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REVISITING THE MIDDLE-INCOME TRAP: ECONOMIC CONVERGENCE AND PATHWAYS TO SUSTAINABLE GROWTH

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ABSTRACT

The challenge of the middle-income trap (MIT)—where economies successfully escape poverty but struggle to maintain the productivity and competitiveness needed to transition to high-income status—is an enduring issue in global development, necessitating an understanding of why some nations advance while others stall amid rising inequality and intensifying global competition. This study was conducted to explore the concept of the middle-income trap, identify nations caught in it, examine the contributing factors, and outline the conditions necessary for sustained convergence toward high-income status and sustainable economic growth. The analysis employed a hybrid empirical methodology using a comprehensive dataset of countries from 1960–2019. The United States served as the benchmark for relative income and the global technological frontier. The β-convergence model measured the speed of income catch-up, while σ-convergence analysis monitored income dispersion over time. The results of the β-convergence model confirm the existence of conditional convergence, with a significant negative relationship between initial income levels and subsequent growth rates. The speed of convergence is estimated at 3.2% per year, implying a half-life of approximately 22 years to halve the income gap with the technological frontier, the σ-convergence analysis demonstrated widening income inequality and divergence across the sample. The analysis identifies institutional quality as the most powerful factor for growth, followed by investment in human capital, physical capital accumulation, and trade openness. Escaping the MIT requires a strategic development approach focused on export-driven growth, innovation-led productivity gains, and institutional effectiveness, particularly given that the rising global income dispersion necessitates targeted interventions to reduce inequality and strengthen competitiveness. Robustness tests, including fixed-effects panel models and sensitivity analyses, corroborate these results.

KEYWORDS: Middle-income trap, Economic convergence, β-convergence, σ-convergence, Divergence.

1. INTRODUCTION

High efforts to foster long term economic growth stays, mostly as always, a focal and important goal for many countries that want, in a way or other, to ensure long-term growth and development and, mostly, rise the living standards level of their people. In the last 20th century period, many nations – mostly in East and Southeast Asia (EA)– showed a rapid and fast, and in some sense constant, expansions. This evolving in economic path led mostly or some scholars, for example Lawrence Summers (1994), to illustrate the same phenomenon happened before as, difficult, a modern parallel of the European Industrial Revolution time period. Such dynamic parallels of these two phenomena, yet, show the crucial role, mostly not clearly illustrated, of showing development trajectories to understand both difficulties faced and possible chances for equilibrium and, most ideally, lasting developing path.

Nevertheless, long term economic paths diverge and do not converge across many large sets of countries. Some impressive economies achieved early and imposing economic output, at least partially and not totally, by repeated and complex rounds of restructuring and advance high-level transformation, tech updating, and mostly better integrating into world across markets.

The exact notable rise of China illustrates this long-term trend of development and rise: a country that, within a few numbers of decades, moved from a low-income level ranking to, mostly the threshold of a high-income ranking level of economy. Meanwhile, other nations appear to have follow less linear path of convergence economy. Most number of these countries have stayed constant without development, encountered issues in spreading their productive structures mechanisms, or mostly even experienced periods of economic devolving.

The current contrasting outputs show a persistent issue in development literature: the issue rise for many nations for crossing from middle-income to high-income ranking level of income a sparking problem mostly showing in the term of the MIT or knowing as middle-income trap.

This terminology shows a level of income in which economies, shows exhausted the initial factor of steady development for long term-term period, such as low-costly labor market factor or commodity expansion, do not generate recent sources of competitiveness deeply rooted in innovation and invention, institutional quality, or advanced industrial sophistication. In a universal general context marked by rising income level of disparities and rising competitive pressures level, comprehending the complex mechanisms outlining this constant becomes, arguably, even more and mostly important and crucial.

2. LITERATURE REVIEW ON IDENTIFYING COUNTRIES TRAPPED IN THE MIDDLE-INCOME TRAP.

The concept of the "middle-income trap" has become more prevalent as many countries have faced challenges in moving from middle-income to high-income status. The concept is often used to describe economic stagnation or the difficulty in maintaining constant development after a defined class level of income has been gained.

Understanding this trap requires an in-depth exploration of two fundamental concepts: the "trap" as a state of equilibrium (or disequilibrium) that resists short-term change, and "middle income" either absolute (income thresholds defined class such as the World Bank) or as GDP relative to the US.

2.1. Conceptual Debates Surrounding the Notion of the Middle-Income Trap

Before the apparent emergence of the term "middle-income trap", researchers such as Garrett (2004) were already discussing the chance that MIT nations could be stable by adopting standardization of industry and services in order to remain competitive in a changing world. The author says that, the biggest obstacle and issue for these economies/countries seems to focus in their limited and incapability, and sometimes not enough, capacity to build and also generate local structural IT capabilities. Without these complex knowledge technologies, countries will stay and remaining in low-income level.

The MIT phenomena was first proposed by Kharas (2007), this concept and phenomena, therefore, show the robustness of relying on merely traditional and classical development scenario without large structural mechanism of improvements, yet the exact specific mechanisms stay, in real world event, sometimes unclear and undefined for most people.

