Happiness in Solow Growth Model

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Abstract

Using annual data from 1961 to 2005 growth rate of gross domestic product at the constant prices of year 2000 is taken in the dependent variable and growth rates of employment level, gross fixed capital formation and lag dependent variable are all the explanatory variables, we obtained total factor productivity by using Cobb Douglas Model. The corresponding time period's data of three happiness indices – life satisfaction, ecological footprint and life expectancy is taken to determine the effect of happiness indices on total factor productivity. Negative impact of ecological footprint index on TFP is found in Canada, Japan, Norway, Spain, and UK, but is found significant in the cases of Canada, Norway, Spain and UK. Life expectancy is found to be significantly explaining TFP in Netherlands, Norway, Spain, UK and USA. As far as the subjective index of happiness – Life Satisfaction – is concerned the slope coefficient is insignificant in all the cases except the USA. Estimates from pooled regression show that growth rates of ecological footprint index and life expectancy both are significantly explaining TFP, but life satisfaction index is found to be insignificant. Endorsing Loria's viewpoint there is not only a need to check national income accounts but there is also a need to develop happier societies. Enhancing happiness – the intangible capital – could be helpful in explaining total factor productivity in the neoclassical growth model.

Key Words: Happiness, Solow Growth Model, Total Factor Productivity.

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1. Introduction

"Happiness" which is defined as a state of tranquility free from anxiety and emotional disturbance has now returned as an important theme in economics. The confrontation between Cain and Abel proves that pursuit of happiness has remained the objective of mankind since the very beginning. Happiness (*Eudaimonia in Greek*) was also the goal of the philosophies beginning with Socrates, Plato, Aristotle, Epicureans etc. For many of them, happiness is not a function of good feeling but rather of living good lives.

Before Adam Smith's famous book "Wealth of Nations" published, in French and Italian traditions, the public happiness issue was considered to be a core of economics. Italian philosopher Ludovico Antonio Muratori in 1749 used the expression *'pubblica felicita'* (On Public Happiness). A similar idea was also discussed by Pietro Verri's (1781) Discourse on Happiness and Giuseppe Palmieri (1788: Reflections on the Public Happiness). Linguet, Rousseau, Necker, Turgot, Sismondi and Condorcet considered happiness in their analyses as a vital objective of the economy.

The earliest western philosophy suggests that high levels of national income are not necessary for happiness. However it is hypothesized in much of the literature on economic growth that ever greater income lends to ever greater utility i.e., consumers derive higher utility from being on a higher indifference curve and higher indifference curve is achievable with high real incomes. Bentham (1789) founded the utilitarian tradition built around the concept of the greatest happiness for the greatest number. In Bentham's view happiness is equal to 'pleasure' or psychological hedonism and become essential to the utilitarian. Adam Smith has also endorsed the above view by advocating that utility - a particular form of happiness - is enhanced by wealth. Whereas, Loria (1893) argues that "deal not so much with the *wealth of nations*, as Adam Smith did, but rather with *public happiness*".

The honor for re-instigating the concept of happiness economics goes to the king of Bhutan, Jigme Singye Wangchuck. The term "gross national happiness" (GNH) was coined in 1972 by him. Unlike many socioeconomic

indicators, GNH is expected to be simpler to understand and in designing happiness related polices. It serves as a combined vision for Bhutan's economic development planning process.

As Bhutan's Buddhist ideology suggests that a beneficial development of society is possible when spiritual and material development occurs simultaneously and thus reinforces each other. Bhutanese concept of GNH is based on the following objectives.

(a) The promotion of sustainable development.
(b) Preservation and promotion of cultural values.
(c) Conservation of the natural environment.
(d) Establishment of good governance.

Applying total factor productivity approach for the data of 10 randomly selected countries (table 1), this study thus attempts to investigate whether variants of happiness carry any significant impact on the economic growth model or not. Rest of the paper is organized as follows. Section two provides eclectic literature review, section three discusses data and methodology, next section explains the results and finally conclusions and recommendations are presented in section five.

