An Empirical Analysis of Obesity Kuznets Curve Model for the Eurasian Economic Union

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Abstract

This paper aims to analyse the relationship between obesity and economic growth in the context of the Obesity Kuznets Curve model for the Eurasian Economic Union for the years between 2000-2016. The relationship between obesity rates and the real gross domestic product has been examined for the Eurasian Economic Union in the context of the Obesity Kuznets Curve model using the fixed-effects model. The results show that the Obesity Kuznets Curve Model is valid for the Eurasian Economic Union. Therefore, this paper points out that the relationship between obesity rates and economic growth within the Eurasian Economic Union is non-linear.

1. Introduction

Obesity is a health status that causes mortal and morbid risks for individuals with a body mass index of 30 and more. Body mass index is medically used to determine whether an individual is obese or not. A person's body mass index is calculated by dividing his weight in kilograms into the square of his height in meters (World Health Organization, 2021).

Obesity had been defined as a medical problem for years affecting individuals mentally and physically. Besides its medical results, obesity has been examined within the scope of health economics regarding its economic background and consequences. Economic growth, unemployment, household income, gender, age, marital status, etc., have been found in the health economics literature as a trigger of gaining weight. Numerous empirical analyses in the literature have stated that economic growth is one of the primary motivations behind the obesity problem for individuals.

Eating habits are generally considered an outcome of rational behaviours of individuals that can be affected by any changes in costs (McCarthy, 2004). Moreover, changes in income may also have significant impacts on eating habits and lifestyle by affecting individuals' decisions.

In 1955, Simon Kuznets analysed a model that examines the relationship between economic growth and income inequality and found a non-linear relationship between these two variables (Kuznets, 1955). After years, the model has renamed the Environmental Kuznets Curve, analysing the non-linear relationship between environment and economic growth (Grossman and Krueger, 1995).

Grecu and Rothoff first presented the Obesity Kuznets Curve Model in 2015 to describe the non-linear relationship between economic growth and obesity (Grecu and Rothoff, 2015). Their study pointed out that people become eligible to have more nutrition as income rises, ending with weight gain. However, considering health is a normal good, people pay more attention to their health as income continues to rise and they start to lose weight.

The Eurasian Economic Union officially established in 1994 consisting of Armenia, Belarus, Kazakhstan, Kyrgyzstan, and the Russian Federation as its member countries. The union had experienced rapid growth in their economies between 2000-2016, with a growing obesity rate for the given years as well. Figure 1 shows the trend of the economic growth and the obesity rates within the union between 2000 and 2016.

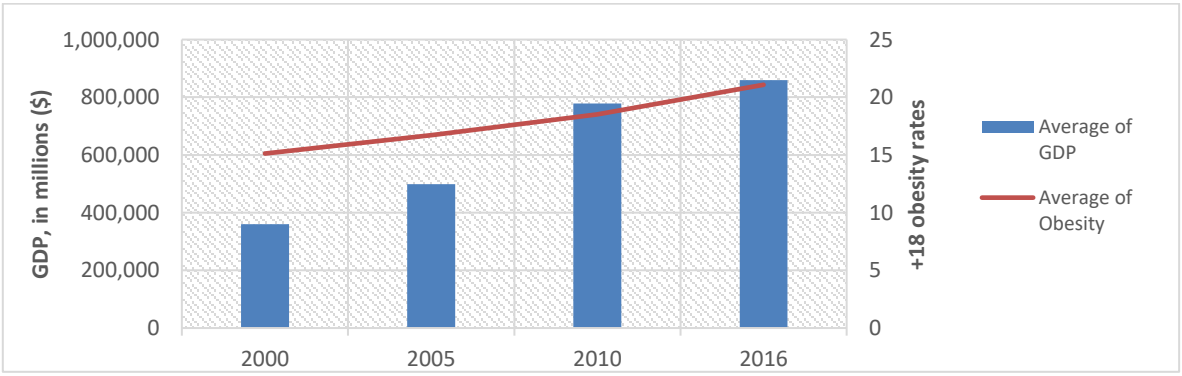

Figure 1. *GDP and obesity rates (2000-2016)* ***Source:*** *Penn World Table and World Health Organization databank*

In the Obesity Kuznets Curve Model framework, we analysed the relationship between obesity and economic growth for the Eurasian Economic Union between 2000-2016. According to the best knowledge of the author of this paper, this study contributes to the literature by using the expenditure-side real gross domestic product at

current purchasing power parity in the Obesity Kuznets Curve Model testing this model to analyse the relationship between obesity rates and economic growth for the Eurasian Economic Union.

