Journal of Economics and Development Studies
ISSN: 2334-2382 (Print) 2334-2390 (Online)

BRPI

Original Article | Open Access | Peer Reviewed

Check for Updates

Testing the Kuznets Curve: Evidence, Sensitivity, and Model Uncertainty

Ebrahim Merza[1] and Mohammad Alawin[2]

[1, 2]Economics Department, Kuwait University, Kuwait.

ORCID iD:

[1]https://orcid.org/0000-0003-3154-8741
[2]https://orcid.org/0000-0002-1553-3139

Address for Correspondence:

Mohammad Alawin, Kuwait. (m_alawin@hotmail.com)

Copyright and Permission:

© **2025**. The Author(s). This is an open access article distributed under the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits sharing, adapting, and building upon this work, provided appropriate credit is given to the original author(s). For full license details, visit https://creativecommons.org/licenses/by/4.0/.

Article History:

Published: 28 January 2026

Abstract

Empirical research in economics and finance rarely speaks with a single, unambiguous voice. The results we obtain often depend on a series of methodological choices—how the model is specified, which time period or countries are included, how key variables are measured, and which estimation techniques are applied. These choices can make it possible, sometimes inadvertently, to produce results that align with prior beliefs. This paper uses three versions of the Kuznets curve—the original income–inequality relationship, the environmental Kuznets curve, and the financial Kuznets curve—to illustrate this problem. In each case, the underlying hypothesis is represented by a simple quadratic relationship with income per capita, while the dependent variable varies according to the dimension under study. Both cross-sectional and time-series data are employed to explore these relationships. The empirical results show a striking degree of sensitivity. Small changes in measurement, sample selection, or estimation method often leads to different—and occasionally contradictory—conclusions. This sensitivity creates room for selective reporting and confirmation bias, particularly when the issues under investigation are ideologically charged. Rather than offering definitive answers, the findings highlight the limits of point estimates in such settings. The paper therefore points toward alternative approaches that confront model uncertainty more directly, emphasizing the reporting of entire distributions of estimated effects instead of relying on single, seemingly precise coefficients.

Keywords Kuznets curve; income inequality; environmental degradation; financialization; confirmation bias

JEL E01, O13, Q56, R11

Volume 13, 2025

Publisher: The Brooklyn Research and Publishing Institute, 442 Lorimer St, Brooklyn, NY 11206, United States

DOI: https://doi.org/10.15640/jeds.v13p12

Reviewers: Opted for Confidentiality

Citation: Merza, E., & Alawin, M. (2025). Testing the Kuznets Curve: Evidence, Sensitivity, and Model Uncertainty. *Journal of Economics and Development Studies*, *13*, 137-152. https://doi.org/10.15640/jeds.v13p12

1. Introduction

Confirmation bias—sometimes called confirmatory bias or "my-side" bias—is a deeply human tendency. It reflects our inclination to seek out, favor, and remember information that supports what we already believe, while discounting or ignoring evidence that challenges those beliefs. Rather than approaching new information with genuine openness, we often use it as a tool to protect existing views. This behavior is especially visible when issues are emotionally charged or tied to personal identity, such as gun control, climate change, or public health. In such cases, evidence rarely changes minds. It is hard to imagine, for example, any amount of data persuading a committed climate-change denier that global warming is real.

This tendency does not stop at everyday debates; it is clearly present in empirical research in economics and finance. These fields rely on complex data that can be sliced, transformed, and modeled in countless ways. As a result, it is often possible—sometimes deliberately, sometimes unintentionally—to produce findings that align neatly with prior beliefs. By selecting different sub-samples from a large dataset, a researcher can show that two variables are positively related, negatively related, or connected through a nonlinear pattern such as a U-shaped or inverted U-shaped curve. One can begin with a relationship that appears strong on average and then highlight specific cases where it breaks down. Introducing additional variables through multiple regression does not necessarily solve the problem; in many cases, it simply creates more room for divergent results. The uncomfortable conclusion is that economic data are flexible enough to support almost any narrative a researcher wishes to advance.

For this reason, empirical findings in economics and finance are rarely uniform. Contradictory results are common, and consensus is often elusive. This is particularly true in research on the Kuznets curve and its various extensions. The original Kuznets curve, which links economic growth to income inequality, tends to be embraced by those skeptical of income redistribution. From this perspective, inequality is seen as a temporary by-product of growth that eventually declines as economies mature. Others strongly disagree, arguing that growth often benefits higher-income groups disproportionately and does not automatically translate into more equitable outcomes.

The environmental Kuznets curve generates similarly polarized reactions. Supporters interpret it as reassurance that economic growth need not be restrained to protect the environment, claiming that environmental quality improves once income reaches a sufficiently high level. Critics, however, question whether such a turning point exists at all and warn that environmental damage may become irreversible long before growth delivers cleaner outcomes. The financial Kuznets curve—still an emerging and contested idea—provokes comparable disagreement. Some view a large and expanding financial sector as a key driver of growth and efficiency, while others argue that excessive financialization undermines productive activity, worsens inequality, and increases economic instability.

The aim of this paper is not to take sides in these debates or to declare one version of the Kuznets curve right and the others wrong. Instead, its objective is more modest and more cautionary: to show how empirical evidence can be used to support or reject each of the three versions—the original, environmental, and financial Kuznets curves—often using the same underlying data. Depending on the choices made about variables, samples, and estimation methods, one can generate results that confirm a favored view or results that undermine it. To make this point concrete, the analysis draws on both time-series and cross-sectional data covering a wide range of countries and country groups. Each version of the Kuznets curve is examined in turn, not as a definitive model of economic reality, but as a useful illustration of a broader problem in empirical research: the ease with which confirmation bias and model uncertainty can shape results, interpretations, and ultimately the stories we tell with data.

2. The Original Kuznets Curve

The idea commonly known as the Kuznets curve originates with Simon Kuznets (1955) and reflects an attempt to make sense of how inequality evolves as economies grow and transform. Kuznets did not present a rigid law, but rather a broad empirical observation: when countries move from low to higher levels of income, inequality tends to worsen at first, reaches a turning point, and then gradually declines. When expressed graphically, this relationship appears as an inverted U-shaped curve linking income per capita to income inequality.

At the heart of this argument is the process of structural change. In the early phases of development, growth is uneven by nature. Industrialization opens up new and profitable opportunities, but these gains are initially captured by a relatively small group—entrepreneurs, investors, and skilled workers. At the same time, large numbers of workers migrate from rural areas into cities, often taking up low-paid jobs in manufacturing or services. The coexistence of a modern, high-productivity urban sector and a traditional, low-productivity rural sector generates widening income gaps, making rising inequality almost unavoidable during this stage.

As development continues, however, the forces shaping the economy begin to change. Education spreads, skills deepen, and human capital gradually replaces physical capital as the central driver of growth. Productivity gains become less concentrated, wages rise for a broader share of the population, and inequality begins to ease. This transition is reinforced by institutional and political developments, including the expansion of the welfare state, redistributive taxation, and social protection systems. Over time, these mechanisms help ensure that the benefits of growth are shared more widely, giving rise to the downward-sloping segment of the Kuznets curve.

The Kuznets hypothesis therefore carries an important, and somewhat controversial, implication: inequality may not only accompany early economic growth but may also be part of the process through which growth is generated. Inequality, in this view, reflects incentives for investment, risk-taking, and entrepreneurship, a perspective later echoed in discussions such as Galbraith (2007).

Empirical research has long debated the validity of this hypothesis. Some studies find historical or cross-country patterns consistent with the inverted U-shape (Williamson, 1985; Lindert, 1986; Feinstein, 1988), while others report weaker, conditional, or context-specific relationships (Anand & Kanbur, 1993; Deininger & Squire, 1998; Schultz, 1998; Morrisson, 2000). Taken together, this evidence suggests that the original Kuznets curve should be interpreted as a stylized narrative rather than a universal rule, with the trajectory of inequality shaped not only by income growth itself but also by institutions, policies, and historical circumstances.

Although the Kuznets curve has long influenced how economists think about the relationship between growth and inequality, confidence in its central claim has steadily weakened. One of the most persistent criticisms is that the well-known inverted U-shape may not describe how inequality actually changes within countries as they develop. Instead, it may simply reflect how different countries, with very different historical backgrounds, happened to line up when compared at a single point in time.

This concern is clearly articulated by Deininger & Squire (1998), who show that much of the apparent empirical support for the Kuznets curve stems from the composition of Kuznets' original dataset. Many of the countries classified as middle-income were located in Latin America, a region with historically high levels of inequality. When such countries are compared with both poorer and richer economies, an inverted U-shaped pattern can emerge almost automatically—even if no individual country actually experiences rising and then falling inequality over time. Seen from this angle, the Kuznets curve appears far more convincing in cross-sectional comparisons than in time-series evidence that follows countries along their development paths.

