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Who moved my candy (sugar)? Happiness or money

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Abstract

This study examines the interlinkages among happiness, income and sugar consumption using a short-balanced panel data of 129 countries for the period 2016-2020. Previous studies are mostly country-wise and do not consider their relationships simultaneously. This study generally finds that the direction of causality is from income to happiness, and to sugar consumption. Similar finding is observed for the developing economies. Meanwhile, income does cause happiness for the developed economies. For the economies in transition, it is from happiness to income and to sugar consumption. Both the impulse response and variance decomposition analyses complements these findings. This study is relevant for policy implications especially, to increase the society's income.

Keywords:
causality;
happiness;
income;
panel data;
sugar consumption.

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1. Introduction

"*How to be happy?*" is an ordinary question which people always ask in their daily life. Philosophers such as Aristotle, Plato and Socrates tried to define happiness and provided different ways of explanations. Researchers from various fields i.e., economics, philosophy, and psychology including social science scholars and politicians attempted to define happiness more precisely, and to identify its measures, access to happiness as well as the determination of happiness. Indeed, happiness economics has emerged to identify and examine the main determinants of happiness, and their association whether positive or negative. For instance, Ng (2022) pointed out that the "4 Fs" of happiness are Faith, Fitness, Family and Friends, and emphasized that a friend's companion could work to boost our moods where it could change from negative to positive. The World Happiness Report 2020 (Helliwell et al., 2020) has mentioned that hiking or walking alone improves mood by 2%, whereas walking with a buddy or partner improves mood by 7.5% or 8.9%. Physical activities which will ordinarily make you unhappy can be enjoyable when conducted with a companion or partner. For example, travelling or commuting on average can lower mood levels (1.9%), but mood increases by 5.3% for a journey done with a friend and 3.9% with a spouse. Even queuing or waiting, which is a considerable negative when done alone (-3.5%), becomes a net positive when conducted with a companion (+3.5%).

From the perspective of happiness economics, there are three fundamental ideas, namely happiness, life satisfaction and subjective well-being. Happiness can be broadly considered as a synonym for joy or as a result of several essential and meaningful activities in an individual's life (Fave et al., 2011). Happiness can be considered by both subjective and objective views (Frey &

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Stutzer, 2002). Life satisfaction captures an individual's various circumstances, whereas emotions and feelings are inconsistent. However, emotions enable us to comprehend both the positive and negative parts of our lives (Helliwell & Barrington-Leigh, 2010). Subjective well-being, on the other hand, is a self-reported judgement of life that falls into three basic categories: negative emotions, positive emotions and life evaluations (Helliwell & Barrington-Leigh, 2010). They assert that it consists of two elements: a person's personality and his or her attitude toward occurrences in life.

More precisely, happiness is measured in the form of utility in happiness economics (Bentham, 1789). Currently, studies utilize happiness economics as a way to measure people’s wellbeing using surveys by focusing on the happiness reported. According to Diener et al. (1985), the concept of "life satisfaction," which is a self-reported measure of overall happiness is one of the common methods of measuring happiness. It is typically measured on a scale from 1 to 10, with 10 indicating the highest level of satisfaction. Dolan et al. (2008) found that self-reported measures of happiness and life satisfaction are reliable and valid indicators of overall well-being. By the same token, Diener et al. (2010a) considered that hedonic measures are useful for predicting long-term changes in well-being. On top of that, happiness economics has broadened the concept of happiness which incorporates factors beyond income and considers their impacts. This has complemented the income-based measures of welfare. They (Diener et al., 2010b) found that factors like positive social relationships, meaningful work, and healthy lifestyles were all related to subjective well-being. Helliwell et al. (2019) documented that social support, generosity, trust, and freedom were all positively associated with life satisfaction across 156 countries.

Happiness, income and sugar are elements which play an important role in our daily life. However, the linkages between these three variables are not clearly ascertained in the field of either happiness economics or social science related studies. Easterlin (1974) analysed the association between happiness and income that income has a direct relation to individual happiness. Easterlin (2001) demonstrates that at a certain period in time, lower income persons are on average less pleased than higher income ones. As reported by The Economist (2019), economic growth does not necessarily guarantee happiness that the correlation between long-term GDP per person and happiness is weak among 125 countries. While 43 countries that move in opposite direction.

Undoubtedly, sugar (sugary goods) is said to make an individual happy (Lenoir et al., 2007; Kendig, 2014) which has been overlooked by happiness economists. Sugar has been found to have an impact on brain function and behaviour, including the release of hormones and neurotransmitters that are associated with happiness and pleasure. Lenoir et al. (2007) revealed that sugar consumption can stimulate the release of dopamine in the brain, which is associated with pleasure and reward. Sugar can increase the release of endogenous opioids, which are associated with pain relief and pleasure. According to Dehlinger (2020), a transitory result of consuming sugar is that serotonin levels will increase, causing the individual to feel happy. Kendig (2014) highlights that sugar can alter reward-related behaviour. However, ingestion of excessive amounts of sugar relies on triggering mechanisms that promote addictive-like behaviours, and on overriding neuroendocrine signals that protect internal milieu (Olszewski et al., 2019).

Biologically, sugar is said to be one of the determinants of happiness. Theoretically, the more sugar we eat, the more dopamine and serotonin will be released by Amygdala leading us to feel happier (Barclay, 2014). Sugar would make people happier, but research has found that higher sugar intake from food and beverages induces a higher chance of mental disorder which in fact causes depression and lower happiness (Knüppel et al., 2017). According to Mintz (1986), in ancient times, sugar was a luxury item that was expensive and only available to the wealthy. It became a symbol of social status and was used to show off one's wealth and status. For example, in medieval Europe, sugar was often used in elaborate banquet dishes to impress guests and demonstrate the host's wealth and power (Willan, 2016). Sugar was also used as a status symbol in other parts of the world, such as in ancient India and China, where it was reserved for the elite and used in religious ceremonies. In the global trade market, it represents power to enslave the population (Galván, 2004). As industrialization takes place, sugar can be consumed in large quantities by the population now. Sugar loses its symbolic value and status as glamorous luxury as dietary importance becomes widespread. Sugar still serves as an important element in ritual or ceremony (Mintz, 1986).

Hence, this study focuses on the direction of causality among happiness, income, and sugar, and complemented by the impulse response and variance decomposition analyses. It covers short-balanced panel data of 129 countries from 2016 to 2020. It also investigates the findings among the three stages of development, namely, development economies, developing economies and economies in transition.

This study is organized as follows: The next section reviews the past studies on happiness associated with income, and sugar. Section 3 is methodology which describes the conceptual framework, variables (data) and the respective testing methods i.e., Granger non-causality tests, impulse response functions, and variance decomposition. The empirical results and discussions are in Section 4. Section 5 concludes this study.

2. Literature review

Over the past few decades, studies have been carried out in the human happiness-related field. Happiness relates to how individuals perceive and assess their lives, as well as particular areas and activities within them (Panel on Measuring Subjective Well-Being in a Policy-Relevant Framework; Committee on National Statistics; Division on Behavioral and Social Sciences and Education; National Research Council, 2013). , while economists are investigating the economic related determinants of happiness. In a nutshell, human happiness could be affected by various factors beyond macroeconomics, like income per capita and food intake, such as sugar and sports.[1] This section considers only two variables viz. income and sugar consumption interlinkage with happiness.

2.1 Happiness and income

The association (relationship) between happiness and income is a controversial issue of happiness study. A group of economists argues that happiness is positively associated with income. According to the Easterlin Paradox, happiness initially fluctuates directly with income both between and within countries; however, happiness and income are not significantly correlated in the long run. Social comparison is the main cause of the paradox, even though people with higher incomes tend to be happier. Easterlin (2001) illustrated that rising everyone's income will not make everyone happier since their relative income has not increased. Graham and Pettinato (2001) demonstrated that at any given time, a society's level of happiness and individual income are positively correlated. Also, they found that self-reported life satisfaction increases with individual income. However, it also decreases with county-level income. The finding is consistent with the idea that relative income affects happiness. In countries with a

[1] Other studies looked at happiness and sport (Kavetsos & Szeymanski, 2010; Huang & Humphreys, 2012). Kavetsos and Szeymanski (2010) found that hosting sporting events such as the FIFA World Cup and Olympic Games affects happiness in general. Hosting the FIFA and UEFA championships has increased happiness among the residents of host countries in the short term. Major sport events bring feel-good effect in the duration of events among the citizens of the hosting country. In addition, Huang and Humphreys (2012) explained that there are higher chances for individuals to be involved in sport and physical activity if there are a greater number of sport facilities. By participating in sports, these individuals recorded higher life satisfaction. Overall, sport has positively affected an individual's happiness.

higher median income, an individual is more likely to observe or interact with someone who earns more than they do, reducing the individual's happiness (Huang & Humphreys, 2012). Another group of studies focuses on the happiness influence on income (Achor, 2010; Como, 2011). For example, Como (2011) found that being positive, happy and high self-esteemed causes a higher income level. Extra happy and high-self-esteem individuals significantly earn higher income as compared to those individuals who are less happy in the labour market. The study concluded that happier people would become wealthier.