This situation places the country in a fragile position, unable to compete with advanced countries in terms of quality and technological innovation, while being at a disadvantage compared to LI countries level with lower labor costs.

Bulman et al (2014) examined the sustainability of middle-income countries through three categories: LI nations (income pc less than ten percent of the US), middle-income countries (per capita income between

ten percent and fifteen percent of the US), and HI nations (per capita income more than 50% of the US).

Another known method has been proposed based on the number of time span which in years it should a nation to move from one group level to another (from MI to HI). Although heuristic and somewhat arbitrary, the advantage of this approach is that it is easy for policy makers to interpret.

Felipe, Abdon, and Kumar (2012) reported an interval as twenty-eight years in the lower MI category and 14 years in the upper MI category. According to the authors, a country exceeding this threshold number of years would be ranked as stuck in MIT. Based on a sample of 38 lower-MI nations and 14 upper MI countries in 2010, the authors identified 35 countries stuck in MIT.

2.2. Identification of MIT Countries by Stage of Development

Inspired by the work of (Rostow 1990; Ohno 2009; Aoki 2012; Tho 2013) attempted to explain MIT through a panel of Asian economies. mostly, Ohno (2009), working in the ASEAN group of nations, explained the moving from poverty level to development group through a five-stage development model.

These stages initially involve identifying areas of economic growth, namely: monoculture exports, subsistence agriculture, and foreign aid. In the first stage, the value added of the agricultural sector is low and industrialization depends on external sources. The design, production, marketing and technology sectors are largely dominated by foreigners. During the second stage, production is fully concentrated and local suppliers, despite their limited capacity, become competitive. In the economy, wages increase while marginal factor productivity decreases.

Countries that reach the middle-income category with significant foreign capital inflows are trapped in an invisible "glass ceiling." In the absence of positive externalities due to the low accumulation of human capital, these countries are unable to absorb or adapt the technology offered. Those who succeed escape this trap.

In the third stage, the country's human capital accumulation has increased and local products are highly competitive in international markets. At this stage, the country must focus on R&D and technological investments, as well as greater promotion of innovative and creative products. This will allow it to reach the fourth stage, where countries have advanced specialization and a range of creative products in the global market.

Aoki's (2012) study of a panel consisting of China, South Korea, and Japan also explained MIT with a five-stage development model, with the same transition constraints, calling the first stage the Malthusian trap (M).

At this stage, the country's per capita income is low, growth is stagnant, and more than 80% of the workforce is employed in agriculture. The second stage is government leadership (G). The government is included in the process of industrial capital accumulation, but the rate of growth and structural change is slow. In the third stage, or Kuznets (K) stage, the development process undergoes rapid structural transformation.

Employment shifts from agriculture to manufacturing and the value added by the industry continues to increase. The fourth stage is characterized by the development of human capital (H) (improved health conditions, low fertility rates, etc.). The sustainability of growth depends on total factor productivity and investment in human capital.

The final stage is the post-demographic transition (PD). Technological, socioeconomic and demographic changes become the drivers of stable growth. According to Aoki (2012), MIT countries are those that have not managed to make the transition from stage K to stage H, with an inability to develop the existing stock of human capital.

Using the same Asian sample, Tho (2013) explained MIT as a three-stage development process: the first stage is the poverty trap, the second is the exit from the poverty trap, and the process ends at the upper-middle-income stage. The third stage indicates the sustainable growth necessary for development. For Tho (2013), a country in the trap is one that has not managed to reach the third stage. In fact, after a decrease in factor productivity and an increase in wages, the country sees its competitive advantage disappear.

2.3 MIT Based on Thresholds and Synthetic Indices.

Other studies have sought to identify countries caught in the trap without going through the stages of development. Various methods and approaches have been proposed, including the use of fixed thresholds (absolute approach), relative thresholds, the temporal approach, and finally the use of synthetic indices.

Spence (2011) was the first to propose a fixed threshold for the middle-income trap, suggesting a range of $5,000 to $10,000 per capita (PPP), arguing that it is at this stage of development that the transition to higher income levels becomes

particularly difficult. The World Bank (2012) and the work of Agenor and Canuto (2012) adopted an approach based on a threshold relative to a reference country. In general, the United States is favored in this regard.

The "China 2030" report (World Bank 2012) set a threshold between 5% and 45% of US GDP per capita to determine whether a given country is caught in the trap. Based on this approach, it was estimated that of 101 middle-income economies in 1960, only 13 had become high-income economies by 2008. Agenor and Canuto (2012) used and popularized the same interpretation.

The comparative analysis carried out by Jankowska et al. (2012) between Asians and Latinos

During the period 1963 to 2005, American countries attempted to explore whether they were caught in the middle-income trap.

The results obtained by the Product Space Index show that the majority of Latin American countries were trapped in the middle-income trap. Similarly, Robertson and Ye (2013) developed a classification of middle-income countries, but this time ranging from 8% to 36% of US GDP per capita. Their results revealed that 19 out of 46 countries are caught in the middle-income trap.