2. Literature Review

Easterlin (1974) has argued that economists' emphasis on growth is misguided, because the findings suggest there is no statistically significant evidence of a link between a country's GDP and the subjective well-being of its citizens. It is referred as Easterlin Paradox which states that *"In all societies, more money for the individual typically means more individual happiness. However, raising the incomes of all does not increase the happiness of all. The happiness-income relation provides a classic example of the logical fallacy of composition—what is true for the individual is not true for society as a whole"*. Easterlin therefore suggested that focusing on economic growth is futile; when everyone grows richer, no one becomes

happier. On the contrary Stevenson and Wolfers (2006) found consistent correlation between subjective well-being and income and found that rising income growth is associated with rising happiness.

Generally happy communities have better relations at leisure and work that lead to better teamwork with colleagues and better employee relation with the bosses and thus efficiency enhances all around. Amabile and Kramer (2011) were of the view, "If people are in a good mood on a given day, they're more likely to have creative ideas that day, as well as the next day, even if we take into account their mood that next day."

Emphasizing the role of happiness on productivity, Seligman (2011) – a psychologist by profession – conducting a micro-level study, concludes that happy people are more positive, optimistic and motivated and are thus more efficient.

There is a large gap in the economic literature that covers happiness-growth relation and we have failed to find any macroeconomic literature covering the significance of happiness in explaining economic growth.

Using happiness data of 39 countries from 1981 to 2006 from the World Values Survey, and the Freedom House measures of democracy levels from 1972 to 2005, Inglehart (2006) links happiness with democracy and found that happiness levels have strong correlations with measures of democracy and concludes that living under democratic environment makes public cheerful and with high well-being. However, according to the author, the relationship could be spurious one, reflecting the fact that both democracy and happiness are strongly correlated with another variable – possibly economic growth.

De Leire and Kalil (2010) study the association between the selected components of consumption and happiness in the Health and Retirement Study (HRS), a nationally representative sample of older Americans. They found that only one component of consumption is positively related to

happiness—leisure consumption. In contrast, consumption of durables, charity, health care, personal care, vehicles, food, and housing are insignificantly linked with happiness.

Zagorski, Kelley & Evans (2010) investigate the hypothesis whether goods bring more happiness if hardly few people possess it. This hypothesis is tested by estimating the impact of income and education on happiness index. From a representative sample of 32 countries, authors explained that under diversified socio-demographic characteristics and country's level of development, the higher the education in a given social order, the smaller the gain in individuals' happiness. Thus, the more the education and income diffuse in a country, the lesser they enhance (subjective) happiness. However the authors noted that such a diminishing effect on happiness is low in poor nations than in rich nations.

On a query that what low-income countries can expect from growth in terms of happiness, Clark and Senik (2010) found that higher income generally correlates with higher happiness but with too small correlation coefficients. They argued that no matter if low correlation exists; growth eventually will increase happiness in low-income countries because the cross-country time-series analysis they worked out was based on less reliable measures than the individual ones. They also argued that development is a qualitative process that involves take-offs and thresholds and thus relating it with happiness is often unpredictable. Authors also reported that for transition countries average life satisfaction is found to be negatively related with the changes in GDP for about the first ten years of the transition process, until the regime becomes more stable.

Graham (2006) in a study considers income inequality, inflation and unemployment issues to trace their effects on well-being and cautioned the potential biases in survey data on happiness like controlling unobservable personality traits that may possibly influence happiness. Graham suggested that open preferences cannot totally measure the welfare effects of a particular policy for which individuals are incapable to transform or control –

the case of environmental degradation.

Based on a comparison of happiness in richer and poorer countries, Easterlin and Sawangfa (2009) stress that economic development will have a significant positive effect on happiness in low-income countries. In a point-of-time comparison, authors expected that the absolute increase in per capita income will have a larger impact on happiness in a poorer than a richer country, but they found no significant relationship in this case as well.

