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Is there an institutional Kuznets curve? New evidence using asymmetric kernel analysis

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***Abstract*---**In this work, we examine the existence of a possible institutional Kuznets curve between GDP per capita and institutional quality over a sample of 132 countries between 2000 and 2017. With the kernel method, interesting results are observed. Our results show an inverted U-shaped relationship between institutional quality and countries' GDP per capita. Specifically, we find that between the interval [0; $60,000], GDP per capita significantly increases institutional quality. In the meantime, GDP per capita creates ideal conditions for an environment that builds confidence among economic agents. Above $60,000, any increase in GDP per capita will significantly reduce institutional quality, which still remains positive. On the other hand, we note that countries will have good institutional quality from a GDP per capita estimated at $20,000. These results show that to improve institutional quality, it would be necessary to act

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on development only for countries whose GDP per capita is below $40,000.

***Keywords*---**GDP Per Capita, institutional quality, Asymmetrics kernel method.
Code JEL: O55; F55; C32

1. Introduction

The empirical basis of the Kuznets curve is Kuznets's (1955) study using inequality data for England, two German Länder, and the United States. Kuznets (1955) proposed an inverted-U relationship between income inequality and per capita income. He argued that inequality initially rises during the "take-off" and industrialization phases, then stabilizes and eventually declines as countries reach advanced stages of development.

Panayotou (1993) extended the Kuznets hypothesis to the environmental domain. According to this "environmental Kuznets curve" (EKC), once income surpasses a turning point,after primary needs are met,concern for environmental quality increases. Beyond this threshold, economic growth is associated with lower pollution, implying an inverted-U relationship between development and pollution. In this framework, environmental quality is treated as a normal good whose demand increases with income. Grossman and Krueger (1995) support this view, showing that pollution first rises with economic development and then falls beyond a certain level of per capita income. By contrast, Jobert and Karanfil (2012) argue that declines in pollution in developed countries reflect a shift from manufacturing to services rather than income effects per se.

This article asks whether an "institutional Kuznets curve" exists. Following North (1990), institutions are the formal and informal rules of the game in a society,that is, the constraints devised to shape interactions, reduce uncertainty, and lower transaction costs. From this perspective, institutions may mediate the links between economic development and both environmental quality and income inequality. This raises the question of a dynamic relationship,i.e., an institutional Kuznets curve,between institutional quality and economic prosperity.

A related literature documents nonlinear effects of institutional quality on development (Anokhin & Schulze, 2009; Law & Azman-Saini, 2012; Mohamadia et al., 2017; Albdulahi et al., 2019; Belarbi et al., 2021). For example, using longitudinal data for sixty-four countries, Anokhin and Schulze (2009) examine how corruption control affects entrepreneurship and innovation. They find a positive, curvilinear, and time-lagged relationship, suggesting that institutional reforms take time to yield benefits. Albdulahi et al. (2019) revisit the nonlinear nexus between natural resource rents and growth under the resource-curse hypothesis, using the rule of law as a threshold variable for fourteen resource-rich sub-Saharan African countries (2005–2010). Their results reveal two significant thresholds: resource rents are positively associated with growth when institutional quality exceeds −1.28 and when it lies between −1.37 and −1.28; below −1.37, the resource curse prevails, hindering growth. These findings imply

that ignoring endogenous nonlinearities can obscure the minimum institutional thresholds needed to sustain growth and the dynamic effects of institutional quality.

Our paper proceeds from economic wealth to institutions and employs a non-parametric estimator, thereby avoiding any a priori functional form for the relationship between the dynamics of economic wealth and institutional quality.

The literature on the impact of economic wealth on institutional quality is inconclusive. Corradini (2019), for instance, finds no evidence that economic performance improves the quality of Italian local institutions, casting doubt on the notion that growth-focused policies alone can forge strong institutions and suggesting that targeted institutional reforms are a prerequisite for sustainable regional development. Arvin et al. (2021) reach a similar conclusion: across their sample, economic growth does not Granger-cause institutional quality in the long run, and this result also holds in the short run for low-income countries. For middle-income countries, however, there is bidirectional Granger causality between institutional quality and economic growth, in line with Nawaz et al. (2014) for Asian economies, Gurdal et al. (2021) for the G7, and Onakoya et al. (2017) for sixteen African countries.