2. Literature Review

Literature does not have numerous studies about the relationship between obesity and economic growth. However, there are notable studies in the literature using different methods and data in order to analyse the relationship between economic growth and obesity.

Author&Year	Period	Sample	Methodology	Findings
Egger, Islam & Swinburn, 2012	2007	175 countries	Spline regression analyses	Positive relationship between GDP per capita and BMI up to $3000. Above $3000, found no significant relationship between two variables.
Goryakin & Suhrcke, 2014	1991- 2009	56 countries	OLS & fixed effects	Prevalance of overweight is likely to increase in low-income countries as GDP per capita decreases 1% and more.
Gortmaker, Kawachi, Neuman & Subramanian, 2014	1991- 2010	38 countries	Ordered multinomial model	Positive but insignificant relationship between GDP per capita and BMI, particularly in rural and poor regions.
Grecu & Rotthoff, 2015	1991- 2010	USA	Differences-in-differences	Non-linear relationship between obesity and household income.
Murphy, Lawson & Williamson, 2016	1995 and 2000-2009	135 countries	Pooled OLS & fixed effects	Positive relationship between BMI and income among men, negative relationship among women in developed countries.
Pisa & Pisa, 2016	1998- 2012	South Africa	Unadjusted time trend plot	Positive relationhsip between GDP per capita and obesity.
Ameye & Swinnen, 2019	1976- 2016	Low, middle and upper income countries	Literature review	Obesity rises as income rises in low-income countries; no relationship in middle-income countries; falls as income rises in upper-income countries.
Asal, Fox & Wengel, 2019	1980- 2008	190 countries	Two-way-fixed-effects & OLS	Curvelinear relationship between obesity and GDP per capita. Positive relationship between economic growth and BMI in low-income countries; negative relationship in upper-income countries.
Aydın, 2019	1991- 2016	20 countries	Bounds test-ARDL	Non-linear relationship between economic growth and obesity in the long-run. Obesity increases as economy grows and falls as economy contious to grow.
Bendavid, Dieleman, Hashiguchi, Templin & Thomson, 2019	1995- 2016	103 countries	Logistics regression & fixed-effects	Obesity decreases with incerasing GDP per capita in wealthy group but increases in less wealthy group.
Hlaing, Kakinaka & Windarti, 2019	1975- 2010	130 countries	OLS-Dynamic panel regression analysis	Obesity rises as income rises in low-income countries; falls as income rises in upper-income countries.
Talukdar, Seenivasan, Cameron and Sacks, 2020	2019-2024	147 countries	Bayesian hierarchical model	Positive relationship between obesity prevalence and national income but there is no evidence for obesity kuznets curve.

Table 1. *Literature review on the relationship between obesity and income*

3. Data, model, and methodology

This paper covers the data for the years between 2000-2016 for the Eurasian Economic Union. The union consists of 5 countries: Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russian Federation.

This study obtained the obesity data (OB) from the World Health Organization database, expenditure-side real gross domestic product at current purchasing power parity (in million 2017 US dollars) data (GDP) and the GDP square (GDP^2) from the Penn World Table, version 10.0 database, for the years between 2000-2016.

The relationship between obesity rates and the real gross domestic product is examined for the Eurasian Economic Union in the context of the Obesity Kuznets Curve Model. The function for the Obesity Kuznets Curve Model is defined as follows:

$$OB = f(GDP, GDP^2) \quad (1)$$

The model to be estimated for the function is as follows:

$$OB_t = \beta_0 + \beta_1 GDP_t + \beta_2 GDP_t^2 + \varepsilon_t \quad (2)$$

In equation (2) β_1 and β_2 stand for the coefficients of the real gross domestic product and the real gross domestic product square, respectively.

The Obesity Kuznets Curve model offers that people start to eat more than they need once the income level increases until they realize the importance of their health, and they change their eating habits into a healthy diet (Grecu and Rotthoff, 2015). We therefore hypothesise that the coefficient of GDP is expected to be positive, and the coefficient of GDP^2 is expected to be negative.

We used the cross-section dependence test to analyse the relationship between the cross-sections. First, the stationary levels of the variables were tested using two different unit root tests consisting Augmented Dickey Fuller (Dickey and Fuller, 1981) and Phillips Perron (Phillips and Perron, 1988). Later on, the fixed-effects model was used with estimating generalized least squares. We also investigated the co-integration between variables since they are stationary at first difference.

