Does economic prosperity bring about a happier society? Mathematical remarks on the Easterlin Paradox debate

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Abstract: The Easterlin Paradox—the perceived absence of a relationship between economic progress and happiness—is one of the most important continuing debates in economics. Yet, both sides of the extant debate are anchored on valid mathematical arguments. The preponderance of evidence is therefore necessary to resolve the Easterlin Paradox.

Keywords: Easterlin Paradox; growth; income; time; happiness

JEL Classification: C60; I30; O40

1. INTRODUCTION

That the pursuit of economic progress has consequential impacts to societies is not a controversial matter. What those impacts might be is of course a matter of discussion. Indeed, that is one reason why the Easterlin Paradox is one of the most important continuing debates in economics.

This brief paper presents a mathematical analysis of Easterlin Paradox. As demonstrated below, both sides of the extant debate are anchored on valid mathematical arguments and, therefore, a resolution of the debate can only be reached through the preponderance of empirical findings.

2. MATHEMATICS OF THE EASTERLIN PARADOX

It is, perhaps, not objectionable to state that there is no paradox if the issue posted as part of the

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title of this article is restricted to the analysis of individuals or countries at a *point in time*. Evidence proves that it is so (Easterlin 1974, 1995; Diener et al. 2005; Diener and Biswas-Diener 2002; Frijters et al. 2004; Stevenson and Wolfers 2008). In this case, those with more income are happier that those with less income, albeit the conclusion is restricted to *evaluative* happiness (Diener et al. 2010; Kahneman and Deaton 2010; Baumeister et al. 2013) and the size of the relationship is small.

However, the paradox manifests if the analysis shifts to individuals or countries *across time*. In this case, the Easterlin group maintains that there is no relationship between income and happiness across time (Easterlin 1974, 1995, 2005, 2013; Oswald 1997; Blanchflower and Oswald 2004; Easterlin and Angelescu 2009; Easterlin and Sawangfa 2010; Clark et al. 2008; Easterlin et al. 2010). The rejection implies that public policy must begin focusing on non-economic targets to achieve greater happiness. The Stevenson-Wolfers group, on the other hand, insists that there is a positive relationship between income and happiness across time (Deaton 2008; Stevenson and Wolfers 2008, 2013; Sacks et al. 2012a, 2012b, 2013; Diener et al. 2013). All the same, the Stevenson-Wolfers group does not claim that economic progress alone can bring about greater happiness.

To some degree, though, the disagreement of the two groups involves an assumption on income and on time. Taking first income Y in the context of the Easterlin Paradox obtains a happiness function like $H(Y) = h(H^*(Y))$, where H is reported happiness and H* is latent happiness. How h relates to H is assumed to follow a positive monotonic transformation: $H(Y_2) > H(Y_1)$ if $H^*(Y_2) > H^*(Y_1)$ given that $Y_2 > Y_1$. The concavity of the happiness function in terms of Y satisfies an economics requirement of diminishing returns.

Thus the Easterlin Paradox can be analyzed using a reduced form like $H(Y) = h(Y)$. As such,

$\frac{dH}{dY} = h'(Y)$ is the marginal effect of income on happiness and $\frac{d^2H}{dY^2} = h''(Y)$ is diminishing returns to income on happiness. It can be stipulated that $h'(Y) \geq 0$ and that $h''(Y) \leq 0$. In fact, these results are not controversial because they are restricted to a *point in time* analysis where *ceteris paribus* is valid.

However, if the relevant analysis is *across time* as both sides of the debate argue, then time t must be explicit in the happiness function. Now, including time in the analysis, the happiness function becomes H(Y(t)) = h(Y(t)), and so $\frac{dH}{dt} = \frac{dh}{dY}\frac{dY}{dt}$, where $\frac{dY}{dt} > 0$ if there is an economic expansion, $\frac{dY}{dt} < 0$ if there is an economic contraction, or $\frac{dY}{dt} = 0$ if there is an economic stagnation (c.f., Blanchflower and Oswald 2004). Given $\frac{dY}{dt} > 0$, the Easterlin group asserts $\frac{dH}{dt} = 0$ (implying $\frac{dh}{dY} = 0$) but the Stevenson-Wolfers group asserts $\frac{dH}{dt} > 0$ (implying $\frac{dh}{dY} > 0$).

