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Is It Possible to Describe a Kuznets Curve for Health Outcomes? An Empirical Investigation

Summary: In this study, we investigate the relationship between economic growth and health outcomes under the Kuznets curve (KC) hypothesis for 60 developing countries during the period 1995 to 2010 using unbalanced panel data method and the health production function model. The results show that the turning points and shapes of the health Kuznets curve (HKC) change based on the kind of health proxy variables, suggesting that there is not a specific HKC for health outcomes. Thus, health policies need to be "customized" for each health indicator and not standardized. Moreover, based on these results, health policies that ignore the detrimental effects of pollution may not deliver the full realizable health gains that could be derived from higher socioeconomic levels.

Key words: Developing countries, Economic growth, Health status, Kuznets curve.

JEL: I15.

Is economic growth part of the solution rather than the cause of health problems? Generally, it is assumed that health outcomes for a population improve when the economy grows (gains of growth); a higher level of income permits more access to consumption of higher quality of goods and services, better housing, and medical care services, which favorably influence the health status. In the recent decades, many theoretical and empirical studies have also confirmed a statistically significant and positive relationship between economic growth and health status (for example, Lant Pritchett and Lawrence H. Summers 1996; Lata Gangadharan and Ma. Rebecca Valenzuela 2001). However, in line with economic growth, environmental quality tends to worsen, as greater output generates more pollution (the scale effect of growth; for such arguments, see for example, Gene M. Grossman and Alan B. Krueger 1995; Xundi Diao et al. 2009). Moreover, as income increases, there are more tendencies to the unhealthy and stressful lifestyle. More explicitly, as income increases, individuals may choose more adverse diets, faster cars, more alcohol consumption, etc. (for such arguments, see for example, Victor R. Fuchs 1994; Bichaka Fayissa and Paulos Gutema 2005). Degradations in the quality of environment and lifestyle are created by economic growth adversely affect the health status (losses of growth). Thus, it can be argued that, although economic growth has a positive effect on the health status, deteriorations in environmental quality and lifestyle could offset this gain, and this challenges the idea that, as income increases, health would always improve. These processes create questions about whether or not the general health status increases until economic growth reaches a certain point and then decreases while the growth continues. Could a positive monotonic relationship between economic growth and health status delink after a certain point of income level? Is there a curve such as Kuznets curve (KC)/environmental Kuznets curve (EKC) for population health status? In fact, EKC (Grossman and Krueger 1995) hypothesized a relationship between environmental degradation and income *per capita*, which takes the form of an inverted-U, after Simon Kuznets (1955) who hypothesized an inverted-U for the relationship between a measure of inequality in the distribution of income and the level of income. If the health Kuznets curve (HKC) hypothesis is not rejected, it may be implied that, after a certain point of income, economic growth is a threat to the health status instead of means for health improvement. If we find that this argument has no empirical support, it may imply that health policies addressing development issues are effectively also addressing the environmental and healthy life style issues.

1. Related Literature Survey

There exists a large literature that has analyzed the relationship between economic growth and health outcomes. A number of previous studies in this literature have found statistically significant and negative income elasticity of infant mortality rate (Kalanidhi Subbarao and Laura Raney 1995; Pritchett and Summers 1996; Alassane Drabo 2010). Similarly, researches on income elasticity of life expectancy at birth have shown that there is a positive relationship between increment income and life expectancy (Gangadharan and Valenzuela 2001). Most of these studies also control other factors that affect the health status such as, the accessibility of health services, population, and education levels. Generally, based on these studies, a positive link between economic growth and health status has been confirmed. However, recently, some researchers argue that, beyond some threshold level of growth, increasing income may no longer lead to better health. In fact, it may lead to a stressful and unhealthy lifestyle that may adversely affect the health status. More explicitly, along with increasing income, individuals may prefer more detrimental diets, faster cars, more alcohol or cigarette consumption, etc. (Fuchs 1994). In addition, economic growth through increasing production scale leads to increasing energy use and industrial waste, which worsens environment quality. Exposure to environmental degradation has also deleterious effects on physical health outcomes. For instance, although some studies in the pollution emission and health status literature have found statistically significant and positive relationship between various pollutants and infant mortality rate (Gangadharan and Valenzuela 2001; Maya Federman and David Levine 2010), in other studies, a negative link between increment pollutants and life expectancy has been concluded (Douglas Coyle et al. 2003; Andrew W. Corria et al. 2013).

