How are Income and Non-Income Factors Different in Promoting Happiness? An Answer to the Easterlin Paradox

Tian, Guoqiang and Yang, Liyan

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How are Income and Non-Income Factors Different in Promoting Happiness? An Answer to the Easterlin Paradox*

Guoqiang Tian†
Department of Economics
Texas A&M University
College Station, Texas 77843, USA

Liyan Yang‡
Rotman School of Management
University of Toronto
Toronto, Ontario M5S 3G7, Canada

Abstract

This paper develops a formal economic theory to explain the Easterlin paradox—average happiness levels do not necessarily increase as countries grow wealthier. The theory analyzes the different roles of income and non-income factors in promoting people's happiness, and provides a foundation for studying happiness from the perspectives of social welfare maximization and individuals' self-interested rationality. It is shown that, for a certain class of economies, whether Easterlin paradox appears depends on the level of non-income factors. Happiness rises with income only up to a critical point that is determined by the level of the non-income factors; but once the critical income level is achieved, raising income further will lead to Pareto inefficient allocations and decrease people's happiness. One policy implication is that government should promote a balanced growth between income and non-income factors. The empirical analysis provides some preliminary evidence consistent with the theory's predictions.

Keywords: Easterlin Paradox, Happiness, Social Comparison, Pareto Optimality

Journal of Economic Literature Classification Number: D61, D62, H23.

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‡Email: ly52@cornell.edu; Tel: 607-253-6502.

1 Introduction

The Easterlin Paradox is the name for the phenomenon that economic growth does not necessarily increase happiness or life satisfaction in a variety of economies. This phenomenon challenges the traditional views of economics that individuals' utilities depend solely on their own consumption of goods and that measures of income are sufficient indices to capture well-being.[1] The Kingdom of Bhutan has even adopted the national happiness product (GHP) rather than the gross domestic product (GDP) to measure her national progress. Over the past decades, economists and psychologists have exerted extensive efforts to explore the puzzling relationship between income and happiness.

Two prominent approaches to explain the Easterlin Paradox are the "omitted variables" approach and the social comparison approach. Di Tella and MacCulloch (2005) coined the term "omitted variables" to stand for non-income factors which have been shown in numerous experimental and empirical studies to be strongly related to happiness.[2] These non-income factors refer to personal characteristics (health, friendship, religion, marriage), macroeconomic variables (inflation, unemployment, inequality) and social variables (environment, human rights, trust, culture, governance). According to the "omitted variables" approach, it is the depreciation of non-income factors that accounts for the stagnation of happiness levels.

The social comparison approach, proposed first by Easterlin himself (1995, 2001), focuses on the income factor only and states that happiness varies directly with one's own income but varies inversely with the incomes of others. When the positive effect of a person's own higher income is offset by the negative effect of others' higher incomes, economic growth will not increase their happiness, even though it increases their wealth. Although social comparison is a social-psychology concept, it has been well modeled as interdependent preference in economics. For example, the "keeping up with the Joneses" models, a growing literature in macroeconomics, rely on status-seeking behaviors to study asset prices (e.g., Campbell and Cochrane, 1999), taxation and growth (e.g., Liu and Turnovsky 2005).

Significant as they are, both approaches have limitations. The studies adopting the "omitted variables" approach are mostly empirical or experimental analysis conducted by psychologists. Very

[1]Tian and Yang (2005) have a detailed discussion on the background of this issue.

[2]See Diener and Seligman (2004) for a review.

few economic models have been proposed to study people's happiness,[3] and partly because of this, the economics of happiness is regarded as non-mainstream economics and has been neglected. More importantly, it also seems unlikely that non-income factors alone can completely explain the Easterlin Paradox. On the one hand, the increase in income seems too dramatic to be counterbalanced by the decrease in non-income factors in many countries. For example, Japan's real GDP per capita in 1987 was five times higher than in 1958, yet the overall happiness remained stationary. On the other hand, some non-income factors, such as leisure and environment, have improved, deepening the Easterlin Paradox rather than solving it (Di Tella and MacCulloch, 2006).

The social comparison approach takes no account of the interactions between income and non-income factors in promoting happiness, so that it fails to explain other aspects of the relationship between income and well-being. In particular, many studies find that "happiness seems to rise with income up to a point, but not beyond it." (Graham 2005, p. 4) For example, Layard (2005) proposes that extra money buys no happiness once personal income rises above USD20,000. In the literature, this critical point is commonly explained as the *exogenous* level of income which is necessary to maintain the basic needs of life. In this paper, in contrast, we are going to show that such a critical point can be *endogenously* generated by the interaction between income and non-income factors.

It may be noted there is some new development on the Easterlin paradox. Recently, Stevenson and Wolfers (2008) reassess the Easterlin Paradox with recent data. They establish a positive link between average levels of subjective well-being and GDP per capita across countries. However, we will show that, for a certain class of economic environments specified in the paper, whether Easterlin paradox appears depends on the level of non-income factors.

Specifically, we develop a theoretical model in which individuals derive utility from both income and non-income factors, but only the income factor exhibits the social comparison effect. It is shown that Pareto efficiency will require free disposal of a certain amount of income once the income reaches some critical level, whose magnitude is determined by the endowment of non-income factors. In consequence, given the non-income factors, raising the income of all beyond the critical level would not raise the happiness of all. In addition, economic growth will eventually

[3] Exceptions are a series of studies by Yew-Kwang Ng and his coauthors (Ng and Wang, 1993; Ng and Ng, 2001; Ng, 2003).

decrease social welfare if the increased income is exhausted in equilibrium and government policies have corrected all the market failures in the pecuniary domain. Those results lead to an important policy prescription: when the critical income level is achieved, improving non-income factors is the only way to raise well-being.

Therefore, integrating the "omitted variables" approach and the social comparison approach sheds new light on the understanding of the Easterlin paradox. On the one hand, income social comparison justifies the *existence* of a critical income point beyond which more income does not make people happier. On the other hand, non-income factors determine the *magnitude* of the critical income level, i.e., improving non-income factors such as health and human rights can push the critical point to a higher level.

We also provide some preliminary empirical evidence to test our theoretical predictions. Specifically, we obtain estimates for the model's implied critical income levels from the *World Value Survey,* and find that for countries whose incomes are below their estimated critical levels, economic growth has a positive effect on happiness; but for those whose incomes are above the critical levels, economic growth has no effect, or even negative effect, on happiness. These findings corroborate our theoretical explanations of the differing evolution of happiness in different countries.

On top of the results we obtained, this paper *per se* also illuminates the possibility of integrating happiness studies into mainstream economics, since we conduct our theoretical analysis within a standard economics textbook model and with standard economics concepts like Pareto efficiency and social welfare functions.

Besides the "omitted variables" approach and the social comparison approach, there are other explanations to the Easterlin Paradox. The hedonic adaptation theory (e.g., Frederick and Loewenstein, 1999), known as habit formation in economics, says that extra income initially provides extra pleasure, but it is usually only transitory, because people become hedonically adapted to the higher income. The set point theory states that every individual goes back to a presumed happiness level over time (e.g., Easterlin, 2003). Some researchers claim that the happiness data are themselves misleading, because happiness scores are not comparable among people, and people redefine their happiness scores over time.[4] Our results complement this literature.

The rest of the paper is organized as follows. Section 2 presents the model, highlights the

[4]See Di Tella and MacCulloch (2006) for a discussion.

different roles of income and non-income factors in promoting happiness, and gives an answer to the Easterlin Paradox. Section 3 considers some extensions to the basic model, and section 4 provides some preliminary evidence. Section 5 concludes. All the proofs are collected in an appendix.

2 The Model

In this section, we first describe the model and underscore the interpretation of the goods and the motivation of the utility functions. Then, we rely on two basic economics concepts, Pareto efficiency and social welfare, to explain two interesting phenomena: (i) at an individual level, raising everyone's income will not necessarily increase everyone's happiness; and (ii) at a society level, economic growth is not necessarily accompanied by increased social happiness (i.e., the Easterlin Paradox). Both explanations highlight the importance of improving non-income factors in promoting individual and social happiness.

2.1 Economic Environment

Consider an exchange economy with $I \geq 2$ consumers who consume two types of goods. Good m indexes the income factor and good n indexes non-income factors such as health, marriage, environment, employment status, that is, all the other factors considered by psychologists to explain the differences in subjective well-being across countries.