Several authors have developed indices to assess whether a country is caught in the trap. The two most common indices are the recovery index (CUI) and the ESCAPE index. Woo et al. (2012) proposed the catch-up index (CUI) and explain that a country is stuck at the MIT when it shows no tendency to converge towards the world economic leader (i.e., the United States).

The CUI index is quite simple to construct: it is obtained by dividing the income level of a given country by the income level of the United States and adding variables based on the economy, quality of life, democracy and governance. Countries with a UHI greater than 55% are classified as high-income countries, those with a UHI less than 20% are called low-income countries, and the rest are middle-income countries.

Furthermore, Hawksworth (2014) developed the ESCAPE index to provide an indication of how different emerging markets were positioned to escape the trap. The index combines 20 key indicators in five dimensions: human capital and education, innovation and technology, institutional quality, macroeconomic policy, and openness and diversification.

3. EMPIRICAL METHODOLOGY AND STYLIZED FACTS

3.1. Trappe Des Pays À Revenu Intermédiaires Et Convergence Réussie

During the period from 1960 to 2019, countries such as Morocco, Tunisia, and South Africa succeeded in doubling their per-capita GDP when measured in purchasing-power-parity terms. By contrast, economies like Taiwan, Singapore, and Hong Kong experienced a far more dramatic transformation, with income levels expanding tenfold over the same horizon.

In this context, this part of the section tries, albeit not perfectly, to compare between nations that sustain long -term convergence path and other nations whose structural growth was seen, some scenario, to have stopped growing.

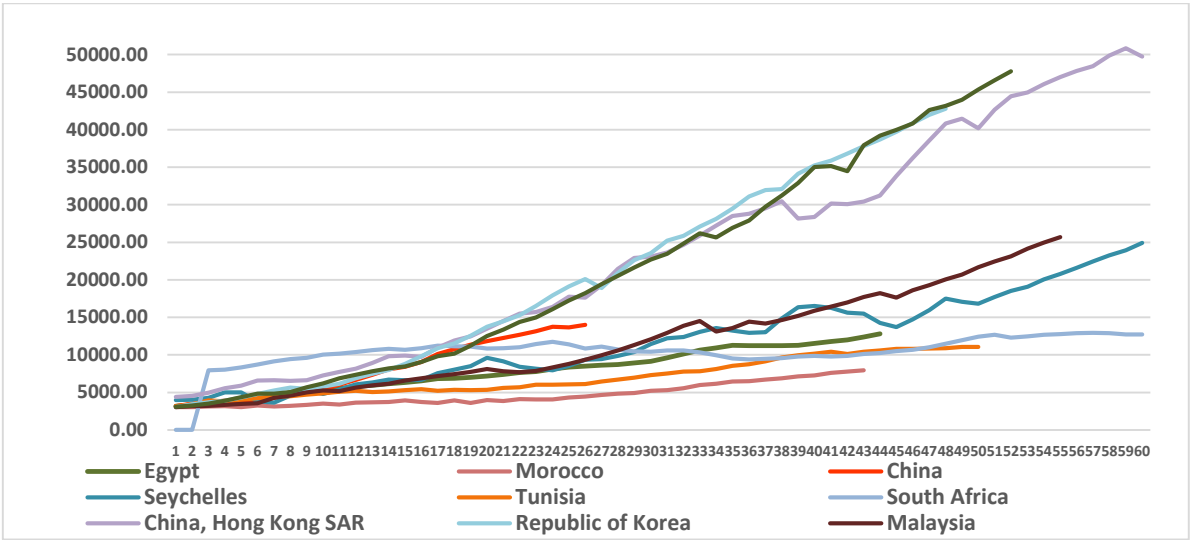
To do this, we use a mixed plan that mixt a relative income perspective with a complex empirical framework and strategy. However, before the application of this mixt plan, in the following part section we show several economic facts, to attempt to describe the nations in the sample.

3.2. Stylized Facts

Economies classified within the middle-income range, as it seems, exhibit rather uneven expansion patterns. Chart 1, which attempts to plot the evolution of GDP per capita (in terms of purchasing power parity) from 1960 to 2019 for the selected sample, makes these disparities somewhat visible. Closer examination indicates that several East Asian economies—most notably Singapore and South Korea—have, over time, steadily narrowed the income gap with the United States and, eventually, appear to have surpassed the threshold commonly associated with high-income status.

However, alongside these relatively notable trajectories of upward mobility, the figure also emphasizes, although perhaps not exhaustively, the enduring challenges facing many African countries, such as Morocco and South Africa, which continue to struggle in achieving sustained improvements in per capita income.

Figure 1: GDP Per Capita from 1960 To 2019 (PPP 2017) for Selected Countries.

