crisis level. This illustrates that economic well-being does

not depend only on economic output and that social and environmental benefits can overcome decrease in economic activity.

Now let us take a closer look on positive and negative items and their role in overall GPI composition. In figure 2 and 3 we can see an average impact of both positive and negative items on GPI. If we focus on positive items we can see that weighted personal consumption is, as expected, the biggest contribution of GPI and it makes on average 45% of all contributors. It is also very interesting to compare personal consumption as it enters to GPI (weighted) and GDP (unweighted). The detailed figure can be seen in appendix B figure 5, but on average personal consumption loses more than 14% of its value by accounting for income distribution. It is also important to notice that value of household work makes 35% of GPI and it is completely ignored by GDP. In my opinion this is very large number to be ignored. Though volunteer work is ignored in GDP too, its contribution is almost negligible. But this is expected, since volunteer work does not have such a high tradition in the Czech Republic compare to for example USA.

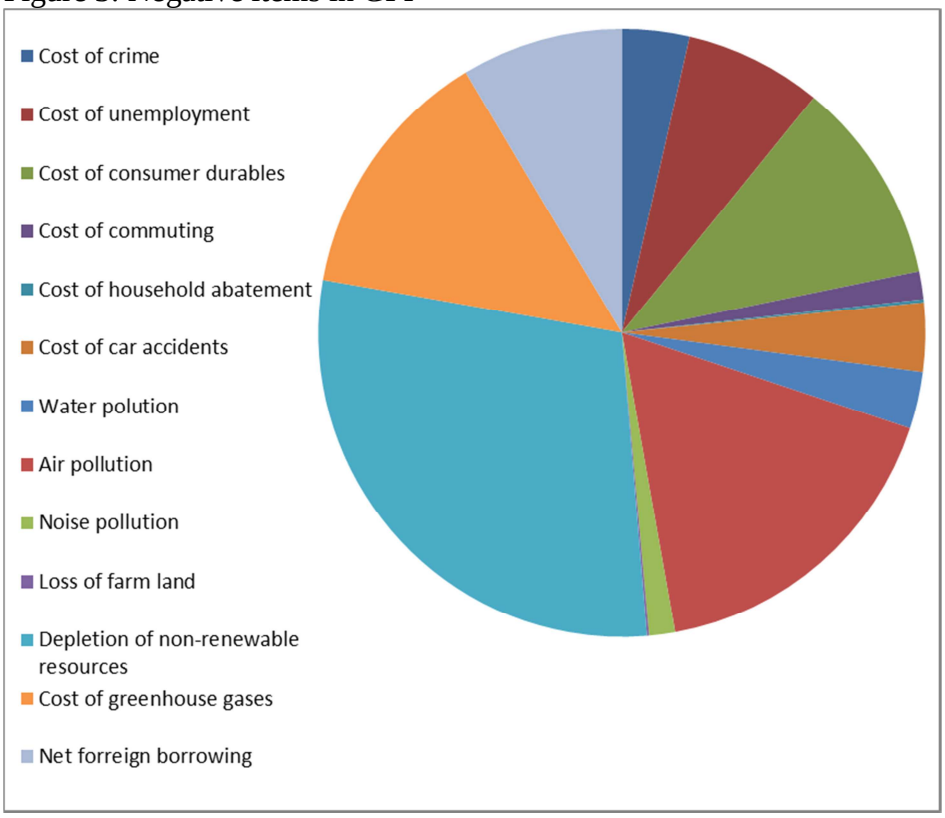
Figure 2: Positive items in GPI



Source: Own computations

The biggest negative item as expected is the cost of depletion of non-renewable resources, which on average makes 29% of negative GPI items. But the most interesting fact and most alarming problem is air pollution; on its own, it makes "only" 17% of negative GPI, but if we include in it damage from greenhouse gases, which makes 14% of all negative items and it can be considered as air pollution. Together they exceed even cost of depletion of non-renewable resources. From socio-economic negative items the biggest value is cost of unemployment with an average of 7% of negative items.

Figure 3: Negative items in GPI



Source: Own computations

If we take a look at all aggregated environmental items, we will see that from 2003 with the exception of the year 2010, it has been steadily dropping. Between these years a cost of environmental damage has decreased by almost 10%, which is undoubtedly a positive sign in GPI development. In GPI all environmental items are negative, thus the aggregate of environmental items has to be negative too. But that is not so for socio-economic and capital adjustment items (clear division is in table 1). The socio-economic is still positive, but it has been dropping with the exception of

2007 since 2002 to 2010. In this period the social side of GPI has decreased by 8,5%. In 2011 we can see a small increase; about one percentage point compared to 2010. It is very diffilcunt to assess capital adjustment especially because of net foreign lending and net capital investment, which are by far the most volatile items of all in GPI. The good thing is that it was negative only in year 2003 and in other years it remained in positive value.

Now let us take a closer look at development of single items. Graphical representation can be found in appendix B figures 5-11. I already mentioned personal consumption and impact of income distribution. Personal consumption expenditure and its weighted counterpart follow more or less the same trend and by weighting it loses about a sixth of its value. It is also very interesting to notice that value of household work was in 2001 and in 2002 the largest positive item, but it has been dropping rather quickly. It is not unexpected, due to the changes of lifestyle of population. People nowadays work more in their employment than at home. On the contrary value of higher education has been increasing, no doubt due to the raising number of people with higher education. If both these variables keep their decreasing and increasing trend respectively, by the year 2017 the value of higher education will be actually higher. As for the items in figure 6: Loss of farmlands, household pollution abatement, services of highway and streets and value of volunteer work, there is not much point in detailed discussion since in compare with other items their value is really small. Worth noticing can be the, rather quick, increase in loss of farmland, but as I said the impact on GPI is minimal.

For someone it may be surprising that there is expanding gap between expenditures and services of consumer durables, but since 8 year depreciation period is applied and this drop begun quite recently, in 2009, this will most likely appear later. The Czech policy makers would be certainly happy about quite big drop in both cost of crime and cost of car accidents; the decreased number of crimes and car accidents is certainly good for the Czech Republic. Drops in costs of air and especially water pollution are also quite satisfactory. The challenges into the future pose costs of greenhouse gases and depletion non-renewable resources, which did not decrease during the monitored time period. In particular for non-renewable resources

depletion it is bad news, since it has been the single largest cost in GPI variables. At 2011 Czech Republic only about 10% of energy was from renewable resources, which is far behind EU 27 average, which is about 20%. Due to their year to year nature net capital investment and net foreign borrowing are very volatile and no clear trends can be traced, but the fact that the Czech Republic was net foreign borrower from its foundation is not flattering.