Several studies claimed that there is no clear-cut relationship between happiness and income. Castellanos (2020) used a combination of quantitative and qualitative methods to synthesize and analyse the data from the selected studies among 127 countries and found that income has a lower incidence of happiness. Indeed, income is not statistically significant even though happiness increases with income. There is a positive correlation between income and happiness, but such correlation is unclear and depends on a variety of factors. Castellanos (2020) pointed out that people living in poverty in Guatemala declare a high level of happiness. Similarly, using data from the European Social Survey and the World Happiness Reports, Gabrielova (2022) examined the relationship between income and happiness across different countries and cultures. The ordinary least squares (OLS) regression estimates showed the strongest relationship between income and happiness in high-income countries and among individuals who are already relatively well-off. In the low- and middle-income countries, the relationship between income and happiness is weaker and may even be negative in some cases. In general, Gabrielova (2022) found that the relationship between income and happiness is complex and multifaceted and varies across different countries and cultures.

2.2 Happiness and sugar consumption

There have been several studies investigating the association between happiness and sugar consumption. While there is no definitive conclusion, are some evidence that support excessive sugar consumption may increase overall happiness. Consuming raw sugar (or sweet foods) can increase the levels of dopamine and serotonin in the human brain. These neurotransmitters play a crucial role in regulating various bodily functions (Fiorino & Phillips, 1999). Movement, coordination, and a person's experiences of reward and pleasure are all influenced by dopamine, while emotion, digestion and metabolism are affected by serotonin. The more sugar we consume, the more dopamine and serotonin will be released by the amygdala leading us to feel happier (Barclay, 2014). Yet, excessive sugar would lead to brain addiction and inflammation. Inflammation will negatively impact human emotions such as depression and anxiety. It could be said that excessive intake of sugar results in poor mental health (Timberlake & Dwivedi, 2018). Happiness can affect sugar consumption (O'Connor et al., 2008). O'Connor et al. (2008) used structural equation modelling to ascertain the relationships between daily hassles, eating style, and eating behaviour. People who reported higher levels of stress and negative emotions were more likely to consume sugary foods and beverages than those who reported lower levels of stress and negative emotions. Therefore, individuals may turn to sugary foods as a way of coping with negative emotions and potentially increasing their happiness levels. Overall, the study concluded that less happiness would lead to higher levels of sugar consumption.

2.3 Income and sugar consumption

The association between sugar consumption and income is complex that may vary depending on different factors such as time period, location, and cultural context. According to Mintz (1986), sugar served as a symbol of wealth, status, and power in many cultures due to its scarcity in the past. Drewnowski & Rehm (2014) found that higher income was associated with greater consumption of added sugars among US adults. The data are from the National Health and Nutrition Examination Survey (NHANES) from 2005 to 2010. The multivariable regression analysis also found that individuals in the highest income group consumed an average of 46.2 36.1 grams per day. Some studies found a negative relationship between income and sugar consumption (Elsevier Health Sciences, 2009; Masood et al., 2012; French et al., 2019). French et al. (2019) found that lower-income households would purchase extra sugary foods as compared to the higher-income groups after adjusting for education, marital status and race. The study compared 202 urban households with 14 days of food shopping. The NDS-R programme was used to evaluate the purchase data, which was then evaluated using the Healthy Eating Index 2010. The study indicates that as income increases, demand for sugar will decrease. This is consistent with the earlier findings found by Elsevier Health Sciences (2009) and Masood et al. (2012). In short, lower income levels are associated with higher sugar consumption.

This topic is further investigated by Liu et al. (2022). They found an "inverted U-shaped" relationship between income level and household consumption of sugar-sweetened beverage. They used the data available from a national survey of beverage consumption patterns in China, that conducted between October 2019 and January 2020. The estimated logistics regression showed that increases in income will induce higher sugar consumption. Nevertheless, given an income threshold, individual consumption of sugar starts to decrease. Higher income individuals tend to have lower consumption of sugar due to education factor and health awareness. Intake of excessive sugar will lead to health problems such as obesity, high blood pressure and fatty liver disease (Harvard Health, 2017).

3. Research method

3.1 Conceptual framework

Figure 1 conceptualizes the directions of causality (or interlinkages) among happiness, income and sugar consumption as inspired by the previous studies. In layman's terms, it is about "*Chicken or egg: which came first*?" Indeed, the cause must come before the effect! (Granger, 1988, p. 200) That is to look at, either income causes sugar consumption, or vice versa, in Granger's sense. Also, if income causes happiness, and vice versa. It is possible that sugar consumption causes happiness and vice versa. A bi-directional between the variables may be hold, i.e. interdependent between happiness and income, for example.

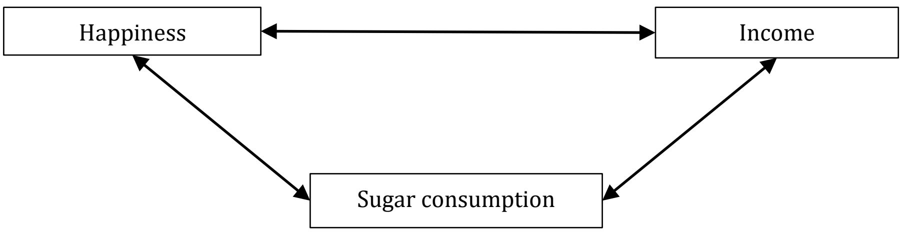

Figure 1. Conceptual framework of interlinkages among happiness, income and sugar consumption.

The key concepts of such interlinkages among happiness, income and sugar consumption are rooted by both theories and empirical findings. Economists consider happiness as subjective well-being, in which an individual's evaluation of their life satisfaction, positive emotions, and sense of purpose or meaning (Kahneman et al., 1999). Income, as viewed by Hewett (1925) is the money measure of the net general welfare that accrues to an individual, group, or nation from economic activity during a certain period of time. It represents the amount of money earned after deducting all expenses incurred in generating that income and includes all forms of compensation such as salaries, wages, profits, dividends, interests, and rents (Hewett, 1925). Income reflects the economic welfare of an individual or group (households), as it enables access to goods and services that contribute to their well-being. Meanwhile, World Health Organization (WHO) considers sugar consumption as the amount of sugar that an individual or population consumes as a part of their diet over a certain period of time.

The Easterlin Paradox explains that at a point in time happiness varies directly with income, both among and within nations, but over time the long-term growth rates of happiness and income are not significantly related (Smith, 2014). Como (2011) found that happier individuals have a higher income as compared to individuals who are less happy in the labour market. The relationship between happiness and sugar consumption mostly to be understood in the context of biological and psychological perspectives (Fiorino & Phillips, 1999; O'Connor et al., 2008; Timberlake & Dwivedi, 2018). A low happiness level induces a higher amount of sugar intake (O'Connor et al., 2008) because individual intake of sugary foods helps individuals cope with their negative emotions and potentially increases their happiness level. Excessive intake of sugar results in poor mental health, which lowers happiness (Timberlake & Dwivedi, 2018). Income and sugar consumption is negatively associated (Elsevier Health Sciences, 2009; Masood et al., 2012; French et al., 2019). Elsevier Health Sciences (2009) considers that higher income levels are associated with lower sugar consumption. However, an “inverted U-shaped” relationship between income and sugar consumption (Liu et al., 2022) - a rise in income will induce higher sugar consumption; however, up to a certain amount of income, individual consumption of sugar starts to decrease.

3.2 Variables and data

Table 1 describes the variables employed by this study, namely happiness, income and sugar consumption. In brief, the happiness variable is the happiness score collected and published by WHR. While the income variable is represented by real GDP per capita based on the Purchasing Power Parity (PPP) constant in 2017. Lastly, sugar consumption per capita represents the sugar consumption - sweet foods (candies). This study collects and uses a short-balanced panel data of 129 countries for the period 2016-2020 (annual) because of data unavailability for longer period. That is, the happiness score is available between 2016 and 2023, while the sugar consumption data last up to 2020 (from 1961). The 129 countries include those with developed economies (35 countries), developing economies (79 countries), and economies in transition (15 countries) as in Appendix A.

