THE IMPACT OF HAPPINESS CAPITAL ON ECONOMIC GROWTH

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Summary

The authors investigate two problems: assessing the impact of the life satisfaction on GDP in developed countries and indication of the factors affecting the perceived well-being. The work consists of two parts where the impact of both subjective and objective variables is measured. Firstly, the authors verify the hypothesis of a significant direct effect of factors immeasurable in monetary terms on the level and growth rate of GDP. A distinction is made between the classic factors of production such as physical or human capital and the additional factor named the capital of happiness. With the use of panel data for OECD countries, the tri-factor Cobb-Douglas production function is estimated. In the second part, a direct impact of objective and measurable variables on happiness is tested and thus their indirect impact on GDP. While the first part of the test is performed on aggregate data, in the second part the data at the individual level supported by socio-economic characteristics of respondents' is used. The data describes the level of environment protection, education, healthcare as well as the public spending. The concluding remarks address the state economic policy to improve both the level of subjective life satisfaction, and the economic growth.

Keywords: economic growth, happiness economics, data mining.

1. Introduction

One of the main objectives of the state economic policy is the citizens' satisfaction with life. From the economic policy perspective, time inconsistency of preferences in the sense of Laibson [9] is of significant practical importance. For instance, smokers often want to quit smoking in the future, but never want to do it immediately, see [3]. In this situation it would be beneficial to increase tax on tobacco products, since the loss of their utility due to increased spending on cigarettes is compensated by a subsequent joy of quitting smoking. American and Canadian data shows that 50% tax increase does not affect the level of happiness of smokers compared to non-smokers, see [7]. It is therefore a proof that the analysis of economic policy from the perspective of individual satisfaction is possible and it is of practical use.

A similar example concerns the labor market policy and the problem of defining the optimal level of work compensation. The decrease of this benefit mobilizes people to work and in the long run it leads to an overall improvement of the unemployed situation. On the other hand, if the job search proves fruitless, the unemployed must accept a lower standard of living. Empirical studies show that an increase of the level of social security benefits in Europe in the period of 1975-1992 did not contribute to a significant decrease in the difference between the level of satisfaction of

the employed and unemployed, see [4]. Other studies verify the impact of direct democracy development level (in Switzerland) on life satisfaction. It turns out that these variables are positively correlated and in the cantons where the democracy index is higher, people are happier, see [6].

If we accept the Easterlin hypothesis that the level of income in absolute terms with constant level of inequality does not contribute to satisfaction, then it would be beneficial to increase state participation in the income redistribution. U.S. data shows that GDP growth per capita does not contribute to the improvement of the life satisfaction, see [5]. Therefore, from the individual point of view additional income is valuable in terms of happiness, only if it is significantly higher in comparison to the income of others.

2. Happiness capital and economic growth - aggregate approach

In this paper we verify the hypothesis that the subjective factors immeasurable in monetary terms, have significant influence on the GDP level or the GDP growth rate. Next to the classical factors of production such as physical and human capital we propose the additional one, named happiness capital. On this basis, we introduce the tri-factor Cobb-Douglas production function.

The data from 25 OECD countries from the years 1965-1999 is used, coming from three sources: HPI, Lee Barro and CEIC.

HPI Database (Happy Planet Index) is run by NEF (the New Economic Foundation) in order to make broader than just the economic assessment of the life quality in many different countries. HPI authors estimate that the categories of the national product measure condition of the economy rather than the welfare of its inhabitants, because too little importance is put on health and environmental conditions. Therefore, they collect data on the life expectancy, the life satisfaction and the environment pollution (approximated by the carbon dioxide concentration in air) and on this basis they formulate HPI (Happy Planet Index). The collected data allows comparisons among 143 countries, see [1]. Due to the high subjectivity of the life satisfaction assessment and the sensitivity of the econometric model to the uncertainty of explanatory variables we use life expectancy of individuals as a proxy variable for HPI.