6.2 International comparison and GPI (PPP)

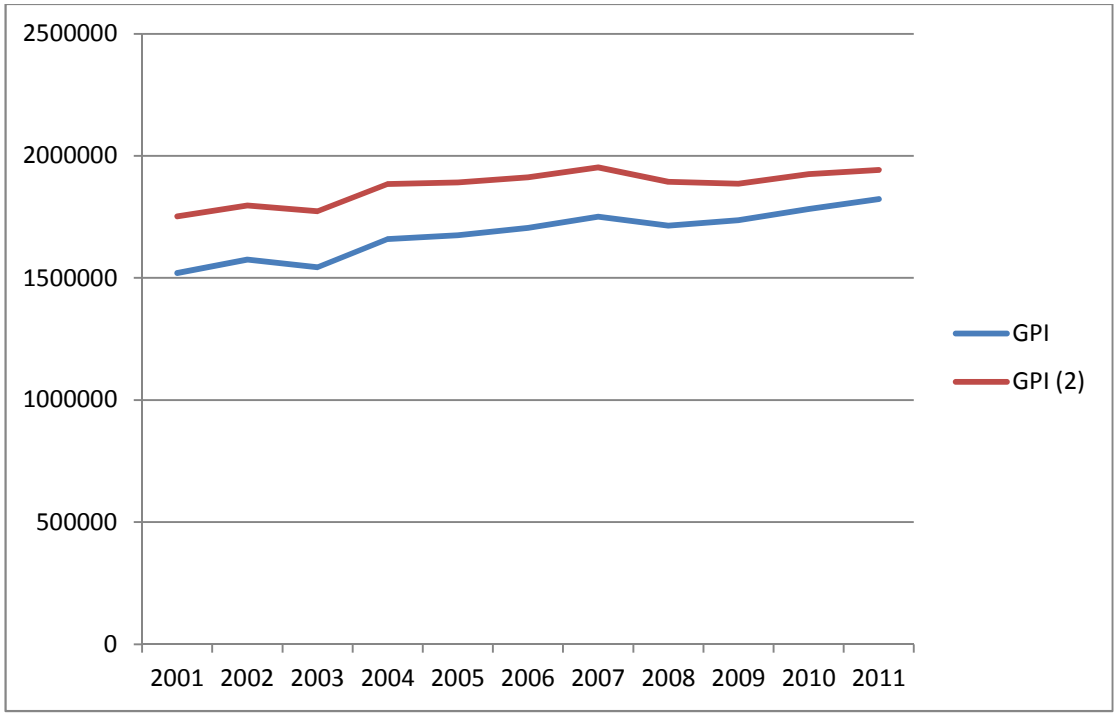
The international comparison is more difficult than initially expected. GPI, or at least ISEW, was computed for a great number of countries, but most of these time series usually ends, before mine begins. Most ISEW's for other countries were created after the original publishing of ISEW for USA, thus ends usually somewhere between 1990 and 2000. GPI is the same case. The first creation of GPI was in 1995, so other GPI studies do not usually go deep inside 21st century. But that does not mean there is nothing for international comparison, nor does it mean that GPI is obsolete and without international recognition. There are several groups that are currently working on updates and usage of GPI such as *redefining progress or GPI Atlantic*. In last several years there has been an increase of GPI to help with decisions of policy makers on regional level, for example in New Zealand, Finland and in several states of USA such as Maryland, Ohio or Vermont. GPI is also part one of the indicators used in *Beyond GDP*, which is initiative of EU for new measurement of economic progress.

Let us now compare the results of Czech GPI with those with adequate data. The latest USA GPI is for 1950-2004, we will however include only figures comparable with the Czech Republic. In period between 2001 and 2004 on per capita basis GDP has risen by 5,57% while GPI only by 4,29%. In the same period Czech GDP increased by almost 14% while GPI only less than 9%. Australian GDP rose in 2001-2006 by 10,77% while GPI only by 2,54%. In CR between 2001 and 2006 GDP rose by more than 24% while GPI only by 11%. Very interesting is GDP and GPI relation in Finland. While GDP grew very well, more than 21% between 2001 and 2008, GPI has actually been decreasing and in this period dropped almost by 7%. In

CR GDP rose almost by 28% while GPI only by 10%. I will also mention one ISEW study concretely for Belgium. It is not GPI, but it is very similar and the results are shocking. While Belgian GDP rose between 2001 and 2006 by 7,03%, its GDP dropped extremely by 29,4% in this short time. We already discussed GDP/GPI calm growth in CR. It is also interesting to mention that in 2004 Czech GPI per capita was about 38% of USA value while in per capita GDP it was only 25%.

Another interesting comparison is with GPI of Maryland. Maryland is a state on the eastern cost of USA with roughly half of population of the Czech Republic and about 45% of its size. Maryland's statistical office is creating GPI annually, so a good comparison of the last years and especially financial crisis can be made. As mentioned earlier GPI is increasing until 2008, then drops, but makes recovery and in 2010 it is already on 2007 value while GDP continues decreasing. Maryland has very similar development, but only with year delay, it rise until 2008, then drops and in 2011 it is already on its 2008 level.

Figure 4: GPI and GPI (PPP)



Source: Own computations

In the figure 4, we can see a difference between GPI and GPI (PPP). As already explained GPI is calculated using exchange rate for converting values in different currency, for GPI (PPP) purchasing power parity was applied. Different conversion method in general decreased value of items for which it was used, thus value of higher education, cost of crime, cost of noise, air, water pollution, depletion of non-renewable resources, and damage from greenhouse gas emission has lower value when using PPP then when using exchange rate. The graphs of differences of each item with different valuation can be found in appendix B as well as per capita GPIs in figures 12-15. As we can see different valuation impacts only one positive and 6 negative items; unsurprisingly this increases absolute values of GPI since the drop in negative outweighs the positive items. The GPI (PPP) is on average 11,5 % higher than GPI. The main impact of PPP evaluating method is that it augments the sluggishness of GPI growth. While GPI growths in monitored period of time by average of 1,99%, for GPI (PPP) it is only 1,08%. The difference between per capita GPIs is even higher. GPI per capita grew on average by 1,65% per annum, while GPI (PPP) per capita only by 0,8%. Because foreign studies use exclusively only exchange rate GPI has been chosen as the "main" result to stay consistent with all GPI studies, but PPP approach should be seriously considered for common use.

6.3 Limitations

We have already discussed at length all general criticism to GPI. Here I would like to address flaws in computation. First of all the methodology itself is neither perfect nor unified. Not every GPI study include all items for whatever reason, some even retake some from ISEW, because they believe they should be included. Though the most parts of methodology are the same, differences cause minor inconsistencies and make international comparison difficult and reduce GPI's use, making it without GDP comparison almost useless.[5] The lack of appropriate data usually accompanies calculation of GPI in every country. There is no study that has complete time series for every single item. This is especial true for social items of GPI. Economic items

[5] This is also one of the reasons for comparing GPI with Finland, USA and Australia. In these papers as well as in mine there was maximum effort to abide 2004 updated methodology.

are usually complete and now thanks to new emerging green side of national accounts also availability of data for environmental items is increasing, but data for items outside of SNA is still very hard to obtain. This all naturally applies to Czech Republic calculation as well.