4. Empirical Results

First off, we tested the cross-section dependence between cross-sections in the data. This test hypothesises that there is no cross-section between the cross-sections. According to the results, the null hypothesis is rejected, meaning there is a cross-section dependence between the cross-sections in the study sample.

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	78.73918	10	0.0000
Pesaran scaled LM	15.37055		0.0000
Bias-corrected scaled LM	15.21430		0.0000
Pesaran CD	6.839777		0.0000

Table 2. *Cross section dependence test result*

We applied unit root tests to determine the stationary levels of the variables. The results of the unit root tests show that obesity, the real gross domestic product, and the real gross domestic product square variables are stationary at first difference. Table 3 shows the results obtained from the unit root tests.

	OB	GDP	GDP sqauare
ADF	77.44 (0.000)*	18.73 (0.044)**	21.58 (0.017)**
PP	98.16 (0.000)*	35.10 (0.000)*	44.44 (0.000)*
Probability values are in parentheses. * stands for 1% significance level and ** stands for 5% significance level.			

Table 3. *Summary of unit root test results*

Since the unit root test results show that all variables are stationary at the first difference, we used the Pedroni (Pedroni, 1999) co-integration test to detect the co-integration between the variables. According to the results, with the rejection of the null hypothesis, which offers no integration, there is a co-integration between obesity and explanatory variables.

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	253.4047	0.0000	237.2488	0.0000
Panel rho-Statistic	0.025315	0.5101	-0.018238	0.4927
Panel PP-Statistic	-3.030553	0.0012	-3.025234	0.0012
Panel ADF-Statistic	-3.395552	0.0003	-3.463470	0.0003

Table 4*. Pedroni residual co-integration test results*

The Obesity Kuznets Curve Model to be estimated for the Eurasian Economic Union is as follows:

$OB_t = \beta_0 + \beta_1 GDP_t + \beta_2 GDP_t^2 + \varepsilon_t$.

The model hypothezises that the coefficients of the explanatory variables are expected to be $b_1 > 0$ and $b_1 < 0$. According to the fixed effects model results, the real GDP positively impacts obesity rates while the real GDP square negatively affects the obesity rates. These findings suggest that an increase in the real GDP within the union

will raise the obesity rates but as long as the real GDP continues to rise, obesity rates will fall. Overall, the results show that the Eurasian Economic Union will experience the Obesity Kuznets Curve Model.

Variable	**Result**
GDP in millions ($)	15.2908*** (1.5672)
GDP in millions ($) square	-2.4880*** (0.2817)
Constant term (c)	12.3237*** (0.5237)
Sample	85
R square	0.8507
Statistical significance *** p value < 0.01	

Table 5. *Fixed effects model test results*

5. Conclusion

This study examined the relationship between obesity and economic growth in the context of the Obesity Kuznets Curve Model for the Eurasian Economic Union for the years between 2000-2016. We used a single model for the Obesity Kuznets Curve Model equation. Firstly, the stationary levels of variables have been examined. Later on, we estimated Pedroni (Pedroni, 1999) residual test to find if there is a co-integration between variables. Consequently, we obtained the results that the Eurasian Economic Union will experience the Obesity Kuznets Curve Model. This result, therefore, suggests that the obesity rates in the Eurasian Economic Union would increase as the economy grows but start decreasing with continuous growth in the economy.

The findings show that this study has notable outcomes in line with the literature stating that the obesity rates are likely to increase with economic growth and start to fall as the economy grows. Therefore, this result points out that the relationship between obesity and economic growth within the Eurasian Economic Union is non-linear. Nonetheless, the relationship between obesity and economic growth differs regarding the nature of the studies in the literature. There are various empirical studies in the literature suggesting different results. The relationship between obesity and economic growth has been found insignificant in rural and impoverished regions (Gortmaker, Kawachi, Neuman & Subramanian, 2014). In contrast, there are mixed results according to the income level of the countries (Ameye & Swinnen, 2019). Aydın (2019) found that the Obesity Kuznets Curve model is valid for Oman, Saudi Arabia, Turkey, and the United Arab Emirates between 1991 and 2016.

Although the Eurasian Economic Union would experience Obesity Kuznets Curve Model with a growing economy, other utmost economic determinants may lead the fluctuations in obesity rates into a different pattern. Therefore, further studies should analyse the other income-related motivations behind obesity, such as household income, disposable income, etc., to determine whether the relationship between obesity rates and other income-related variables is linear or non-linear.

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