Table 1. Variables definition and sources

Variables	Definition	Sources
Happiness (H)	The World Happiness Report (WHR) scores are based on Gallup World Poll surveys, which are performed in more than 160 countries and 140 languages. The worst-case scenario as a 0 and the best-case scenario as a 10.	World Happiness Report (WHR) 2020. Available at https://worldhappiness.report/ed/2020/
Income, (I)	Based on purchasing power parity (PPP), real GDP per capita. Gross domestic product adjusted to international currency using purchasing power parity rates is referred to as PPP GDP. An international dollar has the same purchase power in terms of GDP as the US dollar. Data are in constant 2017 international dollars.	The World Bank. Available at https://databank.worldbank.org/source/world-development-indicators#
Sugar Consumption (S)	Sugar intake per capita (kg) is an important statistic for comparing food consumption and dietary habits between nations and demographic groupings. It is collected by Food and Agriculture Organization of the United Nations statistics division (FAOSTAT) and made accessible as a yearly time series by the Helgi Library.	Helgi Library. Available at https://www.helgilibrary.com/indicators/sugar-consumption-per-capita/

Table 2 tabulates the summary statistics of the variables in general (i.e. all 129 countries), and three groups based on their stages of development, namely developed economies, developing economies, and economies in transition. The average happiness score (as indicated by the median) is 5 score which is ambiguous in between 0 and 10. For the developed economies, that is 7. The happiness for both developing economies and economies in transition are indifferent with an average score rounding to 5. The average world income is about $14 thousand per year. Developed economies have the highest at $42 thousand, followed by economies in transition ($13 thousand), and $9 thousand on average for developing economies. For the sugar consumption, the average is 26.04 kg globally. The developed economies have the highest average sugar consumption of approximately 32 kg, while developing and developed economies had a similar sugar consumption level, about 22kg.

As observed from Table 2, developed economies have the highest average happiness, income and sugar consumption, while developing economies recorded the lowest for these. Consistently, these variables are higher for economies in transition than in developing economies. It intuitively reveals a positive correlation between happiness and income, also the same insight between income and sugar consumption. The standard deviation informs the dispersion (variation) of happiness is 1 for all countries and developing economies. While the smallest dispersion of happiness is for economies in transition (0.6), followed by developed economies (0.8). The dispersion of world income is $21 thousand per year. The developed economies recorded the highest dispersion of income that is $17 thousand, followed by developing economies ($15 thousand) and economies in transition ($6 thousand). For sugar consumption, the world dispersion is 12 kg, while developing economies have the highest dispersion (13 kg) while developed economies (9 kg), and economies in transition (7 kg).

Table 2. Summary statistics

	Mean	Median	Maximum	Minimum	Standard deviation
All 129 countries					
Happiness (Score 1 – 10)	5.476	5.489	7.809	2.567	1.115
Income ($)	22,142	14,253	116,284	711	21,176
Sugar consumption (kg per capita)	25.318	26.04	50.86	2.94	11.767
Developed economies					
Happiness	6.556	6.725	7.809	4.217	0.792
Income	46,357	42,862	116,284	20,741	17,450
Sugar consumption	31.434	31.920	50.860	10.750	8.689
Developing economies					
Happiness	5.041	4.975	7.167	2.567	0.99
Income	12,893	9,048	98,337	711	15,268
Sugar consumption	22.845	21.7	50.77	2.94	12.645
Economies in transition					
Happiness	5.247	5.323	6.258	4.096	0.561
Income	14,350	13,653	27,255	3,091	6,380
Sugar consumption	24.076	21.750	42.300	13.180	7.318

3.3 Unit root tests

Table 3 shows the findings of five types of panel unit root test. They are the Levin, Lin and Chu t-statistics, the Breitung test, Im, et al. W-statistics, the ADF-Fisher Chi-square statistics, and the PP Chi-Square test. It is to ascertain the stationarity of each variable as well as by the three economic groups. They determine whether the trending data (i.e., non-stationary variables. I (1) or $I(2)$) should be first differenced (or regressed on deterministic functions of time) to ensure stationary, $I(0)$. As the findings revealed in Table 3, most of the variables did not reject the null hypothesis at a 10% level of significance, indicating non-stationarity. Therefore, all the variables are differenced once, i.e., $\Delta X_t = X_t - X_{t-1}$ for convenience. This process is crucial for the time series data (including panel data) given that stationary data is often a necessary and sufficient condition for many statistical models, such as OLS regression analysis.

Table 3. The results of panel unit root tests.

	Levin, Lin & Chun t stat	Breitung t-stat	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square stat	PP Chi-square stat
All 129 countries					
Happiness (H)	√	╳	√	√	√
Income (I)	╳	╳	╳	╳	╳
Sugar consumption (S)	√	╳	√	╳	√
Developed economies					
Happiness (H)	√	╳	√	╳	√
Income (I)	╳	╳	╳	╳	╳
Sugar consumption (S)	√	╳	√	√	√
Developing economies					
Happiness (H)	√	╳	√	√	√
Income (I)	╳	╳	╳	╳	╳
Sugar consumption (S)	√	╳	√	╳	√
Economies in transition					
Happiness (H)	√	╳	╳	╳	√
Income (I)	╳	╳	╳	╳	╳
Sugar consumption (S)	√	╳	╳	╳	╳

***Notes:** "√" indicates a rejection of the null hypothesis that the underlying variable (data) has a unit root (individual unit root process) at least at 10% significance level (p<0.10). "╳" indicates not reject the null hypothesis. Automatic lag length selection based on AIC is 0. The underlying assumptions of the tests for the exogenous variables are individual effects, individual linear trends; and Newey-West automatic bandwidth selection and Bartlett kernel apply. The tests assume a common unit root process and individual unit root process. The equations consider individual effects and individual linear trends for the data at levels. All data are transformed into natural logarithm (ln).*

3.4 Panel Granger Non-Causality Tests

In brief, the VAR (vector autoregressive) model is a statistical approach to describe the evolution of multivariate linear time series with k endogenous variables. It ensures all k variables are stationary. The VAR based Granger non-causality tests (Granger, 1969) were applied in order to examine the possible direction(s) of causality among happiness, income and sugar consumption. This study considers this approach (Dumitrescu & Hurlin, 2012) with a trivariate framework (in a panel data) capturing the conceptual interlinkages among happiness, income, and sugar consumption as illustrated in Figure 1. In general, Granger non-causality tests are to test the '*predictiveness*' of one variable in the past to another in the current. For example, it estimates whether the lagged values of income help predict the current happiness. and vice versa. Income is said to Granger cause happiness if income is "helpful" for predicting the happiness score. The term "helpful" in this context means that when lagged value is added to the model, income can improve the explanatory power of happiness. More technically, in the context of VAR (OLS) estimation, income does not Granger cause happiness variable if the estimated coefficients of the lagged variable are jointly statistically insignificant. The following VAR equations are specified for panel Granger non-causality tests:

$$\Delta H_{i,t} = \alpha_{i,t} + \sum_{j=1}^{p=3} \beta 1_{i,j}(\Delta H_{i,t-j}) + \sum_{j=1}^{p=3} \lambda 1_{i,j}(\Delta I_{i,t-j}) + \sum_{j=1}^{p=3} \psi 1_{i,j}(\Delta S_{i,t-j}) + \mu_{i,t} \tag{1}$$

$$\Delta I_{i,t} = \theta_{i,t} + \sum_{j=1}^{p=3} \lambda 2_{i,j}(\Delta I_{i,t-j}) + \sum_{j=1}^{p=3} \beta 2_{i,j}(\Delta H_{i,t-j}) + \sum_{j=1}^{p=3} \psi 2_{i,j}(\Delta S_{i,t-j}) + \varepsilon_{i,t} \tag{2}$$

$$\Delta S_{i,t} = \phi_{i,t} + \sum_{j=1}^{p=3} \psi 3_{i,j}(\Delta S_{i,t-j}) + \sum_{j=1}^{p=3} \beta 3_{i,j}(\Delta H_{i,t-j}) + \sum_{j=1}^{p=3} \lambda 3_{i,j}(\Delta I_{i,t-j}) + \tau_{i,t} \tag{3}$$

where H is happiness, I is income and S is sugar consumption. i refers country and t refers time period. α, θ and ϕ are coefficients that capture the lagged effects for their respective variables in the equations. Δ is first difference operator, *p* is the lag length to be included, μ_t, ε_t and τ_t are error terms for three equations respectively which is assumed to have zero mean, constant variances and uncorrelated.

In VAR equations, the computed *Chi*-square test statistics are used to reject the null hypothesis, or if the computed *p*-value is less than the conventional level of significance, i.e. 1%, 5% and 10%. Such as equation (1), the hypotheses are as follows: The first null hypothesis, $H1_0$: $\sum \lambda 1_{i,j} = 0$ that is "income does not Granger cause happiness". If the computed *Chi*-square test statistics is greater than its critical value at 10% level, or its *p*-value is less than 0.10, this [null] hypothesis can be rejected, and the direction of causality is from income to the happiness. The second null hypothesis, $H2_0$: $\sum \psi 1_{i,j} = 0$ for "the sugar consumption does not Granger cause the happiness". A join causality, that is the third null hypothesis, $H3_0$: $\sum \lambda 1_{i,j} = 0$; $\sum \psi 1_{i,j} = 0$ that "both income and sugar consumption does not jointly Granger cause the happiness". For equations (2) and (3), similar procedure and interpretation apply.