Then $\frac{d^2H}{dt^2} = \frac{d}{dt}\left(\frac{dh}{dY}\frac{dY}{dt}\right) = \frac{dh}{dY}\frac{d^2Y}{dt^2} + \frac{d^2h}{dY^2}\left(\frac{dY}{dt}\right)^2$ gives the behavioral properties of the happiness function across time. If $\frac{dY}{dt} > 0$, then $\frac{d^2Y}{dt^2} < 0$ holds because of diminishing returns, perhaps, arising from the process of economic growth convergence, the exhaustion of excess productive capacity, etc., during a phase of sustained economic progress. Thus, in order for the claim of the Easterlin group to hold, it must be the case that $\frac{dh}{dY} = 0$ and, by extension, $\frac{d^2h}{dY^2} = 0$ as well.

In contrast, for the claim of the Wolfers-Stevenson group to hold even at a diminishing rate (i.e., $\frac{d^2H}{dY^2} < 0$), it must be $\frac{dh}{dY} > 0$ and $\frac{d^2h}{dY^2} < 0$. Notice, for the Stevenson-Wolfers case, $\frac{d^2H}{dt^2} < 0$

holds even under an economic contraction (i.e., $\frac{dY}{dt} < 0$ provided $\frac{d^2Y}{dt^2} < 0$) as long as $\frac{dh}{dY} > 0$ and $\frac{d^2h}{dY^2} < 0$ are maintained. It is only under an economic stagnation that $\frac{dH}{dY} = 0$ and $\frac{d^2H}{dt^2} = 0$ are observed.

Beyond an accounting of time, though, the fundamental difference in the interpretations of the two groups concerns the *length of time* in the analysis. The Easterlin group is clear that if the analysis covers ten or more years, then $\frac{dH}{dt} = 0$ because adaptation, social comparison, and other related processes make happiness converge to its long-run average (c.f., Easterlin 2001). In short, the Easterlin group argues that what the Stevenson-Wolfers group finds is merely the short-run relationship between income and happiness—that is, the length of time in their analysis is not long enough to reflect adaptation, social comparison, and other related processes.

In fact, the above points can be demonstrated with an examination of the happiness equations of both groups. The Easterlin group, for instance, specifies $H^E = \alpha + \beta \cdot g(t)$, where g(t) is income growth, to obtain $\frac{dH^E}{dt} = \beta \frac{dg}{dt}$ and $\frac{d^2H^E}{dt^2} = \beta \frac{d^2g}{dt^2}$. It must be that $\beta = 0$ if $\frac{dg}{dt} > 0$ and $\frac{d^2g}{dt^2} < 0$. Indeed, the empirical regularity of the Easterlin group is that β is statistically not different from zero.[1]

But the Stevenson-Wolfers group specifies $H^{SW} = \theta + \delta \cdot \log Y(t)$ to obtain $\frac{dH^{SW}}{dt} = \frac{\delta}{Y}\frac{dY}{dt}$ and $\frac{d^2H^{SW}}{dt^2} = \frac{\delta}{Y}\frac{d^2Y}{dt^2}$. Both expressions have positive values for Y and $\frac{dY}{dt}$ but negative for $\frac{d^2Y}{dt^2}$,

[1] Graham (2009) and Lora and Chaparro (2009) argue that there are also cases of "unhappy growth".

and so it must be that $\delta > 0$ to get $\frac{dH^{SW}}{dt} > 0$ and $\frac{d^2H^{SW}}{dt^2} < 0$. Indeed, the empirical regularity of the Stevenson-Wolfers group is that β is statistically positive.

Notice, however, that $\frac{dH^{SW}}{dt}$ is $\delta \cdot y(t)$, which corresponds to the second term in the Easterlin group specification. If so, $H^E = \alpha + \beta \cdot g(t)$ can be re-written as $H^E = \alpha + \frac{dH^{SW}}{dt}$. As such, the Easterlin group actually obtains the *average* of happiness since over the long term $\frac{dH^{SW}}{dt} = 0$; but the Stevenson-Wolfers group, on the other hand, finds an increasing happiness since in the *short term* $\frac{dH^{SW}}{dt} > 0$.

3. CONCLUSION

Given the foregoing discussion, the diverging empirical findings that both the Easterlin and the Stevenson-Wolfers groups have put forward should be expected given their assumptions on income and time as well as their specifications of the happiness function. Both groups have valid arguments on mathematical grounds without a doubt. Therefore, the resolution of the debate on the relationship between income and happiness requires the preponderance of empirical findings that supports one group over the other.

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