Other critiques move beyond data issues to question the conceptual simplicity of the curve itself. Lempert (1989) argues that inequality cannot be understood without explicitly accounting for politics and demographics. In his framework, inequality evolves through ongoing interactions between population dynamics, political institutions, and economic change. Rather than tracing a smooth rise and fall, inequality may follow a helical path—cycling over time and ultimately leading either to long-term stability or to social and political rupture, depending on how distributional conflicts are handled.

The development experience of East Asia highlights that the Kuznets trajectory is not an inevitable outcome of economic growth. In several East Asian economies, rapid growth was accompanied by declining inequality from an early stage, largely because inequality was addressed early rather than treated as a temporary cost of development. Policies such as land reform, broad access to education, and growth strategies focused on employment-intensive industrialization limited income concentration and expanded economic opportunities (Stiglitz, 1996). These choices weakened the structural forces that typically produce rising inequality at early stages of development, illustrating how institutions and policy sequencing can fundamentally shape the growth–inequality relationship.

As Joseph Stiglitz (1996) explains, early gains from growth in East Asia were reinvested in land reform, which raised rural productivity and incomes; in universal education, which expanded equality of opportunity and created what he termed an "intellectual infrastructure" for growth; and in industrial policies that supported high and rising wages while restraining sharp increases in commodity prices. These strategies prevented income from becoming concentrated at the outset, undermining the central mechanism assumed by the Kuznets framework.

Historical experience in Western Europe presents a more mixed picture. In England, inequality rose sharply during industrialization—the Gini coefficient increased from 0.400 in 1823 to 0.627 in 1871—before declining to 0.443 by 1901 (Williamson, 1985). Similar patterns have been documented for France, Sweden, and Germany by Acemoglu & Robinson (2002). Yet even within Europe, this trajectory was far from universal. Norway and the Netherlands experienced steadily declining inequality from the mid-nineteenth century onward, with no preceding increase, underscoring how strongly national institutions and political choices shape outcomes.

Later empirical work has grown increasingly skeptical of the Kuznets curve. Palma (2011) finds little evidence for the upward-sloping portion of the curve, arguing that it has effectively disappeared from modern data. Many low- and lower-middle-income countries today exhibit income distributions similar to those of middle-income economies, with Latin America and Southern Africa remaining notable exceptions. Palma instead emphasizes two simultaneous forces at work: inequality widening at the extremes of the income distribution, and relative stability within the middle. Along similar lines, Fields (2001) concludes that the hypothesis underpinning the Kuznets curve has been empirically rejected.

Importantly, doubts about the curve were present from the very beginning. As noted by Fogel (1987), Simon Kuznets himself repeatedly warned about the fragility of the available data, stressing that it covered a short historical period and reflected highly unusual circumstances. These cautions, however, were largely ignored as the curve gained prominence in development economics.

Recent research reinforces this reassessment while refining its implications. Madsen & Strulik (2025), using updated datasets and modern econometric methods, shows that Kuznets-type relationships are highly sensitive to model specification and historical context. Rather than revealing a universal pattern, his findings suggest that inverted U-shaped dynamics emerge only under specific structural and institutional conditions.

Similarly, Pattnaik et al. (2025) argues that the link between growth and inequality cannot be reduced to income levels alone. Institutional quality, labor-market structures, education systems, and redistributive policies play a decisive role in shaping distributional outcomes. From this perspective, the Kuznets curve is best understood as a historically contingent narrative, not a general law of economic development. Taken together, this body of work points to a clear conclusion: inequality does not follow a single, predictable path as economies grow. Its evolution depends on history, institutions, politics, and policy choices—factors that lie beyond the original Kuznets framework but are essential for understanding how inequality actually unfolds in practice.

3. The Environmental Kuznets Curve

The environmental Kuznets curve (EKC) builds on the original Kuznets idea by shifting attention from income inequality to environmental quality. At its core, the EKC suggests a simple but appealing story: in the early stages of development, economic growth tends to go hand in hand with rising pollution, but once a country reaches a higher level of income, further growth can lead to cleaner environmental outcomes. When illustrated graphically, this relationship takes the familiar inverted U-shape, with income per capita on the horizontal axis and environmental degradation on the vertical one.

Much of the intuition behind the EKC comes from historical experience in advanced economies. The United States between 1970 and 2006 is often cited as a textbook case. During this period, economic activity expanded rapidly—GDP nearly tripled, the number of vehicles more than doubled, and total miles driven rose sharply. Yet, despite this expansion in production and consumption, emissions of several major pollutants fell dramatically. Carbon monoxide emissions were cut by more than half, nitrogen oxides and sulphur dioxide declined substantially, particulate matter fell by around 80 percent, and lead emissions were almost entirely eliminated.

A range of explanations has been put forward to account for why environmental pressure might ease as incomes rise. One common argument is that environmental quality behaves like a normal good. As societies become wealthier, citizens care more about clean air, safe water, and healthy surroundings, and they are more willing to demand and support environmental regulation (Beckerman, 1992; World Bank, 1992). Another explanation emphasizes technological change. Higher-income economies tend to adopt cleaner and more efficient technologies, reducing pollution per unit of output (Grossman & Krueger, 1995). Structural change also matters: as development proceeds, economies gradually shift away from heavy industry toward service-based activities, which are typically less pollution-intensive (Jänicke et al., 1997). Demographic changes are sometimes added to this account, as lower fertility rates in richer societies may ease long-run pressure on environmental resources.

Despite the intuitive appeal of these mechanisms, empirical support for the EKC has always been fragile. Studies using different datasets, pollutants, econometric techniques, and country samples often reach very different conclusions. Stern (2003) argues that much of the EKC literature is "econometrically weak," pointing out that many studies fail to deal adequately with issues such as serial correlation and stochastic trends. In related work, Perman & Stern (2003) show that once these econometric problems are handled more carefully, the inverted U-shaped relationship frequently disappears, with many indicators of environmental degradation continuing to rise with income.

Methodological choices play a decisive role in shaping results. Long-run relationships are especially sensitive to how cointegration is tested. Studies relying on Johansen-type tests—known for their tendency to reject the null of no cointegration—are more likely to uncover EKC-type patterns. By contrast, residual-based tests impose stricter requirements and are much less likely to support the existence of an EKC. This divergence has reinforced the perception that empirical findings often reflect methodological preferences as much as underlying economic reality.

As a consequence, the lack of robustness in EKC results has become increasingly evident. Harbaugh et al. (2002) show that both the existence of an EKC and the location of its turning point change markedly with relatively small alterations in data or model specification. Stern & Common (2001) demonstrate that estimated EKCs for sulphur emissions are highly sensitive to the choice of country sample. Moreover, the type of pollutant matters greatly: local pollutants such as sulphur dioxide or particulate matter are more likely to display an inverted U-shaped pattern, whereas global pollutants—most notably carbon dioxide—generally do not.

These sensitivities help explain why the literature offers such a wide range of conclusions. A comprehensive survey by Robalino-López et al. (2015) documents mutually contradictory findings, including evidence both for and against the EKC, different directions of causality between income and emissions, cases of decoupling between economic growth and CO_2, and results suggesting that only a minority of countries exhibit EKC-type behavior. Several studies reviewed in their survey explicitly describe the evidence as mixed rather than conclusive.

Recent research reinforces this perspective while adding important nuance. Koirala et al. (2025), examining G7 countries over the period 1960–2022, find evidence consistent with an EKC-type relationship for CO_2 emissions in advanced economies. Crucially, however, their analysis shows that global policy uncertainty plays a significant role in shaping long-run emissions paths. Uncertainty affects investment decisions, slows the adoption of cleaner technologies, and alters the timing of the income turning point. Their results suggest that even where an EKC pattern appears to hold, it is not driven by income growth alone but is highly dependent on the broader policy environment.

The sheer scale of the specification problem is illustrated by Yang et al. (2015), who identify more than 140,000 possible model specifications based on alternative choices of variables, functional forms, controls, and treatments of heterogeneity. Their conclusion is stark: the EKC hypothesis does not hold robustly for any of the emission indicators they examine. Similar concerns are raised by Auffhammer & Steinhauser (2012), who show how results change with the use of levels versus logarithms, the inclusion of lagged variables, and different treatments of population density and income.