The lag length, *p* to be included in the VAR equation(s) is based on the smallest value of the criterion - final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn criterion (HQ). Their statistics are reported in Table 4. For all countries and developing economies both 1 lag and 3 lags are considered for their VAR equation(s). For the developed economies, 1 lag is preferred (LR, FPE, AIC, and HQ). The SIC suggests 0 (zero) lag which is ignored since no exogenous variables in the VAR, the lag starts at 1. For economies in transition, 1 lag is used since the five criterions select 0 lag, and 2 lags which is infeasible given the nature of short panel data with only 15 countries.

Table 4. VAR lag order selection criteria

Lag	LR	FPE	AIC	SC	HQ
All 129 countries					
0	NA	0.000	-8.307	-8.240	-8.280
1	69.222	0.000	-8.721	-8.455#	-8.613#
2	16.928	0.000	-8.720	-8.254	-8.531
3	17.211#	0.000#	-8.725#	-8.060	-8.455
Developed economies					
0	NA	0.000	-11.597	-11.464#	-11.551
1	27.595#	0.000#	-11.973#	-11.439	-11.789#
2	10.337	0.000	-11.828	-10.894	-11.505
3	8.0667	0.000	-11.636	-10.303	-11.176
Developing economies					
0	NA	0.000	-7.451	-7.361	-7.415
1	50.805#	0.000#	-7.900	-7.541#	-7.756#
2	15.288	0.000	-7.885	-7.255	-7.633
3	16.889	0.000	-7.902#	-7.002	-7.541
Economies in transition					
0	NA#	0.000#	-10.588#	-10.447#	-10.590#
1	6.364	0.000	-9.967	-9.400	-9.973
2	2.772	0.000	-9.113	-8.122	-9.124
3	10.464	0.000	-10.006	-8.590	-10.021

Notes: *# indicates lag order selected by the criterion. Each test at 5% level. LR = sequential modified LR test statistic; FPE = Final prediction error; AIC = Akaike information criterion; SC = Schwarz information criterion; and HQ = Hannan-Quinn information criterion. For FPE, the selection # is based on more decimal places instead of three as presented.*

The VAR based Granger non-causality tests inform the direction(s) of causality among the endogenous variables, but they do not tell how one variable responses to another. Therefore, impulse response functions are utilized to complement the findings of causation. Impulse response functions which based on VAR, through graphical representation, describe how a variable reacts over time to a shock(s) (of one or more standard deviations) which are considered exogenous impulses. More specifically, an impulse response function shows the dynamic effect of a one-time shock to an independent variable on the future values of a dependent variable while holding all other variables constant. It comes with variance decomposition analysis which further describes how the variance of each variable is explained by its own innovations, and the innovations of the other variables in the VAR system. Variance decomposition aims to measure the relative contributions of these different sources of variation to the overall variance of each variable. Technically, it is to decompose the variance of a variable into the proportion of the variance that is due to its own shocks (the "own variance") and the proportion that is due to the shocks of the other variables in the system (the "cross variance").

4. Empirical results

Figure 2 summarizes and illustrates the findings of panel Granger non-causality tests of a trivariate VAR framework involving the variables - happiness, income, and sugar consumption. It covers all 129 countries, and the three different stages of development viz. developed economies, developing economies, and economies in transition. The computed test statistics of Granger non-causality are tabulated in Appendix B for further reference. In general, for all the 129 countries panel, there is a unidirectional causality running from income to happiness with 1 lag and 3 lags at 5% level of significance. In addition, happiness does Granger cause sugar consumption (1 lag) at the 5% level of significance. This implies that happiness has a mediating effect on income to sugar consumption. Indeed, both income and sugar consumption do jointly Granger cause happiness at the 10% level of significance. Also, both happiness and income jointly cause sugar consumption at the 10% level of significance. Looking at the panel of developing economies, the same findings are occurred as the word (i.e. all 129 countries). However, only both income and sugar consumption jointly Granger cause happiness (3 lags) at the 5% level of significance.

For the developed economies, causality is only found from income to happiness in 1 lag at the 10% level of significance. In fact, sugar consumption has no implication in this context. However, both sugar consumption and income are found to have jointly caused happiness. Conversely, for economies in transition, happiness comes first, and does Granger cause income in 1 lag at the 5% level, while income causes sugar consumption (1 lag) at the 10% level of significance. More specifically, both happiness and sugar consumption jointly Granger cause the income. And, both happiness and income do jointly Granger cause the sugar consumption (in 1 lag at the 5% level of significance). Overall, the last variable to be caused (or appear) is sugar consumption for all panels (groups), except for developed economies. Happiness - remains its conventional fashion that income can buy happiness, but it is not the case for the economies in transition, in which happiness is being considered as ‘built-in’ (born) or nature to them.

To understand further the interlinkages (interactions) among the variables, Figures 3-6 show the impulse response results among happiness, income and sugar consumption for all 129 countries, developed economies, developing economies and economies in transition. For all countries' results (Figure 3), both the 1 and 3 lags give different results. In this case, 3 lags results are preferred given their reasonable responses over the period. Happiness increases immediately until year 2 in response to a shock in income before decreasing towards equilibrium in year 10. Happiness responds negatively to other shocks, i.e., own happiness, and sugar consumption. For developed economies ((Figure 4), happiness is found to have negative responses to the two shocks, namely its own happiness and sugar consumption at 1 lag. Happiness shows a positive response to the shock in income over the 10 years. For the developing countries (Figure 6), similar observations are delivered as the case of all countries. For economies in transition (Figure 5), happiness responses negatively to all shocks, i.e., own happiness, income and sugar consumption at 1 lag.

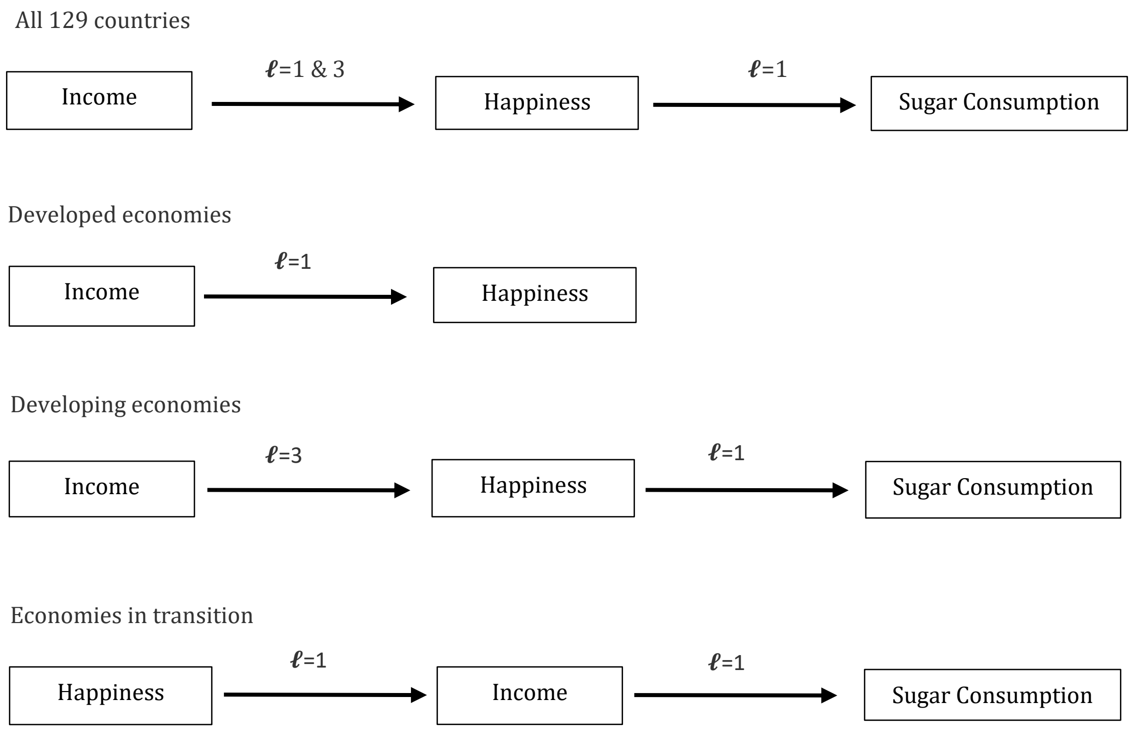

Figure 2. Granger non-causality tests among happiness, income and sugar consumption

***Notes: ℓ** indicates lag. The figures illustrate the direction of causation among the underlying variables, at least at 10% level of significant.*

Table 5 reports the variance decomposition statistics of the three variables for all countries as well as for each stage of development. The results reveal that happiness is largely explained by its own (59-88% for period 10), then by income (12-38%) for all countries, in general. Very little is explained by sugar consumption (3%). In developed economies, happiness is mainly explained by income (84%) followed by its own happiness (16%) at period 10. In developing economies, happiness is explained by its own (48-92%) and by income (7-47%) at period 10. While happiness is slightly explained by sugar consumption (0-5%). For economies in transition, happiness is mostly explained by its own (93%) and little by income (7%) at period 10.

