A Formal Economic Theory for Happiness Studies: A Solution to the Happiness-Income Puzzle*

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Abstract

This paper develops a formal economic theory that is mainly proposed to explain and study the Easterlin paradox — a puzzle at the heart of our lives: average happiness levels do not increase as countries grow wealthier. This theory provides a foundation for studying happiness from the perspectives of social happiness maximization and pursuing individual self-interest. It takes into account both material goods and non-material goods, integrates the existing reference group theory and the "omitted variables" theory, and identifies a fundamental conflict between individual and social welfare/happiness. We show that, up to a critical income level that is positively related to non-material status, increase in income enhances happiness. Once the critical income level is achieved, increase in income cannot increase average happiness and in fact, somewhat surprising, average happiness actually decreases, resulting in Pareto inefficient outcomes. A policy implication of our theory is that government should promote material and non-material goods in a balanced way. Our empirical analysis confirms the implication and shows that the results are robust across the countries under consideration.

Keywords: Economics of Happiness, Happiness-Income Puzzle, Reference Group Theory, Pareto Optimality

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

*We wish to thank Xiaoyong Cao, Richard A. Easterlin, John Helliwell, Li Gan, Lu Hong, Erzo F.P. Luttmer, Yew-Kwang Ng, Tapan Mitra, Andrew Oswald, Chengzhong Qin, Alois Stutzer, Lin Zhou, and the participants at the 2006 Far Eastern Meeting of the Econometric Society for helpful comments and suggestions.

†Financial support from the Private Enterprise Research Center at Texas A&M University is gratefully acknowledged.

1 Introduction

This paper provides a formal and rigorous economic theory that is proposed mainly to explain and solve the puzzling relationship between happiness and income: average happiness levels do not increase as countries grow wealthier. This theory provides a foundation for studying happiness from the perspectives of social optimality and the pursuit of individual self-interest. It unifies the existing reference group theory and "omitted variables" theory, and can help us understand the formulation of happiness/subjective well-being.

1.1 Background of the Issue

The production of goods and government policies serve to increase the happiness of people. In economics, happiness is defined as utility[1], and in psychology it is known as subjective well-being (SWB). Economists prefer to use the simplifying assumption that income can be used as a proxy for utility. In conventional economic theories and models on social welfare, individuals' utilities depend only on their own consumption of goods. As such, these models lie at the heart of claims that the pursuit of individual self-interest promotes aggregate welfare/happiness. Measures of income are thus seen as sufficient indices to capture well-being. Economic policies, which seek to enhance social welfare and reduce poverty, put tremendous importance on economic growth.

In contrast, psychologists prefer to directly measure SWB in a variety of ways. Up to now, most work on SWB, however, is either empirical[2] or descriptive and the explanations are based on psychological analysis. The most popular method is to conduct a large sample survey. For example, in the *World Value Survey*, life satisfaction is assessed on a scale from one (dissatisfied) to ten (satisfied), by asking: "All things considered, how satisfied are you with your life as a whole these days?" [3]

Most of these studies on SWB survey data suggest that one should revisit standard economic theory on welfare economics and its policy implications. In contrast to standard economic theories and models, these empirical findings identify a fundamental conflict between individual and social welfare/happiness. There is a paradox, referred as the Easterlin paradox, at the heart of our lives. Most people want more income. Yet as societies become richer, they do not become

[1] In existing economic literature, most authors equate the term happiness with utility, see Jeremy Bentham's (1781), Kahneman et al (1999), Easterlin (2001, 2003), Gruber and Mullainathan (2002), Stutzer (in press), Frey and Stutzer (2003, 2004), and Layard (2005). However, a few recent papers focus on the difference, see Ng (1999), Kahneman et al (2004), and Miles Kimball and Robert Willis(2005).

[2] Di Tella and MacCulloch (2006) provided an excellent review on the uses of happiness data in economics.

[3] Frey and Stutzer (2002a) provided a good discussion on this kind of survey method.

happier. This is not just anecdotally true, it is evidenced by countless pieces of experimental and empirical studies. We now have sophisticated ways of measuring how happy people are, and all the evidence shows that on average people have grown no happier in the last decades, even as average incomes have more than doubled. Carol Graham (2005, p. 4) summarizes the empirical findings:

> While most happiness studies find that within countries wealthier people are, on average, happier than poor ones, studies across countries and over time find very little, if any, relationship between increases in per capita income and average happiness levels. On average, wealthier countries (as a group) are happier than poor ones (as a group); happiness seems to rise with income up to a point, but not beyond it. Yet even among the less happy, poorer countries, there is not a clear relationship between average income and average happiness levels, suggesting that many other factors – including cultural traits – are at play.

This phenomenon of economic growth without happiness is true of Britain, the United States, continental Europe, and Japan. It thus challenged established welfare propositions that income improves utility in conventional economic models. This leads to a rethinking of policy prescription, that is, happiness in lieu of income should become a primary focus for policymakers. Indeed, the nation of Bhutan uses the national happiness product (GHP) rather than the gross domestic product (GDP) to measure national progress. Most recently, the Second International Conference on Gross National Happiness, held from June 20 through June 24, 2005, chose the theme entitled, "Rethinking Development: Local Pathways to Global Wellbeing", and examined successful initiatives world-wide that attempt to integrate sustainable and equitable economic development with environmental conservation, social and cultural cohesion, and good governance (http://www.gpiatlantic.org/conference/). In the end of year 2006, the Economists magazine had a special issue on happiness and economics.

The recent studies on happiness, which outline the drawbacks of taking income as a proxy for happiness and the failures of standard economic theories and models in explaining the Easterlin Paradox, also have led many scholars to doubt whether utility can generally be derived from observed choices, and whether the exclusive reliance on an objectivist approach by standard economic theory is valid both theoretically and empirically. As a result, many psychologists and economists have come to the conclusion that the subjective, not objective, approach to utility should be used to model human well-being. Numerous scholars have challenged conventional economic theories from different perspectives, especially welfare propositions, as well as some

basic assumptions behind the theories. Some even push their arguments to an extreme of denying the fundamental assumption of individual self-interested behavior in economics. Indeed, some economists claim that "the pursuit of individual self-interest is not a good formula for personal happiness" (Layard 2003, p. 15). On the other hand, since most studies on happiness are either empirical or descriptive that are mainly based on psychological analysis, there are few formal and rigorous economic models that can be used to study people's happiness. It is regarded as non-mainstream happiness economics and has been neglected by most economists.

1.2 Motivation and Significance of the Paper

It will be shown that the assessments that the pursuit of economic growth always promotes aggregate welfare/happiness and that the pursuit of individual self-interest is an invalid assumption for personal happiness both are inappropriate, and the over-valued and under-valued claims on standard economic theories and happiness studies are misleading in a great extent. We will develop a formal economic theory for social well-being/happiness studies, which uses the standard analytical framework and keep basic assumptions such as individual self-interested behavior in economics. This theory can be particularly used to explain and solve the Easterlin Paradox. Furthermore, it is an integrated theory of the "omitted variables" theory and reference group theory.

There are two approaches to explain the Easterlin paradox in the current literature. One approach, based on experimental and empirical estimations, argues that besides income, people care about other factors like health, friendship, family life, etc., and some of them (trust and mental status, for example) are declining during the last decades. Factors other than income or economic growth, not only significantly affect individuals' happiness, but also influence individuals' incentives towards economic policies (Graham & Pettinato, 2002; Diener and Seligman, 2004). However, Di Tella and MacCulloch (2006) suggested this "omitted variables" approach may not work, because some of those factors have gotten better off instead of worse off, which does not solve the Easterlin paradox, but instead deepens the puzzle. Besides, the "omitted variables" approach does not explain the paradox either although it provides a potential prescription to solve the puzzle.

The other approach, Easterlin (1995, 2001) for example, focuses on the income itself, and argues that happiness is not determined by the absolute level of income itself, but by the difference between income and some aspiration level, influenced by social comparison or hedonic adaption. For example, the aspiration level could be the average income of the other people. As

society becomes wealthier, the aspiration level also increases. This process yields no additional increase in overall utility. This explanation is called aspiration theory, also known as relative income theory or reference group theory, which is a variant of social comparison theory. However, when researchers use the reference group theory to explain the Easterlin Paradox, the theory itself does not provide any suggestion to solve the paradox. Furthermore, the approach takes aspiration level as exogenously given. There is no role for non-income factors to play in this framework.

Besides, there are few formal and rigorous economic models, which can be used to study peoples' happiness, especially from the perspective of social optimality. In addition, to our knowledge, these studies, except for a series of studies by Yew-Kwang Ng and his coauthors (Ng and Wang, 1993; Ng and Ng, 2001; Ng, 2003), do not consider optimal choice problems such as personal optimal choice and social happiness maximization. Ng's work only derives the possibility of welfare-reducing economic growth by assuming a large environmental disruption effect and a relative-income effect, which are based on a representative framework.

All in all, none of these studies explicitly derives a critical income level beyond which increase in income has no effect or even hurts happiness, while this critical point is shown to exist by many empirical works (see Graham's summary in the previous subsection). None of these studies focuses on allocative efficiency either. In this paper, we will use Pareto optimality approach to study social happiness and our result is robust to the choice of social welfare function.

1.3 Results of the Paper

This paper provides a formal and simple economic theory that is mainly proposed to explain and solve the Easterlin Paradox. This theory provides a foundation for studying happiness from the perspectives of social optimality and the pursuit of individual self-interest. It formulates a more integrated and complete economic model that unifies the traditional aspiration approach and the "omitted variables" approach. Our theory takes into account both income and non-income factors, and shows how the happiness-income relationship can be rigorously analyzed using the standard analytical framework and keeping the basic assumption of the pursuit of individual self-interest adopted by mainstream economics.