Furthermore, in the framework of health production function literature, the link between economic growth/income and health status has been examined (James Thornton 2002; Fayissa and Gutema 2005). Generally, socioeconomic factors are positively but environmental and lifestyle factors are negatively related to the health status. This main result can also enforce the thought that the degradations in environment and lifestyle are generated in line with economic growth may delink the increasing monotonic link between economic growth and health outcomes.

2. Analytical Framework

In this paper, we first employ the production function approach. Based on the theoretical health production function at the micro level that was developed by Michael Grossman (1972), without losing the theoretical ground, we introduce a health production function at the macro level. The empirical aggregate health production function is given by:

$$ln(h_{it}) = p_i + \alpha_{i1} ln(y_{1it}) + \alpha_{i2}\, ln(y_{2it}) + \beta_i\, ln(s_{it}) + \gamma_i\, ln(e_{it}) + \delta_i\, ln(w_{it}) + \varepsilon_{it}, \quad (1)$$

where $i = 1, 2, ..., N$ and $t = 1, 2, ..., T$ denote country and time period, respectively. In Equation (1), h_{it} refers to the health status in country i; y_{1it} is the economic growth level of country i; y_{2it} is health expenditure and s_{it} is education levels (these variables are assumed as the vector of socioeconomic factors); e_{it} and w_{it} are the environmental degradation and lifestyle factors; p and α, β, γ and δ are the constant and elasticities and ε_{it} is the error term.

Equation (1) just indicates the effects of socioeconomic, environmental, and lifestyle factors on the health status. We also construct another empirical model to examine this hypothesis whether or not there is a KC for the health status. By adding $(y_{1it})^2$ to Equation (1), which denotes the sustainability of economic growth in the sense of environment and health, we can examine what kinds of relationships exist between economic growth and health status. Equation (2) is defined as:

$$\begin{aligned} ln(h_{it}) = p_i + \alpha_{i1}\, ln(y_{1it}) + \boldsymbol{\alpha_{i2}\, ln(y_{1it})^2} + \alpha_{i3}\, ln(y_{2it}) + \\ + \beta_i\, ln(s_{it}) + \gamma_i\, ln(e_{it}) + \delta_i\, ln(w_{it}) + \varepsilon_{it}, \end{aligned} \quad (2)$$

If $\alpha_{i1} > 0$ and $\alpha_{i2} < 0$, there will be an inverse U-shaped relationship between economic growth and health outcomes, but if $\alpha_{i1} < 0$ and $\alpha_{i2} > 0$, there will be a U-shaped link between them.

3. Data and Methods

3.1 Variables and the Data

The data used in this paper are obtained from the World Development Indicators, compiled by the World Bank (2014)[1] and Global Information System on Alcohol and Health (GISAH) compiled by the World Health Organization (2014)[2]. Because the research goal is to include countries that are in the first stage of economic growth (countries with no/lax environmental policy, where in line with economic growth, environmental quality tends to worsen rather than developed countries with strict

[1] **World Bank.** 2014. World Development Indicators. https://openknowledge.worldbank.org/bitstream/handle/10986/18237/9781464801631.pdf?sequence=1 (accessed January 09, 2014).
[2] **World Health Organization.** 2014. Global Information System on Alcohol and Health. http://www.who.int/substance_abuse/activities/gisah/en/ (accessed February 22, 2014).

environmental policy), and according to the data availability, there are total 60 countries included in the analysis. 54% of countries come from the upper middle-income and 46% are lower middle-income. In this paper, to achieve consistent and robust results, we use different proxy variables for the health status, environmental, and education level factors.