Country-level studies further complicate the picture. For instance, Robalino-López et al. (2015), focusing on Venezuela, find no evidence supporting the EKC. At the same time, they argue that environmental stabilization remains possible if economic growth is combined with increased use of renewable energy and structural changes in the energy mix and productive sectors. This reinforces a recurring theme in the literature: policy choices matter at least as much as income levels.

In response to these mixed findings, Dasgupta et al. (2002) propose alternative scenarios that move beyond the simple inverted U. In the "new toxics" scenario, traditional pollutants decline with income but are replaced by new and potentially more harmful ones. The "race to the bottom" scenario emphasizes the relocation of pollution-intensive activities from rich to poor countries, creating the appearance of environmental improvement in advanced economies while global degradation continues. The "revised EKC" scenario offers a more optimistic view, suggesting that technological progress shifts the curve downward and leftward over time, allowing countries to reach lower peak pollution levels at earlier stages of development.

Taken together, the EKC literature conveys a clear message. There is no automatic or universal link between economic growth and environmental improvement. While growth can create the capacity to protect the environment, whether that capacity is actually used depends on technology, institutions, regulatory frameworks, and political choices. Environmental outcomes are shaped less by income itself than by how growth is managed and governed.

4. The Financial Kuznets Curve

The financial Kuznets curve (FKC) is a relatively recent and still unsettled extension of the broader Kuznets tradition. Unlike the original inequality curve or its environmental counterpart, the FKC has emerged out of growing discomfort with the expanding role of finance in modern economies. At its heart lies a deceptively simple question: does a larger financial sector always make an economy stronger? The intuition behind the FKC suggests a more nuanced answer. Finance can be beneficial—sometimes essential—at early stages of development, but beyond a certain point its expansion may begin to undermine growth, productivity, and social outcomes.

One influential line of thinking frames the FKC through the idea of a finance curse. From this perspective, rising financialization initially supports economic growth by easing credit constraints, mobilizing savings, and enabling investment. Over time, however, finance grows faster than the rest of the economy and starts to compete with productive sectors for resources. When this happens, further financial expansion no longer supports growth and may even slow it down. Plotted graphically, this relationship produces an inverted U-shape: finance is growth-enhancing up to a threshold, but excessive financialization becomes harmful.

A second strand of the literature connects the FKC to income inequality rather than aggregate growth. Here, financial development is often portrayed as having a non-linear effect on income distribution. In its early stages, financial expansion may increase inequality by favoring those with better access to financial markets. Over time, as access broadens and institutions mature, inequality may decline. This perspective underpins much of the literature that treats finance as a tool for inclusion and social mobility. Yet, while both strands invoke Kuznets-type logic, they differ fundamentally in how they understand the role of finance.

This distinction is reflected in terminology. Financialization is typically associated with the finance-curse narrative, while financial development carries more positive connotations. Financialization refers to the growing dominance of finance over the rest of the economy, including manufacturing and agriculture. It captures what Epstein (2002) describes as the rising importance of financial markets, motives, institutions, and elites in shaping economic outcomes and governance.

Financial development, by contrast, refers to the ability of the financial system to perform its core functions effectively—allocating capital, managing risk, mobilizing savings, and facilitating exchange. In practice, however, the boundary between financial development and financialization is blurred. The same indicators, such as credit-to-GDP ratios or stock market capitalization, are often used to measure both. This makes it plausible to think of financial

development as the early, beneficial phase of financialization, and excessive financialization as the stage where finance grows beyond what the real economy can productively absorb.

Within the inequality-focused version of the FKC, financial expansion is frequently portrayed as broadly beneficial. Easier access to credit is said to stimulate investment, create jobs, and allow poorer households to invest in education, health, and small businesses. Yet this reasoning has increasingly been questioned. As critics note, such arguments often rely—implicitly or explicitly—on a trickle-down mechanism, an idea that has been widely challenged (for example, Quiggin, 2009).

These findings echo long-standing theoretical debates. Galor & Zeira (1993) warn that in economies with limited financial depth, financial deregulation can harm growth and exacerbate inequality. By contrast, Canavire-Bacarreza & Rioja (2008), as well as Aghion & Bolton (1997), emphasize the potential of financial development to relax credit constraints and reduce inequality. A classic Kuznets-style formulation appears in Greenwood & Jovanovic (1990), who argue that financial development and inequality follow an inverted U-shaped relationship.

The most critical perspectives come from post-Keynesian economics. Black (2011) portrays the financial sector as a predatory force that siphons resources from the real economy and misallocates capital. This critique is supported by empirical evidence on labor markets and productivity. Kneer (2013), examining 13 countries over the period 1980–2005, shows that financialization draws skilled labor disproportionately into finance, creating a "brain-drain" effect that weakens productivity growth in skill-intensive non-financial industries.

Debt dynamics lie at the core of these concerns. As household and corporate indebtedness rises, growing portions of income are devoted to debt servicing, which becomes profit for the financial sector. These revenues are rarely recycled into productive investment. Instead, they fuel asset trading, mergers and acquisitions, and the creation of new financial claims on existing income streams. Firms increasingly struggle to invest in physical capital, while economic activity shifts away from production toward fee- and interest-generating activities.

At the macroeconomic level, financialization is associated with heightened fragility. Sinapi (2013) links financial dominance to rising leverage, opacity, and systemic risk. Bellofiore (2013) emphasizes its role in fueling asset price inflation rather than productive investment, while Lavoie (2012) connects financialization to a debt-driven, consumption-led growth regime that compensates for stagnant real wages. The consequences are most visible during crises: the IMF (2009) shows that recessions linked to financial crises last longer and recover more slowly than ordinary downturns. These concerns are captured succinctly in the work of Cecchetti and Kharroubi, who demonstrate that the size of the financial sector has an inverted U-shaped relationship with productivity growth. Beyond a certain point, further expansion of finance reduces real economic performance (Cecchetti & Kharroubi, 2015). This finding encapsulates the essence of the financial Kuznets curve.

The emerging literature suggests that finance has a dual character. In its early stages, it can support growth, investment, and development. Beyond a certain threshold, however, its expansion risks distorting incentives, deepening inequality, and weakening the productive foundations of the economy. The central issue is therefore not whether finance should grow, but how its scale and structure are shaped within the broader economic system.

5. Representation and Estimation

Across its different variants—income, environmental, and financial—the Kuznets curve is typically represented in a simple and intuitive way. The relationship between the outcome of interest (such as inequality, pollution, or growth) and the level of economic development is commonly modeled using a quadratic specification. This functional form is flexible enough to capture the non-linear dynamics at the heart of the Kuznets hypothesis, allowing the variable of interest to rise at early stages of development and decline once a critical threshold is reached. The quadratic equation is of the form

$$z = \beta_0 + \beta_1 y + \beta_2 y^2 \qquad (1)$$

such that $\beta_2 < 0$ and $\beta_1 > 0$, ensuring the inverted U-shaped relationship that defines the Kuznets hypothesis. In the original Kuznets curve, z represents income inequality—typically measured by indicators such as the Gini coefficient—while y denotes income per capita. In the environmental Kuznets curve, z captures environmental degradation, measured through emissions, pollutants, or broader indicators such as deforestation.

In the case of the financial Kuznets curve, the interpretation of z depends on the specific formulation. In one version, z again represents income inequality, whereas in another it refers to economic growth. Correspondingly, y is measured either by income per capita or by the rate of income growth. This latter formulation is particularly suited to cross-sectional analysis, as it implies that countries with moderately sized financial sectors tend to experience faster growth than those with excessively large financial sectors, while very small financial sectors are also associated with weaker performance.

The turning point of the Kuznets curve can be obtained by differentiating equation (1) with respect to y and setting the first derivative equal to zero. These yields

$$\frac{dz}{dy} = \beta_1 + 2\beta_2 y = 0 \quad (2)$$

which implies that the turning point occurs at

$$y^* = -\frac{\beta_1}{2\beta_2} \quad (3)$$

The second derivative is given by

$$\frac{d^2 z}{dy^2} = 2\beta_2 y < 0 \quad (4)$$

which is negative when $\beta_2<0$. This confirms another defining property of the inverted U-shaped curve: as income increases, the slope of the relationship gradually declines, eventually changing sign. At low values of y, the first derivative is positive, meaning that increases in income are associated with increases in z. Beyond the turning point, the first derivative becomes negative, indicating that further increases in income lead to reductions in z.

Estimating equation (1) and examining the sign and statistical significance of the coefficients across different samples helps explain why empirical evidence for the Kuznets curve is so mixed. Support for the Kuznets hypothesis requires both $\beta_1>0$ and $\beta_2<0$. If the quadratic term β_2 is statistically insignificant, the relationship reduces to a simple linear one, providing no evidence of a Kuznets-type pattern. Likewise, when $\beta_2>0$ and $\beta_1<0$, the estimated relationship becomes U-shaped rather than inverted U-shaped: z initially falls with income and then rises beyond the turning point. In such cases, the data clearly contradict the Kuznets hypothesis.