In the model, we assume that individuals' utility is positively related to their own material and non-material status[4], but negatively related to others' consumption of material goods, which

[4]Throughout the paper, we interchangeably use terms of income, income goods, material goods, pecuniary good, and positional goods to refer to goods that are mainly indexed by GDP. We would go back to this point in detail in Section 3.1 when we set up the model.

is the essential idea of reference group theory (e.g., Frank, 1985, 1997; Frank and Sunstein, 2001; Easterlin, 2003) and is supported by many empirical studies (e.g., Neumark and Postlewaite, 1993; Luttmer, 2005; Solnick and Hemenway, 2006). It is shown that, under this assumption and based on the social welfare maximization criterion, for any exogenous level of non-income resources, an increase in income increases happiness up to a critical point and then beyond this critical point, increase in income alone cannot increase happiness anymore. In fact, increase in income beyond this critical level results in Pareto inefficiency. In other words, Pareto efficiency will require the free disposal of a certain amount of income once the income reaches this critical level.

This conclusion holds even if individual utility is strictly increasing in their own material and non-material consumption and the government policies have corrected all the market failures in the pecuniary domain. More importantly, we show that the critical income level depends on the level of non-income status. When this level is achieved, improving non-income factors is the only way to enhance well-being, as an important policy implication from our theory. Therefore, combing the "omitted variables" approach and reference group theory, our theory sheds new light on the Easterlin paradox: social comparison on income goods is responsible for the *existence* of the critical point beyond which income does not contribute to happiness, and improving non-income goods, such as mental status, family life, health, basic human rights, fighting unemployment and inflation, can push the critical point to an upper level, that is, non-income status determine the *magnitude* of the critical income level.

Thus, only balanced economic growth can enhance happiness steadily. Both income factors and non-income factors are equally important concentrations, when policy-makers attempt to increase happiness. This idea appears formally in our model. Thus, to avoid an unfortunate outcome – the decline in the average happiness of individuals – the government should increase public expenditures on those non-material goods that can be produced from material goods, contrary to the currently popular view against public expenditure among economists.[5] We think the paradox are valid only against the narrow concept of income but not against the wider concepts of a general model. Happiness should take a more central role in economics.

Our findings add new knowledge to what has become the standard view in the literature, while other results challenge those views. In a paper entitled "Diminishing Marginal Utility of Income? A Caveat Emptor," Easterlin (2005, p. 252-253) pushed his assessments further by claiming that "the cross sectional relationship is not necessarily a trustworthy guide to experience

[5] A few authors are exceptions, e.g. Ng (2004).

over time or to inferences about policy", and concluded that in both the within-country and among-country analysis, there is no diminishing marginal utility of income, but zero marginal utility. Our result, however, will show that Easterlin's claim on zero marginal utility may not be valid. Happiness, i.e., overall social welfare on income and non-income factors, eventually declines beyond a certain level of income if non-income status is not improved. Thus, our results make a more precise and rigorous statement: increasing income is important in enhancing happiness in the early stages of economic development, when the basic needs go largely unmet. However, once income reaches a certain level, there may be no effect, a small effect, or eventually a negative effect of further increase in income on happiness.

The results obtained in this paper also illuminate that the optimization approach and self-interested behavior assumption can and should be adopted when studying happiness. From a methodological viewpoint, the psychological explanation can be integrated into mainstream economics, and the happiness of people can be studied under the assumption of individual rational choice and social well-being maximization. The neglect of happiness by economists has occurred neither on account of a perceived analytical intractability nor on a preoccupation with more important concepts. The neglect stems from the inappropriate assumption that individuals' utilities depend only on their own consumptions and consequently from excessive attention on economic growth, which does not consider the non-material factors which have been important to happiness in recent decades.

It should be remarked that our technical result may be a new result in microeconomic theory, which is not explored in the standard textbook such as Laffant (1988), Varian (1992), Salanie (2000). This result shows that one may have to destroy resources in achieving Pareto efficiency for economies with negative consumption externalities. Tian and Yang (2005) studied systematically the problem of achieving Pareto efficient allocations in the presence of externalities, and provided characterization results on the destruction of resources for general economies with negative consumption externalities.

The remainder of this paper is as follows. In Section 2 we will give a brief review on the happiness economics literature to help potential readers who may not be familiar with the happiness literature. We will highlight the importance of relative income suggested by reference group /aspiration explanation. In Section 3 we present a basic and formal economic model that can explain and study the Easterlin paradox. In Section 4 we then consider its extensions to show the generality of our theory. In Section 5 we provide some empirical analysis to support our theory. We present concluding remarks in Section 6.

2 The Income-Happiness Puzzle: The Literature Review

Although the study of happiness has been the province of psychology, and some prominent nineteenth-century economists frequently discussed what they considered to be the basic determinants of happiness, it has been largely ignored in the current economics literature. Only recently has this psychological research been linked to economics.

Easterlin was a pioneer in exploring the relationship between income and happiness. He concluded that economic growth was quite possibly nonhelpful in enhancing happiness. In a cross-country study, he found that individual happiness was the same across poor countries and rich countries, and that for the United States since 1946, higher income was not systematically accompanied by greater happiness (Easterlin 1974, p.118). Scitovsky (1978, p.135) also noticed the fact that "our economic welfare is forever rising, but we are no happier as a result."Oswald (1997) found the similar results for European countries since the early 1970s.

Due to the fact that income is not an exact surrogate for well-being any more when the society becomes wealthy, psychologists advocate to develop a systematic set of well-being indicators to supplement economic indicators to work as good guider (Kahneman et al, 2004; Diener and Seligman, 2004). The national well-being measures are emerging from large-scale national surveys of well-being, surveys of mental health, and many smaller studies focused on particular groups and specific domains of life. For example, the German Socioeconomic Panel, which is a large, ongoing annual survey of life satisfaction in Germany, and the Eurobarometer, which is conducted at regular intervals in the European Union nations, include well-being questions (Diener and Seligman 2004, p. 21).

Diener and Biswas-Diener (1999) found that, in developed countries, economic growth has not been accompanied by an increase in well-being, and increases in individual income do not lead to more happiness. Blanchflower and Oswald (2004) studied well-being in the United States and Great Britain, and found that reported levels of well-being have declined over the last quarter of a century in the US, and well-being has run approximately flat over time in Great Britain. Furthermore, Diener and Seligman (2004) pointed out that in addition to a flat life satisfaction trend, a substantial increase in depression, distrust and anxiety, which are important predictors for ill-being other than well-being, has accompanied the steep rise in economic output in the past decades.

While researchers found little effect of income on reported happiness over time, some of them did find a clearly positive relation between income and happiness in the cross-sectional analysis of the same data sets. For example, Diener and Diener (1995) found that across 101

nations, income was correlated significantly with 26 of the 32 indices chosen to indicate SWB, and concluded that there was higher happiness in wealthier nations. "Studies looking at the relation between average well-being and average per capita income across nations have found substantial correlations, ranging from about .50 to .70" (Diener and Seligman, 2004, p. 5). Furthermore, above a moderate level of income (US$10,000 per capita for example), Diener and Seligman (2004) found that correlations between income and SWB are surprisingly low in developed countries, explaining only about 8% of the variance in SWB, by using the World Value Survey II.

Easterlin (1974, 1995, 2001, 2003) used "aspiration theory" to explain the puzzle of more income not implying more happiness. According to the aspiration theory, individuals derive utility not from the absolute value but from the difference between achievement and some norm (aspiration level). As a society becomes richer, not only are more goods and services available to consumers, but the norm is increasing, which offsets satisfaction. The aspiration theory, or reference group theory, is a variant of social comparison theory. Social comparison here means that people compare themselves to others. The effects of social comparisons on consumption and savings behavior are analyzed in the classic works of Veblen (1899) and Duesenberry (1949) in economics. Frank (1985a, 1985b, 1999, 2004, 2005) uses the term "positional goods" for those things whose consumption are most subject to social comparison, and argues that Americans are experiencing "Luxury Fever", a frenzy of competition for the positional goods consumption, making their lives less comfortable and less satisfying.

In his famous paper "Will raising the incomes of all increase the happiness of all?" Easterlin (1995, p. 36) wrote:

> Judgments of personal well-being are made by comparing one's objective status with a subjective living level norm, which is significantly influenced by the average level of living of the society as a whole. If living levels increase generally, subjective living level norms rise... Put generally, happiness, or subjective well-being, varies directly with one's own income and inversely with the incomes of others. Raising the incomes of all does not increase the happiness of all, because the positive effect of the higher income on subjective well-being is offset by the negative effect of higher living norms brought by the growth in incomes. Formally, this model corresponds to a model of interdependent preferences in which each individual's utility or subjective well-being varies directly with his or her own income and inversely with the average income of others.

The empirical work supports this idea. For example, Stutzer (2004) showed that SWB depends only on the gap between income aspirations and actual income. He also found that the aspiration level itself is substantially increasing with individuals' previous income. Graham and Pettinato (2002) also found that in developing economies, relative income differences affect SWB more than absolute ones do, and there are "frustrated achievers" who, become less happy because their aspirations grow even more quickly than their rapidly increasing income. Luttmer (2005) found that, controlling for an individual's own income, higher earnings of neighbors are associated with lower levels of self-reported happiness. Thus, "lagging behind the Joneses" does diminish well-being.

After realizing that income can do nothing to enhance happiness once a critical income level is reached, some researchers claimed that "I am not saying that happiness is a constant, given by genetics and personality. Nor am I saying that individual or social action aimed at increasing happiness is fruitless"[6] (Easterlin 2004, p. 253). Yet, most current policies overemphasize the importance of income gains to well-being and underestimate that of other non-income factors. But many non-income personal characteristics such as family, mental status, health, marriage, and so on and so forth, and many macroeconomic variables, such as inflation and unemployment, seem also to have strong effect on happiness. (Graham 2005; Easterlin 2003; Diener and Seligman, 2004; Blanchflower and Oswald 2004; Graham and Pettinato, 2002). Thus, improving the environment of such non-income factors becomes an effective way in enhancing well-being.