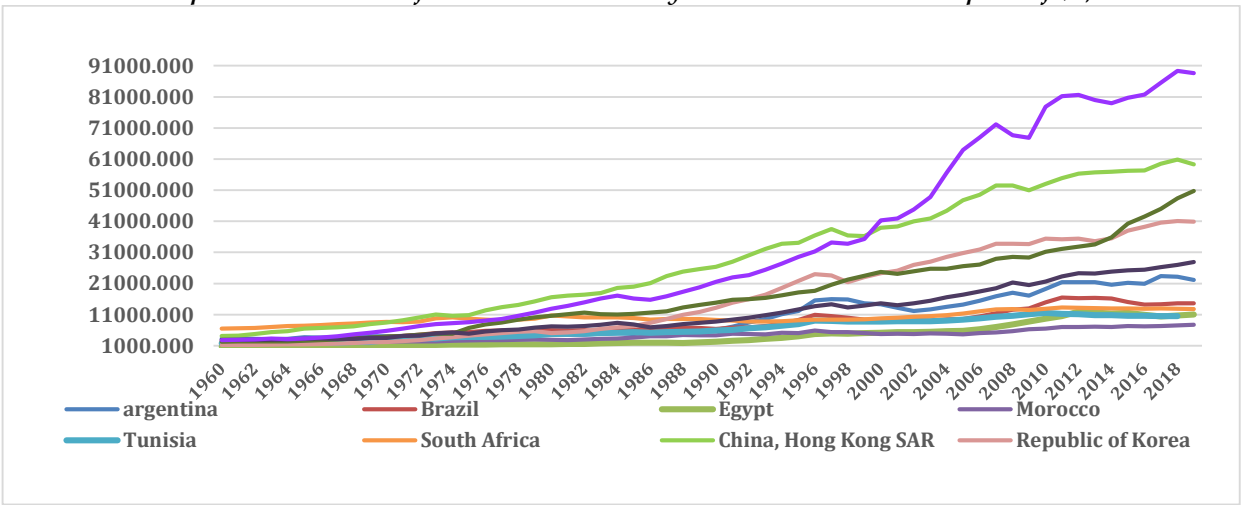


Source: Author's Calculations Based on Data on Per Capita GDP in PPP International 2017 From

Figure 2 show in general trend, the evolving divergence in growth path of a group of East Asian economies and their other in Latin America and Africa. The graph attempting to map the development of GDP pc from year of country gained the income threshold of $3,000 (in 2017 PPP), highlighting a constant, although uneven, evolving of East Asian nations and the sparkly constant progress energised by many nations in the other two regions over the past six decades. The contrast, in this scenario, is exactly sparking: while many East Asian countries show to has built and transitioned to high income group of ranking, numerous African and Latin American economies suffer, more to stay comparable growth scenario.

in this large spectre pattern, it is also notable that the country of China, notwithstanding its more relatively late beginning in growth development, it following a path of constant convergence, which is largely stable, yet not similar, to the first development of the Asian "tigers." The fast advance done by South Korea and Taiwan during this time span stand as long-term convergence.

Graph 2: A Selection Of Countries Since They Reached A GDP Per Capita Of $3,000.



Source: Author's Calculations Based on Data on Per Capita GDP In PPP International 2017 From.

A second exact example of reverse convergence development path trajectories can be illustrated for the case of South Africa. In early 1960s, its GDP pc exceeded that of Taiwan and Hong Kong, placing it in prosperous economies ranking in the developing nations across the world. However, for the next 6 decades, South Africa's income ranks raise moderately (from $7,961 to $12,513), showing a long-term period of inequality observed, and at periods moderately. The same path of middle development is to be seen in other nations: Morocco case show a rise in per capita income from $3,060 to $7,963 over a 43-year span, while Tunisia rose from $3,167 to $11,062 over mostly five decades.

These paths, in contrast, mostly different from

several Asian nations during the exact similar time span. For this period of years 1960-2019, several East Asian nations, less or more, augmented their income pc more than tenfold ranking level. The cases of Hong Kong and Taiwan are exactly the case, though not totally captured, illustrative: income ranks raised from $4,415 to $49,759 in Hong Kong and from $3,091 to $47,794 in Taiwan. These uneven shows, somewhat indirectly a deep heterogeneity of universal development output and show the critical, but sophisticated, role that a broader social dynamic may play in molding long-term economic development outcome

3.3. Middle-Income Trap and Successful Convergence

The convergence development literature, the term of trap mostly shows to an issue and, in some cases, stable state of low—or even back-forward—growth. This situation are eventually interpreted as the outcome of all possible equilibria, which are themselves determined by structural deep issues of an economy. When a country becomes in trapped in one of some unfavorable equilibria scenario, often due to most issues, escaping the issue of trap mostly requires substantial policy and structural reforms (Azariadis and Stachurski, 2005).

The slow movement of a nation to a single stable major equilibrium—evidence say that development issues are mostly joint by slow or incomplete structural convergence. This overlap can, therefore, cause issue the boundaries between the two scenarios, making it, in practice, somewhat issue to differentiate a stable recovery path from a correct growth trap.

The most absolute step to define MIT class is based on the assumption that any constant structural development will finaly bring a country to first level ranking, even if income hole relative to advanced economies continues to spread. This scenario is mostly applicable in devising research. To develop these exercises, our exercise uses mixt strategy plan that compare a relative income level ranking group (the United States as country of first ranking) with an analytical framework.

This convergence exercise is backed by both past theoretical and empirical exercise. In essence, convergence exercise describes a phenomenon by which countries gradually minimize their per capita income hole with the other part of countries. With the hypothesis that economies go to a common income group level of ranking, uneven most decrease in time of years (Barro and Sala-i-Martin, 2004; Acemoglu, 2009).