The main health status proxy variables are life expectancy at birth, which is defined as the mean age at death of a fictitious generation subject to the mortality conditions of the period considered (Scott McDonald and Jennifer Roberts 2004, p. 8), and infant mortality, which defined as the number of infant deaths before one year of age per 1000 live births. This proxy can be defended on the grounds that it offers an indicator of the current health status of the population through those most susceptible to deterioration in the general level of health within the population. However, it partially captures the "quality of health" dimension (McDonald and Roberts 2004, p. 9).

Socioeconomic factors such as economic growth, education level, and health expenditure have been represented for the estimation through the GDP *per capita* (2005 constant USD), school enrollment for secondary and tertiary levels (% gross), and total (private and public) *per capita* health expenditure, respectively. A higher level of income permits more access to the consumption of higher quality of goods and services, better housing, and medical care services, which favorably affect the health status; due to degradations in the quality of environment and lifestyle conditions, the health status can decrease while the growth continues. Based on these scenarios, the coefficients of GDP *per capita* and square of GDP *per capita* are expected to be positive and negative, respectively.

Moreover, as more education gives the people more awareness about their own health status and of what preventive measures may increase their own health, there are expected positive coefficients for both education level proxy variables. Health expenditure is considered as a measure of availability of the health production facilities to a given society. A higher level of health expenditure leads to higher health status and positive coefficient expectation for health expenditure. The use of health expenditures *per capita* may have an econometric problem of multicollinearity that arises from the co-movement of health expenditures and GDP *per capita*. To reduce the possible effects of multicollinearity, such as the research of Fayissa and Gutema (2005), we use the ratio of total health expenditure (y_2) to GDP (y_1). $d(lny_2/lnP(population)) = d(lny_2) - d(lnP)$, but the growth of aggregate income could be approximated by population growth due to the stagnant nature of the economic performance; hence, $d(lnP(population\ growth)) \approx d(lny_1) \rightarrow d(lny_2/P) \approx d(lny_2) - d(lny_1) = d(lny_2/y_1)$. The ratio substitutes the *per capita* expenditure in the health equations.

Furthermore, there are two different environmental degradation proxy variables that are available for the analysis. The air pollutants for which their data are available are carbon dioxide (CO_2) emissions (metric tons *per capita*) and particulate matter PM_{10} concentration country level (micrograms per cubic meter). PM_{10} has health concern, as it is able to penetrate deep into the sensitive regions (thoracic or lower regions) of the respiratory tract (Euston Quah and Tay Liam Boon 2003). CO_2 is responsible to

58.8% of greenhouse gas (GHG) emissions (Robert W. Bacon and Soma Bhattacharya 2007) and has also an adverse influence on health (Kakali Mukhopadhyay and Osmo Forssell 2005). Since air pollutions cause health hazards, we expect negative coefficients for these variables.

The proxy variable for lifestyle factor subject to the availability of its data is alcohol *per capita* (15+) consumption. According to Jurgen Rehm (2011), alcohol consumption is recognized as an important risk factor for most chronic illnesses, such as diseases of the digestive system and cancer cirrhosis, as well as for accidents and violent deaths. However, recent studies (for example, Robert A. Kloner and Sherief H. Rezkalla 2007) suggest that moderate consumption may have beneficial health effects. Thus, the net effect of alcohol consumption on health is uncertain. Although there are different proxy variables for lifestyle factors, such as smoking, the consumption of fast food, etc., the lack of data for the considered period of time and developing countries confined the study from using other lifestyle proxy variables.