Our results indicate an inverted-U relationship between a country's institutional quality and its GDP per capita, consistent with the existence of an institutional Kuznets curve analogous to the EKC. The remainder of the article is structured as follows. Section 2 presents the econometric strategy and empirical results. Section 3 concludes.

2. Empirical Estimation

2.1 Data

Our data are drawn from the World Bank. The sample comprises 132 countries spanning Sub-Saharan Africa, Latin America and the Caribbean, Asia, Eastern Europe, the Middle East and North Africa, North America, and Western Europe over the period 2000–2017. The variables include GDP per capita (in purchasing power parity) and the six Worldwide Governance Indicators (WGI) developed by Kaufmann et al.: (1) Voice and Accountability, (2) Political Stability and Absence of Violence/Terrorism, (3) Government Effectiveness, (4) Regulatory Quality, (5) Rule of Law, and (6) Control of Corruption. Each indicator ranges from −2.5 (low) to +2.5 (high). Table 1 reports the variable definitions, including the descriptions of the six governance indicators.

Table 1: Description of variables and descriptive statistics

Variable-Label	Variable-Signification	Source	Mean	Std-dev	Minimum	Maximum
Endogenous variable						
gdp	Gross domestic product (GDP) at purchasing power parity (PPP)	World Development Indicators	17849	19254	482.88	141635
Institutional Quality Variables						
vaa	Voice and Accountability	World Development Indicators	0.043	0.966	-2.23	1.8
polstable	Political Stability and Absence of violence/Terrorism	World Development Indicators	-0.038	0.906	-2.81	1.76
goveffect	Government Effectiveness	World Development Indicators	0.144	0.983	-2.08	2.44
regulq	Regulatory Quality	World Development Indicators	0.183	0.927	-2.34	2.26
rulaw	Rule of Law	World Development Indicators	0.078	0.997	-1.79	2.1
coc	Control of Corruption	World Development Indicators	0.069	1.05	-1.83	2.47

N = 2376 observations (132 countries, 2000-2017)

To capture interactions among the six governance indicators, we construct an Institutional Quality Index (IQI; Attila, 2011) scaled from −2.5 to +2.5. Unlike Singh and Pradhan (2020), who take the simple average of the six indicators, we follow Capelle-Blancard et al. (2019) and derive a synthetic index using principal components analysis (PCA). Descriptive statistics for the IQI are reported in Table 2.

Table 2: The Aggregate Index of Institutional Quality

Variables	Mean	St-dev	Minimum	Maximum
Synthetic index of institutional quality	2.5.E-10	1.141	-2.314	2.378

N = 2376 observations (132 countries. 2000-2017)

Our data exhibit substantial dispersion. For instance, mean GDP per capita is US$17,849 (SD = US$19,254). The institutional-quality variables also display sizable coefficients of variation, ranging from 5.06 (Regulatory Quality) to 23.9 (Political Stability and Absence of Violence).

Figure 1 plots GDP per capita against institutional quality. The fitted line indicates a positive association, yet the relationship appears more complex, nonlinear and concave, rather than strictly linear.