We will use the basic equation of β-convergence:

$Ln(Yi,2019) = \alpha + \beta \ln (Yi,1960)+\mu it$

Y: GDP per capita relative to the United States

α : the constant (ordinate at the origin)

β : autoregressive parameter

μ_it: Random term

We will use the United States as a reference, based on three main considerations: first, as a high-income country; second, as representative of the global technological frontier according to most economists; and finally, as a country perceived as having balanced long-term growth (around 2%). We also use the Penn World Tables (PWT 10.0) (Feenstra et al., 2015), which covers 157 countries.

Countries will be classified as follows:

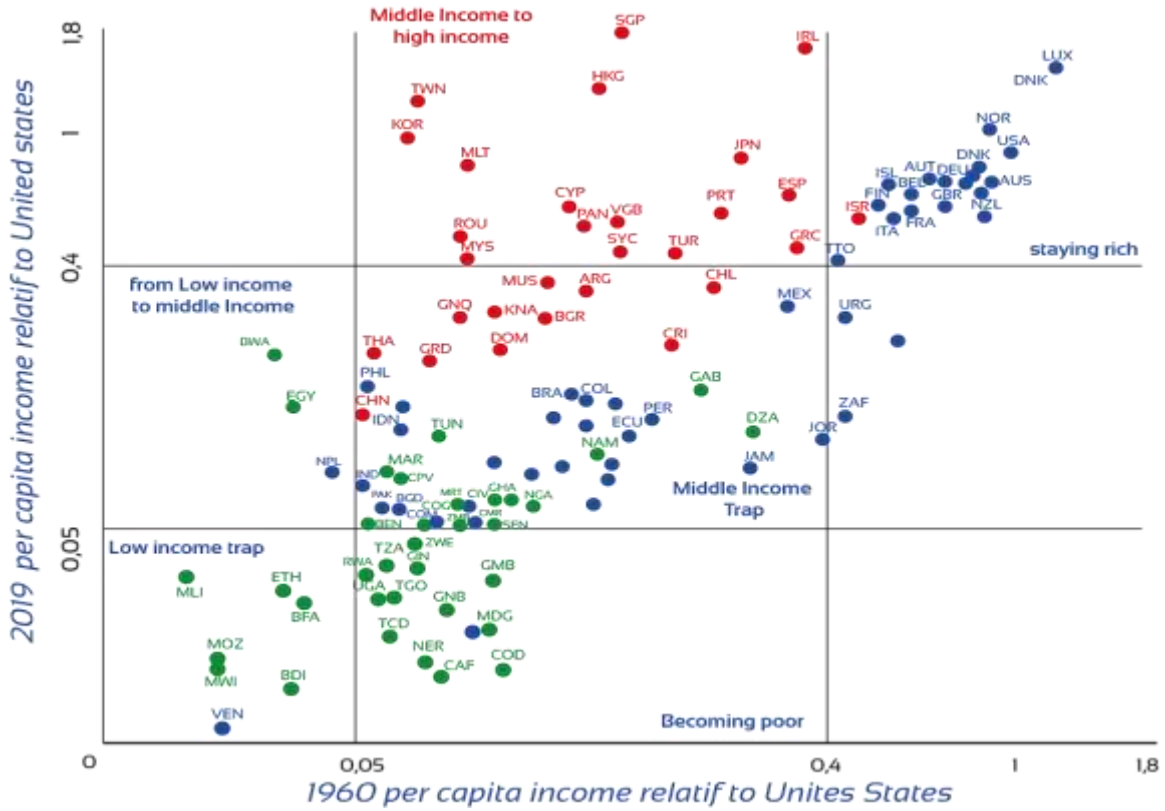
Low-income countries are those with a GDP per capita between 0 and 5% of that of the United States.

Middle-income countries are countries with a GDP per capita between 5% and 40% of that of the United States

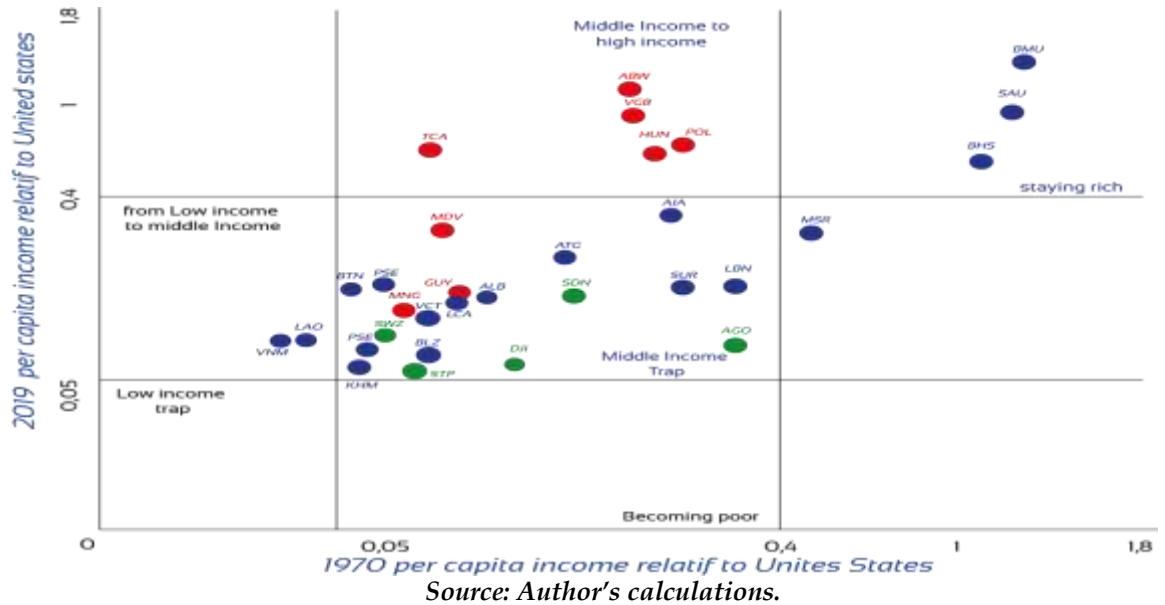
High-income countries are countries with a GDP per capita greater than 40% of that of the United States