Data on human capital for the econometric model is derived from the database by Lee and Barro, see [10]. The database includes the data on the structure of population entering the education system at primary, secondary and tertiary levels and the average duration of these stages of education for 138 countries in the years 1960-1999 with a five-year interval. If the stage of education, s, is known, then the level of human capital, L, is to be calculated from the Mincer formula, see [12]:

$$L=e^{\phi(s)},$$

where

$$\phi(s)=\begin{cases} 0{,}134\cdot s & \text{for } s<4 \\ 0{,}134\cdot 4+0{,}101\cdot(s-4) & \text{for } s\in[4,8) \\ 0{,}134\cdot 4+0{,}101\cdot 8+0{,}068\cdot(s-4) & \text{for } s\geq 8 \end{cases}.$$

The data on the gross domestic product and the tangible capital was built using database run by the University of Pennsylvania, the Penn Word Table, where the information on the national accounts for 188 countries has been gathered since 1950, see [8]. A time series approximating the

value of physical capital was constructed by aggregation of the investment level, taking into account the average GDP growth rate and the depreciation of the capital, see [2].

For 23 OECD countries the cross-section of these databases produces 6 to 8 observations in the period of 1960-2000. Using the following variables:

GDP - gross domestic product,
L - human capital,
K - physical capital,
LE - life expectancy (as a proxy for the quality of life)
we formulate the Cobb-Douglas model:

$$GDP(t)=\alpha_0 \cdot K(t)^{\alpha_K} \cdot L(t)^{\alpha_L} \cdot LE(t)^{\alpha_{LE}} \cdot e^{\varepsilon}.$$

More specifically, we propose the panel model with fixed effects (individual intercepts in groups, common variable parameters):

$$GDP_j(t)=\alpha_{0_j} \cdot K_j(t)^{\alpha_K} \cdot L_j(t)^{\alpha_L} \cdot LE_j(t)^{\alpha_{LE}} \cdot e^{\varepsilon},$$

where j = 1, ..., 23 is the index of the country. The estimates of the model parameters are given in Table 1.

Table 1. Parameter estimates in the panel model with fixed-effects using 182 observations, GRETL software. Includes 23 cross-sectional observations. Time series length: minimum 6, maximum 8.

Parameter	*Value*	*Std. error*	*T*	*p-value*
α_K	0.290	0.046	6.248	<0.00001***
α_L	0.315	0.121	2.605	0.01008**
α_{LE}	3.366	0.577	5.837	<0.00001***

Source: Own calculations.

The test for common intercept value indicates that the functional form of the model is correctly specified. The test statistic F (22, 156) = 12.15 with the p-value of 7.44 E-024 indicates that the null hypothesis of the common intercept in the groups should be rejected.

In addition, the estimated model significantly explains the level of gross domestic product, which is confirmed by the statistic F (25, 156) equal to 154.343 with the p-value lower than 0.00001 and the adjusted determination coefficient equal to 0.95.

The positive and statistically significant value of α_{LE} confirms the authors' expectations on the significant relationship between the happiness capital (approximated by the life expectancy) and the economic growth.

3. Happiness determinants - data mining approach

In Section 2 we showed that happiness of the individuals (approximated by life expectancy) is an important factor of the gross domestic product. The conclusion is significant to the policy makers, because they have to consider the citizens wellbeing as an stimulant of the economy.

The aim of this section is to identify the factors determining the happiness of individuals. The sources and constraints of happiness are manifold and their influence on the GDP is not clear. For example the investment in the human capital such as the educational expenses can support both the

individuals' wellbeing and the economy of the country. On the other hand the expenditures on culture rise the happiness of single people but their contribution to the economic growth is rather small. The transmission is to be explained with the happiness capital of the people. The higher number of sport and cultural events makes people more satisfied and relaxed, and in this way – more productive.

In this research we consider the determinants measured objectively like: education, health, environment, family. On the other hand the happiness is a subjectively perceived phenomenon. Therefore the relations between the factors are subtle and appear in small subsamples. To determine the relations specific methods are needed and we employ the data mining approach, see [13].

3.1. Data

In the microeconomic analysis we use the data from World Values Survey, WVS, maintained by the Tilburg University (Holland) and ASEP/JDS (Spain). The data is collected in ca. 100 countries as European Value Survey, EVS, or World Value Survey, WVS, in the following cohorts: EVS 1981, WVS 1981, EVS 1990, WVS 1990, WVS 1995, EVS 1999 and WVS 2000. Each country sample consists of 1000 -2000 people answering questions about their opinion on the economic situation and the social system. The questions consider both current and expected situation form the individual and global perspective, see [14]. The raw data set includes 350 variables and 67000 observations.