3 The Model

3.1 Economic Environment

Consider an exchange economy with I consumers who consume two types of goods, where $I \geq 2$. Good m indexes income which can be used to purchase material goods, and good n indexes non-income goods, such as human right, family life, social capital (trust for example), democracy, divorce rate, health, social relationships, etc., that is, all the other factors considered by psychologists to explain the SWB differences across countries. As discussed in introduction, our categorization on goods can be linked to the existing literature through two ways:

[6]There is another theory, called set point theory, to explain the Easterlin paradox, which states that every individual goes back to a presumed happiness level over time. The public policy implications of setpoint theory is that programs aimed at improving individual welfare are fruitless (Graham 2005).

One is adopted in the psychology literature and empirical studies in economics. A good is categorized mainly according to whether it is included in GDP. Diener and Seligman (2004) did an excellent review on those factors and concluded that most of those factors are not captured by the current economic indicator. They also mentioned that "GDP is used as a measure of the material well-being of a society because it is designed to capture market production and therefore the goods and services that are produced and consumed in a society."(p. 23) We then define n as all non-material goods, which substantially influence well-being. Thus, we can *roughly* interpret m as those goods included in GDP and n as those not.

The other categorization is adopted in the economic literature (e.g., Frank, 1985b, 1991, 1999, 2005). A good is categorized mainly according to whether it is a "positional good" or a "non-positional good", which is distinguished by the extent of social comparison. According to Frank (1985b, p. 101), positional goods means "those things whose value depends relatively strongly on how they compare with things owed by others. Goods that depend relatively less strongly on such comparisons will be called non-positional goods." Frank (1999, 2004, 2005) argued that in the modern societies, individuals are trapped into an arms race of competition for the consumption of positional goods, which in turn results in a large welfare loss. We then use m to index all the positional good and n all the non positional good, respectively. Thus, income, income factor, income goods, material goods, positional goods, GDP, and GDP goods are interchangeably used to refer to goods m in this paper.

In fact, the above two explanations are consistent. As Solnick and Hemenway (2006, p. 147) summarized, in the positional goods literature, social comparison does not operate equally across all domains, and the following hypotheses are proposed: "(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." Basically, these hypotheses say that material goods are more positional than non-material goods. Furthermore, most of the hypotheses are supported by the empirical studies (Neumark and Postlewaite, 1993; Carlsson et al., 2003; Luttmer, 2005; Solnick and Hemenway, 2006). Easterlin(2003) also directly said that the social comparison in the "pecuniary domain" is less than that in the "nonpecuniary domain". This is true, because, with regard to 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).

As pointed out by Di Tella and MacCulloch (2006), only introducing the non-income factor

itself may not be enough to explain the Easterlin paradox, because the amounts of some non-GDP goods are increasing in many developed countries during the last decades. However, as shown in the paper, combining with the assumption that income goods have larger social comparison effect than non-income goods, which is a reasonable assumption as we discussed above, we can explain the puzzle even when this happens.

Consumer i's consumption of the two goods is denoted by a vector (m_i, n_i), $i = 1, ..., I$. To capture the essential characteristics of reference group/aspiriation theory, we assume that the consumption of good m exhibits a negative externality, which means that the utility of consumer i is adversely affected by other consumers' material goods consumption, $m_{-i} = (m_1, ..., m_{i-1}, m_{i+1}, ..., m_I)$. 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 $j \neq i$. Initially, there are $\bar{m}$ units of income good available and $\bar{n}$ units of non-income good[7].

For computational simplicity purpose and to grasp the essential ingredients of the theory, consumer i's utility function is further specified as[8]

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

which satisfies all the assumptions imposed on the utility function.[9] Nevertheless, this simple specification is enough to explain and solve the Easterlin paradox. We can obtain the main results for general utility functions with these basic characteristics in Section 4.3.

This specification on utility function captures the essential characteristics of the aspiration theory and social comparison theory: People compare themselves to others, and an individual's well-being depends on the difference between his own income and an aspiration level that is given by the average level of the others. As such, we use a Cobb-Douglas form to capture the absolute term, and use the minus term to capture relative income effect so that these two terms capture the difference between his own income and an aspiration level. This specification is rationalized

[7]We thus take $\bar{m}$ and $\bar{n}$ exogenously determined in order for the model to explain the Easterlin Paradox by using Pareto optimality criterion, and we then allow them to be varied for making policy implications.

[8]We may use a more general utility function specification: $u_i(m_i, n_i; m_{-i}) = m_i^{\alpha} n_i^{1-\alpha} - \beta \frac{\sum_{j \neq i} m_j^{\rho}}{I-1}$ with $\rho \geq 1$ so that we allow the diminishing marginal negative externality of others' income for the case of $\rho > 1$ as others' income grows. However, in this case, finding the specific solutions become much more complicated. Nevertheless, we can still find the critical level of income for a given weighted social welfare function as shown in Example 1 below.

[9]As mentioned in Footnote 8, we can get the similar results in explaining and study the Easterlin Paradox from a utility function with diminishing marginal dis-utility.

by the arguments made by Easterlin (1995, 2001) and Graham and Pettinato (2002). Easterlin argued that the negative consumption externality of m_{-i} could be fully captured by a sufficient statistic, i.e., the average $\frac{\sum_{j\neq i} m_j}{I-1}$, and Graham and Pettinato found that the aspiration level itself is *substantially* increasing with individuals' previous income and their aspirations grow even *more quickly* than their rapidly increasing income.

There are a couple of other things we also need to clarify. First, we assume that all the consumers are in the same reference group. One will see that this assumption can be relaxed and extended to multiple reference groups and we have the similar result in Section 4.1. Secondly, we assume that there is a negative externality in the consumption of the income goods, but there is *no* externality in the consumption of non-income goods. So, our assumption is an extreme case in which there is no social comparison in non-income goods. We would see it does not affect our main results by relaxing this assumption in Section 4.2.

Thirdly, some of the non-income goods are public rather than private goods, such as democracy and inflation. This is true, but the main qualitative result of this paper still holds if we assume that good n is a public good. Fourthly, one may be concerned with how to measure the non-income goods. Of course, we can assume there is a measure in principle and argue that we have already done this and then continue our argument. In fact, some of them can be measured in reality, for example, we can use the number of doctors and nurses to work as a proxy for the level of health[10]. Last but not least, one may also be concerned with whether our analysis hinges on a specific functional form of utility. In fact, the main results remain true with a general utility function which carries diminishing marginal utility in consumption of goods, but the idea of the paper is much clearer if we use the suggested functional form. We will illustrate this in Section 4.3.

In the following subsections, we will use the basic Pareto efficiency criterion to give an explanation for the SWB empirical results.

3.2 Pareto Efficiency and Social Happiness Maximization

When economists evaluate the performance of an economic system, they usually adopt the criterion of Pareto efficiency. The importance and wide use of Pareto efficiency lies in its ability to offer us a minimal and uncontroversial test in welfare analysis, which any social optimal outcome should pass. It avoids the pesky comparison between two consumers. Implicity in every Pareto

[10]One may claim this is not an accurate measure. In fact, many economic variables, including GDP itself, are open to query on accuracy, too. Another quantitative measure of health status might be the ratio of sales of preventive medicines to the sales of medicines used in a preventive capacity.

efficient outcome is that all possible improvements on happiness have been exhausted. And if an allocation is Pareto inefficient, some alternative allocation can be supported by consensus.

Definition 1 *An allocation of income and non-income goods* $\{m_i, n_i\}_{i=1}^I \in \mathbb{R}_{++}^{2I}$ [11] *is* feasible *if* $\sum_{i=1}^I m_i \leq \bar{m}$, *and* $\sum_{i=1}^I n_i \leq \bar{n}$[12]. *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 is no 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 are completely 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 on Pareto efficiency.

Lemma 1 *For a pure exchange economy with the above specific utility functions, all income should be completely used up at Pareto efficient status if and only if* $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$. *Specifically, we have*

(1) When $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *not all income should be used up and the set of Pareto optimal allocations is characterized by*

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

(2) When $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *all income should be completely used up and the set of Pareto optimal allocations is characterized by*

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

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

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

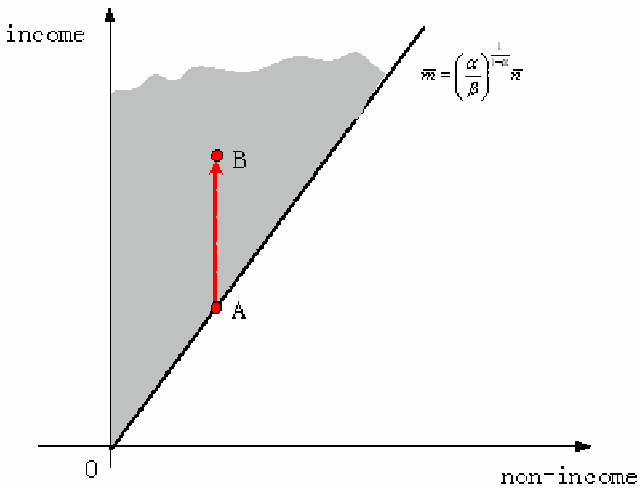

Figure 1: Does raising the income of all increase the happiness of all?

Thus, from the above lemma, we know that, when $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, that is, when the total income is beyond the critical point $\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, Pareto efficiency requires destroying as many as $\bar{m} - \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$ units of income. Otherwise, by using up all the total income (which is usually the case in a market economy), it would result in Pareto inefficient outcomes. In other words, increase in income may not enhance the happiness of everyone in the society, and may actually decrease some individuals' well-being. This explains why raising the income of all need not increase the happiness of all (Easterlin, 1995). This can be seen from Figure 1. The shaded area indicates inefficient economic growth outcomes in terms of Pareto optimality. For example, suppose the initial status of the economy is some Pareto efficient allocation in point A. Then, increasing everyone's income while keeping the level of non-income constant such that the economy moves to point B, some individuals would be hurt no matter how the income is increased. Indeed, if not, the new allocation after growth is either Pareto superior to or utility equivalent to the initial allocation before growth, both of which are not true since by Lemma 1 the initial allocation is Pareto efficient and the new one is not after the income increases. Thus, when the income is relatively high, economic growth may not benefit everyone in the economy.

Formally, we put the above discussions into the following result.