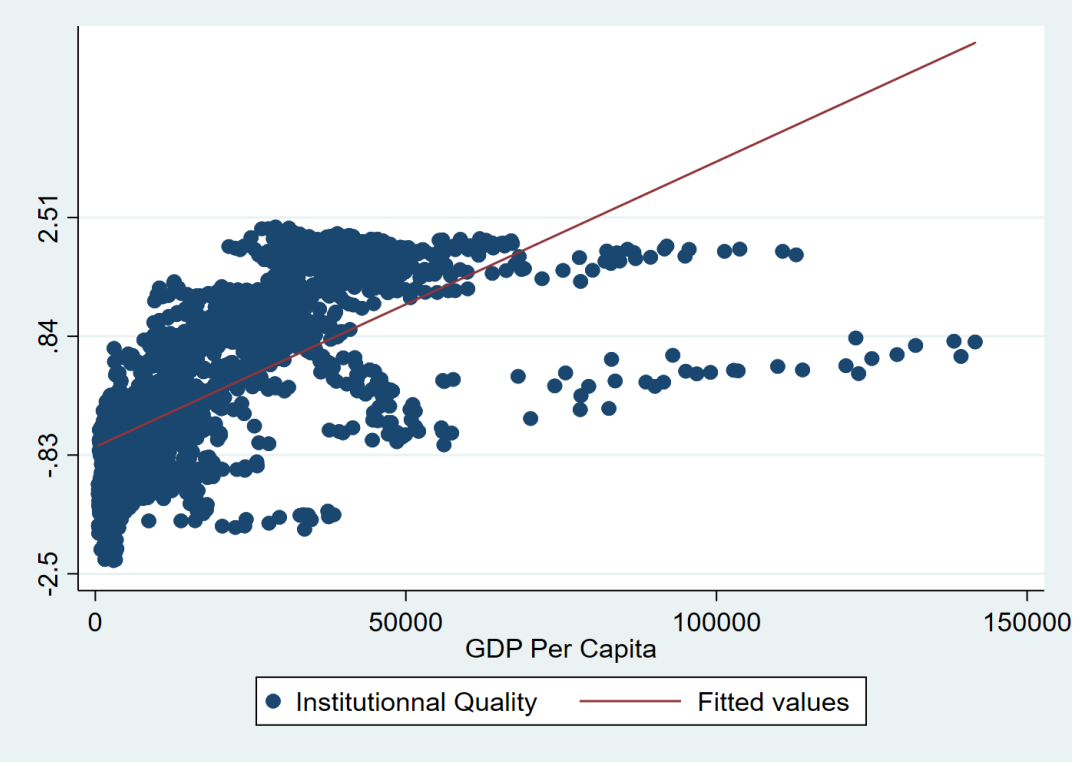

Fig 1: Relationship between GDP per capita and institutional quality

Finally. Graphs 2 and 3 provide a geographic visualization of the relationship between average GDP per capita and average institutional quality across the world between 2000 and 2017. We see that countries with the highest average GDP per capita are associated with a high level of institutional quality.