We offer two explanations for our categorization of goods. Good m could be understood as first *material good* and good n as *non-material good*. In reality, good m roughly corresponds to those goods and services that are currently included in GDP, and good n corresponds to those not included. The first interpretation is consistent with the empirical happiness studies in which GDP is used as a measure of the *material* well-being of a society. Good m can also be interpreted as *positional good* and good n as *non-positional good*. This interpretation is based on the fact that social comparison does not operate equally across different goods. In economics, positional goods refers to "those things whose value depends relatively strongly on how they compare with things owned by others. Goods that depend relatively less strongly on such comparisons will be called non-positional goods." (Frank, 1985, p. 101)

The above two explanations are in fact consistent. The positional goods literature has proposed the following empirically supported hypotheses: "(1) Income is more positional than leisure...(3) Private goods are more positional (competitive) than public goods (cf. Ng, 1987), (4) Consumption goods such as clothing and housing are more positional than health and safety." (Solnick and Hemenway, 2006, p. 147) These hypotheses are basically saying that material goods are more positional than non-material goods. Easterlin (2003) also argues that social comparison in the "pecuniary domain" is stronger than in the "nonpecuniary domain". This is true because in the material goods domain, comparison is easily done, but health, family life, etc., "are less accessible to public scrutiny than material possessions" (Easterlin, 2003, p. 11181), or they are "inconspicuous" consumption (Frank, 2004). Thus, preferences must be interdependent with respect to positional goods.

In the subsequent discussions, we will refer to good m as *income good*, and good n as *non-income good*. Initially, there are $\bar{m}$ units of income good and $\bar{n}$ units of non-income good available. Consumer i's consumption of the two goods is denoted by a vector (m_i, n_i), $i = 1, ..., I$. Assume that the consumption of good m exhibits a negative externality such that the utility of consumer i is adversely affected by other consumers' income good consumption, $m_{-i} = (m_1, ..., m_{i-1}, m_{i+1}, ..., m_I)$. Since good n refers to non-positional good, we assume the consumption of good n has no social comparison effect. Consumer i's utility function is then denoted as $u_i(m_i, n_i; m_{-i})$, which is continuously differentiable, $\frac{\partial u_i}{\partial m_i} > 0$, $\frac{\partial u_i}{\partial n_i} > 0$, $\frac{\partial u_i}{\partial m_j} < 0$, $\frac{\partial^2 u_i}{\partial m_i^2} < 0$, and $\frac{\partial^2 u_i}{\partial m_j^2} \leq 0$, for $i, j = 1, ..., I$ and $j \neq i$. As such, $\frac{\partial u_i}{\partial m_i}$ may be regarded as agent i's marginal benefit from his consumption m_i and $\frac{\partial u_i}{\partial m_j}$ may be regarded as agent i's marginal cost (negative externality) resulting from the other's consumption m_j.

Recently, Vostroknutov (2007) has provided an axiomatic foundation that allows interdependent preferences to have a representation which separates the utility of consumption from the utility of social comparison. He argues that the consumption part of the preferences should depend only on the possessions of the agents themselves, whereas the social comparison part of the preferences should depend on others' possessions relative to their own. Vostroknutov uses Anscombe and Aumann's (1963) framework to show that a group of reasonable axioms leads to the following utility representation for interdependent preferences:

$$u_i(m_i, n_i; m_{-i}) = f(m_i, n_i) + \sum_{j \neq i} \pi_j g(m_i, m_j), \tag{1}$$

where the the first term, $f(m_i, n_i)$, is the utility from consuming income and non-income goods, and the second term, $\sum_{j \neq i} \pi_j g(m_i, m_j)$, is the utility from social comparison in income. The function $g(m_i, m_j)$ describes the specific way that consumer i cares about her income consumption relative to one other consumer j, and $\{\pi_j\}_{j \neq i}$ are the weights that represent the importance of each other consumer to agent i.

For computational simplicity, in our basic model, we adopt the following specific function form to illustrate the essential idea:

$$u_i(m_i, n_i; m_{-i}) = m_i^{\alpha} n_i^{1-\alpha} - \beta \frac{\sum_{j \neq i} m_j}{I-1}, \text{ with } \alpha \in (0,1), \beta > 0, i = 1, ..., I. \tag{2}$$

Here, a standard textbook Cobb-Douglas function is used to represent the utility from consumption of one's own goods, and a simple linear function is used to the capture the income social comparison effect. In terms of equation (1), we have $f(m_i, n_i) = m_i^{\alpha} n_i^{1-\alpha}$, $\pi_j = \frac{\beta}{I-1}$ and $g(m_i, m_j) = -m_j$. Our specification of social comparison is also consistent with Easterlin (1995, 2001), who uses average income to capture the negative consumption externality of m_{-i}. In section 3.3, we demonstrate that our results also hold for more general utility functions given by equation (1), provided that the income social comparison effect is sufficiently large.

More comments about the function form are in order. First, the current utility function assumes that all the consumers are in the same reference group. One will see that this assumption can be relaxed, and an extension of the basic model to multiple reference groups yields similar results in section 3.1. Second, we assume that there is a negative externality in the consumption of the income good, but there is *no* externality in the consumption of the non-income good. So our assumption is an extreme case in which there is no social comparison in non-income goods. By relaxing this assumption in section 3.2, we will see that it does not affect our main results. Third, some of the non-income goods are public rather than private goods, such as democracy and inflation. But the main qualitative result of this paper still holds if we assume that good n is a public good.

2.2 Pareto Efficiency and Social Happiness Maximization

2.2.1 Pareto Efficiency: When Will Raising the Incomes of All Increase the Happiness of All?

When evaluating the performance of an economic system, economists usually adopt the criterion of Pareto efficiency. Implicit in every Pareto efficient outcome is the condition that all possible improvements to a society have been exhausted. If an allocation is Pareto inefficient, some alternative allocation can be supported by consensus. In particular, Pareto efficiency is a suitable concept for answering Easterlin's question: "will raising the incomes of all increase the happiness of all?" (Easterlin, 1995)

Definition 1 *An allocation of income and non-income goods* $\{m_i, n_i\}_{i=1}^{I} \in \mathbb{R}_{++}^{2I}$ [5] *is* feasible *if* $\sum_{i=1}^{I} m_i \leq \bar{m}$ *and* $\sum_{i=1}^{I} n_i \leq \bar{n}$.[6] *An allocation of income and non-income goods* $\{m_i, n_i\}_{i=1}^{I}$ *is* Pareto optimal (efficient) *if it is feasible, and there does not exist another feasible allocation,* $\{m_i', n_i'\}_{i=1}^{I}$*, such that* $u_i(m_i', n_i'; m_{-i}') \geq u_i(m_i, n_i; m_{-i})$ *for all* $i = 1, ..., I$ *and* $u_i(m_i', n_i'; m_{-i}') > u_i(m_i, n_i; m_{-i})$ *for some* i.

For our model, Pareto efficient outcomes $\{m_i^*, n_i^*\}_{i=1}^{I}$ are characterized by the following problem:

$$(PE) \begin{cases} \max\limits_{\{m_i, n_i\}_{i=1}^{I} \in \mathbb{R}_{++}^{2I}} m_I^{\alpha} n_I^{1-\alpha} - \beta \frac{m_1 + ... + m_{I-1}}{I-1} \\ s.t. \ \sum_{i=1}^{I} m_i \leq \bar{m}, \\ \sum_{i=1}^{I} n_i \leq \bar{n}, \\ m_i^{\alpha} n_i^{1-\alpha} - \beta \frac{\sum_{j \neq i} m_j}{I-1} \geq u_i^*, \forall i = 1, ..., I-1, \end{cases}$$

where $u_i^* = m_i^{*\alpha} n_i^{*1-\alpha} - \beta \frac{\sum_{j \neq i} m_j^*}{I-1}$.

By solving the above problem in appendix A, we have the following technical result.

Lemma 1 *For a pure exchange economy with the above specific utility functions, it is necessary to destroy some income good in order to achieve Pareto efficient outcomes if and only if* $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$. *Specifically,*

[5] Here, we implicitly assume the consumption sets of all consumers are open sets $\mathbb{R}_{++}^2$, in order to easily apply the Kuhn-Tucker theorem.

[6] If both weak inequalities hold with equality, then the allocation is called ballanced.