Evaluating of certain items is also worth discussing. For several items of GPI values from foreign studies or values from the updated original methodology were used. There is a problem whether to use exchange rate or PPP. In order to be consistent I followed lead of other GPI studies and used exchange rate. But because PPP might be more suitable it was taken in consideration as well and GPI (PPP) was created. Although both possible methods of conversion were made, studies evaluating these items explicitly for the Czech Republic would be ideal. But since they are not available, this approach will have to do. The author also regrets that he was unable to create longer time series into the past. But for multiple items data detailed enough were impossible to obtain and for example extrapolation to 1993 with latest data from 2001 would be too unreliable.

7 Conclusion

It has been clearly recognized from its very creation what GDP is and what it is not, how it should be used and how not. Yet broad public, policy makers and sometimes even economists have misused and misinterpreted this indicator as something more than just assessment of economic output. In last 25 years there have been various discussions about new ways how to better measure economic progress and well-being of population and there was many suggestions on the subject. In my study I explored many shortcomings of GDP and addressed many of alternative indicators suggested to replace GDP as better measure of progress.

In my thesis a have been addressing one such indicator in particular; a genuine progress indicator. In 2005 Joseph Stiglitz said: “No one would look at just a firm’s revenue to assess how well it was doing. Far more relevant is the balance sheet, which shows assets and liability. That is also true for a country.” This statement shows exactly the biggest strength of GPI. GPI includes both costs and benefits from not only economic sphere, but also environmental and social to create a better measurement of progress and well-being of nation. It is far from perfect, but as Keynes said: “It is better to be roughly right than exactly wrong” and if we would to measure economic well-being with GDP we would be wildly wrong.

The main goal of this study was to construct a GPI for the Czech Republic. The results showed some interesting facts. GPI in the Czech Republic has been growing, but certainly not as fast as GDP. The environmental costs have been declining, but on the other hand so have the social benefits. There are undoubtedly shortcomings in some valuation methods, which are the result of the lack of certain data, but since the need for new indicator was officially recognized in EU quite recently, this wasn’t unexpected. Further methodological development is needed to create more credible and more reliable indicator of economic progress as well as more, especially historical, data to create longer time series, at least for the whole time the Czech Republic existed as a single country. Due to its faults GPI should not

replace GDP as the single most watched economic statistics, but for the time being, until all weaknesses are fixed, it should at least serve as a different perspective in measuring economic growth and progress.

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Appendix A: GPI for the Czech Republic

Table 3: Complete computational results of GPI (in millions of CZK 2000 prices)

Column A Year	Column B Personal Consumption	Column C Income Distribution Index	Column D Weighted Personal Consumption	Column E Value of Household Work	Column F Value of Higher Education	Column G Value of Volunteer Work	Column H Services of Consumer Durables	Column I Services of Highways and streets
2001	1204420	120,4545	999895,5	1082350	279031,8	6548,32	132369,3	9687,459
2002	1234086	119,0909	1036256	1066310	304726,7	6736,94	135524,1	8886,561
2003	1294852	116,8182	1108433	1048474	311450,3	7045,937	141901,7	18177,29
2004	1348109	112,7273	1195903	1004576	323116,8	7474,315	144688,4	11633,82
2005	1374604	115,9091	1185933	971448,3	339810,6	7800,111	148267,5	12187,54
2006	1420945	117,2727	1211659	934502,9	357593,4	8187,537	151067,8	12895,84
2007	1482415	119,0909	1244776	952207	365057	8698,437	154456,2	13268,94
2008	1501894	120	1251579	838154	393010,5	8593,526	153631,1	14687,86
2009	1500545	114,0909	1315218	817224,7	429113,1	8304,922	159117,3	15098,42
2010	1498865	113,1818	1324298	791009,9	462832,8	8277,655	163004	13619,18
2011	1488870	114,5455	1299807	759411	500484,3	8211,543	163791,9	11760,78

Table 3 cont.: Complete computational results of GPI (in millions of CZK 2000 prices)

Column A Year	Column J Cost of Crime	Column K Loss of Leisure Time	Column L Cost of Unemployment	Column M Cost of Consumer Durables	Column N Cost of Commuting	Column O Private Investemnt to env.	Column P Cost of Car Accidents	Column Q Cost of Water Pollution
2001	38654,35	-	68927,68	98576,38	13178,08	1807,741	39151,06	35161,29
2002	40927,66	-	65315,95	93884,9	12620,65	1330,225	41772,8	34811,56
2003	39656,7	-	73669,2	102589,4	13470,41	1726,439	44537,72	39502,76
2004	40555,43	-	81344,44	105194,2	13605,96	1752,218	43682,83	34174,48
2005	35825,38	-	80716	106958,5	14466,68	1931,998	40915,24	32066,56
2006	35831,26	-	75957,39	109697	15266,04	1687,459	35912,57	29565,91
2007	34054,92	-	58942,37	117224,3	15525,03	2554,665	37006,75	26297,87
2008	32608,07	-	49691,1	120560,2	15830,2	1489,343	33412,42	25875,77
2009	30349,22	-	77846,8	117003,3	15524,4	1510,11	29265,6	24046,08
2010	30941,64	-	85482,54	108463,6	16612,46	1358,198	26023,51	24197,37
2011	31616,21	-	78480,08	102917,5	17267,38	1131,486	26888,94	23009,78

Table 3 cont.: Complete computational results of GPI (in millions of CZK 2000 prices)

Column A Year	Column R Cost of Air Pollution	Column S Cost of Noise Pollution	Column T Loss of Wetlands	Column U Loss of Farmlands	Column V Loss of Forests	Column W Depletion of non-renewable Resources	Column X Cost of Greenhouse Emission	Column Y Cost of Ozone Depletion
2001	187105	14446,22	-	202,04	-	277856,9	130782,7	-
2002	182384,1	14315,39	-	302,875	-	272497,9	133449,4	-
2003	182800,5	14443,4	-	521,9649	-	287577,3	136392,3	-
2004	176809,8	14201,21	-	684,4408	-	295551	138220,6	-
2005	175509,7	14070,7	-	851,5318	-	298104,7	138065	-
2006	170449,7	13864,79	-	997,2901	-	297649,9	140067,2	-
2007	171763,6	13618,14	-	1314,878	-	296360,4	140404,7	-
2008	156314,3	12932,25	-	1659,923	-	295997,8	135441,5	-
2009	157210,7	12923,24	-	1887,408	-	280806,6	126923,6	-
2010	153714,9	12870,71	-	1988,839	-	292775,3	131216,4	-
2011	148945,9	12755,19	-	2262,389	-	275692,6	133034	-

Table 3 cont.: Complete computational results of GPI (in millions of CZK 2000 prices, per capita components are in absolute numbers)