Before choosing the method for estimation, we are concerned with the fact that there are significant differences in many aspects (including geographical, social, and economic factors) among the developing countries; hence, it is not appropriate to assume parameter homogeneity, i.e., that all the slope coefficients are the same. The results of fixed effects tests (F and χ^2 tests) also strongly reject the null hypothesis that individual effects are redundant. Therefore, in this paper for the estimation of panel data with individual effects, we employ two models: fixed and random effects models. The fixed and random effects models are based on the assumption that the intercept (an individual effect) varies in every country. On the one hand, the fixed effects model assumes time-independent effects for each country with the need for controlling unobserved heterogeneity when it is constant over time. On the other hand, the random effects model is based on the assumption that the individual effects are randomly distributed. In other words, while the fixed effects model uses dummy variables on the assumption that there is a correlation between the independent variables and the error term, the random effects model assumes that there is no correlation between the two (Damodar N. Gujarati 2003). The Hausman test will be used in choosing the estimation method between the fixed and random effects models. In this case, the null hypothesis is that a constant term is not related to independent variables. The fixed effects model will be selected if the null hypothesis is rejected, while the random effects model will be selected if it is not rejected. The results of the Hausman test show that the fixed effects model should be chosen over the random effects model. In addition, the correlation analysis shows that none of correlation coefficients between any two independent variables exceed 0.6, demonstrating that the variables might not cause a severe multicollinearity problem (see Table 1).

Table 1 Correlation Coefficients

	Life exp.	Infant mortality	GDP *per capita*	Health exp.	School enrollment (secondary)	School enrollment (tertiary)	CO_2 emission	PM_{10} concentration	Alcohol consumption
Life exp.	1								
Infant mortality	-0.796	1							
GDP *per capita*	0.453	-0.591	1						
Health exp.	0.076	-0.169	0.099	1					
School enrollment (secondary)	0.602	-0.656	0.444	0.043	1				
School enrollment (tertiary)	0.611	-0.713	0.435	0.147	0.841	1			
CO_2 emission	-0.096	0.284	0.218	-0.023	0.384	0.330	1		
PM_{10} concentration	-0.185	0.273	0.273	0.010	-0.133	-0.060	-0.158	1	
Alcohol consumption	0.077	-0.029	0.029	0.425	-0.027	-0.062	-0.128	0.10	1

Source: Authors' calculations.

3.2 Results

The results of fixed effects panel estimation of both equations are presented in Tables 2 and 3. The coefficient of GDP *per capita* is found to be statistically significant, suggesting that the variable favorably influences the health status in Equation (1). The results suggest that 1% increment on GDP *per capita* can generate 0.04 to 0.06 percentage improvement in life expectancy at birth and 0.66 to 0.73 percentage reduction in infant mortality, respectively. A higher level of income allows a higher level of the health status. However, to answer the question of whether or not, in line with increasing GDP *per capita*, the improvement in the health status continues, we add the square of GDP *per capita* to Equation (2). The coefficients of GDP *per capita* and its square indicate that when we use life expectancy at birth as a proxy variable for the health status; it first increases and then decreases after the turning point of $16,447.96 to $59,902.29 (2005 constant USD). On the other hand, there is an inverse U-shaped relationship between economic growth and health status.

Furthermore, although the results of Equation (1) represent that GDP *per capita* has an inverse effect on infant mortality, in Equation (2), negative relationship between GDP *per capita* and infant mortality occurs after the turning point of $25.80535 to $57.9435 (2005 constant USD). In other words, infant mortality first increases until the low levels of GDP *per capita* and then decreases, and there is a U-shaped relationship between GDP *per capita* and health status (in fact, an inverse U-shaped link between GDP *per capita* and infant mortality). As a result, as seen like EKC, the null hypothesis that there is a KC for health outcomes is not rejected. According to our findings, the turning points and forms of the HKC change based on the type of the health status proxy variables and there is no specific HKC for health outcomes.

Thus, health policies need to be "customized" for each health indicator, rather to be standardized. On the other hand, different health policies should be implemented for each health status indicator instead of the same or general health policies for all kinds of the health status indicators. When the turning points for life expectancy at birth and infant mortality compare to descriptive statistics - maximum (11,533.82), minimum (307.6060), and mean (2,597.357) of GDP *per capita*, all the existing developing countries have reached the turning point of infant mortality, but the turning point of life expectancy at birth is not still accessible for the considered countries. In these countries, the current infant mortality and life expectancy are decreasing and increasing, respectively. Therefore, policymakers in the considered countries should focus more on policies to prevent decreasing life expectancy at birth in the future.