(1) When $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, income destruction is necessary to achieve Pareto efficient allocations, and the set of Pareto optimal allocations is characterized by

$$\left\{ \begin{array}{c} \{m_i, n_i\}_{i=1}^{I} \in \mathbb{R}_{++}^{2I} : m_i = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} n_i, \forall i = 1, ..., I, \\ \textit{and } \sum_{i=1}^{I} n_i = \bar{n},\ \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n} = \sum_{i=1}^{I} m_i < \bar{m}. \end{array} \right\}$$

(2) When $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, all income good should be exhausted to achieve Pareto efficient allocations, and the set of Pareto optimal allocations is characterized by

$$\left\{ \begin{array}{c} \{m_i, n_i\}_{i=1}^{I} \in \mathbb{R}_{++}^{2I} : m_i = \frac{\bar{m}}{\bar{n}} n_i, \forall i = 1, ..., I, \\ \textit{and } \sum_{i=1}^{I} n_i = \bar{n},\ \sum_{i=1}^{I} m_i = \bar{m}. \end{array} \right\}.$$

Lemma 1 shows that once income level $\bar{m}$ achieves the critical point $\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, one has to freely dispose of some income good to achieve Pareto efficiency; otherwise the resulting allocations will be Pareto inefficient. This result provides an answer to the question of when raising the incomes of all will increase the happiness of all (Easterlin, 1995). Figure 1 illustrates how.

FIGURE 1 GOES HERE

In Figure 1, any point corresponds to a particular economy, with the vertical (horizontal) axis coordinate representing the aggregate consumption of the income (non-income) good. Since we do not specify the individual consumption bundles at any point, many allocations are compatible with an economy. But we assume that any underlying allocation, which could be implemented by a market mechanism with corrective government policies, in the non-shaded area is Pareto efficient. In contrast, lemma 1 indicates that the allocations in the shaded area will be Pareto inefficient, because the aggregate consumption of the income good is greater than the critical values.

Suppose the economy is initially at point A, which is relatively poor in terms of the income good. Then increase everyone's income while keeping the non-income constant, such that the economy moves to another point B. Economic growth of this kind could potentially increase everyone's happiness, because in a richer society (point B), any initial allocation at point A is still feasible but not Pareto efficient by lemma 1, i.e., there is a way to improve everyone's well-being when the economy moves from A to B.

However, if we keep increasing everyone's income without changing the non-income good from point B to point C, then this change will definitely hurt some individuals. To see why, recalling lemma 1, once the income endowment exceeds the critical point, $(\alpha/\beta)^{\frac{1}{1-\alpha}}\,\bar{n}$, income destruction is necessary to achieve Pareto efficient outcomes. Therefore, the original allocation in point B, which is assumed to be Pareto efficient in economy B, is still Pareto efficient in the more affluent economy C. As a result, some individuals are worse off as the economy moves from B to C with different allocations, which is a direct implication of the definition of Pareto efficiency. Thus, raising income alone may not benefit everyone in the economy.

However, if we simultaneously increase income and non-income goods, as from B to D, then everyone could be better off, following a similar discussion as in the change from A to B. The result has important policy implications, suggesting that improving income and non-income factors could potentially support a growth path along which everyone is sustainably getting happier.

2.2.2 Social Welfare Maximization: When Does Economic Growth Produce Social Happiness?

How does one evaluate people's happiness as a whole? What is the corresponding economics concept of the social happiness in the Easterlin Paradox? These questions involve comparing utilities across different individuals. In economics, the concept of social welfare function has been developed to achieve this.

A *social welfare function* (SWF), $W(u_1, ..., u_I)$, takes the individual utilities as arguments and generates a real number to represent the judgement of the whole society about different allocations. A SWF is usually assumed to be strictly monotone in individual utilities. A commonly used SWF is the utilitarian SWF:

$$W(u_1, ..., u_I) = \sum_{i=1}^{I} a_i u_i, \text{ with } a_i \geq 0,$$

which says that social happiness is a linear sum of weighted utilities of individuals. In the happiness studies, some psychologists (e.g., Diener and Seligman, 2004) use mean life satisfaction to represent a society's happiness, which is essentially equivalent to adopting a utilitarian SWF with equal weights.

An ideal society should operate at allocations that maximize some SWF subject to the resource constraints. Clearly, the optimal allocations have to be Pareto efficient, given the monotonicity of a SWF. The optimal allocations could be implemented by a market mechanism with corrective government policies. For this reason, we will refer to the *social happiness* in the Easterlin Paradox literature as the maximum social welfare that could be achieved with feasible allocations.[7] In general, the values of social happiness depend on the choices of the SWF. Following lemma 1, we present the following proposition to characterize the behavior of social happiness in our model.

Proposition 1 *In a pure exchange economy with the above specific utility functions,*
(1) if $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$*, i.e., if the economy is relatively poor, then for any choice of SWF, raising income alone will increase social happiness;*
(2) if $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$*, i.e., if the economy is relatively rich, then for any choice of SWF, raising income alone will not change social happiness; if in addition, no free disposal of income is allowed, then raising income alone will decrease social happiness; and*
(3) if $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$*, the only way to increase social happiness is to increase the amount of non-income good.*

Proposition 1 not only provides an explanation of the Easterlin Paradox, but also gives policy prescriptions to resolve the paradox, i.e., promoting income and non-income goods in a balanced way. To better understand our result, let us choose a simple utilitarian social welfare function, $W(u_1, ..., u_I) = u_1 + u_2 + ... + u_I$, which comports with using mean life satisfaction to represent social happiness in the literature.

Plugging the Pareto efficient allocations given by lemma 1 into the social welfare function $W(u_1, ..., u_I) = u_1 + u_2 + ... + u_I$, social happiness is:

$$W = \begin{cases} \bar{m}^{\alpha}\bar{n}^{1-\alpha} - \beta\bar{m} & \text{if } \bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n} \\ \left(\frac{\beta}{\alpha} - \beta\right)\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n} & \text{if } \bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n} \end{cases}.$$

If free disposal is not allowed, i.e., if all resource constraints have to be balanced, as is more likely the case in reality, then social happiness is given by

$$W = \bar{m}^{\alpha}\bar{n}^{1-\alpha} - \beta\bar{m},$$

[7] If one prefers to interpret social happiness as the social welfare evaluated at a competitive market equilibrium, then the following proposition 1 would change to a slightly different version: the effect of raising income on social happiness has an upper bound, and increasing non-income good will raise this upper bound.

for all $\bar{m} > 0$ and $\bar{n} > 0$. How social happiness varies with income $\bar{m}$ for a fixed $\bar{n}$ is graphically shown in Figure 2.

Figure 2 illustrates the possibility that increasing income alone can bring happiness only up to a point. This result helps us understand the different evolutions of happiness in countries with similar growth performances, for example, there is no trend in the U.S., a decline in Britain, Italy and Germany, and an increase in France (c.f. Cooper *et al.*, 2001). Specifically, if the non-income factors have not changed significantly, for those countries whose income levels are lower than their critical points, economic growth produces happiness; for those countries whose income levels exceed their critical points, economic growth has no impact on happiness if free disposal is allowed, or even a negative impact on happiness if free disposal is impossible. In section 4, we obtain estimates of the critical points from the *World Value Survey* and verify the above explanation for some countries, such as the USA, Ireland, the Netherlands.

FIGURE 2 GOES HERE

Our model suggests that government policies should be tilted towards boosting non-income good when the income level is close to the critical point. A government can actually play an important role in many non-material domains, for example, fighting inflation, improving democracy and freedom, preventing crime. Diener and Seligman (2004) argue that government can also find a way to improve social relations, relieve mental disorder, etc. They also suggest that the government should build a system of well-being indicators and focus on directly improving well-being. All of these suggestions by psychologists can be supported by our theoretical model.

3 Extensions

In our basic model, there is only one reference group, there is no social comparison for non-income good, and a specific utility function is used. All these assumptions will be relaxed in this section, and our main result (proposition 1) will still be found to be valid.