Mahadea and Rawat (2009) were of the opinion that the chase of high economic expansion is considered to be desirable. It generates a boost in a nation's income and employment along an increase in the output. The growing income should enable consumers to buy more goods and services, which in turn should result in higher level of happiness. Examining the qualitative and quantitative sources of well-being, authors found that a higher income level is significantly related to subjective happiness. They also noted that among the non-income factors, a good working environment, family togetherness and better education causes happiness positively and thus concluded that happiness is not only reflected by high economic growth but it encompasses non-economic factors also.

Perovic and Golem (2007) analyzed macroeconomic factors explaining happiness. They combined the data on happiness and macroeconomic variables. They found that budgetary expenditures significantly influence happiness, whereas unemployment and GDP per capita are found to be insignificant. Their study shows that inflation was found to be significant but positively related to happiness.

Francis, Ziebertz and Lewis (2003) found no evidence for a relationship between religiosity and happiness among German students. Authors concluded that their findings are contrary to the findings in the studies that have employed the same indices in UK and the USA. Kenny (1999) is of the view that happiness might be a cause of economic growth rather than an outcome of economic growth. Focus of researchers is now also towards

intangible and non-materialistic perspective of economic growth.

Sgroi (2010) tests a hypothesis whether a rise in happiness might affect productivity. By performing experiments on micro-level data the author suggests that happiness raises productivity and thus concluded that economists need to take the emotional state of economic agents seriously. Using investment ratio, economic growth and life expectancy to be the two expected variables that explain happiness, Li and Lu (2010) test the hypothesis that investment ratio and life expectancy causes impact on happiness. They found a robust positive correlation of these variables with happiness level.

Veenhoven (2000) found counter-logical understanding between equality and happiness. The author found that presumed link fails to appear between equality and happiness since average happiness was found to be high in countries where income inequality was high. In contrast Guriev and Zhuravskaya (2009) found that Gini coefficient is found to have positive and significant effect on life satisfaction.

The literature on happiness imperatively signifies promotion of happiness related policies. This study thus attempts to determine whether economic growth model is explained by happiness or not.

3. Data and Methodology

Happiness in the Neoclassical Growth Model

Usually the starting point for analyzing economic growth is considered as the neoclassical growth theory provided by Solow (1956) and Swan (1956) independently under the assumptions of perfectly competitive firms and constant returns to scale.

The basic form of the growth model is

$$Y(t) = F[K(t), N(t)] \quad (1)$$

where Y represents output growth, K represents capital and N represents labor. Considering non-constant technology factor over time, we have;

$$Y(t) = F[K(t), N(t), t] \quad (2)$$

where t is the time variant technological index.

Savings (S) being a function of income (Y) and can be written as below:

$$S(t) = sY(t);\ 0 < (s = \text{marginal propensity to save}) < 1$$

The saving investment (I) identity is;

$$I(t) = S(t) \quad (3)$$

With the assumption of a two-sector economy, income (Y) is expressed as a sum of consumption (C) and Investment (I)

$$Y(t) = C(t) - I(t) \quad (4)$$

Net Investment is measured as gross capital (K) in year t minus the capital depreciation (δ) as a proportion of (K) in year t;

$$I(t) = K(t) + \delta K(t) \quad (5)$$

Using capital per capita (k) = K/Y to use intensive form, Solow shows growth of capital per capita (grk) as follows

$$grk(t) = sf(k(t)) - (\delta + n_L)k(t) \quad (6)$$

With labor supply (L) assumed to be growing at constant rate n_L, and no technological progress Solow model proves that growth rates of capital, labor, output, investment and savings are all equal to n_L.

Assuming Harrod neutral technological progress; Solow defines effective

labor (N) as…

$N(t) = A(t)L(t)$, where A(t) represents technology assumed to be growing at the rate of n_A. This means that the effective labor force grows at the rate of $n_A + n_{L,}$ and equation (6) can be transformed into the following form:

$$grk(t) = sf(k(t)) - (\delta + n_L + n_A)k(t) \quad (7)$$

i.e., growth rates of capital, labor, output, investment and savings are all equal to $n_L + n_A$.