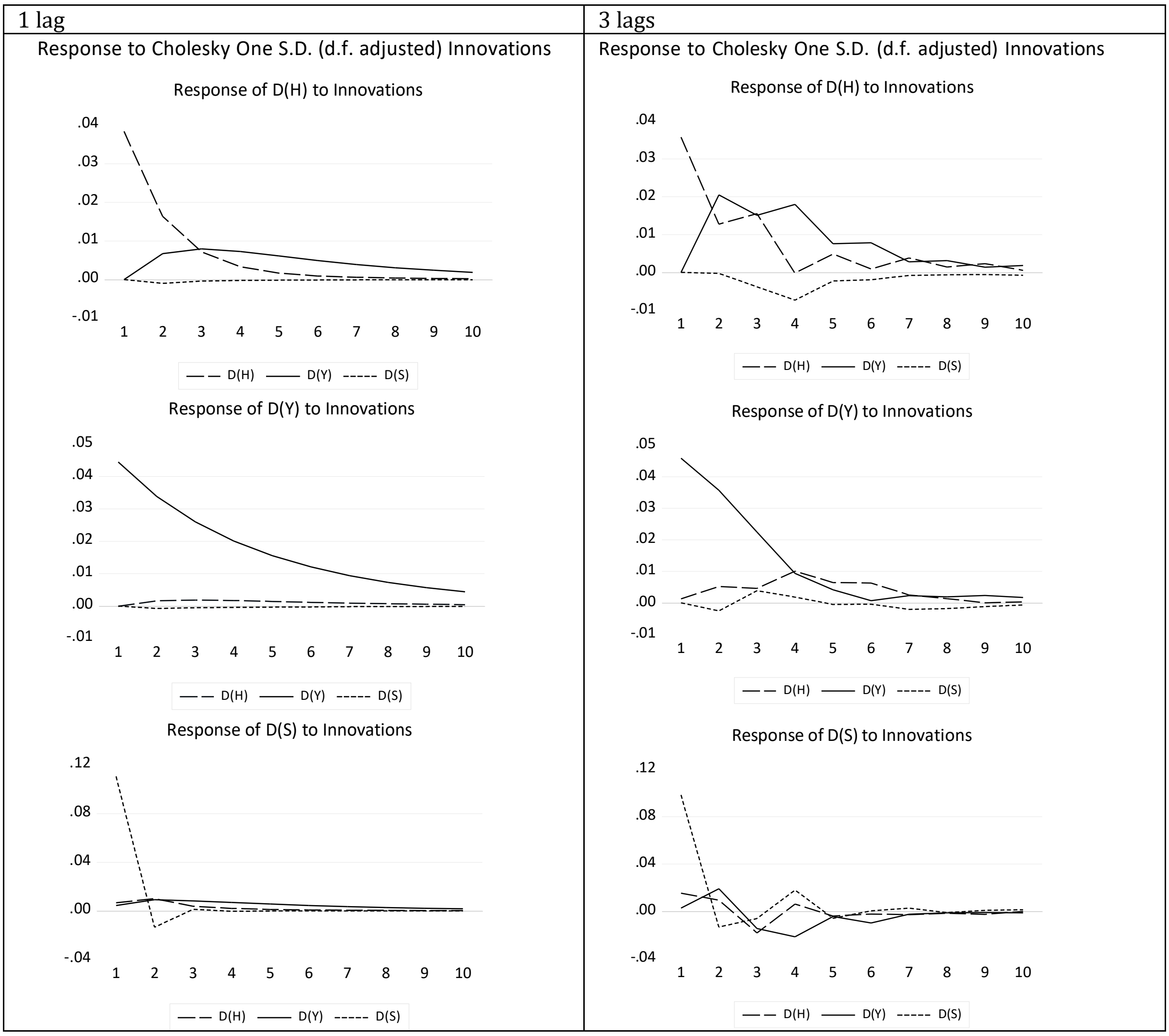

Figure 3. Impulse response for all 129 countries

1 lag	1 lag
Response to Cholesky One S.D. (d.f. adjusted) Innovations	Response to Cholesky One S.D. (d.f. adjusted) Innovations