Proposition 1 *For economies under consideration, raising the income of all need not increase the happiness of all. Specifically, when an economy is less wealthy, i.e.,* $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *economic growth is a good thing in the sense that increase in wealth will make individuals happier. However, when an economy increases its wealth beyond the critical level* $\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *i.e., when* $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *economic growth may not be a good thing in the sense that an increase in wealth*

will make individuals less happier if all the income is used up, and consequently, the economy will be at a Pareto inefficient outcome.

In order to evaluate individuals' happiness as a whole, i.e., social happiness/social welfare of a society, we would encounter utility comparisons across individuals. In economics, one way to do so is to assume the existence of a social welfare function which takes the utility level of each individual as arguments and is strictly monotone in each person's utility. Then, an ideal society should operate at a point that maximizes social happiness. The relationship between outcomes that maximize social happiness and Pareto efficient outcomes is also very nice. That is, any outcome that maximizes a social welfare function must also be Pareto efficient. Furthermore, suppose the utility functions are concave and strictly monotonically increasing in own goods consumption, then any Pareto efficient outcome can be found by the Utilitarian approach, i.e., by solving a linear social welfare function maximization problem with a suitable weight. Thus, if we define the social happiness (welfare) function by

$$W = \sum_{i=1}^{I} a_i u_i(m_i, n_i; m_{-i}),$$

it can be shown that all possible outcomes, which maximize the social happiness function subject to the resource constraints, are characterized by the conditions given in Lemma 1.

By doing social happiness maximization subject to the resource constraints, and noticing that the critical level of income is the same for all Pareto efficient allocations, we have the following proposition which directly follows from Lemma 1.

Proposition 2 *In the pure exchange economy with the above specific utility functions, for* ***any*** *social happiness/welfare function, when the economy is relatively poor, that is,* $\bar{m} \leq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *then increase in income would increase social welfare, i.e., the happiness of the whole society, and when the economy becomes wealthier, that is,* $\bar{m} > \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, *then increase in income alone cannot increase social happiness, and in fact, if the economy uses up all the income endowment, social happiness will decrease. The only way to enhance happiness is to increase the amount of non-income factors along with income.*

Remark 1 Since the critical level of income is given by $\bar{m}^* = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$ which is an increasing function in the level of non-material status $\bar{n}$, improving the status of non-material factors becomes essential in order to increase the happiness of people. Only when the level of non-material factors $\bar{n}$ is large enough, will increase in economic growth enhance individuals' happiness.

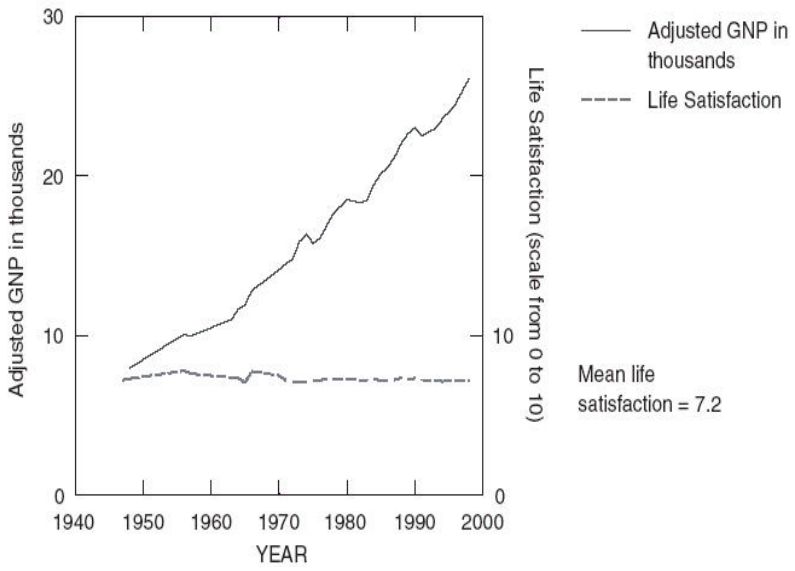

Figure 2: U.S. GNP and mean life satisfaction from 1947 to 1998. Source: (Diener and Seligman, 2004, p. 3, Fig. 1)

We use these result to explain the Easeterlin paradox observed in the developed countries. Psychologists typically use mean satisfaction happiness. See Figure 2. A mean life satisfaction analysis is equivalent to adopting a simple utilitarian social welfare function $W(u_1, ..., u_I) = u_1 + u_2 + ... + u_I$. Suppose by some mechanism, the society can always implement Pareto efficient outcomes. Then, by Lemma 1, plugging the Pareto efficient allocations into the social welfare functions $W(u_1, ..., u_I)$, the maximal social welfare would take the form

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

If free disposal is not allowed, which is likely the case in reality, then the maximal social welfare will be given by

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

for all $\bar{m} > 0$ and $\bar{n} > 0$.

Graphically, we see this in Figure 3 for a fixed $\bar{n}$. If we use the maximal social welfare to denote the potential maximum happiness of the whole society, then Figure 3 can explain why happiness remained constant in the developed countries when the income rose sharply during the past decades, but increases in income can enhance happiness in poor countries. In Figure 3, the income level $\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$ is the critical point. When the non-income factors are the same across countries, then in poor countries, the income level is less than $\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, the social happiness

is increasing in income. Once the income level reaches $\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}}\bar{n}$, the maximal social happiness cannot increase by increasing income alone. The only way is to improve the non-income factors, i.e., to increase $\bar{n}$. If the result is to use up all the income, then the social happiness would decrease as shown in Figure 3.

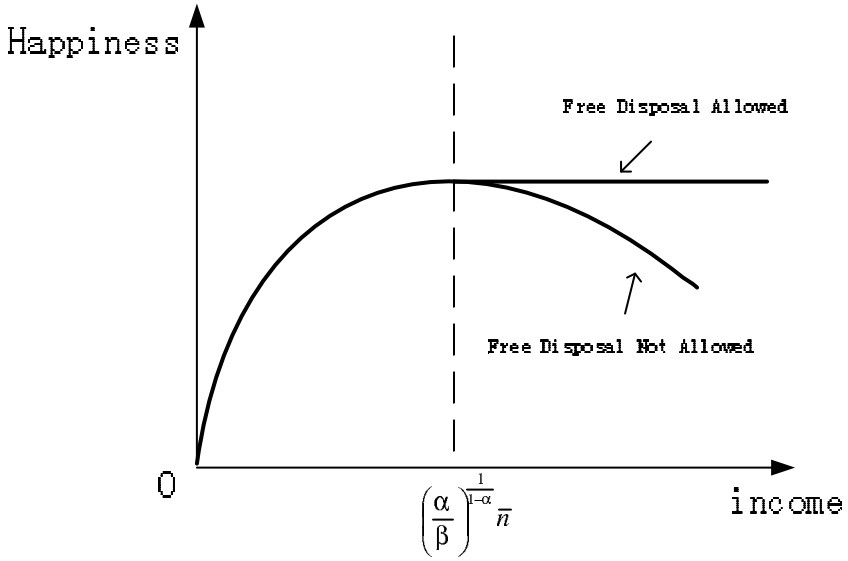

Figure 3: Income VS Happiness

The explanation can be made clearer in a dynamic structure. Obviously, the income endowment $\bar{m}_t$ is increasing as time goes by, since most developed countries enjoyed a long time of economic growth, and growth was also being the focus of the government policies in the last decades. That is, $\bar{m}_t < \bar{m}_{t+1}$. However, the trend of $\bar{n}_t$ is not very clear: some components (like leisure) increased (Di Tella and MacCulloch, 2006), some (like social capital) decreased (Putnam, 2001), and others were unclear due to the unavailability of data. But, Diener and Seligman (2004, p. 23) stated that the psychological Heisenberg principle might be at work, that is, the developed societies take great effort to measure economic activities, then people in those societies are likely to focus more attention on economic activities, sometimes to the detriment of other values. This effect tends to keep $\bar{n}_t$ steady or even declining, while $\bar{m}_t$ is improving over time. So, we may regard $\bar{n}_t$ to be roughly constant over time, that is, $\bar{n}_t = \bar{n}$. Basically, what the economy does is to make $\bar{m}_t$ larger and larger over time, while $\bar{n}_t$ is kept at a constant $\bar{n}$. The government focuses on promoting $\bar{m}_t$ by monetary and fiscal polices, and at each period t, facing the given $\bar{m}_t$ and $\bar{n}_t$, the government makes an effort to implement Pareto efficient outcomes. Thus, beyond some t, we will have $\bar{m}_t > \bar{m}^*$, that is, income exceeds the critical level, then happiness cannot improve. This explains the Easterlin paradox: increase in

income does not help increase in happiness. In reality, a government may have tried to promote the non-material goods, but the growth in n is not big enough to capture the growth of m, i.e., $\bar{n}_t$ increases but at a lower rate than $\bar{m}_t$, as such, income level will eventually exceed the critical level and consequently it would result in decrease in happiness. In next section, by estimating $\bar{m}^*$, we can see that $\bar{m} > \bar{m}^*$ for USA and Japan and increase in income has no effect, but $\bar{m} < \bar{m}^*$ for the Ireland, Netherlands, and Puerto Rico, and income helps to enhance happiness.

Thus, our model suggests that the government policies should be tilted towards boosting non-material goods when the income level is close to the critical point. Actually, a government can play an important role in many non-material domains, although it is the case that it can not do so in all of them. Apparently, fighting inflation, improving democracy and freedom, preventing crime, etc., are the fields where government must play a role. Diener and Seligman (2004) argue that government can also play a role in improving social relations, ameliating mental disorder, etc. Also, they suggest the government should build a system of well-being indicators and focus on improving well-being directly. So, all of these suggestions by psychologists can be supported by our theoretical model.

In conclusion, our theoretical findings show that there is a critical income level that is positively related to the amount of non-income goods and determines whether or not economic growth will bring an increase in happiness. When the income level exceeds this critical point, then the happiness-income paradox would occur. This paradox may be solved if one is willing to spend some portion of income to improve non-material status. Non-material goods must be increased to improve happiness. Thus, as a policy implication of our theory, when an economy becomes wealthier, the government should use a sufficiently large portion of GDP to promote the non-material status of its residents.