To incorporate happiness – the intangible capital – in the model let H represent happiness index growing at the rate of n_H over time. We introduce happiness in the production function as follows:

$$Y(t) = F[K(t), H(t)N(t)] \quad (8)$$

With similar algebraic treatments we have the following expression:

$$grk(t) = sf(k(t)) - (\delta + n_A + n_L + n_H)k(t) \quad (9)$$

That is the growth rates of capital, labor, output, investment and savings are all equal to $(n_L + n_A + n_H)$.

Although the Solow residual is a measure of Total Factor Productivity (TFP) with an assumption that it is a function of time, but the idea of TFP is valid for any growth accounting model. Hornstein and Krusell (1996) conclude that growth in TFP represents output growth that is not explained by the inputs growth. Thus TFP is not only a measure of technology but it could be a function of other things; for example *happiness*. Estimating equation (10) by OLS regression, TFP is obtained i.e., by the residual series $\varepsilon_{it.}$

$$\ln(Y_{it}) = \beta_o + \beta_{1*}\ln(K_{it}) + \beta_{2*}\ln(N_{it}) + \beta_{3*}\ln(Y_{it-1}) + \varepsilon_{it} \quad (10)$$

where Y is the GDP, K is the fixed capital formation and N is the employment level in time t for the i^{th} country.

Annual data is taken from 1961 to 2005 of gross domestic product (Y) at the constant prices of year 2000, employment level (N) and gross fixed capital formation (K) from International Financial Statistics (IFS). All the data is in natural log form. New Economic Foundation" (NEF) has published annual time series composite index called Happy Planet Index (HPI) that includes three sub-indices namely life satisfaction (H1), ecological footprint (H2) and life expectancy (H3). Developed by the New Economics Foundation (NEF) in 2006, the Happy Planet Index (HPI) is an attempt to classify countries by their quality of life and achievement in sustainability. Researchers utilize it to examine a country's ecological efficiency in relation to the welfare (life expectancy) and emotional satisfaction. To compute life satisfaction, NEF researchers appraised people on a series of questions about changeable facets of life outlook and daily life and asked all to order their responses from 0 to 10.

Table 1
Randomly selected OECD countries

Australia (AUS)	*Canada (CAN)*	*Italy (ITA)*	*Japan (JAP)*	*Netherlands (NET)*
New Zealand (NZ)	*Norway (NOR)*	*Spain (SPA)*	*United Kingdom (UK)*	*United States (US)*

In theory, both life expectancy and the HPI should give a better picture of a country's quality of life, however since the HPI is established based on opinion polls for generating life satisfaction index and thus it is relatively subjective. Life expectancy and ecological footprint both are non subjective. Life expectancy is the average time in years that an individual can be expected to live. Ewing (2001) explains ecological footprint as "*The ecological footprint is a measure of human demand on the Earth's ecosystem. It is a standardized measure of demand for natural capital that may be contrasted with the planet's ecological capacity to regenerate*."

The HPI formula is:

HPI = (Life Expectancy * Life Satisfaction Index) / Ecological Footprint

Representing happiness, the data of these three indices has been taken in this study for the same corresponding time period.

Using OLS regression, finally we have estimated equation (11) for 10 randomly selected countries from OECD [Table 1].

$$TFP_{it} = \lambda_o + \lambda_{1*}(H1_{it}) + \lambda_{2*}(H2_{it}) + \lambda_{3*}(H3_{it}) + \mu_{it} \qquad (11)$$

For j being 1 to 3, Hj represents growth rates of happiness indices in time t for the i^{th} country.