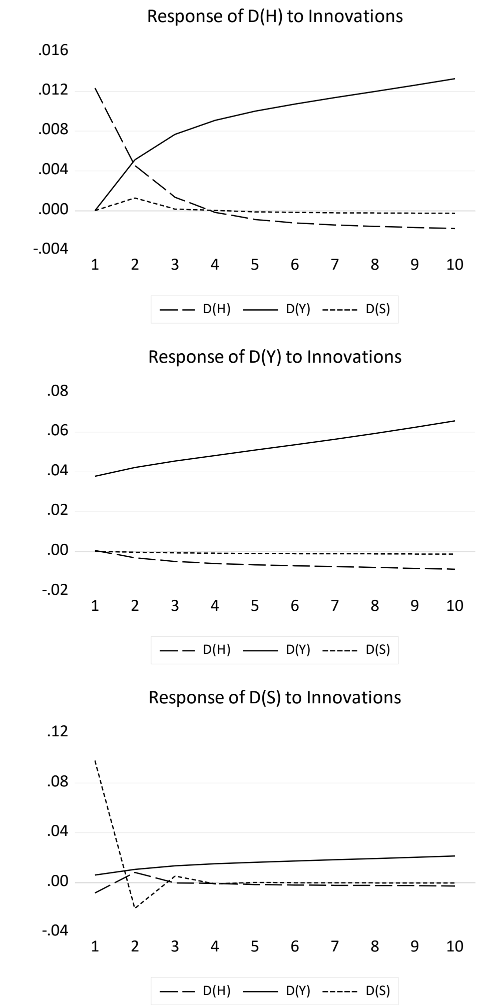

Figure 4. Impulse response for developed economies

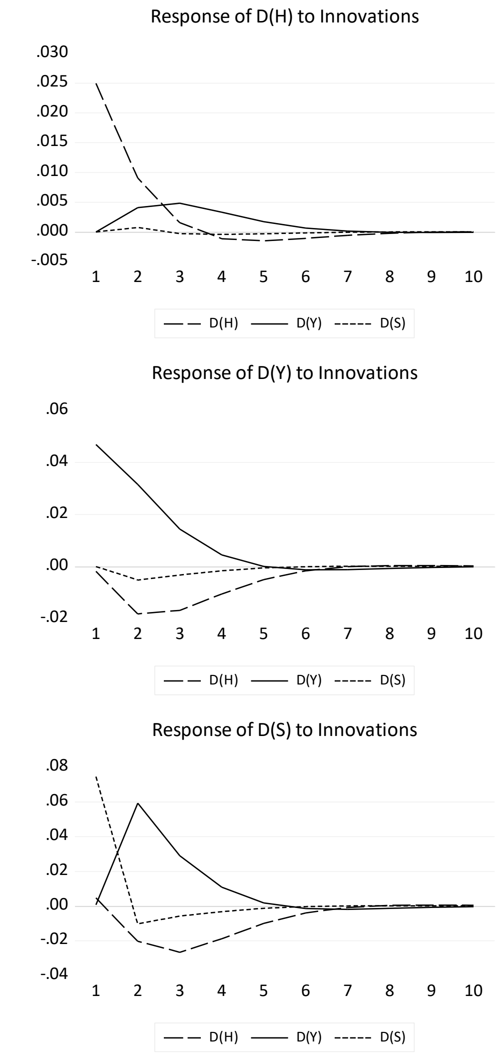

Figure 5. Impulse response for economies in transition

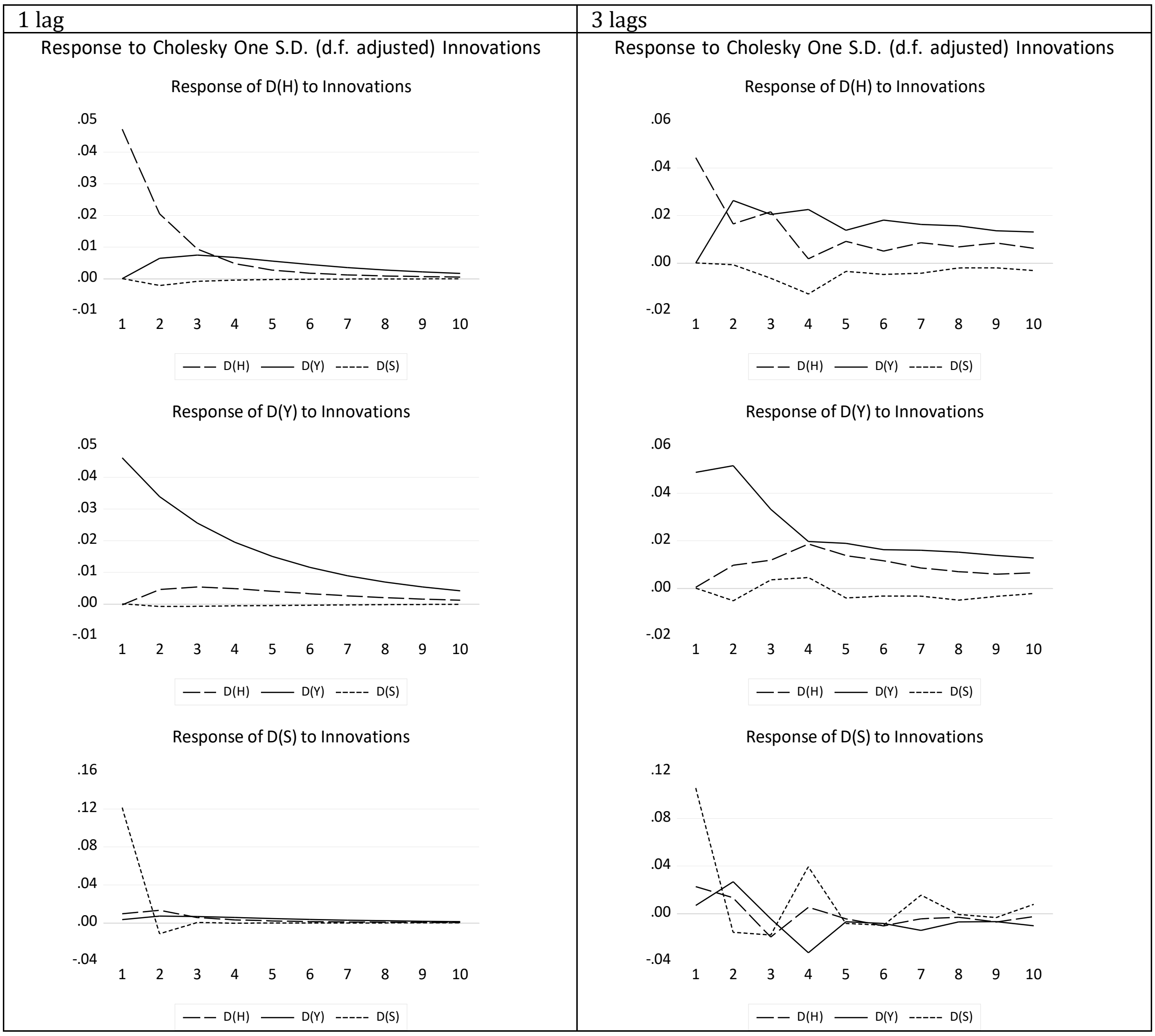

Figure 6: Impulse response for developing economies

Table 5: Results of variance decomposition among happiness, income and sugar consumption

All 129 countries								
Variance Decomposition of ΔH (1 lag):					Variance Decomposition of ΔH (3 lags):			
Period	S.E.	ΔH	ΔY	ΔS	S.E.	ΔH	ΔY	ΔS
1	0.038	100.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.036	100.000 (0.000)	0.000 (0.000)	0.000 (0.000)
2	0.042	97.409 (2.498)	2.533 (2.397)	0.059 (0.405)	0.043	77.429 (11.236)	22.567 (11.307)	0.004 (0.547)
3	0.044	94.238 (5.088)	5.697 (5.019)	0.065 (0.396)	0.048	71.760 (12.280)	27.621 (12.237)	0.619 (1.382)
4	0.044	91.728 (7.006)	8.205 (6.953)	0.067 (0.382)	0.052	61.808 (14.182)	35.689 (15.077)	2.503 (3.023)
5	0.045	90.034 (8.312)	9.899 (8.268)	0.067 (0.372)	0.053	60.753 (15.077)	36.639 (16.180)	2.608 (3.192)
6	0.045	88.961 (9.201)	10.971 (9.164)	0.067 (0.366)	0.054	59.390 (16.087)	37.932 (17.271)	2.679 (3.281)
7	0.045	88.300 (9.820)	11.632 (9.788)	0.067 (0.363)	0.054	59.422 (16.292)	37.898 (17.511)	2.680 (3.264)
8	0.045	87.898 (10.263)	12.035 (10.233)	0.067 (0.361)	0.054	59.240 (16.789)	38.076 (17.996)	2.684 (3.232)
9	0.045	87.654 (10.830)	12.279 (10.560)	0.067 (0.360)	0.054	59.270 (16.975)	38.042 (18.174)	2.688 (3.195)
10	0.045	87.506 (10.830)	12.427 (10.804)	0.067 (0.359)	0.054	59.195 (17.348)	38.101 (18.553)	2.704 (3.187)

Variance Decomposition of ΔY:					Variance Decomposition of ΔY:			
1	0.044	0.000 (0.347)	99.999 (0.347)	0.000 (0.000)	0.046	0.075 (1.307)	99.925 (1.307)	0.000 (0.000)
2	0.056	0.081 (0.492)	99.899 (0.646)	0.019 (0.391)	0.058	0.833 (1.908)	98.972 (1.991)	0.195 (0.582)
3	0.062	0.157 (0.750)	99.819 (0.899)	0.024 (0.457)	0.063	1.248 (2.336)	98.207 (2.933)	0.545 (1.209)
4	0.065	0.211 (0.936)	99.763 (1.078)	0.026 (0.491)	0.064	3.629 (4.332)	95.774 (5.186)	0.598 (1.852)
5	0.067	0.245 (1.055)	99.728 (1.191)	0.027 (0.508)	0.065	4.564 (5.211)	94.840 (5.944)	0.596 (1.923)
6	0.068	0.266 (1.129)	99.706 (1.260)	0.028 (0.518)	0.065	5.449 (6.046)	93.956 (6.623)	0.595 (1.917)
7	0.069	0.278 (1.175)	99.693 (1.303)	0.028 (0.525)	0.065	5.573 (6.168)	93.733 (6.765)	0.695 (1.901)
8	0.069	0.286 (1.204)	99.686 (1.331)	0.029 (0.529)	0.065	5.603 (6.315)	93.623 (6.947)	0.774 (1.902)
9	0.069	0.290 (1.224)	99.681 (1.349)	0.029 (0.532)	0.065	5.594 (6.373)	93.600 (7.026)	0.807 (1.895)
10	0.069	0.293 (1.237)	99.678 (1.361)	0.029 (0.534)	0.065	5.592 (6.461)	93.592 (7.129)	0.817 (1.914)
Variance Decomposition of ΔS:					Variance Decomposition of ΔS:			
1	0.111	0.361 (0.675)	0.159 (0.496)	99.481 (0.763)	0.100	2.345 (2.749)	0.071 (1.389)	97.584 (3.023)
2	0.113	1.123 (1.020)	0.818 (1.380)	98.060 (1.609)	0.103	3.032 (2.930)	3.504 (8.367)	93.464 (8.520)
3	0.113	1.223 (1.106)	1.333 (2.046)	97.444 (2.292)	0.106	5.887 (4.230)	5.225 (11.970)	88.888 (11.260)
4	0.113	1.248 (1.126)	1.699 (2.533)	97.053 (2.788)	0.109	5.785 (4.422)	8.759 (12.521)	85.456 (12.113)
5	0.113	1.253 (1.128)	1.937 (2.864)	96.810 (3.128)	0.110	5.889 (4.552)	8.869 (12.735)	85.242 (12.328)
6	0.113	1.255 (1.127)	2.086 (3.095)	96.660 (3.366)	0.110	5.884 (4.510)	9.603 (12.819)	84.513 (12.517)
7	0.113	1.255 (1.125)	2.177 (3.258)	96.568 (3.534)	0.110	5.945 (4.567)	9.639 (13.087)	84.416 (12.925)
8	0.114	1.255 (1.123)	2.233 (3.377)	96.512 (3.657)	0.110	5.968 (4.588)	9.650 (13.329)	84.383 (13.313)
9	0.114	1.255 (1.122)	2.267 (3.464)	96.478 (3.747)	0.110	6.020 (4.65)	9.653 (13.661)	84.328 (13.739)
10	0.114	1.255 (1.121)	2.288 (3.531)	96.457 (3.816)	0.110	6.019 (4.690)	9.665 (13.948)	84.317 (14.108)