Column A Year	Column Z Net Capital Investment	Column AA Net foreign Borrowing	Column AB GPI	Column AC GDP	Column AD GPI per capita	Column AE GDP per capita	Column AF GPI(PPP)	Column AG GPI(PPP) per capita
2001	16896,78	-100397	1520532	2338686	148984,1	229148,1	1752092	171672,8
2002	-1809,75	-87715,1	1575302	2406050	154396	235817,9	1796649	176090,3
2003	-30521,7	-124871	1543202	2516406	151131,3	246440,7	1772525	173589,8
2004	24147,33	-107028	1658736	2669398	162287	261168	1884716	184396,4
2005	17380,4	-67900,2	1675445	2785754	163442,1	271754,4	1891469	184515,6
2006	18210,51	-62350,6	1704820	2924120	165725,6	284254	1911439	185811,1
2007	68126,57	-140283	1751240	3106585	168696,6	299256,8	1952493	188083,3
2008	-2582,31	-60685,1	1714575	3069116	163792,1	293190,3	1893802	180913,4
2009	-96380,5	-35515,4	1736884	2966043	165307,3	282292,1	1886122	179511
2010	-3485,46	-91909,3	1782001	2956305	169182,7	280670,8	1925347	182791,9
2011	-7174,14	-58706,3	1823585	2932694	173592,1	279171,3	1941807	184846

Appendix B: Graphs of components

Figure 5: Components of GPI (in millions of CZK 2000 price level)

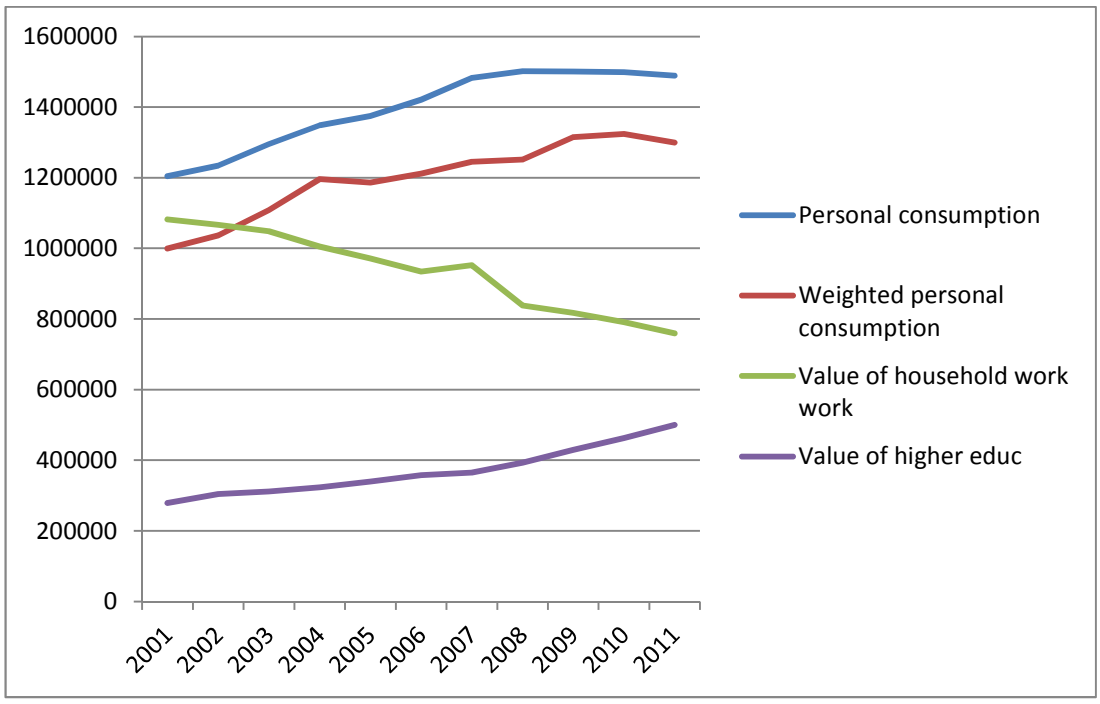


Figure 6: Components of GPI (in millions of CZK 2000 price level)

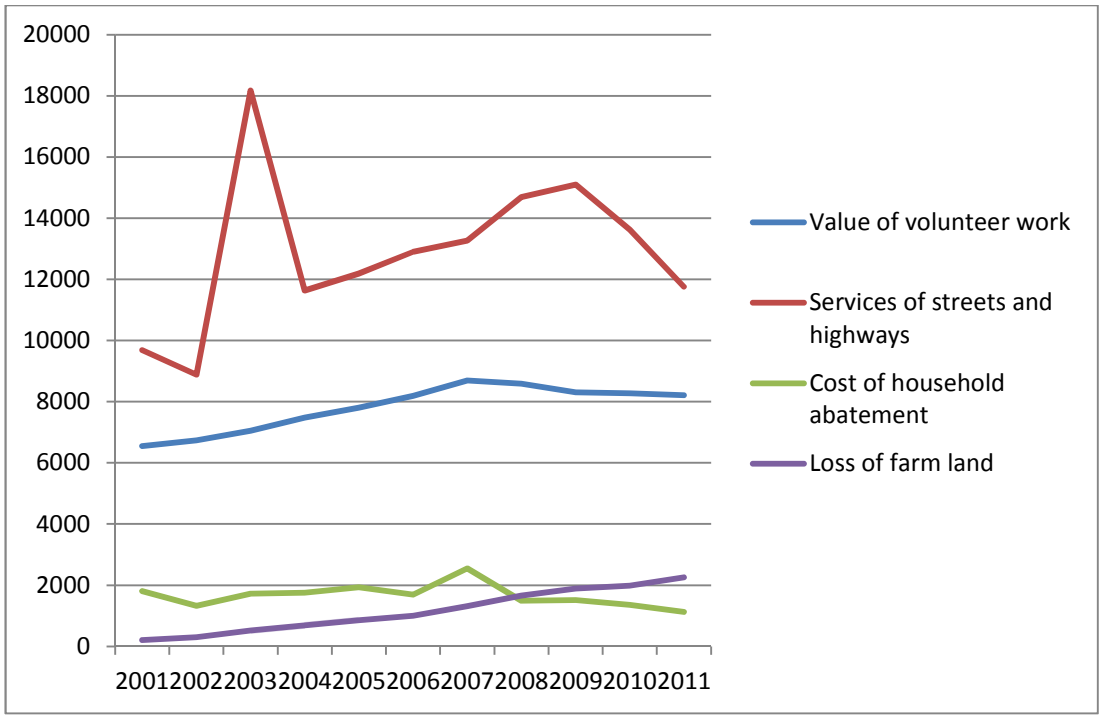


Figure 7: Components of GPI (in millions of CZK 2000 price level)