3.1 Multiple Reference Groups

When people make social comparisons, they usually compare themselves to others in the same reference group, say, people in the same city or of the same profession. In this subsection, assume there are K groups, group k has I_k consumers, and consumers compare themselves with the other agents in the same group. Specifically, a typical consumer i in group k has the following utility function

$$u_{ik}\left(m_{ik}, n_{ik}; m_{-ik}\right) = m_{ik}^{\alpha_k} n_{ik}^{1-\alpha_k} - \beta_k \frac{\sum_{j \neq i} m_{jk}}{I_k - 1},$$

where $0 < \alpha_k < 1$, $\beta_k > 0$, and m_{-ik} denotes the vector $(m_{1k}, ..., m_{i-1,k}, m_{i+1,k}, ...m_{I_k k})$. Our basic model corresponds to $K = 1$ and $I_1 = I$.

Two layers of allocation problems are involved in finding the Pareto efficient outcomes: (i) allocate the society's aggregate resources among groups; and (ii) allocate the group's aggregate resources among consumers within the group. We are going to start with the second problem.

Suppose group k has a total of $(\bar{m}_k, \bar{n}_k)$ units of income and non-income goods available. According to proposition 1, at Pareto efficiency allocations, the critical income level for group k is $\bar{m}_k^C = \left(\frac{\alpha_k}{\beta_k}\right)^{\frac{1}{1-\alpha_k}} \bar{n}_k$. That is, if $\bar{m}_k > \bar{m}_k^C$, then Pareto efficiency requires free disposal of income good within group k. Therefore, for any given endowment vector $(\bar{m}, \bar{n})$ of the whole economy, Pareto efficient allocation would end up with either $\bar{m}_k \geq \bar{m}_k^C$ or $\bar{m}_k \leq \bar{m}_k^C$ for all k. Otherwise, i.e., if $\bar{m}_k > \bar{m}_k^C$ for some k and $\bar{m}_{k'} < \bar{m}_{k'}^C$ for some $k' \neq k$ at the same time, then transferring income from group k to group k' would lead to a Pareto improvement.

Given the above discussion, if the society's aggregate income is relatively high, such that $\bar{m} > \sum_{k=1}^{K} \left(\frac{\alpha_k}{\beta_k}\right)^{\frac{1}{1-\alpha_k}} \bar{n}_k$, then there will be destruction of income good within some group at Pareto efficient allocations. At this time, increasing income goods alone would result in the same set of Pareto efficient allocations as before, and consequently would have no effect on increasing social happiness indexed by any social welfare function. We formalize this result in the following proposition.

Proposition 2 *In the economy with multiple reference groups,*
(1) if the economy is poor (i.e. $\bar{m} \leq \sum_{k=1}^{K} \left(\frac{\alpha_k}{\beta_k}\right)^{\frac{1}{1-\alpha_k}} \bar{n}_k$), then increase in income alone will increase social happiness; and
(2) if the economy is rich (i.e. $\bar{m} > \sum_{k=1}^{K} \left(\frac{\alpha_k}{\beta_k}\right)^{\frac{1}{1-\alpha_k}} \bar{n}_k$), then increase in income alone has no effect on social happiness, and the only way to produce social happiness is to improve non-income good.

3.2 The Social Comparison Effect of Non-Income Good

Although non-income good is less subject to social comparison than income good, it might be too restrictive to assume that non-income good does not have any negative externality. This subsection relaxes this assumption.

To ease exposition, consider an economy with only two consumers. Of course, there is only one reference group in this case. Let the utility function be

$$u_i(m_i, n_i; m_j) = m_i^{\alpha} n_i^{1-\alpha} - \beta m_j - \gamma n_j,$$

where $\alpha \in (0,1), \beta > 0, \gamma > 0,\ i \in \{1,2\}, j \in \{1,2\}, j \neq i$. The parameters β and γ capture the social comparison effects of income and non-income goods, respectively. In addition, assume that the economy adopts a utilitarian social welfare function. That is, we have the following maximization problem:

$$(SCN)\begin{cases} \max\limits_{(m_1,n_1,m_2,n_2)\in\mathbb{R}^4_{++}} & m_1^{\alpha} n_1^{1-\alpha} - \beta m_2 - \gamma n_2 + m_2^{\alpha} n_2^{1-\alpha} - \beta m_1 - \gamma n_1 \\ & s.t.\ m_1 + m_2 \leq \bar{m},\ n_1 + n_2 \leq \bar{n}. \end{cases}$$

Let $\beta^{\frac{1}{1-\alpha}} \gamma^{\frac{1}{\alpha}}$ be a measure of the *joint social comparison effect* of income and non-income goods. It can be shown that the joint social comparison effect has to be smaller than an upper bound, $\alpha^{\frac{1}{1-\alpha}} (1-\alpha)^{\frac{1}{\alpha}}$, in order for everyone to consume both goods in an allocation which maximizes social welfare. This condition will hold even when the income social comparison effect, β, is very large, as long as the non-income social comparison effect, γ, is sufficiently small. For example, when $\alpha = 1/2$, if $\gamma = 1/16$, then β can take values up to 4. The relative magnitudes of β and γ might correspond to reality, as we argued before.

In addition, if income is large enough relative to the non-income good,

$$\bar{m} \geq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n},$$

then social welfare maximization will require free disposal of income good. Social happiness is given by

$$W = \left[\left(\frac{\alpha}{\beta}\right)^{\frac{\alpha}{1-\alpha}} - \beta \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} - \gamma \right] \bar{n},$$

where the coefficient $\left(\frac{\alpha}{\beta}\right)^{\frac{\alpha}{1-\alpha}} - \beta \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} - \gamma$ can be shown to be positive by $\beta^{\frac{1}{1-\alpha}} \gamma^{\frac{1}{\alpha}} < \alpha^{\frac{1}{1-\alpha}} (1-\alpha)^{\frac{1}{\alpha}}$. We state this result formally in the following proposition, which is proved in appendix B.

Proposition 3 *Suppose that both goods have social comparison effects in the economy and that the joint social comparison is small, i.e.,* $\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}} < \alpha^{\frac{1}{1-\alpha}}(1-\alpha)^{\frac{1}{\alpha}}$. *Then,*
(1) in a poor society (i.e. $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$*), raising income alone will increase social happiness, indexed by the utilitarian SWF with equal weights; and*
(2) in a rich society (i.e. $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$*), raising income alone has no effect on social happiness, indexed by the utilitarian SWF with equal weights; the only way to produce social happiness is to improve non-income good.*

3.3 General Utility Functions

The results obtained in section 2 can be extended to economies with general utility functions given by (1). For simplicity, consider a symmetric two-consumer economy and use a simple utilitarian SWF to measure social happiness. In Tian and Yang (2008), the Pareto efficiency problem is considered in the context of more general utility functions with externalities.

As indicated before, consumer i's utility function, equation (1), has its axiomatic foundation provided by Vostroknutov (2007). In a symmetric two-consumer economy, equation (1) changes to:

$$u_i(m_i, n_i; m_{-i}) = f(m_i, n_i) + g(m_i, m_j), \tag{3}$$

where the functions $f(\cdot,\cdot)$ and $g(\cdot,\cdot)$ are twice continuously differentiable. We will solve the following maximization problem to find the allocations that maximize social welfare:

$$(GUF)\begin{cases} \max\limits_{(m_1,n_1,m_2,n_2)\in\mathbb{R}^4_{++}} & f(m_1,n_1) + g(m_1,m_2) + f(m_2,n_2) + g(m_2,m_1) \\ & s.t.\ m_1 + m_2 \leq \bar{m},\ n_1 + n_2 \leq \bar{n}. \end{cases}$$

The first order conditions of the problem (GUF) are given in appendix C.

It can be shown that the way in which social happiness varies with income depends on the value of the following function:

$$H(m,\bar{n}) = f_1(m, \bar{n}/2) + g_1(m,m) + g_2(m,m),$$

where $f_1(\cdot,\cdot)$ is the partial derivative of $f(\cdot,\cdot)$ with respect to its first argument; a similar explanation applies to $g_1(\cdot,\cdot)$ and $g_2(\cdot,\cdot)$. In our basic model with $I = 2$, we have $f_1(m,\bar{n}/2) = \alpha m^{\alpha-1}(\bar{n}/2)^{1-\alpha}$, $g_1(m,m) = 0$ and $g_2(m,m) = -\beta$. The value $H(m,\bar{n})$ measures the marginal effect of income on happiness given $\bar{n}$ units of non-income good. The first term, $f_1(m, \bar{n}/2)$, is the marginal utility derived from the consumption of an extra unit of income good; the second term, $g_1(m, m)$, is the marginal utility derived from the increase of some consumer's social rank; and the third term, $g_2(m, m)$, is the marginal disutility that comes from the decrease of the other consumer's social rank.