Graph 3 illustrates the ranking of economies according to their per capita income relative to US income in 1960 and 2019, while Graph 4 covers the period from 1970 to 2019 for countries for which data is only available from 1970 onwards.

Graph 3: Relative Per Capita Income Changes, 1960-2019 (PPP 2017).



Graph 4: Relative per capita income changes, 1970-2019 (PPP 2017)



Source: Author's calculations.

Each axis is divided into three regions, representing the corresponding income groups.

The middle section represents countries that are in the trap, i.e., countries that were in the middle-income category in 1960 and remained there during this period.

Albania, Gambia, Nicaragua, Bangladesh, Guatemala, Philippines, Bolivia, Honduras, Paraguay, Central African Republic, India, State of Palestine, Chile, Jamaica, Sudan, Ivory Coast, Kenya, Senegal, Cameroon, Cambodia, SierraLeone, Congo, Lebanon, Syrian Arab, Republic, Colombia, Liberia, Chad, Costa Rica, Sri Lanka, Togo, Dominican Republic, Morocco, Tunisia, Ecuador, Madagascar, Uruguay, Gabon, Mauritania,

Venezuela, Ghana, Namibia, South Africa, Guinea, Niger, Zimbabwe.

The upper middle section represents countries that were in the middle-income category in 1960 and achieved high income during this period.

Romania, China, Hong Kong, Taiwan, Panama, Japan, Spain, Poland, Republic of Korea, Greece, Turks, Islands, Malaysia, Hungary, Virgin, Islands, Singapore, Ireland, Portugal, Turkey

The upper right section represents countries that were rich and remained so;

Italy, Austria, Finland, United States, Belgium, France, Israel, Germany, United Kingdom, Netherlands, Denmark Sweden.

The lower left section represents countries that are caught in the poverty trap, including Mozambique, Ethiopia, and Mali.

The middle left section represents countries that have moved from the low-income category to the middle-income category, of which there are five:

Botswana, Laos, Egypt, Nepal, and Vietnam.

However, we cannot stop at countries that have managed to achieve high-income status. Although this initial filter provides a very solid overview of the phenomenon of catching up with the United States since the 1960s, and is the approach most commonly used in the literature, it does not allow us to take into account countries that have experienced significant economic growth during the period without managing to cross the threshold into high-income status (see Table 2). However, it does not allow us to take into account countries that, during the period, recorded considerable economic growth without managing to cross the threshold into high-income countries (see Table 2). Taking the example of Botswana, the country recorded GDP per capita growth of 6% over the period 1960-2019, rising from 4% of US GDP per capita in 1960 to 27% in 2019. Equatorial Guinea recorded GDP per capita growth of 8% over the same period, also rising from 7% of US GDP per capita in 1960 to 35% in 2019.

Based on their speed of transition to high-income country status, we add two additional criteria inspired by the work of Jong-Wha Lee (2018).

To be a successful convergence economy, an economy must meet one of the following two conditions: First, it must be an economy that has already made the transition from middle-income to high income status during the period 1960-2019. As shown in Figures 3 and 4 above, 21 economies fall into this group. They are listed at the top of Table 1.

Second, it must be a middle-income economy that experienced an average annual growth rate of more than 3.5% (excluding oil exporters) during the period 1960-2019 without moving into the high-income category.

The second classification allowed us to add 14 countries: Argentina, Bhutan, Bulgaria, Botswana, Equatorial Guinea, Egypt, Indonesia, the Maldives, Mauritius, Macao, El Salvador, China, Thailand, and Antigua and Barbuda (Table 2).

This classification is based on criteria that are admittedly somewhat arbitrary but still very reasonable. In fact, a country with 5% of GDP in 1960 and a permanent growth rate of 5% would have reached only 26.5% of US GDP in 2019. Similarly, a country with 10% of US GDP per capita in 1960 would have reached only 30.2% in 2019 with a permanent growth rate of 4%.

In light of the above and with data available for 157 countries for 1960 and 1970, here is our new classification with a new category for countries that are successfully converging (Table 2).