The data is extended by the socio-economic characteristics of the country. From the Happy Planet Index we use the life expectancy, the life satisfaction, the ecological footprint and the aggregated HPI index in 1990, 1995 and 2000, see [1]. We add the data on the education level from the data of Barro and Lee, see [10]. We also use the data on public expenditures and national accounts form the CEIC database, see [15].

In the data mining model the dependent variable is the perceived happiness level measured by the question: *Taking all things together, would you say you are*:

1. *Very happy* - 19 053 responses,
2. *Quite happy* - 35 947 responses,
3. *Not very happy* – 9 935 responses,
4. *Not at all happy* – 1 675 responses.

Using the chi^2 statistics we reduce the full data set of 400 variables and choose only 146 of them. Next we reject the highly correlated descriptors: country, health state (subjectively), life satisfaction and economic situation appraisal. The variables explain the perceived happiness very well, but they are beyond the state authority influence.

The data set is divided into the learning and testing partition with 2:1 ratio. The analysis is performed with classification methods: decision table and JRiP in WEKA software, see [13].

3.2. Decision table model

The model M1 includes 1828 rules employing the following attributes :

- total health expenses per capita in 2005,
- public health expenses per capita in 2005,
- perceived freedom level,
- proud of nationality.

The contribution of health expenditures to the happiness level is intuitive, because higher expenditure rises the health level. The contribution of perceived freedom is not so natural. On the other hand, the freedom interpreted in political terms as democracy is consistent with the research on the Swiss welfare, see [6]. Next, the proud of nationality reflects the sociological need for the group membership, see the Maslow hierarchy of needs [11].

The model M1 classifies 13000 cases correctly – 57% of test observations – and the Kappa factor is 0,2028 – it classifies correctly 20% of random model false classifications. Detailed performance of M1 model is presented in Table 2.

Table 2. M1 model performance

Class	*False rate*	*Precision*	*Recall*
Very happy	0.153	0.488	0.364
Quite happy	0.623	0.607	0.811
Not very happy	0.038	0.452	0.182
Not at all happy	0.001	0.458	0.041

Source: Own calculations.

From Table 2 we conclude that the M1 model performs the highest precision for the class "Quite happy" – about 60% of all hits are true and the model classifies correctly about 81% of real "Quite happy" cases (Recall). Whereas the model M1 classified also as "Quite happy" ca. 62% of the observations out of the class (False Positive). In the following classes the model achieves the precision of 45-48%, but the recall drops to the level 4%-36%.

The Receiver Operator Characteristic, ROC, curves are presented for each class separately. All of them are concave and perform better than random prediction (characterized by linear ROC). The Area Under Curve, AUC, value also performs positively. For M1 model it ranges from 0,65 to 0,73, where 0,5 is the performance of random model and 1 – of the perfect prediction, see Fig. 1.

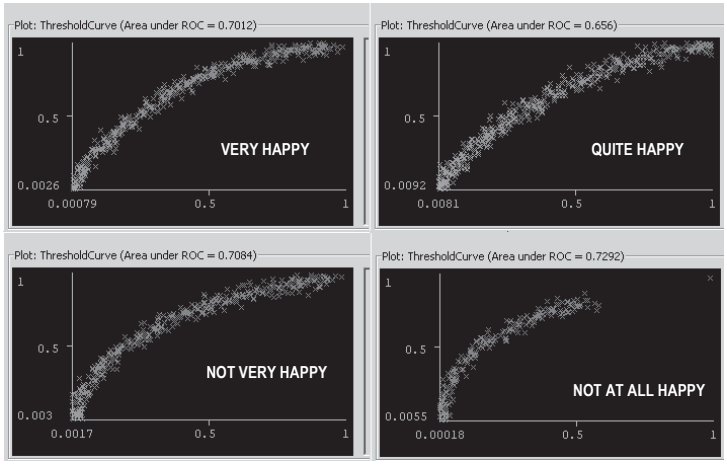

Fig. 1. ROC curve and AUC value in M1 model. Each cross represents one observation randomly disturbed

Source: Own calculations.