This framework highlights why conclusions about the Kuznets curve are highly sensitive to estimation results and sample choice, and why empirical findings across studies often differ in both direction and interpretation.

Equation (1) is estimated using the fully modified ordinary least squares (FMOLS) estimator developed by Phillips & Hansen (1990). This approach is preferred because conventional ordinary least squares does not yield valid inference when the variables are integrated. In such cases, the OLS standard errors—and therefore the associated t statistics—do not converge to an asymptotic normal distribution, making the usual critical values unreliable for hypothesis testing.

FMOLS corrects for these problems by accounting for serial correlation and endogeneity that arise in cointegrated relationships, allowing standard inference to be conducted in a statistically sound manner. As a result, the estimated t statistics can be meaningfully interpreted.

To keep the presentation of results clear and manageable, only three key statistics are reported: the t statistics for β_1 and β_2, and the coefficient of determination (R^2). Evidence in favor of a Kuznets-type relationship is obtained when β_1 is positive and statistically significant, and β_2 is negative and statistically significant. The estimation results are summarized in Tables 1–3 and illustrated graphically in Figures 1–5.

The original Kuznets curve is examined using both cross-sectional and time-series evidence, allowing the analysis to capture broad international patterns as well as country-specific dynamics. The cross-sectional dataset includes 139 countries, while the time-series analysis focuses on Brazil over the period 1981–2022. All data are drawn from the World Bank. Figure 1 presents a scatter plot of the Gini coefficient against GDP per capita for the full cross-sectional sample. At this aggregate level, the relationship between income and inequality is weak and statistically insignificant, as confirmed by the regression results reported in Table 1. In other words, when all countries are considered together, there is no clear evidence of a systematic Kuznets-type relationship between income per capita and inequality.

To explore whether this masks heterogeneity across income levels, countries are then grouped according to their GDP per capita ranges. Even under this disaggregation, the evidence remains limited. A statistically significant relationship emerges only for countries with GDP per capita between 10,000 and 80,000. Importantly, however, the estimated relationship in this group is U-shaped rather than inverted U-shaped. This implies that beyond a certain income level, further increases in GDP per capita are associated with rising, rather than falling, inequality. This finding aligns closely with observed developments in many high-income economies. Since the 1970s, income inequality has increased markedly across most advanced countries, despite continued economic growth. Rather than confirming the traditional Kuznets prediction of declining inequality at high income levels, the cross-sectional evidence points toward a reversal of that pattern, highlighting the limitations of the original Kuznets curve as a general description of modern inequality dynamics.

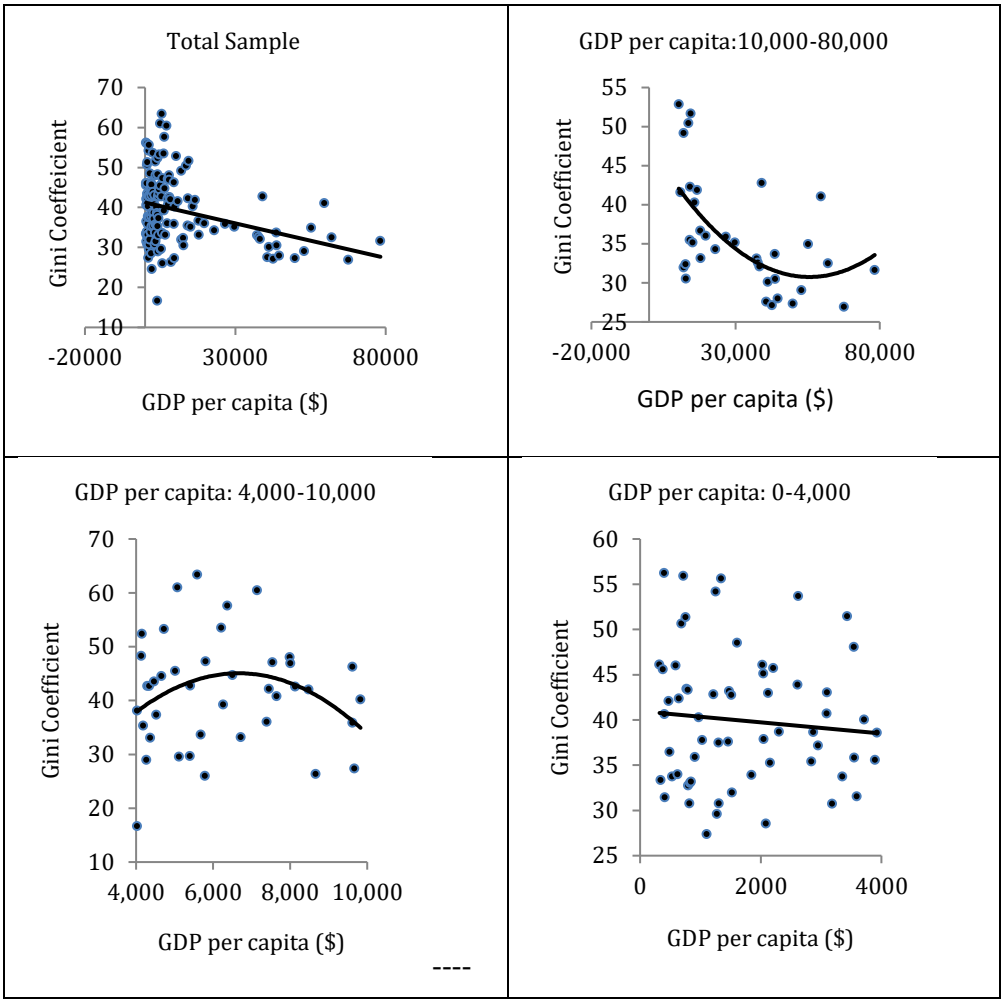


Figure 1. Original Kuznets Curve in Cross-Sectional Data

When the analysis shifts from cross-sectional comparisons to time-series evidence, using Brazil as a case study, the results remain mixed and highly sensitive to how both inequality and income are measured. Different combinations of inequality indicators and income per capita measures produce markedly different outcomes. Evidence in support of a Kuznets-type relationship emerges in only one specification: when inequality is measured by the income share of the top 10 percent and income per capita is expressed in constant local currency units. In this case, the estimated relationship takes the form of a statistically significant inverted U-shaped curve, as illustrated in Figure 2 and reported in Table 1.