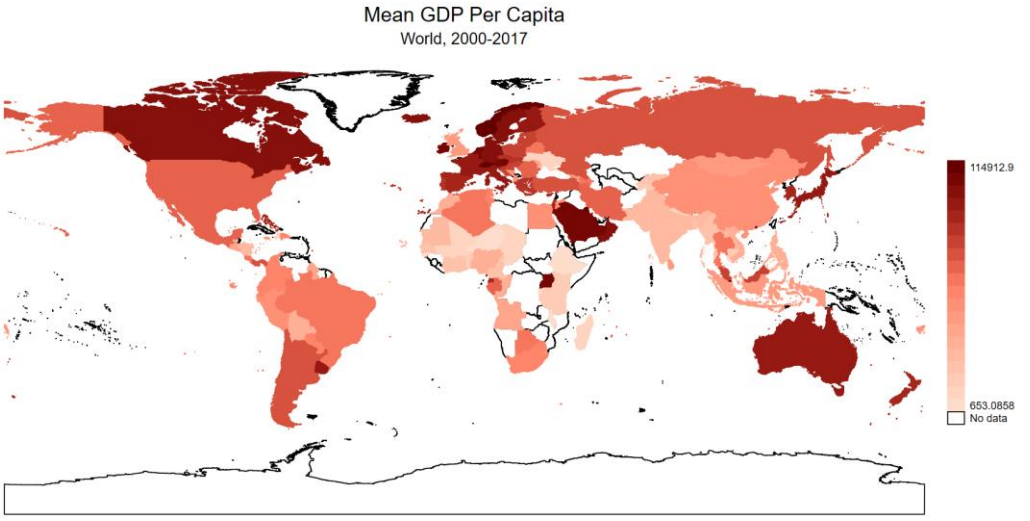

Fig 2: Average GDP per capita over the period 2000-2017

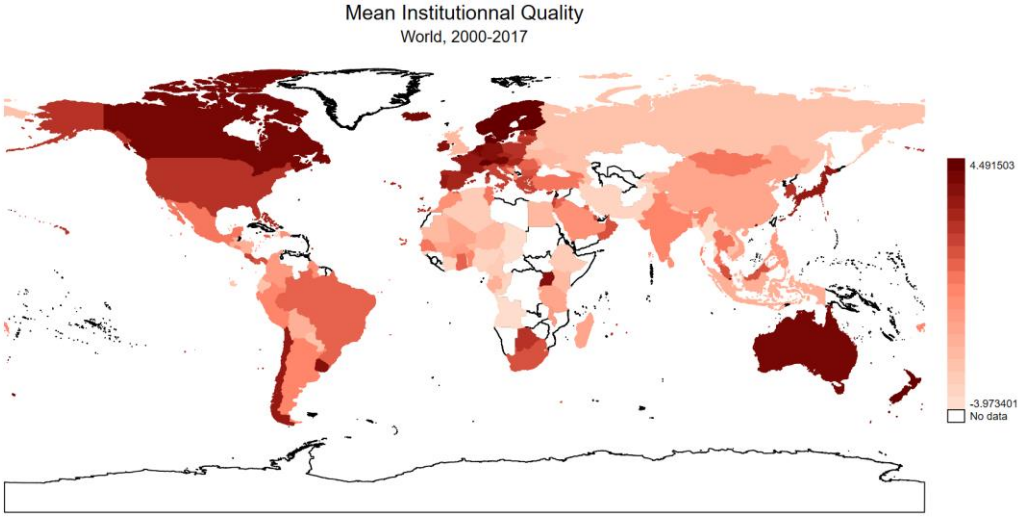

Fig 3 : Average institutional quality index over the period 2000-2017

2.2 Model and Estimation

We implement our nonparametric regression using lognormal, gamma, and inverse Gaussian kernels. These three asymmetric kernels have support on the positive real line and are therefore appropriate for continuous, strictly positive data (Doho et al., 2023). For further details, see Chen (2000), Kokonendji and Somé (2021), and Libengué and Kokonendji (2017). Note that a symmetric Gaussian kernel is not recommended for positive data, as it can induce estimation bias, especially near the boundaries of the support (e.g., Kokonendji and Somé, 2018). These kernels are among the best-performing in the recent literature, and implementations are available in the Ake package for R (Wansouwé et al., 2016), which supports density and regression estimation.

In what follows, we consider the relationship between a variable of interest Y and an explanatory variable x given by:

$$Y = m(x) + \varepsilon \qquad (1)$$

where m is the unknown regression function from $\mathbb{T} \subseteq \mathbb{R}$ $to\,\mathbb{R}$ and ε the disturbance term with null mean and finite variance. Let $(X_1.Y_1).\ldots.(X_n.Y_n)$ be a sequence of independent and identically distributed (iid) random variables on $\mathbb{T}\ \mathrm{X}\,\mathbb{R}\,(\subseteq \mathbb{R}^2)$ with $m(x) = \mathbb{E}(Y|X = x)$ of (1). The regression estimator $\widehat{m}_n$ of m from Nadaraya (1964) and Watson (1964) using associated kernels is:

$$\widetilde{m}_n(x;h) = \sum_{i=1}^{n} \frac{Y_i K_{x.h}(X_i)}{\sum_{i=1}^{n} K_{x.h}(X_i)} = \ \widetilde{m}_n(x).\ \forall x \in\ \mathbb{T}_1 \subseteq\ \mathbb{R} \qquad (2)$$

where $h \equiv h_n$ is the bandwidth parameter such that $h_n \longrightarrow 0$ as $n \longrightarrow \infty$. Notice that the nonparametric topic of associated kernels is adaptable to any support $\mathbb{T}_1$ (e.g. $\{0.1\ldots..\mathrm{N}\}$. $[\mathrm{a.b}]$ or $[0.\infty)$ for given integer N and reals $\mathrm{a} < \mathrm{b}$) of continuous or discrete regression functions). and has been widely studied in very recent years; see. For example, Somé and Kokonendji (2016. 2021) and Kokonendji and Somé (2018 ; 2021). As a remainder. all computations and graphics have been done using the Ake package in the R software; see R Development Kernel Team (2021).