Moreover, Tables 2 and 3 report that the coefficients of health expenditure (only the first cases of both equations and the third case of Equation (1) in Table 2 and except the fourth cases of both equations in Table 3), secondary and tertiary education levels, and alcohol consumption (except the first, second, and fourth cases of Equation (2) in Table 2 and except the second cases of both equations and the fourth case of Equation (1) in Table 3) have statistically positive impacts on the health status, suggesting that a 1% improvement in health expenditure and school enrollment for secondary and tertiary levels would lead to 0.0059% to 0.0084%, 0.058% to 0.060%, and 0.019% to 0.020% increment in life expectancy, respectively, and 0.012% to 0.091%, 0.16% to 0.22%, and 0.10% to 0.11% reduction in infant mortality, respectively. A 1% increment on *per capita* alcohol consumption can also create 0.0022% to 0.0036% increment in life expectancy and 0.015% to 0.029% reduction in infant mortality.

Furthermore, the tables indicate that an increase in CO_2 emission and PM_{10} concentration can contribute to the reduction of the health status. The results represent that a 1% increment on CO_2 and PM_{10} would lead to 0.011 to 0.013 and 0.008 to 0.025 percentage reductions in life expectancy at birth, respectively, and 0.054 to 0.065 and 0.08 to 0.14 percentage increments in infant mortality, respectively.

In general, the estimates suggest that socioeconomic factors (such as GDP *per capita*, education levels, and health expenditure, respectively) have stronger effects on the health status than CO_2, PM_{10} pollutants, and alcohol consumption, respectively. However, health policies that focus on just socioeconomic aspects and ignore the adverse impacts of the pollution may do little in efforts directed to improve the current health status of developing countries and also may not deliver the full realizable health gains that could be derived from higher socioeconomic levels. In fact, the results show that, in line with economic growth, whereas socioeconomic and lifestyle factors improve the health status only environmental factors (air pollution) through their prohibitive effects on health lead to delink the positive monotonic relationship between economic growth and health status (life expectancy). Thus, it is necessary to employ environmental protection policies to keep increasing the income and the health status simultaneously.

It is significant to say that the lack of data on lifestyle factors, such as smoking and fast food consumption hampers our objective. Data on alcohol consumption is also challenging, because it is related to cultural, ethical, and religion factors. A positive coefficient of alcohol consumption also represents more moderate consumption rather than intensive. However, it is probable that using other proxy variables for lifestyle can change the sign of its coefficient.

Finally, given that there is no single indicator or index that can capture the overall aspects of a country's health outcomes, it is not uncanny to obtain different shapes for HKC. Such an index will be useful for a definite result between economic growth and health status.