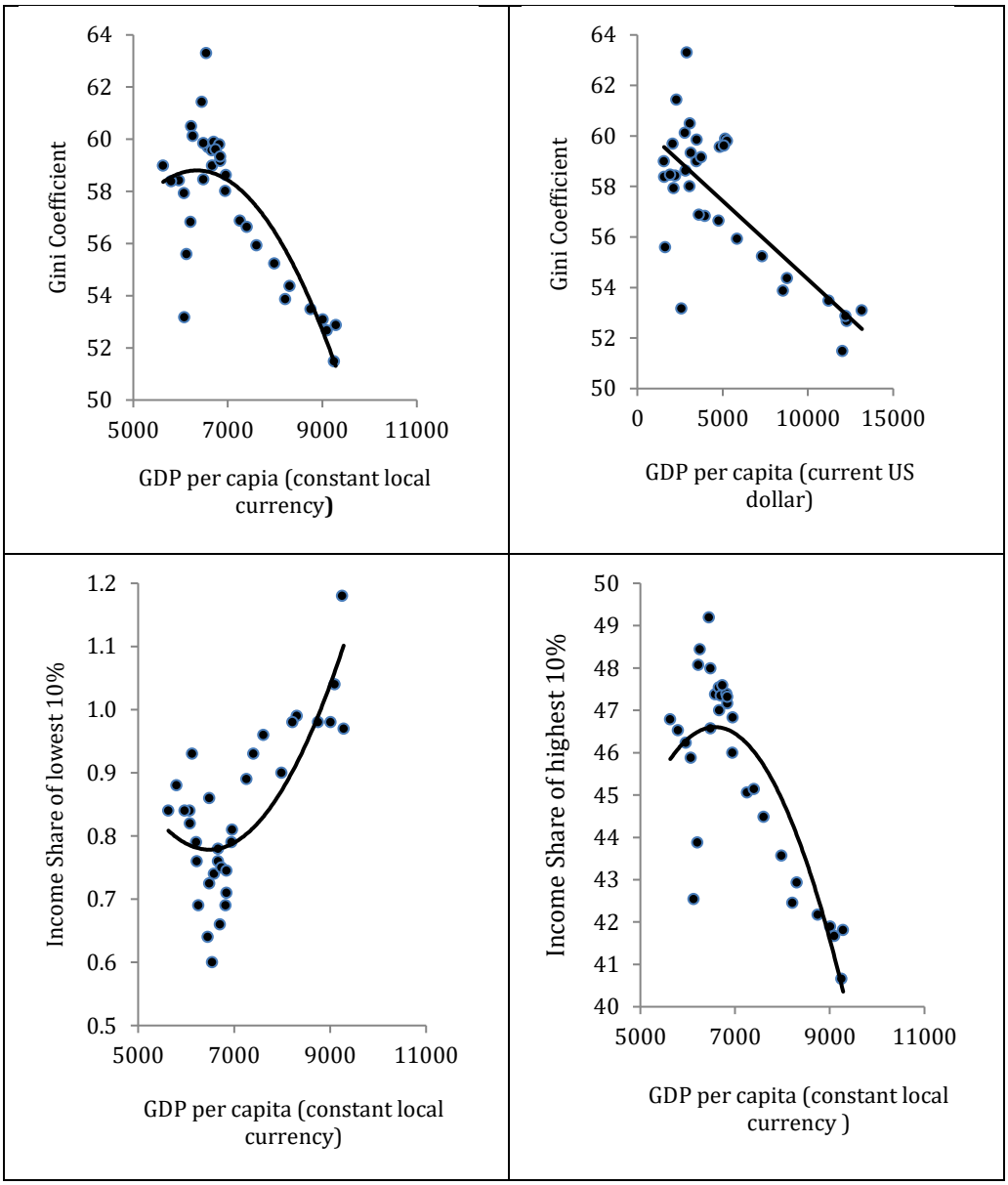


Figure 2. Original Kuznets Curve in Time Series Data (Brazil)

Table 1. Estimates of the Original Kuznets Curve

Data	*z*	*y*	$t(\beta_1)$	$t(\beta_2)$	R^2
CS (109) Total	Gini Coefficient	GDP per capita	0.26	-0.11	0.10
CS (10,000-80,000)	Gini Coefficient	GDP per capita	-4.37	2.95	0.36
CS (4,000-10,000)	Gini Coefficient	GDP per capita	3.20	-3.19	0.08
CS (0-40,000)	Gini Coefficient	GDP per capita	-0.60	0.41	0.01
TS (Brazil)	Gini Coefficient	GDP per capita (constant local currency)	2.96	-3.49	0.64
TS (Brazil)	Gini Coefficient	GDP per capita (current US$)	1.01	-2.45	0.58

TS (Brazil)	Income Share (lowest 10%)	GDP per capita (constant local currency)	-2.74	3.06	0.60
TS (Brazil)	Income Share (highest 10%)	GDP per capita (constant local currency)	3.06	-3.42	0.50

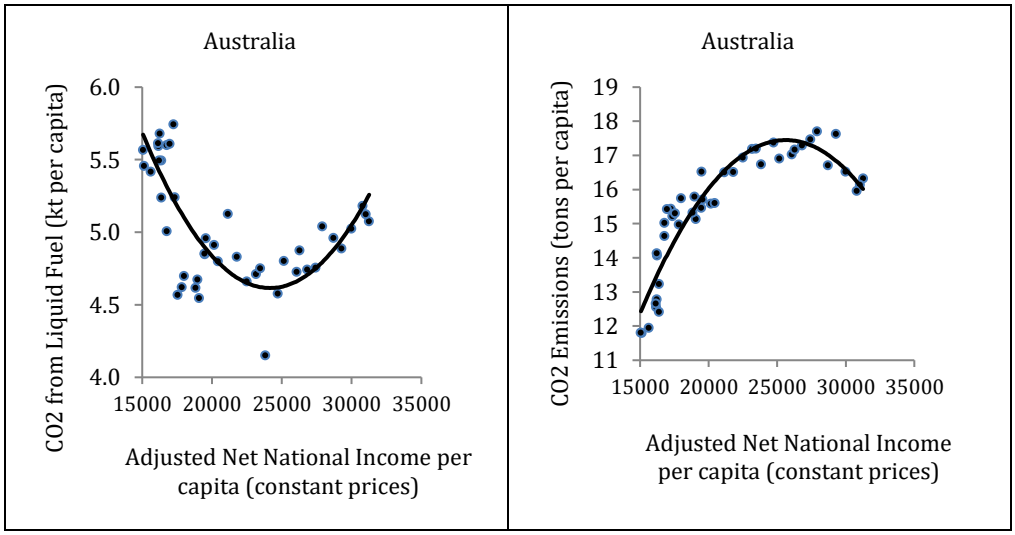
CS: Cross-sectional data; TS: Time-series data.

Turning to the environmental Kuznets curve, the evidence again proves to be nuanced rather than definitive. Using annual time-series data for Australia and the United Kingdom over the period 1970–2022, obtained from the World Bank, we find results that both support and challenge the EKC hypothesis, depending on how environmental degradation and income are defined.

For Australia, evidence consistent with an environmental Kuznets curve emerges when environmental degradation is measured by carbon dioxide emissions and income is captured by adjusted net national income (NNI) per capita at constant prices. However, the nature of the relationship is sensitive to the specific emissions indicator employed. When degradation is measured in terms of CO_2 emissions from liquid fuels, the estimates suggest that environmental pressure continues to rise beyond a certain income level. By contrast, when total CO_2 emissions are used, the relationship implies a turning point after which further increases in income are associated with environmental improvement. These contrasting outcomes, illustrated in Figure 3 and reported in Table 2, underscore how conclusions about the EKC hinge critically on the choice of environmental indicator.

A similar pattern is observed for the United Kingdom. Evidence in favor of the EKC is found only under a narrow specification—namely, when environmental degradation is measured by CO_2 emissions from the transport sector. For broader measures of emissions, the estimated relationships fail to display the inverted U-shape predicted by the EKC framework.

Overall, these results highlight a central theme in the EKC literature: the existence and shape of the growth–environment relationship are highly sensitive to measurement choices. Whether economic growth appears to harm or improve environmental quality depends not only on income levels, but also on which aspects of environmental degradation are considered and how they evolve over time.



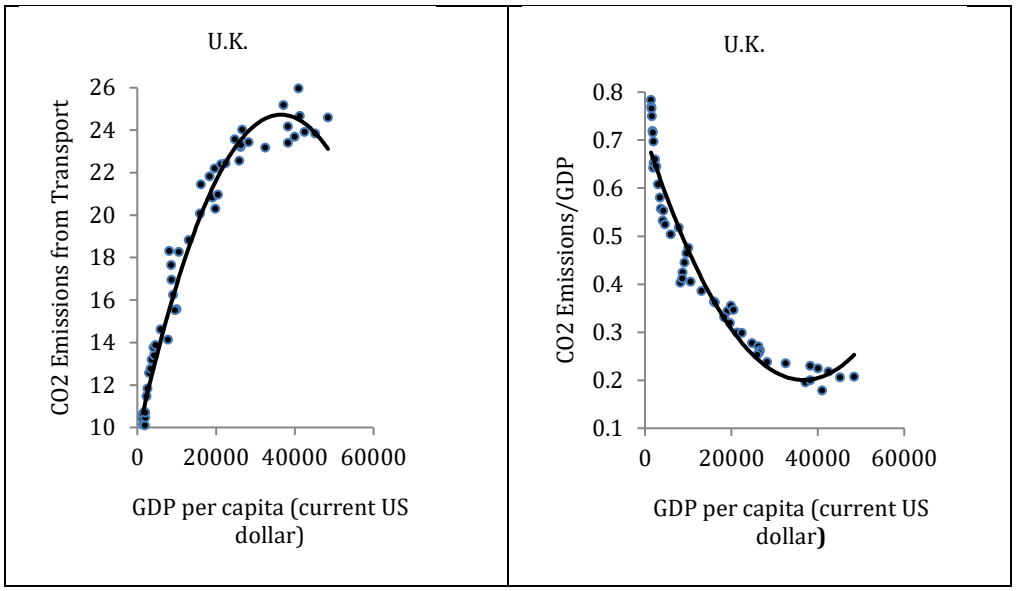


Figure 3. Environmental Kuznets Curve (Time Series Data on Australia and UK)

Table 2. Estimates of the Environmental Kuznets Curve

Data	*z*	*y*	$t(\beta_1)$	$t(\beta_2)$	R^2
TS (Australia)	CO_2 from liquid fuel	Adjusted NNI (constant prices)	-5.39	5.11	0.59
TS (Australia)	CO_2 Emissions per capita	Adjusted NNI (constant prices)	6.25	-5.65	0.86
TS (UK)	CO_2 Emissions from Transport (%)	GDP per capita (current US $)	19.56	-11.77	0.97
TS (UK)	CO_2 Emissions/ GDP	GDP per capita (current US $)	-9.66	5.56	0.94

CS: Cross-sectional data; TS: Time-series data.