Given that $f_1(m, \bar{n}/2)$ and $g_1(m, m)$ are marginal benefits and that $g_2(m, m)$ is marginal cost, the following assumptions sound reasonable:

(A1) $f_1(m, \bar{n}/2)$, $g_1(m, m)$ and $g_2(m, m)$ are weakly decreasing in m, and at least one of them is strictly decreasing in m;

(A2) $\lim_{m\to 0}[f_1(m, \bar{n}/2) + g_1(m, m)] > \lim_{m\to 0} g_2(m, m)$; and

(A3) $\lim_{m\to\infty}[f_1(m, \bar{n}/2) + g_1(m, m)] < \lim_{m\to\infty} g_2(m, m)$.

Assumption (A1) states that the marginal benefits are diminishing in income good, but the marginal cost is increasing in income good. Assumptions (A2) and (A3) say that the marginal benefits outweigh the marginal cost when income is low and that the reverse is true when income is high. Clearly, the utility function of our basic model satisfies these two assumptions.

Assumptions (A1)-(A3) lead to the following proposition:

Proposition 4 *Suppose the quasiconcave utility functions given by (3) satisfy assumptions (A1)-(A3). Then, there exists a critical point, $\bar{m}^C$, which is implicitly determined by $H\left(\bar{m}^C/2, \bar{n}\right) = 0$ such that*
(1) in a poor society (i.e., $\bar{m} \leq \bar{m}^C$), raising income alone will increase social happiness, as indexed by the utilitarian SWF with equal weights; and
(2) in a rich society (i.e., $\bar{m} > \bar{m}^C$), raising income alone has no effect on social happiness, as indexed by the utilitarian SWF with equal weights; increase in social happiness can be achieved only by raising non-income good.

4 Empirical Evidence

In this section, we fit the data to our theoretical model to estimate the critical values, and provide some preliminary evidence to support our theoretical results. We demonstrate that economic growth does increase happiness for those countries whose income levels are lower than their estimated critical values, but does not for those whose income levels are larger than the estimated critical values.

4.1 Data

Our data sets are the *World Values Survey* (WVS) and the *ERS International Macroeconomic Data Set*. The *World Values Survey* has four successive waves, in 1981-1982, 1989-1993, 1995-1998, and 1999-2003. Different waves cover different but overlapping countries. The most recent survey covers more than 70 countries. We do a cross-nations analysis, in which each country from each wave constitutes one observation.[8] Our main purpose is to get estimates of α and β in the utility function (2), and calculate the model-implied critical values.

The WVS provides a life satisfaction variable, scaled from 1 (Dissatisfied) to 10 (Satisfied). In line with the previous empirical happiness studies, we use the mean satisfaction to index happiness u, while the real per capita income (in 2000 USD) in the *ERS International Macroeconomic Data Set* is used to represent the income explanatory variable m.

The non-income good n in our model should be understood as a composite good made up of a large number of factors with significant influence on happiness. According to the previous empirical studies,[9] we focus on the following non-income factors available from the WVS data set: state of health, marital status, human rights and time with friends. We have tried other non-income factors, for example, age, and got similar results not reported here. Other variables in the WVS, such as corruption, could also serve as candidates for non-income factors which we did not explore in the analysis. The main reason is that in many cases the data are missing for a large number of countries in some waves, even for the U.S. and Britain.

Because we have a small sample size in the cross-nations analysis, we are not going to use many non-income variables in one regression, but instead, we will try different ways to combine two of them in a Cobb-Douglas form to index the composite non-income good. That is, we assume

$$n = n_1^{\phi_1} n_2^{\phi_2}, \tag{4}$$

where $\phi_1 > 0$, $\phi_2 > 0$, and n_1, n_2 denote two non-income factors.

[8] This is aggregate information. The *World Values Survey* contains data at the individual level.

[9] For a review, see Diener and Seligman (2004).

All non-income factors are ordered data in the WVS. For example, the variable A009 asks "(a)ll in all, how would you describe your state of health these days?" The correspondents can choose any answer from "very good" to "very poor." We use percentage to measure n_1 and n_2 so that the explanatory variables will be independent of the order scale. To be specific, "state of health" is the percentage of respondents who report good health conditions; "marital status" is the percentage who are "married" or "living together as married" (X007 in the WVS); "human rights" is the percentage who report "there is a lot of respect for individual human rights" (E124 in the WVS); and "time with friends" is the percentage who visit friends frequently (A058 in the WVS).

In addition, in order to control the effect of the dissolution of the Former Soviet Union, a dummy variable is introduced. For Belarus, Estonia, Latvia, Lithuania, Russia, and Ukraine, this dummy variable takes value 1 and for the other countries, it takes value 0. Table 1 reports the data summary.

TABLE 1 GOES HERE

4.2 Results

We estimate the following utility function,

$$u = m^{\alpha}\left(n_1^{\phi_1} n_2^{\phi_2}\right)^{1-\alpha} - \beta m - \kappa D, \tag{5}$$

where D denotes the dummy variable to indicate whether the country belongs to the Former Soviet Union. Equation (5) implicitly assumes that individuals are identical within one country and compare themselves only with other people in the same country.

We do a non-linear least squared estimation with Eviews4, and the results for various combinations of non-income factors are reported in Table 2.[10] For example, regression I chooses n_1 and n_2 as "state of health" and "marital status" and gives the following estimated values: $\hat{\alpha} = 0.09$, $\hat{\beta} = 3.22\text{e-}5$, $\hat{\phi}_1 = 0.23$, $\hat{\phi}_2 = 0.08$, and $\hat{\kappa} = 0.52$. There are 147 observations included in this regression, and the adjusted R^2 is 0.59. The t-statistics reported in parentheses indicate that $\hat{\alpha}$ and $\hat{\phi}_1$ are significant at the 1% level and the other parameters are significant at the 5% level. Similarly, regression II gives the result based on taking n_1 and n_2 as "state of health" and "human

[10] Graham (2005) pointed out that the result of the OLS method is almost the same as that of the ordered probit or logit model.

rights," and so forth. The signs of the estimated coefficients are consistent with the previous works. For example, due to the instability effect of the dissolution of the Soviet Union, belonging to the Former Soviet Union has a negative effect on happiness.

TABLE 2 GOES HERE

The patterns of coefficients are similar across all regressions. We focus on those regressions whose parameters are all significant: regression I ($n_1 =$"state of health", $n_2 =$"marital status"), regression III ($n_1 =$"marital status", $n_2 =$"human rights"), and regression V ($n_1 =$"human rights", $n_2 =$"time with friends"). According to equation (4), we can estimate the composite non-income factor by

$$\hat{n} = n_1^{\hat{\phi}_1} n_2^{\hat{\phi}_2},$$

which gives the critical income level of one country in a specific year:

$$\hat{m} = \left(\frac{\hat{\alpha}}{\hat{\beta}}\right)^{\frac{1}{1-\hat{\alpha}}} \hat{n}. \tag{6}$$

Table 3 and 4 report the estimated critical income levels for the U.S., Japan, Ireland, the Netherlands, and Puerto Rico.

TABLE 3 GOES HERE

Table 3 shows that in the 1990s, both the U.S. and Japan were operating in the inefficient area, because their real income levels exceeded the estimated critical values. Moreover, the estimated critical income levels did not change much over time (regression I), suggesting that the non-income good did not improve much in the last decade. Therefore, according to proposition 1, we are not surprised to observe the flat trace of both countries' happiness in the last 10 years. Note that the critical levels are also similar across regressions. For example, the critical income level of the U.S. in 1999 is 24729.09 when "state of health" and "marital status" are selected as non-income factors (regression I), 25816.65 when "marital status" and "human rights" are non-income factors (regression III), and 24763.60 when "human rights" and "time with friends" are non-income factors (regression V). Thus, the results are quite robust.

TABLE 4 GOES HERE

The estimated model can also predict an increase in happiness for countries such as Albania, Ireland, Mexico, the Netherlands, Puerto Rico, Slovenia. Table 4 reports the results for Ireland, the Netherlands, and Puerto Rico. We could see that, in these three countries, the real incomes do not exceed the estimated critical levels (which are again almost constant over time), and the increase in income does add to happiness.