Table 2 Estimated Results for Life Expectancy at Birth

Variables	Equation (1)				Equation (2)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	3.592206 (14.3043)	3.671389 (16.8032)	4.659911 (12.26562)	3.840097 (15.87595)	2.185948 (20.92074)	3.131851 (21.89004)	3.236794 (21.39397)	2.231018 (22.715)
GDP *per capita*	0.052007 (12.99903)***	0.064455 (19.85731) ***	0.045247 (10.65433)***	0.052411 (13.45133) ***	0.164303 (3.925778) ***	0.212503 (5.458061) ***	0.167554 (4.028613) ***	0.223283 (5.85531) ***
(GDP *per capita*)^2	-	-	-	-	-0.007468 (-2.69537) ***	-0.009944 (-3.8155) ***	-0.008183 (-2.9559) ***	-0.0115 (-4.5037) ***
Health expenditure	0.006814 (1.659903)*	***0.002566*** ***(0.65918)***	***0.003911*** ***(0.951053)***	***0.004771*** ***(1.2388)***	0.008417 (2.038600) **	***0.000626*** ***(0.16148)***	0.005900 (1.723882)*	***0.002461*** ***(0.6426)***
School enrollment (secondary)	0.059974 (10.71864) ***	-	0.060680 (10.56781)***	-	0.058617 (10.48281) ***	-	0.058458 (10.15113) ***	-
School enrollment (tertiary)	-	0.019766 (8.552480) ***	-	0.019360 (8.449196) ***	-	0.020281 (8.853222) ***	-	0.020117 (8.83069) ***
CO_2 emission	-0.012048 (-5.33284) ***	-0.013219 (-5.67284) ***	-	-	-0.011951 (-5.31415) ***	-0.013034 (-5.65159) ***	-	-
PM_{10} concentration	-	-	-0.008924 (-2.50339)***	-0.023187 (-4.37838) ***	-	-	-0.012182 (-2.02872) **	-0.025884 (-4.92664) ***
Alcohol consumption	0.003453 (1.767183)*	0.002222 (1.781230)*	0.003693 (1.864648)*	0.003457 (1.82161)*	***0.002720*** ***(1.385140)***	***0.000941*** ***(0.497669)***	0.002720 (1.707142)*	***0.002308*** ***(1.224302)***
R^2	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
N	725	700	745	721	725	700	745	721
Fixed effect test								
F	254.74 (0.00)	229.76 (0.00)	264.31 (0.00)	234.27 (0.00)	257.09 (0.00))	238.92 (0.00)	268.38 (0.00)	243.94 (0.00)
χ^2	2314.30 (0.00)	2192.32 (0.00)	2384.48 (0.00)	2250.28 (0.00)	2321.82 (0.00)	2219.64 (0.00)	2396.50 (0.00)	2279.33 (0.00)
Hausman test χ^2	35.04 (0.00)	14.19 (0.015)	9.99 (0.07)	29.79 (0.00)	14.72 (0.022)	35.05 (0.00)	10.16 (0.01)	29.27 (0.001)
The turning points					59902.29	43694.87	27943.22	16447.96

Notes: Figures in the parenthesis indicate *t*-statistic. * %10, ** %5 and *** %1 denote statistical significant level. *p*-values of tests are in brackets. Countries in our samaple are: Albania, Algeria, Angola, Armenia, Argentina, Azerbaijan, Belarus, Belize, Bhutan, Botswana, Bolivia, Bulgaria, Cameroon, China, Colombia, Cuba, Djibouti, Egypt, Arab Republic, El Salvador, Georgia, Ghana, Guyana, Hungary, India, Indonesia, Iran, Islamic Republic, Iraq, Jordan, Kazakhstan, Kyrgyz Republic, Lao PDR, Lebanon, Macedonia, Malaysia, Mauritania, Mauritius, Mexico, Moldova, Montenegro, Mongolia, Morocco, Namibia, Panama, Pakistan, Paraguay, Philippines, Peru, Romania, Senegal, Swaziland, Syrian Arab Republic, St. Lucia, Thailand, Tunisia, Turkey, Ukraine, Uzbekistan, Vanuatu, Venezuela, RB, Republic of Yemen.

Source: World Bank (2014).