Table 3. Contingency table for M1 model

Classified as =>	*Very happy*	*Quite happy*	*Not very happy*	*Not at all happy*
Very happy	2362	3927	194	1
Quite happy	1860	9961	444	13
Not very happy	530	2177	603	12
Not at all happy	87	341	93	22

Sorce: Own calculations.

The contingency table in Table 3 shows that the number of correct classifications is the highest in each predicted class. For example, there is 22 correct cases among 48 observations classified as "Not at all happy", and only 1 observation from the class "Very happy", 13 – from the class "Quite happy" and 12 – from the class "Not very happy".

3.3. JRiP models

The second type of models exploited in microeconomic research employs JRiP method, see [13]. Six models of the growing complexity are built. In Table 4 we present the variables used by particular JRiP models.

Table 4. Variables in JRiP models

No.	*Model* / *Descriptive variables*	*JRiP_100*	*JRiP_125*	*JRiP_250*	*JRiP_500*	*JRiP_1000*	*JRiP_2000*
1	Current expenses on education as % of GDP	X	X	X	X	X	X
2	Public expenses on education as % of GDP	X	X	X	X	X	X
3	How much freedom do you fell	X	X	X	X	X	X
4	How proud of nationality	X	X	X	X	X	
5	Ethnic group	X	X	X	X	X	
6	Leisure time – important?	X	X	X	X	X	
7	Total expenses on health per capita in 2005	X	X	X	X		
8	Social security expenses on health per capita in 2005	X	X	X	X		
9	Scale of incomes	X	X	X	X		
10	Religion important	X	X	X	X		
11	Life Satisfaction (0_10)	X	X	X			
12	Total expenses on health as % of GDP in 2005	X	X	X			
13	Respect for individual human rights in country	X	X	X			
14	How often use of PC	X	X	X			
15	And which party would be your second choice?	X	X			X	
16	Most people would try to take advantage of you if they got a chance	X	X	X			
17	Marital status	X	X	X			
18	One of main goals in life has been to make my parents proud	X	X	X			
19	Ecological footprint	X	X				
20	Education gross enrolment rate	X	X				
21	Incomes should more equal	X	X				
22	Confidence in churches	X	X				
23	Highest educational level attained	X	X				
24	Membership of church or religious organizations	X	X				
25	Family savings during past year	X	X				
26	Language in which interview was conducted	X	X				
27	Friends important	X	X				
28	Important to this person to help the people	X	X				

No.	Descriptive variables \ Model	JRiP 100	JRiP 125	JRiP 250	JRiP 500	JRiP 1000	JRiP 2000
29	Government expenses on health per capita in 2005	X					
30	Government should take more responsibility	X					
31	I see myself as a world citizen	X					
32	Which party on this list would you vote	X					
33	Membership of sport or recreation	X					
34	Important looking after environment	X					
35	Interested in politics	X					

Source: Own elaboration

The list covers the variables used in M1 model. The most important variables describe the perceived freedom and the group membership (national, religious, ethnic, political). The health expenditures appear only on 7-8 position, though they were very important in M1 model. Moreover, they are preceded by the educational expenditures. The additional variables used by JRiP are economic (income level, family savings), ecological and sociological (friends, family, altruism, marital status).

The particular JRiP_2000 model consists of the following two rules:

Rule 1:

Perceived freedom level ≥ 8/10 AND

Current expenses on education as % of GDP ≥ 4,737035) AND

Public expenses on education as % of GDP ≤ 5.533351 THEN *VERY HAPPY*

Rule 2:

In other cases *QUITE HAPPY*.

The performance of the JRiP model classifications presented in Table 5.

Table 5. Performance of JRiP models

Model	JRiP_100	JRiP_125	JRiP_250	JRiP_500	JRiP_1000	JRiP_2000
Kappa	0.1736	0.1635	0.1067	0.1067	0.0916	0
No rules	24	18	10	4	3	2
No variables	35	28	17	10	7	3

Source: Own calculations.