In addition, we fix the non-income good at the mean of its estimates, $\tilde{n}$, and get an explicit relationship between happiness and income:

$$u = \tilde{n}^{1-\hat{\alpha}} m^{\hat{\alpha}} - \hat{\beta} m.$$

Then, we calculate the response of happiness to an increase in income, $\frac{\partial u}{\partial m}\frac{m}{u} = \frac{\hat{\alpha}\tilde{n}^{1-\hat{\alpha}} m^{\hat{\alpha}} - \hat{\beta} m}{\tilde{n}^{1-\hat{\alpha}} m^{\hat{\alpha}} - \hat{\beta} m}$; the result based on regression V is reported in Table 5. According to regression V, the mean of estimated non-income good is $\tilde{n} = 3.10$, and the estimated preference parameters are $\hat{\alpha} = 0.11$ and $\hat{\beta} = 3.85\text{e-}5$. Plugging those estimates into equation (6), we find an estimated critical income level at $23,405$ USD.

TABLE 5 GOES HERE

Table 5 illustrates the decreasing elasticity in income for a given amount of non-income good; the elasticity does not vary much once income level exceeds $10,000$ dollars, and will become negative once income is beyond the estimated critical level, $23,405$ USD.[11] This observation is consistent with the previous cross-nations studies, which state that below USD $10,000$ per capita, the effect of income is significant in increasing happiness, and above that level, the effect is fairly small or null (Frey and Stutzer, 2002; Helliwell, 2003; Schyns, 2003).

5 Conclusion

In this paper, we develop an economic theory for studying happiness. Our model highlights the idea that social comparison affects utility less in nonpecuniary than in pecuniary domains. We show that there is a critical point beyond which rising income alone has no effect on social happiness. More importantly, the critical income level is determined by the level of non-income factors in the society, and improving non-income factors could raise the critical income point. We provide empirical evidence for our theoretical predictions.

[11] If we allow free disposal of income, then the elasticities vanish for those income larger than the critical level.

These results have important policy implications. In particular, government should promote balanced growth between income and non-income factors. In many countries, the reality might be that policy makers have overemphasized economic growth, and the economies have produced too much income good, which has led to a happiness stagnation problem. A simple but effective solution to this problem is to convert income good into non-income good.

Appendix

Appendix A. Proof of proposition 1.

In the problem (PE), the Pareto efficient points are completely characterized by the first order conditions (FOCs), because the objective function and constraints are continuously differentiable and concave on $\mathbb{R}^{2I}_{++}$.

Define the Lagrangian function as:

$$
\begin{aligned}
L \;=\; & m_I^{\alpha} n_I^{1-\alpha} - \beta\left(\frac{m_1 + ... + m_{I-1}}{I-1}\right) + \lambda_m\left(\bar{m} - \sum_{i=1}^{I} m_i\right) + \lambda_n\left(\bar{n} - \sum_{i=1}^{I} n_i\right) \\
& + \mu_1\left[m_1^{\alpha} n_1^{1-\alpha} - \beta\left(\frac{m_2 + m_3 + ... + m_{I-1} + m_I}{I-1}\right) - u_1^*\right] \\
& + \mu_2\left[m_2^{\alpha} n_2^{1-\alpha} - \beta\left(\frac{m_1 + m_3 + ... + m_{I-1} + m_I}{I-1}\right) - u_2^*\right] \\
& + ... \\
& + \mu_{I-1}\left[m_{I-1}^{\alpha} n_{I-1}^{1-\alpha} - \beta\left(\frac{m_1 + m_2 + ... + m_{I-2} + m_I}{I-1}\right) - u_{I-1}^*\right].
\end{aligned}
$$

We can obtain the following FOCs:

$$\begin{aligned}
m_i &: -\frac{\beta}{I-1} - \lambda_m + \mu_i \alpha m_i^{\alpha-1} n_i^{1-\alpha} - \beta\left(\frac{\mu_1 + ... + \mu_{i-1} + \mu_{i+1} + ... + \mu_{I-1}}{I-1}\right) = 0, && (7)\\
n_i &: -\lambda_n + \mu_i (1-\alpha) m_i^{\alpha} n_i^{-\alpha} = 0, && (8)\\
m_I &: \alpha m_I^{\alpha-1} n_I^{1-\alpha} - \lambda_m - \beta\left(\frac{\mu_1 + ... + \mu_{i-1} + \mu_i + \mu_{i+1} + ... + \mu_{I-1}}{I-1}\right) = 0, && (9)\\
n_I &: (1-\alpha) m_I^{\alpha} n_I^{-\alpha} - \lambda_n = 0, && (10)\\
\lambda_m &: \sum_{i=1}^{I} m_i \leq \bar{m},\ \lambda_m \geq 0,\ \lambda_m\left(\bar{m} - \sum_{i=1}^{I} m_i\right) = 0, && (11)\\
\lambda_n &: \sum_{i=1}^{I} n_i \leq \bar{n},\ \lambda_n \geq 0,\ \lambda_n\left(\bar{n} - \sum_{i=1}^{I} n_i\right) = 0, && (12)\\
\mu_i &: m_i^{\alpha} n_i^{1-\alpha} - \beta\frac{\sum_{j\neq i} m_j}{I-1} \geq u_i^*,\ \mu_i \geq 0,\ \mu_i\left(m_i^{\alpha} n_i^{1-\alpha} - \beta\frac{\sum_{j\neq i} m_j}{I-1} - u_i^*\right) = 0, && (13)
\end{aligned}$$

where (7), (8) and (13) hold for any $i = 1, ..., I-1$.

By (10), we have $\lambda_n > 0$. Thus, by (12), we have

$$\sum_{i=1}^{I} n_i = \bar{n}. \tag{14}$$

Using (7)-(10), we have

$$\mu_i\left(\mu_i^{\frac{1-\alpha}{\alpha}} \alpha m_I^{\alpha-1} n_I^{1-\alpha} + \frac{\beta}{I-1}\right) = \alpha m_I^{\alpha-1} n_I^{1-\alpha} + \frac{\beta}{I-1},$$

which implies that $\mu_i = 1$ for any i, since the left hand side is an increasing function in μ_i.

By $\mu_i = 1$, $\lambda_n > 0$, equations (7) and (8), we have

$$\lambda_m = \lambda_n^{-\frac{1-\alpha}{\alpha}} \alpha (1-\alpha)^{\frac{1-\alpha}{\alpha}} - \beta. \tag{15}$$

In addition, (8), (10), $\mu_i = 1$ and $\lambda_n > 0$ yield

$$n_i = (1-\alpha)^{\frac{1}{\alpha}} \lambda_n^{-\frac{1}{\alpha}} m_i, \tag{16}$$

for $i = 1, 2, ..., I$.

Summing up (16) over i and using (14), we have

$$\lambda_n = (1-\alpha)\left(\frac{\sum_{i=1}^{I} m_i}{\bar{n}}\right)^{\alpha}, \tag{17}$$

which implies that,

$$n_i = \frac{m_i \bar{n}}{\sum_{i=1}^{I} m_i}, \tag{18}$$

for $i = 1, 2, ..., I$.

Substituting (17) into (15) yields

$$\lambda_m = \alpha \left(\frac{\bar{n}}{\sum_{i=1}^{I} m_i} \right)^{1-\alpha} - \beta, \tag{19}$$

which will be used to determine the critical income level for Pareto efficiency.

Since $\lambda_m \geq 0$ at equilibrium, there are two cases to consider:

Case 1. $\lambda_m > 0$. In this case, we must have $\sum_{i=1}^{I} m_i < \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$ by (19), and thus by (11),

$$\sum_{i=1}^{I} m_i = \bar{m}. \tag{20}$$

Therefore, if $\bar{m} < \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, the income good should be exhausted in order to achieve Pareto efficiency.

In addition, by (18)

$$n_i = \frac{\bar{n}}{\bar{m}} m_i, \tag{21}$$

for $i = 1, 2, ..., I$.

Case 2. $\lambda_m = 0$. Then, by (19), we must have $\sum_{i=1}^{I} m_i = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, which is true for any $\bar{m} \geq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$.

By (18) and $\sum_{i=1}^{I} m_i = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, we have

$$n_i = \left(\frac{\beta}{\alpha} \right)^{\frac{1}{1-\alpha}} m_i, \tag{22}$$

for $i = 1, 2, ..., I$.

Summarizing the two cases gives rise to proposition 1.

Appendix B. Proof of proposition 3.