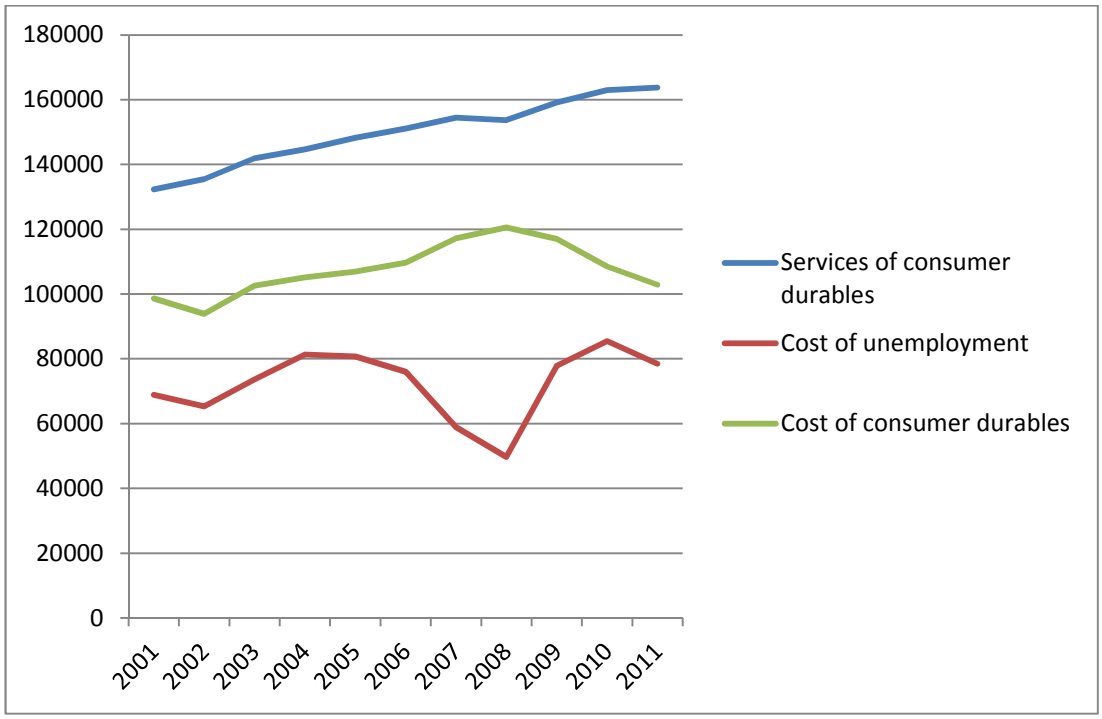


Figure 8: Components of GPI (in millions of CZK 2000 price level)

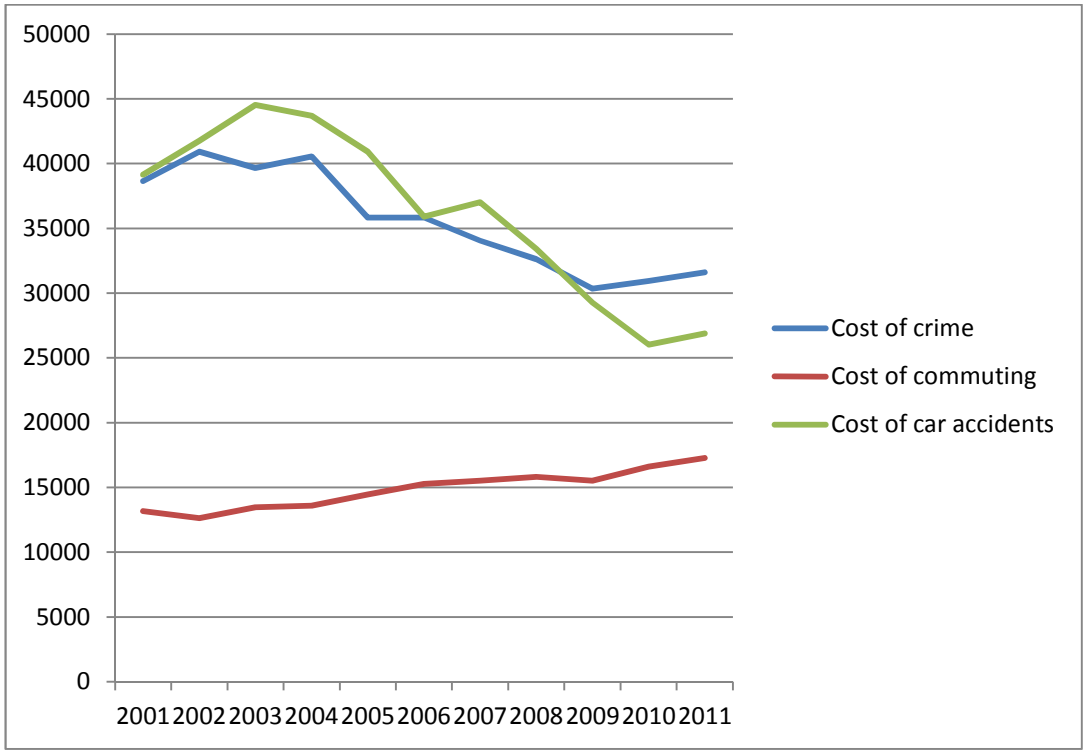


Figure 9: Components of GPI (in millions of CZK 2000 price level)

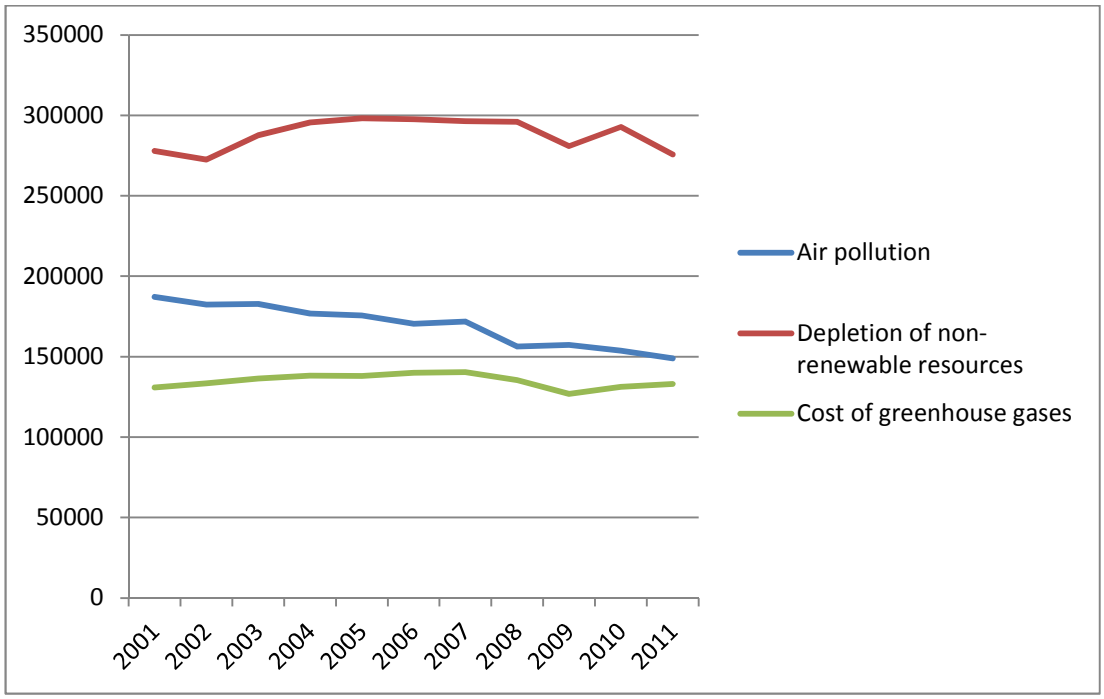


Figure 10: Components of GPI (in millions of CZK 2000 price level)