Table 3 Estimated Results for Infant Mortality

Variables	Equation (1)				Equation (2)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	9.36414 (21.82271)	9.065715 (10.59885)	8.42 8881 (28.57552)	7.984552 (30.36454)	3.692674 (4.170316)	4.292866 (5.221319)	3.516860 (3.954442)	3.790865 (4.558427)
GDP *per capita*	-0.721216 (-30.2290) ***	-0.73721 (-38.9298) ***	-0.677233 (-26.6430) ***	-0.660157 (-28.8121) ***	0.846456 (3.478366) ***	0.572441 (2.558537) ***	0.742651 (3.037654) ***	0.516342 (2.315926) **
(GDP *per capita*)^2					-0.104257 (-6.47143) ***	-0.087965 (-5.87356) ***	-0.094998 (-5.83790) ***	-0.079423 (-5.30386) ***
Health expenditure	-0.091649 (-3.74921) ***	-0.029909 (-38.9298) ***	-0.084503 (-3.43335) ***	***-0.018152 (-0.80159)***	-0.069271 (-2.88558) ***	-0.012757 (-3.57131) ***	-0.061606 (-2.52096) **	***-0.002251 (-0.1005)***
School enrollment (secondary)	-0.207847 (-6.22910) ***		-0.169606 (-4.93504) ***		-0.226796 (-6.97556) ***		-0.195392 (-5.77201) ***	
School enrollment (tertiary)		-0.112798 (-8.36566) ***		-0.115548 (-8.56756) ***		-0.108236 (-8.2216) ***		-0.110333 (-8.3329) ***
CO_2 emission	0.054325 (4.032244) ***	0.063621 (4.664965) ***			0.055682 (4.258279) ***	0.065056 (4.908545) ***		
PM_{10} concentration			0.126941 (3.572768) ***	0.148297 (4.762053) ***			0.089124 (2.520969) **	0.129724 (4.223071) ***
Alcohol consumption	-0.015594 (-1.73822) *	***-0.001482 (-0.13507)***	-0.023232 (-1.9599)*	***-0.009763 (-0.87594)***	-0.025827 (-2.26193) **	***-0.009847 (-0.9057)***	-0.029216 (-2.51414) **	-0.017674 (-1.60330) *
R^2	0.97	0.98	0.98	0.98	0.97	0.98	0.97	0.98
N	725	700	745	721	725	700	745	721
Fixed effect test								
F	355.78 (0.00)	330.85 (0.00)	324.002 (0.00)	292.47 (0.00)	366.56 (0.00)	353.32 (0.00)	336.09 (0.00)	311.79 (0.00)
χ^2	2547.99 (0.00)	2438.20 (0.00)	2530.57 (0.00)	2403.92 (0.00)	2573.95 (0.00)	2483.93 (0.00)	2558.06 (0.00)	2449.54 (0.00)
Hausman test χ^2	20.32 (0.0001)	39.39 (0.00)	24.009 (0.0003)	33.09 (0.00)	28.53 (0.0001)	49.90 (0.00)	26.52 (0.0002)	37.35 (0.00)
The turning points					57.9435	25.88852	49.83771	25.80535

Notes: Figures in the parenthesis indicate *t*-statistic. * %10, ** %5 and *** %1 denote statistical significant level. *p*-values of tests are in brackets.

Source: Authors' calculations.

4. Conclusion

In this paper, we first examine a health production function for developing countries in line with the Grossman theoretical model using socioeconomic, lifestyle, and environmental factors as inputs of the production function. We then explore whether or not there is a curve such as KC/EKC for population health outcomes.

The results obtained from the fixed effects regression model suggest that, whereas socioeconomic and lifestyle factors improve the health status, only environmental factors (air pollution) have a prohibitive effect on health outcomes. Such a negative impact on health leads to negate or diminish some of the health gains already derived by socioeconomic and lifestyle factors, and by delinking positive monotonic relationship between economic growth and health outcome (life expectancy) creates a KC for the health status. These results are consistent with those of Gangadharan and Valenzuela (2001), Thornton (2002) and Drabo (2010), who found a negative effect of environmental degradation on health. However, our results show that there is no specific HKC for health outcomes and the turning points and forms of the HKC change based on the type of proxy variables. Based on these results, general health policies for population health outcomes cannot be effective. Generally, health policies that ignore the detrimental effects of pollution may not deliver the full realizable health gains that could be derived from higher socioeconomic levels.

In conclusion, one of the ways this research can be extended is to use other health and environment indicators and compare the results for each indicator. The second way to extend this article is the use of other technical approach in order to confirm our idea. A third extension is to create a single indicator or index that could capture the overall qualitive and quantitative aspects of health status.

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