Turning to the financial Kuznets curve, the analysis relies on two alternative measures of financialization. The first is the ratio of private credit to GDP, obtained from the World Bank. The second is the ratio of the market value of publicly traded shares to GDP. This latter measure reflects a broader conception of financialization, one that goes beyond banking activity to capture the growing involvement of non-financial firms in financial markets. Greta Krippner (2005) emphasizes the tendency of non-financial firms to channel a growing share of profits into financial asset acquisition rather than productive investment. The indicator is constructed as the ratio of the value of traded shares to GDP measured on a purchasing power parity basis, using data obtained from IndexMundi.

When financialization is measured by the credit-to-GDP ratio, evidence in favor of a financial Kuznets curve is found only for high-income OECD countries (Figure 4 and Table 3). In this group, economic growth initially rises with financial expansion but eventually declines once financialization reaches high levels. For lower-middle-income countries, however, the pattern is very different: growth continues to increase with financialization even beyond relatively high levels of credit intensity. This contrast is economically intuitive. High-income OECD economies already operate with elevated credit-to-GDP ratios, so additional financial expansion is more likely to crowd out productive activity. In lower-middle-income countries, by contrast, financial deepening still relaxes binding constraints on investment and growth.

A similar message emerges when financialization is measured by the ratio of traded shares to GDP. As shown in Figure 5 and Table 3, the relationship between growth and financialization is statistically significant only for low-growth countries. In these economies, growth begins to slow once the stock market capitalization ratio approaches around 0.5. Taken together, these results reinforce the central insight of the financial Kuznets curve: finance can be growth-enhancing at low to moderate levels, but beyond a certain threshold, further financial expansion becomes a drag on real economic performance rather than a source of dynamism.

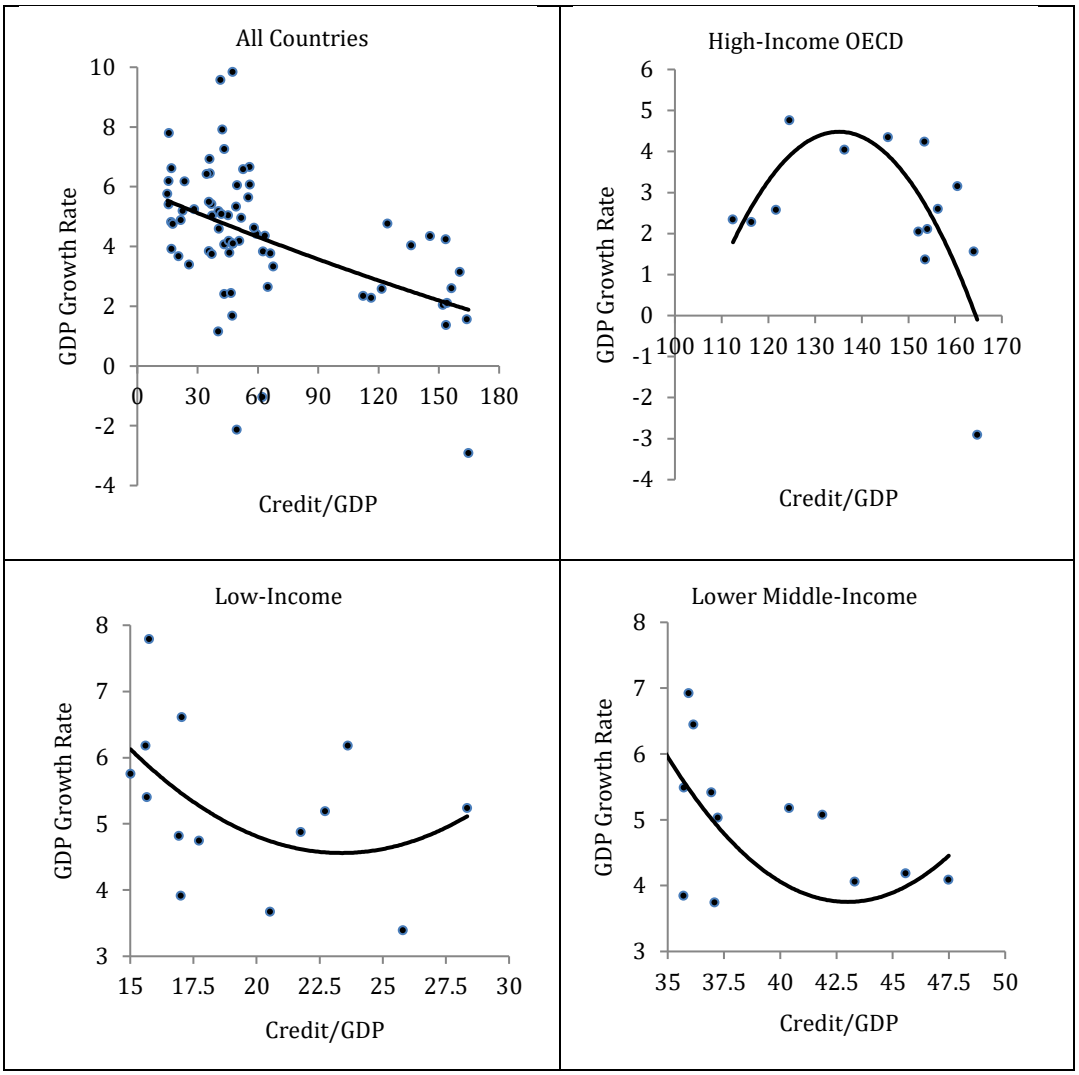
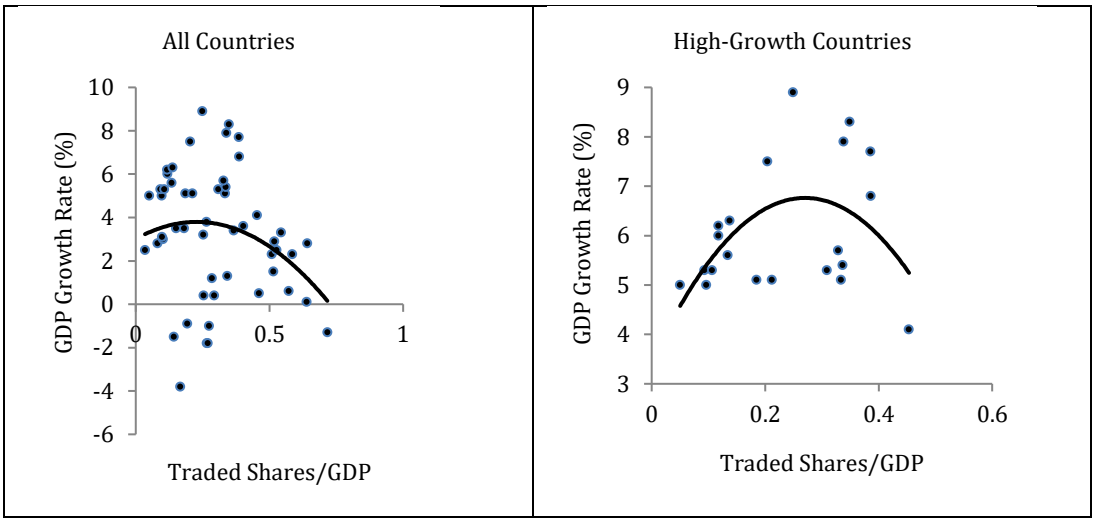


Figure 4. Financial Kuznets Curve (Time Series Data)