4 Extensions

For simplicity, in the model discussed above, we made some simplified assumptions. We assume that there is only one reference group, there is no social comparison for non-material goods, and a specific utility function is used. All these simplified assumptions, however, can be relaxed. In this subsection, we show that our main results are still true for economies with multiple reference groups, small comparison effect for non-material goods, as well as general utility functions.

4.1 Multiple Reference Groups

Each person has his/her own reference group, say, people in the same country, the same age range, the same sex, etc. When he/she makes a comparison about his/her life, he/she usually only compares to relevant others in the same reference group. In the previous basic model, for simplicity, it is assumed that there is only one group and each consumer compares himself/herself with all the others.

We now assume that there are K groups, and each group has I_k consumers. Then, consumer i only compares himself/herself 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 $(m_{1k}, ..., m_{i-1,k}, m_{i+1,k}, ...m_{I_k k})$. The Pareto efficiency problem would change a little bit accordingly. That is, besides the allocation within the group for given resources, there is another higher order resource allocation among groups. In fact, our basic model is the simplest case, where $K = 1$ and $I_1 = I$. But the basic idea of the model can carry over to the cases where $K > 1$ as shown below.

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

Suppose the amount of income goods in the whole economy 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 exists at lease one group such that there will be free disposal of income within the group at Pareto efficient allocations. Clearly, increasing income goods only would result in the same set of Pareto efficient allocations as before, and consequently has no effect on increasing happiness indexed by any social welfare function. We formally state this result in the following proposition.

Proposition 3 *In the economy with multiple reference groups, when the economy is less wealthy, 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 will make individuals happier. However, when the total amount of income goods is sufficiently high relative to that of non-income goods, 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 only leads to decline in happiness.*

4.2 Social Comparison Effect for Non-Material Goods

In this subsection, we extend our results to the economies where there is also social comparison effect for the non-material goods. As we discussed in Section 3.1, a good can be categorized according to whether it is a "positional good" whose value depends relatively strongly on how they compare with things owed by others or a "non-positional good"that depend relatively less strongly on such comparisons, and thus they are distinguished by the extent of social comparison. Easterlin(2003) and Solnick and Hemenway (2006, p. 147) further argued that material goods are more positional than non-material goods. Their assessments are supported by the empirical studies of Neumark and Postlewaite (1993), Carlsson et al. (2003), Luttmer (2005), and Solnick and Hemenway (2006). Our theoretical results below also support their assessment.

For the simplicity of exposition, assume there are only two consumers in the economy. 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 $\alpha \in (0,1), \beta > 0, \gamma > 0$, $i \in \{1,2\}, j \in \{1,2\}, j \neq i$.

Again, we assume that the economy adopts a utilitarian social welfare function. That is, we have the following maximization problem

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

The parameter β and γ capture the social comparison effects for material goods and non-material goods, respectively. It can be shown that the joint social comparison effects, measured by $\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}}$, cannot be too high, if everyone enjoys both material goods and non-material goods in an allocation which maximizes the social welfare. In particular, if the joint social comparison is small enough, i.e.,

$$\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}} < \alpha^{\frac{1}{1-\alpha}}(1-\alpha)^{\frac{1}{\alpha}}, \tag{2}$$

and the amount of income goods is already large enough relatively to the non-income goods, i.e.,

$$\bar{m} \geq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}, \tag{3}$$

then social welfare maximization would require free disposal of income goods. We can calculate the social welfare or happiness,

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

where the coefficient $\left[\left(\frac{\alpha}{\beta}\right)^{\frac{\alpha}{1-\alpha}} - \beta\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} - \gamma\right]$ can be shown to be positive by using inequality (2) .

Note that the inequality given in (2) states that the degree of the *joint* social comparison should be small. This is true whatever how big the social comparison on income goods β is, provided the social comparison on non-income goods γ is sufficiently small. For example, when $\alpha = 1/2$, inequality (2) is $\beta\gamma < 1/4$. If $\gamma = 1/16$, then β can take values up to 4. This is possibly the case in reality as we argued before.

We state this result formally in the following proposition.

Proposition 4 *Suppose that the joint social comparison is small, i.e., provided* $\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}} < \alpha^{\frac{1}{1-\alpha}}(1-\alpha)^{\frac{1}{\alpha}}$ *(a sufficient condition for this to be true is that social comparison effect for non-material goods,* γ*, is sufficiently small), and the amount of income goods is already large enough relatively to the non-income goods, i.e.,* $\bar{m} \geq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}}\bar{n}$*. Then the social happiness only depends on* $\bar{n}$*:* $W = \left[\left(\frac{\alpha}{\beta}\right)^{\frac{\alpha}{1-\alpha}} - \beta\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} - \gamma\right]\bar{n}$*, and consequently, improving wealth would not increase happiness in this case, and the only way to improve happiness is to improve* $\bar{n}$*.*

The proof is contained in Appendix B.

Thus, introducing small social comparison effect on non-material goods would not change our qualitative result. Our theoretical results also support the assessment that material goods are more positional than non-material goods.

4.3 General Utility Functions

The results obtained in the previous subsections can be also extended to the economies with general utility functions. Again, for simplicity, we consider a two-consumer economy. The first order conditions for characterizing Pareto efficiency are related to equating two social marginal rates of substitution corrected by the negative externality effect. Again, we assume that $u_i(m_i, n_i; m_j)$ 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 $j \neq i$.

Let $SMRS^i$ be the social marginal rate of substitution of consumer i's income consumption for non-income consumption. From Tian and Yang (2005), we know that $SMRS^i = \frac{\partial u_i/\partial m_i}{\partial u_i/\partial n_i} + \frac{\partial u_j/\partial m_i}{\partial u_j/\partial n_j}$, in which the first term is the ordinary individual marginal rate of substitution, and the second term captures the effect of externality. Let $SMRS = SMRS^1 = SMRS^2$ in the FOCs. Then, combining the resource constraints, we have a system, which defines Pareto efficiency,

$$(GPE)\begin{cases} SMRS = SMRS^1 = SMRS^2 \geq 0, \\ m_1 + m_2 \leq \bar{m}, SMRS \cdot (\bar{m} - m_1 - m_2) = 0, \\ n_1 + n_2 = \bar{n}. \end{cases}$$

If we also assume that $\lim_{m_i \to 0} \frac{\partial u_i/\partial m_i}{\partial u_i/\partial n_i} \to \infty$ and $\lim_{m_i \to \infty} \frac{\partial u_i/\partial m_i}{\partial u_i/\partial n_i} \to 0$, the social marginal rate of substitution is diminishing and eventually becomes negative.[13] Thus, when $SMRS$ satisfying the system (GPE) is positive, any Pareto efficient allocation must be balanced, that is, $m_1 + m_2 = \bar{m}$. In this case, let $m_2 = \delta m_1$ for $\delta \in (0, \infty)$. Then, we have $m_1 = \frac{1}{1+\delta}\bar{m}$ and $m_2 = \frac{\delta}{1+\delta}\bar{m}$,[14] and thus an increase in the wealth of a country will increase individuals' happiness. For any given $\delta \in (0, \infty)$, when $\bar{m}$ becomes sufficiently large, m_1 and m_2 also become sufficiently large, and then this balanced allocation would give negative $SMRS_i$ for all i, which implies free disposal of income goods at Pareto efficient status. As a result, for any social welfare function, there is a critical point, beyond which increase in income cannot increase aggregate happiness since the income constraint is already non-binding once this critical point is reached. This would give us the relationship between income and happiness: increasing income helps in enhancing happiness only before some critical income level is reached.

We formally state this result in the following proposition.

Proposition 5 *For the economy with general utility functions, suppose $u_i(m_i, n_i; m_{-i})$ is continuously differentiable, $\frac{\partial u_i}{\partial m_i} > 0$, $\frac{\partial u_i}{\partial n_i} > 0$, $\frac{\partial u_i}{\partial m_j} < 0$, $\frac{\partial^2 u_i}{\partial m_i^2} < 0$, $\frac{\partial^2 u_i}{\partial m_j^2} \leq 0$, $\lim_{m_i \to 0} \frac{\partial u_i/\partial m_i}{\partial u_i/\partial n_i} \to \infty$, and $\lim_{m_i \to \infty} \frac{\partial u_i/\partial m_i}{\partial u_i/\partial n_i} \to 0$ for $j \neq i$. Then, for any given social welfare function, when the total amount of income goods is low, increase in income increases happiness. However, when the total amount of income goods is sufficiently high, then increase in income only leads to decline in happiness.*

Example 1 Suppose consumers' preferences are given by the following specific utility function:

$$u_i(m_i, n_i; m_{-i}) = m_i^{\alpha} n_i^{1-\alpha} - \beta m_j^{\rho} \quad \rho \geq 1.$$

Note that the utility function is increasing in one's own consumption but with diminishing marginal utility and decreasing in the average consumption of other individuals with diminishing marginal disutility for $\rho > 1$ as others' income grows. Now we want to determine the critical

[13] As long as one adopts the Pareto efficiency as the criterion in evaluating the performance of an economic system, an economy is inefficient whenever the Easterlin paradox appears, which means that the social marginal rate of substitution must eventually become negative.

[14] Note that, when δ varies from 0 to ∞, m_1 (resp. m_2) varies from $\bar{m}$ (resp. zero) to zero (resp. $\bar{m}$), which gives all possible combinations of m_1 and m_2 that satisfy $m_1 + m_2 = \bar{m}$.

level of income for each social welfare function. From Tian and Yang (2005), we know that the critical points are characterized by $SMRS^1 = SMRS^2 = 0$.