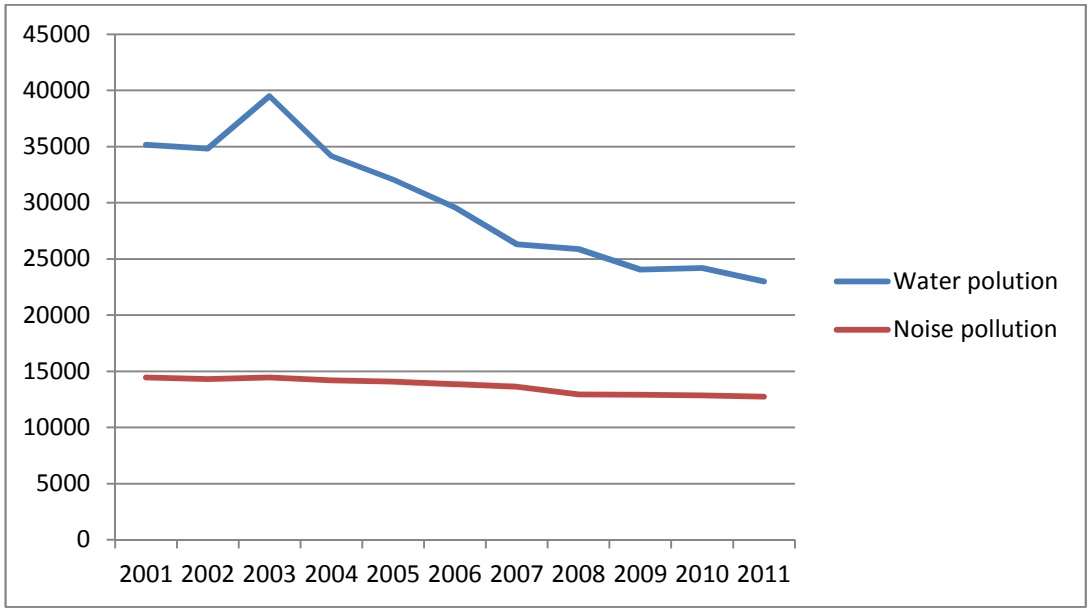


Figure 11: Components of GPI ((in millions of CZK 2000 price level)

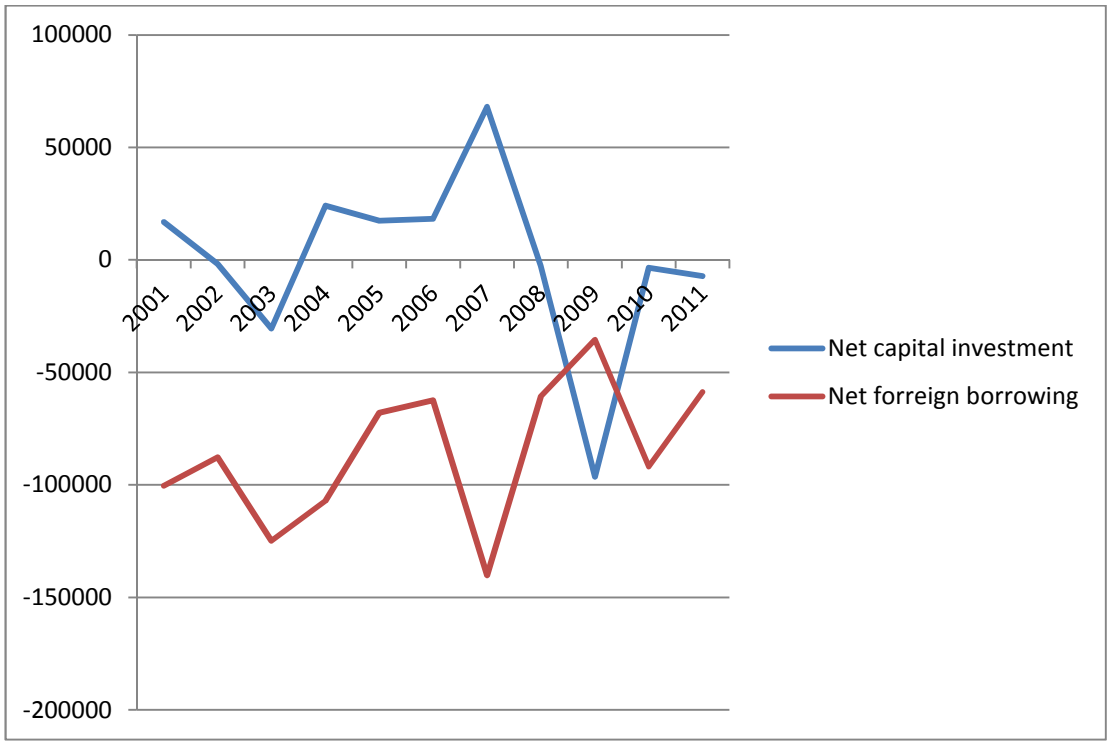


Figure 12: GPI per capite vs. GPI (PPP) per capita (in millions of CZK 2000 price level)