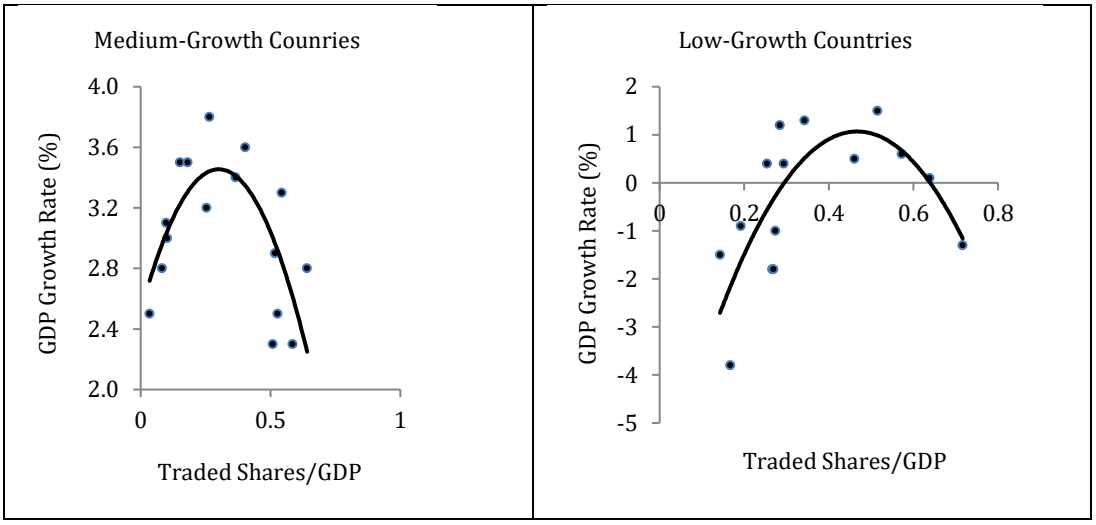


Figure 5. Financial Kuznets Curve (Cross-Sectional Data)

Table 3. Estimates of the Financial Kuznets Curve

Data	*z*	*y*	$t(\beta_1)$	$t(\beta_2)$	R^2
Pooled Country Groups	GDP growth rate	Credit/GDP	-1.02	-0.08	0.23
TS (OECD)	GDP growth rate	Credit/GDP	3.24	-3.55	0.52
TS (low income)	GDP growth rate	Credit/GDP	-1.62	1.13	0.22
TS (lower-middle income)	GDP growth rate	Credit/GDP	-4.53	4.31	0.30
CS (all countries)	GDP growth rate	Traded Shares/GDP	0.56	-0.99	0.06
CS (high growth)	GDP growth rate	Traded Shares/GDP	0.69	-0.65	0.13
CS (medium growth)	GDP growth rate	Traded Shares/GDP	0.52	-0.90	0.23
CS (low growth)	GDP growth rate	Traded Shares/GDP	3.37	-2.99	0.55

CS: Cross-sectional data; TS: Time-series data.

The results are unavoidably mixed—and this, in itself, is an important finding. The Kuznets curve, whether in its original, environmental, or financial form, speaks directly to questions on which economists and policymakers hold sharply different views. Where such ideological divisions exist, confirmation bias becomes difficult to avoid. Researchers may—consciously or not—emphasize results that align with their prior beliefs while downplaying those that do not. This is not a flaw unique to this study; it is a structural feature of empirical work in economics and finance. Unlike a physicist testing Boyle's law, the economist operates in a domain where social values, institutional contexts, and interpretation are inseparable from measurement.

6. Conclusion

Empirical research in economics and finance is inherently shaped by choices—choices about data construction, variable definitions, sample selection, model specification, and estimation methods. These choices matter. Small changes can lead to substantially different, and sometimes contradictory, results. As this study has shown, findings related to the original, environmental, and financial versions of the Kuznets curve are highly sensitive to such decisions. When the underlying issue is ideologically charged, this sensitivity is often compounded by selective reporting, where results are highlighted not because they are definitive, but because they are convenient.

The analysis presented here illustrates this problem clearly. For each version of the Kuznets curve, evidence can be found both supporting and rejecting the hypothesized inverted U-shaped relationship. Whether growth is seen as a driver of inequality or a remedy for it depends not only on data, but also on how the benefits of growth are distributed. Views on the environment are similarly divided: some regard economic growth as a long-run solution to environmental degradation, while others see it as the root of the problem. Opinions also differ sharply on finance—

whether a large financial sector strengthens the economy or becomes a source of instability once it exceeds a certain scale. Empirical results, as demonstrated in this paper, can be marshaled to support each of these positions.

For this reason, the Kuznets curve is used here primarily as a vehicle to highlight a broader and more fundamental issue: model uncertainty in empirical economics and finance. This problem was identified decades ago by Edward Leamer (1983) in his influential essay *"Let's Take the Con out of Econometrics"* (1983). Despite this early warning, the dominant practice remains unchanged in many areas of applied research—estimating a large number of regressions and reporting only the one that tells the most compelling story.

More recent contributions suggest addressing model uncertainty in a more transparent and explicit way by moving beyond reliance on a single preferred specification. Instead of asking whether a result holds in one particular model, these approaches examine how conclusions change across a range of plausible modeling choices. Methods such as multimodel inference and the reporting of coefficient distributions make it clear when results are genuinely robust and when they depend heavily on specification choices (Young & Holsteen, 2017; Slez, 2019; Auffhammer & Steinhauser, 2012; Yang et al., 2015). In doing so, they reduce the risk of selective reporting and provide a more honest representation of empirical uncertainty.

A clear limitation of this paper is that such methods are not applied to the estimation of the three Kuznets curves examined here. This is a deliberate choice. The objective is not to resolve the debate surrounding the Kuznets hypothesis, but to illustrate how fragile empirical conclusions can be when model uncertainty is ignored. Identifying the problem is a necessary first step, even if addressing it properly requires more than a single study.

The stakes are high. Questions about inequality, environmental sustainability, and financial sector expansion carry profound implications for public policy. When empirical evidence is fragile or selectively reported, policy decisions risk being guided by conviction rather than robust analysis. This is precisely why greater transparency, humility, and methodological rigor are essential in empirical research—especially when the conclusions are used to justify far-reaching economic and social policies.

Conflict of Interest: The author declares no conflict of interest.

Ethical Approval: Not applicable.

Funding: None.

References

Acemoglu, D., & Robinson, A. (2002). The Political Economy of the Kuznets Curve. *Review of Development Economics*, *6*, 183-203. https://doi.org/10.1111/1467-9361.00149

Aghion, P., & Bolton, P. (1997). A Theory of Trickle-Down Growth and Development. *Review of Economic Studies*, *64*, 151-172. https://doi.org/10.2307/2971707

Anand, S., & Kanbur, R. M. (1993) Inequality and Development: A Critique. *Journal of Development Economics*, *41*, 19-44. https://doi.org/10.1016/0304-3878(93)90035-L

Auffhammer, M., & Steinhauser, R. (2012). Forecasting the Path of U.S. CO_2 Emissions Using State-Level Information. *Review of Economics and Statistics*, *94*, 172-185. https://doi.org/10.1162/REST_a_00152

Beckerman, W. (1992). Economic Growth and the Environment: Whose Growth? Whose Environment? *World Development*, *20*, 481-496. https://doi.org/10.1016/0305-750X(92)90038-W

Bellofiore, R. (2013). Two or Three Things I Know about her: Europe in the Global Crisis and Heterodox Economics. *Cambridge Journal of Economics*, *37*, 497-512. Retrived from: https://www.jstor.org/stable/23601975

Black, W. (2011). *How the Servant Became a Predator: Finance's Five Fatal Flaws, 25 May*. http://www.huffingtonpost.com/william-k-black/how-the-servant-became-a_b_318010.html

Canavire-Bacarreza, G.J., & Rioja, F.K. (2008). Financial Development and the Distribution of Income in Latin America and the Caribbean. *IZA Discussion Papers*, No 3796. Available at: https://docs.iza.org/dp3796.pdf

Cecchetti, S.G., & Kharroubi, E. (2015). Why Does Financial Sector Growth Crowd out Real Economic Growth? *BIS Working Papers*, No 490. Available at: https://www.bis.org/publ/work490.pdf

Dasgupta, S., Laplante, B., Wang, H., & Wheeler, D. (2002). Confronting the Environmental Kuznets Curve. *Journal of Economic Perspectives*, *16*, 147-168. Retrieved from: https://www.jstor.org/stable/2696580

Deininger, K., & Squire, L. (1998). New Ways of Looking at Old Issues. *Journal of Development Economics*, *57*(2), 259-287. https://doi.org/10.1016/S0304-3878(98)00099-6

Epstein, G.A. (2002). *Financialization, Rentier Interests, and Central Bank Policy*. Working Paper, Department of Economics and Political Economy Research Institute (PERI) University of Massachusetts, Amherst. Available at: https://peri.umass.edu/wp-content/uploads/joomla/images/publication/fin_Epstein.pdf

Feinstein, C.H. (1988). The Rise and Fall of the Williamson Curve. *Journal of Economic History*, *48*, 699-729. Retrieved from: https://www.jstor.org/stable/2121551