For the models in Table 5 it can be observed that the growing complexity of the model structure enables higher performance. The simple JRiP_2000 model (two rules) achieves Kappa = 0 and performs at the random level, while the more complicated models obtain Kappa of 0,16-0,17. They use much more variables than decision table – 35 variables in JRiP_100 and 4 variables in model M1, but they use limited number of rules – 24 in JRiP_100 comparing to 1828 rules in M1.

The model M1 seems to be more applicable, because it requires only 4 variables, though the model consists of a huge number of rules. On the other hand the tractable number of rules in JRiP_100 is presented at the cost of the rules length (up to 9 predecessors) and the variables number. As a result both M1 and JRiP_100 are complex and difficult to be interpreted and verified. The Kappa level both in JRiP_100 and M1 is moderate, but there is still practical use form explanation of 17-20% observations over the random model in the spatial model, where the natural variables have been removed, see Section 3.1.

4. Concluding remarks

The paper presents a study on the level of individuals' satisfaction in the economic context. More precisely, the authors consider economic factors determining the level of happiness in the microeconomic scale and the impact of perceived level of happiness on the economy in the macroeconomic scale.

From the macroeconomic perspective, the impact of happiness capital (measured by the average life expectancy) on GDP was proved. In microeconomic terms, it was confirmed that the level of happiness depends significantly on various socio-economic factors such as the expenditures on the healthcare and the educational system, the declared importance of social ties, the participation and the trust in social organizations, the income level. The importance of these factors derives from the grounded economic and psychological theories, as well as from the empirical studies.

The microeconomic part of this study indicates that the welfare is mostly affected by the level of social development, and the economic factors are of second importance. However, the macroeconomic part of the study indicates that the welfare of society contributes to the economic growth. In practice, the economic and social development are considered independently and therefore they are stimulated in an independent manner. Moreover, the greater support of social development is interpreted as a limitation of economic development. However, this study shows that the socio-economic interaction is important and the social policy strongly supports the economic growth. As a result, the direct postulates can be formulated towards the state policy-making bodies that funding of social development and welfare of individuals significantly strengthens economic development, and therefore it can be considered more as an investment than as a cost for the budget.

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WPŁYW KAPITAŁU SZCZĘŚCIA NA WZROST GOSPODARCZY

Streszczenie

W pracy podjęto problem oceny wpływu poziomu zadowolenia z życia mieszkańców państw rozwiniętych na PKB, a także poddano analizie czynniki kształtujące odczuwany dobrobyt. Badanie składa się z dwóch części, w których badany jest wpływ zmiennych odpowiednio mierzalnych subiektywnie i obiektywnie.

W pierwszej części pracy weryfikowana jest hipoteza o istotnym bezpośrednim wpływie na poziom oraz tempo wzrostu PKB czynników subiektywnych i niemierzalnych w kategoriach pieniężnych, takich jak poziom zadowolenia mieszkańców z ekonomiczno-społecznych sfer życia. Autorzy wyróżnili obok klasycznych czynników produkcji, takich jak kapitał rzeczowy czy ludzki, również dodatkowy czynnik określony w pracy mianem kapitału szczęścia. Wykorzystując dane panelowe dla państw OECD zbudowano trójczynnikową funkcję produkcji Cobba-Douglasa.

W drugiej części badany jest bezpośredni wpływ zmiennych obiektywnych i mierzalnych na szczęście, a przez to, ich pośredni wpływ na poziom produktu krajowego. O ile pierwsza część badania jest realizowana na danych zagregowanych, to część druga wykorzystuje dane na poziomie indywidualnym, wspomagane społeczno-ekonomicznymi charakterystykami regionu, w którym mieszkają respondenci. Dane opisują także poziom ochrony środowiska, edukacji, opieki zdrowotnej oraz wydatki sfery publicznej na te cele.

Wnioski sformułowane w pracy mają za zadanie podnosić sprawność realizowania polityki gospodarczej państwa zarówno przez poprawę poziomu subiektywnie odczuwanego zadowolenia, jak również przez wspieranie procesów stymulujących wzrost gospodarczy.

Słowa kluczowe: wzrost gospodarczy, ekonomia szczęścia, data mining.

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