Set up the Lagrangian for problem (SCN) as

$$\begin{aligned} L &= m_1^{\alpha} n_1^{1-\alpha} - \beta m_2 - \gamma n_2 + m_2^{\alpha} n_2^{1-\alpha} - \beta m_1 - \gamma n_1 \\ &\quad + \lambda_m \left(\bar{m} - m_1 - m_2 \right) + \lambda_n \left(\bar{n} - n_1 - n_2 \right). \end{aligned}$$

The FOCs related to the choices of m and n are

$$\begin{aligned} m_1 &: \alpha m_1^{\alpha-1} n_1^{1-\alpha} - \beta - \lambda_m = 0, \\ n_1 &: (1-\alpha) m_1^{\alpha} n_1^{-\alpha} - \gamma - \lambda_n = 0, \\ m_2 &: \alpha m_2^{\alpha-1} n_2^{1-\alpha} - \beta - \lambda_m = 0, \\ n_2 &: (1-\alpha) m_2^{\alpha} n_2^{-\alpha} - \gamma - \lambda_n = 0, \end{aligned}$$

which imply

$$\left(\frac{n_1}{m_1}\right)^{1-\alpha} = \left(\frac{n_2}{m_2}\right)^{1-\alpha} = \frac{\beta+\lambda_m}{\alpha}, \tag{23}$$

$$\left(\frac{n_1}{m_1}\right)^{-\alpha} = \left(\frac{n_2}{m_2}\right)^{-\alpha} = \frac{\gamma+\lambda_n}{1-\alpha}. \tag{24}$$

Equations (23) or (24) implies $\frac{n_1}{m_1} = \frac{n_2}{m_2}$. Equations (11), (12), (23) and (24) consist of a system to characterize the solutions.

There are four cases to consider:

Case 1. $\lambda_m > 0, \lambda_n > 0$. *In this case, we must have*

$$m_1 + m_2 = \bar{m}, n_1 + n_2 = \bar{n},$$

which imply that

$$\frac{n_1}{m_1} = \frac{n_2}{m_2} = \frac{\bar{n}}{\bar{m}}. \tag{25}$$

(25), (23) and (24) give us

$$\lambda_m = \alpha\left(\frac{\bar{n}}{\bar{m}}\right)^{1-\alpha} - \beta > 0, \tag{26}$$

$$\lambda_n = (1-\alpha)\left(\frac{\bar{n}}{\bar{m}}\right)^{-\alpha} - \gamma > 0, \tag{27}$$

which are true when $\left(\frac{\gamma}{1-\alpha}\right)^{\frac{1}{\alpha}} < \frac{\bar{m}}{\bar{n}} < \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}}$. This would imply

$$\beta^{\frac{1}{1-\alpha}} \gamma^{\frac{1}{\alpha}} \leq \alpha^{\frac{1}{1-\alpha}} (1-\alpha)^{\frac{1}{\alpha}}. \tag{28}$$

Case 2. $\lambda_m = 0, \lambda_n > 0$. *By* (12) and $\lambda_n > 0$, we have (14).

By (23) and $\lambda_m = 0$,

$$\frac{n_1}{m_1} = \frac{n_2}{m_2} = \left(\frac{\beta}{\alpha}\right)^{\frac{1}{1-\alpha}}. \tag{29}$$

Equations (29), (14) and (11) require

$$\bar{m} \geq \left(\frac{\beta}{\alpha}\right)^{-\frac{1}{1-\alpha}} \bar{n}.$$

By (29) and (24),

$$\lambda_n = (1-\alpha)\left(\frac{\beta}{\alpha}\right)^{-\frac{\alpha}{1-\alpha}} - \gamma > 0,$$

which implies the weak inequality (28) holds.

Case 3. $\lambda_m > 0, \lambda_n = 0$. By (11) and $\lambda_m > 0$, we have

$$m_1 + m_2 = \bar{m}.$$

By (24) and $\lambda_n = 0$,

$$\frac{n_1}{m_1} = \frac{n_2}{m_2} = \left(\frac{\gamma}{1-\alpha}\right)^{-\frac{1}{\alpha}}. \tag{30}$$

Equations (30) and (12) imply

$$\bar{m} < \left(\frac{\gamma}{1-\alpha}\right)^{\frac{1}{\alpha}} \bar{n}.$$

Equations (23) and (30) require

$$\lambda_m = \alpha\left(\frac{\gamma}{1-\alpha}\right)^{-\frac{1-\alpha}{\alpha}} - \beta > 0,$$

which is equivalent to $\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}} < \alpha^{\frac{1}{1-\alpha}}(1-\alpha)^{\frac{1}{\alpha}}$.

Case 4 $\lambda_m = 0, \lambda_n = 0$. By (23) and (24), this is true only when

$$\frac{m_1}{n_1} = \frac{m_2}{n_2} = \left(\frac{\gamma}{1-\alpha}\right)^{\frac{1}{\alpha}} = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}}, \tag{31}$$

which implies

$$\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}} = \alpha^{\frac{1}{1-\alpha}}(1-\alpha)^{\frac{1}{\alpha}}.$$

The conditions in proposition 3 ensure that case 2 holds. The results follow directly.

Appendix C. Proof of proposition 4.

Set up the Lagrangian for problem (GUF) as

$$\begin{aligned} L &= f(m_1, n_1) + g(m_1, m_2) + f(m_2, n_2) + g(m_2, m_1) \\ &\quad + \lambda_m(\bar{m} - m_1 - m_2) + \lambda_n(\bar{n} - n_1 - n_2). \end{aligned}$$

The FOCs related to the choices of m and n are

$$
\begin{aligned}
m_1 &: \frac{\partial f(m_1,n_1)}{\partial m_1}+\frac{\partial g(m_1,m_2)}{\partial m_1}+\frac{\partial g(m_2,m_1)}{\partial m_1}-\lambda_m=0, & (32)\\
n_1 &: \frac{\partial f(m_1,n_1)}{\partial n_1}-\lambda_n=0, & (33)\\
m_2 &: \frac{\partial g(m_1,m_2)}{\partial m_2}+\frac{\partial f(m_2,n_2)}{\partial m_2}+\frac{\partial g(m_2,m_1)}{\partial m_2}-\lambda_m=0, & (34)\\
n_2 &: \frac{\partial f(m_2,n_2)}{\partial n_2}-\lambda_n=0. & (35)
\end{aligned}
$$

Equations (32)-(35), (23) and (24) consist of a system to characterize the solutions.

In particular, $m_1 = m_2 \equiv m$, $n_1 = n_2 = \bar{n}/2$, $\lambda_n = \frac{\partial f(m,\bar{n}/2)}{\partial n_1}$, and $\lambda_m = f_1(m,\bar{n}/2)+g_1(m,m)+g_2(m,m)$ satisfy this system. Given the quasiconcavity of the objective function, FOCs are both necessary and sufficient, and the solution is unique. Therefore, we have

$$\lambda_m = f_1(m,\bar{n}/2)+g_1(m,m)+g_2(m,m) \equiv H(m,\bar{n}),$$

which is the marginal effect of increasing income on social happiness, by Envelope theorem. In addition, assumptions (A1)-(A3) imply that for any fixed $\bar{n}$, $H(m,\bar{n})$ varies inversely from positive to negative as m increases from 0 to $+\infty$. Then, the results follow directly.

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Figure 1 Does Raising the Incomes of All Increase the Happiness of All?