Developed economies				
Variance Decomposition of ΔH (1 Lag):				
Period	S.E.	ΔH	ΔY	ΔS
1	0.012	100.000 (0.000)	0.000 (0.000)	0.000 (0.000)
2	0.014	86.087 (10.068)	13.105 (10.144)	0.809 (1.582)
3	0.016	66.787 (17.764)	32.584 (17.960)	0.629 (1.341)
4	0.019	50.755 (21.923)	48.767(22.164)	0.478 (1.157)
5	0.021	39.410 (24.104)	60.217(24.369)	0.373(1.019)
6	0.024	31.500 (25.394)	68.199 (25.681)	0.302 (0.938)
7	0.026	25.830 (26.213)	73.918 (26.520)	0.252 (0.899)
8	0.029	21.625 (26.665)	78.161 (26.986)	0.215 (0.880)
9	0.032	18.407 (26.843)	81.407 (27.176)	0.186 (0.870)
10	0.034	15.879 (26.873)	83.956 (27.216)	0.164 (0.864)
Variance Decomposition of ΔY:				
1	0.038	0.020 (1.650)	99.980 (1.650)	0.000 (0.000)
2	0.057	0.331 (1.717)	99.664 (1.835)	0.005 (0.559)
3	0.073	0.681 (2.110)	99.306 (2.213)	0.014 (0.610)
4	0.088	0.948 (2.425)	99.031 (2.516)	0.020 (0.652)
5	0.102	1.140 (2.636)	98.835 (2.719)	0.025 (0.673)
6	0.115	1.278 (2.775)	98.693 (2.853)	0.029 (0.689)
7	0.128	1.379 (2.868)	98.590 (2.944)	0.031 (0.699)
8	0.142	1.455 (2.933)	98.512 (3.008)	0.033 (0.707)
9	0.155	1.513 (2.980)	98.452 (3.054)	0.035 (0.713)

10	0.169	1.559 (3.013)	98.405 (3.087)	0.036 (0.717)
Variance Decomposition of ΔS:				
1	0.099	0.735 (2.189)	0.356 (1.449)	98.910 (2.511)
2	0.102	1.309 (2.378)	1.403 (4.955)	97.288 (5.535)
3	0.103	1.286 (2.339)	3.074 (8.543)	95.639 (8.846)
4	0.104	1.265 (2.309)	5.104 (12.290)	93.631 (12.416)
5	0.105	1.264 (2.292)	7.369 (15.785)	91.367 (15.838)
6	0.106	1.270 (2.292)	9.801 (19.101)	88.929 (19.106)
7	0.108	1.282 (2.308)	12.366 (22.199)	86.352 (22.157)
8	0.110	1.297 (2.335)	15.043 (25.001)	83.660 (24.907)
9	0.112	1.313 (2.369)	17.819 (27.488)	80.868 (27.343)
10	0.114	1.331 (2.405)	20.681 (29.665)	77.988 (29.473)

Developing economies

Variance Decomposition of ΔH (1 lag):					Variance Decomposition of ΔH (3 lags):			
1	0.047	100.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.044	100.000 (0.000)	0.000 (0.000)	0.000 (0.000)
2	0.052	98.293 (1.828)	1.532 (1.656)	0.175 (0.639)	0.054	76.420 (14.047)	23.557 (14.134)	0.024 (0.745)
3	0.053	96.398 (3.696)	3.410 (3.596)	0.192 (0.669)	0.062	70.114 (14.999)	28.765 (14.536)	1.120 (2.683)
4	0.054	94.917 (5.279)	4.887 (5.209)	0.196 (0.666)	0.067	59.645 (16.966)	35.604 (17.534)	4.752 (5.214)
5	0.054	93.923 (6.528)	5.881 (6.473)	0.196 (0.660)	0.069	57.829 (17.479)	37.426 (18.077)	4.745 (5.013)
6	0.054	93.296 (7.519)	6.508 (7.474)	0.196 (0.655)	0.072	54.143 (18.955)	40.992 (19.865)	4.865 (4.948)
7	0.055	92.913 (8.324)	6.891 (8.286)	0.196 (0.652)	0.074	51.978 (19.325)	43.118 (20.265)	4.904 (5.073)
8	0.055	92.681 (8.991)	7.124 (8.959)	0.195 (0.650)	0.076	50.130 (20.093)	45.135 (21.152)	4.736 (4.963)
9	0.055	92.541 (9.555)	7.263 (9.526)	0.195 (0.648)	0.078	49.158 (20.300)	46.231 (21.332)	4.611 (4.964)
10	0.055	92.457 (10.039)	7.347 (10.013)	0.195 (0.647)	0.079	48.059 (20.945)	47.320 (22.066)	4.620 (5.065)
Variance Decomposition of ΔY:					Variance Decomposition of ΔY:			
1	0.046	0.003 (0.584)	99.997 (0.584)	0.000 (0.000)	0.049	0.005 (1.822)	99.995 (1.822)	0.000 (0.000)
2	0.057	0.629 (1.282)	99.350 (1.339)	0.020 (0.472)	0.072	1.799 (3.657)	97.647 (3.901)	0.553 (1.085)
3	0.063	1.238 (2.029)	98.731 (2.068)	0.031 (0.542)	0.080	3.601 (4.927)	95.767 (5.526)	0.633 (1.807)
4	0.066	1.658 (2.545)	98.304 (2.571)	0.037 (0.576)	0.085	8.038 (7.008)	91.122 (7.822)	0.840 (2.281)
5	0.068	1.922 (2.886)	98.037 (2.903)	0.041 (0.592)	0.088	9.881 (7.545)	89.116 (8.541)	1.003 (2.676)
6	0.069	2.081 (3.113)	97.876 (3.125)	0.044 (0.601)	0.090	11.022 (8.068)	87.888 (9.000)	1.090 (2.918)
7	0.070	2.176 (3.268)	97.779 (3.277)	0.045 (0.607)	0.092	11.430 (8.294)	87.387 (9.248)	1.182 (2.986)
8	0.070	2.233 (3.377)	97.722 (3.384)	0.046 (0.610)	0.094	11.581 (8.518)	86.981 (9.543)	1.438 (3.201)
9	0.070	2.267 (3.456)	97.687 (3.461)	0.046 (0.613)	0.095	11.661 (8.600)	86.801 (9.725)	1.538 (3.368)
10	0.070	2.287 (3.514)	97.667 (3.518)	0.046 (0.614)	0.096	11.844 (8.763)	86.594 (9.892)	1.562 (3.565)
Variance Decomposition of ΔS:					Variance Decomposition of ΔS:			
1	0.122	0.620 (1.087)	0.076 (0.606)	99.304 (1.288)	0.108	4.326 (4.682)	0.382 (2.180)	95.293 (5.236)
2	0.123	1.736 (1.702)	0.408 (1.546)	97.856 (2.390)	0.113	5.270 (4.431)	5.885 (9.449)	88.846 (9.769)
3	0.124	1.931 (1.869)	0.700 (2.161)	97.369 (3.059)	0.117	7.918 (6.115)	5.711 (10.479)	86.371 (10.086)
4	0.124	1.989 (1.927)	0.911 (2.602)	97.100 (3.524)	0.128	6.782 (6.085)	11.532 (11.407)	81.686 (11.108)

5	0.124	2.009 (1.948)	1.048 (2.927)	96.944 (3.860)	0.128	6.848 (5.900)	11.739 (12.391)	81.413 (12.290)
6	0.124	2.017 (1.958)	1.133 (3.176)	96.850 (4.114)	0.129	7.396 (5.721)	11.976 (12.883)	80.627 (12.954)
7	0.124	2.022 (1.964)	1.185 (3.372)	96.793 (4.312)	0.131	7.319 (5.825)	12.853 (13.789)	79.829 (13.916)
8	0.124	2.024 (1.968)	1.217 (3.530)	96.760 (4.471)	0.131	7.356 (5.898)	13.106 (14.828)	79.538 (14.975)
9	0.124	2.025 (1.971)	1.236 (3.658)	96.739 (4.600)	0.132	7.613 (5.990)	13.299 (15.532)	79.087 (15.829)
10	0.124	2.026 (1.974)	1.247 (3.765)	96.727 (4.707)	0.132	7.583 (6.125)	13.786 (16.647)	78.631 (16.980)

Economies in transition

Variance Decomposition of ΔH (1 lag):