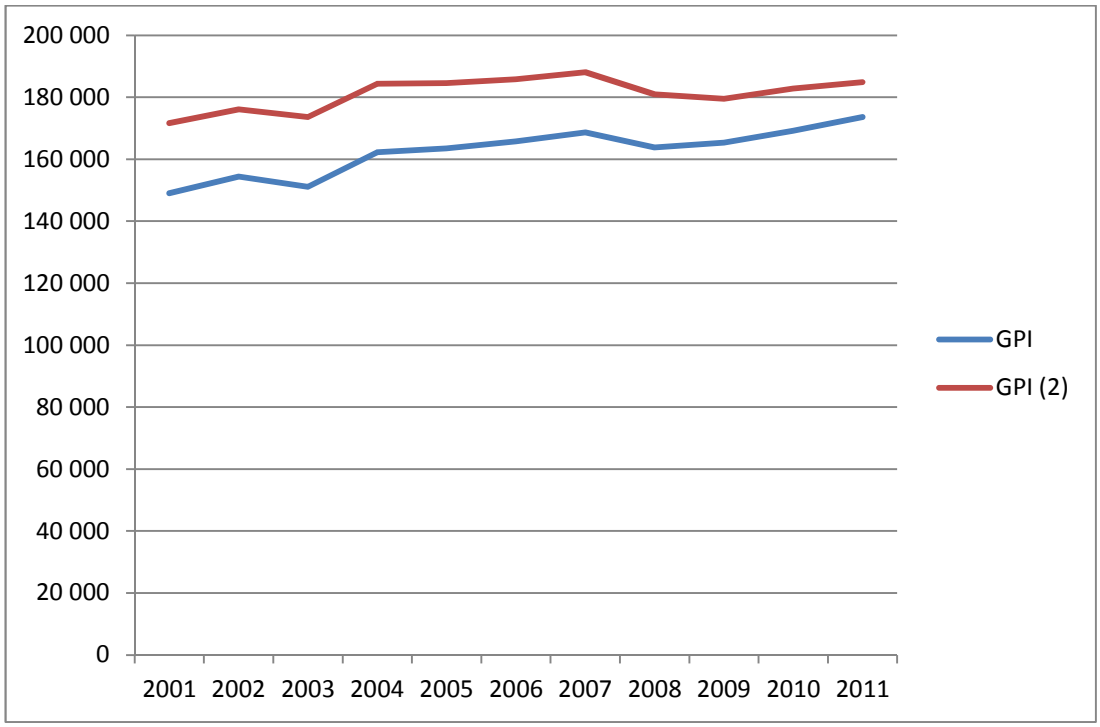


Figure 13: Comaprison of PPP and exchage rate computational approach (in millions of CZK 2000 price level)

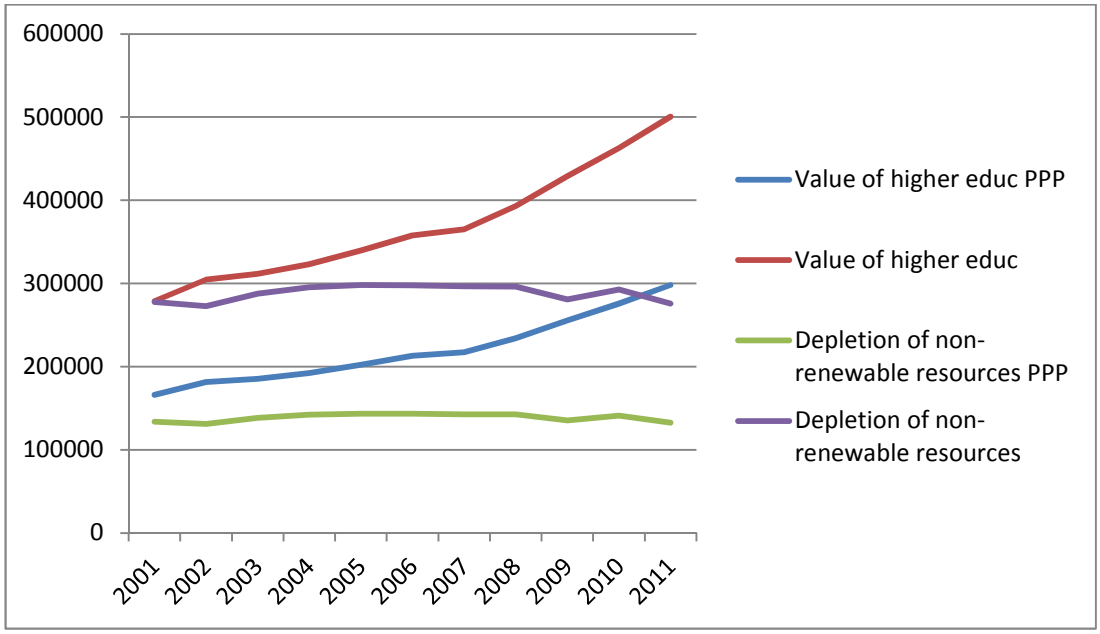


Figure 14: Comaprison of PPP and exchage rate computational approach(in millions of CZK 2000 price level)