Table 1: Countries That Have Successfully Converged Without Crossing the Threshold into High-Income Countries.

Country	*Contin*	*Regi*	*per Cap / us GDP*	*per Cap / us GDP*	*Global av growth*	*Global av per capita*
Botswana	AF	SAF	0.04	0.27	0.05	0.06
Egypt	AF	NAF	0.05	0.17	0.06	0.05
Equatorial Gi	AF	MAF	0.07	0.35	0.07	0.08
Mauritius	AF	EAF	0.19	0.37	0.04	0.03
Argentina	AM	SAM	0.16	0.35	0.04	0.04
El Salvador	AM	CAM	0.04	0.13	0.04	0.04
Antigua and Barbuda	AM	CAR	0.19	0.32	0.04	0.03
Grenada	AM	CAR	0.07	0.25	0.05	0.05
Saint Kitts an	AM	CAR	0.12	0.44	0.06	0.05
Bhutan	AS	SAS	0.06	0.18	0.08	0.04
China	AS	EAS	0.05	0.22	0.06	0.05
Indonesia	AS	SEAS	0.04	0.18	0.06	0.04
China, Macao SAR	AS	EAS	0.28	1.66	0.06	0.06
Maldives	AS	SAS	0.07	0.30	0.06	0.05
Thailand	AS	SEAS	0.10	0.28	0.05	0.05
Bulgaria	EU	EEU	0.18	0.36	0.05	0.04

Source : Authors Calculations.

3.4. Econometric Modeling Of Convergence

Table 2 : Convergence Estimation Results

Variable	Model (1)	Model (2)	Model (3)
$\ln(y_{i,1960})$	-0.25***	-0.22***	-0.19***
	(0.05)	(0.04)	(0.04)
$Invest_i$	-	0.12**	0.10**
		(0.05)	(0.05)
Edu_i	-	0.15***	0.13***
		(0.04)	(0.04)
$Open_i$	-	0.09**	0.08**
		(0.04)	(0.04)
$Inst_i$	-	-	0.20***
			(0.06)
Adjusted R^2	0.32	0.45	0.52
Observations	157	157	157
RESET test (p)	0.12	0.18	0.22
White test (p)	0.03	0.06	0.08

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.
Source : Authors calculations.

Specification of the conditional convergence model

The general model of conditional β-convergence is estimated in the form:

g_(i,t)=α+βln(y_(i,t_0))+γ^' X_(i,t)+ϵ_(i,t)

Where :

g_(i,t)=1/T ln(y_(i,t)/y_(i,t_0)) The average annual growth rate of GDP per capita

y_(i,t) GDP per capita in PPP of country i in year t

X_(i,t) Vector of control variables

T=t-t_0 Observation period

Estimated main equation

1/59 ln(y_(i,2019)/y_(i,1960))=α+βln(y_(i,1960))+γ_1 〖"Invest" 〗_i+γ_2 〖"Edu" 〗_i+γ_3 〖"Open" 〗_i+γ_4 〖"Inst" 〗_i+ϵ_i

Where the control variables are:

〖"Invest" 〗_i average investment rate (% of GDP)

〖"Edu" 〗_i: average years of schooling

〖"Open" 〗_i: trade openness (X+M)/GDP

〖"Inst" 〗_i: institutional quality index

3.4.1. Robustness Tests and Extensions

Panel model with fixed effects

To control for unobserved heterogeneity, we estimate a dynamic panel model:

ln(y_(i,t))=α_i+δ_t+ρln(y_(i,t-1))+γ^' X_(i,t)+u_(i,t)

With α_i country fixed effects and δ_t time fixed effects.

3.4.3. Stationarity and cointegration test:

To avoid spurious regressions, we test the stationarity of the series using the Levin-Lin-Chu test:Δy_(i,t)=ρy_(i,t-1)+∑_(j=1)^p▒〖ϕ_j Δy_(i,t-j)+ϵ_(i,t) 〗

Null hypothesis: ρ =0 (presence of a unit root)

3.4.3. Measurement of Convergence Speed

The convergence speed λ is derived from the coefficient β:

λ =-(ln(1+β·T))/T

The half-life τ_(1/2) (time required to reduce the initial deviation by half) is:

τ _(1/2)=(ln(2))/λ

For our estimate with: β=-0.25 et T=59 :

λ =-(ln(1-0.25×59))/59=-(ln(1-14.75))/59=(ln(13.75))/59≈2.621/59≈0.0444

τ _(1/2)=(ln(2))/0.0444≈0.693/0.0444≈15.6" years"

3.4.4. Hypothesis Testing and Diagnostics

Ramsey specification test RESET

g ^_i=α+βln(y_(i,1960))+γ^' X_i+δ_1 g ^_i^2+δ_2 g^_i^3+v_i

Null hypothesis: δ_1=δ_2=0 (correctly specified model)

White's heteroscedasticity test :

ϵ ^_i^2=α+∑_(j=1)^k▒〖β_j x_ij 〗 +∑_(j=1)^k▒∑_(l=j)^k▒〖γ_jl x_ij x_il+η_i 〗

Sensitivity analysis of thresholds

Probabilistic classification function

Rather than using fixed thresholds, we model the probability of being “trapped” as:P(〖trapped〗_i=1)=Φ(α+β_1 g ¯_i+β_2 σ_(g_i)+β_3 〖"Period" 〗_i)

Where :

g ¯_i : average growth rate

σ_(g_i) : growth volatility

〖"Period" 〗_i : number of years in the intermediate category

Optimal thresholds by minimizing classification errors

We determine the optimal thresholds s* by minimizing:

(min)┬s [α·"Type I"(s)+(1-α)·"Type II"(s)]

With α reflecting the relative cost of errors.