Fields, G.S. (2001). *Distribution and Development, A New Look at the Developing World*. Cambridge (MA): MIT Press. https://doi.org/10.7551/mitpress/2465.001.0001

Fogel, R.W. (1987). Some Notes on the Scientific Methods of Simon Kuznets. *NBER Working Papers*, No W2461. Available at: https://www.nber.org/system/files/working_papers/w2461/w2461.pdf

Galbraith, J. (2007). Global Inequality and Global Macroeconomics. *Journal of Policy Modeling*, *29*(4), 587-607. https://doi.org/10.1016/j.jpolmod.2007.05.008

Galor, O., & Zeira, J. (1993). Income Distribution and Macroeconomics. *Review of Economic Studies*, *60*(1), 35-52. https://doi.org/10.2307/2297811

Greenwood, J., & Jovanovic, B. (1990). Financial development, growth, and the distribution of income. *Journal of Political Economy*, *98*(5, Part 1), 1076–1107. Retrieved from: https://www.jstor.org/stable/2937625

Grossman, G.M., & Krueger, A.B. (1995). Economic Growth and the Environment. *Quarterly Journal of Economics*, *110*, 353-378. https://doi.org/10.3386/w4634

Harbaugh, W., Levinson, A., & Wilson, D. (2002). Re-examining the Empirical Evidence for an Environmental Kuznets Curve. *Review of Economics and Statistics*, *84*(3), 541-551. Retrieved from: https://www.jstor.org/stable/3211570

IMF (2009). *World Economic Outlook*. International Monetary Fund: Washington DC. Retrieved from: https://www.elibrary.imf.org/display/book/9781589068070/9781589068070.xml

Jänicke, M., Binder, M., & Mönch, H. (1997). Dirty Industries: Patterns of Change in Industrial Countries. *Environmental and Resource Economics*, *9*, 467-491. https://doi.org/10.1007/BF02441762

Kneer, C. (2013). Finance as a Magnet for the Best and Brightest: Implications for the Real Economy. *DNB Working Papers*, No. 392. https://www.dnb.nl/media/yohdwm3p/working-paper-392.pdf

Koirala, B., Pradhan, G., & Mensah, E. C. (2025). The Environmental Kuznets Curve and CO_2 Emissions under Policy Uncertainty in G7 Countries. *Economies*, *13*(12), 363. https://doi.org/10.3390/economies13120363

Krippner, G. (2005). The Financialization of the American Economy. *Socio-Economic Review*, *3*, 173-208. Available at: https://www.depfe.unam.mx/actividades/10/financiarizacion/i-7-KrippnerGreta.pdf

Kuznets, S. (1955). Economic Growth and Income Inequality. *American Economic Review*, *45*, 1-28.

Lavoie, M. (2012). Financialization, Neo-Liberalism, and Securitization. *Journal of Post Keynesian Economics*, *35*(2), 215-233. Available at: https://assets.aeaweb.org/asset-server/files/9438.pdf

Leamer, E. (1983). Let's Take the Con Out of Econometrics. *American Economic Review*, *73*(1), 31-43. https://gwern.net/doc/economics/1983-leamer.pdf

Lempert, D. (1989). A Demographic-Economic Explanation of Political Stability: Mauritius as a Microcosm. *Eastern Africa Economic Review*, *3*(1), 77-90. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/12342159/

Lindert, P.H. (1986). Unequal English Wealth Since 1670. *Journal of Political Economy*, *94*(6),1127-62. Available at: http://links.jstor.org/sici?sici=0022-3808%28198612%2994%3A6%3C1127%3AUEWS1%3E2.0.CO%3B2-8

Madsen, J.B., & Strulik, H. (2025). *Taking Kuznets Seriously*. *Journal of Economic Growth*. Advance online publication. https://doi.org/10.1007/s10887-025-09262-6

Morrisson, C. (2000). Historical Perspectives on Income Distribution: The case of Europe. In A. B. Atkinson & F. Bourguignon (Eds.), *Handbook of Income Distribution* (Vol. 1, pp. 217–260). Elsevier. https://doi.org/10.1016/S1574-0056(00)80007-X

Palma, J.G. (2011). Homogeneous Middles vs. Heterogeneous Tails, and the End of the 'Inverted-U': It's all about the Share of the Rich. *Development and Change*, *42*(1), 87-153. https://doi.org/10.1111/j.1467-7660.2011.01694.x

Pattnaik, S., Rizinski, M., & Pinsky, E. (2025). Rethinking Inequality: The Complex Dynamics Beyond the Kuznets Curve. *Data*, 10(6), Article 88. https://doi.org/10.3390/data10060088

Perman, R., & Stern, D.I. (2003). Evidence from Panel Unit Root and Cointegration Tests that the Environmental Kuznets Curve Does Not Exist. *Australian Journal of Agricultural and Resource Economics*, *47*(3), 325-347. https://doi.org/10.1111/1467-8489.00216

Phillips, P.C.B., & Hansen, B. E. (1990). Statistical inference in instrumental variables regression with I(1) processes. *The Review of Economic Studies*, *57*(1), 99–125. https://doi.org/10.2307/2297545

Quiggin, J. (2009). Six Refuted Doctrines. *Economic Papers*, *28*(3), 239-248. https://doi.org/10.1111/j.1759-3441.2009.00027.x

Robalino-López, A., Mena-Nieto, A., García-Ramos, J., & Golpe, A. (2015). Studying the relationship between economic growth, CO_2 emissions, and the environmental Kuznets curve in Venezuela (1980–2025). *Renewable and Sustainable Energy Reviews*, *41*, 602-614. https://doi.org/10.1016/j.rser.2014.08.081

Schultz, T.P. (1998). *Inequality in the Distribution of Personal Income in the World: How it is Changing and Why*. *Journal of Population Economics*, *11*(3), 307–344. https://doi.org/10.1007/s001480050072

Sinapi, C. (2013). The Role of Financialization in Financial Instability: A Post-Keynesian Institutionalist Perspective. *LIMESplus*, *3*, 207–231. Retrieved from: https://www.ceeol.com/search/article-detail?id=497434

Slez, A. (2019). The Difference Between Instability and Uncertainty: Comment on Young and Holsteen (2017). *Sociological Methods & Research*, *48*(2), 400-430. https://doi.org/10.1177/0049124117729704

Stern, D.I. (2003). The Environmental Kuznets Curve. *Online Encyclopedia of Ecological Economics*, International Society for Ecological Economics. http://isecoeco.org/pdf/stern.pdf.

Stern, D.I., & Common, M. S. (2001). Is There an Environmental Kuznets Curve for Sulfur? *Journal of Environmental Economics and Management*, *41*(2), 162-178. https://doi.org/10.1006/jeem.2000.1132

Stiglitz, J.E. (1996). Some Lessons from The East Asian Miracle. *World Bank Research Observer*, *11*(2), 151-177. https://doi.org/10.1093/wbro/11.2.151

Williamson, J.G. (1985). *Did British Capitalism Breed Inequality*? Boston (MA): Allen and Unwin.

World Bank. (1992). *World Development Report 1992: Development and the Environment*. New York: Oxford University Press. Available at: https://documents1.worldbank.org/curated/en/995041468323374213/pdf/105170REPLACEMENT0WDR01992.pdf

Yang, H., He, J., & Chen, S. (2015). The Fragility of the Environmental Kuznets Curve: Revisiting the Hypothesis with China Data via an "Extreme Bound Analysis". *Ecological Economics*, *109*, 41-58. https://doi.org/10.1016/j.ecolecon.2014.10.023

Young, C., & Holsteen, K. (2017). Model Uncertainty and Robustness: A Computational Framework for Multimodel Analysis. *Sociological Methods & Research*, *46*(1), 3-40. https://doi.org/10.1177/0049124115610347

Author Biography

Dr. Ebrahim Abdullah M. Merza is an Associate Professor of Economics at Kuwait University, College of Business Administration. His research focuses on econometrics and public finance, particularly government expenditure, public debt, and banking sector dynamics. He has published widely on economic growth and fiscal policy and has served in academic leadership roles within the College.

Dr. Mohammad Alawin is a Professor of Economics at Kuwait University. He earned his Ph.D. in Economics from Kansas State University. His research interests include international economics, financial economics, monetary theory, and econometrics. He has supervised numerous graduate students and has received several academic awards for his teaching and research contributions.

Disclaimer/Publisher's Note: The views, opinions, and data presented in all publications are exclusively those of the individual author(s) and contributor(s) and do not necessarily reflect the position of BRPI or its editorial team. BRPI and the editorial team disclaim any liability for any harm to individuals or property arising from the use of any ideas, methods, instructions, or products mentioned in the content.