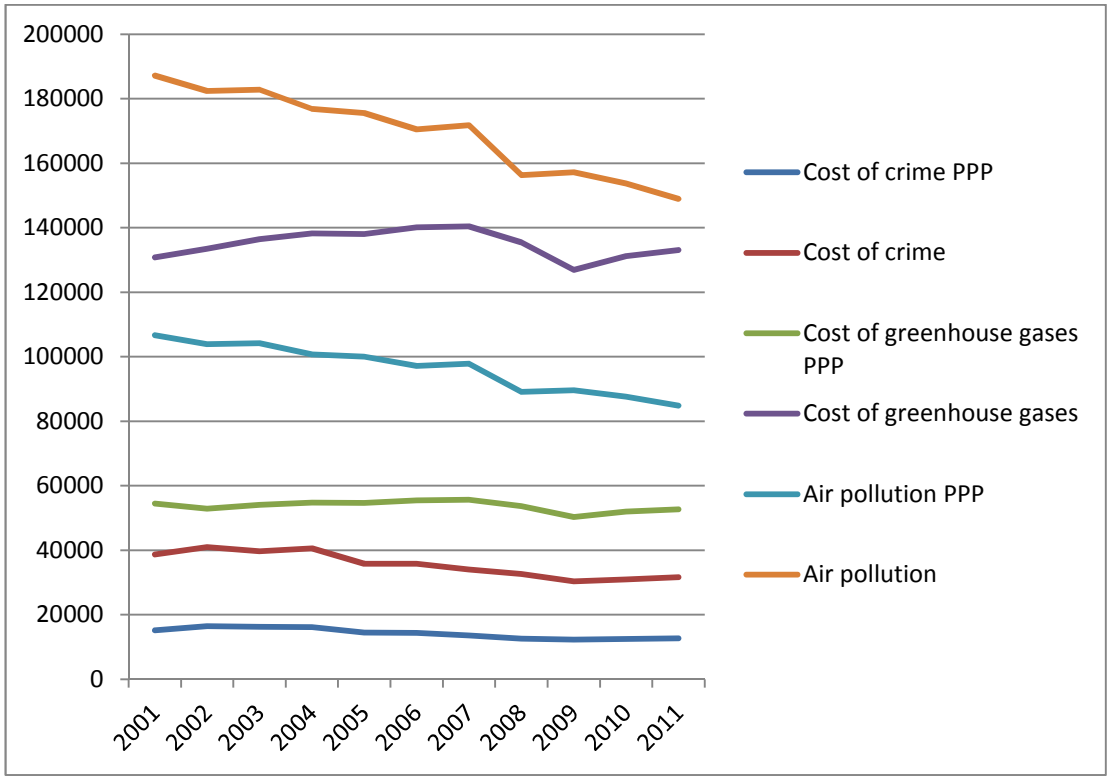
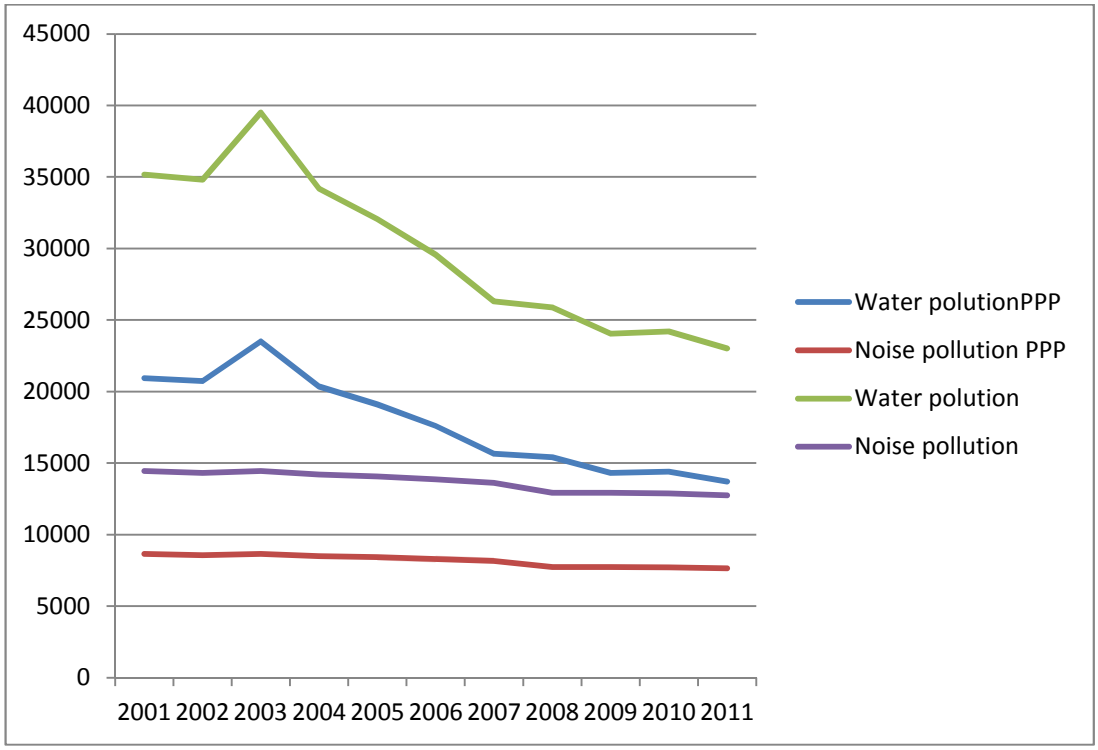


Figure 15: Comaprison of PPP and exchage rate computational approach (in millions of CZK 2000 price level)



Bachelor Thesis Proposal

Genuine Progress Indicator and other alternative measures of economic development: First estimates for the Czech Republic

Název v anglickém jazyce:	Genuine Progress Indicator and other alternative measures of economic development: First estimates for the Czech Republic
Název v českém jazyce:	Genuine Progress Indicator a další alternativní ukazatele ekonomického rozvoje: První odhady pro Českou republiku
Klíčová slova anglicky:	genuine progress indicator, welfare, measuring well-being, gross national product, alternative indicators of economic growth, index of sustainable economic welfare
Akademický rok vypsání:	2011/2012
Typ práce:	bakalářská práce
Jazyk práce:	angličtina
Ústav:	Institut ekonomických studií (23-IES)
Vedoucí / školitel:	Mgr. Bc. Petr Janský, M.Sc.
Řešitel:	Michal Král - zadáno vedoucím/školitelem
Datum přihlášení:	31.05.2012
Datum zadání:	04.06.2012

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Předběžná náplň práce v anglickém jazyce

Measuring and forecasting an economic growth is an important part of economic theory. Nowadays the most used indicator of economic growth all over the world is Gross domestic product (GDP) and Gross national product (GNP). However, in growing discussion about environmental problems, sustainability

and general welfare of population, there are alternative indicators, which can be better suited for measuring economic growth.

What are the main alternative indicators and why can they be better than GDP?

Among the most important alternative indicators are genuine progress indicator (GPI), index of sustainable economic welfare (ISEW), green national product (GNP) and human development index (HDI).

GDP measures an output of economy without consideration of an impact of its production. Every monetary transaction increases GDP and common believe is, that higher GDP automatically increases welfare of society. However not every monetary transaction is desirable, for example protection against crime increases GDP, but with absolute certainty we can say, that higher crime doesn't increase welfare. GDP also does not calculate with pollution of environment and many steps, that lead to higher outcome cause damage to environment. These are only few reasons why in recent years there is a criticism of GDP and growing need to discover some new indicators, which will take in account more than just raw production and because of that, they will be better suited for measuring development and general well-being of society. In my theses, I will introduce the most important alternative indicators (GIP, ISEW, GNP, HDI and other) and compare their theoretical background in order to reveal biggest weaknesses and advantages.

What are the components of GPI?

GPI consists of twenty-six components divided into three groups: Economical components, social components and environmental components. Economical components are Weighted Personal Consumption (computed by Personal Consumption and Income Distribution Index), Net Capital Investment, Net Foreign Borrowing, Cost of Underemployment, Cost of Consumer Durables, Services of Consumer Durables.

Social components are Value of Household Work and Parenting, Value of Higher Education, Value of Volunteer Work, Services of Highways and Streets, Cost of Crime, Loss of Leisure Time, Cost of Commuting, Cost of Automobile Accidents.

Environmental are: Cost of Household Pollution Abatement, Cost of Water Pollution, Cost of Air Pollution, Cost of Noise Pollution, Loss of Wetlands, Loss of Farmland, Loss of Primary Forests and Damage from Logging Roads, Depletion of Non-renewable Energy Resources, Carbon Dioxide Emissions Damage and Cost of Ozone Depletion.

For some of these components may not be sufficient data and because GPI was created in USA, there can be few components that are not that significant for Czech Republic. In my theses, I will attend to every component individually and compute or approximate them using data from Czech statistical office, Eurostat and other institutions that collect data significant for my theses.

How is Czech Republic doing?

GPI is computed as a sum of all components mentioned above, where some are positive and other negative. I will compute GPI for Czech Republic and compare it with its GDP. GPI was also created for several countries for example some states of USA, some provinces of Canada, Australia, Finland, so there can be comparison between GPI of Czech Republic and these countries.

Outline:

1. Introduction
2. Alternative indicators and their comparison
3. Analysing and computing individual components of GPI
4. Creating GPI for Czech Republic
5. Comparing GPI with other countries and GDP
6. Conclusions