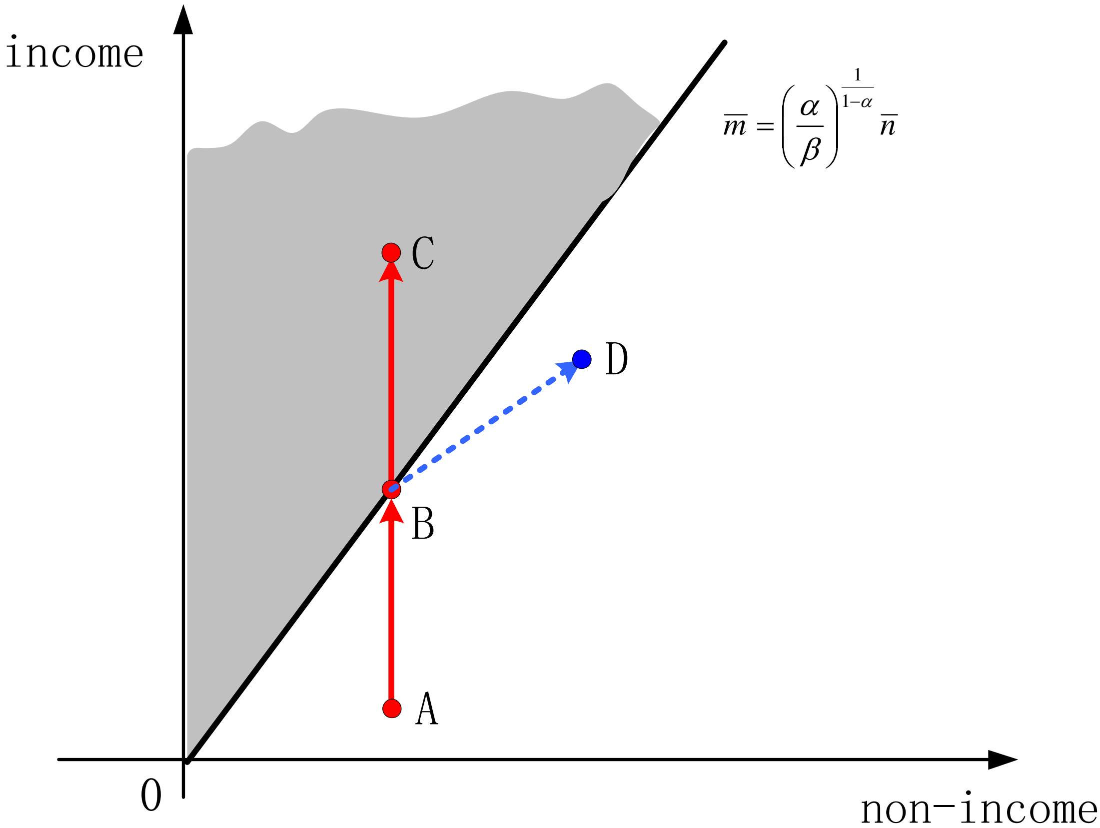

Figure 2 Income VS Happiness

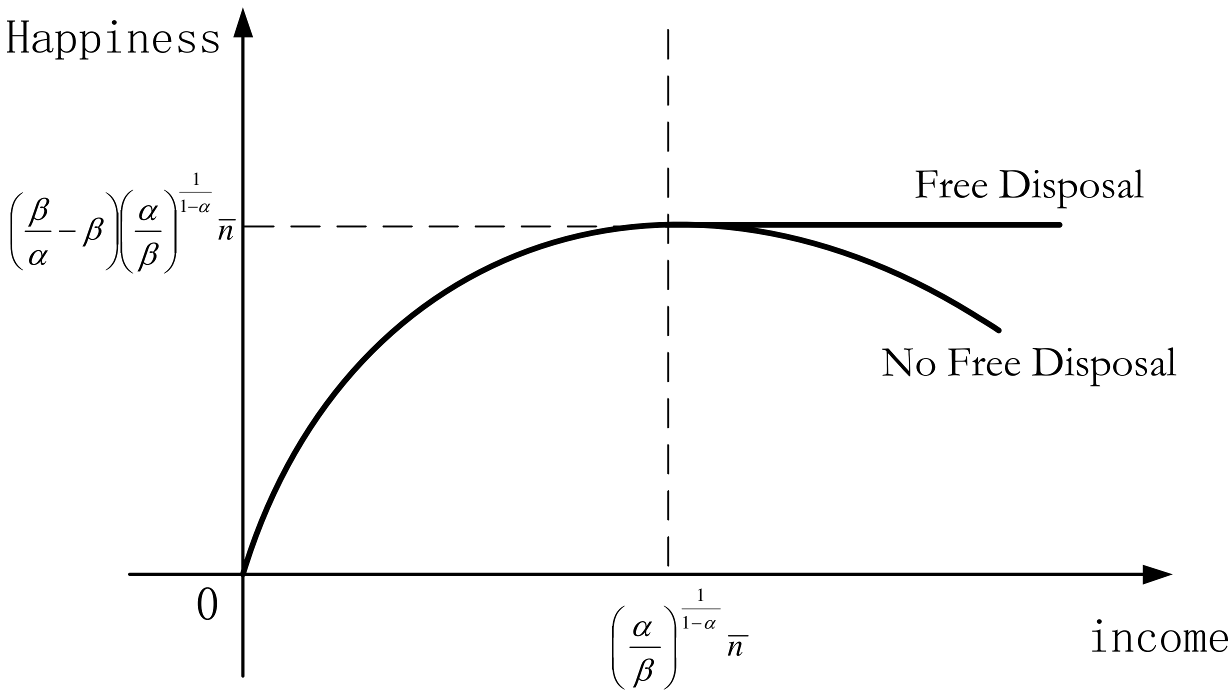

Table 1 Data Summary

	Min	Max	Mean	S.D.	# Obs.
Mean life satisfaction	3.73	8.49	6.63	1.09	187
GDP per capita (2000 US$)	261.00	37459.00	9210.81	9408.34	187
State of health	25.93	89.46	60.64	15.29	148
Marital status	39.81	87.46	64.46	8.20	185
Human rights	0.41	61.90	13.18	11.81	79
Time with friends	58.47	97.78	81.12	10.19	69
Former Soviet Union	0.00	1.00	0.09	0.29	187

Table 2 Estimation Results (Nonlinear Least Squared)

	I	II	III	IV	V
α	0.09***	0.09***	0.13***	0.10***	0.11***
	(7.17)	(3.46)	(7.83)	(5.00)	(5.85)
β	3.22e-5**	2.84e-5	4.21e-5**	1.42e-5	3.85e-5*
	(2.20)	(0.93)	(2.02)	(0.64)	(1.78)
State of health	0.23***	0.27***			
	(6.65)	(6.15)			
Marital status	0.08**		0.20***	0.11	
	(2.14)		(7.28)	(1.63)	
Human rights		0.04	0.07***		0.05***
		(1.59)	(4.60)		(3.07)
Time with friends				0.16**	0.23***
				(2.35)	(7.33)
Former Soviet Union	0.52**	0.22	0.56**	0.93***	0.55*
	(2.13)	(0.54)	(2.33)	(3.05)	(1.74)
# observations	147	46	79	69	68
Adjusted R^2	0.59	0.58	0.73	0.61	0.64

Note: The t-statistics are shown in parentheses. The superscripts *, **, and *** indicate the coefficients are significant at the 10%, 5%, and 1% significance levels, respectively.

Table 3 Economic Growth Does Not Bring Happiness

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
		Panel A: the U.S.			
1982	7.67	22518.19	24284.04	NA	NA
1990	7.75	28467.86	24621.31	NA	NA
1995	7.68	29910.29	24688.02	NA	NA
1999	7.65	33717.43	24729.09	25816.65	24763.60
		Panel B: Japan			
1981	6.59	24176.56	21652.87	NA	NA
1990	6.53	33438.54	21865.49	NA	NA
1995	6.72	35332.73	22958.70	NA	NA
2000	6.48	37459.16	22886.39	24790.58	21261.54

Table 4 Economic Growth Does Bring Happiness

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
Panel A: Ireland					
1981	7.82	9915.67	24239.53	NA	NA
1990	7.88	13444.14	24778.52	NA	NA
1999	8.17	22952.64	NA	26773.26	25402.69
Panel B: Netherlands					
1981	7.70	15564.10	24332.80	NA	NA
1990	7.76	18498.68	23940.34	NA	NA
1999	7.88	22669.39	NA	26525.55	25676.55
Panel C: Puerto Rico					
1995	7.70	11502.26	23646.51	NA	NA
2001	7.88	13394.87	24013.54	25563.74	22895.78

Table 5 Happiness-Income Elasticity

Income(2000 USD)	$1,000$	$2,000$	$3,000$	$5,000$	$10,000$
Happiness-income Elasticity	0.1035	0.0983	0.0935	0.0840	0.0612
Income(2000 USD)	$15,000$	$23,405$	$25,000$	$30,000$	$40,000$
Happiness-income Elasticity	0.0386	0.0000	-0.0075	-0.0313	-0.0812

Note: Here the report is based on regression V with $\tilde{n} = 3.10$, $\hat{\alpha} = 0.11$, and $\hat{\beta} = 3.85\text{e-}5$.