Period	S.E.	ΔH	ΔY	ΔS
1	0.025	100.000 (0.000)	0.000 (0.000)	0.000 (0.000)
2	0.027	97.622 (14.369)	2.304 (14.546)	0.073 (2.387)
3	0.027	94.590 (19.625)	5.328 (19.819)	0.082 (2.685)
4	0.028	93.218 (21.324)	6.675 (21.467)	0.107 (2.717)
5	0.028	92.871(22.126)	7.008 (22.254)	0.121 (2.743)
6	0.028	92.827 (22.923)	7.048 (23.075)	0.125 (2.817)
7	0.028	92.828 (23.599)	7.046 (23.776)	0.126 (2.869)
8	0.028	92.828 (23.972)	7.046 (24.155)	0.126 (2.874)
9	0.028	92.826 (24.152)	7.048 (24.333)	0.126 (2.864)
10	0.028	92.826 (24.351)	7.048 (24.529)	0.126 (2.864)
Variance Decomposition of ΔY:				
1	0.047	0.161 (2.778)	99.839 (2.778)	0.000 (0.000)
2	0.060	9.436 (8.746)	89.789 (9.224)	0.775 (2.720)
3	0.064	15.294 (11.851)	83.759 (12.283)	0.947 (3.318)
4	0.065	17.459 (13.337)	81.561 (13.750)	0.980 (3.623)
5	0.065	17.950 (13.845)	81.068 (14.317)	0.982 (3.818)
6	0.065	17.997 (14.091)	81.022 (14.528)	0.981 (3.854)
7	0.065	17.991 (14.331)	81.028 (14.701)	0.981 (3.855)
8	0.065	17.991 (14.545)	81.027 (14.886)	0.981 (3.868)
9	0.065	17.993 (14.635)	81.025 (14.990)	0.981 (3.884)
10	0.065	17.995 (14.748)	81.024 (15.118)	0.982 (3.897)
Variance Decomposition of ΔS:				
1	0.075	0.400 (2.872)	0.011 (2.521)	99.589 (3.691)
2	0.098	4.504 (5.813)	36.572 (19.227)	58.923 (18.886)
3	0.106	10.168 (8.172)	38.925 (18.705)	50.907 (20.008)
4	0.108	12.779 (10.036)	38.331 (19.295)	48.890 (21.222)
5	0.109	13.510 (10.848)	38.020 (19.845)	48.470 (22.156)
6	0.109	13.621 (11.250)	37.980 (20.361)	48.399 (22.846)
7	0.109	13.622 (11.673)	37.996 (20.605)	48.382 (23.299)
8	0.109	13.621 (12.104)	38.004 (20.716)	48.375 (23.585)
9	0.109	13.623 (12.341)	38.006 (20.810)	48.372 (23.750)
10	0.109	13.624 (12.437)	38.005 (20.890)	48.370 (23.820)

Notes: *H indicates happiness, Y indicates income and S indicates sugar consumption and Δ indicates data at first difference. (.) indicates standard error run by Monte Carlo for 100 repetitions.*

5. Conclusion

This study discovers the causal relationship among happiness, income and sugar consumption more comprehensively by using data of all 129 countries, and three economy groups, namely developed economies, developing economies, and economies in transition. This study adds fresh insights to the existing literature, with the main finding, that income causes happiness which the latter further causes sugar consumption, in general for all countries. Similar finding is found for the developing economies. For the developed economies, only from income leads to happiness. For economies in transition, happiness causes income, and the latter then causes sugar consumption. In addition, both the impulse response and variance decomposition analyses further enhance these findings with some feasible interpretations. This study aligns with previous studies which conclude that income causes (effects) happiness including the Easterlin Paradox, which suggests that income has a positive effect on happiness up to a certain threshold. This also emphasises the importance of economic factors in overall well-being.

This study is relevant for policy implications, in particular to raise their income which is the core cause of happiness. Also, in general, to control the sugar consumption, happiness needs to be given up (while income only applies to economies in transition) because over consumption of sugar increases the risk of a variety of chronic diseases (i.e. obesity, cardiovascular disease, diabetes and non-alcoholic fatty liver disease (NAFLD) as well as cognitive decline and even some cancers) (Rippe & Angelopoulos, 2016). Additionally, policymakers should prioritize economic growth and development as part of efforts to improve happiness and well-being, particularly in economies in transition. Policies and interventions aimed at improving well-being should consider long-term perspectives and address the reciprocal relationship between happiness and income. Also, policymakers can consider income-related interventions and policies that aim to improve overall well-being and happiness. These findings can help in planning strategies for poverty alleviation, income redistribution, and economic development that take into account the potential impact on individuals' happiness.

There are three immediate drawbacks in this study. Firstly, the short panel data consists of 5 years of time dimension which diminishes its validity. Future studies might consider a longer timeframe especially, earlier happiness data, and the latest sugar consumption data, in order to capture more time dynamics. Secondly, only three variables – happiness, income, and sugar are included for simplicity reason, which may ignore other potential [macroeconomic] variables those cause happiness (or sugar consumption). The 'other' macroeconomic variables that influence happiness among them are unemployment rate, and inflation rate. While factors affecting sugar consumption are consumer behaviour, income distribution, population growth, and so on. Further study has to consider them including other social, cultural, and individual factors that contribute to happiness across different contexts.

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Appendix

Appendix A. *Selected sample countries.*

Development Status	Countries
Developed economies (35 countries)	Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.
Developing economies (79 countries)	Afghanistan, Algeria, Argentina, Bangladesh, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cambodia, Cameroon, Chad, Chile, China, Colombia, Congo (Brazzaville), Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Guinea, Haiti, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kenya, Kuwait, Lebanon, Liberia, Libya, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, South Korea, Sri Lanka, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, Uruguay, Vietnam, Zambia, Zimbabwe.
Economies in transition (15 countries)	Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Montenegro, Russia, Serbia, Tajikistan, Ukraine, Uzbekistan.

Appendix B. *The results of Granger non-causality (block exogeneity) tests.*

Null Hypothesis:	1 Lag	3 Lags
All 129 countries		
ΔY =/=> ΔH	5.441 (0.020)**	10.658 (0.014)**
ΔS =/=> ΔH	0.246 (0.620)	4.962 (0.175)
ΔY & ΔS =/=> ΔH	5.514 (0.064)*	16.585 (0.011)**
ΔH =/=> ΔY	0.589 (0.443)	2.884 (0.410)
ΔS =/=> ΔY	0.110 (0.745)	2.359 (0.501)
ΔH & ΔS =/=> ΔY	0.649 (0.723)	4.778 (0.573)
ΔH =/=> ΔS	3.863 (0.049)**	5.117 (0.164)
ΔY =/=> ΔS	1.340 (0.247)	2.148 (0.542)
ΔH & ΔY =/=> ΔS	5.364 (0.068)*	7.099 (0.312)
Developed economies		
ΔY =/=> ΔH	3.084 (0.051)*	
ΔS =/=> ΔH	1.034 (0.309)	
ΔS & ΔY =/=> ΔH	5.121 (0.077)*	
ΔH =/=> ΔY	2.296 (0.130)	
ΔS =/=> ΔY	0.011 (0.918)	
ΔH & ΔS =/=> ΔY	2.301 (0.317)	
ΔH =/=> ΔS	0.825 (0.364)	
ΔY =/=> ΔS	0.323 (0.570)	
ΔH & ΔY =/=> ΔS	1.736 (0.420)	
Developing economies		
ΔY =/=> ΔH	2.453 (0.117)	6.557 (0.087)*
ΔS =/=> ΔH	0.437 (0.509)	6.002 (0.112)
ΔY & ΔS =/=> ΔH	2.699 (0.259)	12.779 (0.047)**
ΔH =/=> ΔY	2.604 (0.107)	4.831 (0.185)
ΔS =/=> ΔY	0.066 (0.798)	2.699 (0.440)
ΔH & ΔS =/=> ΔY	2.605 (0.272)	6.285 (0.392)
ΔH =/=> ΔS	3.190 (0.074)*	4.215 (0.239)
ΔY =/=> ΔS	0.486 (0.486)	2.517 (0.472)
ΔH & ΔY =/=> ΔS	3.635 (0.162)	6.568 (0.363)
Economies in transition		
ΔY =/=> ΔH	0.142 (0.707)	
ΔS =/=> ΔH	0.036 (0.850)	
ΔY & ΔS =/=> ΔH	0.203 (0.904)	
ΔH =/=> ΔY	6.044 (0.014)**	
ΔS =/=> ΔY	0.528 (0.468)	
ΔH & ΔS =/=> ΔY	6.485 (0.039)**	
ΔH =/=> ΔS	2.562 (0.109)	
ΔY =/=> ΔS	3.366 (0.067)*	
ΔH & ΔY =/=> ΔS	4.757 (0.093)*	

Notes: *H indicates happiness, Y indicates income and S indicates sugar consumption and Δ indicates data at first difference. The reported value in (.) is p-value. The symbol, "=/=>" stand for "does not Granger cause". ***p-value < 0.01; **p-value < 0.05; *p-value < 0.1., rejected the null hypothesis that Y variable does not Granger cause X variable.*