For consumer 1, by $SMRS^1 = \frac{\partial u_1/\partial m_1}{\partial u_1/\partial n_1} + \frac{\partial u_2/\partial m_1}{\partial u_2/\partial n_2} = 0$, we have

$$\frac{n_1}{m_1} = \left(\frac{\beta\rho}{\alpha}\right) m_1^{\rho-1} \left(\frac{n_2}{m_2}\right)^{\alpha}. \tag{4}$$

Similarly, for consumer 2, by $SMRS^2 = \frac{\partial u_2/\partial m_2}{\partial u_2/\partial n_2} + \frac{\partial u_1/\partial m_2}{\partial u_1/\partial n_1} = 0$, we have

$$\frac{n_2}{m_2} = \left(\frac{\beta\rho}{\alpha}\right) m_2^{\rho-1} \left(\frac{n_1}{m_1}\right)^{\alpha}. \tag{5}$$

Substituting (5) into (4) and rearranging the terms, we have

$$n_1 = \left(\frac{\beta\rho}{\alpha}\right)^{\frac{1}{1-\alpha}} m_1^{\frac{\rho-\alpha^2}{1-\alpha^2}} m_2^{\frac{\alpha(\rho-1)}{1-\alpha^2}}. \tag{6}$$

By symmetricity, we have

$$n_2 = \left(\frac{\beta\rho}{\alpha}\right)^{\frac{1}{1-\alpha}} m_2^{\frac{\rho-\alpha^2}{1-\alpha^2}} m_1^{\frac{\alpha(\rho-1)}{1-\alpha^2}}. \tag{7}$$

Adding (6) and (7) gets

$$\bar{n} = \left(\frac{\beta\rho}{\alpha}\right)^{\frac{1}{1-\alpha}} \left[m_1^{\frac{\rho-\alpha^2}{1-\alpha^2}} m_2^{\frac{\alpha(\rho-1)}{1-\alpha^2}} + m_1^{\frac{\alpha(\rho-1)}{1-\alpha^2}} m_2^{\frac{\rho-\alpha^2}{1-\alpha^2}} \right]. \tag{8}$$

Letting $m_1 = \frac{1}{1+\delta}\bar{m}^*$ and $m_2 = \frac{\delta}{1+\delta}\bar{m}^*$, we have

$$\bar{n} = \left(\frac{\beta\rho}{\alpha}\right)^{\frac{1}{1-\alpha}} \bar{m}^{*\frac{\rho-\alpha}{1-\alpha}} \left[\frac{\delta^{\frac{\alpha(\rho-1)}{1-\alpha^2}} + \delta^{\frac{\rho-\alpha^2}{1-\alpha^2}}}{(1+\delta)^{\frac{\rho-\alpha}{1-\alpha}}} \right],$$

and thus the critical level of income $\bar{m}^*$ is given by

$$\bar{m}^* = \left(\frac{\alpha}{\beta\rho}\right)^{\frac{1}{\rho-\alpha}} \bar{n}^{\frac{1-\alpha}{\rho-\alpha}} \left[\frac{(1+\delta)^{\frac{\rho-\alpha}{1-\alpha}}}{\delta^{\frac{\alpha(\rho-1)}{1-\alpha^2}} + \delta^{\frac{\rho-\alpha^2}{1-\alpha^2}}} \right]^{\frac{1-\alpha}{\rho-\alpha}}. \tag{9}$$

Thus, for a given δ, when the total amount of income goods $\bar{m} \leq \bar{m}^*$, increase in income increases a weighted average happiness. However, when the total amount of income goods $\bar{m} > \bar{m}^*$, increase in income only leads to decline in the weight average happiness.

Note that, when $\rho = 1$, we have the $\bar{m}^* = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$ which is independent of δ so that for all Utilitarian social welfare functions, the critical level of income is the same. This is the result obtained in Section 3. It may be also remarked that δ in (9) represents the relative equity among individuals. For instance, when $\delta = 1$, we have the equal weighted social welfare function, and the allocation $(m_1, m_2, n_1, n_2) = (\frac{\bar{m}^*}{2}, \frac{\bar{m}^*}{2}, \frac{\bar{n}}{2}, \frac{\bar{n}}{2})$ is a Pareto efficient allocation with the total endowment $(\bar{m}^*, \bar{n})$. In this case, the critical level of income is given by

$$\bar{m}^* = \left(\frac{\alpha}{\beta\rho}\right)^{\frac{1}{\rho-\alpha}} \bar{n}^{\frac{1-\alpha}{\rho-\alpha}} 2^{\frac{\rho-1}{\rho-\alpha}}, \tag{10}$$

beyond which increase in income may decrease average happiness. $\delta = 1$ in fact minimizes $\bar{m}^*$ in (9), which means that, when the total income $\bar{m} < \left(\frac{\alpha}{\beta\rho}\right)^{\frac{1}{\rho-\alpha}} \bar{n}^{\frac{1-\alpha}{\rho-\alpha}} 2^{\frac{\rho-1}{\rho-\alpha}}$, there is no destruction in income for any Pareto optimal outcome or for any social welfare functions. Thus, increase in income would increase individuals' happiness. This can be seen from Figure 4. Also, when δ is very small or very large, the ratio, $\frac{m_2}{m_1}$, becomes very larger or small, which means one person is very richer and the other is very poor. That is, more inequity in income among individuals, larger the critical level of income will be.

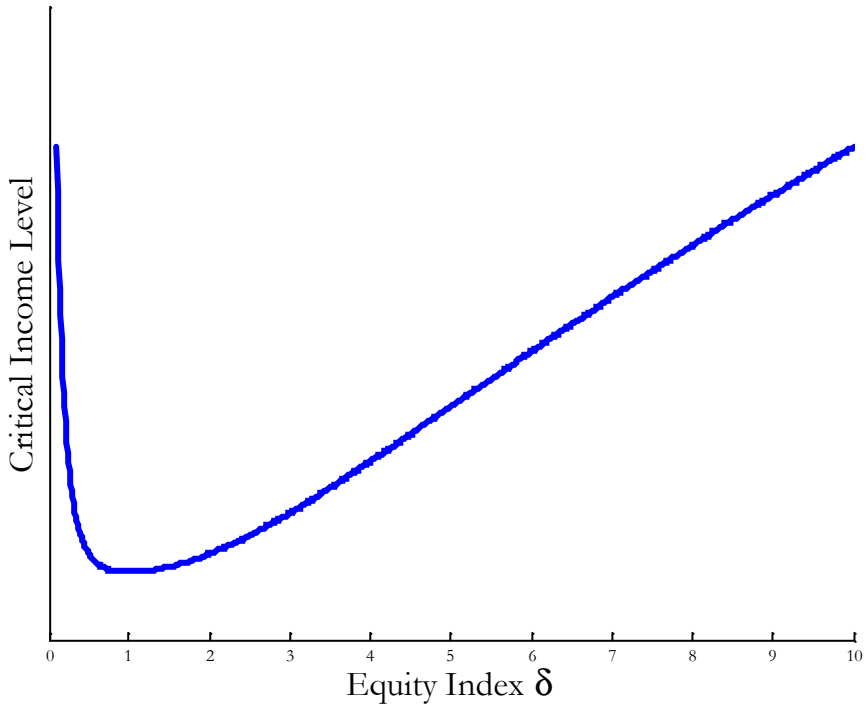

Figure 4: Equity VS the Critical Income for Happiness

5 Empirical Evidence

In the previous section, we conclude that for any given level of non-income good $\bar{n}$, if the income level $\bar{m}$ is greater than the critical value that is positively related to $\bar{n}$, then any effort to enhance happiness (indexed by any social welfare function) through increasing income turns out to be useless, although it may be the case that the government has already done perfectly in correcting the market failures in the pecuniary domains. As a consequence, the only way to increase happiness is to increase $\bar{n}$ instead of $\bar{m}$.

In this section, we make some empirical analysis that supports our theoretical results and identify the critical income point in reality, by fitting the data to our theoretical model and estimating the parameters α, β and $\bar{n}$. If a real income level is greater than the corresponding estimated critical value, then it suggests that the economy is producing too much income goods and too little non-income goods. This could explain why in those countries increase in income only cannot help enhance happiness.

5.1 Data

We use the World Values Survey data and the ERS International Macroeconomic Data Set to fit our theoretic model. The World Values Survey has four successive waves, in 1981-1982, 1989-1993, 1995-1998, and 1999-2003, respectively. Different waves cover different but overlapping countries. The most recent survey covers more than 70 countries. We do a cross nations analysis, and each country in each wave constitutes one observation in our analysis[15]. The World Values Survey provides a life satisfaction variable. This is an ordered variable scaled from 1 (Dissatisfied) to 10 (Satisfied). We use the mean satisfaction to index happiness u, in line with the analysis in most psychology work, Diener and Seligman (2004) for example. We use the real per capita income (in 2000 U.S. dollars) provided in the ERS international macroeconomic data set to represent the income explanatory variable m.

Since many factors other than income can significantly affect the well-being, according to our definition of n, the non-income variable should be a composite good constructed from some of those potential factors. According to the previous empirical work such as those in Helliwell (2003), Graham and Pettinato (2002), Blanchflower and Oswald (2004), and the studies review by Diener and Seligman (2004), we mainly choose the following non-income factors available from the WVS data set: state of health, marital status, human rights and time with friends. Of course, some other variables in WVS, such as corruption, also serve as candidates. But in many cases the data are missing for a large number of countries in some waves, including the USA and Great Britain. We do not use macroeconomic variables such as inflation and unemployment either because we want to keep the non-income factors being private goods. Because we do a cross nations analysis and have a small sample size, therefore, we could not use many non-income variables in one regression, and therefore we would try different ways to combine two of the above-mentioned variables in a Cobb-Douglas form to index the non-income goods. That

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

is, we assume

$$n = n_1^{\phi_1} n_2^{\phi_2}, \tag{11}$$

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

All of the non-income factors are ordered data in the World Values Survey. We want the explanatory data to be invariant of the order scale. So, we use the percentage to measure n_1 and n_2. The variable A009 asks "(a)ll in all, how would you describe your state of health these days?" The correspondents can choose the answer from (1) very good, (2) good, (3) fair, (4) poor or (5) very poor. We would use the percentage of respondents who choose (1) and (2), that is, those who are in good health condition, to represent the state of health for the country in the corresponding year. According to variable X007, the percentage of respondents who choose "married" or "live together as married" can work as the proxy for marrital status, since the other answers like "divorce", "separated", "widowed" etc., would negatively affect happiness according to previous studies. Similarly, we use the percentage of respondents who choose "there is a lot of respect for individual human rights" in variable E124, to represent the human right variable, and use the percentage of respondents who visit friends frequently (who choose visit friends weekly or once or twice a month), to represent time with friend in variable A058. 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, Ukraine, this dummy variable takes value 1 and for the other countries, it takes value 0.