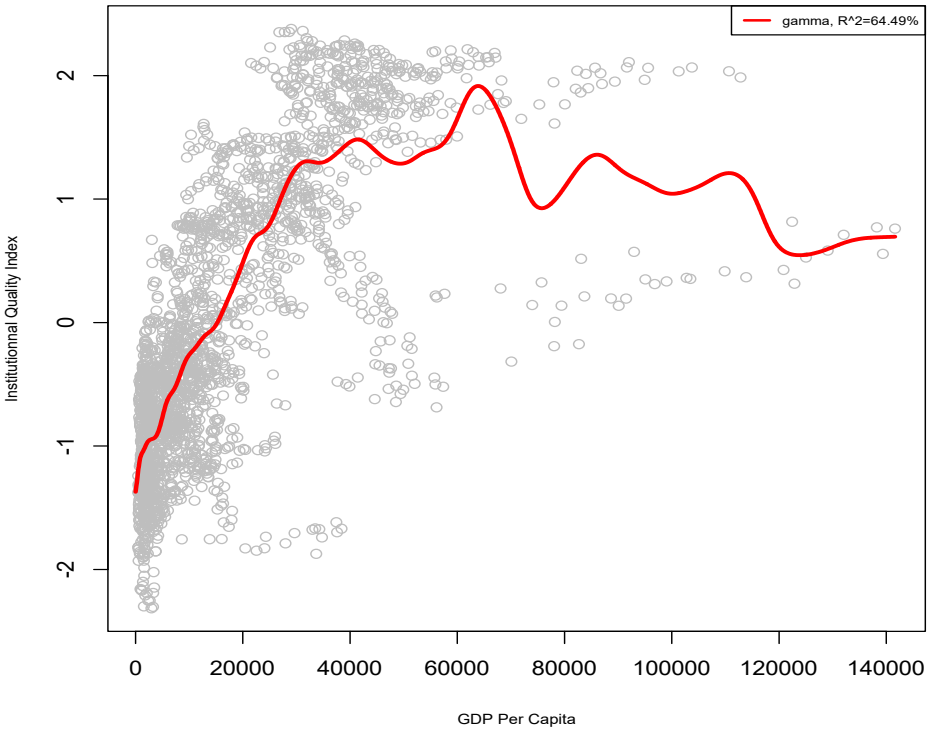

Fig 4: Relationship between GDP per capita and institutional quality index

Using the Gamma kernel (red), we obtain R2 = 64.49% indicating that GDP per capita explains roughly 64.5% of the variation in the Institutional Quality Index (IQI). The Gamma fit closely tracks the point cloud in Figure 4. The data are unevenly distributed, with a pronounced concentration between US$0 and US$20,000 in GDP per capita,consistent with Table 1, where mean GDP per capita is US$17,849 and the standard deviation is US$19,254.

Two main patterns emerge in Figure 4. First, over US$0–US$60,000, the IQI rises steeply,approximately exponentially,suggesting that increases in GDP per capita within this range are associated with substantial improvements in institutional quality. Second, at US$60,000 and above, further increases in GDP per capita are associated with slight declines in the IQI; however, the IQI remains above zero throughout this upper range.

These up-then-down patterns have three implications. (i) They confirm a nonlinear relationship between GDP per capita and institutional quality, in line with prior studies (Anokhin & Schulze, 2009; Law et al., 2013; Mohamadia et al., 2017; Albdulahi et al., 2019; Belarbi et al., 2021). (ii) They imply a threshold: below it, higher GDP per capita tends to improve institutional quality; above it, additional income gains tend to erode it. (iii) Beyond about US$20,000, the IQI is, on average, positive. Since the sample mean GDP per capita is US$17,849, the overall average level of institutional quality appears low (potentially non-positive), even though some, especially developed,countries exhibit very high institutional

quality. In short, countries tend to reach a clearly positive IQI once GDP per capita is at least about US$20,000.

3 Conclusion

In this study, we test for an institutional Kuznets curve between GDP per capita and institutional quality using kernel regression on a panel of 132 countries over 2000–2017. We uncover an inverted-U relationship. Specifically, for GDP per capita between US$0 and US$60,000, increases are associated with statistically significant improvements in institutional quality; beyond about US$60,000, further increases are associated with significant declines, although the institutional quality index remains positive. We also find that institutional quality becomes, on average, positive once GDP per capita exceeds roughly US$20,000.

These results suggest that policies aimed at raising income can improve institutions primarily for countries below about US$40,000 in GDP per capita; this does not appear to hold for economies above US$60,000. This work opens several avenues for future research, notably how the GDP, institutions relationship varies by geographic region.

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