4. Results

Estimation of equation (10) for each of the selected countries yield mixed results for the model's appropriateness (see table II). The value of coefficient of determination (R^2) shows the model's standing which seem to be good in case of all the selected countries, though Durbin's h test in 5 countries were not rejecting the presence of serial correlation but we are ignoring it because, (i) Durbin's h test is questionable for small sample size and (ii) we are concerned with total factor productivity (residuals) for each country to be considered as a dependent variable to estimate equation (11) and econometrically there is no problem if a dependent variable is auto-correlated.

Growth rate of employment is found to be significantly explaining growth rate of income in all the countries except Australia at one percent level of significance. However the sign of the slope coefficient is found to be negative for Japan, Norway, New Zealand and UK. This may be attributed to the fact that rising employment growth rate usually has a lag effect on potential rise in income growth and a use of capital intensive production processes or cybernization – a term used by Zineldin (2008) – is considered as another cause of this anomaly. However due to a massive potential of

Table 2
OLS Regression Estimates
GRGDP = f [GREMP, GRFCF, GRGDP(-1)]

	GREMP	GRFCF	GRGDP(-1)	R^2	Durbin's h Stat
AUS	-0.15	0.32***	0.47***	0.70	1.69*
	(-1.07)	(5.28)	(4.66)		
CAN	1.03***	-0.41**	0.63***	0.57	-2.66**
	(2.69)	(-1.11)	(5.73)		
ITA	0.45***	0.10**	0.52***	0.53	-0.98
	(2.73)	(1.95)	(4.19)		
JAP	-0.85***	0.45***	0.43***	0.95	0.62
	(-2.67)	(12.22)	(9.11)		
NET	0.14***	-0.01	1.06***	0.52	0.86
	(2.52)	(-0.61)	(26.64)		
NOR	-0.57***	0.22***	-0.23	0.44	0.00
	(-3.55)	(3.27)	(-1.17)		
NZ	-0.36***	0.26***	0.36***	0.67	1.64*
	(-3.77)	(5.00)	(2.85)		
SPA	0.17***	0.31***	0.57***	0.73	0.60
	(2.48)	(4.64)	(7.74)		
UK	-0.73***	0.37***	0.51***	0.78	-1.66*
	(-2.58)	(6.22)	(6.02)		
US	0.48***	0.28***	0.30***	0.69	0.79
	(4.23)	(5.17)	(3.51)		

*** significant at 1% level of significance, ** significant at 5% level of significance and * significant at 10% level of significance

labor market absorption capacity the USA and Canada enjoys – reflected by Canadian immigration policy, the cybernization process is not causing its negative role on the relationship between growth of employment and income. Growth rate of fixed capital formation and lagged dependent variables were found theoretically valid for almost all the countries and their slope coefficients were also found to be statistically significant.

Table 3
OLS Regression Estimates
TFP = f (GREF, GRLE, GRLS)

	GREF	GRLE	GRLS	R^2	D-W Stat
AUS	0.19***	3.20**	0.34	0.22	1.98
	(2.69)	(2.09)	(0.86)		
CAN	0.28***	-3.91*	0.17	0.10	2.41
	(2.49)	(-1.80)	(0.35)		
ITA	0.17	2.84	0.62	0.07	2.16
	(0.66)	(1.44)	(0.65)		
JAP	-0.03	1.06*	-0.08	0.09	2.02
	(-0.76)	(1.78)	(-0.97)		
NET	0.16*	1.77	-0.46	0.08	1.80
	(1.74)	(0.97)	(-0.48)		
NOR	-0.14**	-0.86	-0.06	0.09	2.16
	(-1.96)	(-0.39)	(-0.08)		
NZ	0.19**	-1.98	-0.40	0.07	1.57
	(1.03)	(-1.67)	(-0.32)		
SPA	-0.44***	0.29	0.17	0.20	2.28
	(-3.00)	(0.30)	(0.27)		
UK	-0.25**	-1.03	-0.39	0.11	2.61
	(-2.00)	(-1.01)	(-0.46)		
US	0.01	0.89	0.31*	0.11	1.99
	(0.16)	(1.33)	(1.77)		