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 1 shows the data summary for the whole sample and Tables 2 and 3 show the data values related to the USA and Japan. From Table 2, we could see that the state of health has increased but marital status has declined in the USA. According to Table 3, health condition and marital status have increased in Japan. The trend of the other two variables are unknown to both countries only according to the WVS data.

Table 2 Data Summary for the USA

	USA (1982)	USA (1990)	USA (1995)	USA (1999)
Mean life satisfaction	7.67	7.75	7.68	7.65
GDP per capita (2000 US$)	22518.19	28467.86	29910.29	33717.43
State of health	75.72	77.13	79.38	83.81
Marital status	59.68	67.63	64.15	55.46
Human rights	NA	NA	NA	16.53
Time with friends	NA	NA	NA	92.24

Table 3 Data Summary for Japan

	Japan (1981)	Japan (1990)	Japan (1995)	Japan (2000)
Mean life satisfaction	6.59	6.53	6.72	6.48
GDP per capita (2000 US$)	24176.56	33438.54	35332.73	37459.16
State of health	43.92	44.43	55.76	54.74
Marital status	70.56	77.45	73.18	74.31
Human rights	NA	NA	NA	3.80
Time with friends	NA	NA	NA	66.24

5.2 Results

We will estimate the following utility function,

$$u = m^{\alpha}\left(n_1^{\phi_1} n_2^{\phi_2}\right)^{1-\alpha} - \beta m - \kappa D, \tag{12}$$

where D denotes the dummy variable to indicate whether the country belongs to the Former Soviet Union. Our specification of equation (12) implicitly assumes that the individuals are identical within the country (or region) and compare themselves only with others within the country (or region). We use Eviews4 to run the non-linear least squared estimation [16] equation (12) by choosing different non-income factors, and the results are shown in Table 4.

The t-statistic and p-values are shown in parentheses below the estimated coefficients. For example, regression I choose n_1 and n_2 as state of health and marital status respectively. There

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

are 147 observations included in this regression and the adjusted R^2 is 0.594387. This regression gives the following estimated values: $\hat{\alpha} = 0.092527$, $\hat{\beta} = 3.22E-05$, $\hat{\phi}_1 = 0.233889$, $\hat{\phi}_2 = 0.075882$, and $\hat{\kappa} = 0.524054$. From the t-statistic or p-values, we know that $\hat{\alpha}$ and $\hat{\phi}_1$ are significant at 1% level and all the other parameters are significant at 5% level. Similarly, regression II gives the result based on taking n_1 and n_2 as state of health and human rights, and so on and so forth.

Table 4 Estimation Result (Nonlinear Least Squared)

	I	II	III	IV	V
α	0.092527	0.093458	0.125614	0.098697	0.109372
	(7.171212)(0.0000)	(3.459937)(0.0013)	(7.828737)(0.0000)	(5.002098)(0.0000)	(5.853875)(0.0000)
β	$3.22E-05$	$2.84E-05$	$4.21E-05$	$1.42E-05$	$3.85E-05$
	(2.200947)(0.0294)	(0.932844)(0.3564)	(2.022390)(0.0468)	(0.644555)(0.5215)	(1.781473)(0.0797)
State of health	0.233889	0.274318			
	(6.651826)(0.0000)	(6.153632)(0.0000)			
Marital status	0.075882		0.203546	0.114758	
	(2.141776)(0.0339)		(7.277331)(0.0000)	(1.629491)(0.1081)	
Human rights		0.037387	0.068115		0.051787
		(1.593145)(0.1188)	(4.597381)(0.0000)		(3.073338)(0.0031)
Time with friends				0.164427	0.230641
				(2.348191)(0.0220)	(7.326869)(0.0000)
Former Soviet Union	0.524054	0.219093	0.558825	0.929902	0.550694
	(2.126308)(0.0352)	(0.537811)(0.5936)	(2.326378)(0.0227)	(3.046352)(0.0034)	(1.736389)(0.0874)
# observations	147	46	79	69	68
Adjusted R^2	0.594387	0.578009	0.729653	0.606168	0.642556

The signs of the coefficient are consistent with the previous works, and the patterns are very similar for all regressions. Belonging to the Former Soviet Union has negative effect on happiness, possibly due to the instability effect of the dissolution in the Soviet Union. We would analyze those regression whose parameters are all significant. That is, regression I (n_1 =State of health, n_2 =Marital status), III (n_1 =Marital status, n_2 =Human rights), and V (n_1 =Human rights, n_2 =Time with friends).

According to (11), we can estimate the composite non-income factor, that is,

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

This estimation can also be used to estimate the critical income level, which is given by

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

In Tables 5 and 6, we show the real income and estimated critical level for the USA and Japan respectively, based on different estimations. We can see that the in 1990s, both USA and Japan are on the inefficient area since the real income exceeded the critical values, which explains the flatness of their happiness trace in the last 10 years. The critical levels are very

similar across regressions. For example, according to Table 6, the critical income level of the USA 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). Also note that the critical income levels did not change much over time for regression I, that is, when we choose state of health and marital status as non-income factors, and this suggests the non-income goods did not improve much in the last decades. Thus, the results are very robust.

Table 5 Real Income and Critical Income Levels for the USA

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
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

Table 6 Real Income and Critical Income Levels for Japan

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
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

Besides these estimation results, in WVS, the variable E014 asks the correspondents to directly state their attitude towards "less emphasis on money and material possessions" in the near future, by choosing it as a "good thing", "don't mind" or a "bad thing". Those subjects who choose "good thing" as the answer account for 65% - 70% in each wave for the USA. At the same time, the variable E019, asks the correspondents to indicate their attitude towards "more emphasis on family life", and roughly 94% of the USA subjects choose it as a "good thing" in those waves. Great Britain and Japan have similar situations. Those facts also suggest that the current possessions of material goods are too high relatively to those of the non-material goods.

The estimated model can also predict increase in happiness for the following less developed countries: Albania, Ireland, Mexico, Netherlands, Puerto Rico, Slovenia, etc.. For example, by using the mean satisfaction and real income level (in 2000 US dollars), the various estimated income levels under different combinations of non-material goods for Ireland, Netherland, and Puerto Rico are shown in Tables 7-9, which are based on regression I with state of health and marital status as non-income factors, regression III with marital status and human rights as non-income factors, and regression V with human rights and time with friends, as non-income factors. We could see that, when the real income do not exceed the estimated critical levels for these countries, the increase in income does contribute to an increase in happiness in these tables.

Table 7 Real Income and Critical Income Levels for Ireland

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
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

Table 8 Real Income and Critical Income Levels for Netherlands

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
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

Table 9 Real Income and Critical Income Levels for Puerto Rico

Year	Mean Satisfaction	Real Income	Critical Level		
			I	III	V
1995	7.70	11502.26	23646.51	NA	NA
2001	7.88	13394.87	24013.54	25563.74	22895.78

If we fix the non-income factor at the mean of the estimated non-income factor, $\tilde{n}$, then we can get an explicit relationship between happiness and income. That is,

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

According to this relationship, we could calculate the relative response of happiness to the 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 shown in Table 10.

Table 10 Happiness-Income Elasticity

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

In Table 10 the elasticity is decreasing in income for the given non-income factor. Note that the elasticity does not vary much before income level increases up to 10,000 dollars. So, the effect of income on happiness at the early stage is significant. The critical income level for this $\tilde{n} = 3.102932$ is, 23,405 dollars. When the income is beyond this level, the elasticity becomes negative. The only way to increase happiness is to increase the non-income factors rather than income. This is consistent with the previous across nations studies, which state that below US dollar 10,000 per capita income, the effect of income is significant in increasing happiness, and above that level, the effect is pretty small or no effect (Frey and Stutzer, 2002b; Helliwell, 2003; Schyns, 2003).

6 Conclusion

Conventional economic theories and models lie at the heart of claims that promoting income promotes aggregate welfare/happiness. Economic policies thus put tremendous importance on economic growth. However, these theories and models fail to explain the Easterlin Paradox, a paradox at the heart of our lives: average happiness levels do not increase as countries grow wealthier. Because of this, many psychologists and some economists suspect or even deny the methodologies and role of modern economics in studying happiness of human beings, and some even push their criticisms to an extreme of denying individual self-interested behavior, a fundamental assumption in economics. On the other hand, because most studies on happiness are either empirical or descriptive, which are mainly based on psychological analysis, there are few formal and rigorous economic models that can be used to study people's happiness. It is regarded as non-mainstream happiness economics and has been neglected by most economists.

The results in our paper show that the assessments that the pursuit of economic growth always promotes social welfare/happiness and the pursuit of individual self-interest is a bad assumption are problematic and inappropriate, and both the over-valued and under-valued claims on standard economic theories and happiness studies are misleading to a great extent.

In this paper we have offered a formal and general economic theory that provides a foundation for happiness studies from the perspectives of social happiness maximization, which can be especially used to study the Easterlin paradox. There is no such kind of approach adopted in the current happiness study literature, which uses the standard analytical framework and basic welfare analysis tools such as Pareto efficiency in mainstream economics. This theory integrates the two conventional approaches, the omitted variables approach and the reference group theory, into a unified framework, and obtains new findings. The omitted variables approach emphasizes the effect of non-income factors, but it actually cannot explain the paradox itself because many non-income factors have increased overtime. The reference group theory, on the other hand, explains the income-happiness paradox, but does not provide any solution to solve the paradox. Our theory not only explains but also solves the paradox.

Our basic model is general and the theoretical results are robust, which are true for any number of agents, multiple reference groups, the presence of comparison effect for non-material goods, as well as general utility functions. We prove that there is a critical income level, beyond which increase in income alone cannot increase aggregate happiness anymore and below which increase in income can increase aggregate happiness. This critical point is evidenced by numerous empirical studies but not explained well in theory. The magnitude of the critical level is determined by the amount of non-income resources in our model.