3.5. Analysis of Convergence Results

Evidence of Conditional Convergence

The negative and statistically significant coefficient of ln(y_(i,1960))in all three models confirms the conditional convergence hypothesis:

Model (1): Coefficient of -0.25 (p<0.01)

Indicates that a 10% reduction in relative initial income is associated with an average annual growth

rate that is 2.5 percentage points higher.

Adjusted R^2 of 0.32 suggests that initial income explains 32% of the variation in growth rates.

Model (2): Coefficient reduced to -0.22 with the addition of investment, education, and openness variables

Confirms that convergence is conditional on these structural factors

The effect of investment (0.12), education (0.15), and openness (0.09) is positive and significant

Model (3): Coefficient of -0.19 with the addition of institutional quality

Further reduction in the convergence effect, indicating that institutions capture a significant part of the process

Institutional quality has the strongest effect (0.20) among the control variables

Economic Interpretation of the Speed of Convergence

From the coefficient $\beta = -0.19$ in Model (3), we can calculate:

$\lambda = -(\ln(1+\beta \cdot T))/T = -(\ln(1-0.19 \times 59))/59 \approx 0.032$

$\tau\_(1/2) = (\ln(2))/\lambda \approx 0.693/0.032 \approx 21.7$" years"

Interpretation: On average, countries take 21.7 years to halve the initial gap with the US benchmark, which represents relatively slow convergence.

3.6. Analysis of Growth Determinants

3.6.1 Relative Importance of Factors

Comparing standardized coefficients:

Institutional Quality (0.20): Strongest effect

- An improvement of one standard deviation in institutional quality increases growth by 0.20 percentage points
- Confirms the literature on the crucial role of institutions
- Human Capital (0.15 then 0.13): Robust and significant effect
- Education remains an essential driver even after controlling for institutions
- Investment (0.12 then 0.10): Positive but lesser impact
- The accumulation of physical capital remains important, but its effect diminishes with the addition of institutions
- Trade Openness (0.09 then 0.08): Moderate but significant impact
- The positive effect confirms international trade theories

3.6.2. Increase in Explanatory Power

Adjusted R^2 increases from 0.32 to 0.52 between Models (1) and (3), this 20%-point increase shows that the control variables capture a substantial portion of the differences in growth

Model (3) explains 52% of the variance in growth rates

3.7. Robustness and Model Quality Tests

3.7.1. Functional Specification

RESET test: p-values from 0.12 to 0.22 (> 0.05)

- Does not reject the null hypothesis of correct specification
- Suggests that the linear form is appropriate

3.7.2. Heteroscedasticity Issues

White test: p-values from 0.03 to 0.08

· Model (1) shows signs of heteroscedasticity (p=0.03)

· Adding control variables reduces this issue (p=0.08 in Model 3)

· Use of robust standard errors mitigates the problem

3.7.3. Stability of Coefficients

The relative stability of the convergence coefficient (-0.25 to -0.19) suggests that:

- The convergence effect is robust to different specifications
- Control variables do not fully capture the convergence effect

5. CONCLUSION

Identifying countries caught in the trap is hampered by the complexity of the assessment criteria, as traditional indicators such as GDP per capita do not necessarily capture quality of life, income distribution, or other crucial dimensions of well-being. Two additional obstacles exist. The first is the complex and varied nature of development trajectories, which are influenced by a multitude of factors, making it difficult to apply uniform models to assess their progress. The second lies in accurately determining when a country enters or exits the middle-income trap, as a country's economic and social conditions can change rapidly in response to internal and external events such as economic shocks, commodity price fluctuations, political crises, or technological advances.

Despite its complexity, this analysis is crucially important because of its potential to shed light on structural challenges and obstacles to development. By identifying countries caught in the trap, we can better understand the factors that hinder economic growth and keep these countries in persistent cycles

of underdevelopment. This identification enables policymakers and development actors to design targeted policies and programs to address these specific problems, thereby promoting solutions tailored to each country's unique needs. It can also direct international resources and efforts to where they are most needed. Donors and development agencies can use this information to direct their assistance to regions where poverty and inequality persist, helping to concentrate resources where they have the most potential impact.

Our research has also focused on identifying countries that have crossed the threshold into high-income status and those that have achieved convergence. This analysis is essential because it offers valuable insights into the policies and strategies that promote sustainable economic growth. By closely examining these nations, we can identify key factors such as good governance, institutional quality, political stability, and economic diversification that have contributed to their success. These lessons can guide policymakers in developing countries in designing effective and sustainable economic policies.

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