*** significant at 1% level of significance, ** significant at 5% level of significance and * significant at 10% level of significance

Estimations of equation (11) for each selected country are presented in table 3. Although there is no presence of autocorrelation found in the model (11) for each country, the weakness in terms of explanatory power of the model is still prevailing as reflected by low R^2 values. Theoretically the impact of ecological footprint index should be negative on TFP and this rationale is found valid in the cases of Canada, Japan, Norway, Spain, and

UK. However the impact of ecological footprint index on TFP is found significant in the cases of Australia, Canada, Netherlands, Norway, Spain and UK. Thus the odd members in this club are Australia and Netherlands where the impact of ecological footprint is positive on TFP. Such a relationship could be possible for the economies that are possessing unutilized natural resources in abundance. One such example is generating energy by means of windmill in which both Australians and Dutch are tapping their natural resources swiftly.

Life expectancy is significantly explaining TFP in Netherlands, Norway, Spain, UK and USA. Among the significant cases, only New Zealand is showing its negative impact on TFP. The population of New Zealand is ageing. Its most documented feature is the growing size of the elderly population and its increasing share of the total population i.e., an ageing labor force could be a main factor behind this negative relation. As far as the subjective index of happiness – Life Satisfaction – is concerned the slope coefficient is insignificant in all the cases except the USA.

The study re-estimates equation (10) and (11) by using pooled regression approach (see table 4 and table 5). Such a regression approach is useful to handle issues like small number of observations to estimate a model, invariant explanatory variables in a single cross section case that may become divergent under pooled data, and the possibility to capture not only the variation of what emerges through time, but also the variation of other cross sections. The results for equation (10) under pooled regression fixed effect model show that all the explanatory variables are significant at 1% level of significance with no presence of autocorrelation. Estimation of equation (11) under pooled regression technique returned us relatively better estimates than what country-specific simple OLS regression technique has shown. With estimated model do not showing any sign of autocorrelation, growth rates of ecological footprint index and life expectancy both are found to be significant. Life satisfaction index is again found to be insignificant and strengthen the finding for the case of life satisfaction's insignificant role (see table 3) and highlighting the accuracy issue of a subjective nature of data.

Table 4
Pooled Regression Estimates (Fixed Effect)
GRGDP = f [GREMP, GRFCF, GRGDP(-1)]

GREMP	GRFCF	GRGDP(-1)	R^2	Durbin's h Stat
-0.22***	0.09***	0.56***	0.63	2.11*
(-3.87)	(6.84)	(16.14)		

_AUS—C	0.59
_GER—C	0.63
_ITA—C	0.59
_JAP—C	0.58
_NET—C	0.56
_NOR—C	0.56
_NZ—C	0.53
_SPA—C	0.63
_UK—C	0.61
_US—C	0.62

*** significant at 1% level of significance, ** significant at 5% level of significance and * significant at 10% level of significance

Table 5
Pooled Regression Estimates
TFP = f (GREF, GRLE, GRLS)

GREF	GRLE	GRLS	R^2	D-W Stat
0.004**	0.007***	0.011	0.12	2.07*
(2.07)	(2.88)	(0.86)		

*** significant at 1% level of significance, ** significant at 5% level of significance and * significant at 10% level of significance

5. Conclusion

Happiness is now considered as a vital economic indicator to be a goal to

achieve. Happiness research is a mix of objective and subjective approaches towards happiness maximization. It is much broader than the way the utility maximization concept is examined. In our study we have tried to test the impact elements of happiness on economic growth and have thus suggested policy makers to pursue a happiness maximization policy also. Across the globe the economic activities are now shaped in such a competitive way that no relaxation is affordable. Thus this pursuit of income growth has made life styles extremely difficult. In reality we are paying heavy cost in terms of sacrificing happiness.

Endorsing Loria's viewpoint there is not only a need to check national income accounts but there is also a need to develop happier societies. Enhancing happiness – *the intangible capital* – could be helpful in explaining total factor productivity in neoclassical growth.

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