Our theory thus fits the Easterlin facts perfectly. Although the conclusions of the paper are so unconventional, any economist who does not like the results would face the problem that they have to provide an alternative theory to solve the paradox. Because the problem is so important, we need such a theory. The empirical results obtained in the paper also fit the predictions of our model very well for many countries. For the USA and Japan, the real income exceeds the estimated critical level, and hence increase in income has no effect on increasing happiness. For Ireland, Netherlands, etc., the income is below the critical level, and increase in income contributes to happiness. The result is robust to different regressions when experimenting with distinct non-income factors.

Thus, our theoretical and empirical results both indicate that, when a country is poor and less developed, increasing the wealth of the country is a good thing, since it can enhance happiness

of individuals. However, when a country reaches a critical income level, increase in income is no longer helpful to increase the happiness of human beings, and in fact, it actually reduces social happiness, resulting in Pareto inefficient outcomes.

A policy implication of our theoretical results is that the government should promote a balanced growth between income goods and non-income goods. The government should pay attention to increasing public expenditure on non-material wants as long as they can be promoted, when national income reaches a certain level. Our empirical results confirm the implication and are robust across the countries under consideration. In addition, we approach this problem based on the basic Pareto efficiency criterion and the basic assumption on the pursuit of individual self-interest, and thus it is consistent with the mainstream economics.

Finally, it may be remarked that our theoretical model has assumed that the total endowments for material and non-material goods are exogenously given. One may be wondering why we make this assumption, while the endowment of non-material goods in fact can in many cases be increased by spending income m on them. Our answer is that this assumption is necessary for adopting Pareto efficiency criterion and is standard in an general equilibrium model. Nevertheless, we can then allow them to be varied when making comparative static analysis for policy implications. One should know that "can be" is different from "has been". That is, "possibility" does not equal "reality." Although non-material goods n *can be* increased by spending income m on them by a government, but if the government has not done enough, the Easterlin Paradox appears. So, we has to use the comparative approach for policy implications. Whether it really happens depends on the focus of current policies to a large extent. For example, larger portion of GDP on public health can increase the health condition of all citizens, but the government has not done it enough yet. Otherwise, according to our theoretical model, there would be no Easterlin Paradox if non-materials consist of health and age.

Thus, to explain the paradox theoretically, we should and can reasonably assume that the endowment of non-material goods is fixed since the government has not done enough to promote non-materials goods. As such, to solve the paradox, the policy suggestion from our theoretical results is that the government should pay more attention to increasing public expenditure on promoting non-material wants. (Indeed, Tian and Yang (2005) showed that there is no disposal for income good and thus the paradox would disappear when non-material goods are allowed to be produced from materials goods.) This is why we first consider the case where the endowment of non-material goods is fixed for explaining the paradox, and then suggest that it should be increased for solving the paradox as a policy implication of our theoretical results. Thus, this

approach is essentially the standard comparative static approach: first find the optimal solution, the critical level that is given by $\bar{m}^* \geq \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, which is the function of the parameter $\bar{n}$, and then make the comparative static study by changing $\bar{n}$. Thus, no intellectual difficulty runs throughout the paper.

7 Appendix

7.1 Appendix A. Proof of proposition 1.

In the problem (PE), since the objective function and constraints are continuously differentiable and concave on $\mathbb{R}^{2I}_{++}$ and Slater's condition[17] is satisfied, the Pareto efficient points are completely characterized by the FOCs.

Define the Lagrangian function as:

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

We can obtain the following FOCs:

$$m_i : -\frac{\beta}{I-1} - \lambda_m + \mu_i \alpha m_i^{\alpha-1} n_i^{1-\alpha} - \beta\left(\frac{\mu_1+...+\mu_{i-1}+\mu_{i+1}+...+\mu_{I-1}}{I-1}\right) = 0, \quad (13)$$

$$n_i : -\lambda_n + \mu_i (1-\alpha) m_i^{\alpha} n_i^{-\alpha} = 0, \quad (14)$$

$$m_I : \alpha m_I^{\alpha-1} n_I^{1-\alpha} - \lambda_m - \beta\left(\frac{\mu_1+...+\mu_{i-1}+\mu_i+\mu_{i+1}+...+\mu_{I-1}}{I-1}\right) = 0, \quad (15)$$

$$n_I : (1-\alpha) m_I^{\alpha} n_I^{-\alpha} - \lambda_n = 0, \quad (16)$$

$$\lambda_m : \sum_{i=1}^{I} m_i \leq \bar{m},\ \lambda_m \geq 0,\ \lambda_m\left(\bar{m} - \sum_{i=1}^{I} m_i\right) = 0, \quad (17)$$

$$\lambda_n : \sum_{i=1}^{I} n_i \leq \bar{n},\ \lambda_n \geq 0,\ \lambda_n\left(\bar{n} - \sum_{i=1}^{I} n_i\right) = 0, \quad (18)$$

$$\mu_i : m_i^{\alpha} n_i^{1-\alpha} - \beta\frac{\sum_{j\neq i} m_j}{I-1} \geq u_i^*,\ \mu_i \geq 0,\ \mu_i\left(m_i^{\alpha} n_i^{1-\alpha} - \beta\frac{\sum_{j\neq i} m_j}{I-1} - u_i^*\right) = 0, \quad (19)$$

where (13), (14) and (19) hold for any $i = 1, ..., I-1$.

By (16), we have $\lambda_n > 0$ and thus, in (18), we obtain the following restriction:

$$\sum_{i=1}^{I} n_i = \bar{n}. \quad (20)$$

Using (13)-(16), we have

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

[17] Slater's condition states that there is an point $\{\hat{m}_i, \hat{n}_i\}_{i=1}^{I} \in \mathbb{R}^{2I}_{++}$ such that all constraints hold with strict inequality.

which implies that $\mu_i = 1$ for any i, because the left hand side is an increasing function in μ_i, which guarantees the uniqueness of solution.

Using the fact that $\mu_i = 1$ and $\lambda_n > 0$, from (13) and (14) we have

$$\lambda_m = \lambda_n^{-\frac{1-\alpha}{\alpha}} \alpha \left(1-\alpha\right)^{\frac{1-\alpha}{\alpha}} - \beta. \tag{21}$$

By (14), (16), $\mu_i = 1$, and $\lambda_n > 0$, we have

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

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

Summing up (22) over i and using (20), we have

$$\lambda_n = (1-\alpha) \left(\frac{\sum_{i=1}^I m_i}{\bar{n}} \right)^{\alpha}, \tag{23}$$

which implies that,

$$n_i = \frac{m_i \bar{n}}{\sum_{i=1}^I m_i}, \tag{24}$$

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

By substituting (23) into (21), we have

$$\lambda_m = \alpha \left(\frac{\bar{n}}{\sum_{i=1}^I m_i} \right)^{1-\alpha} - \beta, \tag{25}$$

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

Since it is required that $\lambda_m \geq 0$ 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 (25), and thus by (17), we have

$$\sum_{i=1}^I m_i = \bar{m}. \tag{26}$$

Therefore if $\bar{m} < \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, from the Pareto efficient point of view, all the income should be spent, and thus increases in income will increase individuals' happiness/utility. Then, by (24)

$$n_i = \frac{\bar{n}}{\bar{m}} m_i, \tag{27}$$

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

Case 2. $\lambda_m = 0$. Then, by (25), 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 (24) and by $\sum_{i=1}^{I} m_i = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}} \bar{n}$, we have

$$n_i = \left(\frac{\beta}{\alpha}\right)^{\frac{1}{1-\alpha}} m_i, \tag{28}$$

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

Summarizing the two cases would give us proposition 1.

7.2 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 first order conditions related to the choice 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

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

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

The equations (17), (18), (29) and (30) consist of the whole system to characterize the solutions. Note that either (29) or (30) implies $\frac{n_1}{m_1} = \frac{n_2}{m_2}$. 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

$$\frac{n_1}{m_1} = \frac{n_2}{m_2} = \frac{\bar{n}}{\bar{m}}. \tag{31}$$

(31), (29) and (30) give us

$$\lambda_m = \alpha \left(\frac{\bar{n}}{\bar{m}}\right)^{1-\alpha} - \beta > 0, \tag{32}$$

$$\lambda_n = (1-\alpha) \left(\frac{\bar{n}}{\bar{m}}\right)^{-\alpha} - \gamma > 0, \tag{33}$$

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

$$\beta^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{\alpha}} \leq \alpha^{\frac{1}{1-\alpha}}(1-\alpha)^{\frac{1}{\alpha}}. \tag{34}$$

Case 2. $\lambda_m = 0, \lambda_n > 0$. *By* (18) and $\lambda_n > 0$, we have (20).

By (29) and $\lambda_m = 0$,

$$\frac{n_1}{m_1} = \frac{n_2}{m_2} = \left(\frac{\beta}{\alpha}\right)^{\frac{1}{1-\alpha}}. \tag{35}$$

(35), (20) and (17) require

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

By (35) and (30),

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

which implies the weak inequality (34).

Case 3. $\lambda_m > 0, \lambda_n = 0$. By (17) and $\lambda_m > 0$, we have

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

By (30) and $\lambda_n = 0$,

$$\frac{n_1}{m_1} = \frac{n_2}{m_2} = \left(\frac{\gamma}{1-\alpha}\right)^{-\frac{1}{\alpha}}. \tag{36}$$

(36) and (18) imply

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

(29) and (36) 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 (29) and (30), this is true only when

$$\frac{m_1}{n_1} = \frac{m_2}{n_2} = \left(\frac{\gamma}{1-\alpha}\right)^{\frac{1}{\alpha}} = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{1-\alpha}}, \tag{37}$$

which implies

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

(37), (17) and (18) would determine the optimal allocation. Which goods are going to be disposed of is undetermined.

The conditions in proposition 3 ensure that case 2 is true. Plugging the optimal allocations into the objective function would give the result.

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